HIGHLY HAZARDOUS PESTICIDES IN MEXICO

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Highly Hazardous Pesticides in Mexico

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The Pesticide Action Network in Mexico (RAPAM in Spanish) is a non-profit civil association that works to phase out pesticides that affect human health and the environment. It promotes changes in public policies to achieve agroecological pest control and the protection of the rights to healthy food -free of pesticides and GMOs-, food sovereignty and a pollutant-free environment. www.rapam.org

IPEN is a global network of over 550 health and environmental public interest organizations in 125 countries working to eliminate the world's most harmful chemicals through movement-building and policy action. IPEN's mission is a toxics-free future for all. www.ipen.org

RAPAM is the IPEN regional hub for Latin America and the Caribbean, member of the Pesticide Action Network in Latin America (RAP-AL, in Spanish, www.rap-al.org)) and of Pesticide Action Network (PAN) International www.pan-international.org

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Acronyms

CCD	Colony Collapse Disorder
CICOPLAFEST	Comisión Intersecretarial para el Control del Proceso y Uso de Plaguicidas, Fertilizantes y Sustancias Tóxicas / Inter-Ministerial Commission for the Control of the Processing and Use of Pesticides, Fertilizers and Toxic Substance Control
COFECE	Comisión Federal de Competencia Económica / Federal Economic Competition Commission
COFEPRIS	Comisión Federal de Protección contra Riesgos Sanitarios / Federal Commission for the Protection Against Sanitary Risks
EFSA	European Food Safety Authority
EPA	Environment Protection Agency
ESCER	Economic, Social, Cultural and Environmental Rights
FAO	Food and Agriculture Organization of the United Nations
GHS	Globally Harmonized System
IAASTD	International Assessment of Agricultural Knowledge, Science and Technology for Development
IARC	International Agency for Research on Cancer
ICCA	International Council of Chemicals Associations
ICCM	International Conference of Chemicals Management
ICESCR	International Covenant on Economic, Social and Cultural Rights
IFOAM	International Federation of Organic Agriculture Movements
ILO	International Labor Organization
IOMC	Inter-Organisation Programme for the Sound Management of Chemicals
IPEN	International POPs Elimination Network
JMPM	Joint Meeting of Pesticide Management
LGEEPA	Ley General de Protección al Equilibrio Ecológico y Protección al Ambiente / General Law on Ecological Equilibrium and Environmental Protection
NAFTA	North American Free Trade Agreement
OECD	Organisation for Economic Co-operation and Development
PAN	Pesticide Action Network
PANNA	Pesticides Action Network North America
PROCCYT	Protección de Cultivos, Ciencia y Tecnología A.C. / Crop Protection, Science and Technology, Civil Association

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PROFEPA	Procuraduría Federal de Protección al Ambiente / Federal Attorney for Environmental Protection
R- PLAFEST	Reglamento para el registro de Plaguicidas, Fertilizantes y Sustancias Tóxicas / Regulation for Pesticide, Fertilizer and Toxic Substance Registration
SAGARPA	Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación / Mexican Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food
SAICM	Strategic Approach for International Chemicals Management
SEMARNAT	Secretaría del Medio Ambiente y Recursos Naturales / Mexican Ministry of Environment and Natural Resources
SENASICA	Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria / National Agro-Food Health, Safety and Quality Service
SOCLA	Sociedad Científica Latinoamericana de Agroecología / Latin American Scientific Society of Agroecology
TTIP	Transatlantic Trade and Investment Partnership
UMFFAAC	Unión Mexicana de Fabricantes y Formuladores de Agroquímicos, A.C / Mexican Union of Agrochemical Manufacturers and Formulators, Civil Association
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
UNITAR	United Nations Institute for Training and Research
WHO	World Health Organization

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Foreword to the English edition

Human rights are grounded in the principles of universality, non-discrimination, and indivisibility under which human rights are guaranteed for all persons, including the most susceptible and vulnerable groups of society. These principles apply to all aspects of preventing human rights violations. States, as duty bearers, must respect existing human rights principles; protect everyone regardless of income, age, ethnicity or gender from the abuse of human rights by those in positions of power, including abuses brought by powerful industries; and fulfill their commitments by providing services in times of emergency and hardship.

Sadly, today, fundamental rights, including the rights to life and health of women, children, agricultural communities, farmworkers, peasants and indigenous peoples, the disabled, people living in poverty, and many other vulnerable groups, are abused by our addiction to hazardous insecticides, herbicides, among other dangerous pesticides. Discriminatory practices and policies remain deeply entrenched between wealthy countries that export pesticides and poorer countries those who import these substances, which are often banned from use in the country of export. Our over-reliance on this chemical-intensive model of agriculture is far too often neither a decision based in independent science, nor our understanding of the complexity of agroecosystems interaction with rural communities, but rather in profits and politics that are under the control of powerful chemical companies.

Protection from exposure to hazardous pesticides is neither a privilege nor charity. It is a human right that flows directly from a myriad of principles and rights that include the right to the highest attainable standard of health, the right to adequate food and nutrition, the right to clean water, the right to safe work, the right to adequate housing, among others. Our continued reliance on hazardous pesticides is a short-term solution that undermines the long term accessible, available, sustainable and safe food for present and future generations.

Increasingly, the international community has recognized the need to transition to more sustainable models of agricultural production, consistent with their human rights obligations. From the Strategic Approach to International Chemicals Management, to the 2030 Agenda for Sustainable Development, to the UN Human Rights Council, there is increasing emphasis on the need to transition to safe, healthier models of agricultural production through a transition away from hazardous pesticides.

Without or with minimal use of toxic chemicals, it is possible to produce healthier, nutrient-rich food, with higher yields in the longer term, without

polluting and exhausting environmental resources. The solution requires a holistic approach to the right to adequate food that includes phasing out dangerous pesticides and enforcing an effective regulatory framework grounded on a human rights approach, coupled with a transition towards agroecology, that take into account the challenges of resource scarcity, environmental degradation, growing populations and climate change, while providing local communities decision making power for where, how and what to produce.

An important shift is underway, regarding the future of food and agriculture. We encourage States to choose an agroecological path that is more likely to protect and fulfill human rights for present and future generations, by urgently transitioning to healthier, more sustainable, less toxic modes of agricultural production.

This book provides an excellent overview about the peril of the wide use of highly hazardous pesticides in Mexico, many banned in other countries. It highlights the need for changes in the regulatory framework and the promotion of emerging agroecological alternatives from peasant communities, including organic farming. It is a very good source to convince other developing countries to phase out dangerous agro-chemicals, achieve healthy food and healthy environments, all the while protecting human rights in agrarian communities and the right to adequate food for all people.

Hilal Elver
UN Special Rapporteur on the right to food.

Baskut Tuncak
UN Special Rapporteur on the implications for human rights of hazardous substances and wastes.

February 2018

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Executive Summary

This document presents a panorama of ***highly hazardous pesticides*** in Mexico. This is a new regulatory category emerging from the context of the Strategic Approach to International Chemicals Management (SAICM) and the International Code of Conduct on Pesticide Management, both of which are voluntary. Governments, various specialized UN bodies, industry, and civil society organizations have been participating in development of this field.

The criteria to define highly hazardous pesticides proposed by experts from the World Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO), in addition to those proposed by the Pesticide Action Network International (PAN International), are used for the national analysis and the case studies in this document. Pesticides presenting one or more of the following intrinsic characteristics of risk have thus been included: high acute toxicity capable of causing damage to health in the short term; or chronic toxicity with long-term effects that could lead to the development of cancer, genetic mutations, reproductive harm, and hormonal alterations in humans; or producing harmful environmental effects on aquatic organisms; causing mortality to pollinators; or being restricted by the terms of either the Stockholm Convention, Rotterdam Convention or Montreal Protocol.

This report compares PAN International's list of highly hazardous pesticides to the active ingredients authorized in Mexico. No less than 183 active ingredients contained in highly hazardous pesticides are authorized in the 2016 Official Pesticide Catalogue of the Federal Commission for the Protection against Sanitary Risks (COFEPRIS, in Spanish). These active ingredients have been authorized in over 3,000 commercial presentations such as insecticides, herbicides, fungicides and fumigants, mainly for agricultural use, although they are also permitted for animal husbandry and farming, forestry, industry, the household, and some are even authorized for use in public health campaigns. Currently, 140 highly hazardous pesticides enjoying sanitary registration have been banned in other countries or are not authorized for one or more of their uses.[1] Both domestic and foreign corporations participate in the global chemical oligopoly that benefits from the authorizations for commercialization.

1 The detailed lists of active ingredients contained in highly hazardous pesticides authorized in Mexico, as well as those banned or unauthorized in other countries, are presented in two annexes at the end of this book.

In Mexico, highly hazardous pesticides are used both in intensive agriculture, i.e., commercial export-oriented monocrops and agro-industrial chains of the domestic market, and in small-scale production carried out by peasants and indigenous communities. This report presents eight case studies in seven different states of the Mexican Republic in which synthetic pesticides are in use. It provides a summary of health effects and environmental impacts of the highly hazardous pesticides researched in exposed populations. The cases analyzed are in the municipalities of Culiacán Valley of Sinaloa State, those further north in the state, the Yaqui Valley in Sonora State, those specializing in flower greenhouses in the State of Mexico, the Bajio region of Guanajuato State, Campeche State, Yucatan State, and communities in the Highlands of Chiapas State.

The use of highly hazardous pesticides, considering their intrinsic characteristics, represents serious risk to human health and the environment. It violates a series of human rights, such as the right to life, the right to enjoy the highest possible level of health, children´s and workers´rights to protection, as well as others. This has been recognized by two United Nations special rapporteurs on human rights: one specializing in hazardous chemicals and waste and the other on the right to adequate food. Chief among causes for deep concern are: the great number of highly hazardous pesticides authorized in Mexico although they are banned in other countries; the damage documented in some of the studies presented in this report; the lack of control over aerial pesticide spraying; the paucity of adequate and trustworthy environmental monitoring, particularly of the water and soil; and the impact on biodiversity, especially on pollinators.

Fortunately, Mexico has an arsenal of alternatives to the use of synthetic pesticides. Over 100 crops have been certified as grown organic; the experiences of agroecological pest management promoted by both university level institutions devoted to agricultural research and peasant organizations are increasing. What's needed is greater governmental support for this.

Recommendations

The report presents two main recommendations for change: one in the public policies of both federal and state authorities vis a vis pesticides, the other in the regulatory framework. These recommendations must be bolstered with proposals made by peasant, indigenous, and agricultural worker organizations:

1) Change the pesticide management policy in Mexico, so that it primarily focuses on the promotion, respect, protection and assurance of the right to

health, a healthy environment and healthy, sufficient and adequate food; so that it enables the construction of an ecologically sustainable food system and complies with the constitutional obligation to protect human rights in accordance with the principles of universality, interdependence, inclusiveness and progress.

2) Develop a *National Plan for the Reduction and Phasing-Out of Highly Hazardous Pesticides and Support for Agroecological Alternatives.* This plan must contain goals regarding the reduction and banning of highly hazardous pesticides (above all, those banned in other countries) that may be evaluated and monitored at a local and state level in specific territories. The plan must also promote agroecological alternatives for the control of pests, undesirable plants (weeds) and diseases. This could strengthen the domestic market, reduce Mexico's food dependence and contribute to the recovery of food sovereignty.

This plan requires a change in the regulatory framework and policies in order to be able to achieve the greatest level of human rights protection, strengthening the prevention and reparation of damage to exposed populations, including agricultural workers, communities and consumers. For this purpose, it is necessary to incorporate the recommendations made by the Special Rapporteur on the Right to Food at the United Nation's Human Rights Council in its 34th regular session, included in Annex III of this book. It is necessary, in particular, to strengthen access to justice in health, environmental, labor and human rights matters related to pesticide use with participation from civil society groups interested in ending impunity and promoting effective protection of the rights involved. Attention must be payed to the recommendations of the United Nations Committee on the Rights of the Child, issued on June 5, 2015, for the Mexican State to ban the importation and use of any pesticide that has been banned or restricted for use in the exporting country.

Such a plan must be developed and implemented in a transparent and participatory manner in order to ensure that it aims toward the common good, rather than private interests. The Inter-Ministerial Commission for Control over the Processing and Use of Pesticides, Fertilizers and Toxic Substances (CICOPLAFEST, in Spanish) would participate in this process in coordination with an interdisciplinary collegiate group of academic specialists, agricultural research centers, and non-governmental organizations that do not have conflicts of interest with industry, together with organizations of peasants, indigenous communities, private producers and agricultural workers. Details of the measures that could be included in this plan appear at the end of this report.

Through the actions we are proposing, Mexico would contribute to achieving SAICM's goal so that by the year 2020 chemicals can be produced and used in such a way that their adverse effects on health and the environment

are significantly reduced. In addition, these actions would make it possible to comply with the resolution on highly hazardous pesticides passed by the Fourth International Conference on Chemicals Management, which recommended prioritizing agroecological alternatives.

Similarly, the measures we recommend will contribute to achieving the second Sustainable Development Goal 2015-2030, in particular, the attainment of food production system sustainability and the application of resilient agricultural practices that increase not only productivity but also production, contribute to maintaining ecosystems, strengthen the capacity to adapt to elimate change, and progressively improve soil and earth quality.

Chapter 1

Highly Hazardous Pesticides: A New International Regulatory Issue and its National Profile in Mexico

Fernando Bejarano González [1]

Introduction

In this chapter, we narrate how *highly hazardous pesticides* emerged as a new international regulatory issue within the realm of the United Nations (UN), engaging governments, the international chemical industry and public interest non-governmental organizations. We describe the proposed criteria defining highly hazardous pesticides. We also comment on the resolution and strategy proposed by the UN Food and Agriculture Organization (FAO), the World Health Organization (WHO) and the United Nations Environment Program (UNEP).

In a second part, we present the general characteristics of the Mexican pesticide market, the entrepreneurial groups that constitute it, the limitations of the registration that the authorities grant for their commercialization, and the national profile of authorized highly hazardous pesticides, emphasizing those devoted to agricultural use and identifying those banned in other countries. In addition, we analyze the perspectives regarding the ban on highly hazardous pesticides. Lastly, we close the chapter with some reflections that point to the need for developing a change in public policy toward a transition strategy that increasingly bans the use of these pesticides, simultaneously supporting alternatives for the control of pests, undesirable plants and diseases with an agroecological approach that transforms the food system and potentiates small-scale agriculture.

1 Director of the Pesticide Action Network and its Alternatives in Mexico, a non-profit organization (RAPAM, A.C., in Spanish).

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1. Highly Hazardous Pesticides within the Realm of SAICM and the International Code of Conduct on Pesticide Management

The discussion regarding highly hazardous pesticides as a new international regulatory category emerged in two United Nations agreements: the "*Strategic Approach to International Chemicals Management*" (SAICM[2]) and the FAO-promoted *International Code of Conduct on Pesticide Management*. Representatives from government, UN institutions, the pesticide industry, and other public interest groups, identified as stakeholders, participate in both international agreements, although they hold diverse and opposing positions.

Both the *Strategic Approach* and the *Code of Conduct* are international environmental rights instruments characteristic of what specialists call *soft law*, the compliance of which depends on the political willingness of the actors involved, as opposed to *hard law*, which is legally binding and leads to obligations and sanctions when there is lack of compliance (Nava, 2005). The Strategic Approach and the Code of Conduct are agreements that are considered frameworks of reference. They are not legally binding instruments and lack sanction mechanisms in case of non-compliance. They are voluntary international cooperation initiatives, which is why their members are *invited* or *encouraged* to comply. It has been argued that one of the consequences of soft law instruments is that they have helped to identify basic environmental principles that the States have accepted to observe (like those included in the 1992 Rio Declaration on the Environment and Development) that guide the States behavior and conduct, and could set a precedent of hard law emerging in the future (Nava, 2005: 823). In fact, voluntary agreements and codes of conduct could lead to national proposals or binding legislative reforms, but this depends on the correlation of national political forces among the stakeholders and social classes involved, which becomes more difficult in the context of neoliberal policies that have weakened the States ruling function and strengthened corporate transnational interests.

In administrative law, and by extension environmental law, it has also been argued that one reason that has encouraged the production of soft law regulation is the ability to integrate diverse interests and stakeholders, and to promote a greater participation of affected parties in view of the fact that all stakeholders should participate. However, as we will see in the first part of this chapter, in the case of SAICM, although the flexibility of the discussion procedures in this international agreement allows for a greater participation of public interest civil society groups, it

2 SAICM: Strategic Approach for International Chemicals Management.

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comes up against the limitations inherent in soft law instruments when they are applied nationally, in particular when the interests of transnational corporations are affected, and government regulation has been accommodated to protect such interests.

1.1 The Strategic Approach to International Chemicals Management (SAICM)

In February 2006, after two years of negotiation and three preparatory meetings, delegates from more than 100 governments, as well as private sector and civil society representatives approved the *SAICM*. This took place during the *First International Conference on Chemicals Management* (ICCM[3]) held in Dubai, United Arab Emirates, constituted as a multisectoral body that meets periodically to discuss SAICM's progress.

SAICM's Secretariat is under the mandate of both the UNEP, which assumes administrative responsibility,[4] and the WHO, which has had minor participation and stepped away from the Secretariat arguing budget limitations.[5] SAICM and the ICCM Conference are multisectoral bodies designed for the participation of the government sector, UN specialized bodies, the private sector, worker organizations and non-profit civil society groups. The current ICCM Board of Directors is formed by a president, four vice presidents with a worldwide regional balance, the president of the Inter-Organizational Program for the Sound Management of Chemicals (IOMC)[6] and four representatives from non-governmental organizations: chemical industry, unions and public interest non-governmental organizations, one working in the area of health and another in environment. The industrial representative on the Board of Directors belongs to the International Chemicals Council of Associations (ICCA), which is comprised of the sector's main transnational corporations, including the pesticide sector organized around CropLife.[7]

The Strategic Approach is understood as a regulatory framework of public

3 ICCM: International Conference on Chemicals Management referred to in this text as ICCM Conference.

4 The SAICM Secretariat is integrated as part of the Chemicals Branch of the UNEP Division of Technology, Industry and Economics. See: http://www.saicm.org/Default.aspx?tabid=5459

5 In 2006, the WHO resolved that a focal point would be appointed in each country to communicate SAICM-related themes, but it was not until May 2016, at the Sixty-Ninth World Health Assembly that the theme was discussed in greater depth and a resolution was passed regarding the role played by the WHO in reaching SAICM's 2020 goal and subsequent activities (Resolution WHA.69.4, 2016). The Latin American and Caribbean countries have requested that the WHO be restored within the SAICM Secretariat.

6 The IOMC is constituted by the UNEP, the FAO, the International Labor Organization (ILO), the Organization for Economic Cooperation and Development (OECD), the United Nations Industrial Development Organization (UNIDO), the United Nations Institute for Training and Research (UNITAR) as well as the WHO.

7 The current composition of the ICCM Bureau can be seen at: http://www.saicm.org/About/Bureau/tabid/5458/language/en-US/Default.aspx

policies guiding efforts to comply with the goal of the Application Plan passed in 2002 at the World Summit on Sustainable Development held in Johannesburg, South Africa. This goal has also been included as a SAICM's general goal: "13. The overall objective of the Strategic Approach is to achieve the sound management of chemicals throughout their life-cycle so that by 2020, chemicals are used and produced in ways that lead to the minimization of significant adverse effects on human health and the environment" (UNEP, 2007: 16, point 13 of the General Strategy)[8].

SAICM has an extensive scope comprising environmental, economic, social, labor and health aspects related to the management of chemicals used in agriculture and industry throughout all stages of their "life-cycle" (from production, distribution and use until waste management, including those chemicals contained in products). The chemicals in the food industry (for instance, additives) and the pharmaceutical industry[9] (SAICM, 2007: 12) are not included.

SAICM is composed of three constitutional texts: a) the *Dubai Declaration on International Chemicals Management,* expressive of top level political commitment to adopt SAICM as a strategic framework of reference for a global chemicals policy, approved and signed by Environment and Health ministers, as well as government delegates; b) the *Global Policy Strategy,* which defines developing countries' scope and specific needs, financial considerations, principles and criteria, as well as the implementation of the SAICM strategy and evaluation of its progress; and c) a *Global Action Plan,* which proposes 273 activities as part of a menu of voluntary options. Besides these constitutional documents, there are ICCM resolutions. All of this forms part of a voluntary regulatory framework to guide national, regional and global cooperation initiatives.

SAICM's Global Policy Strategy defines specific interrelated objectives regarding chemicals management that contribute to achieving the 2020 goal: (1) measures to support risk reduction; (2) strengthened knowledge and information; (3) governance: strengthened institutions, legislation and policies; (4) capacity building and technical cooperation; and (5) measures against illegal international traffic. These objectives are developed in a Global Action Plan with activities, actors, goals, deadlines, progress indicators, and aspects to consider regarding implementation.

8 The "sound management of chemicals" has been translated into Spanish as the "rational management of chemicals" or "ecological sound management".

9 The SAICM does not include chemicals used by the food industry (such as additives, for instance) or by the pharmaceutical industry in as much as they are regulated by the environmental or health authority, or by national agreement (SAICM, 2007:12, footnote 1). However, as of 2015, environmental persistent pharmaceutical pollutants have been added as a new regulatory theme in SAICM, and its presence in water is reason for increasing concern.

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It should be noted that when the SAICM strategy refers to "risk reduction" within the global policy strategy, the following activities are included: "prevention, reduction, mitigation, minimization and elimination" (SAICM, 2016: Statement of Needs, point 7), understood as an essential requirement to achieve "sound management" of chemicals during their whole life cycle. Risk reduction measures are necessary in order "to prevent the adverse effects of chemicals on the health of children, pregnant women, fertile populations, the elderly, the poor, workers and other vulnerable groups and susceptible environments" (SAICM, 2016:13-14). Strictly speaking, "risk prevention and reduction" should have been included as an objective in order to preserve this preventive aspect, since there is a tendency to consider what has already been authorized in the market as acceptable, in spite of not having been through rigorous assessment of its health and environmental effects.

The language of the SAICM Overarching Policy Strategy constantly alludes to the fact that risk minimization should be grounded "on a science-based risk assessment … taking into account the costs and benefits." In other words, SAICM's text calls for prevention, as well as risk assessment and a cost-benefit analysis, which, as we will see throughout the rest of this chapter, reflects the tension existing between contradictory social interests. Schematically speaking, we could say that during the negotiations and discussions about SAICM we have observed that the position closest to the chemical industry intends to use risk assessment as the only guide for any decision-making about public policy regarding chemicals management, and subordinates the discussion about alternatives to a narrow analysis of their economic viability without taking into account environmental and health costs. In contrast, public interest non-governmental organizations note that in the face of the intrinsic hazardness of some chemicals and the possibility of causing irreversible damage to health and the environment, it is necessary to take preventive measures, apply the precautionary principle, and comply with the obligations to comprehensively respect and protect human rights. Thus, preventing exposure to highly hazardous chemicals and the search for alternatives must be a top priority. If this is not possible, hazardous chemicals must be assessed in order to reduce risk.

Although implementation of the actions proposed by SAICM is voluntary, the governments have committed to develop national implementation plans in accordance with their priorities, taking into account the above mentioned Global Action Plan, which includes a wide variety of activities, goals and indicators defined by consensus at the preparatory meetings in which the final text was negotiated (UNEP, 2007). In spite of the top level political commitment of the Environment and Health ministers signing the *Dubai Declaration*, in fact, very few countries have taken SAICM as a strategic framework of reference on which to base a national implementation plan. Because SAICM is not a legally binding instrument, it is

given less importance than other environmental conventions on chemicals that are binding and furthermore have larger funds to support and facilitate compliance by countries. SAICM is often erroneously considered a commitment acquired by an environmental authority, rather than a national strategic framework to foster internal changes that may strengthen interinstitutional chemicals management coordination between government authorities in labor and economic as well as environmental and health aspects.

SAICM is an international multisectoral framework of reference agreed to via consensus by the different stakeholders participating in chemicals management: governments, the chemical industry, and civil society non-governmental organizations. Since it is not a legally binding convention, there is greater flexibility for chemical industry and public interest non-governmental organizations to contribute with informative documents, attend regional discussion meetings, comment on agenda proposals, or even propose resolution texts to the plenary that may eventually be approved. This would never occur in legally binding conventions, in which only governments are involved in the negotiations. For this reason, not only governments participate in SAICM's negotiation process and follow-up activities, but also representatives of chemical industry transnational corporations, like CropLife,[10] that dominate the world market, as well as civil society organizations like the International POPs Elimination Network (IPEN),[11] and the Pesticide Action Network – International (PAN International).[12]

Since its approval, SAICM has incorporated new regulatory issues into the discussion agenda: nanotechnology, hormone-disrupting chemicals, lead in paint, chemicals in products, hazardous chemicals in the life cycle of electronic products, highly hazardous pesticides, and recently, environmentally persistent pharmaceutical products. IPEN and PAN International, in alliance with other groups, such as unions and indigenous organizations have had outstanding participation in the discussion of these new regulatory themes and proposals for action (Weinberg, 2014).

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10 CropLife is an organization representing the interests of the main transnational corporations and national associations of the chemical industry, called the "crop science industry." See http://croplife.org/about/members/

11 IPEN is a global network constituted by over 700 non-governmental organizations in more than 100 countries. Since 2003, it has been involved in the process to negotiate and apply the Stockholm and Minamata Conventions, and, in particular, SAICM. See: http://www.ipen.org/

12 Pesticide Action Network or PAN is a network of over 600 non-governmental organizations, institutions and individuals that work in more than 90 countries to replace hazardous pesticides with ecologically healthy and socially fair alternatives. PAN was founded in 1982 and has five independent regional centers that collaborate with each other in order to implement their projects and campaigns. Its regional center in Latin America is the Pesticide Action Network and its Alternatives in Latin America (RAP-AL, in Spanish). See: http://pan-international.org/

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As far as pesticides are concerned, point 6 of SAICM's Dubai Declaration states that, "agriculture's dependence on pesticides" and "workers' exposure to hazardous chemicals" are problems requiring concerted measures to reach solutions, particularly in developing countries (UNEP, 2007:7). SAICM's Global Action Plan includes several working areas or spheres dedicated to reducing pesticide risks. The working sphere for "highly toxic pesticide risk management and reduction" indicates that the application of the FAO International Code of Conduct on Pesticide Distribution and Use (currently known as the Code of Conduct on Pesticide Management) must be considered. The area dedicated to "Reducing Health and Environmental Risks Posed by Pesticides" includes activity 39: "To facilitate the sale and use of less toxic pesticides" (UNEP, 2007: 55). The working sphere dedicated to "*Sound Agricultural Practices*" includes activity 51: "Provide training in ecological agricultural practices and others, including those that do not use chemicals" (UNEP, 2007: 55). The language used by SAICM demonstrates some progress compared with the proposals made by the chemical pesticide industry that persist with the idea of "safe management" without setting forth a substitution. This language reflects the active participation of non-governmental groups in the process of negotiating the language of the Global Action Plan.[13]

1.2 The FAO Initiative for Highly Hazardous Pesticide Risk Reduction

In November 2006, the FAO Council[14] approved engaging in the application of SAICM in order to help developing countries to reduce risks posed by highly hazardous pesticides, calling upon governments to develop actions in this direction, including *the progressive ban on highly hazardous pesticides*:

> "In view of the broad range of activities envisaged within SAICM, the Council suggested that the activities of FAO could include risk reduction, *including the progressive ban on highly hazardous pesticides*, promoting good agricultural practices, ensuring environmentally sound disposal of stock-piles of obsolete pesticides and capacity building in establishing national and regional laboratories." (FAO Council 2006, CL 131/REP, emphasis added).

13 Because of opposition from industry and some governments, several of the Global Action Plan proposals were not approved in the third and last SAICM negotiation meeting, such as: banning or restricting the availability and use of highly toxic pesticides (WHO classification Ia and Ib) and those causing cases of frequent and serious intoxication; ending the sale of pesticides the use or management of which imply inadmissible risks, regardless of their application or restriction; as well as other activities related to company responsibility and victim compensation. In: SAICM/ ICCM.1/4.

14 This Council is formed by 49 States and is the executive branch of the FAO Conference. See http://www.fao.org/unfao/govbodies/gsbhome/gsb-home/en/

The theme of highly hazardous pesticides was thus incorporated as a new initiative into the FAO agenda. Months later, in April 2007, the FAO Committee on Agriculture[15] called a joint meeting of the FAO/WHO Panel of Experts on Pesticide Management (known as JMPM[16]) in order to establish technical criteria to define highly hazardous pesticides. These experts participate as FAO or WHO appointed specialists, and are not meant to represent the position of the government or institution where they work. The discussion meetings among experts to define the technical criteria were open to observers from intergovernmental organizations, the chemical pesticide industry, through CropLife, and public interest non-governmental organizations, such as PAN International and IPEN. As observers, they did not directly participate in the decision-making, but they did contribute with scientific information, comment on the discussion drafts and organize parallel events at the joint meetings.

1.3 Criteria to Define Highly Hazardous Pesticides

1.3.1 Criteria Established by FAO and WHO

In October 2008, the Second FAO/WHO Joint Meeting of Experts on Pesticide Management approved the criteria to define highly hazardous pesticides.[17] According to these criteria, highly hazardous pesticides are defined as those pesticides presenting one or more of the following characteristics: high acute toxicity, chronic toxicity, those characteristics included in the binding international environmental conventions (i.e., conventions with compulsory compliance), as well as active ingredients or pesticide formulations that show a high incidence of

15 One of the FAO's governing bodies, advisor to the Agriculture and Consumer Protection Department, comprised of over 100 States. See http://www.fao.org/unfao/govbodies/gsbhome/gsb-home/en/

16 The Joint Meeting on Pesticide Management (JMPM) is constituted by members selected from the FAO Panel of Experts on Pesticide Management and the WHO Expert Committee on Vector Biology and Control. See: http://www.fao.org/agriculture/crops/thematic-sitemap/theme/pests/code/panelcode/en/ There exist other panels of experts that meet at the FAO/WHO Joint Meeting on Pesticide Waste and the Joint Meeting on Pesticide Specifications, FAO statutory bodies that advise FAO on matters pertaining to plant production and protection. See: http://www.fao.org/unfao/govbodies/gsb-subject-matter/en/

17 This meeting was attended by ten FAO panel experts from Tanzania, USA, Sweden, Brazil, China, Malaysia, Sri Lanka, Italy, Canada and Germany; five WHO experts from Uruguay, India, the Philippines, Thailand and Finland; plus observers from ILO, UNEP, UNITAR, the World Bank, the pesticide industry, CropLife and ALINA; the International Union of Food and Allied Workers (IUF); PAN New Zealand and Germany; and the WHO and FAO Secretariats (FAO/WHO JMPM, 2008, Annex 1).

irreversible or severe adverse effects on health or the environment, depending on the circumstances of use in the country (FAO/WHO JMPM, 2008). We will proceed to describe these characteristics in greater detail:

A) High acute toxicity: Pesticides with formulations that fulfill the criteria of WHO Category 1A, 1B, classification according to hazardness, i.e., if they enter the body, they can cause serious symptoms of intoxication and even death a few hours after exposure. In Mexico, the label appears as a red band with the warning "Danger" printed on it, the symbol of a skull and crossed bones, and the statement "*Fatal in case of ingestion*" or "*Fatal through skin contact*" (NOM-232-SSA1-2009).

B) Chronic toxicity: active ingredients or pesticide formulations that produce chronic effects on human health, which usually develop slowly as a consequence of repeated exposure to low doses over extended time. These effects include:
   - ◊*Cancer in humans:* according to Globally Harmonized System (GHS) carcinogenicity Categories 1A and 1B the pesticide is known or presumed to cause malignant tumors.
   - ◊*Mutagens in humans:* according to GHS mutagenicity Categories 1A and 1B, the pesticide is known or presumed to cause human germ cell mutations (ova and sperm) that can be inherited and cause malformation.
   - ◊*Reproductive toxicity:* according to GHS Categories 1A and 1B, the pesticide is known or presumed to cause adverse effects on sexual function and fertility or affect human development before or after birth.

C) The binding international environmental agreements stipulate:
   - ◊The *Stockholm Convention on Persistent Organic Pollutants* includes chemicals to be globally eliminated and/or restricted (Annexes A and B) meeting the following criteria: persistence, bioaccumulation, potential for long-range environmental transport of the chemical, and adverse effects due to its toxicity or ecotoxicity on human health and the environment. In other words, the Convention includes pesticides and other chemicals that are persistent, can transfer far away from its original release point into the environment, and can be stored and concentrate in fatty tissues such as chicken, meat, fish, or even breast milk.
   - ◊The *Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (Annex III)* includes severely hazardous active ingredients and pesticide formulations (the use of which produces severe health or environmental effects observable within a short period of time, under circumstances of use) that have been banned or rigorously restricted in some countries in order to protect human health and the environment. For chemicals included in Annex III, the Convention

requires that the exporting countries inform the importing country before shipment, a mechanism known as prior informed consent procedure (PIC). The Convention aims to avoid shipping these chemicals without the informed consent of the importing party.

◊The *Montreal Protocol on Substances that Deplete the Ozone Layer* includes substances that destroy the ozone layer, related to methyl bromide or bromomethane, a fumigant (see Table 1).

D) Pesticides (active ingredients or formulations) that have shown a high incidence of severe or irreversible adverse effects on health or the environment, under circumstances of use in a country. The JMPM joint meeting of experts recommended that FAO, WHO and UNEP develop criteria to define adverse effects. In my opinion, this implies having a good intoxication registration system that requires the recording of the name of the commercial product or active ingredient that caused the intoxication or damage.

The Joint FAO/WHO Meeting of Experts recommended that highly hazardous pesticides not be registered for their use unless: a) governments establish a clear need for them; b) there are no other alternatives available based on a cost-benefit analysis; and c) control measures and good commercial practices are insufficient to ensure that the product can be handled with acceptable risk to health and the environment. The panel of experts also recommended, as a top priority risk reduction measure, that updated information regarding highly hazardous pesticides be made available to countries on a regular and extensive basis using the criteria of the FAO/WHO experts in collaboration with the UNEP (FAO/WHO JMPM, 2008).

The report of the Second FAO/WHO Joint Meeting of Experts recognized that endocrine or hormone disruption can be an important expression of pesticide hazardness, but noted that it was "premature" to include it as a separate classification defining highly hazardous pesticides. However, it recommended that it should be reviewed in future meetings (FAO/WHO JMPM, 2008:15). The proposal to include endocrine disruptors as an additional definition criteria is a PAN proposal supported by IPEN, as will be seen in the next subsection.

Table 1
Highly Hazardous Pesticides Included in Environmental Conventions

Stockholm Convention on Persistent Organic Pollutants	Annex A. Elimination: aldrin, alpha and beta hexachlorocyclohexane; chlordane, chlordecone, dieldrin, endrin, heptachlor, hexachlorobenzene, lindane, mirex, toxaphene and endosulfan. Annex B. Restriction on DDT. To be used only to control malaria via WHO supervision.
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	Annex III includes 30 pesticides and 3 formulations considered to be severely hazardous that enter the PIC procedure, among other substances. Pesticides: 2,4,5-T, alachlor, aldrin, azinphos methyl, binapacryl, captafol, chlordane, chlordimeform, chlorobenzilate, dieldrin, DNOC, dinoseb and its salts and esters, dibromoethane (EDB), DDT, endosulfan, ethylene dichloride, ethylene oxide, fluoroacetamide, HCH, heptachlor, hexachlorobenzene, lindane, mercury compounds, methamidophos, monocrotophos, parathion, pentachlorophenol and its salts and esters, toxaphene, tributyl tin compounds. Formulations: benomyl equal to or greater than 7 percent; carbofuran equal to or greater than 10 percent; thiram equal to or greater than 15 percent; methyl parathion EC at or above 19.5 percent, and dusts at or above 1.5 percent.
The Montreal Protocol on Substances that Deplete the Ozone Layer	The Protocol includes methyl bromide or bromomethane for its global elimination with some limited and specific exceptions for "critical uses," quarantine and pre-shipment uses.

Source: developed by RAPAM.

1.3.2 Criteria Proposed by the Pesticide Action Network International

Besides the criteria established by the joint FAO/WHO meeting of experts, PAN International has proposed a more extensive set of hazard indicators (PAN International, 2015a), some of which have been used by recognized authorities, such as the European Union and US Environmental Protection Agency (EPA). These indicators are described as follows:

◊ *Fatal inhalation toxicity* - This hazardous characteristic is symbolized by a diamond, a skull and code H 330 with the statement, "*Fatal if inhaled*" on pesticide labels that follow the Globally Harmonized System.

◊ *Hormone disruption (endocrine disruption)* - It includes pesticides corresponding to European Union Classification 1 (with at least one study providing evidence of endocrine disruption in an intact body).

◊ *High toxicity for bees* - It includes those chemicals classified by the US EPA as "*Highly toxic for bees*" since they contain a mean lethal dose of less than 2 micrograms per bee (DL_{50}, µg/bee < 2).

◊ *Very persistent in water, soil or sediments* - This means that it takes months, and even years to degrade in order to cease being toxic.

◊ *Very toxic for aquatic organisms* - They can cause the death of fish, crustaceans or algae in rivers, lakes and the sea.

◊ *Very bioaccummulative* - It is the potential of a pesticide to concentrate in aquatic organisms through the trophic chain and may cause toxic effects.

Among the new criteria proposed by PAN International, we will proceed to highlight those related to endocrine disruption and high toxicity for bees.

Pesticides that Disrupt Hormone Action

According to the definition of the Endocrine Society, chemical *endocrine disruption* refers to the "effect of some chemical, or mixture of chemicals, that interferes with any aspect of hormone action" (Gore *et al.* 2014, emphasis added).[18] The WHO defines endocrine disruptors as "an exogenous substance or mixture that alters function(s) of the endocrine system and consequently causes adverse health effects in an intact organism, or its progeny or (sub) populations" (IPCS, 2002 and WHO-UNEP, 2012:12). Hormones are natural chemicals produced by the endocrine glands that are distributed throughout the body (mainly hypothalamus, pineal, pituitary, pancreas, thyroid, parathyroid, adrenals, ovaries and testicles). They are fundamental for the reproductive function and essential for the normal development of body and brain (see Figure 1).

According to an assessment of the *State of the Science of Endocrine Disrupting Chemicals* prepared by a group of experts for WHO and UNEP, approximately 800 chemicals currently on the market are known or suspected to interfere with hormone reception and its synthesis or conversion, albeit the vast majority of chemicals in the global market have not been assessed in relation to these effects (WHO-UNEP Bergman A. *et al.*, 2013:2). Chemicals, by imitating or blocking a

18 The Endocrine Society is the world's oldest, largest and most active scientific organization devoted to research on hormones and the clinical practice of endocrinology. See: http://endocrinenews.endocrine.org/category/health-topic/endocrine-disruptors/

natural hormone, can lead to malfunctioning of the endocrine system and disrupt various biological and physiological functions, causing various diseases and even death. Insecticides like DDT and chlorpyrifos, as well as herbicides like atrazine, 2,4-D and glyphosate are found among the most widely studied endocrine disrupting pesticides (Gore *et al.* 2014).

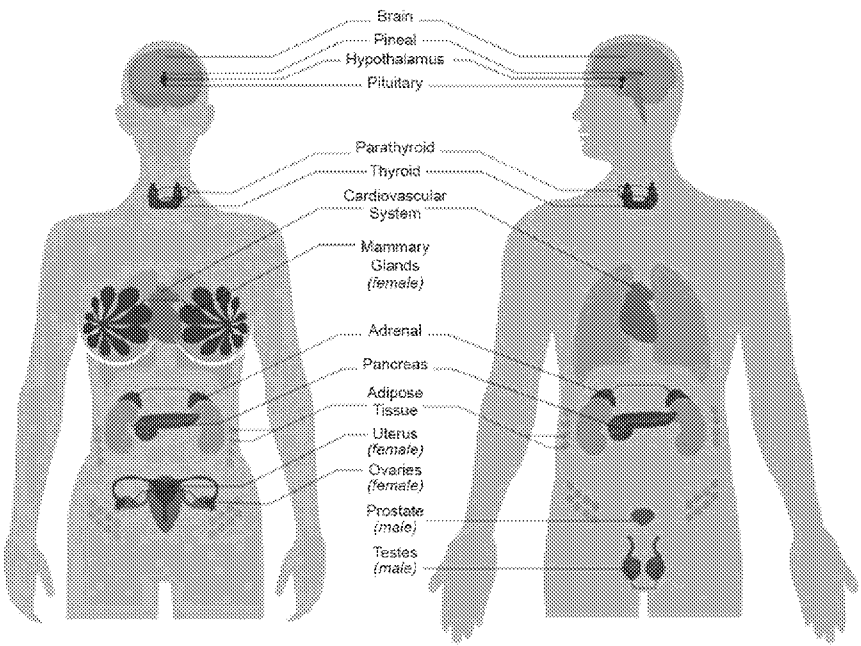

Figure 1. Diagram of the main endocrine glands of the male and female body. Source: Gore *et al.*, 2014.

Experts from the Endocrine Society have set forth that in order to assess the effects of hormone or endocrine disruption, it is necessary for the prevailing toxicological paradigm to change regarding its appraisal of chemical risk based on the assumption that "*it is the dose that makes the poison.*" This paradigm presupposes a simple linear relationship between dose and toxicity, assuming that the higher the dose, the greater the toxicity, and the lower the dose, the lower the toxicity. This paradigm may be useful when establishing safety thresholds in trials with adult animals and evaluating chemicals individually, but it is inadequate for defining endocrine disruption activity, as can be seen in the following table developed by an Endocrine Society specialist:

Table 2
Traditional Concepts Used in Chemical Trials and Why They are Inadequate to Define Endocrine Disrupting Activity

Traditional approach to chemical trials: '*The dose makes the poison*'	Why is this approach insufficient for chemicals causing endocrine disruption?
It analyzes each chemical individually.	Each inhabitant of the world currently carries a body burden of chemicals that did not exist before 1940. Many more chemicals are produced and liberated into the environment each year. Testing each chemical, one by one, cannot keep up with the pace of exposure and does not take into account how the mixture of chemicals within the body affects human development and health.
It assumes that individual chemicals have a "safe or acceptable" exposure level with no negative effects.	The endocrine system tacitly regulates each aspect of human health, from intrauterine development, through growth, until reproduction, and health in general. Recent scientific research shows that even very small amounts of these chemicals, or mixture of chemicals disrupt the endocrine system, reducing intelligence, disrupting the reproductive system and causing other health problems. In fact, there might not be a safe exposure level, particularly when people have hundreds of these chemicals in their body.
Testing focuses on adult animals.	Hormones regulate the body systems. Their effects start in the uterus and continue throughout life. Testing carried out on adult animals only cannot capture the impact chemicals have on the endocrine system throughout the life cycle.
It assumes that the doses lower than those that can cause death or disease (usually cancer) are safe in animals subjected to a trial.	Endocrine-disrupting chemicals have a diversity of impacts and manifest not only as disease or death.

Source: Adapted from Gore *et al.*, 2014:25.

The WHO and UNEP report on the State of the Science of Endocrine Disrupting Chemicals indicates that possible associations have been observed between pesticides and negative effects on humans such as undescended testicles (cryptorchidism), abnormality of penile development (hypospadias) and decreased production of sperm; prostate, breast, endometrial, ovarian and thyroid cancer; childhood leukemia and developmental neurotoxicity; longer menstrual cycles, early menarche, benign uterine tumors (uterine fibroids), growth of endometrial tissue outside the uterus (endometriosis), increased risk of miscarriages and

premature birth; type 2 diabetes, and gum diseases (WHO-UNEP, 2012:7). Endocrine-disrupting chemicals are a new regulatory theme in SAICM, thus requiring global measures. However, this is not actually such a "new" theme since the first scientific reference to this effect was reported by Theo Colborn and others in 1993 (Colborn *et al.*, 1993); and published for dissemination purposes in 1996 under the title of "Our Stolen Future," authored by Theo Colborn, John Peterson Myers and Dianne Dumanoski, translated into over 16 languages and disseminated through environmental organizations and unions (Colborn, *et al.*, 2001).[19]

The PAN International List of Highly Hazardous Pesticides includes the chemicals classified under European Union Category 1 as endocrine disruptors (i.e., chemicals with at least one study providing evidence of endocrine disruption in an intact organism). According to Regulation 1107/2009 of the European Parliament and of the Council, Category 2 carcinogens and reproductive toxicants specified in Regulation 1272/2008/CE classify as endocrine disruptors (PAN, June 2015). This European Union classification is provisional and will be in force until the new criteria to define endocrine disruption proposed by the European Commission in June 2016 are approved and come into effect. This might take place during 2017, unless the criteria are reformed by the expert committees in charge of reviewing them and/or are rejected by the European Parliament and the European Council, which is what scientific organizations, civil society groups, and the Ministers of the Environment from France, Denmark and Sweden have requested. This issue will be addressed below.

According to regulations currently in force in Europe,[20] agricultural pesticides and non-agricultural pesticides or biocides[21] with endocrine disruptive properties that may have harmful health or environmental effects cannot be commercialized. This is a legal mandate resulting from the application of the precautionary principle.[22] However, the scientific criteria to identify such hormone-disrupting properties are still to be defined so that they can serve as hazard cut-off criteria in order to withdraw from the market products with such properties and achieve a higher level of health and environmental protection. These criteria should have been presented in 2013, but the drafting process has been subject to

19 See: https://www.amazon.com/Our-Stolen-Future-Threatening-Intelligence/dp/0452274141

20 Pesticide Regulations (1107/2009) and Biocide Regulations (528/2012).

21 The European Union classifies biocides into four large groups: general disinfectants and biocides, preservatives, pesticides, and other biocides. See: http://www.pan-germany.org/download/biocides/new_european_regulation_on_biocides.pdf

22 Article 174 of the European Union Treaty in its second section reads as follows: "Union policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Union. It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay."

intense lobbying and pressure from the European chemical industry, especially the pesticide, plastic, and cosmetic sectors. The lobbying and pressure tactics used include delaying tactics to defer actions, the presentation of studies carried out by industry as the only reliable data, inflating the possible economic cost of these product restrictions or prohibitions until a study of potential impact is made, thus influencing the regulatory bodies in order to prevent their interests from being affected (Horel, 2015).

According to the Corporate Europe Observatory, the main lobbying groups involved were the European Chemical Industry Council (CEFIC) and the European Crop Protection Association (ECPA), particularly the German corporations BASF and Bayer. This corporative pressure took place within the context of negotiations between Europe and the United States to establish the proposed "Transatlantic Trade and Investment Partnership" (TTIP), the consequence of which would be to achieve a downward standardization of the strictest European regulations (Corporate Europe Observatory, June 16, 2016). The proposal made by the European Commission reflects the successful lobbying carried out by corporate groups and their allies, particularly the Directorate General for Health and Food Safety (DG SANTE) and the Secretary-General of the Council of the European Union, with support from some of the member states, in particular Germany and the UK, as declared by the Corporate Europe Observatory (*Op. cit.*).

If the criteria proposed by the European Commission in June 2016 to define the endocrine-disrupting properties of pesticides and biocides are approved, practically all the pesticides and biocides that had previously been identified to demonstrate evidence of hormonal disruption would remain on the market (PAN Europe, 2016). In fact, PAN Germany warned that of the 50 priority pesticides reporting some hormone-disrupting activity, 31 should be regulated by the European Union, but if the options presented by the Commission's roadmap were to be followed, the regulated pesticides could be reduced to 7, 4, or even none (Lyssimachou, 2015-2016).

The European Commission's proposal has been described by Endocrine Society scientists as insufficient for an effective protection of the population's health, since the criteria to define what is an endocrine disruptor are extremely narrow. Criteria that would allow for a classification of the substance into different categories and accept evidence from animal trials or epidemiological analyses were not taken into account, which is an obstacle to incorporate new scientific findings (Endocrine Society, 2016). Another 15 recognized experts from Sweden, Australia, the UK, Switzerland, Denmark and the United States, in an open letter addressed to Commissioner Vytnes Adriutakis, European Commission Director General of Health and Food Safety expressed that the proposal required unprecedented causality tests in humans and that the regulatory process is confusing (Whaley, 2016).

In fact, the Commission's proposal of June 2016 required that for a chemical to be identified as an endocrine disruptor "there must be evidence that it causes adverse effects relevant for human health as a consequence of an endocrine mode of action." This requires an extremely high and unprecedented level of demonstration that is not consistent with the criteria used by the European Union to classify substances as carcinogenic, mutagenic or reproductive toxicants. The criteria are classified into various categories, such as: substances known to be hazardous based on human evidence (Category 1A), based on animal evidence (Category 1B), or based on partial animal evidence and other laboratory trials (Category 2). Established practice assumes that animal evidence is considered relevant for humans by default, unless there is information indicating the contrary. In contrast, the proposal made by the European Commission reverses this practice and demands proof that animal evidence is relevant for humans, thus excluding a significant part of existing scientific evidence (Ecologistas en Acción, June 21, 2016).

The European Commission aimed for the criteria proposals for the definition of hormone-disrupting substances in pesticides and biocides to come into force in January 2017, but the process was extended due to opposition and the fact that meetings must include experts and member countries. Before being presented at the European Parliament to be passed or not, the proposal can still be reformed in part and go through qualified majority vote at the Standing Committee on Plants, Animals, Food and Feed, in the case of pesticides, and at another Committee of Experts, in the case of biocides (Premium Newsletter No. 28, June 2016). Through a joint letter written on June 20, 2016, the Ministers of the Environment from France, Denmark and Sweden requested that the European Commissioner for Health and Food Safety modify his criteria and legislative change proposal since it does not ensure the highest level of health and environmental protection, does not consider the application of the precautionary principle, nor the health care cost caused by the hormone-disrupting chemicals, estimated at 160 billion Euros.[23]

Similarly, the main groups participating in a broad campaign against hormonal pollutants in Europe,[24] like PAN Europe, the Health and Environment Alliance (HEAL),[25] Ecologists in Action and the Corporate Europe Observatory

23 See: http://www.regeringen.se/globalassets/regeringen/dokument/miljo--och-energidepartementet/pdf/vytenisandriukaitis.pdf

24 The Endocrine Disruptive Chemicals-Free Europe campaign (EDC-Free Europe) is constituted by 65 organizations. See: http://www.edc-free-europe.org/about-us/

25 HEAL: Health and Environment Alliance is a non-profit organization that provides advice and scientific evidence in public policy decision-making processes. It is constituted by over 70 members including health professionals, cancer and asthma groups, women and youth groups, environmental organizations, as well as public health research institutes. See: http://www.env-health.org/

have requested that the European Commission's proposal be rejected by the European Council and Parliament, which includes parliamentary groups, like the Group of the Greens, that have criticized and rejected the Commission's conservative proposal.[26]

Governmental and civil society opposition to the European Commission's proposal on endocrine disruptors could take advantage of the change in the international situation with Donald Trump's unexpected victory that gave him the US presidency, and the cancellation of the negotiations of the TTIP with the European Union on January 23, 2017 through President Trump's first executive order.[27] This could remove an element of external political pressure, but does not cancel out pressure from corporations in Europe. In April 2017, Europe was still discussing the criteria regarding endocrine disruptors. The European Food Safety Agency (EFSA) and the European Chemicals Agency (ECHA) have developed preliminary guidelines to identify chemicals with endocrine disruptive properties in pesticides and biocides. These guidelines must align with the European Commission's criteria once they are approved, before being submitted to public consultation and eventually authorized during 2017.[28]

Pesticides that May Lead to the Death of Bees

For food safety, it is essential to protect bees and other pollinators. 35 percent of global crop production depends on pollination by insects like bees, which increases the yields of 87 different crops (Van der Valk *et al.*, FAO, UNEP, GEF, 2013). Pollination is essential for fruit trees (apple, plum, pear, peach, cherry, almond trees, etc.), forage legumes (alfalfa, red, white and sweet clover), vegetable crops for seed production (cabbage, carrot, cauliflower, onion, eggplant), horticultural vegetables (tomato, cucumber, cantaloupe, pumpkin, watermelon), oleaginous plants (sunflower, rapeseed), nuts, spices and stimulants such as coffee and cocoa, to mention a few. Beneficial insects such as bees can be heavily impacted by pesticides. The countries that evaluate pesticide impact on pollinators as a requirement for their registration only consider one of the pollinating species, the European honeybee (*Apis mellifera*), ignoring the impact on other pollinators. For many tropical crops, it is the wild non-*Apis* bees that are the main if not only

26 A group constituted by Europarliamentarians from the Green Party and the European Free Alliance. See: https://www.greens-efa.eu/en/article/toxic-substances-6726/ Retrieved on August 12, 2016.

27 See: http://edition.cnn.com/2017/01/23/politics/trans-pacific-partnership-trade-deal-withdrawal-trumps-first-executive-action-monday-sources-say/

28 Updated information from the European Commission regarding the criteria discussion and approval can be found at: https://ec.europa.eu/health/endocrine_disruptors/next_steps_en

pollinators, constituting approximately 90 percent of the bees worldwide (Nates-Parra, 2005). Therefore, pesticide impact assessment should consider the impact on both the European honeybees and the local native bees or other relevant pollinators.

The high toxicity for bees of neonicotinoid pesticides –synthetic nicotine-derived insecticides introduced into the world market in 1991– has been documented in recent years (Watts, 2011). The European Union has temporarily restricted some neonicotinoid insecticides, such as fipronil and imidacloprid, which nonetheless are not the only pesticides that can be highly toxic for bees. The PAN International List of Highly Hazardous Pesticides includes those classified by the US EPA as highly toxic for bees when the mean lethal dose is less than 2 micrograms per bee. PAN also consulted the EU-funded FOOTPRINT –Functional Tools for Pesticide Risk Assessment and Management– Pesticide Properties Database developed by the University of Hertfordshire (PAN International, 2015a). Besides high acute toxicity, other sublethal effects caused by some pesticides on bee physiology and behavior (mobility, learning and orientation) have been documented, including the behavior of worker bees in the beehive, as noted by Rémy Vandame in his chapter in this book where this issue is analyzed in greater detail.

1.4 PAN International List of Highly Hazardous Pesticides

PAN International took the initiative to develop a list of highly hazardous pesticides based on the criteria recommended by FAO and WHO, adding others, described before. In 2009, PAN International published a first version of the list of highly hazardous pesticides developed by PAN Germany experts. The list, which is periodically updated, was translated into Spanish by RAPAM, and its most recent version of December 2016 includes 297 active ingredients.

The *PAN International List of Highly Hazardous Pesticides* includes pesticides used in agriculture, forestry, fisheries, vector control, households, other buildings and transport; those used for ectoparasite control (like cattle tick, for instance); rodenticides and other vertebrate poisons; wood preservatives; plant growth regulators; fumigants; and those pesticides incorporated into materials and other products. It excludes pesticide synergists, protectors and other additives of pesticide formulations, as well as all degradation products (metabolites) of pesticide active ingredients (PAN International, 2016). As the authors recognize, the PAN List of Highly Hazardous Pesticides presents several limitations, which can be summarized as follows:

◊ The criteria used to define the list are based on classifications accepted by international bodies such as the International Agency for Research into Cancer (IARC), part of the WHO, the Globally Harmonized System (GHS)

adopted in the European Union, or national authorities such as the EPA. Given the time needed to gain consensus within these bodies, they are not synchronized with international scientific literature reports. In other words, if a pesticide is not classified by these bodies, this does not mean that there are no reports in the scientific literature regarding its possible hazardous effects, such as whether it is carcinogenic, etc.

◊ Another reason is that scientific research on certain "emergent properties," for example, pesticides that disrupt normal hormone action are not yet sufficiently operative, and there is a debate whether there are threshold values that can be considered to be safe.

◊ Pesticides that can be linked to high incidence of adverse effects on human health and the environment due to their high and chronic toxicity have not been systematically identified. This is due to deficiencies in the epidemiological and ecotoxicological surveillance, particularly in Latin American, Asian and African countries.

◊ The list does not include pesticides classified by the WHO as "moderately hazardous" (Class II), even if there are concrete examples of damage caused by some of the pesticides within this category, such as the insecticide endosulfan and the herbicide paraquat, which have caused thousands of poisonings, particularly in developing countries; or pyrethroid insecticides known for their incidence in various health problems in the United States. PAN, nonetheless, decided to prioritize only those pesticides included in the WHO Category I.

◊ It does not include dioxin pollutants as a category. Within the context of the Stockholm Convention, the *Toolkit for Identification and Quantification of Relesases of Dioxins, Furans and Other Unintentional POPs* in its most recent version[29] identified several pesticides that can be polluted with dioxins. These dioxins are a persistent organic pollutant unintentionally generated during the pesticide production process remaining in the end product. These pesticides include herbicides 2,4-D and chlornitrofen or 2,4,6-trichlorophenyl-4-nitrophenyl ether (CNP), as well as the wood preservative pentachlorophenol (PCP) and its sodium salt (Na-PCP).

◊ Because they are not used worldwide, the list does not include pesticides classified as obsolete by FAO and WHO, such as first generation organochlorine pesticides, aldrin, and eldrin, among others. Nonetheless, they might still have limited or illegal uses, particularly if countries still have obsolete stocks.

29 See: http://toolkit.pops.int/Publish/Main/01_Index.html

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In spite of these limitations, the PAN List of Highly Hazardous Pesticides is a very useful guide that must be complemented by local research in order to identify the registered and most widely used highly hazardous pesticides, and visibilize the dimension of the problem vis-à-vis exposed producers, workers and communities, as well as private sector decision-makers, governments, mass media and consumers.

1.5 Discussion about Highly Hazardous Pesticides within SAICM

The discussion about highly hazardous pesticides at SAICM meetings has mainly been promoted by public interest non-governmental groups like PAN and IPEN with support from international organizations, labor unions, the African region, and some Asian and Latin American governments.

At the third session of the International Conference on Chemicals Management (ICCM) held in September 2012, a draft resolution was presented calling for more action on highly hazardous pesticides. However, due to time constraints, it was not discussed at the plenary. The theme was transferred to the agenda for ICCM's fourth session in 2014. In Latin America, the Fourth Regional Meeting for Latin America and the Caribbean on SAICM, held in Mexico City in August 19-22, 2013, participant governments, industry, and the non-governmental organizations passed a resolution on highly hazardous pesticides, inviting the FAO to develop a document about the safest existing alternatives, including ecosystem-based approaches. SAICM's Regional Coordination Committee was also exhorted to develop a regional survey on the state of highly hazardous pesticides and their alternatives, as well as to promote information exchange among different countries regarding their state, restrictions and prohibitions.

Since 2015, PAN International has been promoting a signature campaign calling for a ban on highly hazardous pesticides. This campaign has received support from an extensive group of scholars, non-governmental and social organizations. To date, it is constituted by over 500 organizations in 106 countries (PAN International, 2016). For ICCM's fourth session, PAN International released an open letter addressing UNEP, FAO and WHO officials, signed by 118 toxicologists and health professionals from Africa, Asia, Latin America, the United States, Canada, Australia and Europe, demanding an end to the use of highly hazardous pesticides. The letter points to the weaknesses of current regulations and risk assessments regarding effects such as immunotoxicity, endocrine disruption and postnatal reproductive toxicity (PAN International, September 28, 2015).

IPEN and PAN International proposed the creation of a Global Alliance for the voluntary phase out of highly hazardous pesticides open to the participation of all stakeholders. It was argued that this Alliance could favor information exchange

and promote agroecological alternatives in crop management, as well as prevention and reduction of health and environmental risks. In Mexico, 23 organizations and 25 scholars from the country's main universities demanded that the Mexican delegation support the proposal to create this global alliance (RAPAM, 2015).

During the fourth session of the International Conference on Chemicals Management (ICCM4) held in Geneva, 28 governments from Africa, Asia, and Latin America (including the Dominican Republic, Honduras, Peru, Panama, and El Salvador), as well as IPEN, PAN, and the International Union of Food, Agricultural, Hotel, Restaurant, Catering, Tobacco and Allied Worker´s Associations (IUF) presented a draft resolution on the creation of such a voluntary global alliance open to participation by all stakeholders. In view of their capabilities and mandates, FAO, WHO, and UNEP were invited to serve as the alliance's Secretariat. One proposal was to develop a business plan to provide technical and financial viability, among other points (SAICM/ICCM.4/CRP.4). In spite of these efforts, the proposal was not accepted by the majority of governments, nor by industry, represented by CropLife. Instead, it was decided to base the negotiation on the draft resolution and the strategy developed by FAO in collaboration with WHO and UNEP, which eluded the explicit formation of this alliance, although a policy resolution was reached by consensus recommending the promotion of agroecological alternatives, as will be seen below.

1.5.1 Resolution on Highly Hazardous Pesticides Adopted at ICCM4 and Emphasis on Promoting Agroecological Alternatives

The over 450 delegates from governments, international organizations, public interest non-governmental organizations, and the chemical industry participating in the fourth session of ICCM held in Geneva in 2015, consensually approved a resolution on highly hazardous pesticides that supports concerted actions to be carried out by stakeholders, and welcomed the strategy proposed by FAO, UNEP and WHO.

The resolution textually, "... encourages relevant stakeholders to undertake concerted efforts to implement the strategy at the local, national, regional and international levels, *with emphasis on promoting agroecologically-based alternatives*, and strengthening national regulatory capacity to conduct risk assessment and risk management, including the availability of necessary information, mindful of the responsibility of national and transnational enterprises" (SAICM/ICCM.4/CRP.16 October 2015, emphasis added).

The emphasis on promoting agroecological alternatives in the approved resolution was the result of negotiations during the fourth session of the ICCM. Clarity was reached regarding the orientation of priorities when discussing

alternatives to the use of highly hazardous pesticides. The emphasis on agroecological alternatives made it possible to set forth that the problem will not be solved with a mere substitution of a highly hazardous pesticide by a less hazardous one, nor with focusing on "safe management," as the chemical industry has posited. However, what is required is a change in how the problem is defined in order to thus prevent and control the emergence of pests, diseases, and undesirable plants from an ecosystemic approach, as proposed by agroecology. It must be recognized that the FAO's strategy accompanying such a resolution –which we will analyze in greater detail in the next point– does not delve deeply enough into the differences between the agroecological approach and so-called Integrated Pest Management. It is clear, however, that the intention is to reduce dependence on pesticides, as indicated in strategy point 28, "Where possible, *priority should be given* to the introduction of integrated pest management or integrated vector management that makes optimal use of *agro-ecological approaches and reduces reliance on pesticides.*" (SAICM/ICCM.4/CRP.16, emphasis added).

1.5.2 FAO, UNEP and WHO Proposal for a Strategy on Highly Hazardous Pesticides

The strategic approach to highly hazardous pesticides proposed by FAO, WHO, and UNEP, approved during the fourth session of the International Conference on Chemicals Management (ICCM4), notes in its considerations that it aims to contribute toward reaching SAICM's 2020 goal of achieving sound management of chemicals, i.e., to significantly reduce the health and environmental risks associated to this particularly hazardous group of pesticides. In a broader context, it indicates that a reduction of the use of highly hazardous pesticides would significantly contribute to achieving several of the Sustainable Development Goals in the new 2030 Agenda for Sustainable Development, such as promoting sustainable agriculture (Goal 2), healthy living and well-being (Goal 3), sustainable water management (Goal 6), decent work (Goal 8), the sustainable use of terrestrial ecosystems, and halting biodiversity loss (Goal 15) (SAICM/ICCM.4/8, point 4).[30]

The strategy proposed by FAO, WHO and UNEP sets forth the participation and collaboration between eight stakeholders involved in pesticide management, so that through concerted actions at local, national and international levels, measures can be taken to significantly reduce health and environmental risks. It recommends linking these actions to SAICM's Global Action Plan and the *Guidelines on Highly Hazardous Pesticides* developed by FAO and WHO experts and divulged in April, 2016.

30 The new sustainable development goals can be consulted at: http://www.un.org/sustainabledevelopment/sustainable-development-goals/

The stakeholders identified by the FAO/WHO-UNEP strategy are:

a) Government regulatory authorities;
b) Agricultural extension services and public health consultation;
c) Sanitary services and intoxication control centers;
d) Farmer organizations and networks;
e) Agricultural worker unions and organizations;
f) Private sector (both transnational pesticide industries, members of CropLife, and national formulation companies, distributors and consumer goods companies, like Wal-Mart, for example);
g) Civil society (public interest groups, such as PAN and IPEN are mentioned as examples); and
h) Academic and scientific circles that play an important role in providing information.

Each stakeholder is expected to inform about progress at the next general meeting of the ICCM Conference in 2020 and in preparatory meetings. The strategy surveys the work carried out by the various organizations participating in the IOMC working on pesticide-related issues, including the International Code of Conduct for Pesticide Management, the OECD's Working Group on Pesticides, the World Bank, WHO activities, as well as the pesticides included in the international environmental conventions. However, it also points out the deficiencies that continue to exist for the achievement of SAICM's 2020 goal.

The strategy notes that there is a lack of awareness-raising work to reach the different stakeholders and the mass media "about the risks of highly hazardous pesticides, the availability of safer alternatives and the desirability of making a transition to more sustainable agro-ecological approaches to pest management;" finding and sharing information about viable alternatives, such as cultural controls, biological and less hazardous pesticides; and risk reduction measures in cases in which pesticides cannot be substituted and continue to be used (SAICM/ICCM.4/8, point 34).

The strategy provides valuable examples of actions that each stakeholder could carry out. However, it does not acknowledge the power relations between stakeholders during pesticide management in the food system, particularly the power wielded by transnational corporations; neither does it recognize how agricultural public policies and the dominant regulatory frameworks have favored transnational corporations. It does not explain the conflict of interest between the search for profit to extend the market life of pesticides and the public interest in protecting human health, the environment and other common goods. The State's responsibility remains ambiguous. The role of the State, as "another stakeholder," seems to be more that of a facilitator of the actions that private actors can take

in the market, than that of a central actor with the fundamental obligation of protecting the health and environment of those it governs.

In my opinion, the application of the most significant risk reduction measures proposed by the FAO, WHO, and UNEP strategy will depend on changes in the relations of power between social stakeholders participating in pesticide management, and changes in public policies that have favored their expansion. It will particularly depend on counterbalancing the influence transnational corporations have on the pesticide market and the food system, on changes in the public policy support for agrotoxics, and the acknowledgement by the authorities of their responsibility to ensure the highest level of human rights protection in the living conditions of those affected by exposure to highly hazardous pesticides.

1.6 The Code of Conduct on Pesticide Management and the FAO/WHO Guidelines on Highly Hazardous Pesticides

The concept of highly hazardous pesticides was incorporated into the fourth update of the *Code of Conduct on Pesticide Management*, published in 2014. This Code was originally called the "International Code of Conduct for Pesticide Distribution and Use," adopted by the FAO in 1985. It was later signed by the WHO in its fourth edition. It establishes voluntary standards of conduct that provide a framework of reference for government, private sector and civil society regulation regarding good practices in pesticide management, including pesticide production, distribution, consumption and waste management, particularly when there is inadequate or non-existent national legislation. The Code is complementary to other binding and non-binding legal instruments, such as SAICM and other FAO guidelines (FAO/WHO, 2014).

One of the criticisms of the Code's first versions was that it assumed that pesticide "safe use" can be ensured if label instructions are followed and adequate personal protection equipment is used, in spite of the fact that field research has demonstrated that under the circumstances of use prevailing in Asian, African and Latin American countries, this hardly ever happens. In fact, in 2002, the term "safe use of pesticides" was withdrawn from the Code of Conduct's objectives and other clauses. Instead, it now reads, "promote practices that minimize potential health and environmental risks associated with pesticides."

The transnational pesticide industry organized under CropLife, its members and other business organizations have accepted the Code of Conduct as a framework of reference and have committed to comply with it. Nonetheless, they often infringe it. Community monitoring coordinated by non-governmental organizations pertaining to PAN International have denounced their lack of compliance in Asian, African and Latin American countries (Dinham, 2010).

An ad hoc report, addressed to FAO and WHO, coordinated by human rights defense non-governmental organizations and PAN in the Asian Pacific region recently documented that the Code of Conduct and FAO guidelines are being violated by Bayer and Syngenta corporations, their subsidiaries, sales agents and distributors in India, particularly regarding labeling, the use of personal protection equipment, training, and pesticide use monitoring and their effects on health and the environment. The report is based on field surveys carried out in Punjab, India, between 2014 and 2015 (PANAP, 2015).

Highly hazardous pesticides were defined as follows in the fourth version of the Code of Conduct currently in force:

"*Highly Hazardous Pesticides* means pesticides that are acknowledged to present particularly high levels of acute or chronic hazards to health or environment according to internationally accepted classification systems such as WHO or GHS,[31] or their listing in relevant binding international agreements or conventions. In addition, pesticides that appear to cause severe or irreversible damage to health or the environment under conditions of use in a country may be considered to be highly hazardous and treated as such" (FAO, 2013, Article 2, Terms and Definitions).[32]

In April, 2016, FAO and WHO released the *Guidelines on Highly Hazardous Pesticides* with the purpose of helping countries to interpret and apply the pertinent articles in the Pesticide Management Code of Conduct (see Table 3).

The *Guidelines* cover all pesticides, not only those used in agriculture, but also those used for public health, household, recreational, and industrial use. A group of international experts participated in the development of these *Guidelines*. The members of this group declared that they had no conflict of interest and were elected because of their abilities and experience. There were also observers, such as CropLife, PAN, and IPEN, but they were not able to participate in the decision-making.

The *Guidelines* are a supplement to other FAO-developed guides, like the pesticide registration guidelines, which develop a reporting system for health and environmental incidents, those that address legislation, and the toolkit for pesticide registration that includes a risk assessment guide, all of which are available on electronic media.[33]

The FAO/WHO guidelines invite governments to develop a three-step process with their respective actions: the identification of highly hazardous pesticides, health and environment risk assessment, and mitigation actions, which can lead to restricting or banning a product (see Table 4).

31 Globally Harmonized System (GHS).

32 See http://www.fao.org/agriculture/crops/thematic-sitemap/theme/pests/code/en/

33 See: http://www.fao.org/pesticide-registration-toolkit/tool/home/

Table 3
Articles Related to Highly Hazardous Pesticides in the Code of Conduct

3.6 Pesticides whose handling and application require the use of personal protective equipment that is uncomfortable, expensive or not readily available should be avoided, especially in the case of small-scale users and farm workers in hot climates (6).

5.1.6 Utilize all possible means for collecting reliable data and maintaining statistics on health effects of pesticides and pesticide poisoning incidents, using harmonized tools where available and submit, where appropriate, the Rotterdam Convention Human Health Incident Report Forms on Severely Hazardous Pesticide Formulations (SHPF), to the relevant designated national authority (34). Suitably trained personnel and adequate resources should be made available to ensure the accuracy of information collected.

6. Governments should:
6.1.1 Introduce the necessary policy and legislation for the regulation of pesticides, their marketing and use throughout their life cycle, and make provisions for its effective coordination and enforcement, including the establishment of appropriate educational, advisory, extension and health-care services, using as a basis FAO and WHO guidelines and, where applicable, the provisions of relevant legally binding instruments. In so doing, governments should take full account of factors such as local needs, social and economic conditions, levels of literacy, climatic conditions, availability and affordability of appropriate pesticide application and personal protective equipment;

7.5 Prohibition of the importation, distribution, sale and purchase of highly hazardous pesticides may be considered if, based on risk assessment, risk mitigation measures or good marketing practices are insufficient to ensure that the product can be handled without unacceptable risk to humans and the environment.

9.4 All entities addressed by this Code should:
9.4.1 Support the process of information exchange and facilitate access to information on matters including pesticide hazards and risks, residues in food, drinking water and the environment, the use of pesticides in or on non-food products, IPM/IVM,* pesticide efficacy, alternatives to highly hazardous pesticides and related regulatory and policy actions;

Source: FAO/WHO. (2015). *International Code of Conduct for Pesticide Management.*
(6) *Guidelines on Personal Protection When Using Pesticides in Hot Climates*, FAO, Rome. 1990. [Text at: http://www.fao.org/fileadmin/templates/agphome/documents/Pests_Pesticides/Code/Old_guidelines/PROTECT.pdf]
(34) Rotterdam Convention, Severely Hazardous Pesticide Formulation Incident Reporting Forms. See: http://www.pic.int/Procedures/SeverelyHazardousPesticideFormulations/FormsandInstructions/tabid/1192/language/en-US/Default.aspx
* IPM: Integrated Pest Management; IVM: Integrated Vector Management.

Table 4
FAO/WHO Guidelines on Highly Hazardous Pesticides (2016)

Step 1 Identification of highly hazardous pesticides: ▪ Based on FAO/WHO-proposed criteria
Step 2 Health and environmental risk assessment, including: ▪ Human health exposure (occupational/residential) ▪ Exposure of livestock, domestic animals and wildlife ▪ Environmental exposure (soil, water, air, beneficial insects) ▪ Unintentional exposure of crops (e.g., derived from aerial fumigations) ▪ Exposure due to local circumstances of use ▪ Assessment of exposure levels: (current use practices, biomonitoring, etc.) ▪ Assessment of the need to use each pesticide (benefits/effective lower risk alternatives) E.g., agroecology-organic agriculture/considering direct and indirect economic costs (public expenditure due to impact on health and the environment)
Step 3 Mitigation actions: ▪ Restricting certain uses/changing formulation ▪ Voluntary withdrawal/cancellation/ban ▪ Plan of action / extensive communication and civil society participation

Source: Developed by the author based on FAO/WHO, 2016.

Schematically speaking, the first step that the *Guidelines* set forth is the *identification of highly hazardous pesticides in use,* using criteria approved by the FAO/WHO group of experts that can be conducted by the registration authorities or an intergovernmental group. As we have noted, PAN International network proposes the inclusion of additional criteria, such as high toxicity in bees and hormone-disruption, since it considers that these criteria are relevant to achieving better health and environmental protection.

The second step, *assessment of risks associated with health and the environment,* describes how to achieve a more extensive assessment that includes occupational and residential exposure affecting human health either directly or via food; exposure of livestock, domestic animals, and wildlife; environmental exposure (soil, ground or surface water, air, beneficial insects and organisms that provide ecosystem functions); unintentional exposure of crops due to spray drift; exposure due to local circumstances of use (non-availability of appropriate personal protection equipment, limited ability to safely store and maintain pesticides, poor advise or knowledge about pesticide use and risks, not respecting prescribed re-entry intervals and pre-harvest intervals after fumigation; lack of disposal options/facilities for obsolete stocks, left-over product or empty containers); assessment of exposure levels (using different

approaches: intoxication registrations may be used or current use practices may be assessed, based on extremely simple or highly complex exposure models, or direct biomonitoring of blood, urine or breast milk). Lastly, this step recommends an *assessment of the need to use* each pesticide for the authorized applications, considering the benefits, availability of alternatives, and total cost.

It is interesting to highlight that in the *needs assessment* of highly hazardous pesticides, the FAO/WHO guidelines recommend that the assessment of a possible substitution include the identification of possible effective alternatives that pose less risk, considering their availability and the economic aspects involved. According to the guidelines, alternatives can include biopesticides, non-chemical approaches to pest control, less hazardous chemicals, or different low-risk formulations; and indicate that it would be preferable to identify alternatives in the sphere of "agroecologically-based production systems such as organic agriculture." Besides, the guidelines appearing in the Proceedings of the International Symposium on Agroecology organized by FAO in Rome, Italy in 2014 indicate that "FAO describes agroecology as 'the science of applying ecological concepts and principles to the design and management of sustainable food systems'" (FAO/WHO 2016: 10).

In the assessment of the need to use highly hazardous pesticides and available alternatives, the FAO/WHO *Guidelines* note that it is important to take economic aspects into account. They propose that the assessment of both public and private costs and benefits should consider total pesticide cost. In other words, not only application cost, but also direct and indirect costs must be assessed, from the need to use personal protection equipment to healthcare expenses due to short and long-term damage to health, as well as long-term public expenditures made by rural communities and consumers, the environmental cost associated with water pollution, biodiversity loss (including pollinators), and pesticide residues in food (FAO/WHO, 2016: 12-13).

Failing to act on reducing or substituting chemical pesticide use implies a high cost. UNEP has developed a report entitled *The Cost of Inaction in Chemicals Management* that estimates that pesticide intoxications in Europe cost $15 million dollars per year due to hospitalization expenses, and $3.9 million dollars due to loss of employment. In the United States, annual costs are $1.1 billion dollars in public health care, $1.5 billion dollars in pesticide-caused pest resistance, $1.4 billion dollars in crop damage, $2 billion dollars in underground water pollution, and $ 2.2 billion dollars in bird loss, which together with other expenses, account for a total of 10 billion dollars per year spent on environmental and social costs caused by agrotoxics (UNEP, 2013: 30). In Latin America, where studies of this type are scarce, it has been estimated that in Paraná State in Brazil, of each dollar spent on pesticides, $1.28 dollars are spent on healthcare and absenteeism in the workplace due to occupational intoxication (Soares, 2012).

The third step recommended by the *Guidelines* is to decide on the most appropriate measures to mitigate these risks, which may lead to a restriction of certain uses, a change of formulation, voluntary removal, or cancellation or prohibition by the competent authorities. In my opinion, it is important to set forth not only risk mitigation or reduction, but also to emphasize prevention in order to prevent damage taking place and aim for the highest level of health and environmental protection. It should be taken into account that compliance with measures restricting the use or formulation of highly hazardous pesticides would hardly be viable in countries like Mexico, where government inspection and surveillance mechanisms are very weak or hardly reliable. The search for the highest level of protection must be seen not only as an option that depends on or is subordinated to a cost-benefit analysis, but also as an obligation that in many countries is included in the constitution, and is linked to the protection of life and human rights.

Lastly, the *Guidelines* recommend developing a plan of action comprising an effective communication strategy, stakeholder participation, i.e., farmers, distributors in the food and pesticide supply chains, extensive civil society participation, including epidemiologists, among others, as well as pesticide use for vector control in public health campaigns (FAO/WHO, 2016).

To sum up, in my opinion, the FAO/WHO *Guidelines* are a voluntary guide and in spite of contributing valuable elements, particularly regarding the necessity to evaluate the need for pesticides, consider non-chemical alternatives, and evaluate total costs, must be seen critically when discussing the language of a public policy on highly hazardous pesticides. However, this guide must not be the only element to take into account for the development of a public policy on this serious issue, but rather it should be based on the authorities constitutional obligation to protect human rights. This obliges authorities to provide the highest level of health and environmental protection. Public policy must also be informed by the reports of UN Special Rapporteurs on human rights that have analyzed the consequences of using pesticides, which we will address below.

One of the limitations of the FAO/WHO *Guidelines* is that the proposed methodology, in spite of its improvements, continues to follow the prevailing risk management and assessment paradigm. The discussion about pesticide alternatives is part of the final stage of health and environmental risk assessment and is subject to discussions regarding economic impact, although environmental and public health costs are also included. In any case, considering the real, political, social, economic, and cultural conditions of pesticide use in Southern countries like Mexico, it would be indispensable to ensure that a qualified technical body without conflicts of interest with the pesticide industry be in charge of conducting the recommended assessments. In the *Guidelines*, the prohibition measures seem to be the last ones to be taken into account once other pathways, such as the partial

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restriction of certain uses, formulation changes, or voluntary withdrawal have been discarded, all this within a time frame that might allow pesticide market life to be extended. Within this paradigm, albeit improved, the pesticide industry and other stakeholders that benefit from this market may have greater margins for negotiation within the discussion regarding the measures to be taken. The risk is that economic interests may gain priority over the fundamental human rights to protect health and the environment in order to achieve a healthy and appropriate diet.

From my point of view, given the serious consequences of the hazard potential inherent in highly hazardous pesticides, a risk prevention strategy should be developed, rather than focus only on risk mitigation. This strategy should contain a definition of what is or is not acceptable consistent with the obligation to protect and provide the highest level of protection to human life and dignity. Within this context, it is important to consider the application of the *precautionary* and *substitution principles* applied in other countries when facing hazardous chemicals or particularly hazardous activities. In the European Union, for example, hazard cut-off criteria is applied. If chemicals present specific characteristics, such as being persistent, bioaccumulative and toxic, or potentially causing cancer or mutagenesis, reproductive toxicity, or endocrine disruption, they are not allowed to pass on to the next stages of risk assessment.[34] In any case, deadlines for the withdrawal of highly hazardous pesticides from the market can be negotiated, at the same time as less hazardous alternatives are promoted.

Given the hazardness of these pesticides and evidence of their health and environmental impact recorded at a national level, the *substitution principle* should also be applied so that a strong highly hazardous pesticide program can be established to make it possible to substitute them as part of a strategy based on the agroecological management of pests, diseases and undesired plants, in which the experience of producer organizations from the social and private sectors is valued, as well as that of academia and non-governmental organizations. In this regard, the formulation of the required public policy must consider not only the *Guidelines*, but also social experiences and national policies from other countries, particularly those in Latin America, like Brazil, where a national proposal to reduce pesticide use has been developed.

34 According to Regulation (EC) Nº 1107/2009, if a pesticide's active ingredient, safener or synergist contains certain hazardous properties, such as Category 1A-1B mutagens (Regulation 1107/09 Annex II, para. 3.6.2), carcinogens Category 1A or IB (Ibid., para. 3.6.3), reproductive toxicity (Ibid., para. 3.6.4), and endocrine-disrupting properties (Ibid., para. 3.6.5), it does not obtain the necessary approval for its commercialization. Those pesticides that upon going through a hazardness assessment turn out to be persistent organic pollutants (POP), i.e., persistent, bioaccummulative and toxic (PBT) (Ibid., paras: 3.7.2.1/2/3), as well as those that are very persistent or very bioaccummulative (vPvB) (Ibid., para. 3.7.3) do not obtain registration either.

In Latin America, only Brazil has a pesticide legislation that includes hazard cut-off criteria and establishes a ban on the registration of teratogenic, carcinogenic, mutagenic and hormone-disrupting pesticides, their components or similar products (Article 3, Section 6, Act 7.802, July 11, 1989 and Article 31, Decree 4.074, January 4, 2012). Although the application of this legislation suffers serious deficiencies, it did enable the health authorities in Brazil to demand a reassessment of the current registrations and cancel some chemicals. Thanks to a national public policy supportive of agroecology and organic agriculture, and to an extensive movement of professional health associations and social movements, Brazil was able to develop a National Agrotoxic Reduction Program in 2014 (PRONARA in Spanish, 2014).[35]

Unfortunately, former president Dilma Rousseff was unable to sign PRONARA as the National Congress in Brazil removed her from her position during the second half of 2016. The *Ongoing Campaign against Agrotoxics and for Life*, that fights for an alternative agricultural and agrarian development model, and groups of the Landless Workers Movement (MST by its acronym in Portuguese), the collective health professionals groups (ABRASCO) and organizations that promote agroecology and organic agriculture, are currently promoting initiatives in the Brazilian Congress for a national pesticide reduction policy. Campaign actions confronted the legislative "rural caucus," representing the interests of the large-scale agro-exporting landowners who aim to weaken the powers of the Health Ministry and accelerate the pesticide registration process by reducing sanitary and environmental requirements.[36]

1.7 Agroecology: From Highly Hazardous Pesticide Substitution to Food System Transformation

As we have seen, the resolution on highly hazardous pesticides approved at the fourth session of the ICCM4 calls governments and other stakeholders to implement the strategy proposed by FAO/WHO/UNEP and to *emphasize on the promotion of agroecological alternatives*. Furthermore, the FAO/WHO *Guidelines on Highly Hazardous Pesticides* note that it would be preferable to identify "agroecology-based production system" alternatives, such as organic agriculture. We will thus step into reviewing how agroecology is conceptualized as there is an attempt to

35 PRONARA was developed by a multisectoral working group constituted by social movement representatives, like the Permanent Campaign against Pesticides and for Life, health professionals organizations (ABRASCO) and government public health institutions promoting the creation of a National Commission and National Plan for Agroecology and Organic Production.

36 See: http://contraosagrotoxicos.org

neutralize its critical charge and make it compatible with the industrialized food system dominated by transnational corporations.

Agroecology is a scientific discipline, a set of agricultural practices, as well as a social and political movement. Since the times in which the term was first used by Basil Bensin, a Russian agronomist, to classify local varieties of corn in 1928-1930, the meaning of the term agroecology has expanded in order to include social, economic, environmental, and political dimensions (Wezel *et al.*, 2009). As a science, agroecology is the result of a cross between ecology and agronomy, as well as the knowledge and applied sciences these disciplines are constituted by. It is a "hybrid discipline," an interdisciplinary form with a new epistemological and methodological proposal (Toledo *et al.*, 2002). It is based on the "application of ecological science to the study, design and management of sustainable agroecosystems" (Altieri, 2002). Agroecology has extended its field of analysis and action from focusing on ecological and social relations in agricultural fields as an object of study, to understanding itself as an applied science in search of food system sustainability (Gliessman, 2007). It aims for food systems to become sustainable and find a balance between ecological responsibility, economic viability, and social justice (Gliessman, 2013, 2015). Agroecology is developed as an alternative to reductionist and productivist approaches of capitalist industrialized agriculture, which bases productivity increases on the intensification of a few crops through monocultures dependent on large-scale external inputs, including pesticides.

In Latin America, agroecology has developed an intimate relationship and dialogue with peasant movements, reclaiming and interacting with peasant and indigenous movements that play an indispensable role in the construction of agroecological knowledge. This discipline revalues the knowledge of biodiversity and agricultural practices pertaining to peasant and indigenous cultures as part of their strategy to make multiple use of resources, thus enabling agriculture to flourish in Latin America for more than 10 thousand years. Production systems based on agroecological principles constitute the foundation of an energetic and productive strategy strongly linked to food sovereignty (Altieri and Toledo, 2011:5). Food sovereignty, in turn, is a political concept introduced by Vía Campesina in 1996, understood as "the peoples' right to nourishment and culturally appropriate foods that are sustainably and ecologically produced, and their right to decide their own food and productive systems..." (Vía Campesina, 2015). In Latin America, the agroecological experiences and scientific proposals and technologies in Brazil, the Andes region, Mexico, Central America, and Cuba are causing an "agroecological revolution" at an epistemological, technical, and social level (Altieri and Toledo, 2011).

By studying the issue of the emergence and control of pests, diseases, and unwanted plants, agroecology aims to understand the role biodiversity plays in an agroecosystem, its components and functions to develop habitat diversification

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strategies with organic soil management and zero tillage practices. The strategies agroecology proposes for insect population management aim to increase natural enemy diversity in order to achieve low-density population via practices such as promoting polycrops, crop rotation, cover crops and strip cropping (see Figure 2) (Altieri and Nichols, 2000).

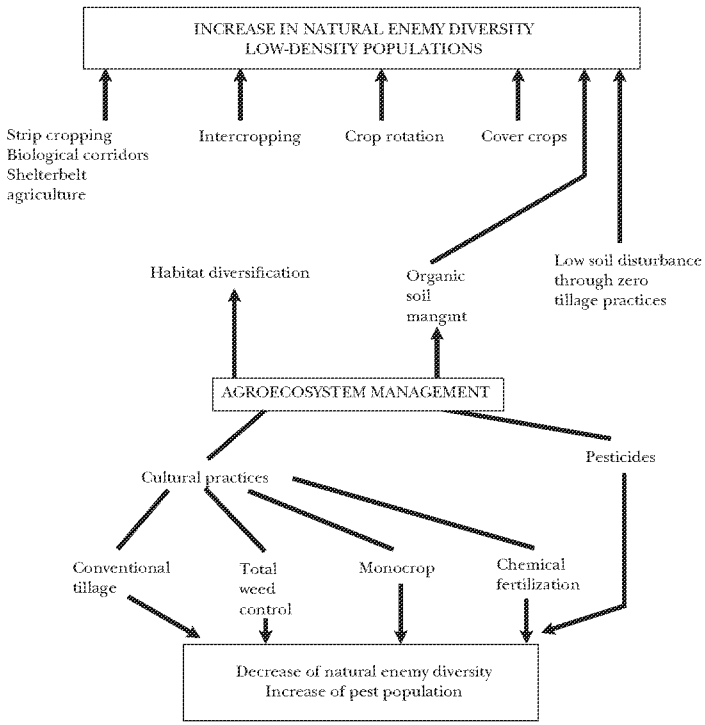

Figure 2. Effects of Agroecosystem Management and Cultural Practices Associated with Natural Enemy Diversity and Pest Insect Abundance
Source: Altieri M. and Clara I. Nichols, 2000, p. 172.

During the fourth session of ICCM, PAN International and IPEN presented a book that proposes the replacement of highly hazardous pesticides via the application of agroecological principles and the documentation of numerous successful examples in countries in Asia, Africa, Latin America, and Europe, as well as in the United States (Watts and Williamson, 2015).

Furthermore, during the negotiation week in ICCM4, CropLife organized a parallel event in which an information sheet was distributed recognizing that agroecology is a scientific discipline, but only as an additional tool for agricultural

management. It criticized its pretension to orient "agroecological practices" and become part of a social movement (CropLife, 2015). In Latin America, CropLife representatives refer to the inclusion of "ecological principles" as part of the Integrated Pest Management strategies, side-by-side with zero tillage and the use of genetically modified crops (Perdomo, 2016). In the Nyéléni Declaration, Vía Campesina warned about the need to struggle against corporate and institutional appropriation of agroecology (Vía Campesina, 2015).

Agroecology has been gaining recognition within the assessments regarding the future of agriculture and the food system promoted by various UN agencies. The role of the International Assessment of Agricultural Sciences and Technologies for Development (IAASTD) should be noted. It provided public policy guidance in order to define the way in which agricultural knowledge, sciences, and technologies can reduce hunger and poverty, improve the means of rural subsistence and human health, as well as facilitate equitable and sustainable development in environmental, social and economic terms. The assessment was carried out by over 400 development scientists and experts from over 80 countries, from 2004 to 2008, and was sponsored by five UN agencies (FAO, WHO, UNEP, UNIDO, UNESCO), the World Bank, and the Global Environment Fund. In April 2008, IAASTD's recommendations were approved in an intergovernmental plenary that reaffirmed the need to understand agriculture's multifunctional character with environmental, economic and social roles and functions. In its recommendations, IASSTD included a call to increase and strengthen investment in agroecological sciences and suggested that governments should establish national frameworks of reference to be applied to agroecological production (IAASTD, 2009; PANNA, 2009; Ishii, 2010).

It should be kept in mind that as a topic, agroecology has been under discussion as part of the FAO agenda since 2014. From September 18 to 19 of that year, FAO organized the *International Symposium on Agroecology for Food Security and Nutrition* in Rome with the participation of more than 400 people from 61 countries belonging to international agencies and civil society, including the Latin American Scientific Society of Agroecology (SOCLA in Spanish) the International Federation of Organic Agriculture Movements (IFOAM), and the Pesticide Action Network of North America (PANNA), as well as universities and peasant organizations (including Vía Campesina). The seminar included papers on agroecology and resilience in the face of climate change, traditional knowledge as a foundation, energy efficiency, and the key role social movements play for scaling-up agroecology. Examples were presented from successful experiences in Latin America, Asia, Africa, and Europe. The event culminated with a top-level round table with agriculture ministers from various countries, in which Brazil's Minister of Rural Development raised that agroecology is a technological-methodological foundation to improve family agriculture. As FAO's Brazilian Director General,

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José Graziano da Silva stated, "Agroecology continues to grow both scientifically and in terms of its policies. It is an approach that will help face the challenge of ending hunger and malnutrition within the framework of the necessary adaptation to climate change."[37] However, he also set forth that this is only one approach among others that can coexist with genetically modified organisms and "climate-smart agriculture"[38] (SOCLA, 2014). This is an expression of a concession to the pressure of countries like the United States and large-scale transnational corporations that have significant influence on FAO policies.

A year later, within the framework of the International Year of Family Agriculture,[39] the FAO called a Regional Seminar on Agroecology in Latin America and the Caribbean held in Brasilia in September 2015, with participation of public and private sectors, as well as organizations for regional integration. This seminar was developed within the framework of the Family Agriculture Action Plan pertaining to the Community of the Latin American and Caribbean States (CELAC in Spanish), where agroecology was included as part of the regional integration agenda, particularly within Mercosur. The seminar was promoted by FAO, the Brazilian Ministry of Agrarian Development, CELAC, Mercosur's Specialized Family Agriculture Meeting (REAF in Spanish), and the Alliance for the Food Sovereignty of the Peoples from Latin America and the Caribbean (constituted in August 2013 by 23 networks, movements and grassroots organizations from the region).[40]

The final recommendations of this seminar were a reminder that for decades the construction of agroecology in the region has been in hands of farmers, indigenous peoples, shepherds and fishermen, constituted as social movements. Firstly, the seminar recommended promoting public policies fostering agroecology and food sovereignty, defined, executed and monitored with the active participation of social movements and organized civil society, ensuring the necessary budget for its implementation. Secondly, it recommended creating the conditions to restrict monocropping practices, the use of agrotoxics, and land ownership concentration in order to thus foster the increase of agroecological, rural, smallholder production in Latin America and the Caribbean.[41]

37 See: http://www.fao.org/about/meetings/afns/en/

38 "Climate-smart agriculture" is a concept introduced by FAO in 2010, defined as an approach that seeks to reorient agricultural systems in order to effectively support development and ensure food security within the context of an increasingly unstable climate. The *Global Alliance for Climate- Smart Agriculture* was officially launched during the Climate Summit in September 2014. However, harsh criticisms have been issued for backing the interests of the transnational fertilizer industry and other agri-food transnationals. See statement made by 55 national and international organizations. See: http://www.ecologistasenaccion.org/article30742.html

39 See: http://www.fao.org/family-farming/themes/agroecology/en/

40 See: http://alianzasoberaniaalimentaria.org/

41 http://www.fao.org/3/a-au442e.pdf

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The FAO has currently installed a family farming knowledge platform[42] that defines agroecology as a scientific discipline, a set of practices, and a social movement that is essential to ensure food safety, all of which are key elements to produce food in an agroecological way (FAO, June 2015).

Besides the discussion regarding agroecology, the global growth of organic agriculture must be considered. This proves that when agriculture is practiced at a small-scale level by a family or a community, but also at a larger commercial scale, there are alternatives to both chemical pesticides and chemical fertilizers. According to IFOAM, organic agriculture is based on health, ecological, equity and precautionary principles, and it is defined as "a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and good quality of life for all involved." Within this definition, the notions of organic, ecological or biological agriculture are considered to be synonymous (IFOAM, 2005, 2008).

According to the survey conducted by IFOAM and the Organic Agriculture Research Institute (FIBL by its acronym in German) using 2014 data, the global organic food market accounts for a value of 80 billion dollars. The United States is the country with the largest sales, with an 11 percent growth rate, followed by Germany, France and China. In the whole world, there are 43.7 million hectares of organic land, 16 percent in Latin America, including conversion areas. There are 2.3 million producers globally and 17 percent is located in Latin America. It is important to highlight that existing organic agriculture is not only practiced at a small scale, but also commercially in countries in which industrialized agriculture predominates. Organic agriculture, however, requires monocrop diversification. In Latin America, according to 2013 data, 300 thousand producers cultivated 6.6 million hectares of organic food (15 percent of the total worldwide). Commercial organic production comprises vegetables, cereals, sugarcane, oilseeds, industrial crops, coffee, cocoa, and tropical and subtropical fruit. Argentina, Uruguay and Brazil are the countries with the largest surface of organic produce (FIBL/IFOAM, 2016).

The second part of this chapter will analyze the situation of alternatives to highly hazardous pesticides in Mexico, delving more deeply into agroecology and organic agriculture.

42 http://www.fao.org/family-farming/en/

1.8 The UN Special Rapporteurs on Human Rights' Recommendations Regarding Highly Hazardous Pesticides

During the fourth session of ICCM in Geneva, an important joint statement was made by two UN Special Rapporteurs on human rights: Baskut Tuncak, *Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and waste,* and Hilal Elver, *UN Special Rapporteur on the right to food.* The latter developed a report for 2017 with specific recommendations regarding pesticides, which will be commented at the end of this section.

In his intervention during the ICCM plenary, Baskut Tuncak, on behalf of both special rapporteurs on human rights, noted the companies and the states lack of capacity to ensure the safe use of highly hazardous pesticides throughout their life cycle. He highlighted that this negligence creates the risk of victimizing agricultural workers, girls and boys, and low-income communities, among others, particularly in developing countries. He expressed his concern for the lack of accountability regarding the broad range of rights violated by the use of highly hazardous pesticides, such as the right to life, to an effective remedy against the violation of rights (to redress, compensation) and the right to information, as well as the right to the highest level possible of health, the right to water, and the right to food. The intervention noted that "the substitution of highly hazardous pesticides with safer alternatives is imperative for better protection, and the exercise and respect for human rights" (Tuncak, 2014).

The UN Special Rapporteurs highlighted their deep concern for the slowness of global actions and called upon participants "to accelerate global action to substitute highly hazardous pesticides with safer alternatives." Besides supporting elements of the highly hazardous pesticide strategy jointly proposed by FAO/UNEP/WHO, the UN Special Rapporteurs recommended three measures:

a) that the process include clear deadlines for the global phase out of highly hazardous pesticides and their replacement with safer alternatives;
b) that pesticide producers ensure traceability of hazardous pesticides throughout the food supply chains in order to better protect human rights, make them effective, and respect them; and
c) the producers' commitment to implement the *Guiding Principles on Business and Human Rights* (Tuncak, 2014).

In a press release, the Special Rapporteur Hilal Elver emphasized that "agroecology is a proven alternative to intensive dependence on highly hazardous pesticides" (UNHR, Press Release, September 28, 2015).

The Special Rapporteurs first recommendation regarding the establishment of clear deadlines for the global phasing out of highly hazardous pesticides was not included in the declaration approved at ICCM4. There was

only the commitment to inform about advances. The FAO/WHO *Guidelines on Highly Hazardous Pesticides,* because of their voluntary nature, do not establish agreed deadlines. The swiftness or slowness with which substitution actions, withdrawal or progressive banning of highly hazardous pesticides are carried out is left to each government's discretion. From my perspective, this process can only be conducted with clear goals and deadlines if the State recovers its central role of actively promoting human rights, and makes this duty compatible with pesticide management policies that emphasize precautionary measures and promote agroecological alternatives that enable their substitution.

The recommendation that pesticide producers and formulators ensure waste traceability through food supply chains would allow this information to be accessible to all, workers, exposed communities and consumers. Traceability is linked to the recognition and respect of the "right to know" that anyone has about whether they are exposed to hazardous chemicals or may be damaged by them. Special Rapporteur Baskut Tuncak's first report on the right to information delivered to the United Nations Human Rights Council at its thirtieth session in July 2015 addresses the link between the right to information and the obligations held by both the State and private individuals to the highest protection of human rights in the management of hazardous chemicals, including pesticides, and their waste. This document entitled *Report of the Special Rapporteur on the Implications for Human Rights of the Environmentally Sound Management and Disposal of Hazardous Substances and Wastes* (OHCHR. A/HRC/30/40, 2015a) recommends and argues that information about hazardous chemicals and their wastes must be available, accessible, and functional for anyone. It also notes that information must be generated, assessed and disseminated in a way that is compatible with the principle of non-discrimination, and illustrates the disproportionate impact on children, workers, indigenous peoples and other groups particularly at risk (*Op. cit.*: 32-36).

Baskut Tuncak's report argues that the right to information about hazardous chemicals and their wastes is linked to Article 7 of the International Covenant on Civil and Political Rights: "people have the right not to be subjected without free consent to medical or scientific experimentation, which includes human exposure to substances whose potential adverse effects are unknown. In the context of hazardous substances, the lack of information and the lack of consent to be exposed to certain substances and their risks, directly affects this right (*Op. cit.* fr. 27). In other words, it is a fundamental right to not be treated as a "guinea pig for lab research" and to not be exposed without free consent to hazardous chemicals in the workplace, at home, in the environment, and in food. In the case of highly hazardous pesticides, exposure takes place without direct consultation of those potentially affected despite the authorities knowing about the intrinsically hazardous properties of the active ingredients. This is due to the

existence of a regulatory regime that establishes acceptable risk limits and aims to only control, rather than search for and apply all the means to prevent exposure. Without a doubt, the rights approach adds a critical perspective to the current practice focused on functional risk assessment and management with the idea of attaining "adequate pesticide management," as proposed by the industry that gains profit from them.

In our opinion, the human rights-focused perspective adds more arguments to the limitations of the assessment of toxicological results carried out by governments in order to authorize the commercial use of pesticides. Government assessments are usually conducted with confidential information provided by companies producing and commercializing pesticides. The exposure levels required by the permits consider very limited scenarios that do no reflect the situation of chronic and multiple exposure, in particular of the most vulnerable populations that experience inequality and poverty, like agricultural workers, children and women in rural communities.

With regard to the recommendation that enterprises implement the *Guiding Principles on Business and Human Rights: Implementing the United Nations "Protect, Respect and Remedy" Framework,*[43] it should be kept in mind that these principles were developed by John Ruggie, who was then Special Representative of the General Secretariat of human rights and transnational corporations and other business enterprises, which is why they are also known as the "Ruggie Framework." The *Guiding Principles* include foundational and operative principles for the State to comply with its obligation to protect human rights, for the companies' responsibility to respect them, as well as access to remedy mechanisms once damage has taken place. The principles must be applied in a non-discriminatory manner, paying special attention to the rights, needs, and problems of groups or populations with a higher risk of vulnerability or marginalization, taking into account the diversity of risks men and women face (UN A/HRC/17/31, 2011). In June 2011, the UN Human Rights Council established a working group on business and human rights that reports annually to the Council and the General Assembly the progress in implementing the *Guiding Principles,* based on country visits. It also organizes dialogue forums for civil society representatives and professionals, enterprises and States in order to reflect upon and debate the challenges in the implementation of these Principles (OHCHR, 2016).

However, these *Guiding Principles,* according to critics, are not nor aspire to be binding standards to control and sanction the transnational corporations that violate human rights, but rather were a concession to these corporations and governments like the United States, opposed to discussing a binding international

43 Adopted by the UN Human Rights Council on June 16, 2011 (UN Resolution 17/4).

legal framework to contain business activity (Teitelbaum, 2014). It should also be kept in mind that before UN Secretary General Kofi Annan appointed John Ruggie as Special Representative, Ruggie had been his advisor on the *Global Compact*, an initiative emerging in the year 2000 aimed to bring together CEOs from the main transnational corporations in order to adhere to the principles of sustainability, and promote "corporate responsibility" and best practices, encouraging alliances with governments.[44] Its critics claim that the Global Compact promoted greenwashing and was an example of the power strategy followed by the corporations with a "sustainable development" agenda (Bruno and Karliner, 2002). After completing his function as Special Representative, Ruggie was hired as a consultant by the Canadian mining company Barrick Gold Corporation, a leading gold mining corporation, with a terrible polluting trajectory in Peru, the Dominican Republic, Argentina, and Chile (Restrepo *et al.*, 2012), also present in Mexico.

The recommendation of the Special Rapporteurs on human rights for enterprises that produce pesticides to comply with the *Guiding Principles* is extremely important, but since the *Guidelines* are voluntary, they are insufficient. Given the context of impunity and power abuse transnational corporations take in labor, social and environmental violations, including chemical accidents of enterprises producing or formulating pesticides in Latin America and Mexico, which have been documented internationally, a binding international and national legal instrument is required.

In addition, the hostile and dangerous atmosphere experienced by human rights defenders in the face of projects developed by transnational corporations that threaten the land and territory of numerous communities must also be taken into account, as it has even led to assassinations (Article 19, CIEL, Vermont Law School, 2016).

Today, as a consequence of the initiative set forth by Ecuador and South Africa, an international legally binding instrument is being negotiated to address human rights in transnational corporations and other enterprises, in accordance with the resolution adopted by majority vote at the UN Human Rights Council on July 2014. In Latin America, this initiative had the favorable votes of Cuba and Venezuela; Argentina, Brazil, Chile, Costa Rica, Mexico, and Peru abstained, and there were no votes against in the region. The votes against this initiative came from countries outside Latin America in which the headquarters of the main transnational corporations are located: United States, Germany, UK, France, Italy, Japan and the Korean Republic, among others (UN-A7HRC/RES/26/9, 2014). A binding international convention of this kind would take several years to be negotiated, approved and implemented. According to the Ecuadorian government, these two processes, the negotiation of this binding convention and

44 The Global Compact's current website at the UN is: https://www.unglobalcompact.org/what-is-gc

the discussion of the *Guiding Principles* can complement each other (Permanent Mission of Ecuador to the United Nations, 2015).

In contrast, and following a logic that differs from the judicial logic of classical international law, since 2014, social movements, indigenous peoples, unionists and communities affected by the practices of transnational corporations have been promoting the establishment of an *International Peoples Treaty for the Control of Transnational Corporations* as a framework treaty that can serve as a tool for both reflection and action in the resistance to transnational corporate power. This resistance has been increasing throughout the world (Global Campaign, 2014).

Lastly, and most significantly, attention should be paid to the report that Hilal Elver, Special Rapporteur on the Right to Food submitted to the Human Rights Council in its 34th session held from February 27 to March 24, 2017. It recommends going beyond voluntary instruments so that the international community can develop an extensive and binding treaty that includes the generation of "policies to reduce pesticide use worldwide and develop a *framework for the banning and phasing-out of highly hazardous pesticides*" (UN A/HRC/34/48, 2017: Point 106, emphasis added). This report chose the analysis of pesticides and its negative repercussions on human rights as a core theme, and was developed in collaboration with aforementioned Special Rapporteur Baskut Tuncak.

Special Rapporteur Hilal Elver's report on the right to food reviews the impact of pesticides on health and the environment, the scope and limitations of the international judicial structure regarding pesticides (including international environmental law, other conventions, the International Code of Conduct and SAICM), the challenges of the current pesticide regime, as well as the alternatives offered by agroecology. This report's conclusions, in spite of recognizing that there have been national and international laws as well as non-binding guidelines, state that these instruments are not able to protect human beings and the environment against hazardous pesticides. Firstly, the conclusions recommend that, "The international community must work on a comprehensive, binding treaty to regulate hazardous pesticides throughout their life cycle, taking into account human rights principles." The report adds, "Such an instrument should: a) Aim to remove existing double standards among countries that are particularly detrimental to countries with weaker regulatory systems; b) Generate policies to reduce pesticide use worldwide and develop *a framework for the banning and phasing-out of highly hazardous pesticides*; c) *Promote agroecology*; and d) Place strict liability on pesticide producers" (UN A/HRC/34/48, 2017: 26-27, emphasis added). Because of its importance, the full text of these recommendations has been included in Annex 3 of this book, and in our opinion, must be considered when public policy is drafted to propose changes regarding pesticides, ensure the right to enjoy the greatest level possible of health, an adequate diet, a healthy environment and a sustainable food system.

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2. National Profile of Highly Hazardous Pesticides Authorized in Mexico

2.1 Pesticide Use within the Green Revolution Technology Paradigm and Oligopolistic Concentration in the Global Pesticide Market

The agricultural use of chemical pesticides in Mexico results from the adoption of the technological paradigm of capitalist modernization in agriculture, which since the 1940s has been known as the "Green Revolution." This paradigm proposes intensive industrial agriculture based on monocropping reliant on external inputs: seeds, fertilizers, pesticides, agricultural machinery, water supply via irrigation works, and credit to finance agricultural operations. This paradigm was first constructed in the United States and was later transferred and adapted to Mexico with support from the Rockefeller Foundation and a public policy that saw US agriculture as the model to be followed on the way to development. This modernization strategy was later implemented in other countries in Latin America, Asia and Africa, creating a network of international research centers with support from private institutions such as the Ford Foundation, UN organizations like the FAO, and financial bodies such as the World Bank and the Inter-American Development Bank (IDB), among others (Hewit, 1985; Bejarano and Mata, 2003).

The "Green Revolution" technology paradigm became more extensive and accentuated in Mexico and globally with the free trade agreements and neoliberal capitalist globalization under the control of transnational corporations. These corporations promote genetically modified crops and have become a dominant stakeholder requiring the support and intervention of the State in order to maintain the conditions of transnational domination, thus creating a global neoliberal food regime (Otero, 2014). Food has become a commodity, a product subject to financial speculation. Between production and consumption there are different stages of trade and processing carried out in agri-food chains that expand geographically, where a few transnational corporations compete for control over strategic agricultural production inputs. Transnational competition and control takes place in the realm of both hybrid and genetically modified seeds, pesticides, fertilizers, agricultural machinery, animal pharmaceuticals and cattle genetics. Similarly, transnational oligopolistic concentration takes place in trade (Cargill in corn, for instance), food processing and distribution, all the way down to retail trade controlled by large-scale supermarket chains like Walmart (ETC, 2013, 2015, 2016a).

In the last two years, capital concentration and centralization in the global oligopolistic pesticide and seed market has accelerated. The number of transnational corporations dominating the global pesticide and seed market for more than a decade has dropped from six to four: DowDupont, a merger of

equals between American companies Dow and Dupont in December 2015, the 43 billion dollar purchase of Switzerland's Syngenta by China National Chemical Corporation or ChemChina in February 2016, and German chemical company Bayer's acquisition of American company Monsanto for 66 billion dollars in September 2016. According to 2013 data, these three corporations together with the German company BASF, which had been wanting to merge with the seed or pesticide sector, constituted four transnational mega-corporations that together concentrated 75 percent of the global pesticide market, 63 percent of the global commercial hybrid seeds market, 100 percent of the genetically modified seed market, and over 75 percent of all private research in the field of these two strategic inputs (ETC, 2016a and 2016b). Other specialized journals estimate that the three corporations Bayer+Monsanto, Chem-China+Syngenta+Adama,[45] and Dow+Dupont control 79 percent of the global pesticide market and 46 percent of the global seeds market; and together with BASF, they concentrated 79 percent of the sales in both sectors in 2016 (Yuan, G. 2017).

After purchasing Monsanto, Bayer became the largest global company producing seeds and pesticides, thus controlling a third of the global market in both sectors, besides being one of the main pharmaceutical corporations (ETC, 2016a, and 2016c). It should be noted that DowDupont, Bayer and BASF are giant transnational corporations in which the pesticide or seed sector is a minor segment within the entirety of other segments of the chemical industry controlled by each corporation. Corporations use technological innovations throughout in the fields of genetic engineering, nanotechnology, synthetic biology, and other technologies to ensure profitability levels and open new markets. New products are thus generated without sufficient assessment of health or environmental impacts, responding more to capital accumulation and reproduction needs, rather than the needs of the majority of the population.

Likewise, in ChemChina, currently also owners of Syngenta, the agrochemical segment, where pesticide and fertilizer production is located, is one of the six business segments of this state-owned megacorporation that comprises investments in the basic chemicals industry, new chemical materials and specialty chemical products, oil processing and refining products, rubber-derived products

45 ADAMA resulted from the Chinese acquisition of Israeli company Makhteshim Agan in 2011, which also operated in various Latin American countries, including Mexico. ADAMA occupies seventh place in pesticide sales, after European and US transnational corporations. It is the first producer of *generic* pesticides in the world, and first or second generic pesticide supplier in the United States (ADAMA, September 14, 2016). In April 2017, the Federal Trade Commission in the United States conditioned approval of the purchase of Syngenta by ChemChina to the latter selling its ADAMA shares and rights in relation to paraquat, abamectin and chlorothalonil pesticides to AMVAC company with headquarters in California in order to allow more competition and thus not damage the market for these chemicals (FTC, 2017).

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and tires, and a segment dedicated to science and research. ChemChina was created in 2004 as a result of the reorganization of subsidiary companies under the former Ministry of Chemical Industry of the People's Republic of China, and according to *Fortune* in 2015, ranked 265th among the main 500 global companies (ChemChina, 2016).

2.2 Corporate Concentration in the Food System and Characteristics of the Pesticide Market in Mexico

Reports by both non-governmental organizations and public entities coincided in pointing to the concentration of the Mexican food system in a few transnational corporations, although they differed in identifying how this impacts the living conditions of the population and the proposed alternatives.

A brief study carried out by Oxfam and El Barzón specialists argued that thirty agroindustrial corporations, 14 of which come from other countries, dominate the food system inputs (seeds and agrochemicals), as well as the production and commercialization of large numbers of foods consumed by the majority of the population in Mexico (beer, sodas and beverages, processed foods, meat processing, dairy products, as well as retail trade). This makes small and medium-sized rural producers and consumers remain captive in an international network based on the corporations' profitability; supported by a national policy that favors these interests which has led to the economic and social precarization of small-scale producers in rural societies (Bautista *et al.*, 2015).

The Federal Commission of Economic Competition report (COFECE in Spanish) regarding competition conditions in the agri-food sector in Mexico, based on INEGI's 2009 economic census, estimates that the four main companies that produce pesticides and other agrochemicals, except fertilizers, concentrate 54.3 percent of the sales; the first six produce 64.2 percent, and the first eight benefit from 71.8 percent of the sales (COFECE, 2015: 225). According to the Mexican Union of Agrochemical Producers and Formulators (UMFFAAC in Spanish) the Mexican agrochemicals market has an approximate annual value of 15,684 million pesos (COFECE, 2015:223).

According to FAO data, based on government sources, in Mexico consumption of the main groups of pesticides in formulated products (insecticides, herbicides, fungicides, and bactericides) was 98,814 tons in 2014, representing a 59.2 percent increase with respect to the year 2000 in which a total of 62,062 tons was estimated, although the highest peak was achieved in the year 2010 with a total consumption of 113,880 tons (FAO/STAT, December 20, 2016 update). Fungicides and bactericides were the most widely used types of pesticides in the whole period with 40,016 tons (40.5 percent) in 2014; followed by insecticides

with 32,406 tons (32.8 percent), and herbicides with 26,392 tons (26.7 percent) (*Op. cit.*). Regionally, Mexico is the third most important pesticide market in Latin America, after Brazil and Argentina. However, according to FAO statistics (*Ibid*), Mexico comes second after Brazil in fungicide and bactericide consumption with slightly over 42 thousand tons of active ingredients, and also occupies second place in insecticide use with 37 thousand 455 tons, in 2013.

Pesticide use has concentrated in Mexico's irrigation areas in which "Green Revolution" type intensive industrial agriculture has penetrated more either to produce export-oriented crops or those to feed the input chains for the domestic agroindustry. Nonetheless, it has also spread to the seasonal peasant agriculture thanks to both company marketing strategies and also government assistance programs. According to the National Agriculture Census conducted in 2014, of the total production units (66,398), 62.7 percent used herbicides, 48.2 percent used insecticides, and only a minority (16.7 percent) carried out biological pest control (INEGI–ENA, 2014). According to data from the Agrifood and Fishing Information System (SAGARPA-SIAP in Spanish, 2014), in 2014, phytosanitary actions were conducted in 8 million 506 hectares throughout Mexico, mainly in the states of Sinaloa, Tamaulipas, Chihuahua, Veracruz, Sonora, Michoacán, San Luis Potosí, Chiapas, Puebla and the State of Mexico, in order of importance, including both seasonal and irrigation areas.

The aforementioned COFECE report indicates that pesticides and other agrochemicals are the second input with the greatest value for agricultural production in Mexico, after fertilizers, and with more weight than seeds, machinery and equipment. With regard to the value of total inputs for production, according to data from COFECE's Technical Secretariat based on INEGI's 2008 input-output matrix, the demand for pesticides and other agrochemicals represented, in order of importance, 21 percent in fruit and nuts (orange, lemon, coffee, banana, mango, avocado, grape, apple and cocoa crops, among others), 16.6 percent in cereals (wheat, corn, rice, sorghum, oats and barley, among others), 15.1 percent in legumes (beans and chickpeas, among others), 8.8 percent in vegetables (including tomato, hot pepper, onion, cantaloupe, watermelon, husk tomato, potato and squash), 10 percent in oil seeds (soybean, safflower and sunflower crops, among others) and 11.9 percent in other crops (including tobacco, cotton, sugarcane, alfalfa, pasture and fodder) (COFECE, 2015:186-187).

The pesticide market in Mexico to a large extent is dependent on the United States. According to the Mexican Tariff Information System (SIAVI in Spanish), consulted over the Internet with 2014 data, 38 percent of the total pesticide imports, estimated to be 67,110 tons come from the United States and almost half of Mexico's total exports, 27,631 tons (48 percent) go to the United States, an estimated 57,471 tons (COFECE, 2015:226). The agricultural export-

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oriented crop market, which consumes large amounts of pesticides, is also dependent on the United States. The United States is Mexico's main market in fruit and fresh vegetable exports, tomatoes being the main exported product. According to data from the US Department of Agriculture (USDA), Mexico is the main exporter to the United States of the following fruits and vegetables (percentage participation in the market): strawberries (99 percent), artichoke (97 percent), zucchini (94 percent), tomatoes (88 percent), peppers (84 percent), cucumbers (83 percent), eggplant (82 percent), olives (82 percent), spinach (82 percent), celery (80 percent), papaya (72 percent), avocados (71 percent), and onions (57 percent) (SAGARPA-ASERCA, 2015:4).

According to 2014 data, after the United States, the other countries of relevance from which Mexico imports pesticides are: China, occupying a second place with a 7 percent participation of total imports, followed by Germany and Israel with 6 percent, France with 6 percent, and other countries with 39 percent (COFECE, 2015:220). In the Mexican exports, after the United States, pesticides are exported in the second place to Guatemala (8 percent), followed by Canada (4 percent), Colombia (2 percent), Venezuela (2 percent), and other countries (35 percent) (COFECE, 2015:220). Due to China's accelerated agricultural modernization project, as well as its global export platform, the Chinese government's policy has turned China into an important national consumer of chemical pesticides. Exports are conducted not only by the transnational corporations that have transferred their factories to China, but also by numerous Chinese companies formulating *generic pesticides*, i.e., formulators of active ingredients with expired patents. In 2014, the exports of 110 Chinese companies to Mexico reached 19,310 tons, accounting for 138.79 million dollars, comprising 12,550 tons of technical products, and 6,760 tons of formulations. The Chinese government's priority in the region, however, is to gain greater participation in the Brazilian market, the largest market in Latin America (Agropages, August 12, 2015).

2.3 The Pesticide Industry in Mexico and its Sectoral Associations

According to data from the Ministry of Agriculture, Livestock Farming, Rural Development, Fisheries and Food (SAGARPA in Spanish), in charge of certifying companies producing pesticides in compliance with the Official Mexican Standard NOM-034-FITO-1995, the pesticide industry for agricultural use in Mexico is constituted by 119 companies that produce, formulate, assemble, import or export pesticides (SENASICA, 04-2015). Of the total number of companies, only 14 (11.76 percent) are registered as producers of the chemical molecules that constitute the technical-grade active ingredients in each formulation. Before a pesticide is used, it must be formulated by mixing the active ingredient with other

chemical compounds in a commercial product.[46] Most companies in Mexico are therefore formulators and/or importers of already formulated products. The formulating companies are both transnational corporations that import active ingredients over which they have patent rights –intellectual property rights– or companies that import off-patent active ingredients referred to as "*generic active ingredients,*" i.e., ingredients with expired patents. The generic pesticide market has been growing constantly throughout the world and is estimated to represent from 70 percent to 80 percent of the global market. It should also be clarified that the companies formulating generic active ingredients may develop innovations in the formulation technologies and own new patents, which enables them to compete advantageously and even become transnational corporations (Agrow, 2014:13).

The chemical pesticide industry in Mexico is organized under two civic associations: Crop Protection, Science and Technology, (PROCCYT in Spanish) that groups the main transnational corporations dominating the global market, and UMFFAAC that brings together that brings together the main generic pesticide formulators. These two associations form part of the international organizations and networks competing in the global, regional and national markets, but coordinate actions when their common interests are threatened.

Since 2013, PROCCYT has been the new name given to the former Mexican Association of the Phytosanitary Industry, a non-profit society (AMIFAC in Spanish) founded in 1994. PROCCYT brings together 51 member companies (PROCCYT, 2015) comprising the large-scale transnational corporations dominating the national, regional and global pesticide market, like Syngenta, Bayer, Monsanto, Dow-Dupont and BASF, as well as national formulating companies with international, national or regional coverage in the states of Sinaloa, Chiapas, and Michoacán, among others. In 2014, PROCCYT offered 2,300 different pesticide formulations in the market (PROCCYT, 2014). It is the main business group, and, according to its leaders, in 2013, it concentrated 75 percent of the agrochemical market (Perea, 2013). PROCCYT aims to strengthen the institutional relations with top-level decision-makers in the federal and local governments and with agricultural leaders, academia, and the mass media (AgroSíntesis, January 30, 2014).

PROCYYT is a member of CropLife Latin America, which groups the nine transnational corporations dominating regional sales. CropLife works with 25

46 Technical-grade active ingredients comprise both so-called technical materials and technical concentrates. Formulated products can come in solid form, i.e., dry, wettable, or soluble powders, different kinds of granules or toxic bait; in liquid form, like water-soluble concentrates, emulsifiable concentrates or suspensions; in gases, aerosols, and fumigants, among other presentations. For a general introduction, see Albert L. (1997:359-382); for more technical details, see FAO/WHO (2004).

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associations in 18 countries in Latin America and the Caribbean (CropLife Latin America, 2016). CropLife Latin America is one of the 16 regional associations affiliated to CropLife International, known as the "Global Federation of the Crop Science Industry," that brings together the main transnational corporations in the world, and, as we saw in the first part of this report, participated actively in the SAICM meetings.

The UMFFAAC was founded in 1975 and according to its website has 31 associated companies that "conduct pesticide and fertilizer synthesis and formulation activities, simultaneously promoting the development of other similar companies such as packing, raw materials, or other inputs applied to agrochemicals, as well as companies distributing and commercializing pesticides ..." The UMFFAAC also "coordinates actions and positions between its members in order to assist them with the authorities in developing and improving the application of and compliance with regulations, as well as providing presentations in training courses on adequate pesticide and fertilizer use, always with the vision of protecting human health and the environment" (UMFFAAC, 2016).

UMFFAAC's Vice President is President of AgroCare Latin America (formerly known as Latin American Association of the Agrochemical Industry (ALINA in Spanish) with headquarters in Costa Rica, and is also part of AgroCare, the World Association of Generic Agrochemicals (Agrocare, 2016). AgroCare was constituted in April 2008 with headquarters in Brussels. It groups 988 companies through regional representations from Latin America (17 companies), Europe (15), India (113) and a majority from China (850) (Codex Alimentarius Commission, 2016: 2-4). As a non-governmental organization, AgroCare has observer status with Codex Alimentarius and the World Trade Organization (WTO) and participates in the Collaborative International Pesticides Analytical Council (CIPAC) that holds joint meetings with FAO and WHO (*Ibid*).

In 2010, PROCCYT and UMFAAC created another non-profit association called Amocalli A.C., in order to coordinate actions around empty pesticide container collection and management as part of the "Clean Field Program." According to their website, this program has allies including the Mexican Ministry of Environment and Natural Resources (SEMARNAT in Spanish), the Ministry of Health (COFEPRIS in Spanish), SAGARPA and the Federal Attorney for Environmental Protection (PROFEPA in Spanish), as well as state committees and local plant sanitation boards, municipalities (from which they seek land donations), and several universities (Amocalli, 2016). This program has temporary and final destination collection centers. The latter comprise: traditional recycling, chemical recycling, incineration, co-processing to be used as alternative fuel in cement kilns, and smelting. Although the claims that these final destinations "ensure the environmental, technological, economic and social efficiency necessary for the

comprehensive management" of pesticide waste, the truth is that incineration and co-processing as a form of waste treatment not only of pesticides, but also of other urban or industrial waste have been severely criticized due to the pollutants they generate (GAIA, 2016).

AgroBio-Mexico A.C. is another business association created in 1999 by the transnational corporations grouped in PROCCYT/Crop-Life that dominate the pesticide market in Mexico (Syngenta, Monsanto, Bayer and Dupont-Pioneer). It aims to "create a favorable environment" for the development of "agricultural biotechnology," represent the industry in order to "collaborate with the authorities in the development of policies and regulations," and "sensitize society about the benefits of a responsible application of agricultural biotechnology" (AgroBio-Mexico, 2016). In other words, this actually implies promoting genetically modified crops, particularly of soybean, cotton, and wheat, which currently enjoy permits for commercial cultivation. Because of the risk of polluting native corn in Mexico, the center of origin of corn, genetically modified corn has faced strong opposition from social organizations and civil society groups, like those forming part of the "Sin Maíz no hay País" campaign ("Without Corn, There is No Country") and independent scientists like the Union of Socially Concerned Scientists (UCCS in Spanish).

Although strictly speaking AgroBio-Mexico does not appear as a member of the sectoral associations of the pesticide industry, their corporations, do. They form part of the corporate strategy for seed control that aims to modify seeds in order to make them tolerant to herbicides and insecticides, which they themselves sell, or also to insert toxic bacteria into insects (in *Bt* crops), and to a lesser degree, to make certain crops resistant to drought and saltpetrous soil conditions. Similar associations promoting genetically modified crops have been formed in the main Latin American countries: Agro-Bio for the Andean region with headquarters in Colombia, the Agricultural Plant Biotechnology Association (Agro-Bio in Spanish) in Peru, the Information Council on Biotechnology in Brazil, Argen-Bio in Argentina, Chile-Bio in Chile; and Agrobio NCS in Costa Rica, as stated in Agro-Bio's website (AgroBio-Mexico, 2016).

Both PROCCYT and UMFFAAC have representation in the National Chamber of the Transformation Industry (CANACINTRA in Spanish) in Branch 85 corresponding to Agrochemical Formulation Manufacturers. They participate as members of the National Farming Council (CNA in Spanish), as well as Amocalli and Agro-Bio. The main pesticide companies are included in the list of CNA sponsors, that in turn forms part of the Business Coordination Board (CNA, 2016). CNA is the main spokesperson of the agri-food sector vis-à-vis SAGARPA and the and the federal government.

Besides the chemical pesticide industry, there is a business sector that offers synthetic non-chemical inputs for pest and disease control, as well as other

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products. It is organized under the Mexican Association of Organic, Biological and Ecological Input Producers, Formulators and Distributors, a non-profit association (AMPFYDIOBE in Spanish) that brings together 44 small enterprises (AMPFYDIOBE, 2016). This association provides alternative biological or botanical inputs for crops seeking organic certification, or producers practicing agroecological agriculture, although most of the inputs used by peasant agroecological production come from local resources. It is nonetheless important to mention this association because the government should also include it in its consultation with the pesticide industry, above all in the discussion regarding alternatives to highly hazardous pesticides.

2.4 Pesticide Registration in Mexico

With the neoliberal policy pushed in Mexico since the end of the administration of President Miguel de la Madrid with Mexico's entry into the General Agreement of Tariffs and Trade (GATT) in 1986, the pesticide regulatory framework in Mexico has been undergoing modifications, particularly under the influence of an open trade policy reinforced by the North American Free Trade Agreement (NAFTA) in 1992 (Bejarano, 1997:227-270). These modifications continued in the subsequent administrations under which new free trade agreements were signed with other countries. The Inter-Ministerial Commission for the Control of the Processing and Use of Pesticides, Fertilizers and Toxic Substance Control (CICOPLAFEST in Spanish), constituted by the Ministries of Trade, Agriculture and the Environment, was created in October 1987 (*Diario Oficial de la Federación*, October 1, 1987). In later years, the Mexican Department of Labor joined CICOPLAFEST. One of CICOPLAFEST's main tasks since its creation has been to administratively simplify each Ministry and coordinate their activities in order to establish uniform and comprehensive procedures through granting licenses, permits and registrations that include pesticides. The procedure to register pesticides and import applications changed in order to be conducted in "one stop" to CICOPLAFEST, and paperwork was simplified with support from the Deregulation Unit pertaining to what used to be the Ministry of Trade and Industrial Promotion (SECOFI in Spanish), which not only reduced the time it takes to process a sanitary license, but also expedited imports. With NAFTA, pesticide registration was aligned with that of the United States and Canada, and with Mexico's admission into the OECD registration requirements were systematized (Olay and Barraging, 2001).

At present, the government authorization to sell and use pesticides is conducted through a unified sanitary registration granted by COFEPRIS. This decentralized public body pertaining to the Ministry of Health, created during the Vicente Fox administration in 2001, is in charge of conducting an analysis,

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assessment and resolution regarding the information presented in the registration applications. According to the regulation concerning Pesticide, Fertilizer and Toxic Substance Registration (R-PLAFEST in Spanish), issued by the Ministry of Health in 2004 and reformed in 2014 (R-PLAFEST, 2014), COFEPRIS must take into account the technical opinion of SEMARNAT's assessments. When it is related to pesticides used in agriculture and farming, SAGARPA's assessments must also be considered. This takes place in agreement with the responsibilities that the General Health Law grants the Ministry of Health, the General Law of Ecological Equilibrium and Environmental Protection (LGEEPA in Spanish) grants SEMARNAT, and the Plant Health Law grants SAGARPA.

The table below summarizes each Ministries responsibilities regarding pesticide registration:

Table 5
Government Responsibilities in Pesticide Registration in Mexico

Federal Commission for Protection against Sanitary Risks (COFEPRIS)	a) to authorize registration and issue pesticide certificates of free sale and pesticide export certificates;
	b) to issue pesticide import permits; and
	c) to conduct the respective risk assessments to establish maximum limits applicable to residues.
Ministry of Environment and Natural Resources (SEMARNAT):	a) to issue technical opinions regarding environmental protection in the cases stipulated in the Regulation of pesticide, plant nutrient, and toxic or hazardous substance and material registration, import and export authorizations and export certificates; and
	b) to authorize pesticide, plant nutrient, and toxic or hazardous substance and material import and export permits (PLAFEST)
Ministry of Agriculture, Livestock Farming, Rural Development, Fisheries and Food (SAGARPA):	a) to issue technical resolutions regarding the biological effectiveness of pesticides and phytosanitary aspects of the maximum pesticide residue limits, in the cases established in the PLAFEST Regulation and standard NOM-032-FITO-1995.
	b) to define the agricultural and farming use of pesticides that could be resorted to in animal and plant sanitary emergencies.

Source: SENASICA https://www.gob.mx/senasica Retrieved on January 10, 2016.

The application procedure for pesticide registration is conducted through a "single window" mechanism in which the applicant hands in all the documentation that the

PLAFEST format demands from COFEPRIS. Afterwards, the Sanitary Authorization Commission distributes the respective documentation to SEMARNAT, SAGARPA, or both, for review, in order to issue a technical opinion and take a resolution (see schematic on the following page).

It should be noted that according to the PLAFEST regulation (Article 9, fraction II) SEMARNAT and SAGARPA authorities have a fifty-working day deadline to inform whether it is necessary to advise the applicant to present missing or complementary documentation, or to clarify the information accompanying their application. If SAGARPA or SEMARNAT fail to request this information from COFEPRIS, it is interpreted as a favorable opinion. In case additional information is requested, after COFEPRIS receives the applicant's response and forwards it, SAGARPA and SEMARNAT have an additional 25 working days to issue a technical opinion, but may abstain from expressly responding to COFEPRIS, in which case it will be considered as an opinion favoring the application (Article 9, fraction IV).

The PLAFEST regulation exempts companies from this registration procedure when it is requested through a joint evaluation program simultaneously at COFEPRIS and the respective authority of another country with which trade agreements have been signed (Article 9, fraction V) as is the case with the United States and Canada, which will be addressed below.

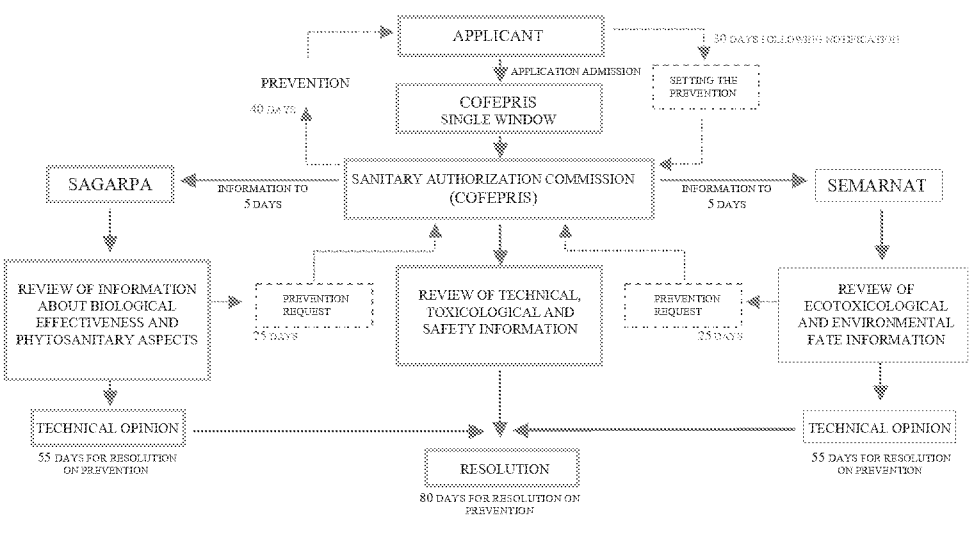

Figure 3. Procedure to apply for pesticide and plant nutrient registration in accordance with the PLAFEST regulation in Mexico.
Source: SEMARNAT, 2012: 11.

The PLAFEST regulation requires specific information and documentation according to the type of pesticide to be registered. Pesticides can be differentiated into seven types: chemical, biochemical, microbian, botanical, microbial, GMO-based, and miscellaneous (when authorization is sought for various uses of the same product). In the case of chemical pesticides, differentiated information is required depending on whether they are technical chemical pesticides (with an active ingredient at its maximum concentration, used as raw material in the formulation), or chemical formulations (one or more active ingredients together with "inert" ingredients and safeners). In the case of formulated pesticides, the required information is differentiated into the following uses: agricultural and forestry, household, urban, public health and gardening, and lastly farming (Ministry of Health, 2014).

According to PLAFEST instructions, the information applicants must provide can be divided into five sections: a) administrative data; b) identity and composition of the technical or formulated chemical pesticide; c) toxicological information; d) ecotoxicological studies and environmental fate; and e) physical properties related to pesticide use and specific information, depending on pesticide type.[47] The reports on the studies and methodologies on physicochemical, toxicological and ecotoxicological properties and environmental fate should be conducted following the principles of "Good Laboratory Practice" (GLP) or a certified quality system that follows internationally recognized scientific guidelines, such as those developed by the by the OECD, FAO and WHO or US EPA methods (Mexican Ministry of Health, 2014).

Besides granting registration, COFEPRIS is in charge of issuing pesticide and plant nutrients free sale and import–export certification, and conducting the respective risk assessment to establish maximum residue limits, besides exercising the responsibilities granted by the General Health Act (Article 3 of PLAFEST regulation). As detailed in Article 12 of the PLAFEST regulation, the toxicological information the applicant should present and COFEPRIS should check are toxicological studies of the active ingredient, as well as acute and chronic toxicity studies (carcinogenicity, reproduction and fertility, teratogenicity, neurotoxicity, mutagenicity, toxic effects of metabolites, acceptable daily intake).

According to Article 3 of the PLAFEST regulation, SEMARNAT is in charge of issuing the technical opinion regarding environmental protection based on reviewing the information contained in the ecotoxicological and environmental fate studies, as well as the labeling project the applicant submits. This information includes, for instance, for agricultural and forestry use: lixiviation, mobility,

47 For a comparative summary of the requirements of each pesticide type and a comparison with the registration requirements in the United States and Canada, see Castro, 2013.

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chemical accumulation and persistence in water and soil; water, soil and plant degradation; effects on land and water animals and plants; acute mean lethal concentration study on fish species; and impact on beneficial and pollinating insects. SEMARNAT should review the legends applicable to the section on environmental protection measures in the labeling project. The instructions developed by the General Department of Integral Management of Hazardous Materials and Activities (DGGIMAR by its acronym in Spanish) includes the list of international guidelines that can be used to comply with the above mentioned studies (Ministry of Health, 2014; SEMARNAT, 2012).

According to Article 3 of the aforementioned regulation, PLAFEST is in charge of issuing the technical opinion about the pesticides' biological effectiveness and defining the maximum levels of pesticide residues in each approved crop. The applicant must present an *assessment of biological effectiveness* defining pest control effectiveness according to a pesticide use pattern that must specify crop, pest, dosage, security interval and the phytosanitary aspects of the maximum residue level (MRL) in accordance with standard NOM-032-FITO-1995.[48] PLAFEST is also responsible for defining which pesticides for agricultural and farming use can be applied during a plant or animal health emergency and may also use the other responsibilities that the PLAFEST laws confer. Within SAGARPA, it is the National Agro-Food Health, Safety and Quality Service (SENASICA in Spanish) that is in charge of issuing the resolution regarding the pesticides' biological effectiveness, as well as establishing the specificities under which field studies must be developed in order to establish the maximum residue levels in agricultural pesticides. It is also responsible for checking and certifying companies that produce, formulate, assemble, import, distribute, market and spray agricultural pesticides (SENASICA. DOF 21/07/2016).

Apparently the submission of the full packet of information from the toxicological, ecotoxicological and environmental fate studies, plus the biological effectiveness resolution as well as the review conducted by COFEPRIS, SEMARNAT and SAGARPA should ensure the safety of the registered pesticide, i.e., ensure that it does not represent an unacceptable health and environmental risk.[49] Nonetheless, this is far from true. Even though the studies submitted by the applicant are in compliance with international standards, as stipulated by the PLAFEST regulation, the Mexican authorities do not conduct a risk assessment,

48 Published in the Federation's Daily Gazette (Diario Oficial de la Federación) on January 8, 1997, modified and published on August 11, 2015.

49 Standard NOM-032-FITO-1995, for example, defines pesticide registration as a "process through which the competent authority approves the sale and use of a pesticide, prior an assessment of the full scientific data demonstrating that the chemical is effective for the use it is allocated to, and does not imply unacceptable health and environmental risks" (Article 2).

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like other countries. In other words, the aforementioned regulation does not stipulate the legal mandate that COFEPRIS or SEMARNAT should conduct a risk assessment in which, for example, expected environmental concentrations should be estimated depending on the pesticide's intended use, and should be compared with the reported concentrations that might cause a hazardous effect on the organisms that are used to test its health or environmental effects. The people in charge of checking the file CICOPLAFEST handed in to SEMARNAT (León, 2013), and INECC experts recognize that the obligation to assess ecological risk is lacking (Mendoza, 2016). This legal loophole is particularly serious since molecules are being authorized based on information provided by the industry itself in compliance with the international guidelines, but without conducting a risk assessment that includes clear criteria to restrict or deny a permit based on estimated unacceptable risks, or without applying the *precautionary principle* and thus not applying hazard cut-off criteria. Furthermore, information presented by the applicant in the registration application is protected by industrial secrecy and cannot be consulted or checked by an independent scientific assessment group.

Pesticides authorized before 2005 have unlimited validity and as of this date the registration is valid for five years (Article 376, General Health Act), with the possibility of requesting a five-year extension (Article 23 Bis4 R-PLAFEST). Once the second deadline expires, a new registration must be applied for. However, the PLAFEST regulation does not request additional information to re-register pesticides, thus missing the opportunity to incorporate new scientific evidence and refuse to register molecules that are either hazardous or have an unacceptable risk level. Thus, according to the 2016 Pesticide Catalogue, the vast majority of pesticide registrations authorized by COFEPRIS have unlimited validity, reaching 80.7 percent in all uses (i.e., 4,459 registrations out of a total of 5,524) (CICOPLAFEST, 2016, Annex 2).

It is reasonable to think that periodic cuts to public expenditure have reduced the personnel appointed to reviewing and evaluating pesticide registration applications submitted via COFEPRIS and SEMARNAT. SEMARNAT, for instance, only has one person in charge of CICOPLAFEST's Department of Materials and Resolutions pertaining to the Subdirection of Hazardness Assessment and Infectious Biological Waste within the DGGIMAR, and it is not known how many staff members of COFEPRIS and SENASICA have been appointed to this task.

In the face of this situation of administrative simplification to expedite pesticide registration and ensure the supply of these inputs in the market, the limited deadline to review the submitted information, the legal loopholes to conduct a risk assessment or apply the precautionary principle when a registration is rejected or revoked, the high number of registrations with unlimited validity, and the limited human resources to evaluate each application, it is no surprise to

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see the large number of highly hazardous pesticides authorized in Mexico that are banned in other countries, as we will see later on in subsections 2.5 and 2.9.

Pesticide Registration Together with the United States and Canada

Trade integration with the United States and Canada, resulting from the North American Free Trade Agreement (NAFTA) has led to the creation of a technical task force on pesticides. Within this context, since 2013 COFEPRIS has been conducting a new registration procedure for new pesticide molecules through a multilateral cooperation mechanism with the EPA in the United States and the Pest Management Regulatory Agency in Canada (PMRA). Mexico is a pioneer in this joint review mechanism in Latin America, which is why in 2013 it was granted recognition by the business organization called CropLife. Mikel Arriola, COFEPRIS high commissioner, announced that this joint analytic mechanism of the three authorities was used to evaluate four new molecules that entered the market in 2013 (CropLife, 2013).

The strategy of the NAFTA technical working group on pesticides for the period from 2016 to 2021 includes continuing to work jointly to improve the free trade of pesticides and food, remove trade barriers, jointly review new molecules, continue collaborating in scientific and regulatory matters, and standardize systems, when possible. The goals for the following years include, first, the alignment of pesticide maximum residue levels via a joint revision in order to ensure access to global markets, reduce the number of applications for new pesticide use or new pesticide authorizations, and reduce possible trade barriers. Joint Working Group meetings prior to Codex Alimentarius meetings have been proposed in order to discuss each country's position and reach joint positions, if possible. Another goal is to work jointly to protect pollinators through exchanging policies and risk assessment, and taking measures in this regard. The EPA in the United States and the PMRA in Canada will train SAGARPA and SEMARNAT in the process of conducting pollinator risk assessment. It also includes aligning information and policy requirements regarding science in the new risk assessment methodologies (like accumulated exposure, for instance); and the adoption of integral approaches for alternative acute toxicity testing and assessment (NAFTA TWG, 2016).

SAGARPA's actions have been aimed to mainly protect export-oriented crops so that they comply with the maximum residue levels for pesticides established in Mexico, or when they do not exist, to comply with those established in agreements signed with the United States and international bodies such as the Codex Alimentarius Commission. In plant health matters, SAGARPA has two ancillary bodies: the state-level plant health committees and the local plant health boards, producer organizations that participate in the development of

phytosanitary measures and pollution risk reduction in agricultural production. The state-level plant health committees provide training lectures to agricultural workers regarding best management practices for agrochemicals (BMP) and "Clean Field" campaigns to collect empty containers in coordination with the pesticide industry. They provide technicians and producers with courses in Hazard Analysis and Critical Control Points (HACCP),[50] phytosanitary alert management and phytosanitary management campaigns for pests and diseases of economic importance. In addition, they conduct surveillance to determine heavy metal levels in irrigation water and pesticide residues in fruit (CESAVESIN, 2014).

2.5 Highly Hazardous Pesticides Authorized in Mexico and their Health and Environmental Effects

In order to identify the highly hazardous pesticides authorized in Mexico, we carried out a comparison between the PAN International List of Highly Hazardous Pesticides in its December 2016 version (PAN International, 2016) and COFEPRIS's 2016 Pesticide Catalogue, containing the pesticides registered at the Mexican Ministry of Health, the only ones in Mexico authorized for importation, marketing and use. In this catalogue we consulted the annexes corresponding to the data sheets with the chemical and toxicological information of each active ingredient as well as an Excel chart with basic information on registered products (the list of registrations granted to different companies with different formulations and brands). Each active ingredient can have several "registrations," i.e., specific authorization modalities depending on pesticide type (insecticide, herbicide, fungicide, etc.) for different formulations, certain companies with different brand names and for different uses. We did not include cancelled registrations or registrations with an expiration date before the consultation carried out on September 19, 2016. From this comparison we obtained the following results:

In Mexico, 183 active ingredients in highly hazardous pesticides have been authorized for various uses (agricultural, household, gardening, industrial use). The full list can be found in Annex 1 at the end of this publication. With regard to their hazardness for human health, we found that following WHO classification 1A and 1B, almost one third, i.e., 63 active ingredients have high acute toxicity (34.43 percent), plus those that can be fatal when inhaled and are not included in WHO's earlier classification. With regard to chronic toxicity, 43 pesticides have been authorized, which according to the EPA are probable human carcinogens

50 HACCP is an internationally recognized method to identify food safety risks (the presence of pathogenic bacteria and pesticide residues). It is obligatory in the United States and the European Union, among other countries. The Codex Alimentarius Commission has adopted the principles and guidelines for the application of HACCP.

(23.50 percent) in addition to other pesticides classified by other institutions. Following the Globally Harmonized System accepted by the European Union, 35 pesticides are considered to be endocrine disruptors (19.13 percent); 21 pesticides are reproductive toxicants (11.48 percent) and two are mutagenic (see Table 6).

Considering the environmental toxicity of the highly hazardous pesticides authorized in Mexico it should be noted that approximately half of them (44.81 percent) have a very high toxicity level for bees, and, according to the US EPA can be lethal when the dose is higher than 2 micrograms per bee. With regard to pesticides authorized by international environmental conventions, the largest number (15) is included in Rotterdam Convention Annex III because of the toxicity of their formulations or because they are banned in other countries; three pesticides (DDT, insecticide endosulfan and pentachlorophenol, a wood preservative) are included in the Stockholm Convention on Persistent Organic Pollutants; and only one pesticide, methyl bromide, a fumigant is included in the Montreal Protocol on Substances that Deplete the Ozone Layer.

In our list, we have included DDT, which is part of the Stockholm Convention, since it still appears as a "restricted use" chemical in the Data Sheets of the 2016 Pesticide Catalogue. According to the Catalogue, DDT is reserved for the Ministry of Health to control malaria or other vector-borne diseases and is no longer used, produced or exported, although strictly speaking its registration has not been cancelled or its use banned in Mexico.

Table 6
Effects of Highly Hazardous Pesticides Authorized in Mexico

Group	Effects	Number of active ingredients	Percentage of total HHP authorized (183)
High Acute Toxicity	Extremely hazardous (WHO IA)	18	9,84
	Extremely hazardous (WHO IB)	25	13,66
	Fatal if inhaled (GHS H330)	36	19,67

Group	Effects	Number of active ingredients	Percentage of total HHP authorized (183)
Chronic Toxicity	Human Carcinogen according to IARC	1	0,55
	Human Carcinogen according to EU GHS (1A, 1B)	2	1,09
	Probable Carcinogen - IARC	4	2,19
	Probable Carcinogen - EPA	43	23,50
	Mutagenic - EU GHS (1A, 1B)	2	1,09
	Reproductive Toxicity - EU GHS (1A,1B)	21	11,48
	Endocrine Disruptor - EU (1) or GHS C2 & R2	35	19,13
Environmental Toxicity	Very Bioaccummulative	9	4,92
	Very Persistent in Water, Soil or Sediment	9	4,92
	Very Toxic in Aquatic Organisms	13	7,10
	Very Toxic for Bees	82	44,81
Environmental Conventions	Montreal Protocol: Ozone Layer Depletion	1	0,55
	Rotterdam in Annex III: Banned or Severely Restricted Subject to the PIC Procedure	15	8,20
	Stockholm on Persistent Organic Pollutants	3	1,64

WHO: World Health Organization; GHS: Globally Harmonized System; IARC: International Agency for Research on Cancer; EU: European Union; EPA: United States Environmental Protection Agency; PIC: Prior Informed Consent.
Source: RAPAM based on *December 2016 PAN International List of Highly Hazardous Pesticides*, Hamburg, and COFEPRIS, *Catálogo de Pesticides*, Mexico, 2016.

Similarly, in the case of endosulfan, registrations under review by COFEPRIS could still be found in the 2016 Pesticide Catalogue in September 2017, in spite of the fact that until August 1, 2016, SENASICA had been inviting producer organizations to cease using it without actually being explicit about the reason

why it should not be used (SAGARPA-SENASICA, 2016). Before then, COFEPRIS had agreed with the companies that as of January 1, 2013, endosulfan imports would no longer be authorized and had established December 31 as the deadline for formulators and producers to exhaust their inventories by December 31, 2014 (COFEPRIS Actions, 2013). However, during 2015 agricultural technicians collaborating with RAPAM were pointing out that it was still being used in some states of the Mexican Republic and in August, 2016 it was still being publicized in websites of companies in Sinaloa State[51] and Monterrey City.[52] This demonstrates COFEPRIS's lack of effectiveness in enforcing compliance with agreements made with companies.

In the case of insecticide lindane, it was nominated by Mexico for inclusion in the Stockholm Convention for being a persistent organic pollutant. For years, it had been used as an insecticide, an acaricide, in seed treatments and even in shampoo for anti-lice treatment in children, until in August 2016, SENASICA officially announced that COFEPRIS had cancelled its uses and that it no longer appeared as authorized by COFEPRIS in the 2016 Pesticide Catalogue.

2.6 Highly Hazardous Pesticides in Commercial Formulations and Brands Authorized in Mexico

According to the 2016 Pesticide Catalogue, of the total 183 active ingredients of the highly hazardous pesticides authorized in Mexico, a great number of sanitary registrations are still in force (3,140). These pesticides enjoy some form of authorization: for agricultural use, for forestry, farming, household use, urban, gardening and industrial use, including formulations of mixtures with one or more active ingredients, or with permits for formulation plants. Most highly hazardous pesticide registrations, 91 percent corresponding to 2,865 registrations, have unlimited validity since they were granted registration before 2005.

Of the total registrations currently in force, almost two thirds (63 percent) are authorized to be used as insecticides (insecticide, insecticide-acaricide, insecticide-larvicide, or insecticide-nematocide with 1,987 registrations); as fungicides (474 registrations including fungicides and fungicides/bactericides), and as herbicides (442, including herbicides and those authorized as desiccants). To a lesser degree, they are authorized as rodenticides (126), fumigants (78), acaricides (24) (including acaricides and acaricides/fungicides); and miticide-ovicide-acaricides with only three registrations (see Table 7).

51 See: http://www.passa.com.mx/productos.html Retrieved on August 8, 2016.

52 See: http://www.quimicasagal.com/misulfan.html Retrieved on August 8, 2016.

Table 7
Registrations per Highly Hazardous Pesticide Types Authorized in Mexico

Pesticide Type	Number ofregistrations (*)	Percentage
Acaricide	24	0.76
Acaricide, fungicide	2	0.06
Subtotal acaricide	26	0.83
Fungicide	465	14.81
Fungicide, bactericide	9	0.29
Subtotal fungicides	438	15.10
Herbicide	438	13.95
Herbicide, desiccant	4	0.13
Subtotal herbicides	442	14.26
Insecticide	1413	45.00
Insecticide acaricide	490	15.61
Insecticide larvicide	23	0.73
Insecticide nematicide	61	1.94
Subtotal insecticides	1987	63.98
Fumigant	78	2.48
Miticide ovicide acaricide	3	0.10
Nematicide	4	0.13
Rodenticide	126	4.01
Total	3140	100.00

(*) Including all those registrations with unlimited validity, under revision, or actually in force on the day of the consultation: September 19, 2016.

Source: RAPAM based on COFEPRIS, *Catálogo de Pesticides 2016.* Mexico; and PAN International *List of Highly Hazardous Pesticides,* December, 2016. Hamburg.

The large number of authorized registrations of highly hazardous pesticides implies that most of their patents have expired. Other national or international companies can produce and formulate them with equivalent products, thus competing with the transnational corporations that originally introduced them into the market.

Each registration corresponds to a specific use of an active ingredient or a mixture of active ingredients in a determined formulation, granted to various companies, and thus with different brand names. The fact that a brand has a registration in force in COFEPRIS's 2016 Pesticide Catalogue, or on its online database does not necessarily indicate that it is currently being marketed in Mexico inasmuch as it might include some registered products that have been

withdrawn by the companies. The fact that pesticide active ingredients have a larger number of registrations does not necessarily mean that they are used in larger volumes, although we can consider this as an indicator of their demand and the commercial interest in their formulation and sale. In Mexico, we do not have publically accessible information regarding the name, type, and quantity of each authorized pesticide that is applied nationally. The case studies in the second part of this book show us in greater detail the highly hazardous pesticides used for agricultural purposes in different zones of the Mexican Republic.

The table below presents the 30 active ingredients in highly hazardous pesticides with the greatest number of authorized registrations in force in Mexico. It includes any of the uses of these ingredients (agriculture, farming, household, urban, and industrial use), which together account for more than two thirds (69.20 percent) of the total authorized registrations of highly hazardous pesticides in Mexico towards the end of 2016. In the first place, the following insecticides should be noted: methyl parathion, chlorpyrifos ethyl, cypermethrin, malathion, permethrin, mancozeb, chlorothalonil, glyphosate, atrazine and deltamethrin that together represent almost 41.16 percent of the total highly hazardous pesticides authorized in Mexico (see Table 8).

Table 8
Highly Hazardous Pesticides with Larger Number of Registrations in All Uses in Mexico

	Active Ingredient	Type	Toxicological Category	Classification	Use	Total registrations	percent
1	Methyl parathion	Insecticide	II	Organophosphates	Agricultural and industrial	166	5,29
2	Chlorpyrifos ethyl	Insecticide	III	Organophosphates	Agricultural, household, farming, urban & industrial	165	5,25
3	Cypermethrin	Insecticide Acaricide	III	Pyrethroids	Agricultural, farming, household, gardening, urban & industrial	156	4.97

	Active Ingredient	Type	Toxicological Category	Classification	Use	Total registrations	percent
4	Malathion	Insecticide	IV *	Organophosphates	Agricultural, farming, gardening, urban & industrial	139	4,43
5	Permethrin	Insecticide	IV	Pyrethroids	Agricultur al, farming, household, gardening, urban & industrial	139	4,43
6	Mancozeb	Fungicide	IV	Dithiocarbamate	Agricultural & industrial	122	3,89
7	Chlorothalonil	Fungicide	IV *	Polychlorinated Aromatic Compounds	Agricultural & industrial	119	3,50
8	Glyphosate	Herbicide	IV *	Phosphonomethyl glycine	Agricultural, urban and gardening	110	3,50
9	Atrazine	Herbicide	IV	Triazine	Agricultural & industrial	92	2,93
10	Deltamethrin	Insecticide	III	Pyrethroids	Agricultural, farming, household, urban & industrial	88	2,80
11	Methamidophos	Insecticide Acaricide	II	Organophosphates	Agricultural & industrial	82	2,61
12	Dimethoate	Insecticide	III	Organophosphates	Agricultural, gardening & industrial	80	2,55
13	Dichlorvos	Insecticide	II	Organophosphates	Agricultural, farming, household, urban & industrial	65	2,07

	Active Ingredient	Type	Toxicological Category	Classification	Use	Total registrations	percent
14	Diuron	Herbicide	IV *	Urea derivative	Agricultural & industrial	64	2,04
15	Imidacloprid	Insecticide	IV	Imide	Agricultural, industrial, farming, urban	60	1,91
16	Cupric Hydroxide	Fungicide	IV	Inorganic	Agricultural	53	1,69
17	Carbofuran	Insecticide-Nematicide	II	Carbamate	Agricultural & industrial	47	1,50
18	Endosulfan (*)	Insecticide Acaricide	II	Organochlorine	Agricultural & industrial	47	1,50
19	Bromadiolone	Rodenticide	I	Coumarin	Agricultural	40	1,27
20	Abamectin	Insecticide Acaricide	II	Pentacycline compounds	Agricultural, industrial, farming, urban	37	1,18
21	Methomyl	Insecticide		Carbamate	Agricultural, household, farming, urban & industrial	37	1,18
22	Monocrotophos	Insecticide Acaricide	II	Organophosphates	Agricultural & industrial	36	1,15
23	Bifenthrin	Insecticide Acaricide	III	Pyretroid	Agricultural, gardening, urban & industrial	33	1,05
24	Lambda cyhalothrin	Insecticide	III	Pyretroid	Agricultural farming, urban	32	1,02
25	Tetramethrin	Insecticide	IV*	Pyretroid	Industrial & farming	32	1,02

	Active Ingredient	Type	Toxicological Category	Classification	Use	Total registrations	percent
26	Propoxur	Insecticide	III	Carbamate	Farming, urban, industrial	30	0,96
27	Fenvalerate	Insecticide	III	Pyretroid	Agricultural & industrial	28	0,89
28	Carbendazim	Fungicide	IV*	Benzimidazole	Agricultural, urban & industrial	27	0,86
29	Trifluralin	Herbicide	IV *	Nitrosamine	Agricultural	27	0,86
30	Acephate	Insecticide	IV	Organophosphates	Agricultural, farming, & industrial	26	0,83
					Total	2179	69,39
					Rest of the HHP	961	30,6
					Total HHP	3140	

HHP: Highly Hazardous Pesticides.
(*) Authorizations with unlimited validity, under review, or currently in force when the consultation was conducted, Catálogo de Plaguicidas, COFEPRIS, September 19, 2016.
(**) According to other sources, it can also be classified as a neonicotinoid.

The 2016 Pesticide Catalogue defines the following uses:

- Agricultural: used in different surface extensions, in agricultural production systems, and in products and subproducts of plant origin
- Forestry: used in forests and on wood
- Urban: used exclusively in urban, industrial and uncultivated areas, drainage and irrigation channels, lakes, dams, lagoons and highways.
- Gardening: used in gardens and ornamental plants.
- Farming: used for animals, or in intensive or extensive production facilities producing food for human consumption or for industrial use. It includes use for domestic animals.
- Household: used within the household.
- Industrial Use: the formulated pesticide is used in the manufacture of non-edible direct use products, like paint, lacquer, varnish, paper, cellulose, or cardboard, and used for recirculating water treatment in industrial processes, as defined in PLAFEST's regulation.

Source: RAPAM, based on COFEPRIS, Catálogo de Pesticides 2016. Mexico; and December 2016 PAN International List of Highly Hazardous Pesticides. Hamburg.

If we analyze the total highly hazardous pesticides authorized in Mexico by their toxicity degree, we find both higher and lower acute toxicity in Categories I to V, according to the government regulation in force. Pesticides Category I and II can be fatal in case of ingestion, skin contact, or if inhaled, and Category III, toxic in case of ingestion, skin contact or if inhaled. Pesticides in Category I and II must be labeled with a red or yellow band, the skull and cross-bones symbol and the warning: "*danger*" on the packing. In the case of pesticides with lower acute toxicity (Categories IV and V), they must have a blue or green band with the warning: "*caution.*" In other words, the color of the band, the symbols and the words of warning are based on the pesticides' acute toxicity that can cause short-term effects, but say nothing about the chronic human health effects or other problems of environmental toxicity as in the criteria proposed in the definition of highly hazardous pesticides, explained in the first part of this chapter.

With regard to chemical classification, there is no group of chemicals that can be considered "safe" since we can find highly hazardous pesticides in a broad variety of groups, from organophosphates, carbamates, pyrethroids, and neonicotinoids, in the case of insecticides, the triazine and phosphonomethyl glycine groups in the case of herbicides, and polychlorinated aromatic and dithiocarbamate in the case of fungicides, among other groups. The case of the pyrethroids should be noted since it is one of the chemical groups in which molecules were presented as more reliable when they entered the market. They were not considered as persistent as the first generation of organochloride pesticides such as DDT, aldrin, endrin or lindane. Besides, it was promised that, as opposed to organophosphates and carbamates, there would not be any acute toxicity problems, nor would they affect the nervous system. However, some pyrethroids may also present toxicity, persistence, and other environmental problems, as will be seen below.

In the case of highly hazardous insecticides authorized in Mexico, we have identified that the insecticide methyl parathion, which has the largest number of registrations (166), has high acute toxicity, and may be fatal in case of inhalation. It was one of the first organophosphate insecticides to enter the global market after World War 2 and has been authorized for agricultural and industrial use.

It is followed in second place by insecticide chlorpyrifos ethyl with 165 registrations authorized for agricultural, household, farming, urban and industrial use. It is a chlorinated organophosphate and because it has been identified as an endocrine disruptor, it has been included in the PAN International list. Chlorpyrifos ethyl also has other hazardous characteristics and environmental behavior that meet the criteria to be nominated to and included in the Stockholm Convention on Persistent Organic Pollutants. It is persistent, bioaccummulative, and has the ability to transfer far away from its original release point into the environment.

Besides, it has been detected in breast milk, cervical fluid, sperm fluid, cord blood, and meconium (Watts, 2013). Nonetheless, research reviews funded by Dow Agrosciences have reached different conclusions, questioning its possible nomination (Giesy *et al.*, 2014). The US Environmental Protection Agency has discontinued its use in households and gardening in order to avoid unnecessary risks to children, animals, and wildlife. Statements in writing presented to the Environmental Protection Authority of New Zealand reveal that the Dow company itself, which initially introduced it into the US market in 1965, has declared that it does not support its use in households or gardens (Watts, 2013:7).

Because of its number of registrations (156), cypermethrin, used as insecticide and acaricide, occupies third place. It is a pyrethroid that is highly toxic for bees and because of this characteristic it has been included in the PAN International List of Highly Hazardous Pesticides. In Mexico, cypermethrin is authorized for all uses: agricultural, farming, household, gardening, urban and industrial use. Research reports in the international scientific literature associate cypermethrin with potential development problems, immune system problems, problems with the male reproductive system, breast cancer, and effects on the immune system (Watts, 2014). Imidacloprid, another pyrethroid insecticide, is also fatal for bees. It is authorized for all uses and has 60 registrations in Mexico. Imidacloprid is very restricted in Europe in order to thus protect pollinators. There is a ban on its use for seed and soil treatment, as well as foliar application for the following crops: corn, rapeseed, soybean, barley, millet, oats, rice, rye, sorghum and wheat (European Commission Implementing Regulation (EU) No. 485/2013).[53]

Glyphosate is among the highly hazardous herbicides with the largest number of authorized registrations in Mexico. It has 110 authorized registrations for agricultural, urban and gardening use. Glyphosate has been surrounded by an international controversy due to differences between the regulatory authorities of the International Agency for Research on Cancer (IARC), pertaining to the WHO, and the European Food Safety Authority (EFSA). The former classifies glyphosate as a possible carcinogen in humans, whereas the latter does not. These differences, to be later addressed, illustrate how regulatory decisions regarding the assessment of glyphosate, as well as other pesticides which have commercial interest for transnational corporations are a field of dispute between the corporate interest in extending their market life and those defending a critical use of science that does not submit to such interests.

53 For a critical analysis of restrictions on neonicotinoids in the European Union, see Greenpeace *Briefing Ban imidacloprid, thiamethoxam and clothianidin.* December 2, 2013. At: http://www.greenpeace.org/eu-unit/Global/eu-unit/reports-briefings/2011%20pubs/2013%20Nov-Dec/20131128%20BR%20partial%20neonics%20ban.pdf

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2.7 The Case of Glyphosate

As stated in the 2016 COFEPRIS Pesticide Catalogue, glyphosate is an herbicide that has been authorized for agricultural, urban, gardening and industrial use in formulation plants in Mexico. It has a total of 110 authorized registrations currently in force for any of its uses, although most of its formulations are dedicated to agricultural use in an enormous diversity of crops: grains, vegetables, fruit trees, sugarcane, coffee, and grape vineyards, among others. Glyphosate is used to control plants that are considered undesirable in crops, commonly referred to as "weeds." This erroneous name, however, hides the possible contribution of various plants to check soil erosion, provide shelter for beneficial insects, or as edible herbs, which is why agroecologists refer to them as agrestal. Glyphosate is also used as a drying agent in crops like sorghum or soybean in order to accelerate the drying down of the grain and the harvest,[54] or in sugarcane crops as a ripener to raise sucrose content.

Forty-five companies, including Monsanto, are authorized to commercialize glyphosate. Transnational corporation Monsanto has 20 registrations with unlimited validity including authorizations for agricultural use, "weed" control in urban and industrial areas, water hyacinth control, highway "weed" control, gardening and export-oriented products. Other companies that commercialize herbicides containing glyphosate in Mexico are: transnationals Dow, FMC, and Syngenta, and national formulation companies like Agricultura Nacional, Agri-Estrella, Agroquímicos Versa, Polaquimia, Química Agrícola de Morelos, Similia Defensivos Agrícolas, and Velsimex, among others.

According to government data (SIAVI), the United States occupies first place in the importation of glyphosate (N-phosphonomethyl glycine, isopropylamine salt), followed by the People's Republic of China and Taiwan, Colombia and India. From 2013 to 2016, no exports were registered (SIAVI section on tariffs 2931.90.19, consulted on June 5, 2016). In Mexico, we can assume that at least 13,773 tons of glyphosate were used in 2014, which according to government data (SIAVI section on tariffs 2931.90.19) was mainly imported from the United States. According to our estimates, this would represent 10 percent of the total pesticides used that year.

This book includes a special chapter dedicated to glyphosate, written by Dr. Omar Arellano, who reviewed the reported scientific literature on the health and environmental effects of this herbicide. Glyphosate's effects go beyond being a possible cause of cancer in humans, which is the criterion used to include it in the PAN

54 Other advantages adduced for its use as a desiccant is to facilitate threshing and diminish loss due to humidity (INIFAP, 2014).

International List of Highly Hazardous Pesticides. Experts from this international network have developed a monograph about glyphosate summarizing the current state of scientific evidence that associates it with liver damage, hormone disruption, alterations of the intestinal microbiome, reproductive, neurologic and immune system problems. It is also associated with numerous environmental damages, such as water pollution and the effects on beneficial insects (Watts *et al.*, 2016).

Glyphosate is the most widely used herbicide in the world and is applied to over 150 crops. In 1974, it was patented as an herbicide by transnational corporation Monsanto and introduced into the market as Roundup. Although the patent expired in 1991, in spite of competition with other companies that can produce and formulate it, it continues to generate profits for the transnational corporation. It is part of Monsanto's technological package in genetically modified crops tolerant to this herbicide in the "Roundup Ready" varieties mainly used in soybean, but also cotton, corn, canola, alfalfa, sorghum, and recently promoted in wheat crops.

The intensive and repeated use of glyphosate has caused resistance in 22 "weed" species in 27 countries (Watts *et al.*, 2016:6), including Brazil and Argentina, where the use of genetically modified soybean has increased dramatically in recent decades. Resistance to glyphosate and herbicides in general also emerges from their ongoing use in non-genetically modified crops. This means that plants considered "weeds" develop a natural inheritable capacity that allows them to survive a dosage of the herbicide that used to be fatal. The transnational corporations' commercial response to the problem of resistance has been to introduce new genetic varieties tolerant to other herbicides, or combined with the resistance-causing herbicide. Monsanto thus introduced a new variety of genetically modified soybean resistant both to glyphosate and the herbicide dicamba. Furthermore, Dow has developed a new variety of genetically modified corn tolerant to glyphosate and herbicide 2,4-D. In Mexico, Syngenta received authorization for a product that is a mixture of glyphosate and dicamba. Other companies like Cheminova, and Síntesis y Formulaciones de Alta Tecnología have received authorization for products composed of glyphosate and 2,4-D. According to the 2016 Pesticide Catalogue developed by COFEPRIS, Dow also received authorization for a product containing herbicides glyphosate with oxyfluorfen.

In Mexico, it has been documented how the expansion of genetically modified soybean tolerant to glyphosate is polluting groundwater aquifers in Campeche State, where herbicide residues have been found in drinking water, urine and the blood of residents of peasant communities in proximity to the places where it is applied (Rendón, 2015; Chim, 2016).

In 2015, the IARC, pertaining to the WHO, reclassified glyphosate as a probable carcinogen in humans (Group 2A). The assessment conducted by

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an IARC working group of 17 experts from 11 countries concluded that there is "*limited evidence*" in humans and "*sufficient evidence*" in animal trials, as well as "*strong evidence*" of the two mechanisms of action associated with carcinogenicity: genotoxicity and the ability to cause oxidative stress (IARC, 2015). However, months later the EFSA published that it is unlikely that glyphosate is carcinogenic to humans, and that evidence did not support its classification as a potential carcinogen, in contradiction with IARC's conclusion (EFSA, 2015).[55] CropLife Latin America and Monsanto welcomed the EFSA assessment and criticized the IARC's classification (Rodríguez, 2015).

Based on a study conducted by the German Federal Risk Assessment Institute (BfR by its acronym in German), EFSA does not classify glyphosate as a probable carcinogen in humans, but it contradicts evidence from its own assessment. In the face of this, 44 European non-governmental organizations asked the European Union Health and Food Safety Commissioner to use a scientific basis to conduct the glyphosate assessment and criticized the deficiencies of the German assessment (Greenpeace, HEAL, PAN Germany *et al.*, 2015). A PAN Germany expert disseminated a detailed criticism of the Addendum or comparative document of the German risk assessment conducted by BfR, on which EFSA's decision was based, and PAN Europe requested that the decision be reconsidered (Clausing, 2015a, 2015b; PAN Germany, 2016; PAN Germany and PAN Europe, Press Release, January 20, 2016).

The European Corporate Observatory carried out a detailed analysis comparing the assessment processes followed by IARC and EFSA, in which it highlights the greater transparency of the IARC process, which only examined public information and held open meetings with observer participation, including industry and non-governmental organizations. It should also be noted that the group of high-level experts was selected on the basis of their experience and "the absence of real or apparent conflict of interest," as declared by IARC's monograph (Corporate Europe Observatory, 2015). In contrast, as the European Corporate Observatory concluded that BfR and EFSA had based their assessment not only on scientific information that can be publically accessed, but also on industry-funded studies, provided by a Monsanto-led group of experts with confidential information, no possibility of public access, a process conducted in secrecy, making it impossible to determine the independence of the experts, and whether or not there was conflict of interest (Corporate Europe Observatory, 2016). Another report published in March 2017, entitled "Glyphosate and Cancer: Buying Science," documented in detail how Monsanto and other companies paid

55 EFSA also established for the first time a maximum residue level of glyphosate in food that can be ingested (acute reference dose) of 0.5 mg per kilogram of body weight.

university and research institute experts to write "scientific" reviews of glyphosate's health effects, which were published in peer reviewed journals, distorting the evidence on its health effects with serious methodological errors, granting greater weight to unpublished information provided by industry, thus revealing notorious conflicts of interest. This report documents the corporate strategy to counteract the impact of the IARC's assessment and influence the European regulatory authorities (Burtscher-Schaden, Clausing and Robinson, 2017).[56]

Based on EFSA's approval, the European Commission attempted to pass a 15-year reauthorization for glyphosate in the European Union, but it failed to obtain consensus to reach a qualified majority in the Standing Committee on Plants, Animals, Food and Feed, formed by officials of the governments' ministries related to food security or agriculture. In the face of this rejection, and based on new recommendations issued by this Committee, the European Commission opted to extend the license to use glyphosate in the European Union for an additional 18 months until the end of 2017, awaiting a new toxicity study conducted by the European Chemicals Agency (ECHA), meanwhile imposing certain restrictions on glyphosate (comitology.eu No. 28, June 2016; Europe Press, June 29, 2016). The European Commission has banned the use of surfactant POEA (polyethoxylated tallow amine) used for decades in glyphosate formulations. It recommended that glyphosate stick to "good agricultural practices" in its use prior to harvest, as desiccant, for instance, and that its use in parks and public places be restricted. Besides, it stipulated that special attention should be placed on the protection of underground water in vulnerable zones, above all in non-agricultural uses of the herbicide (EU, 2016).

These restrictions on glyphosate have had repercussions in some European Union member countries, such as Italy and the Republic of Malta. Italy has banned the use of surfactant POEA in glyphosate formulations, affecting 85 registered products, including various Monsanto and Syngenta products. It has also banned glyphosate in preharvest and its use in places frequented by children and the elderly. In addition, it has not authorized its use in non-agricultural soils with a high sand content (higher than 80 percent) in order to protect underground water (Italian Health Ministry, 2016). In the case of the Republic of Malta, as stated by the Minister of the Environment, following the precautionary principle, a complete national ban on glyphosate has been demanded. Glyphosate had previously been banned by several local governments (Ganado, 2016). Furthermore, a coalition of more than 70 civil society organizations, including Ecologists in Action, PAN Europe and others, introduced a citizens' initiative in January 2017 to ban glyphosate in

56 See: https://www.global2000.at/sites/global/files/Glyphosate_and_cancer_Buying_science_EN_0.pdf

the European Union, proposing to collect a million signatures supporting this initiative (Ecologistas en Acción, communiqué dated January 11, 2017).[57]

In the United States, the EPA is in the process of reassessing the risks of glyphosate found in urine, blood, and breast milk (Moms Across America and Sustainable Pulse, 2014) and in numerous processed products of commercial brands (Food Democracy Now and DETOX Project, 2016). It has been denounced that the EPA pronouncement that glyphosate is not an endocrine disruptor was based on confidential research provided and funded by the industry's Monsanto-led Task Force (Sass and Hwang, 2016). Furthermore, the transnational corporation Monsanto faces various lawsuits filed by agricultural workers with cancer in federal courts and California, New York and Delaware states (*Ibid.*).

The Federal Judiciary of the United States declassified more than 250 pages of Monsanto's internal correspondence, demonstrating that in 1999 Monsanto knew about the mutagenic potential of glyphosate, the active ingredient in its star product, Roundup. It also revealed that Monsanto had strong links with EPA officials and a couple of genotoxicological experts whose studies were used in the European review of its genotoxic potential. Thanks to a state regulation in California that forces companies to label products, which according to IARC's classification may cause cancer, glyphosate labeling must state that it is a carcinogen in humans[58] (OEHA, March 28, 2017).

Sri Lanka is the only country that has totally banned glyphosate in all its uses. El Salvador has also made attempts to ban it.

The dispute regarding the scientific status of glyphosate in the European Union, the United States and other countries reveals how regulatory agencies have been penetrated by corporate interests, thus violating the model that separates "scientific risk assessment" from "risk management," where scientific assessment is assumed to be "objective" and must guide the final regulatory decisions. It is essential that the regulatory authorities or the committees involved in pesticide assessment be free from conflicts of interest, i.e., that they are not associated directly or indirectly with the economic interests they would be affecting. These assessments must be based on information resulting from research open to public scrutiny by independent scientists, rather than on confidential information provided by research financed by the same industries they will be regulating. In

57 See the website of the citizens' initiative against glyphosate at: https://stopglyphosate.org/en/

58 The Safe Drinking Water and Toxic Enforcement Act, known as *Proposition 65*, was passed in 1986 to protect the water supply from substances that can increase cancer risk. The effective date of this listing will be determined following a decision from the Court of Appeal regarding the case Monsanto vs. the Office of Environmental Health Hazard Assessment (OEHA). See: https://oehha.ca.gov/proposition-65/crnr/glyphosate-be-listed-under-proposition-65-known-state-cause-cancer

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Mexico, like in most Latin American countries, the regulatory authorities have fewer staff members and less infrastructure. Their assessment and surveillance capacity has waned due to budget restrictions imposed by neoliberal policies. It is thus much more urgent to strengthen their analytic capacity and independence from conflicts of interest.

The ban on the surfactant POEA in glyphosate formulations in the European Union is relevant since it topples the assumption that chemical compounds that are mixed with active ingredients as pesticide adjuvants are "inert ingredients," as argued by the chemical industry. Based on this assumption, regulatory authorities in most countries only assess the safety of the declared active principle and do not carry out sufficient studies on the toxicity of these coadjuvants and their possible synergic effect (Ecologistas en Acción, July 14, 2016). The European Food Safety Authority confirmed that POEA's toxicity is even greater than that of glyphosate (EFSA Journal, November 12, 2015). Scientific research has demonstrated that the ethoxylated coadjuvants used in glyphosate formulations, particularly POEA tallowamine, are toxic active principles for human cells, producing adverse effects on liver, embryonic and placental cells, such as necrosis and damage to cell membranes (Mesnage, Bernay, Seralini, 2012). It is very likely that glyphosate formulations in Mexico contain this surfactant, and COFEPRIS authorities must clarify and inform whether POEA toxicity was assessed when glyphosate was authorized when registering its different formulations for commercialization. This is highly unlikely. POEA is an example of the need for authorities to conduct an in-depth assessment of the toxicity of so-called "inert ingredients" or coadjuvants in the formulations authorized for all pesticides.

2.8 Companies Authorized to Commercialize Highly Hazardous Pesticides for Agricultural Use in Mexico

The 2016 Pesticide Catalogue identified 282 companies in Mexico that hold a total of 3,140 sanitary registrations of active ingredients included in the PAN International List of Highly Hazardous Pesticides, which have been authorized by COFEPRIS and are currently in force. This includes all kinds of pesticides (insecticides, herbicides, fungicides, etcetera), used in agriculture, forestry, farming, households, cities and industry. As noted earlier, the fact that companies have product or formulation registrations included in the Pesticide Catalogue does not necessarily imply that they are currently for sale on the market. Some authorized products may have been removed from the market by companies without the registration having been cancelled. However, what it does indicate is the enormous amount of formulations and products to which the population,

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including workers in the companies that have benefited from their sale, as well as the environment have been and are exposed.

There is a high concentration of highly hazardous pesticide registrations in a few dozen companies, thus reflecting how concentrated the pesticide market is. Of the total 282 companies, the first 12 concentrate one third of the total authorized highly hazardous pesticide registrations (33.28 percent), and 30 of them concentrate slightly over half of the registrations (54.94 percent) corresponding to 1,726 authorized registrations (see Table 9).

Table 9
Companies with the Largest Number of Highly Hazardous Pesticide Registrations Authorized in Mexico

	COMPANIES	AGRICULTURE, FORESTRY & FARMING USE	HOUSEHOLD, GARDENING & URBAN USE	INDUSTRIAL USE	TOTAL REGISTRATIONS
1	Bayer de México	150	40	12	202
2	Syngenta Agro	112	20	1	133
3	FMC Agroquímica de México	72	18	3	93
4	Dow Agrosciences de México	73	12	7	92
5	BASF Mexicana	67	17	1	85
6	Velsimex	64	9	3	76
7	Agricultura Nacional	53	6	13	72
8	United Phosphorus de México	61	2	0	63
9	Agroquímicos Versa	51	9	2	62
10	Agrevo Mexicana	38	20	4	62
11	Cheminova Agro de México / Cheminova Agroquímica*	47	4	2	53

	COMPANIES	AGRICULTURE, FORESTRY & FARMING USE	HOUSEHOLD, GARDENING & URBAN USE	INDUSTRIAL USE	TOTAL REGISTRATIONS
12	Makhteshim-Agan de México	52	1	0	53
13	Cyanamid Agrícola de México	41	6	1	48
14	Koor Intercomercial	49	2	0	51
15	Agricultura Nacional de Jalisco	48	2	0	50
16	Dupont México	47	2	0	49
17	Novartis Agro and Novartis Salud Animal*	35	11	0	46
18	Agroquímica Tridente	27	14	3	44
19	Química Lucava	37	4	1	42
20	Agromundo	31	9	1	41
21	Internacional Química de Cobre	38	0	0	38
22	Tekchem	28	7	2	37
23	SC Johson and Son	2	30	1	33
24	Rhone Poulenc Agro	29	3	0	32
25	Ingeniería Industrial	31	0	0	31
26	Monsanto Comercial	23	8	0	31
27	Gowan Mexicana	29	0	1	30
28	Síntesis y Formulaciones de Alta Tecnología	26	0	0	26
29	Química Amvac de México	23	0	3	26

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	COMPANIES	AGRICULTURE, FORESTRY & FARMING USE	HOUSEHOLD, GARDENING & URBAN USE	INDUSTRIAL USE	TOTAL REGISTRATIONS
30	Polaquimia	22	0	3	25
	SUBTOTAL	1,406	256	64	1,726
	Total number of registrations of the 282 companies				3,140

Source: RAPAM based on COFEPRIS, *Catálogo de Plaguicidas* 2016. Mexico, Archivo Registros Autorizados; and PAN International *List of Highly Hazardous Pesticides*, December 2016. Hamburg.

Most of the companies with highly hazardous pesticide authorizations in Mexico belong to one of two sectoral non-profit associations, PROCCYT or UMFFAAC, including the main transnational corporations that dominate the global market with headquarters in the United States, Germany, Australia, and Japan; Mexican companies affiliated or belonging to a transnational group producing and exporting generic pesticides with headquarters in China, India, Israel, Australia, and the United States; as well as other domestic Mexican companies.

It should be noted that the five main companies with the greatest number of authorized highly hazardous pesticide registrations for any uses in Mexico are transnational corporations. Bayer occupies the first place, followed by Syngenta Agro, FMC Agroquímica de México, Dow Agrosciences, and BASF. Other transnational corporations within the thirty main companies are Dupont, which merged with Dow in 2016, and Monsanto, acquired by Bayer in 2016. It should be clarified that the names of companies that have merged, or form part of a transnational corporation still remain in the 2016 Pesticide Catalogue in spite of no longer using that name in the market, albeit they are still registered at COFEPRIS, such as Agrevo, Rhone Poulenc, and Novartis. For this reason, they have been included in Table 9.

If we group the transnational corporations with the companies that have merged or changed names and keep active ingredient registrations in force in Mexico, Bayer occupies the first place with 202 (to which we would need to add Monsanto's 31 registrations, plus Agrevo's 62 registrations, Rhone Poulenc's 32 registrations, Aventis's 15 registrations, and Hoechst Roussel Vet's 6 registrations). Syngenta, a company of Swiss origin that is now mostly owned by ChemChina Corporation follows in second place with 133 registrations (plus Zeneca's 14 registrations, Novartis Agro's and Salud Animal's 46 registrations). FMC occupies the third place with 93 registrations (Cheminova's 53 registrations); followed

by Dow with 92 registrations, and Dupont with 49 registrations, which are now one company called DowDupont, since the two US firms have merged; and the German BASF Company with 85 registrations. Other transnational corporations that do not appear in Table 9 are Helm de México, with German capital and 16 registrations; Valent de México with 16 registrations, a subsidiary of the Japanese company Sumitomo Chemical Co.; Nufarm Grupo México with 7 registrations that is part of Nufarm Limited with headquarters in Australia; Chemimport from the United States, registered as an importation company with 6 registrations, besides other companies with a lesser number of sanitary registrations.

The main companies with majority Mexican capital and the largest number of authorized highly hazardous pesticide registrations in Mexico are: Velsimex with 76 registrations; Agricultura Nacional with 72; Agroquímicos Versa with 62; Agricultura Nacional de Jalisco with 50; Agroquímica Tridente with 44; Química Lucava with 42; Agromundo with 41; and Síntesis y Formulaciones de Alta Tecnología (Sifatec) with 26 registrations.

The companies that are part of or are affiliated to a transnational group with headquarters outside Mexico and are dedicated to the production and distribution of generic pesticides or off-patent pesticides with the largest number of registrations of highly hazardous pesticides in Mexico are, firstly, United Phosphorus de México with 63 registrations, and headquarters in India (UPL), where it is the main pesticide seller, being one of the five main off-patent pesticide manufacturers in the world.[59] It is followed by Koor Intercomercial, an Israeli-Chinese group with 51 registrations, plus Makhthesim Agan (MA) with 53; and 31 held by Ingeniería Industrial (an MA subsidiary) that came under majority control of the transnational corporation ADAMA, the main transnational corporation selling generic pesticides in the world, with a presence in Mexico. Ingeniería Industrial was also part of ChemChina (ADAMA, 2015) until April 2017, when it had to transfer its rights over paraquat to AMVAC company. Gowan Mexicana, which belongs to the US Gowan Group with headquarters in Yuma, Arizona, has 30 registrations; Agri-Estrella company, which forms part of Albaugh Inc., a transnational group with headquarters in Ankeny Iowa, USA, has 18 registrations; and Similia Defensivos Agrícolas, which is part of Shandong Weifang Rainbow Chemical, one of the three main pesticide exporters from China with a presence in 37 countries, has 3 registrations. It is also the main exporter for Latin America with factories in Panama and Argentina.[60]

As can be seen, the interests of the companies with authorizations to use highly hazardous pesticides in Mexico form a complex intertwined of networks

59 See: http://www.chemeurope.com/en/companies/18946/united-phosphorus-de-mexico-s-a-de-c-v.html

60 See: http://news.agropages.com/News/print—18794—.htm

and interests with national and international chains of supply comprising both transnational corporations that are the original owners of the molecules, and generic pesticide companies linked to other international companies, as well as some Mexican companies.

The vast majority of the authorized highly hazardous pesticide registrations included in Table 9 are for use in agriculture, forestry or farming with 1,406 registrations (81.46 percent), although there are also pesticides that have been authorized for household, gardening, and urban use with 256 registrations (14.83 percent), and a minority has been authorized for industrial use with 64 registrations (3.71 percent). This means that the population exposed to highly hazardous pesticides is not only workers who carry out agricultural, farming or forestry activities in rural areas, but also people living in cities who use them in their gardens or homes. Pesticide exposure is not only occupational, but also residential and environmental. The most common form in which most babies, children and adult populations are exposed to pesticides is through ingesting food with pesticide residues. Therefore, the problem of reducing pesticide exposure, avoiding their use, and finding less hazardous alternatives concerns everyone, although it is the rural populations that suffer it more dramatically, in the first place the agricultural workers, both men and women, as well as the neighboring communities, particularly when there is spray drift.

2.9 Highly Hazardous Pesticides Authorized in Mexico and Banned in Other Countries

A comparison between the PAN International *Consolidated List of Banned Pesticides* (PAN CL, 2017)[61] and the active ingredients included in COFEPRIS's Pesticide Catalogue, valid until September 2016, led to the following results:

61 The PAN International *Consolidated List of Pesticides Banned in the World*, in its third edition of April 2017, identified 370 active ingredients that have been totally banned by one or more of 106 countries, in which the ban has a government notification or backing, or has been reported by the Rotterdam Convention or the FAO. It includes some non-authorized pesticides in the European Union. It also indicates whether or not these pesticides are classified as highly hazardous according to criteria defined by the FAO/WHO Joint Meeting on Pesticide Management (JMPM) or PAN International criteria. It does not include pesticides identified as obsolete or that according to the WHO 2009 Recommended Classification of Pesticides by Hazard are no longer in use (WHO 2010, Table 6). Restricted pesticides are not included. It is not an exhaustive list since many countries do not publish the banned pesticides or do not notify the Rotterdam Convention. It is thus regularly updated when more information is obtained. In our opinion, the PAN list is the most updated source of information on the theme since the United Nations ceased publishing its *Consolidated List of Products Whose Consumption and/or Sale Have Been Banned, Withdrawn, Severely Restricted or Not Approved by Governments*, which included pharmaceutical, agrochemical, industrial and consumer products.

There is a total of 140 active ingredients that are authorized pesticides in Mexico whereas they are banned or non-authorized in other countries. The complete list can be consulted in Annex 2 in the back of this book. This total list includes 65 pesticides that have been banned or non-authorized in other countries that are highly hazardous pesticides according to criteria established by the FAO and WHO group of experts. If the additional criteria proposed by PAN International were used, this figure would increase to 111 (79.29 percent). We have also identified other pesticides that are banned in other countries that are not included in the PAN list or do not meet the FAO/WHO criteria, such as herbicide 2,4-D, acaricide and insecticide amitraz, fungicide captan, and insecticide dicofol. Dicofol was nominated by the European Union for the Stockholm Convention on Persistent Organic Pollutants and was accepted by the Review Committee that developed a risk profile in which it confirmed that it met the criteria of toxicity, persistence and biomagnification. The Review Committee is currently assessing its alternatives and economic viability before developing its final recommendation to the Conference of Parties (UNEP/POPS/POPRC.11/INF/17, 2015).

The following table presents a selection of 42 banned or non-authorized pesticides in 31 or more countries that have sanitary registration in Mexico.

Table 10
Main Pesticides Authorized in Mexico that are Banned in Other Countries

	Pesticide Active Ingredient	Highly hazardous pesticides according to FAO/WHO criteria	Highly hazardous pesticides according to PAN International criteria	Number of countries in which it is banned
1	Endosulfan	1	1	75
2	DDT	1	1	71
3	Captafol	1	1	64
4	Pentachlorophenol (PCP) and salts	1	1	62
5	Monocrotophos	1	1	60
6	Parathion methyl	1	1	59
7	Aldicarb	1	1	56
8	Carbofuran	1	1	49
9	Phosphamidon	1	1	49
10	Methamidophos	1	1	49
11	Alachlor	1	1	48

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	Pesticide Active Ingredient	Highly hazardous pesticides according to FAO/ WHO criteria	Highly hazardous pesticides according to PAN International criteria	Number of countries in which it is banned
12	Dicofol			45
13	Carbosulfan		1	40
14	Triazofos	1	1	40
15	Azinphos-methyl	1	1	39
16	Disulfoton	1	1	38
17	Paraquat			38
18	Quintozene (penthachloronitrobenzene)			38
19	Atrazine		1	37
20	Phorate	1	1	37
21	Mevinphos	1	1	37
22	Methoxychlor		1	36
23	Methyl Bromide	1	1	35
24	Chloropicrin		1	34
25	Methidathion	1	1	34
26	Terbufos	1	1	34
27	Amitraz			33
28	Benomyl	1	1	33
29	Carbaryl	1	1	33
30	Fonofos			33
31	Vinclozolin	1	1	33
32	Zineb		1	33
33	Dichlorvos (DDVP)	1	1	32
34	Omethoate	1	1	32
35	Trichlorfon		1	32
36	Acephate		1	31
37	Cadusafos	1	1	31
38	Edifenphos	1	1	31
39	Maneb	1	1	31
40	Quinalphos (+)		1	31

	Pesticide Active Ingredient	Highly hazardous pesticides according to FAO/WHO criteria	Highly hazardous pesticides according to PAN International criteria	Number of countries in which it is banned
41	Simazine			31
42	Vamidothion	1	1	31

(+) Highly hazardous pesticides that are not banned in any country, but are not allowed in the European Union
(++) DDT is included since it is not banned, and has "restricted use" registration exclusively for the Mexican Ministry of Health, although it not used.
(+++) Azinphos-methyl, captafol and endosulfan are included since their registration is still under review, according to the *2016 Pesticide Catalogue*; although a statement from SAGARPA-SENASICA dated August 1, 2016 informed that COFEPRIS had cancelled its registration, advising not to use it in agriculture.
Source: PAN *Consolidated List of Bans*, April 2017; COFEPRIS *Catálogo de Pesticides 2016*, Mexico.

As indicated earlier, DDT was included in our list since it continues classified under "restricted use" in the Pesticide Catalogue, for exclusive use of the Mexican Ministry of Health for disease transmission vector control, although it is no longer used. It is not understandable why COFEPRIS has not banned definitely, as 71 countries throughout the world have done, including Latin America countries like Brazil, Panama, and Costa Rica, among others.

The fact that in Mexico there are 140 authorized pesticides that are banned or non-authorized in other countries is a consequence of the standardization with the US pesticide market and the neoliberal regulatory policy applied in the last decades during which free trade has prevailed. In relation to pesticides, the US market, which is where the main Mexican agricultural exports go, is less strict than the European Union. In the United States, at least 82 pesticides are authorized that are banned or non-authorized in the European Union, as detailed in a report of the Center for International Environmental Law (CIEL) (Smith *et al.*, 2015).[62] Of this list, we identified that 23 are authorized in Mexico, like herbicides atrazine, paraquat, permethryn, terbufos, and thiodicarb.

62 The above mentioned CIEL report notes that if the Transatlantic Trade and Investment Partnership (TTIP) between the United States and Europe had moved forward, it would have provided greater influence of the transnational pesticide industry organized under the European Crop Protection Association and CropLife USA. The TTIP included a chapter for "regulatory cooperation" so it was likely that the European health and food security standards would drop in order to standardize with the US market and favor transnational corporations. One of the first measures implemented by President Trump after taking office in 2017 was to cancel the TTIP negotiations. This threat has not disappeared and there is the fear that with Brexit, the UK might negotiate a free trade agreement with the United States.

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The precautionary principle is applied in the European Union, and active ingredients are classified according to hazard cut-off criteria. The registration of substances that are mutagens (Category IA or IB) (Regulation 1107/09 Annex II, item 3.6.2); carcinogens (Categories 1A and 1B) (Regulation 1107/09 Annex II, item 3.6.3); with reproductive toxicity (Regulation 1107/09 Annex II, item 3.6.4); or that are considered endocrine disruptors (Regulation 1107/09 Annex II, item 3.6.5) are not authorized, although as we saw in the respective section, the approval of the technical criteria to define them has not yet been completed. Besides, a pesticide's active ingredient is not approved if it is a persistent organic pollutant, or if according to more detailed technical criteria it is defined as "persistent, bioaccummulative and toxic," or "very persistent and very bioaccummulative" (Regulation 1107/09: items 3.7.2 and 3.7.3) (Peláez *et al.*, 2013:651). For active ingredients that do not present these hazardness characteristics, a risk assessment is carried out both for the active ingredients and the formulated products, in a double system in which European Commission authorities and member States intervene. The European regulatory system is constantly subject to corporate lobbying. The EFSA responsible for regulating pesticides has been criticized for not sufficiently investigating its officials' conflicts of interest and for being under the influence of institutions in the service of industry, which favor less rigorous and more economical risk assessment (Robinson, 2011). Besides, as we saw earlier in the case of the assessment of glyphosate, the EFSA has been harshly criticized for its contradictions and deficiencies.

Since 1972, the US authority responsible for pesticide registration was transferred from the Department of Agriculture to the EPA, which demands that pesticide assessment be based on a series of studies on human and environmental toxicology. The burden of proof was transferred to the applicant companies through a scheme based on a cost-benefit balance, as a complementary assessment criterion. Pesticide assessment is exclusively based on risk assessment, although it establishes stricter control limits for food consumed by babies and children. The Food and Drug Administration (FDA) is responsible for establishing maximum limits to pesticide residues in food. After the revocation of the Delaney clause in 1996, which in a contradictory manner demanded zero risk analysis for carcinogenic additives in processed foods, but allowed a certain degree of tolerance in fresh food, the EPA has used cost-benefit analysis discretionally, registering pesticides case by case (Peláez *et al.*, 2013:649, quoting Zandler, 2010:309).

In 2009, the EPA had approximately 850 people working in the Office of Pesticide Programs, responsible for pesticide assessment and registration. The EPA also has 4 ad hoc Expert Consultant Committees (Peláez, *Ibid.*). Since

the beginning of the Reagan administration in 1981, various non-governmental organizations, including a former official who worked at the EPA's Office of Pesticide Programs for 25 years, denounced, using numerous examples, how chemical corporations have been gaining influence over the EPA, both under Republican and Democratic administrations (Vallianatos and Jenkins, 2014). The EPA budget has gradually been reduced, the library preserving the institutional memory of EPA-funded studies was dismantled, the number of laboratories under its control was first reduced, and the analysis services were later privatized. The government's pesticide assessment thus started to depend on information provided by the industry itself. In addition, the "revolving door" mechanism between industry and government that allows key people from the private sector to occupy important positions in the regulation offices, and vice versa, therefore, allow government officials to transfer to the companies they used to regulate (*Op. cit*). In February 2017, a few months after taking office, Donald Trump announced a cut to the agency's budget and staff, which is likely to also weaken pesticide regulation.[63]

In the case of Mexico, as we saw in the respective section, in order to be accepted by the OECD, pesticide registration was adapted to align with the US market, the main destination for Mexican agricultural exports. The Mexican Ministries SAGARPA and SEMARNAT are the competent authorities granting pesticide registration in Mexico. The regulatory framework is based on the application of a risk assessment approach and cost-benefit analysis.

2.10 Perspectives on Banning Highly Hazardous Pesticides in Mexico

If there were a highly hazardous pesticide phase-out policy in Mexico, it would face opposition from the chemical pesticide industry organized under PROCCYT and UMFFAAC. These two organizations propose that pesticide assessment be based exclusively on risk assessment, rather than on hazardness, comprising a set of risk mitigation measures which in extreme cases would lead to removing or cancelling a molecule with no commercial interest following the deadlines agreed with COFEPRIS.

PROCCYT, pertaining to CropLife, is interested in keeping profitable products on the market, even those whose patent has expired but are linked to the

63 President Trump's proposal of February 2017, was to cut the EPA's general budget from $8.1 billion USD to around $2 billion, and a cut of three thousand employees is estimated, a fifth of its total staff. This would regress the EPA to the level it had in the late 1980s or early 1990s. Note from Climate Nexus at: https://www.ecowatch.com/epa-budget-cuts-2290423810.html?utm_source=EcoWatch+List&utm_campaign=511c76bb55-MailChimp+Email+Blast&utm_%20medium=email&utm_term=0_49c7d43dc9-511c76bb55-85370713 Retrieved on February 28, 2017.

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expansion of genetically modified crops tolerant to the herbicides and insecticides controlled by transnational corporations. In SAICM negotiations, as well as in the development of FAO and WHO Guidelines for Highly Hazardous Pesticides, CropLife has argued that the measures to be taken for highly hazardous pesticides or any other regulation must be based on pesticide risk management rather than on hazardness. CropLife contends that in pest control what really matters is the balance between risks and benefits under the recommended circumstances of use. Pesticide packaging improvements, formulation changes, restriction to some of its uses, appropriate training in "responsible pesticide use," integrated pest management and the appropriate disposal of empty pesticide containers are examples of risk mitigation measures. According to CropLife, its member transnational corporations are committed to managing the "potential health and environmental risks" of highly hazardous pesticides. They are also committed to reviewing the products in their sales portfolios in order to regularly identify highly hazardous pesticides, conduct use assessments with the products and formulations under the circumstances of use in different geographical locations, carry out risk mitigation actions, or the voluntary withdrawal of certain uses, as well as offering developing countries training in risk assessment (CropLife International, 2015).

UMFFAAC's position is similar to that of CropLife with an interest in maintaining generic pesticide commercialization. It has made alliances with transnational corporations from other countries that have patents on new generic formulations. UMFAAC is part of Agrocare Latin America and Agrocare International, which groups the generic agrochemicals industry. The Agrocare Latin America's General Associates' Meeting held in Mexico City in February 2016 informed that UMFFAC participates in a voluntary scheme to revoke the pesticide registration of those molecules included in the international conventions "or that for reasons specific to the industry are no longer of interest to them." They added that, "It is important to highlight that subsequently this dynamic will be carried out after performing a risk analysis for each molecule considered in the program." This is a declaration by Rocío Alatorre, Risk Management and Evidence Commissioner of COFEPRIS (UMFFAAC, 2016b). At that same meeting, another Agrocare guest, Dr. Keith Solomon "emphasized the importance of assessing pesticide molecules through their risk rather than their hazardness; based on the fact that risk can be characterized through a probabilistic model of toxicity-exposure interaction (hazard), which would make it possible to define when a pesticide must be considered highly hazardous" (UMFFAAC, *Ibid.*).

In Mexico, the pesticide regulatory framework approach is based on risk assessment and management rather than hazardness-based decision-making and the application of the precautionary principle, although the latter approach would be more consistent with the constitutional obligation to protect the basic human

rights to health and the environment that pesticide exposure affects. From our perspective, exposing the population to highly hazardous pesticides with intrinsic characteristics that cause serious damage to human health in the short and long-term, besides severely damaging other living organisms that are essential for biodiversity and the healthy preservation of ecosystems justifies an in-depth review of the assumptions underlying the regulatory system in Mexico.

As noted previously, there are legal loopholes in the pesticide registration process in Mexico, as well as limiting conditions that lead to a failure to conduct risk assessments similar to those in the United States or Europe. Neither is the hazard cut-off criterion applied to pesticides, as in Europe or as included in legislations similar to that of Brazil. According to specialists, the pesticide regulatory framework in Mexico is insufficient and inefficient, requiring a comprehensive review and reform in order to achieve actual risk reduction; actions taken by different governments have been belated measures responding more to international pressure or commitments, without sufficient surveillance to protect health and the environment, or the recognition that it is an issue of priority in public policy (Albert, 2005, 2014). In this section, we only analyze some examples related to the power to ban pesticides that the General Health Law grants COFEPRIS, and that the LGEEPA grants SEMARNAT. We also comment on recommendations issued by human rights protection organizations, although we must warn that a deeper and more systematic analysis is required with the participation of lawyers and organizations specialized in this theme.

According to the General Health Act, the Mexican Ministry of Health could cancel or revoke the sanitary registration granted to pesticides if the stakeholders do not apply for an extension within the established deadline or if the product is changed or modified without prior authorization (Article 376), but also "When, for supervening causes, it is proven that the products or authorized activities represent a risk or damage for human health" (Article 380, Section 1, General Health Act). In other words, "supervening causes" means that there were changes in the knowledge regarding the intrinsic hazardness or damage or risk due to changes in the actual circumstances of use in relation to the moment in which the registration was granted. It also established that the application of the pesticide to a crop or use different from that for which it was authorized is another cause for revoking the registration. Other causes are a serious lack of compliance with provisions in the General Health Act, and the applicable regulations and general provisions; the repeated reluctance to follow health authority stipulations; or when the information or documents submitted by the stakeholder upon applying for registration turn out to be false, among other causes (Article 380, General Health Act, Sections II to XII). However, considering the small number of cases in which the Ministry of Health has decided to revoke or cancel a pesticide registration,

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analyzed below, it is evident that the regulatory framework needs to be adjusted in order to allow for a more expeditious procedure for the cancellation of a pesticide registration.

In Mexico, only 20 pesticides have been banned since 1991 (DOF, January 3, 1991),[64] and another 7 pesticide registrations were cancelled in 2016 with deadlines established in agreement with the industry. Several of these pesticides are included in the Stockholm and Rotterdam Conventions. Under the most recent administrations, most of the pesticides included in the Stockholm Convention have been banned. DDT is no longer used, although legally it has not been banned (it continues to appear indicated for "restricted use for vector control and is no longer used by the Executive Branch") (Catálogo de Pesticides, 2016:173). Lindane registrations have been revoked as well as the majority of registrations of endosulfan. The revocation of the wood preservative pentachlorophenol, listed in the Stockholm Convention is pending. This Convention is a legally binding instrument, i.e., it is compulsory. Mexico has signed the Stockholm Convention, which thus forms part of the Mexican judicial framework. Nonetheless, even in these instances, the process to cancel the authorized registrations has been very lengthy and has included significant concessions to industry regarding the deadlines for their elimination.

For example, in the case of endosulfan, listed in the Stockholm Convention since 2011 for the global elimination of its use, COFEPRIS negotiated with companies that commercialize it in Mexico and reached an agreement to not authorize importations as of January 1, 2013 with a two-year deadline to enable companies to use up their stock. The agreement was valid until December 31, 2014, which was meant to be the deadline for its commercialization. The revoking of registrations was meant to start as of January 2015.[65] However, in 2015, although endosulfan was no longer imported into Mexico, it was still being commercialized. It was not until August 1, 2016, that SENASICA informed farmers, professionals and companies that COFEPRIS had cancelled its registration, as well as that of lindane and another five pesticides. They were thus "invited to avoid the use of the formulated pesticides" in agricultural crops (SAGARPA-SENASICA, August 1, 2016).

In the case of lindane, Mexico nominated this insecticide to the Stockholm Convention, and in 2009 supported the decision to eliminate its use globally.

64 Diario Oficial de la Federation (Federal Official Gazette), January 3,1991. CICOPLAFEST indicates that the importation, production, formulation, commercialization and use of the following pesticides have been banned: phenyl acetate or propianate, mercury, 2,4-5-T acid, aldrin, cyanophos, chloranil, DBCP, dialifor, dieldrin, dinoseb, endrin, erbon, formothion, sodium fluoroacetate (1080), phosphine, kepone/chlordecone, mirex, nitrofen, schradan and triamiphos.

65 Communiqué from the Mexican Ministry of Health and COFEPRIS entitled "Actions to Eliminate Endosulfan in Mexico" (nd), informing about the cancellation of the registration for azynphos methyl, captafol, chlordane, DDT, endosulfan, phenthoate, and lindane.

However, the procedure to apply this measure was very slow as the only company holding registration started a legal battle filing an injunction for each one of its uses. This delayed the process several years. In spite of its experience, COFEPRIS has not taken the initiative to propose legislation changes in order to speed up the cancellation procedure. In May 2016, the COFEPRIS website still showed registrations authorizing the use of lindane as a seed protector, in spite of the fact of not being included in the *2016 Pesticide Catalogue* divulged in September that same year.

In the case of pesticides included in Annex III of the Rotterdam Convention cancelled by COFEPRIS, it should be noted that this Convention only establishes a mandatory prior notification mechanism, whereas the ban on products included in that Annex is not compulsory. It is a regulatory option that each member country is free to adopt. COFEPRIS has cancelled the registration of insecticides azynphos methyl, captafol and chlordane, in agreement with and through voluntary negotiation with companies. Nonetheless, in the consultation conducted in September 19, 2016, some of the registrations of azynphos methyl and captafol still appeared to be under review in the *2016 Pesticide Catalogue* and its annexes. On August 1, 2016, SENASICA communicated the decision to cancel these pesticides in an official letter addressed to farmers and the agricultural sector. However, this letter did not explain the reasons why COFEPRIS had cancelled the registration, nor did it mention that some of these insecticides are included in the Rotterdam Convention because they are very hazardous formulations or because they have been banned in some countries.

In all the cases in which COFEPRIS cancelled pesticide registrations, the negotiation and communication of these bans were carried out with the business sector. Neither COFEPRIS nor the Mexican Ministry of Health had or have a communication policy to inform rural producers or the public in general in a timely manner about the pesticides that have been banned and the health and environmental protection that motivated such decision. This is contrary to what is stipulated in the General Health Act (Article 381).[66] The fact that the Ministry of Health or other ministries responsible for pesticide control lack a communication policy leads to disinformed citizens, who are thus unable to denounce the illicit trafficking of banned pesticides in Mexico.

The LGEEPA stipulates in Chapter IB on Soil Pollution Prevention and Control that "authorization to import pesticides, fertilizers, and other hazardous materials cannot be granted when their use is not allowed in the country in

66 Article 381 of the Mexican General Health Law stipulates, "When the revocation of an authorization is based on the risk or damage that a product or service might cause or actually causes, the health authority will inform the public offices and agencies responsible for guiding the consumer about such revocation."

which they were elaborated or produced" (Article 144 resulting from the reform published in the Federal Official Gazette on December 13, 1996). Apparently, this provision is applied in the first stage of registration of new molecules, but there is no regulation of hazardous materials that includes pesticides in order for such stipulation to become effective. In addition, there has been no political willingness or institutional capacity to monitor the changes in the regulatory status of the ban or restrictions on the pesticides authorized in other countries. Besides, the language of this clause is insufficient to offer adequate protection in the face of pesticides that have been banned in other countries in the context of capitalist corporate globalization. This is due to the fact that it is only applied to pesticides banned in the exporting country and not in the country where the corporation headquarters are located. What has happened in the last decades is that the transnational corporations that produce the pesticides that have been banned in their country of origin, such as the United States or Europe have transferred their production mainly to China, in order to thus respond to Mexico's domestic demand and make use of the advantages it offers as an export platform to the rest of the world. In China, exports are carried out not only by the transnational corporations that hold the original patent rights, but when the patent expires it is also conducted by companies that produce generic formulations, taking advantage of the favorable conditions created by the government. The search for higher profits by transnational corporations, favored by globalization to be in permanent competition to grow and conquer new markets, results in the continued production of pesticides (banned in the countries of origin to protect the population and the environment) for export only. In other instances, their production is transferred to other countries with more lenient regulation, from which it is exported to the rest of the world.

Let's illustrate this trend with the case of the herbicide paraquat. Originally synthetized in 1882, its herbicide properties were discovered in 1955. It started to be produced industrially for sale in the UK in 1961 by a transnational corporation called Imperial Chemicals Industry (ICI) under the commercial brand Gramoxone. ICI was one of the oldest and largest chemical corporations of the British Empire investing in pharmaceutical, paint, polymers, electronics, and pesticides, among other products. Paraquat use was banned in the UK in 2007, but its industrial production for exportation was and still is allowed to continue, although since then its patent rights have been lost, and the transnational corporation has changed owners and name. In 1993, ICI separated its business segment corresponding to pharmaceuticals, pesticides, seeds, and biological products, and formed another new British corporation that was listed on the stock exchange as Zeneca Agrochemicals, which continued producing paraquat not only in the UK, but also in industrial plants in Texas, United States, and in Japan. In the

year 2000, ICI concentrated on the paint sector, a sector in which it is a market world leader, and sold Zeneca to the Swiss company Novartis Agrochemicals, changing its name to Syngenta AG, with headquarters in Switzerland, where paraquat has been banned since 1989 (PAN UK, 1996; Encyclopedia.com, 2016). In 2001, Syngenta constructed a new industrial plant to produce paraquat in continental China, which enables Syngenta to remain the largest paraquat producer and exporter in the world. To date, Syngenta occupies first place in global pesticide sales. As aforementioned, in February 2016, Syngenta was purchased by ChemChina, a Chinese state-owned company (Spegele and Chu, 2016).[67]

In July 2016, the Chinese government banned the sale and use of all paraquat liquid formulations (emulsifiable and soluble concentrates), but allows export to other countries. Besides, other paraquat formulations continue to be authorized (CCM International, 2012). As well as Syngenta, there are a number of Chinese formulators exporting paraquat, which considering the sales value in 2015 is the main pesticide exported to Mexico (Agropages 2016, March 24).[68] Considering its market value, paraquat is the second main pesticide exported to Latin America, after glyphosate (Agropages 2016, July 27:41). The Berne Declaration (now called Public Eye) and PAN International have developed a worldwide campaign to ban paraquat, documenting violations of the Code of Conduct by Syngenta and other companies with regard to the use of paraquat and other pesticides, in countries like India (Kumar, 2005).

In Mexico, both Syngenta and other formulator companies sell liquid paraquat formulations (such as paraquat dichloride and other salts). Therefore, considering what was mentioned earlier, Article 144 of the LGEEPA should be enforced, banning all paraquat formulations coming from the UK and all the liquid formulations in Mexico coming from China, as a first step toward total ban. In our opinion, the LGEEPA act must be revised so that the ban on pesticides can be understood as a measure to prevent not only soil but also water pollution, as well as to protect biodiversity.

Furthermore, the recommendations issued by international human rights protection bodies regarding pesticide ban in the context of the environmental health necessary to ensure the human rights of boys and girls should also be taken into account. In this regard, the historical recommendation of the UN Committee on the Rights of the Child, surveillance body of the Convention on the Rights of the Child, issued on June 5, 2015, should be highlighted. It requests that the

67 The purchase of Syngenta by ChemChina was approved by the US Foreign Investment Committee, which can block mergers if they threaten national security. It is currently awaiting the approval of the EU's antitrust regulators (Spegele and Chu, August 22, 2016).

68 According to this source, paraquat exports from China accounted for a value of $15,420 million dollars, representing 14 percent of the total export value to Mexico in 2015.

Mexican State, "b) Ban the importation and use of any pesticide or chemical the use of which has been banned or restricted in the exporting country" (Committee on the Rights of the Child CRC/C/MEX/CO/4-5: paragraphs 51 and 52). The recommendation also requests that the State, "a) Evaluate the impact of air, water, soil and electromagnetic pollution on child and maternal health, as the foundation of a strategy endowed with resources at a federal, state and local level based on consulting all the communities, particularly indigenous peoples, in order to remedy the situation and drastically reduce exposure to pollutants;" and "(c) Examine its regulatory framework more in depth and adapt it in order to ensure that companies participating in activities that have a negative impact on the environment assume legal responsibility, taking into account its General Comment No. 16 (2013) on the States' obligations regarding the impact of the business sector on the rights of the child" (*op cit*).

This recommendation of the Committee on the Rights of the Child resulted from the presentation of various reports about violations of the rights of boys and girls from Yaqui communities in Sonora state caused by the use of highly restricted pesticides banned or non-authorized in the United States, the European Union and other importing countries filed by the International Indian Treaty Council (IITC) together with its affiliates in Mexico (IITC, Press Release, June 2015). If the Committee's recommendation were taken seriously, the Mexican regulatory framework would have to be reviewed in order to not only prohibit the use of banned pesticides, but also include pesticides restricted in the exporting country. The alternative report of indigenous peoples, coordinated by the IITC, sent to the Committee, questions the Rotterdam Convention that only demands a prior notification procedure for the exportation of pesticides or severely hazardous formulations that have been banned or restricted in other countries. The IITC holds that this is not consistent with the goal of achieving the highest level of protection to humans. In contrast with the Convention, which demands prior informed consent from exporting countries, at a national level, indigenous peoples are not asked for their consent when pesticides are sprayed aerially, nor are mothers and children compensated or cared for appropriately when they are affected (CITI, 2015).[69]

69 This report was coordinated by IITC and its affiliate organizations: Congreso Nacional Indígena de México; Consejo de Pueblos Nahuas del Alto Balsas, Guerrero, A.C. (CPNAB); Autoridades Tradicionales, Yaqui Pueblo de Huirivis, Río Yaqui, Sonora; Autoridades Tradicionales, Yaqui Pueblo de Potam, Río Yaqui, Sonora; Autoridades Tradicionales, Yaqui Pueblo de Torim, Río Yaqui, Sonora; Jittoa Bat Nataka Weria, Río Yaqui, Sonora; Unidad de la Fuerza Indígena y Campesina (UFIC, the regional members of which include indigenous peoples in 25 states in Mexico); Red Indígena de Turismo de Mexico A.C. (RITA); Di Sugave a Nana Shimajai, San Francisco Magú in Mexico. Co-presenters include Coordinadora Nacional de Mujeres Indígenas (CONAMI) and Coordinadora Nacional de Mujeres Indígenas-Vinajel (COEMICH-Vinajel), Mexico.

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From our perspective, the Mexican regulatory framework should be reviewed in depth in order to address the recommendations made by the aforementioned human rights bodies and develop a strategy for the progressive ban on highly hazardous pesticides parallel to supporting agroecological alternatives to replace them.

2.11 SAICM in Mexico

The General Office for Global Matters pertaining to the Mexican Ministry of Foreign Affairs (SRE in Spanish) is Mexico's focal point for SAICM. However, it is the National Center for Disaster Prevention (CENAPRED, in Spanish) pertaining to the Ministry of the Interior with support from the DGGIMAR, a branch of SEMARNAT, that serve as the Technical Secretariat. Both offices coordinate a working group to develop a national SAICM plan in order to comply with the commitment to present advances and reports at the preparatory meetings prior to the 2020 meeting. This group is formed by industry, academia, and non-governmental organizations belonging to the National Advisory Committee for the Integral Management of Chemicals, Persistent Organic Compounds and Hazardous Waste Subject to International Conventions on Environmental Matters (CCNSQ in Spanish), pertaining to SEMARNAT. The working group is reviewing the advances Mexico has made regarding the Global Plan of Action approved by SAICM in 2007, as well as the agreements reached in the previous administration. It has also requested greater collaboration from COFEPRIS. However, until March 2017, no agreement had been reached concerning highly hazardous pesticides.

As concerns civil society organized groups –as noted in the first part of this chapter– 24 public interest non-governmental organizations and academics in Mexico have joined PAN International's worldwide call for the progressive ban on highly hazardous pesticides (PAN International, 2016). In addition, during the fourth session of the ICCM in 2015, 13 outstanding toxicologists and health professionals in Mexico signed the international charter addressing the UNEP, FAO and WHO to demand an end to the use of highly hazardous pesticides[70] (RAPAM, 2015a). Furthermore, in SAICM discussions, 25 professors or researchers

70 Including Lilia Albert, Omar Arellano, from the UCCS, as well as researchers from the Mexican National Public Health Institute, the Autonomous University of San Luis Potosi, Research Center on Food and Development (CIAD in Spanish), the Sonora Technological Institute, the Autonomous Metropolitan University (UAM in Spanish), the Autonomous University of Nayarit, the Autonomous University of Campeche and the National Polytechnic Institute (IPN in Spanish).

from the main universities in Mexico (RAPAM, 2015b)[71] addressed a letter to the Mexican authorities demanding that the Mexican government support the proposal to create a global alliance for the progressive ban on highly hazardous pesticides, together with 23 public interest non-governmental organizations and social organizations like the National Association of Rural Producers' Enterprises (ANEC in Spanish) (RAPAM, 2015b). It must be kept in mind that the Mexican Ministry of Foreign Affairs, SEMARNAT, and even the Ministry of Health gave a positive response in writing, as opposed to SAGARPA and the Ministry of Economy. RAPAM, in turn, declared that it favored including the progressive ban on highly hazardous pesticides in the agenda to develop the national SAICM implementation plan, prioritizing support for agroecological alternatives for pest, weed and disease management, as indicated in the ICCM4 resolution.

Although the proposal to form a global alliance for banning highly hazardous pesticides did not reach consensus in ICCM4, as explained in the first part of this chapter, it is a task that can be promoted at a national level through forming a broad coalition between non-governmental, academic and social organizations, incorporating the increasing experience of agroecology and organic agriculture in Mexico, as well as experiences from other Latin American countries.

3. Alternatives to the Use of Highly Hazardous Pesticides in Mexico

As we have seen in the first part of this chapter, the proposals made by non-governmental organizations like PAN and IPEN were partially incorporated into the ICCM4 resolution on highly hazardous pesticides that recommends governments emphasize the promotion of agroecological alternatives to highly hazardous pesticide use. From our point of view, this implies changing the focus on how the problem and the pesticide use policy are defined.

The alternatives to the use of highly hazardous pesticides must be set forth beyond the narrow framework of "adequate pesticide management," which

71 Chapingo Autonomous University (UACh in Spanish); Institute of Science, Autonomous University of Puebla (BUAP); Rural Development, Postgraduate College, Montecillo, State of Mexico; Research Institute on Environment and Health, West University Sinaloa State; Research Center on Food and Development (CIAD), in Hermosillo and Guaymas in Sonora state; Higher Technological Institute in Cajeme Ciudad Obregón, Sonora state; EPOMEX Institute, Autonomous University of Campeche; Agricultural and Animal Production Unit of the Autonomous Metropolitan University, Campus Xochimilco; UNESCO Chair on Human Rights at the UNAM, Economy Faculty; Autonomous University of Yucatan State (UADY); Center for Research and Advanced Studies in Social Anthropology (CIESAS); The Resources Institute, University of the Sea, Puerto Angel, Oaxaca State; Agroecological Pest Management, INIFAP experimental unit in Uruapan, Michoacan State.

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emphasizes the appropriate use of personal protection equipment as indicated on the product label, or the substitution of less hazardous pesticides in place of highly hazardous chemical pesticides. In order to assess alternatives to highly hazardous pesticide use, the defining question must be changed. The issue is no longer how to manage pesticides adequately, but how to manage pests, undesired plants, and diseases in order to avoid using chemical pesticides or other toxic substances that represent an unacceptable health and environmental hazard. The response lies in the adoption of a systemic approach that comprises and promotes biodiversity in how agricultural-forestry-farming production operates in a specific ecosystem with active participation and ongoing dialogue with rural producers and their communities. As follows, we will be reflecting about agroecology and organic agriculture since we consider that they have had a major impact on Mexico, without disavowing that there are other alternative experiences in pest and disease management, such as regenerative agriculture, permaculture, biodynamic agriculture, as they define themselves, among other alternatives.

The agricultural practices for agroecological pest and disease management practiced in Mexico include cultural control methods that diversify the agroecosystem (crop association and rotation, density and sowing date management, provision of shelter for predators and pest insect parasitoids through weed management); physical and mechanical controls (such as the use of traps, as well as physical and natural barriers); applied biological control (introduced or native natural enemy conservation strategies, use of beneficial fungi, bacteria, and viruses); phytogenetic improvement for the use of varieties with greater resistance to diseases and insect attacks; use of plant extracts (like neem, garlic, chaparral, wormseed, castor-oil-plant, grains of paradise, wandering Jew, among many others); vegetable oils and prepared minerals (lime, sulphur, copper sulphate, ash). All this is conducted together with the sampling of insect populations to be applied only when justified (Rodríguez, 2000; 2005; Bahena, 2008; Trujillo, 2016). It should be noted that it is not a question of applying a set of recipes or alternative inputs, but rather of explaining the appearance of diseases, unwanted plants, and insects as pests, resulting from population imbalance, and the interactions and interdependencies of the components of an agroecosystem in specific territories and communities.

Agroecology in Mexico has a history yet to be constructed. However, there are reports that a First Congress on Agroecology was held in Meoqui, Chihuahua state in 1926 (Rosado, 2016:124). Decades later, agroecology emerged as a form of resistance to the "Green Revolution" approach in the humid tropics with three programs that were developed almost simultaneously between 1974 and 1980 thanks to the work carried out by Efraím Hernández Xolocotzi, an agricultural engineer and ethnobotanist from the Chapingo Autonomous University; Arturo

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Gómez-Pompa, an ecologist and botanist who founded the National Biotic Resource Research Institute (INIREB in Spanish); and the experience of the Superior School of Tropical Agriculture (CSAT in Spanish) in Cárdenas, Tabasco state, from 1974 to 1984, the year in which the federal government closed it down (Gliessman, 2013).

Heirs to this agroecological tradition, the creation of an MA and a PhD Program in Agroecology and Sustainability, for instance, at the Chapingo Autonomous University (UACh in Spanish), the Autonomous University of San Luis Potosí (UASLP in Spanish), the Autonomous University of Puebla (BUAP in Spanish); the PhD and MA in Science in Agroecological Pest and Disease Management from the National Polytechnic Institute (IPN in Spanish), and the recent opening of an MA in Agroecology from the Postgraduate College in its Montecillo campus in the State of Mexico are gradually extending the institutional offer of graduate studies in agroecology. Furthermore, it is important to note the work carried out by the National BioControl Reference Center and the Mexican Biological Control Society in their multiple congresses, the creation of professional associations that propound agroecological pest management, such as the Mexican Society of Sustainable Agriculture (SOMAS in Spanish); and civil society organizations as well as scholars and non-governmental organizations that have formed the Agroecological Movement in Mexico, pertaining to the Agroecological Movement in Latin America and the Caribbean (MAELA in Spanish) (MAELA, 2016). All this is generating a growing critical mass of professionals with experience and proposals that would need to become part of the discussion regarding a public policy that supports transition strategies for the progressive ban on highly hazardous pesticides in Mexico.

In identifying alternatives to chemical pesticide use, it is important to also consider the experience of organic agriculture in Mexico, i.e., agriculture that has stopped using not only chemical pesticides, but also chemical fertilizers. This agriculture is extremely dynamic, with growth rates of 25 percent, mostly resulting from the work of peasant organizations and the international demand for organic products, as well as their increasing presence in the national market. According to experts from the Chapingo Autonomous University, the official statistics do not appropriately reflect the evolution of organic agriculture (Schwentesius R. *et al.*, 2014). In Mexico, organic agriculture is mainly practiced by peasant family units (2.9 hectares per family on average) grouped in peasant organizations, most of which are located in poor areas and indigenous communities where women participate to a great extent. According to IFOAM's global survey based on 2013 data, Mexico is the country with the largest number of producers involved in organic production in Latin America and the world (1,689,703). This production is carried out in slightly over half a million hectares of land and slightly over 30

thousand hectares of wildlife areas where medicinal and aromatic plants, as well as various types of fruit are harvested (FIBL–IFOAM, 2016). The main organic crops in Mexico are coffee (50 percent of the total surface), vegetables, avocados, various herbs, cocoa, mango, wild grapes, agave and coconuts. The experience of organic agriculture in Mexico, like in other countries, dissipates the myth that organic production necessarily has lower yields since both cocoa and coffee offer examples of higher yields than conventional production (Schwentesius R. *et al.*, 2014). In 2008, 67 organic crops were identified (*Ibid*). Experts in this area, however, claim that 100 organic crops are currently being produced in Mexico (Gómez, 2016). Organic production in Mexico not only includes organic crops, but also emergent farming and beekeeping.

There is consensus among academics studying this field that the number of producers and areas dedicated to organic production in Mexico would increase if there were a public policy promoting it not only as an additional niche for the export-oriented market, but also as part of a strategy to bolster local food systems with participatory certification mechanisms that strengthen the domestic market.

In our opinion, it is evident that the experience of peasant and indigenous producers and organizations, as well as that of companies dedicated to organic agriculture in Mexico must be incorporated into a national strategy that promotes the exchange of experiences aiming to substitute highly hazardous pesticides in Mexico. However, organic agriculture, as noted by Altieri and Toledo, could simply be an agroexportation strategy. Although it does not use chemical fertilizers or pesticides, it nevertheless maintains a dependence on external inputs without addressing the issue of food sovereignty, referred to below (Altieri and Toledo, 2011).

As set forth in the first part of this chapter, agroecology is not only a scientific discipline or a set of good agricultural practices, but it also seeks to integrate and strengthen a social movement to change the relations of power and exploitation that condition the prevailing industrialized agrifood system. One of the conclusions at the "International Meeting of Peasant Agriculture and Agroecology in America: Social Movements, Knowledge Dialogue and Public Policies," in which 310 people participated from 16 countries and 16 states of the Mexican Republic, organized By ANEC from August 31 to September 2 in Mexico City, was to tighten the link between peasant and indigenous social organizations with scientists, university students and non-governmental organizations in order to change the agrifood model and gradually construct a peasant-indigenous agroecological movement in agreement with the conditions of each country (ANEC, 2015). In search of agroecological alternatives to strengthen a social movement that can step-by-step construct a sustainable food system, there is much to learn from the experience of sibling organizations in Latin America (Altieri and Toledo, 2011; *La Jornada del*

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Campo, No. 97, 2015 and No.111, 2016[72]).

Furthermore, at the "National Forum Value the Peasant Farmer: For an Agrifood Public Policy Developed by the group Valor al Campesino" held in Mexico City on July 18 and 19, 2016, it was proposed that the budget support program for small-scale agriculture contained within the expenditures in the federal budget for 2017 exclude the purchase of inputs that are banned in other countries, or can cause chronic health effects, damage biodiversity, or pollute the environment (pesticides, seeds, hormones, among others). Legislative changes were also proposed in order to apply the precautionary principle and ban input production and commercialization that have the capacity to cause chronic health effects, significantly damage biodiversity or the environment, or are banned in other countries for environmental or public health reasons (pesticides, seeds, chemical additives, etc.) (ANEC, 2016).[73]

One of the characteristics of the agroecological movement in Mexico and Latin America is that it links the modification of agricultural systems to diversify agroecosystems to the recovery of food security and food sovereignty as an organizational response to food dependence on the foreign market caused by neoliberal policies.

Food sovereignty is a set of public and social policies that can be adopted at a community, municipality, regional or national level in order to ensure the production of food necessary for the survival of the population living there. It is a more extensive concept than food security since it is based on the principle that in order to be sovereign the people must enjoy the necessary conditions, resources and support to produce their own food (Stedile and Martins, 2015). According to the definition disseminated by FAO, food security is achieved "... when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2011). This definition, however, does not question whether the food is produced domestically or comes from the foreign market.

The neoliberal version of this concept of food security proposes that it can be achieved through free trade as stipulated in the free trade agreements. These

72 See the content of this issue at: http://www.jornada.unam.mx/2016/12/17/delcampo.html

73 ANEC. *Foro Nacional Valor al Campesino: por una política pública agroalimentaria construida por las y los campesinos,* (internal document) Mexico City, July 18-19, 2016. This forum gathered 100 people from different states of the Mexican Republic. The Valor al Campesino Initiative was created in 2015 by the following civil society and peasant organizations: Asociación Nacional de Empresas Comercializadoras de Productores del Campo (ANEC), Ashoka, El Poder del Consumidor, Fundar, Centro de Análisis e Investigación, Fundación Semillas de Vida, Subsidios del Campo, and Nuup. It seeks to join efforts, from a variety of different approaches, in order to improve the living conditions of peasants and promote a healthy environment and healthy food for the whole of the Mexican society (ANEC, 2016).

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agreements emphasize the fact that hunger is an issue resulting from a lack of productivity that can be solved through deepening the productive specialization strategies that started with the "Green Revolution." Conversely, the concept of food sovereignty that emerged as a response to the neoliberal version of food security was proposed by Vía Campesina in 1996, and has been evolving ever since. During the International Forum for Food Sovereignty held in Mali in 2007, in the Declaration of Nyéléni, as we pointed out towards the end of the first part of this chapter, the organizations that form part of Vía Campesina stated that food sovereignty is "the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agricultural system..." (Vía Campesina, 2015). Food sovereignty is based on an earlier principle that food must not be considered a commodity, but rather a human right. This principle sets forth that food production and distribution is a question of survival, and both popular and national sovereignty (Stedile and Martins 2015:41).

As noted in the most recent report by Hilal Elver, the UN Special Rapporteur on the Right to Food, "the assertion promoted by the agrochemical industry that pesticides are necessary to achieve food security is not only inaccurate, but dangerously misleading. In principle, there is adequate food to feed the world; inequitable production and distribution systems present major blockages that prevent those in need from accessing it" (UN A/HRC/34/48, 2017: point 91). In the conclusions, she stated, "Today's dominant agricultural model is highly problematic, not only because of damage inflicted by pesticides, but also their effects on climate change, loss of biodiversity and inability to ensure food sovereignty. These issues are intimately interlinked and must be addressed together to ensure that the right to food is achieved to its full potencial" (*Op. cit.* Conclusions: point 105).

In the current situation, with Donald Trump taking office as US President and his decision to renegotiate NAFTA with Canada and Mexico, it is important for Mexico to assess the effects of over twenty years of neoliberal policies regarding Mexican agriculture. This balance should consider the consequences of the greater food dependence it has produced, as well as the social, health and environmental impact of highly hazardous pesticides like those currently authorized in Mexico, which violate a series of human rights. Within this context, it is necessary to promote the search for alternatives to the existing neoliberal policies, which could enable better conditions of equity, justice and sustainability in order to achieve food security and food sovereignty.

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Conclusions

The term *highly hazardous pesticides* emerged as an international regulatory category within the context of SAICM and the FAO/WHO Code of Conduct with the limitations inherent to these kinds of *soft law* international agreements that are voluntary frameworks of reference without any sanction mechanisms in case of non-compliance. Two contradictory interests are confronted in the political and technical discussion of the criteria to define highly hazardous pesticides and the recommendations governments must follow. On the one hand, there are interests that seek to ban highly hazardous pesticides based on their intrinsic hazardness due to the fact that they can have irreversible health and environmental effects, particularly under the circumstances of use prevailing in Latin America, Asia and Africa. On the other, there exist interests that seek to obtain maximum profits from pesticides, preferring risk assessment in order to obtain acceptance rather than prevention of exposure to these harmful chemicals. These two contradictory interests are expressed in SAICM's policy recommendations and the FAO/WHO Guidelines on Highly Hazardous Pesticides.

The globalization of the technological paradigm of intensive industrial agriculture dependent on external inputs, and the dynamics characterizing capital concentration and centralization have led to the creation of an oligopolistic world market of strategic inputs from the neoliberal food regime. This concentration and the oligopolistic control of the market is significant in the case of pesticides and seeds, where a few European and US transnational companies dominate, together with Chinese state-owned capital that has recently acquired Syngenta. The emergence of new global competitors in what are called generic pesticides (i.e., pesticides with an expired patent) should also be noted, particularly with the expansion of companies with capital of Chinese, Indian and Israeli origin.

We can state, without being afraid of exaggerating that there is a global offensive of transnational corporations seeking to stop attempts at establishing international, regional or national regulations to restrict or ban the use of pesticides that generate profits for them. We have documented this in the case of the herbicide glyphosate, linked to the expansion of genetically modified crops tolerant to this herbicide; or the pressure of transnational corporations in Europe to influence the criteria to define hormone disruption in order to regulate certain pesticides and other chemicals. We have noted that international scientific societies, together with non-governmental organizations, have set forth the need for an in-depth review of the regulation paradigm based on the assumption that "the dose makes the poison" in the case of pesticides and other hormone-disrupting chemicals. In this context, once again what stands out is the need to count on groups and institutions that ensure the critical independence of environmental

health and social sciences with regard to deregulation and being co-opted by regulatory bodies that favor corporate interests.

The numerous active ingredients in the highly hazardous pesticides authorized in Mexico that may cause cancer in humans, hormone disruption or serious environmental repercussions, such as the death of bees and other pollinators, among other effects represents a threat to public health and to the ecosystems, thus demanding urgent attention from the competent authorities. It is imperative to prevent damage to people and ecosystems before it actually occurs. In the face of scientific evidence of the hazardous effects of pesticides included in the PAN International list, it is advisable to modify the existing legislation in order to apply the precautionary principle and incorporate hazard cut-off criteria that make it possible to cancel and not authorize sanitary registrations, and thus obtain the greatest level of protection to the human right to health and to a healthy environment.

The recommendations that the authors of the different chapters consensually agreed are presented at the end of this book. They are addressed to the competent authorities at a federal and state level and can enrich the contributions made by social organizations and other civil society groups in specific territories of the states of the Mexican Republic. The pesticide regulatory framework in Mexico should be redesigned in order to be able to effectively comply with the constitutional obligation to protect human rights, emanating from the reforms to the Mexican Constitution made in 2011, and following the general recommendations made by the UN Special Rapporteurs on human rights, toxics and waste, and on the right to food. Given their relevance, we have included the recommendations made by the Special Rapporteur on the right to food in her analysis of pesticides in Annex III. Attention should also be paid to the recommendations issued by the UN Committee on the Rights of the Child on June 5, 2015 for the Mexican State to ban the importation and use of any pesticides whose use has been banned or restricted in the exporting country.

A change in public policy is essential in order to formulate a transition strategy that could lead to a *National Plan for the Reduction and Progressive Ban on Highly Hazardous Pesticides and Support for Agroecological Alternatives.* This plan could help reach SAICM's 2020 goal of significantly reducing the adverse effects on health and the environment through sound management of chemicals, including pesticides. This demands the authorities' political willingness and the construction of a social force to promote the achievement of this goal, but it also demands a different vision of development that is compatible with the full respect for human rights under conditions of equity and justice.

Since the idea of establishing a global alliance for the progressive ban on highly hazardous pesticides did not achieve international consensus within SAICM

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because it was blocked by some governments and transnational corporations, it is therefore necessary to construct an alliance from the grassroots up, nationally, in order to trigger change at local, state and federal levels. It is up to civil society to organize and defend its rights, including the rights of men and women agricultural workers, rural, urban and consumer communities, supported by a critical scientific community that is free of ties to large-scale economic interests. Agroecology as a critical science, an agricultural practice, and a social movement is gaining increasing strength in Mexico and the world. Fortunately, there exist agroecological alternatives for the control of pests, unwanted plants and diseases that are already being practiced by peasant and indigenous organizations, as well as an expanding sector of organic agriculture. However, in order to increase the impact of these alternatives, it is necessary to change the neoliberal agricultural policies and develop a government program that supports agroecology and organic production, particularly aimed to address the domestic market, ensure the right to adequate and sufficient food without agrotoxics or genetically modified organisms. These changes will make it possible for Mexico to recover its food sovereignty.

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Chapter 2

Basic Reflections on Human Rights and Pesticides

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This document presents an initial approach to the subject of human rights in relation to pesticides, based on the consideration that recognized human rights must take into account their effective enjoyment and people's real living conditions. The authors present a brief analysis of some Economic, Social, Cultural and Environmental Rights (ESCER) related to pesticide use, within the framework of international human rights instruments, general observations by relevant international committees, as well as Special Rapporteur reports.

Our point of departure for the purposes of this text is the definition of human rights proposed by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as "a condition of living, without which, in any given historical stage of a society, men cannot give the best of themselves as active members of the community because they are deprived of the means to fulfill themselves as human beings" (Centro Vitoria, 2009: 31). Although there are many definitions, we believe that it is necessary to return to the experience-based foundations of these rights and to keep in mind their link with social struggles waged by men and women throughout history. The importance of this approach is that it prevents easy departures from the discourse on rights, which like any other discourse can be stripped of content.

In this way, the human rights we refer to in this section are those that it does not suffice to invoke, but rather must be nurtured on a daily basis with social demands, without being confined to mere acknowledgement in regulatory texts. Likewise, these rights must be compared with the way in which people experience

1 Colectivo de Abogados y Defensores del Interés Público (Collective of Lawyers and Advocates for the Public Good).

2 Person in charge of Greenpeace Mexico's legal department.

them, their effective enjoyment, as well as their enforceability and justiciability[3] (Sandoval Terán, 2007: 118).

Pesticide use is directly related to the enjoyment and exercise of the rights to health, food, and the environment, among others. Therefore, we will refer to Economic, Social, Cultural and Environmental Rights as ESCER, first making reference to the principle of non-discrimination that traditionally is found in the first articles of most international instruments,[4] and permeates all rights.

This principle is so important that if it is infringed, the rest of the provision scaffolding will crumble. Daniel O'Donnell, a scholar specializing in treaties, commenting on the first and second articles of the 1948 Universal Declaration of Human Rights,[5] noted that: "The relationship between the two articles suggests that

3 "We can thus speak of two major types of enforceability: political and judicial. Political enforceability would include political and social processes, and more concretely refers to all those actions that promote the improvement of conditions for realization of ESCER or the resolution of a situation that violates them through advocacy initiatives on public policy and government programs, lobbying for bills and reforms to existing laws, demands for budget increases or reallocations for social issues, public denunciation of abuses through press releases, radio programs, demonstrations, alternative reports to those presented by governments to both national and international non-jurisdictional instances –such as public human rights commissions, the UN CESCR, and the Inter-American Commission. Enforceability as a legal process (or judicial enforceability) is known as justiciability, which implies the defense of violated rights in courts and other jurisdictional instances." Sandoval Terán, Areli, *Comprendiendo los derechos económicos, sociales, culturales y ambientales (DESCA)*, DECA Equipo Pueblo, A.C.

4 For example, from the American Convention on Human Rights (Pact of San José, ACHR): "Article 1. Obligation to Respect Rights, 1. The States Parties to this Convention undertake to respect the rights and freedoms recognized herein and to ensure to all persons subject to their jurisdiction the free and full exercise of those rights and freedoms, *without any discrimination for reasons of* race, color, sex, language, religion, political or other opinion, national or social origin, economic status, birth, or any other social condition. 2. For the purposes of this Convention, 'person' means every human being." From the International Covenant on Economic, Social and Cultural Rights (ICESCR): "Article 2, 1. Each State Party to the present Covenant undertakes to take steps, individually and through international assistance and co-operation, especially economic and technical, to the maximum of its available resources, with a view to achieving progressively the full realization of the rights recognized in the present Covenant by all appropriate means, including particularly the adoption of legislative measures. 2. The States Parties to the present Covenant *undertake to guarantee that the rights enunciated in the present Covenant will be exercised without discrimination of any kind as to* race, colour, sex, language, religion, political or other opinion, national or social origin, property, birth or other status" (emphasis added).

5 "Article 1. All human beings are born free and equal in dignity and rights. They are endowed with reason and conscience and should act towards one another in a spirit of brotherhood." "Article 2. Everyone is entitled to all the rights and freedoms set forth in this Declaration, without distinction of any kind, such as race, colour, sex, language, religion, political or other opinion, national or social origin, property, birth or other status. Furthermore, no distinction shall be made on the basis of the political, jurisdictional or international status of the country or territory to which a person belongs, whether we are speaking of an independent country or of a territory under trusteeship, a non-autonomous territory or a territory subject to any other limitation of sovereignty."

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the idea that the law should not establish or allow distinctions between the people's rights based on the aforementioned characteristics is a consequence of the idea acknowledged in Article 1, that all people are equal" (O'Donnell, 2012:942). The right to not be discriminated against is secondary, "that is, whenever its violation is alleged, the violation of another fundamental right must be evidenced" (COPRED and Centro Vitoria, nd:31).

Because of the inequalities existing in Mexico, as well as the current reflection about the responsibility of private parties, especially business enterprises, in the violation of human rights, we consider it crucial to keep in mind this principle of non-discrimination as a means to demand the enforcement of rights from the perspective of doctrine and jurisprudence, but perhaps more importantly from the trenches of litigation, denunciation and social mobilization.

The ESCER are: "those human rights that enable people to enjoy an adequate standard of living, both individually and collectively" (Sandoval Terán, 2007: 9). In order to identify them, it is useful to "[identify] the basic and necessary elements to have a dignified life, food, health, housing, education, a healthy environment, a decent job and working conditions, and water" (Nerio Monroy, A. L., Gay Arellano, A. and Almaraz Reyes, S., 2011:7). It should be noted that these basic elements also help us to recognize when ESCER have been violated.

In relation to pesticide use, the rights that can be compromised include: the right to health, food, water, a healthy environment, information, the rights of indigenous peoples and communities, as well as children's rights. Clearly, all these rights share one point in common: they are pillars for the enjoyment of other rights.

The Right to Health. The Constitution of the World Health Organization (C-WHO) expressly recognizes the right to health as a fundamental right that should be enjoyed without distinction, defining health as: "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." Not being restricted by the negative aspect formulated as 'absence of...' opens the door to a structural dimension. In fact, the C-WHO itself recognizes that: "The health of all peoples is fundamental to the attainment of peace and security and is dependent upon the fullest co-operation of individuals and States."

The Committee on Economic, Social and Cultural Rights (CESCR) in General Comment No. 14, on the content of article 12 of the ICESCR[6] specifies

6 General Comment No. 14 (2000). The right to the enjoyment of the highest attainable standard of health. "Article 12 ICESCR: 1. The States Parties to the present Covenant recognize the right of everyone to the enjoyment of the highest attainable standard of physical and mental health.
2. The steps to be taken by the States Parties to the present Covenant to achieve the full realization of this right shall include those necessary for:
a) The provision for the reduction of the stillbirth-rate and of infant mortality and for the healthy development of the child; b) The improvement of all aspects of environmental and industrial hygiene;

that the highest possible standard of health is conducive to "living a life in dignity" (paragraph 1) and warns that this right "embraces a wide range of socio-economic factors that promote conditions in which people can lead a healthy life" (paragraph 4), including a healthy environment.

The Right to Food. In General Comment No. 12, The right to adequate food, the CESCR points out that this right is realized: "when every man, woman and child, alone or in community with others, have physical and economic access at all times to adequate food or means for its procurement" (paragraph 6). It is particularly important that the basic content of this right is constituted by "the availability of food in a quantity and quality sufficient to satisfy the dietary needs of individuals," clarifying that this must be, among other characteristics, "*free from adverse substances*" and that the "accessibility of such food [be] in ways that are sustainable and that do not interfere with the enjoyment of other human rights" (paragraph 8, authors' emphasis).

The Committee explains that the phrase "free from adverse substances" refers to: "the requirements for food safety and for a range of protective measures by both public and private means to prevent contamination of foodstuffs through adulteration and/or through bad environmental hygiene or inappropriate handling at different stages throughout the food chain" (paragraph 10).

The Right to Water. Water is a resource that is limited and indispensable for life. Addressed as a human right, it is considered implicit[7] in articles 11 and 12 of the International Covenant of Economic, Social and Cultural Rights (ICESCR), concerning the rights to an adequate standard of living and to health, respectively.[8]

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c) The prevention, treatment and control of epidemic, endemic, occupational and other diseases; d) The creation of conditions which would assure to all medical service and medical attention in the event of sickness."

7 See *Comprendiendo los derechos económicos, sociales, culturales y ambientales (DESCA)*, DECA Equipo Pueblo, A.C.; p. 71, and paragraph 3 of General Comment No. 15: The Right to Water (Articles 11 and 12 of the International Covenant on Economic, Social and Cultural Rights).

8 This right is explicitly recognized in the Mexican Constitution, specifically in Article 4. In order to provide clarity, the referred to articles of the Covenant are reproduced here: "Article 11; 1. The States Parties to the present Covenant recognize the right of everyone to an adequate standard of living for himself and his family, including adequate food, clothing and housing, and to the continuous improvement of living conditions. The States Parties will take appropriate steps to ensure the realization of this right, recognizing to this effect the essential importance of international co-operation based on free consent. 2. The States Parties to the present Covenant, recognizing the fundamental right of everyone to be free from hunger, shall take, individually and through international co-operation, the measures, including specific programmes, which are needed: a) To improve methods of production, conservation and distribution of food by making full use of technical and scientific knowledge, by disseminating knowledge of the principles of nutrition and by developing or reforming agrarian systems in such a way as to achieve the most efficient development and utilization of natural resources; b) Taking into account the problems of both food-importing and food-exporting countries, to ensure an equitable distribution of world food supplies in relation to needs."

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In accordance with General Comment No. 15, The Right to Water (ICESCR Articles 11 and 12) of the CESCR, this right entitles "everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses" (paragraph 2).

The same General Comment includes "environmental hygiene" as one of the aspects of this right that "encompasses taking steps on a non-discriminatory basis to prevent threats to health from unsafe and toxic water conditions" (paragraph 8).

The right to water includes the protection of people against interference, concomitant with the provision that this resource not be contaminated (paragraph 10). Quality is a constant factor for realizing the right to water, i.e., "The water required for each personal or domestic use *must be safe, therefore free from* microorganisms, *chemical substances* or radiological hazards that constitute a threat to a person's health. Furthermore, *water should be of an acceptable colour, odour and taste for each personal or domestic use.*" (Section "b" of paragraph 12, emphasis added).

The Right to a Healthy Environment. This interesting right alludes to a greater framework in which all the other rights develop, which "in addition to the natural biophysical scope refers to the relationship established between humans and nature" (Nerio Monroy, A. L., Gay Arellano, A. and S. Almaraz Reyes, 2011:113). This right implies, "freedom, equality and the enjoyment of adequate living conditions in an environment that allows [people] to live a life of dignity and to enjoy wellbeing" and, correlatively, "the responsibility to protect and improve the environment for current and future generations" (Centro Vitoria, 2010:50). It is recognized as a right in the Additional Protocol to the American Convention on Human Rights known as the Protocol of San Salvador, which in paragraph 1 of Article 11 stipulates that, "Everyone shall have the right to live in a healthy environment and to have access to basic public services" (Nerio Monroy, A. L., Gay Arellano, A. and S. Almaraz Reyes, 2011:114).

We close this section on the right to a healthy environment referring to the precautionary principle, which is recognized in different instruments. However, we

"Article 12; 1. The States Parties to the present Covenant recognize the right of everyone to the enjoyment of the highest attainable standard of physical and mental health. 2. The steps to be taken by the States Parties to the present Covenant to achieve the full realization of this right shall include those necessary for:

a) The provision for the reduction of the stillbirth-rate and of infant mortality and for the healthy development of the child; b) The improvement of all aspects of environmental and industrial hygiene; c) The prevention, treatment and control of epidemic, endemic, occupational and other diseases; d) The creation of conditions which would assure to all medical service and medical attention in the event of sickness."

will only focus on the Rio Declaration on Environment and Development. Principle 15 of the Rio Declaration literally states, "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation." The precautionary principle must accompany the actions that are carried out or raised in favor of the enjoyment of the right to a healthy environment. Otherwise, there is a risk that the latter will become a merely empty statement.

We must also bear in mind "the right's core or essential content," regarding which a thesis of Mexican jurisprudence states that, "In this regard, to determine the minimum elements needed to demand enforcement of a fundamental right, it is necessary to identify what is referred to as the 'core or essential content of fundamental rights,' that is, that part of the content of the right which is absolutely necessary to ensure that legally-protected interests that give it life are real, concrete and effectively protected." The text ends as follows, "From this it is concluded that the authorities do not recognize the protection of a fundamental right when, for some reason, its essential content is subject to limitations that prevent its exercise, it is impeded more than is reasonable, or it is stripped of necessary protection."[9]

Although the principle and the core are not identical, they are so closely related that in order to ensure the protection of the basic core of the right to a healthy environment, in many cases it will also need to be scrutinized in the light of the precautionary principle.

The Right to Information. This right issues from freedom of expression and the right to participate in public affairs,[10] "it includes the freedom to seek, receive and impart information and ideas of all kinds, regardless of frontiers, either orally, in writing or in print, in the form of art, or through any other media of his choice" (Article 13, paragraph 1 of the American Convention on Human Rights),[11] and

9 Thesis: 2a. XCII/2016 (10a.), DERECHOS ECONÓMICOS, SOCIALES Y CULTURALES: SU NÚCLEO O CONTENIDO ESENCIAL. (Segunda Sala), *Gaceta del Semanario Judicial de la Federación*, book 34, volume I, September 2016, p. 842.

10 "The right to information is a right in and of itself, and one of those which give support to free and democratic societies (see E/CN.4/2000/63, para. 42). The right to information is derived from the right to freedom of expression and the right to participate in public affairs, stipulated in articles 19 and 25, respectively, of the International Covenant on Civil and Political Rights." Report of the Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes, Baskut Tuncak, United Nations Human Rights Council A/HRC/30/40, July 8, 2015, p. 7.

11 For purposes of reference, we reproduce section two of Article 19 in the International Covenant on Civil and Political Rights (ICCPR) which stipulates that: "Everyone shall have the right to freedom of expression; this right shall include freedom to seek, receive and impart information and ideas of all kinds, regardless of frontiers, either orally, in writing or in print, in the form of art, or through any other

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it impacts private parties, as is noted in the Dubai Declaration on International Chemicals Management, "We stress the responsibility of industry to make available to stakeholders such data and information on health and environmental effects of chemicals as are needed to safely use chemicals and the products made from them" (United Nations Environment Program, 2007:9).

This right to information, without being an ESCER, is directly related to their effective enjoyment. In the particular case of pesticides, we consider that the Mexican State must pay more attention to the protection of the right to information and publicize the effects these chemicals have on health and the environment, including their application, as well as distribution and commercialization. Regarding the right to information, we return to the statement by Special Rapporteur Baskut Tuncak about the implications of environmentally management and disposal of substances and hazardous wastes on human rights. In his 2015 report, he warned that while it is essential to have information for the prevention of human rights violations related to exposure to hazardous substances and waste, "this crucial information ... is often non-existent or inaccessible" (Report of the Special Rapporteur on the implications for human rights of environmentally sound management and disposal of hazardous substances and waste, 2015:3).

In addition, having information about hazardous substances like pesticides has practical consequences directly related to other basic issues such as: health, food safety, the environment, and citizen participation, among others. In this regard, the Special Rapporteur continues to say, "Information is critical to the enjoyment of human rights and fundamental to good governance. *Information about hazardous substances is essential to prevent risks, mitigate harms, conduct focused research on safer alternatives, provide treatment and remedy* and ensure transparency, participation and consent in decision- and policymaking" (*Ibid.* p. 4, emphasis added).

According to the Special Rapporteur in the aforementioned report, "States are the primary duty-bearers to respect, protect and fulfill human rights, and *are bound to take all the steps necessary to ensure the right to information with respect to the adverse impacts of hazardous substances and wastes. States must ensure that related information is available, accessible and functional for everyone*" (*Ibid.* p. 13, emphasis added). In addition, this right is linked with the obligation of States to investigate the effects of hazardous substances on human rights (*Ibid.* p. 14).

Upon addressing the issue of pesticides, the rights of specific groups, such as indigenous peoples and communities, men and women workers, women and children must also be considered. In this text, we will only address the last group, since, "Children are particularly at risk of serious and irreversible effects

media of his choice."

from exposure to a myriad of hazardous substances in their homes, schools and playgrounds. *Children are often exposed to higher levels of hazardous substances than adults and this exposure comes during critical periods of development,* when children are at greatest risk of adverse impacts from carcinogens, hormone disrupting chemicals, mutagens, reproductive toxicants and other hazardous substances" (*Ibid.* p. 9, emphasis added).

The Rights of the Child. The statement quoted above resonates with other instruments and documents dealing with children, such as the Convention on the Rights of the Child, the preamble of which notes that it is based on bearing "in mind that ... 'the child, by reason of his physical and mental immaturity, needs special safeguards and care ...'". That is to say, it acknowledges that children are a group requiring enhanced protection.

General Comment No. 16 regarding the obligations of the States in relation to the impact the business sector has on the rights of the child as noted by the Committee on the Rights of the Child, in its introductory paragraph includes a warning about the importance that there exist legal and institutional frameworks appropriate for effective enjoyment of the rights of the child, since it should be taken into account that the violations to these rights during that age period can be grave: "*exposure ... to unsafe products or environmental hazards* may have *lifelong, irreversible and even transgenerational* consequences" (Part "a" of paragraph 4, emphasis added).

The principle known as the best interests of children must also be referred to. It is represented in Mexican jurisprudence with a definition that is in keeping with that of human rights on which this paper is based, namely: "The best interest of the child is understood as the catalogue of values, principles, interpretations, actions and processes aimed at forging comprehensive human development and a decent life, *as well as to generate the material conditions that allow children to live fully and achieve the greatest personal, family and social wellbeing possible, the protection of which should be promoted and ensured by the State* in the exercise of its legislative, executive, and judicial functions, since it is a matter of public order and social interest"[12] (emphasis added). Although the State, through its institutions, plays a predominant role regarding the best interests of boys and girls, it is not the only stakeholder involved. General Comment No. 16 of the Committee on the Rights of the Child stipulates that, "States *are obliged to integrate and apply this principle* [the best interests of the child] in all legislative, administrative and judicial proceedings *concerning business activities and operations that directly or indirectly impact on children*" (paragraph 15, emphasis added).

12 Jurisprudence: I.5o.C. J/16, INTERÉS SUPERIOR DEL MENOR. SU CONCEPTO. (Tribunales Colegiados de Circuito). Semanario Judicial de la Federación y su Gaceta, Volume XXXIII, March, 2011, p. 2188.

The rights to health and to a healthy environment are protected in the case of children and for their full enjoyment must be translated into concrete actions by the authorities. In this regard, in General Comment No. 15 on the right of the child to the enjoyment of the highest attainable standard of health (Article 24 of the Convention on the Rights of the Child),[13] the Committee on the Rights of the Child in addressing environmental pollution establishes that, "States *should take measures to address the dangers and risks that local environmental pollution poses to children's health in all settings*" (paragraph 49, emphasis added). That same General Comment includes a statement on State responsibility regarding private parties who may affect the environment, "States *should regulate and monitor the environmental impact of business activities that may compromise children's right to health* ... and access to safe drinking water and to sanitation" (paragraph 49 *in fine*, emphasis added). In General Comment No. 16, the Committee stipulates that the effective enjoyment of the right contained in Article 6 of the Convention on the Rights of the Child,[14] which refers to children's right to life, survival and development, which may be compromised, for example, due to "*environmental degradation and contamination arising from business activities* [that] can compromise children's rights to health, food security and access to safe drinking water and sanitation" (paragraph 19, emphasis added). General Comment No. 16 points out that in order to ensure that companies respect the rights of the child, States have the obligation to: "require businesses to undertake child-rights due diligence"[15] (paragraph 62). And in a

13 Article 24 1. States Parties recognize the right of the child to the enjoyment of the highest attainable standard of health and to facilities for the treatment of illness and rehabilitation of health. States Parties shall strive to ensure that no child is deprived of his or her right of access to such health care services. 2. States parties shall pursue full implementation of this right and, in particular, shall take appropriate measures: a) To diminish infant and child mortality; b) To ensure the provision of necessary medical assistance and health care to all children with emphasis on the development of primary health care; c) To combat disease and malnutrition, including within the framework of primary health care, through, inter alia, the application of readily available technology and through the provision of adequate nutritious foods and clean drinking-water, taking into consideration the dangers and risks of environmental pollution; d) To ensure appropriate pre-natal and post-natal health care for mothers; e) To ensure that all segments of society, in particular parents and children, are informed, have access to education and are supported in the use of basic knowledge of child health and nutrition, the advantages of breastfeeding, hygiene and environmental sanitation and the prevention of accidents; f) To develop preventive health care, guidance for parents and family planning education and services. 3) States Parties shall take all effective and appropriate measures with a view to abolishing traditional practices prejudicial to the health of children. 4. States Parties undertake to promote and encourage international co-operation with a view to achieving progressively the full realization of the right recognized in the present article. In this regard, particular account shall be taken of the needs of developing countries.

14 Article 6 1. States Parties recognize that every child has the inherent right to life. 2. States Parties shall ensure to the maximum extent possible the survival and development of the child.

15 By due diligence we mean: "'such a measure of prudence, activity, or assiduity, as is properly to be expected from, and ordinarily exercised by, a reasonable and prudent [person] under the particular circumstances; not measured by any absolute standard, but depending on the relative facts of the special

given case, "Where there is a high risk of business enterprises being involved in violations of children's rights because of the nature of their operations or their operating contexts, *States should require a stricter process of due diligence and an effective monitoring system*" (paragraph 62, emphasis added). This is important because it should be kept in mind that pesticides are hazardous substances.

Lastly, the ESCER are rights that the State has the obligation to promote, respect, protect and ensure and must take into account people's effective living conditions. They are directly related to the social demands raised for all people to enjoy an adequate standard of living, so they must therefore be enforceable. They imply a significant commitment and solidarity with humankind. However, industry's responsibility within the framework of respect for human rights must be kept in mind. We therefore coincide with what Special Rapporteur Baskut Tuncak notes that, "businesses have a responsibility to respect, at the very least, all internationally recognized human rights" (Report of the Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes 2015:19, emphasis added).

Health, water, and the environment are basic resources or needs that the authorities must consider as rights and thus as enforceable and justiciable. Correlatively, States should safeguard that rights be ensured and respected, both by public authorities, and by hindering and preventing the private sector, in particular companies, from trampling rights or becoming an obstacle to the enjoyment of these rights. In that regard, we conclude the following: it is urgent for human rights movements to strengthen bonds with environmental struggles, since they share goals in common in striving for decent living conditions for all people in harmony and with respect for our environment. In the case of pesticide use, human rights considerations must be included both in civil society's demands, as well as in State actions, which should be ruled by these considerations.

Finally, embracing what is expressed in Resolution A/HRC/RES/25/21 approved by the UN Council of Human Rights that states, "5. [The Council] *reaffirms the duty of States to protect against human rights abuse within their territory and/or jurisdiction by third parties, including business enterprises,* as provided for in the Guiding Principles on Business and Human Rights; 6. *Also reaffirms the importance of non-discrimination in the application of environmental laws, but also of paying due attention to the members of groups particularly vulnerable* to environmental harm, bearing in mind that environmental damage is felt most acutely by those segments of the

case.' In the context of the Guiding Principles, human rights due diligence comprises an ongoing management process that a reasonable and prudent enterprise needs to undertake, in the light of its circumstances (including sector, operating context, size and similar factors) to meet its responsibility to respect human rights." The Corporate Responsibility to Respect Human Rights, An Interpretive Guide; United Nations Office of the High Commissioner for Human Rights; p. 7.

population already in vulnerable situations; ... 8. *Urges States to comply with their human rights obligations* when developing and implementing their environmental policies; 9. Recognizes the important role played by individuals, groups and organs of society, *including human rights defenders, in the promotion and protection of human rights as they relate to the enjoyment of a safe, clean, healthy and sustainable environment*" (emphasis added).

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Recommended Reading

International Instruments

Rio Declaration on Environment and Development, available at: http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm

Universal Declaration on Human Rights, available at: http://www.un.org/en/universal-declaration-human-rights/

Constitution of the World Health Organization, available at: http://apps.who.int/gb/bd/PDF/bd47/EN/constitution-en.pdf?ua=1

American Convention on Human Rights (Pact of San José, ACHR), available at: http://www.oas.org/dil/treaties_B-32_American_Convention_on_Human_Rights.pdf

Convention on the Rights of the Child, available at: http://www.ohchr.org/EN/ProfessionalInterest/Pages/CRC.aspx

International Covenant on Civil and Political Rights (ICCPR), available at: http://www.ohchr.org/EN/ProfessionalInterest/Pages/CCPR.aspx

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From the United Nations Human Rights Council

Resolution: A/HRC/RES/25/21 dated April 15, 2014, corresponding to the 25th Period of Sessions, *25/21 Human Rights and the Environment,* available at: https://documents-dds-ny.un.org/doc/UNDOC/GEN/G14/136/17/PDF/G1413617.pdf?OpenElement

Chapter 3

Bees and Insecticides

Rémy Vandame[1]

1. Introduction

Beekeepers in southeastern Mexico and other parts of the world have become spokespersons for the environmental crisis due to the effects that insecticides and genetically modified crops are having on their production. The mobilization of beekeepers led to the cancellation in December 2017 of the permit to grow genetically modified soybean in Campeche and Yucatan, as well as the suspension in December 2013 of the use of the three main neonicotinoid insecticides in the European Union.

To understand the scope of the problem, the ecology of bees will be described, particularly *Apis mellifera*, the honey producer that allows Mexico to be the world's third exporter of honey. Honeybees are social insects that live in colonies of up to 50,000 individuals. The worker bees leave the hive to visit flowers in search of nectar and pollen as sources of sugars and proteins. When enough of these resources are close by, the bees remain near the hives, a few hundred meters away, but when flowers are scarce, they may fly far away, commonly 3 or 4 miles, covering several thousand hectares.

This distinctive characteristic makes beekeepers the only producers whose animals cover such a large territory, without having control over what takes place in that territory. This situation has positive implications for consumers, as bee foraging leads to a production of different types of honey, dependent on the environment, ranging from the butter honey of the highlands of Mexico to mangrove honey on the coasts and coffee honey from the mountains. This territorial range also allows bees to pollinate wild plants, thus maintaining their biodiversity, as well as cultivated plants, hence contributing greatly to agricultural productivity.

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However, this vast range of foraging places the bees and beekeepers in a vulnerable situation, as bees are exposed to human practices, such as agrochemicals and genetically modified crops, by visiting such extensive areas.

Since the 1980s, beehives have been experiencing increasing weakening or mortality both in the United States and Europe. It was recently reported that in some countries up to 40 percent of the beehives die annually. Although several factors are involved, one of the most important ones is no doubt the bees' exposure to chemicals used in agriculture, particularly insecticides.

The following pages analyze information related to bee mortality globally and in Latin America. Less intensive agriculture, particularly with lower levels of pesticide use, may explain the lower mortality of bees on the sub-continent. The possible toxic effects of insecticides on bees will also be reviewed, as well as actions that are being carried out to face this situation.

2. Bee Mortality

The recent years have been marked by a considerable increase in bee mortality (*Apis mellifera*) in Europe (Neumann & Carreck, 2010) and the United States (van Engelsdorp *et al.*, 2008, 2009). The mortality of colonies characterized by rapid loss of adult bees has been called "Colony Collapse Disorder" (CCD) (van Engelsdorp *et al.*, 2009). There is scarce information available about this phenomenon in other regions, such as Latin America. Even Argentina and Mexico, in spite of their great beekeeping tradition, their ranking among the greatest honey producers in the world (2nd and 6th place, respectively) and their being honey exporters (1st and 3rd place; FAOSTAT, 2009) have limited information. It would thus be interesting to focus on Latin America in order to determine whether these phenomena have been reported.

Bee health assessment in Latin America is a difficult task for two reasons. Firstly, this is a large and very diverse region in which beekeeping is practiced, spanning a broad range of climates (from tropical to temperate zones) and altitudes (from sea level to around 2000 meters) by beekeepers with very diverse production capacities (in Mesoamerica there are beekeepers who manage 15 colonies, whereas in northern Mexico or the Pampa region of Argentina others manage up to 15,000 colonies). Secondly, there is scarce information on bee health in the region.

No studies exist in the literature where massive mortality has been reported between Mexico and Argentina, as opposed to the case of the United States (USA) and the European Union (EU), where data reveal between 30 to 50 percent bee mortality in colonies, annually. Similar situations have also been observed in Africa, southern Asia and Australia (Neumann and Carreck, 2010). However, a lack of data should not imply that the problem does not exist in Latin America.

What might be happening is that producers might not be keeping records of these events, or do not report them to official authorities. The cases listed below demonstrate this situation.

Beekeepers from southeast Guatemala have reported frequent and considerable losses during the months of February to April (the flowering period). They attribute responsibility for this to the international program for the control of the Mediterranean fruit fly (*Ceratitis capitata*), for which the insecticide spinosad is commonly used on a large scale. Edwards *et al.* (2003) demonstrated this compound's toxicity for bees under laboratory conditions, although Mangan and Moreno (2009) demonstrated that bees are repelled by the attractant components of this insecticide. However, field observations indicate that apiaries are regularly sprayed with this insecticide, therefore causing the death of the bees due to its toxic effects (Vandame *et al.*, 1995).

In the northern state of Chihuahua, Mexico, bee losses are common (Arnulfo Ordóñez, personal communication) and remain unexplained. However, bee losses are limited locally.

In the municipality of Hopelchén, Campeche state, between 2012 and 2013, two thousand bee colonies died in Suc-Tuc, Oxa and San Luis, among other communal lands ("ejidos"). The beekeepers claimed that the bees died because of aerial insecticide spraying in neighboring ranches where corn is grown on a large scale. This event did not draw the attention of the corresponding authorities, so it was never proven that the bees' death had been due to this activity. Thus, the beekeepers had to negotiate directly with those who were responsible in order to receive compensation.

In Brazil, several similar events have also taken place. In the last 40 years, cases of bee mortality were initially attributed to a type of local sacbrood virus, but are now attributed to the toxicity of the pollen from the native trees of El Cerrado (savannah type biome) (de Carvalho and Messaje, 2004; de Souza *et al.*, 2006). In addition, the expansion of crops for agrofuel has intensified pesticide use. Beekeepers have attributed the losses they are experiencing to the use of these chemicals, especially neonicotinoids, although scientific evidence of this fact is still undocumented.

These cases, which are probably much more common than what may be found in published reports, do not always have a clear cause and seem to be geographically related to intensive agriculture.

3. Factors Explaining Bee Decline

In recent years, important elements of the debate on bee declines were generated by an international initiative that Mexico participates in, the Intergovernmental

Platform on Biodiversity and Ecosystemic Services (IPBES), under the United Nations (UN). IPBES conducted a thematic assessment of pollinators, pollination and food production, drafted by experts from all member states, including the author of this chapter.[2]

After assessing the situation of pollinators in the world, a core part of this assessment focused on analyzing the factors involved in bee and beehive decline. In this regard, the report mentions that, *"The abundance, diversity and health of pollinators and the provision of pollinization are threatened by direct drivers that generate risks to societies and ecosystems. Threats include land-use change, intensive agricultural management and pesticide use, environmental pollution, invasive alien species, pathogens and climate change."*

With respect to the role played by pesticides, it establishes that, *"The risk to pollinators from pesticides arises through a combination of toxicity and the level of exposure, which varies geographically with the compounds used and the scale of land management and habitat in the landscape. Pesticides, particularly insecticides, have been demonstrated to have a broad range of lethal and sublethal effects on pollinators under controlled experimental conditions."*

Among other elements, it states that, *"Recent research focusing on neonicotinoid insecticides shows evidence of lethal and sublethal effects on bees, and some evidence of impacts on the pollinization they provide. There is evidence from a recent study that shows impacts of neonicotinoids on wild pollinator survival and reproduction at actual field exposure."* However, it acknowledges that, "*Evidence, from this and other studies, of the effects on managed honey bee colonies is conflicting."*

The document also includes recommendations. For example, it establishes that, *"A number of features of current intensive agricultural practices threaten pollinators and pollinization. Moving towards more sustainable agriculture and reversing the simplification of agricultural landscapes offer key strategic responses to risks associated with pollinator decline."*

With respect to pesticides, it states that, *"Exposure of pollinators to pesticides can be decreased by reducing the use of pesticides seeking alternative forms of pest control and adopting a range of specific applications practices, including technologies to reduce pesticide drift. Actions to reduce pesticide use include promoting Integrated Pest Management, supported by educating farmers, organic farming and policies to reduce overall use."*

4. Effects of Insecticides on Bees

Insecticides have been developed to kill insects, and bees are insects. It is therefore legitimate to assess the role played by pesticides in general, and particularly

2 The abstract for decision-makers, as well as some chapters, are available at: https://www.ipbes.net/sites/default/files/downloads/pdf/individual_chapters_pollination_20170305.pdf

insecticides, in bee mortality. It is even more legitimate, considering the recurring complaints of beekeepers, who observe intoxications characterized by the sudden depopulation of hives. This is called acute toxicity (only one exposure), which generates mortality in a short time. Although these phenomena exist, they are not the most common intoxication event . These usually occur at a chronic level, e.g., from repeated exposure at doses that do not necessarily cause the bees' death, but affect their condition and activity, leading to a weakening of the hives, and perhaps later on to their death. These phenomena are evidently much more difficult to detect, analyze and prove.

Within this framework, since the 1970s, an increasing number of studies have focused on the sublethal effects of pesticides on pollinators. These events are significantly toxic, but not lethal (Desneux *et al.,* 2007). A pioneering study by Schricker and Stephen (1970) showed that when bees were exposed to a sublethal dose of parathion, an organophosphate insecticide, they were unable to communicate the direction towards a food source to other bees. Diverse studies have demonstrated the damaging effects of new types of insecticides, such as pyrethroids (Vandame *et al.,*1995) and neonicotinoids (Henry *et al.,* 2012), which have been associated with disruptions of bee navigation and orientation towards food, resources and colony location, thus resulting in colony loss.

The sublethal damages that have been studied may be classified into effects at he individual level (physiology and behavior) and at the colony level. Table 1 shows diverse examples of each detected effect.

Table 1
Non-exhaustive list of sublethal effects of different classes of pesticides on diverse bee species, at an individual level (physiology and behavior) and at the colony level

	Species	Family	Compound	Effect
1. Physiology				
Neurophysiology	*Am*	Op Py	Fenitrothion Cypermethrin	Enzyme inhibition
Immunity	*Am*	Nn	Clothianidin	Decreased immunity, increased viral pathogen replication
Thermoregulation	*Am*	Az Az Py	Prochloraz Difenoconazole Deltamethrin	Hypothermia (separately and in synergistic action)

	Species	Family	Compound	Effect
Reproduction	*Ac, Am*	Bz Bz	Diflubenzuron Penfluron	Decreased brood production
	Bt	Nn	Imidacloprid	Decreased brood production
	Ob	Nn Nn	Thiamethoxam Clothianidin	Reduced offspring production, male biased offspring sex-ratio
Longevity	*Am*	Py Nn	Deltamethrin Imidacloprid	Reduced adult longevity
	Bt	Nn Nn	Thiamethoxam Clothianidin	Truncated worker production, reduced worker longevity
Fecundity	*Mr*	Py	Deltamethrin	Reduced egg laying
2. Behavior				
Feeding	*Bt*	Py	Deltamethrin	Reduced feeding stimulation
Mobility	*Am*	Py	Permethrin	Increased self-cleaning, trembling, decreased walking and food giving
	Mq	Nn	Imidacloprid	Affected mushroom bodies development, impaired walking behavior
	Am	Nn Nn Nn	Thiamethoxam Imidacloprid Clothianidin	Loss of posture control, failure to right body
Learning	*Am*	Az Py Oc Nn	Prochloraz Deltamethrin Endosulfan Fipronil	Decreased olfactory performance, impaired memory and brain performance
	Am	Nn	Imidacloprid	Impaired olfactory associative behavior
	Am	Op Nn	Coumpahos Imidacloprid	Impaired conditioning of proboscis extension
	Bt	Nn	Imidacloprid	Chronic behavioral impairment
	Am	Ph	Glyphosate	Reduced sensitivity to sucrose and reduced learning performance

	Species	Family	Compound	Effect
Navigation	*Am*	Py	Deltamethrin	Failure in returning to the colony
	Am	Nn	Imidacloprid	Failure in returning to the colony
	Am	Nn	Thiamethoxam	Failure in returning to the colony
Communication	*Am*	Op	Parathion	Incorrect communication of information during dance
Defense	*Ac*	Nn	Imidacloprid	Decreased avoidance of predators
3. Colony				
Foraging	*Bt*	Nn	Imidacloprid	Reduced pollen foraging
	Am	Nn Nn	Fipronil Imidacloprid	Reduced rate active/total bees, decreased foraging
Colony performance	*Bt*	Nn	Imidacloprid	Reduced growth rate, reduced queen production
	Bt	Py Nn	Cyhalotrin Imidacloprid	Increased worker mortality and pollen collection, reduced brood development
	Am	Nn Nn	Thiamethoxam Clothianidin	Declining number of bees, queen failure, reduced propensity to swarm
	Bt	Nn	Imidacloprid	Decreasing birth rate, colony failure

Species: *Ac: Apis cerana; Am: Apis mellifera; Bt: Bombus terrestris; Mq: Melipona quadrifasciata; Mr: Megachile rotundata; Ob: Osmia bicornis.*

Chemical group and type of pesticide: Insecticides: *Bz:* benzamides; *Oc:* organochlorines; *Nn:* neonicotinoids; *Op:* organophosphates; *Py:* pyrethroids; herbicides: Ph: Phosphonoglycines; Fungicides: Az: azoles

Sources: The references for each case are in the following studies:

Thompson, 2003; Desneux *et al. 2007*;Belzunces *et al. 2012;* Sluijs *et al. 2013;* Godfray *et al. 2014;* Pisa *et al. 2014.*

As shown in table 1, there is a broad variety of sublethal effects, including physiological effects and those on individual behavior, as well as effects at the colony level. Most of these effects have been documented in the honeybee (*Apis mellifera*) and with neonicotinoid insecticides. In spite of this research, there are still important gaps in knowledge, for example:

1) Most of the studies have been carried out on bees, a few on the *Bombus terrestris* bumblebee, and even fewer on other social or solitary bee species (Sandrock *et al.,* 2014b). In consequence, the actual effects on pollinator communities are still unknown; 2) most research has been done on insecticides, particularly neonicotinoids; thus, little is known about the sublethal effects of other compounds, such as herbicides and fungicides; 3) the interaction between pesticides at sublethal doses and other factors that also cause problems for pollinators, such as the intensification of land use, climate change, exotic species, pests and pathogens, among others, have hardly been studied.

The general vision provided by table 1 raises an important question: What is the present role played by these numerous sublethal effects regarding the decreasing number of bees worldwide? Several studies have been conducted, but in spite of the overlap of the cited articles, their conclusions are varied. There is clear consensus on the fact that wild bees, as well as managed bees, are exposed to pesticides (mainly through nectar and pollen, in the case of neonicotinoids) and the spectrum of sublethal effects is quite broad. There is significant evidence of the highly negative impacts of sublethal effects under controlled laboratory conditions. However, there is still significant uncertainty about the actual effects of pesticides in field conditions; this is a vacuum of knowledge that has drawn the interest of various recent studies. For example, Goulson (2015), upon analyzing data from a study on the impacts of neonicotinoid exposure on bumblebee colonies, demonstrates a negative relation between colony growth, the production of queens and neonicotinoid levels in the food the bees collect.

Some other topics provide reason for disagreement, particularly regarding the chemical doses bees are actually exposed to in the field, or the effects of the environmental context and crop management (Sluijs *et al.,* 2013; Carreck and Ratnieks, 2014). Also, the chronic and synergistic effects have been greatly underestimated.

5. The Benefits of Small-Scale Agriculture in Latin America

Although there are numerous cases of bee mortality, in general bees are in better condition in Latin America than in the United States or Europe. Furthermore, there is consensus that bee mortality is due to three major factors: deforestation, insecticide exposure and pathogens. The first two factors are derived from the agricultural model that is currently used. We will thus proceed to analyze this situation and its consequences for bees in Latin America.

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5.1 Land Use

Intensive agriculture has the effect of reducing the diversity of the plant resources available for bees, which affects the source of protein provided by pollen (Crailsheim *et al.*, 2010). It has been demonstrated that the quality of worker bees raised in springtime is strongly influenced by pollen availability in colonies during larval development (Mattila and Otis, 2006). Furthermore, "pollen nutrition can play an important role in the development of disease because poor nutrition may result in a less robust defense system" (Managed Pollinators CAP, 2008). Fries (1993) demonstrated that good quality pollen supply reduced infection levels in the colonies.

The importance of nutrition pollen may imply that heavily managed landscapes are poor for the sustainability of bee colonies, a hypothesis that still requires testing. Some studies in the United States seem to validate this idea (Naug, 2009), but for Latin American countries there is no published data. Thus, we use indirect parameters to compare different regions of the world. The first parameter is the percentage of original forest remaining, as determined for the major watersheds of the world by the World Resources Institute (2003). As can be seen in Figure 1, watersheds in the United States and Europe are heavily influenced by human management and consequently the forested areas within them occupy less than 50 percent, and often less than 25 percent of their surface. Although few watersheds are quantified in Latin America, they appear commonly covered by over 50 percent and sometimes over 75 percent with original forest. Although this is still a very general analysis, it supports the observation that forests and by extension, natural resources, may be better preserved in Latin America than in the United States and Europe. However, the percentage of forested areas may not be the best indicator of bee nutrition, since these forests offer limited resources for bees.

Another consideration is based on data extracted from EarthTrends country profiles (2003), synthesized in Table 2, showing the fraction of cropland within total land area. In Western European countries with strong agriculture, croplands represent around 35 percent of the total area. In the United States, cropland represents only 19 percent of the total area (value lowered by extended uncultivated areas). This percentage decreases to 14 percent in Mexico, and varies between 3 percent and 10 percent in South America.

Such national level data do not represent the diversity at regional levels, like in the United States or in Argentina. However, it is clear that land use is much more intense in the United States and Europe than in Latin America, and it is possible that pollen nutrition in Latin America is more abundant throughout the year (or of better quality) than in more industrialized countries.

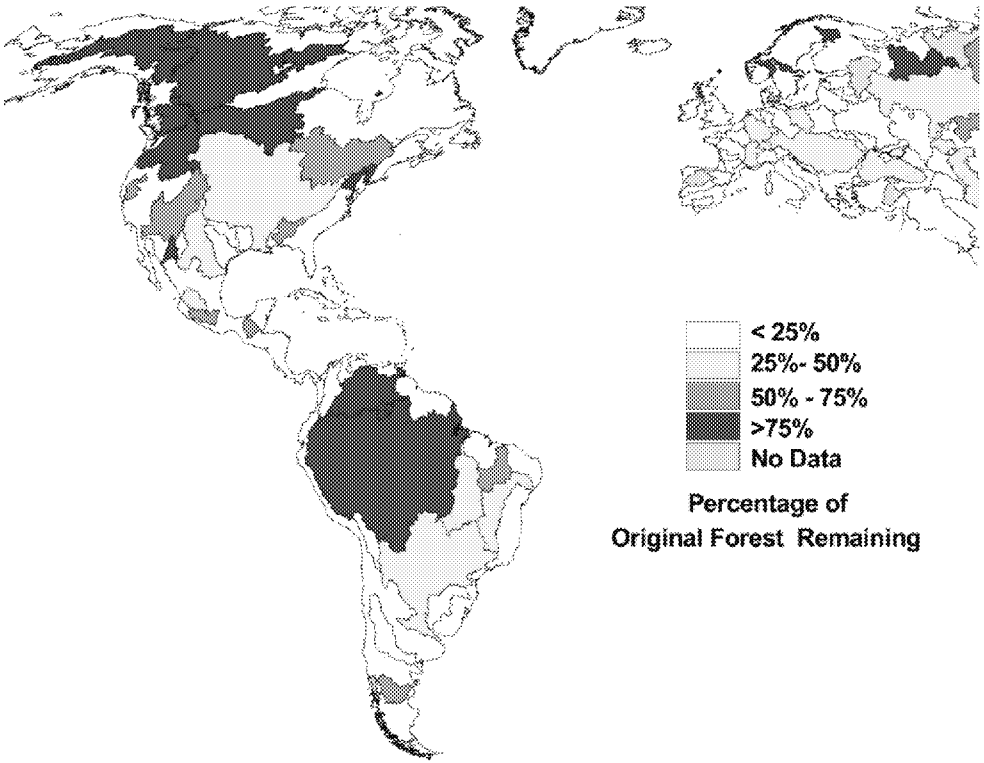

Figure 1. Percentage of Original Forest Remaining, World Resources Institute (2003).

Our hypothesis is that the generally smaller scale of agriculture in Latin America permits a greater diversity of pollen, and thus better pollen nutrition and a lower susceptibility to bee diseases. This hypothesis could explain why colony collapse disorder (CCD) has not been reported in Latin America, which would support the hypothesis that the risks to bee health are gradually increasing due to agricultural intensification.

Table 2
Summary of Statistics on Land and Pesticide Use in Some Countries of Europe and the Americas

	Total cropland (1000 ha)	Cropland per 1000 population	Cropland as % of total land area	Fertilizer use (kg/ha)	Insecticide Use (T)	Insecticide use (g/ha)
Source	EarthTrends	EarthTrends	EarthTrends	EarthTrends	FAOSTAT	Calculated
Date	1999	1999	1998	1999	1990-2001	
Planet	**1,501,452**	**251**	**11.3**	**94**	**388,743**	***259***
Europe	**307,286**					
Netherlands	949	60	23.0	501	488	514
Germany	12,038	147	33.9	252	1,426	118
France	19,515	331	35.4	244	6,109	313
Italy	11,422	199	37.0	155	25,215	2208
Spain	18,530	464	36.6	125	9,345	504
North America	**224,703**					
USA	179,000	638	19.1	111	102,682	574
Central America	**43,426**					
Mexico	27,300	280	13.9	66	na	
Guatemala	1,905	172	17.5	95	234	123
Cuba	4,465	400	40.3	33	na	
South America	**116,131**					
Brazil	65,200	388	7.6	90	15,076	231
Chile	2,294	153	3.0	207	2,893	1261
Argentina	27,200	744	9.8	30	7,422	273
Uruguay	1,307	394	7.4	103	222	170

na: not available data

Source: Extracted from EarthTrends, the environmental information portal of the World Resources Institute and FAOSTAT, of the Food and Agriculture Organization of the United Nations (http://faostat.fao.org) from September 2009. The insecticide use value is the average of the 1990-2001 data on FAOSTAT. The last column was calculated based on the previous data.

5.2 Insecticides

Another permanent threat for bees coming from human manipulated environments is the exposure to pesticides used in crop production. For a long time, this topic has been a source of conflict between beekeepers and the agrochemical industry. There is an extensive amount of data showing the sublethal effect of pesticides on bees under laboratory conditions (Vandame *et al.,* 1995; Vandame and Belzunces, 1997; Desneux *et al.,* 2007). It has been demonstrated that pesticides may alter bee development, worker bee longevity, mobility, navigation, orientation, feeding behavior or learning, and produce CCD, where worker bees do not return to their nest (Managed Pollinators CAP, 2008).

In general, intensive crops are less abundant in Latin America, but again, it is rather difficult to compare pesticide use in Europe, the United States and Latin America. We have shown that croplands represent a greater proportion of the total land surface in industrialized countries compared to Latin America (as a whole) (Table 2). Furthermore, EarthTrends data (2003) show that fertilizer use is approximately twice as high in Western Europe compared to the amount used in the United States or Latin America. According to FAOSTAT data (2009), the insecticide use per unit of area is about twice as high in the United States and in Europe than in LA (except in Chile, where reports are probably influenced by vineyard data), a situation derived from the high level of subsidized agriculture in the European Union and United States (Mayrand *et al.,* 2003; Pearce, 2002).

Overall, it seems that small-scale agriculture has protected bees, due to lower pesticide use and consequently low exposure to chemical contaminants, which could be the second reason why CCD has not been reported in Latin America. However, there are intense changes in agricultural practices that could become threats to bee survival, like the agricultural intensification of genetically modified crops in Argentina and Brazil, or the increasing use of insecticides in all countries. Currently in Argentina, the strength of bee colonies in spring is decreasing each year, thus requiring more intensive feeding. This fact could be pointing to forthcoming problems.

6. Situation in Mexico and Proposals

In general, the factors more often considered responsible for colony loss in the United States and Europe are diseases (pathogens, parasites) and environmental factors (nutrition, pesticides). This same situation is observed in Mexico, but under different conditions or different degrees of intensity. Diseases are not a major problem, probably due to the genetic background of bees and their consequent resistance to pathogens. Nutrition is not a great problem, probably due to less

intensive agriculture. The role of pesticides in bee health is under great debate. Although serious problems were not reported during the last decades, this does not imply that problems did not exist. Above all, during the last years, there have been repeated reports of sudden mortality of large numbers of hives, which seems to point to recurrent cases of intoxication.

The small scale that characterizes most agriculture and beekeeping in Mexico may explain how and why the conditions in the region lead to more sustainable health for bees.

The situation in Mexico appears to be a fragile equilibrium, due to a different set of risks. Some examples of these risks are: 1) a greater frequency of beekeepers are actually working with selected queens, but knowledge about resistance to diseases and mites (mainly *Varroa*) is still insufficient to include desirable traits in queen selection; 2) agriculture is covering more land, pesticide use is increasing, and genetically modified organisms are becoming more common; 3) natural vegetation is being lost to urban development and increase crop areas.

Although speculative, it is possible that a CCD-like phenomenon could happen in Mexico if principles of sustainability are not immediately included in beekeeping and agricultural development projects. It would make sense to develop a bee health surveillance project together with SAGARPA (Ministry of Agriculture, Stockbreeding, Rural Development and Fisheries), to collect statistics on land use and bee loss in Mexico, in order to validate the hypotheses suggested in this chapter. This project would be important to pollinator diversity conservation and crop production in Mexico, and more generally, for understanding the conditions leading to sustainability.

From the point of view of the national context, the regulatory framework for the standardization of pesticides allowed in Mexico requires careful analysis. For example, the US Environmental Protection Agency recommends that an insecticide should be considered highly hazardous for bees when the LD_{50} is greater than 2 μg per bee (LD_{50} is the dose that kills 50 per cent of the bee population). It would thus be indispensable to evaluate under what conditions it is possible to use the insecticide in agriculture (US-EPA, 2014). A preliminary analysis of pesticides allowed in Mexico shows that a large number exceeds this threshold, implying the evident existence of risk for pollinators in Mexico.

Overall, bee mortality is a worldwide phenomenon. Particularly in the European Union and the United States, intensive pesticide use seems to be the main cause of bee mortality. It is thus important to conduct studies on pesticide toxicity for bees and determine which are safe to use. Considering the lack of strict pesticide regulations in Mexico, it is evident that bees are under threat.

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7. Conclusion

Mexico is a country with great richness, including its bees. Its more than 1,800 species highlights the importance of bee diversity. At least for the last eight centuries, they have been part of Mexico's natural and cultural heritage, having been cultivated by the Mayan, Nahua, Totonac and Zapotec people. They are also part of Mexico's economic wealth, since both native bees and the European *Apis mellifera* allow Mexico to be a significant honey producer, ranking third place as an international honey exporter.

However, this wealth is currently endangered. Bees are at risk of entering a period of marked decline, and thus beekeepers, as is happening in many countries, may lose the bees they need in order to be able to grow, work and use this practice as their *modus vivendi*.

All of these issues – including the loss of food resources resulting from conversion to monocrop agriculture, as well as increasing pesticide use with its lethal and sublethal effects on bees– are due to a change in the agricultural model.

For thousands of years, agriculture has been practiced in order to sustain the population by providing food. It has pursued a social objective, and, considering the respect peasants have for Mother Earth, it could even be said that it has pursued an environmental objective. However, an intensive agricultural model has been gradually imposed, where production volume matters more than its quality, thus affecting the environment. Throughout this process, bees and beekeepers are revealing how much agricultural intensification is threatening our social, cultural and environmental wealth.

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Recommendations

Having shown how the discussion about highly hazardous pesticides emerged as a new regulatory category within the international arena and having documented how the use of these pesticides is widespread in extensive regions of Mexico, with its corresponding environmental and health consequences, the authors of this document have agreed to set forth the following recommendations to the competent federal and state authorities, as well as the peasant and indigenous organizations, and organizations of rural producers and agricultural workers:

1) To change the pesticide management policy in Mexico in order to focus on the promotion, respect, protection and assurance of the right to health, a healthy environment, and sufficient and appropriate nutrition; that fosters the creation of a sustainable food system; as well as complies with the constitutional obligation of protecting human rights, in accordance with the principles of universality, interdependence, indivisibility and progressiveness. This requires a change in the regulatory framework and policies that will enable the achievement of more extensive human rights protection, strengthening prevention and reparation for the damage caused to the populations that have suffered exposure, including agricultural workers, communities and consumers.

   For this purpose, it is necessary to incorporate the recommendations made by the Special Rapporteur on the Right to Food at the United Nation's General Assembly's Human Rights Council in its 34th regular session, included in Annex III of this book. It is necessary, in particular, to strengthen access to justice in health, environmental, labor and human rights matters related to pesticide use with participation from civil society groups interested in ending impunity and promoting effective protection of the rights involved. Attention must also be placed on the recommendations of the United Nations' Committee on the Rights of the Child, issued on June 5, 2015, for the Mexican State to ban the importation and use of any pesticide that has been banned or restricted for use in the exporting country.
2) To develop a *National Plan for Reduction and Phasing-Out of Highly Hazardous Pesticides and Support for Agroecological Alternatives.* This plan must include reduction goals that can be evaluated and monitored at a local and state level in specific territories, establish a ban on the most hazardous pesticides,

particularly those banned in other countries, promote agroecological alternatives in order to strengthen the domestic market, reduce Mexico's dependence on food from other countries, and contribute toward the recovery of food sovereignty.

Such a plan must be developed in a transparent and participatory manner in order to ensure that it aims toward the common good, rather than private interests. The Inter-Ministerial Commission for Control over the Processing and Use of Pesticides, Fertilizers and Toxic Substances (CICOPLAFEST) would participate in this process in coordination with an interdisciplinary collegiate group of academic specialists, agricultural research centers, non-governmental organizations without conflicts of interest with industry, together with organizations of peasants, indigenous communities, private producers and agricultural workers. The first tasks that we recommend are as follows:

<> To identify highly hazardous pesticides currently authorized in Mexico, based on the criteria developed by FAO-WHO, and the Pesticide Action Network-International (PAN-International), as well as those pesticides banned in other countries. Information derived from this task must be made available to the public. The Annexes to this report may be consulted for this purpose.

<> To carry out the necessary legislative changes in order to have a procedure that may allow for an expeditious revocation of the authorization granted highly hazardous pesticides in Mexico, prioritizing those chemicals that are used to control pests, undesired plants, diseases and vectors that have been banned in other countries as well as those replaceable by less hazardous alternatives (biochemical, microbial, botanical alternatives or alternatives coming from chemical synthesis).

<> To ban aerial pesticide spraying, particularly highly hazardous pesticides, of crops close to populations and/or vulnerable ecosystems. It is a top priority to ban the presence of "flagmen" during these operations.

<> To exclude highly hazardous pesticides from government programs supporting agricultural production and phytosanitary control programs promoted by SAGARPA and SENASICA.

<> To strengthen public access to information regarding pesticide use and monitoring, complying and extending current regulation so that it includes:

- ensuring the public's right to know how much, where and what pesticides are applied in all their different applications. Article 41 of the Federal Plant Health Act authorizes SAGARPA, the Ministry of Agriculture, to request the farm owners' records with information about pesticide use, including application volumes, crops, regions, pests, weeds, and diseases

for which each product was applied, so that the authorities may make use of this information.[1]

- improving the registration of acute intoxications, including one for chronic diseases associated with the exposure to pesticides in order to thus reinforce the epidemiological surveillance by the Ministry of Health.
- carrying out ongoing monitoring of the presence of pesticide residues in food for domestic consumption (basic grains, fruit and vegetables) by both SENASICA and the Mexican Ministry of Health.
- monitoring pesticide residues in the atmosphere, particularly highly hazardous pesticides, complying with competent legislation and eliminating loopholes in regulations. The aforementioned must be linked to an evaluation of control measures, prioritizing phase-out of highly hazardous pesticides in water, soil, atmosphere and their effects on species, ecosystems and pollinators.

These measures would allow for a territorial and seasonal diagnosis of the use of highly hazardous pesticides that would make it possible to establish goals to reduce their use on specific crops and territories, thus guiding the programs that support agro-ecological alternatives. In a similar manner, this would allow for greater public visibility of the problem and an improved multidisciplinary analysis aimed to identify whether there is an unequal impact on the poorest and most vulnerable populations. All this would help establish priority measures to reduce and substitute highly hazardous pesticides, applying the precautionary principle wherever there is scientific evidence of damage, even if it is not conclusive.

<> To develop a national program to promote agroecological alternatives for pest, weed and disease control with support from the National Council of Science and Technology (CONACYT), the Ministry of Agriculture (SAGARPA), and the Ministry of the Environment (SEMARNAT). This program would strengthen the work carried out by agricultural research institutions, and should be open to collaboration with professional associations and farming organizations with experience in this field, so that research can be applied to agricultural production in Mexico, and to face environmental pollution and degradation. It could also contribute to a database emerging from a public consultation process with alternatives to highly hazardous pesticides classified by pests and crops that includes successful agroecological management practices and pesticides that are less hazardous for health and the environment.

1 For this recommendation, it would be useful to get to know experiences from other places regarding this issue; for example, the state authorities in California keep a record that allows for an identification of the trends in pesticide use per county.

<> To provide economic incentives to support agroecological control alternatives and other less hazardous alternatives proposed by agricultural research centers as well as rural organizations. One of the sources of these incentives could come from the measure to expand and label the federal tax on acutely toxic pesticides currently in force. The Ministry of Finance and Public Credit, in its 2014 fiscal reform established a tax on pesticides with acute toxicity classified by the World Health Organization under categories IA and IB, in accordance with the Ministry of Heath's standard NOM 232-SSAI-2009. However, these resources are allocated to the federal income. What is proposed is that the resources earned with these taxes be "earmarked" for a specific program to support measures of greater pesticide control, reduction and substitution by agroecological practices. Given the chronic effects that highly hazardous pesticides have on health and their impact on the environment, another consideration could be to raise the tax and include highly hazardous pesticides, rather than just consider acute toxicity, which is the current practice. This would create an economic incentive to expand the market for products of biological and botanical origin as well as others alternatives to the use of synthetic chemical pesticides.

With the actions we propose, Mexico would be able to contribute to reaching the SAICM goal that by 2020 chemicals be produced and used in a manner that significantly reduces the adverse effects upon health and the environment. To the same effect, Mexico would comply with the resolution about highly hazardous pesticides approved by the Fourth International Conference on Chemicals Management, which recommended prioritizing agroecological alternatives.

Similarly, the proposed measures would support the attainment of number two of the 2015-2030 Sustainable Development Objectives, in particular, to achieve food production system sustainability, and apply resilient agricultural practices that increase productivity and production, contribute to the maintenance of ecosystems, strengthen the capacity to adapt to climate change, and progressively improve land and soil quality.

About the Contributors

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beekeeping organizations and communities in the Yucatan Peninsula to stop the commercial planting of transgenic soy that GMO pollen does not contaminate honey. An advocate for environmental justice in Mexico, she is convinced that collective actions are advanced mechanisms to achieve reparation for environmental damage and that the Mexican Law of Environmental Responsibility must be improved to help communities and NGOs obtain compensation for damages from companies and governments that cause or allow contamination to communities and ecosystems.
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Annex 1. List of Highly Hazardous Pesticides authorized in Mexico, 2016.

					"Group 1: Acute Toxicity"				Group 2: Long Term Effects									Group 3: Environmental Toxicity					Grupo 4: Conventions					
	CAS Number	Pesticide	Grouped	Sum of max=1 in Groups 1-4	WHO Ia	WHO Ib	H330	max = 1	EPA carc	IARC carc	EU GHS carc (1A, 1B)	IARC prob carc	EPA prob likel carc	EU GHS muta (1A, 1B)	EU GHS repro (1A, 1B)	EU EDC (1) or C2 & R2 GHS	max = 1	Very bio acc	Very pers water, soil or sediment	Very toxic to aq. Organism	Highly toxic bees	max = 1	Montr Prot	PIC	See note below the table	POP	max = 1	H330 Solo
	Totales			263	18	25	36	61	0	1	2	4	43	2	21	35	89	9	9	13	82	97	1	15	0	3	16	20
1	542-75-6	1,3-dichloropropene		1				0					1				1					0					0	
2	94-82-6	2,4-DB		1				0								1	1					0					0	
3	71751-41-2	Abamectin		2			1	1									0				1	1					0	1
4	30560-19-1	Acephate		1				0									0				1	1					0	
5	34256-82-1	Acetochlor	x	1				0			1						1					0					0	
6	101007-06-1	Acrinathrin		1				0								1	1					0					0	
7	15972-60-8	Alachlor		1				0							1	1	1					0					0	
8	116-06-3	Aldicarb		1				0									0				1	1					0	
9	20859-73-8	Aluminum phosphide		2				0								1	1					0		1			1	1
10	1912-24-9	Atrazine		3	1		1	1									0				1	1		1			1	
11	68049-83-2	Azafenidin		1				0									0				1	1					0	
12	35575-96-3	Azamethiphos		1				0								1	1					0					0	
13	86-50-0	Azinphos-methyl		1				0							1		1					0					0	
14	41083-11-8	Azocyclotin		1				0									0				1	1					0	1
15	22781-23-3	Bendiocarb		3		1	1	1									0				1	1		1			1	
16	17804-35-2	Benomyl		2			1	1									0	1		1		1					0	
17	741-58-2	Bensulide		1				0									0				1	1					0	
18	177406-68-7	Benthiavalicarb-isopropyl		2				0						1	1		1					0		1	X		1	
19	68359-37-5	Beta-cyfluthrin		1				0									0				1	1					0	
20	82657-04-3	Bifenthrin		1				0					1				1					0					0	
21	28434-01-7	Bioresmethrin		2		1	1	1									0				1	1					0	
22	1303-96-4	Borax		2				0								1	1				1	1					0	

					"Group 1: Acute Toxicity"				Group 2: Long Term Effects										Group 3: Environmental Toxicity					Grupo 4: Conventions					
	CAS Number	Pesticide	Grouped	Sum of max=1 in Groups 1-4	WHO Ia	WHO Ib	H330	max = 1	EPA carc	IARC carc	EU GHS carc (1A, 1B)	IARC prob carc	EPA prob likel carc	EU GHS muta (1A, 1B)	EU GHS repro (1A, 1B)	EU EDC (1) or C2 & R2 GHS	max = 1	Very bio acc	Very pers water, soil or sediment	Very toxic to aq. Organism	Highly toxic bees	max = 1	Montr Prot	PIC	See note below the table	POP	max = 1	H330 Solo
23	10043-35-3	Boric acid		1				0									0				1	1					0	
24	56073-10-0	Brodifacoum	X	1				0							1		1					0					0	
25	28772-56-7	Bromadiolone		2	1		1	1							1		1					0					0	
26	63333-35-7	Bromethalin		2	1		1	1							1		1					0					0	
27	1689-84-5	Bromoxynil		2	1			1									0	1		1		1					0	1
28	95465-99-9	Cadusafos		1			1	1									0					0					0	
29	2425-06-1	Captafol		1				0									0					0	1				1	
30	63-25-2	Carbaryl		2		1		1									0		1	1	1	1					0	
31	10605-21-7	Carbendazim		3	1			1			1	1	1				1					0		1			1	
32	1563-66-2	Carbofuran		2				0					1			1	1				1	1					0	
33	55285-14-8	Carbosulfan		1				0						1	1		1					0					0	1
34	500008-45-7	Chlorantraniliprole		3		1	1	1									0				1	1		1	X		1	
35	57-74-9	Chlordane		2			1	1									0				1	1					0	
36	122453-73-0	Chlorfenapyr		1				0									0				1	1					0	
37	470-90-6	Chlorfenvinphos		1				0									0				1	1					0	
38	3691-35-8	Chlorophacinone		1				0									0		1	1		1					0	
39	76-06-2	Chloropicrin		3				0					1			1	1	1				1		1		1	1	1
40	1897-45-6	Chlorothalonil		1				0									0				1	1					0	1
41	2921-88-2	Chlorpyrifos		2		1		1									0				1	1					0	
42	5598-13-0	Chlorpyrifos-methyl		1	1			1									0					0					0	
43	210880-92-5	Clothianidin		1			1	1									0					0					0	
44	56-72-4	Coumaphos		2			1	1					1				1					0					0	
45	5836-29-3	Coumatetralyl		1				0									0				1	1					0	
46	20427-59-2	Copper hydroxide		1				0									0				1	1					0	1
47	76703-62-3	Cyhalothrin, gamma		1				0									0				1	1					0	

					"Group 1: Acute Toxicity"				Group 2: Long Term Effects									Group 3: Environmental Toxicity					Grupo 4: Conventions					
	CAS Number	Pesticide	Grouped	Sum of max=1 in Groups 1-4	WHO Ia	WHO Ib	H330	max = 1	EPA carc	IARC carc	EU GHS carc (1A, 1B)	IARC prob carc	EPA prob likel carc	EU GHS muta (1A, 1B)	EU GHS repro (1A, 1B)	EU EDC (1) or C2 & R2 GHS	max = 1	Very bio acc	Very pers water, soil or sediment	Very toxic to aq. Organism	Highly toxic bees	max = 1	Montr Prot	PIC	See note below the table	POP	max = 1	H330 Solo
48	52315-07-8	Cypermethrin		2		1	1	1							1		1					0					0	
49	67375-30-8	Cypermethrin, alpha		1		1		1									0					0					0	
50	65731-84-2	Cypermethrin, beta		3				0					1			1	1		1	1		1		1		1	1	
51	50-29-3	DDT (**)		2				0								1	1				1	1					0	
52	52918-63-5	Deltamethrin		2				0				1					1				1	1					0	
53	333-41-5	Diazinon		1				0					1				1					0					0	
54	62-73-7	Dichlorvos; DDVP		2		1	1	1									0				1	1					0	
55	51338-27-3	Diclofop-methyl		1	1			1									0					0					0	
56	56073-07-5	Difenacoum		2	1			1									0	1				1					0	
57	104653-34-1	Difethialone		2	1		1	1							1		1					0					0	
58	60-51-5	Dimethoate		1				0									0				1	1					0	
59	39300-45-3	Dinocap		1				0							1		1					0					0	
60	165252-70-0	Dinotefuran		1				0									0				1	1					0	
61	82-66-6	Diphacinone		1			1	1									0					0					0	
62	4032-26-2	Diquat dichloride		1	1			1									0					0					0	1
63	298-04-4	Disulfoton		1				0					1				1					0					0	
64	330-54-1	Diuron		1		1		1									0					0					0	
65	17109-49-8	Edifenphos		2			1	1									0					0		1		1	1	
66	115-29-7	Endosulfan		1				0					1		1	1	1					0					0	1
67	133855-98-8	Epoxiconazole		1				0									0				1	1					0	
68	66230-04-4	Esfenvalerate		1				0									0		1	1	1	1					0	
69	13194-48-4	Ethoprophos		2	1		1	1					1				1					0					0	
70	80844-07-1	Etofenprox; Ethofenprox		2		1	1	1									0				1	1					0	
71	22224-92-6	Fenamiphos		1				0								1	1					0					0	
72	60168-88-9	Fenarimol		2				0								1	1				1	1					0	

					"Group 1: Acute Toxicity"				Group 2: Long Term Effects									Group 3: Environmental Toxicity					Grupo 4: Conventions					
	CAS Number	Pesticide	Grouped	Sum of max=1 in Groups 1-4	WHO Ia	WHO Ib	H330	max = 1	EPA carc	IARC carc	EU GHS carc (1A, 1B)	IARC prob carc	EPA prob likel carc	EU GHS muta (1A, 1B)	EU GHS repro (1A, 1B)	EU EDC (1) or C2 & R2 GHS	max = 1	Very bio acc	Very pers water, soil or sediment	Very toxic to aq. Organism	Highly toxic bees	max = 1	Montr Prot	PIC	See note below the table	POP	max = 1	H330 Solo
73	13356-08-6	Fenbutatin-oxide		2				0					1				1				1	1					0	1
74	122-14-5	Fenitrothion		2			1	1									0				1	1					0	
75	72490-01-8	Fenoxycarb		1				0									0				1	1					0	
76	39515-41-8	Fenpropathrin		2			1	1								1	1					0					0	1
77	55-38-9	Fenthion		1				0									0				1	1					0	
78	900-95-8	Fentin acetate; Triphenyltin acetate		1				0									0				1	1					0	1
79	51630-58-1	Fenvalerate		2	1		1	1							1		1					0					0	
80	120068-37-3	Fipronil		1				0							1		1					0					0	
81	90035-08-8	Flocoumafen		1				0									0	1		1		1					0	1
82	69806-50-4	Fluazifop-butyl		1				0							1		1					0					0	
83	101463-69-8	Flufenoxuron		1				0							1		1					0					0	
84	103361-09-7	Flumioxazin		1				0					1				1					0					0	
85	85509-19-9	Flusilazole		1				0					1				1					0					0	
86	117337-19-6	Fluthiacet-methyl (*)		2	1			1									0				1	1					0	
87	133-07-3	Folpet		1				0		1			1				1					0					0	
88	50-00-0	Formaldehyde		3	1			1									0				1	1		1	X		1	
89	77182-82-2	Glufosinate-ammonium		2			1	1									0				1	1					0	
90	1071-83-6	Glyphosate		1			1	1									0					0					0	
91	69806-40-2	Haloxyfop-methyl (unstated ste-reochemistry)		1		1		1									0					0					0	
92	86479-06-3			1				0									0				1	1					0	
93	78587-05-0	Hexythiazox		1				0									0				1	1					0	
94	35554-44-0	Imazalil		1				0				1					1					0					0	
95	138261-41-3	Imidacloprid		1				0							1		1					0					0	
96	72963-72-5	Imiprothrin		1				0					1				1					0					0	

					"Group 1: Acute Toxicity"				Group 2: Long Term Effects									Group 3: Environmental Toxicity					Grupo 4: Conventions					
	CAS Number	Pesticide	Grouped	Sum of max=1 in Groups 1-4	WHO Ia	WHO Ib	H330	max = 1	EPA carc	IARC carc	EU GHS carc (1A, 1B)	IARC prob carc	EPA prob likel carc	EU GHS muta (1A, 1B)	EU GHS repro (1A, 1B)	EU EDC (1) or C2 & R2 GHS	max = 1	Very bio acc	Very pers water, soil or sediment	Very toxic to aq. Organism	Highly toxic bees	max = 1	Montr Prot	PIC	See note below the table	POP	max = 1	H330 Solo
97	173584-44-6	Indoxacarb		1				0									0				1	1					0	
98	36734-19-7	Iprodione		1				0					1				1					0					0	
99	140923-17-7	Iprovalicarb		2			1	1									0		1	1		1					0	
100	141112-29-0	Isoxaflutole		1				0					1				1					0					0	
101	143390-89-0	Kresoxim-methyl		1				0									0				1	1					0	
102	91465-08-6	Lambda-cyhalothrin		1				0									0				1	1					0	1
103	330-55-2	Linuron		1				0									0				1	1					0	
104	12057-74-8	Magnesium phosphide		1				0					1				1					0					0	1
105	121-75-5	Malathion		1				0					1				1					0					0	
106	8018-01-7	Mancozeb		1				0					1				1					0					0	
107	12427-38-2	Maneb		1				0					1				1					0					0	
108	139968-49-3	Metaflumizone		3			1	1								1	1				1	1					0	
109	137-41-7	Metam-potassium		1				0							1	1	1					0					0	
110	137-42-8	Metam-sodium		2				0				1					1				1	1					0	
111	10265-92-6	Methamidophos		1				0					1			1	1					0					0	
112	950-37-8	Methidathion		1				0					1			1	1					0					0	
113	2032-65-7	Methiocarb		1				0									0				1	1					0	
114	16752-77-5	Methomyl		1				0					1				1					0					0	
115	72-43-5	Methoxychlor		1				0					1			1	1					0					0	
116	74-83-9	Methyl bromide		3		1	1	1									0				1	1		1	X		1	
117	9006-42-2	Metiram		2		1		1									0				1	1					0	
118	21087-64-9	Metribuzin		2		1		1									0				1	1					0	
119	7786-34-7	Mevinphos		1				0					1			1	1					0					0	
120	51596-10-2	Milbemectin		2		1		1									0				1	1					0	
121	2212-67-1	Molinate		1				0								1	1					0					0	

					"Group 1: Acute Toxicity"				Group 2: Long Term Effects									Group 3: Environmental Toxicity					Grupo 4: Conventions					
	CAS Number	Pesticide	Grouped	Sum of max=1 in Groups 1-4	WHO Ia	WHO Ib	H330	max = 1	EPA carc	IARC carc	EU GHS carc (1A, 1B)	IARC prob carc	EPA prob likel carc	EU GHS muta (1A, 1B)	EU GHS repro (1A, 1B)	EU EDC (1) or C2 & R2 GHS	max = 1	Very bio acc	Very pers water, soil or sediment	Very toxic to aq. Organism	Highly toxic bees	max = 1	Montr Prot	PIC	See note below the table	POP	max = 1	H330 Solo
122	6923-22-4	Monocrotophos		1				0								1	1					0					0	
123	300-76-5	Naled		2	1			1									0				1	1					0	
124	1113-02-6	Omethoate		1				0									0				1	1					0	
125	19044-88-3	Oryzalin		1				0								1	1					0					0	
126	19666-30-9	Oxadiazon		3		1	1	1									0				1	1		1			1	
127	23135-22-0	Oxamyl		1				0									0				1	1					0	
128	301-12-2	Oxydemeton-methyl		3		1		1								1	1				1	1					0	
129	42874-03-3	Oxyfluorfen		1				0					1				1					0					0	
130	Various	Paraffin oils; mineral oils		1				0					1				1					0					0	
131	1910-42-5	Paraquat dichloride		2		1	1	1									0				1	1					0	1
132	298-00-0	Parathion-methyl		2		1		1									0				1	1					0	1
133	87-86-5	PCP, pentachlorphenol		2			1	1									0		1	1		1					0	
134	40487-42-1	Pendimethalin		1				0					1				1					0					0	
135	52645-53-1	Permethrin		1			1	1									0					0					0	
136	298-02-2	Phorate		2	1		1	1									0					0		1	X		1	
137	732-11-6	Phosmet		1				0									0	1	1			1					0	
138	13171-21-6	Phosphamidon		3		1	1	1					1			1	1					0		1			1	
139	1918-02-1	Picloram		2				0					1				1				1	1					0	
140	23103-98-2	Pirimicarb		1				0								1	1					0					0	
141	29232-93-7	Pirimiphos-methyl		1				0									0				1	1					0	
142	23031-36-9	Prallethrin		2				0					1				1		1	1		1					0	
143	41198-08-7	Profenofos		1				0									0				1	1					0	
144	139001-49-3	Profoxydim		1				0									0				1	1					0	
145	2312-35-8	Propargite		1				0									0				1	1					0	
146	114-26-1	Propoxur		1				0								1	1					0					0	

					"Group 1: Acute Toxicity"				Group 2: Long Term Effects									Group 3: Environmental Toxicity					Grupo 4: Conventions					
	CAS Number	Pesticide	Grouped	Sum of max=1 in Groups 1-4	WHO Ia	WHO Ib	H330	max = 1	EPA carc	IARC carc	EU GHS carc (1A, 1B)	IARC prob carc	EPA prob likel carc	EU GHS muta (1A, 1B)	EU GHS repro (1A, 1B)	EU EDC (1) or C2 & R2 GHS	max = 1	Very bio acc	Very pers water, soil or sediment	Very toxic to aq. Organism	Highly toxic bees	max = 1	Montr Prot	PIC	See note below the table	POP	max = 1	H330 Solo
147	123312-89-0	Pymetrozine		2				0					1				1	1		1		1					0	
148	13457-18-6	Pyrazophos		2				0					1				1				1	1					0	
149	96489-71-3	Pyridaben		1				0					1				1					0					0	
150	13593-03-8	Quinalphos		1				0									0				1	1					0	
151	124495-18-7	Quinoxyfen		2				0								1	1				1	1					0	
152	119738-06-6	Quizalofop-p-tefuryl		1				0									0	1		1		1					0	
153	10453-86-8	Resmethrin		1				0							1		1					0					0	
154	187166-15-0	Spinetoram		2				0					1			1	1				1	1					0	
155	168316-95-8	Spinosad		1				0									0				1	1					0	
156	148477-71-8	Spirodiclofen		1				0									0				1	1					0	
157	946578-00-3	Sulfoxaflor (*)		1				0					1				1					0					0	
158	21564-17-0	TCMTB		1				0									0				1	1					0	1
159	96182-53-5	Tebupirimfos		1			1	1									0					0					0	
160	79538-32-2	Tefluthrin		2	1			1									0		1	1		1					0	
161	3383-96-8	Temephos		2		1		1									0				1	1					0	
162	13071-79-9	Terbufos		1				0									0				1	1					0	
163	886-50-0	Terbutryn		1	1			1									0					0					0	
164	22248-79-9	Tetrachlorvinphos		1				0								1	1					0					0	
165	112281-77-3	Tetraconazole		2				0					1				1				1	1					0	
166	7696-12-0	Tetramethrin		1				0					1				1					0					0	
167	111988-49-9	Thiacloprid		1				0									0				1	1					0	
168	153719-23-4	Thiamethoxam		1				0					1				1					0					0	
169	59669-26-0	Thiodicarb		1				0									0				1	1					0	
170	23564-05-8	Thiophanate-methyl		2				0					1				1				1	1					0	
171	137-26-8	Thiram		2				0								1	1					0		1	X		1	

					"Group 1: Acute Toxicity"				Group 2: Long Term Effects									Group 3: Environmental Toxicity					Grupo 4: Conventions					
	CAS Number	Pesticide	Grouped	Sum of max=1 in Groups 1-4	WHO Ia	WHO Ib	H330	max = 1	EPA carc	IARC carc	EU GHS carc (1A, 1B)	IARC prob carc	EPA prob likel carc	EU GHS muta (1A, 1B)	EU GHS repro (1A, 1B)	EU EDC (1) or C2 & R2 GHS	max = 1	Very bio acc	Very pers water, soil or sediment	Very toxic to aq. Organism	Highly toxic bees	max = 1	Montr Prot	PIC	See note below the table	POP	max = 1	H330 Solo
172	66841-25-6	Tralomethrin		1				0					1				1					0					0	
173	24017-47-8	Triazophos		1				0									0				1	1					0	
174	52-68-6	Trichlorfon		1		1		1									0					0					0	
175	81412-43-3	Tridemorph		2				0								1	1				1	1					0	
176	1582-09-8	Trifluralin		1				0							1		1					0					0	
177	2275-23-2	Vamidothion		2				0								1	1	1				1					0	
178	50471-44-8	Vinclozolin		2		1		1									0				1	1					0	
179	81-81-2	Warfarin		1				0							1	1	1					0					0	
180	52315-07-8z	zeta-Cypermethrin		2		1	1	1							1		1					0					0	
181	1314-84-7	Zinc phosphide		2		1		1									0				1	1					0	
182	12122-67-7	Zineb		1				0								1	1					0					0	
183	137-30-4	Ziram		1			1	1									0					0					0	1

WHO Ia:	Extremely hazardous (Class 1a) according to World Health Organisation
WHO Ib:	Highly hazardous (Class 1b) according to World Health Organisation
H330	'*Fatal if inhaled*', hazard classification according to the Globally Harmonized System (GHS)
max = 1	This active ingredient meets at least one criteria in this Group
EPA carc	Human carcinogen according to EPA
IARC carc	Human carcinogen according to IARC
EU GHS (1A, 1B):	Known or presumed human carcinogens (1A or 1B) according to EU GHS Regulation 1272/2008/EC

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EPA prob/likel carc	Probable/ Likely carcinogen according to EPA IARC prob
carc	Probable carcinogen according to IARC
EU GHS (2):	Suspected human carcinogen (Cat. 2) according to EU GHS Regulation 1272/2008/EC
EU GHS muta (1A, 1B)	Substances known to induce heritable mutations or to be regarded as if they induce heritable mutations in the germ cells of humans. Substances known to induce heritable mutations in the germ cells of humans' (Category 1A or 1B) according to EU Regulation 1272/2008/EC
EU GHS repro (1A, 1B):	Known or presumed human reproductive toxicant according to EU GHS Regulation 1272/2008/EC
EU EDC (1) or C2 & R2 GHS:	Endocrine disruptor or potential endocrine disruptor according to EU Category 1 or pesticides classified GHS Carcinogen Category 2 AND EU Reproductive Category 2
Very bio acc:	Very bioaccumulative (BCF >5000) or Kow logP >5 (BCF values supersede Kow logP data)
Very persistent water, soil or sediment:	Very persistent in water (half-life > 60 days), soils or sediments (half-life > 180 days)
Very toxic to aq. Organism:	Very toxic to aquatic organisms (Acute LC/EC50 <0,1 mg/l for Daphnia species) Highly toxic bees:
Hazard to ecosystem services – Highly toxic to bees (<2 µg/bee) according to U.S. EPA as listed by FOOTPRINT data	
Montreal Protocol:	Ozone depleting chemical according to the Montreal Protocol
PIC:	Listed in Annex III of the Rotterdam Convention
POP:	Listed in Annex III of the Stockholm Convention

Group (a) Some pesticides are listed as a group in the PAN list. This is the case of paraffin oils and mineral oils containing more than 3% dimethylsulfoxid (DMSO); also borax and borate salts, such as disodium octaborate anhydrous, disodium octaborate tetrahydrate and disidodium octaborate decahydrate.

(X) Annex III of the PIC/Rotterdam Convention, includes certain formulations of that chemical marked with an X

(*) Appears in the online database with a record http://189.254.115.252/Resoluciones/Consultas/ConWebRegPlaguicida.asp consulted on December 9, 2016 and in the file of the Data Sheet, although not in the archive file of the 2016 Pesticide Catalog.

(**) DDT appears as "restricted use" in the 2016 Pesticide Catalog Data Sheets, and "exclusive for the Health Ministry (SSA) in sanitary campaigns, its marketing prohibited" in the Catalog's record file. Therefore its registration has not been canceled, although it is not produced or used.

NOTE: Cyalothrin, Fenazaquin and Isopyrazam were not included, although appear in the file of Data Sheets of the 2016 Pesticide Catalog do not appear in the records file or in the online database consulted on December 9, 2016.

Source: RAPAM, based on the consultation of PAN International List of Highly Hazardous Pesticides. December 2016 (PAN 2016). Hamburg; and COFEPRIS, Pesticide Catalog 2016. México.

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ANNEX 2
Pesticides authorized in Mexico that are prohibited or not allowed in other countries

	Active ingredient	Highly Hazardous Pesticides with FAO-WHO criteria	Highly Hazardous Pesticides with PAN international criteria	Number of countries where there is a ban *
1	1,3-Dichloropropene	1	1	29
2	2,4-D			3
3	2,4-DB		1	1
4	Acephate		1	31
5	Acetochlor (+)		1	28
6	Alachlor	1	1	48
7	Aldicarb	1	1	56
8	Aluminum phosphide		1	1
9	Amitraz			33
10	Atrazine		1	37
11	Azafenidin	1	1	29
12	Azamethiphos		1	28
13	Azinphos-methyl	1	1	39
14	Azocyclotin (+)		1	28
15	Bendiocarb		1	29
16	Benomyl	1	1	33
17	Bensulide (+)		1	30
18	Beta-cyfluthrin; Cyfluthrin	1	1	29
19	Bifenthrin		1	2
20	Bioresmethrin		1	28
21	Bitertanol			29
22	Boric acid	1	1	28
23	Brodifacoum	1	1	30
24	Bromadiolone	1	1	2
25	Bromethalin	1	1	29
26	Bromoxynil octanoate		1	2
27	Bromuconazole			1
28	Cadusafos	1	1	31
29	Captafol	1	1	64

	Active ingredient	Highly Hazardous Pesticides with FAO-WHO criteria	Highly Hazardous Pesticides with PAN international criteria	Number of countries where there is a ban *
30	Captan			6
31	Carbaryl	1	1	33
32	Carbendazim	1	1	29
33	Carbofuran	1	1	49
34	Carbosulfan		1	40
35	Chlorfenapyr		1	28
36	Chloropicrin		1	34
37	Chlorothalonil	1	1	3
38	Chlorpyrifos		1	2
39	Chlorpyrifos-methyl		1	1
40	Chlorthal-dimethyl			28
41	Cyanazine			29
42	DDT	1	1	71
43	Diazinon		1	30
44	Dichlorvos; DDVP	1	1	32
45	Dicloran			28
46	Dicofol			45
47	Difenoconazole			1
48	Difethialone	1	1	30
49	Dimethoate		1	4
50	Dinocap	1	1	29
51	Diquat		1	1
52	Disulfoton	1	1	38
53	Diuron	1	1	1
54	Edifenphos	1	1	31
55	Endosulfan	1	1	75
56	Epoxiconazole	1	1	1
57	Ethion			30
58	Ethoprophos; Ethoprop	1	1	8
59	Fenamiphos	1	1	6
60	Fenarimol (+)		1	28
61	Fenbutatin oxide		1	29

	Active ingredient	Highly Hazardous Pesticides with FAO-WHO criteria	Highly Hazardous Pesticides with PAN international criteria	Number of countries where there is a ban *
62	Fenitrothion		1	28
63	Fenpropathrin		1	28
64	Fenthion		1	30
65	Fentin acetate ; Tryphenyltin acetate		1	29
66	Fenvalerate (+)		1	28
67	Ferbam			29
68	Fipronil		1	8
69	Fluazifop-butyl	1	1	1
70	Fluazinam			1
71	Flufenoxuron		1	28
72	Flusilazole (+)	1	1	28
73	Folpet	1	1	2
74	Fonophos			33
75	Glyphosate		1	1
76	Hexaflumuron (+)		1	29
77	Hexazinone			29
78	Imazapyr			29
79	Imazethapyr			28
80	Iprodione			1
81	Isoxaflutole	1	1	1
82	Linuron	1	1	2
83	Magnesium phosphide		1	1
84	Malathion		1	2
85	Mancozeb	1	1	1
86	Maneb	1	1	31
87	MCPA			2
88	Metam-sodium	1	1	1
89	Methamidophos	1	1	49
90	Methidathion	1	1	34
91	Methiocarb	1	1	4
92	Methomyl	1	1	13
93	Methoxychlor		1	36

	Active ingredient	Highly Hazardous Pesticides with FAO-WHO criteria	Highly Hazardous Pesticides with PAN international criteria	Number of countries where there is a ban *
94	Methyl bromide	1	1	35
95	Metsulfuron-methyl			1
96	Mevinphos	1	1	37
97	Monocrotophos	1	1	60
98	Naled		1	28
99	Omethoate	1	1	32
100	Oxadiargyl			29
101	Oxamyl	1	1	3
102	Oxydemeton-methyl	1	1	30
103	Oxyfluorfen	1	1	1
104	Paraffin oils (+)	1	1	28
105	Paraquat			38
106	Paraquat dichloride		1	10
107	Parathion-methyl	1	1	59
108	Pendimethalin			1
109	Pentachlorophenol (PCP) and salts	1	1	62
110	Permethrin	1	1	29
111	Phorate	1	1	37
112	Phosphamidon	1	1	49
113	Phoxim			29
114	Picloram		1	4
115	Profenofos (+)		1	29
116	Propanil			29
117	Propargite			29
118	Propoxur	1	1	29
119	Pymetrozine	1	1	2
120	Quinalphos (+)		1	31
121	Quintozene (pentachloronitrobenzene)			38
122	Resmethrin (+)	1	1	28
123	Simazine			31
124	TCMTB (+)		1	28
125	Tefluthrin	1	1	1

	Active ingredient	Highly Hazardous Pesticides with FAO-WHO criteria	Highly Hazardous Pesticides with PAN international criteria	Number of countries where there is a ban *
126	Temephos		1	28
127	Terbufos	1	1	34
128	Terbutryn (+)		1	28
129	Thiabendazole			1
130	Thiodicarb	1	1	29
131	Tralomethrin (+)		1	29
132	Triazophos	1	1	40
133	Trichlorfon		1	32
134	Tridemorph (+)	1	1	28
135	Trifluralin		1	28
136	Vamidothion	1	1	31
137	Vinclozolin	1	1	33
138	Warfarin	1	1	28
139	Zinc phosphide	1	1	2
140	Zineb		1	33
	Total	65	111	

(+) Highly hazardous pesticides that are not prohibited in any country, but are not allowed in the European Union.

(++) DDT is included because it is not banned, it has a "restricted use" registry from the Ministry of Health although it is not used.

(+++) Azinfos methyl, captafol and endosulfan are included because they still have registers under review, according to the 2016 COFEPRIS Pesticide Catalog; although by communication of Sagarpa-Senasica of 1 August 2016 it is reported that COFEPRIS has canceled its registration and "invites" not to use them in agriculture.

* The complete list of countries who had banned this pesticide can be found in the PAN Consolidated list of bans, April 2017.

Source: PAN Consolidated List of Bans, April, 2017; COFEPRIS Catálogo de Plaguicidas 2016, México.

ANNEX III

Report of the Special Rapporteur on the right to food to the Human Rights Council Thirty-fourth session 27 February-24 March 2017

B. Recommendations

106. The international community must work on a comprehensive, binding treaty to regulate hazardous pesticides throughout their life cycle, taking into account human rights principles. Such an instrument should:

a) Aim to remove existing double standards among countries that are particularly detrimental to countries with weaker regulatory systems;

b) Generate policies to reduce pesticide use worldwide and develop a framework for the banning and phasing-out of highly hazardous pesticides;

c) Promote agroecology;

d) Place strict liability on pesticide producers.

107. States should:

a) Develop comprehensive national action plans that include incentives to support alternatives to hazardous pesticides, as well as initiate binding and measurable reduction targets with time limits;

b) Establish systems to enable various national agencies responsible for agriculture, public health and the environment to cooperate efficiently to address the adverse impact of pesticides and to mitigate risks related to their misuse and overuse;

c) Establish impartial and independent risk-assessment and registration processes for pesticides, with full disclosure requirements from the producer. Such processes must be based on the precautionary principle, taking into account the hazardous effects of pesticide products on human health and the environment;

d) Consider non-chemical alternatives first, and only allow chemicals to be registered where need can be demonstrated;

e) Enact safety measures to ensure adequate protections for pregnant women, children and other groups who are particularly susceptible to pesticide exposure;

f) Fund comprehensive scientific studies on the potential health effects of pesticides, including exposure to a mixture of chemicals as well as multiple exposures over time;

g) Guarantee rigorous and regular analysis of food and beverages to determine levels of hazardous residues, including in infant formula and follow-on foods, and make such information accessible to the public;

h) Closely monitor agricultural pesticide use and storage to minimize risks and ensure that only those with the requisite training are permitted to apply such products, and that they do so according to instructions and using appropriate protective equipment;

i) Create buffer zones around plantations and farms until pesticides are phased out, to reduce pesticide exposure risk;

j) Organize training programmes for farmers to raise awareness of the harmful effects of hazardous pesticides and of alternative methods;

k) Take necessary measures to safeguard the public's right to information, including enforcing requirements to indicate the type of pesticides used and level of residues on the labels of food and drink products;

l) Regulate corporations to respect human rights and avoid environmental damage during the entire life cycle of pesticides;

m) Impose penalties on companies that fabricate evidence and disseminate misinformation on the health and environmental risks of their products;

n) Monitor corporations to ensure that labelling, safety precautions and training standards are respected;

o) Encourage farmers to adopt agroecological practices to enhance biodiversity and naturally suppress pests, and to adopt measures such as crop rotation, soil fertility management and crop selection appropriate for local conditions;

p) Provide incentives for organically produced food through subsidies and financial and technical assistance, as well as by using public procurement;

q) Encourage the pesticide industry to develop alternative pest management approaches;

r) Eliminate pesticide subsidies and instead initiate pesticide taxes, import tariffs and pesticide-use fees.

108. Civil society should inform the general public about adverse impact of pesticides on human health and environmental damage, as well as organizing training programmes on agroecology.

Source: A/HRC/34/48 . Report of the Special Rapporteur on the right to food. Human Rights Council Thirty-fourth session 27 February-24 March 2017 Agenda item 3; in https://documents-dds-ny.un.org/doc/UNDOC/GEN/G17/017/85/PDF/G1701785.pdf?OpenElement