Environmental and Health Impacts of Pesticides and Fertilizers and Ways of Minimizing Them

Envisioning A Chemical-Safe World

Chapter 3 of 12

The regulatory and policy environment for pesticide management

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About

In December 2017, Resolution 4 of the 3rd Session of the United Nations Environment Assembly (UNEA 3) requested "the Executive Director to present a report on the environmental and health impacts of pesticides and fertilizers and ways of minimizing them, given the lack of data in that regard, in collaboration with the World Health Organization (WHO), the Food and Agriculture Organization of the United Nations (FAO) and other relevant organizations by the fifth session of the United Nations Environment Assembly". In response to this request, UNEP published a *Synthesis Report on the Environmental and Health Impacts of Pesticides and Fertilizers and Ways to Minimize Them*[1] in February 2022 (United Nations Environment Programme [UNEP] 2022).

The overall goal of the synthesis report is to provide the information base to enable other advocacy actions to be taken by stakeholders to minimize the adverse impacts of pesticides and fertilizers. Specific objectives of the synthesis report are to:

- Update understanding of current pesticide and fertilizer use practices;
- Present major environmental and health effects of pesticides and fertilizers, during their life cycle, and identify key knowledge gaps;
- Review current management practices, legislation and policies aimed at reducing risks in the context of the global chemicals, environmental and health agenda;
- Identify opportunities to minimize environmental and health impacts, including proven and innovative approaches.

This chapter on "The regulatory and policy environment for pesticide management" is the 3rd in a series of 12 chapters that make up a comprehensive compilation of scientific information. The chapters were developed to both inform and further elaborate on the information provided in the synthesis report. Please note that the disclaimers and copyright from the synthesis report apply

1 The Synthesis report is available at https://www.unep.org/resources/report/environmental-and-health-impacts-pesticides-and-fertilizers-and-ways-minimizing.

The regulatory and policy environment for pesticide management

3

3.1 Overview

A broad and varied legislative and policy landscape exists for pesticide management. It addresses the manufacturing, trade and use of pesticides at international, regional and national levels. A range of instruments and mechanisms can exert a direct influence on pesticide management, for example through provisions that address individual pesticides, the trade in pesticides or pesticide-treated commodities, and pesticide legislation; or they may affect pesticide distribution and use indirectly by shaping broader environmental, health or economic legislation and policies. The extent to which such instruments contribute to pesticide risk reduction is assessed in this report, although not exhaustively.

Most international instruments, both legally binding and voluntary, have substantial provisions and programmes aimed at promoting information exchange, conducting training and awareness building activities, providing guidance on best practices, and strengthening technical and administrative skills. However, improving knowledge, awareness and attitudes with regard to sound pest and pesticide management does not necessarily reduce pesticide risks in a given country, region or situation. [Chapter 3.2]

Four legally binding instruments (the Montreal Protocol and the Rotterdam, Stockholm and Minamata Conventions) address individual pesticides. When those pesticides were listed under the respective conventions, however, the use of a considerable number of them had already been greatly reduced or had discontinued. At the same time, prospects of new listings of pesticides of concern have been shown to face constraints due to both technical and political limitations. The contribution of these instruments to reducing the environmental and human health risks posed by pesticides has therefore been limited. Exceptions are methyl bromide (under the Montreal Protocol) and endosulfan (under the Rotterdam and Stockholm Conventions), where significant reductions in use have been noted after they were listed. [Chapter 3.2.2]

There are indications that participation in multilateral environmental agreements (MEAs) results in the strengthening of national legislation. This improvement has occurred through strengthening of legislation and pesticide registration, harmonization of standards such as maximum residue limits (MRLs), and better evaluation and hazard classification of pesticides. An international mechanism, the Strategic Approach to International Chemicals Management (SAICM), has set the stage for addressing issues of concern such as the risks posed by Highly Hazardous Pesticides, globally. [Chapter 3.2]

A challenge in the case of many legally binding and voluntary international instruments is that their impact on pesticide risk reduction cannot be well evaluated. Appropriate indicators and procedures to allow such evaluation are not adequate, partly because the key objectives of these instruments may focus on addressing some specific aspects of the broader pesticide or chemical risk reduction. An exception is the Global Monitoring Plan of the Stockholm Convention on Persistent Organic Pollutants (POPs) and the implementation of the International Code of Conduct of Conduct on Pesticide Management [Chapter 3.2.6].

Regional cooperation is potentially a powerful approach for activities carried out over larger geographical regions, such as efficacy and residue testing and the evaluation, classification and authorization of pesticides, especially if resources are limited. Regional collaboration has also proven effective in high income regions. Such collaboration tends to be easier to implement in regions with similar administrative cultures, economic and agronomic conditions, and constraints. [Chapter 3.3].

Most countries in the world have adopted dedicated pesticide legislation providing a national legal basis for managing the registration, trade and use of pesticides. In many cases, however, not all aspects of the pesticide life cycle are effectively covered by national legislation, while procedures may be insufficient for effective pesticide management. Furthermore, legislation on domestic and public health pesticides is still inadequate in many countries (FAO 1996; WHO 2004; FAO 2010; Matthews *et al*. 2011; FAO and WHO 2019a). [Chapter 3.4.1].

The majority of countries have a pesticide registration system in place to evaluate and authorize the use of agricultural pesticides. Nevertheless, registration of public health and domestic use pesticides is inadequate in many countries. Especially in low and lower-middle income countries, human resources for the sound evaluation of pesticides are very limited while assessing efficacy, hazards and risks is becoming increasingly complex. [Chapter 3.4.2].

Government inspection and control of pesticide-related activities are essential for effective implementation of national pesticide legislation. However, capacity for enforcement is generally considered weak in many countries, often due to limited resources and fragmented regulatory entities. [Chapter 3.4.3].

Globally, the adoption of comprehensive pesticide management policies or strategies has been rare so far. Targets for the reduction of pesticide risks and/or use have mainly been established in Europe. Other countries have incorporated pest management principles in their legislation, regulations and associated policies. In countries that lack a comprehensive national pest/vector and pesticide management policy, adopted by the main stakeholders, the elaboration of such a policy would represent an important first step towards setting concrete targets for pesticide risk reduction. [Chapter 3.4.5].

Identifying ways to minimize the human health and environmental impacts of pesticides is part of the mandate of the report. It should be emphasized that pesticide risk reduction may not be a formal or explicit objective of some of the instruments reviewed. The evaluation is therefore not an assessment of the effectiveness of those instruments against their specific objectives, for which other mechanisms may be in place.

To assess whether an international, regional or national instrument contributes to a reduction of pesticide risks or impacts, outcome indicators and output indicators are used. Outcome indicators can be quantitatively related to a likely reduction in pesticide risks. Output indicators may lead to a reduction in pesticide risks if an instrument is implemented effectively.

Outcome indicators:

- Reduction in the authorization or use of pesticides (particularly hazardous ones) and/or banning, for example through cancelling imports or registration of such pesticides and/or replacing them with less hazardous alternatives such as biopesticides or low-risk pesticides, or through using approaches such as integrated pest or vector management (IPM/IVM) and agroecology;

- continued use of pesticides (particularly hazardous ones), but in such a manner that they pose lower risks to human health and the environment, e.g., through use restrictions, user training, less hazardous formulations, lower application rates and frequencies, and more/better use of personal protective equipment (PPE).

Output indicators:

- generation of tools, such as best practice guidelines and training materials for risk assessment, that may lead to reduced pesticide risks;

- implementation of activities, such as technical support for pesticide regulators and training in IPM or IVM, that may lead to reduced pesticide risks.

3.2 International instruments that address pesticide distribution and use

3.2.1 Introduction

A considerable number of international instruments and mechanisms address one or more aspects of the life cycle of pesticides. Some are legally binding, while others are voluntary. Although international instruments may directly address pesticide management, production, distribution and use, they can also provide more general policy context that indirectly addresses how pesticides are managed and used (Figure 3.2-1). The main provisions of these international instruments, insofar as they concern pesticides, are reviewed below.

3.2.2 Legally binding international instruments that directly address pesticides

The Rotterdam Convention

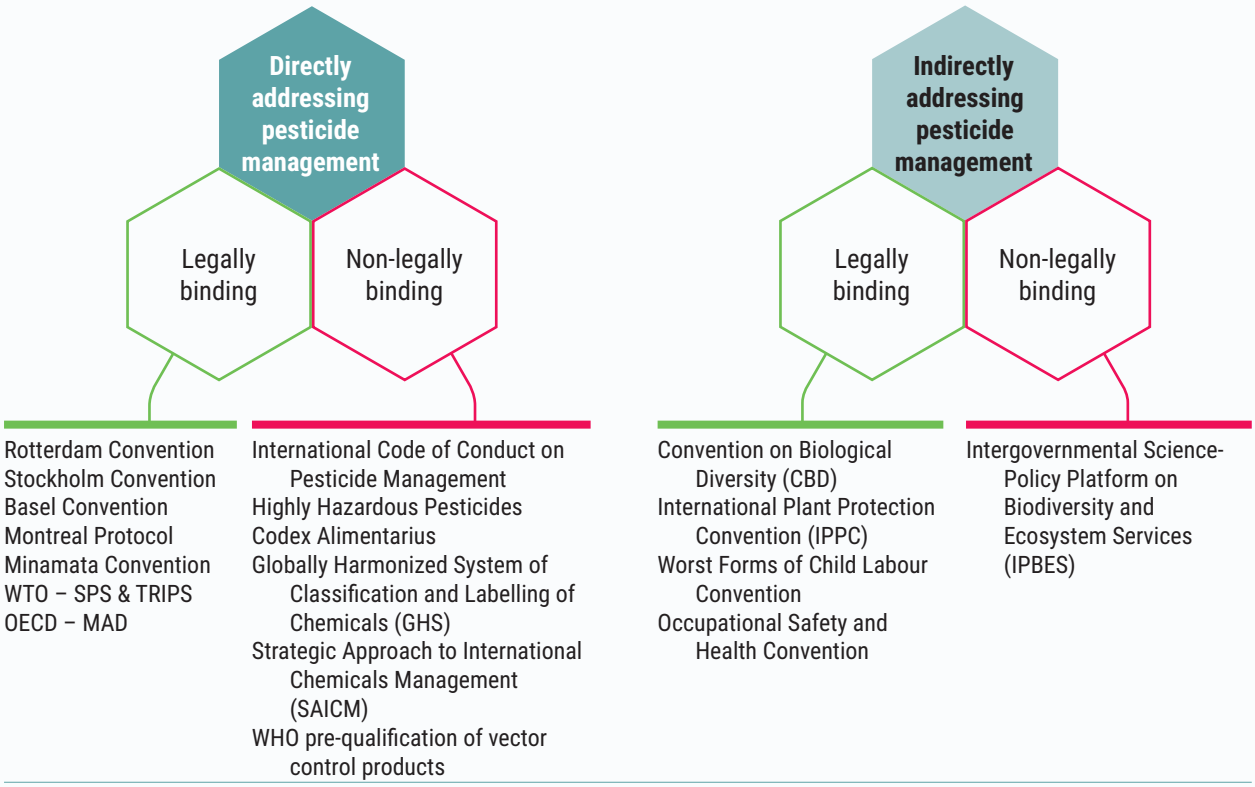
The Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade was adopted in 1998 and entered into force in 2004. As of late 2020, there were 164 Parties to the Convention (Rotterdam Convention 2020a).

Objectives and provisions

The objective of the Rotterdam Convention is to "promote shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals in order to protect human health and the environment from potential harm and to contribute to their environmentally sound use, by facilitating information exchange about their characteristics, by providing for a national decision-making process on their import and export and by disseminating these decisions to Parties" (Rotterdam Convention 2019).

The Convention provides for listing of pesticides and industrial chemicals in its Annex III. Listing in Annex III does not in itself constitute a ban. Instead, it is based on national bans or severe restrictions for health and/or environmental reasons, notified to the Secretariat, in at least two countries in different prior informed consent (PIC) regions – or, in the case of Severely Hazardous Pesticide Formulations (SHPFs) (Rotterdam Convention n.d. a), nomination by one country. Following the listing of chemicals in Annex III, Parties communicate whether they consent to the importation of these chemicals.

Figure 3.2-1 Key international instruments and mechanisms which address pesticide management and use, either directly or indirectly. Conventions are listed only if they have been ratified by more than 50 countries. Based on Food and Agriclture Organization of the United Nations and World Health Organization [FAO and WHO] (2014).



Note: Conventions are only listed if they are ratified by more than 50 countries.

The main provisions of the Rotterdam Convention are:

- *Notification of bans or severe restrictions*: Parties are required to inform other Parties, through the Secretariat, of any final regulatory action to ban or severely restrict a chemical. Notification of a final regulatory action is a first step that may lead to a decision by the Conference of the Parties (COP) to list a chemical in Annex III and subject it to the prior informed consent (PIC) procedure.

- *Severely hazardous pesticide formulations*: A Party which is a developing country, or a country with an economy in transition, that experiences problems caused by a pesticide formulation under conditions of use in its territory may propose its listing in Annex III as a severely hazardous pesticide formulation.

- *Prior informed consent (PIC)*: Parties are required to indicate whether they consent (with or without conditions) to future importation into their territory of chemicals listed in Annex III. Other Parties are required to respect those decisions.

- *Export notification*: Parties that plan to export a chemical which is banned or severely restricted for use within its territory are required to inform the importing Party that such export will take place.

- *Safety information*: Parties are required to ensure that both chemicals listed in Annex III and chemicals banned or severely restricted in their territory, when exported, are adequately labelled with regard to risks and/or hazards to human health or the environment, and, if the chemicals are used for occupational purposes, are accompanied by a safety data sheet;

- *Information exchange*: Parties shall facilitate the exchange of scientific, technical, economic and legal information concerning the chemicals within the scope of the Convention, including toxicological, ecotoxicological and safety information.

Given the importance of information exchange and transparency about trade in hazardous chemicals, the Rotterdam Convention and its PIC procedure have been described as a system of "global governance by disclosure" (Jansen and Dubois 2014). Nevertheless, the Rotterdam Convention covers only a small fraction of the pesticides currently traded internationally.

The Rotterdam Convention and pesticides

There are 52 chemicals listed in Annex III of the Rotterdam Convention, of which 36 are pesticides (including three severely hazardous pesticide formulations) (Rotterdam Convention n.d. b) (Table 3.2-1). In addition, more than 80 per cent of all bans and severe restrictions notified to the Convention, but not listed yet, concern pesticides. Thus a large percentage of the chemicals within the scope of the Rotterdam Convention are pesticides and the Convention can potentially have a great impact on their trade, management and use. It should be noted, however, that many of the pesticides listed in Annex III are hardly, if at all, produced and used any more.

Table 3.2-1 Pesticides listed in Annex III of the Rotterdam Convention. Rotterdam Convention (n.d.b).

Pesticide	Listed since
2,4,5-T and its salts and esters	1998
Aldrin	1998
Captafol	1998
Chlordane	1998
Chlordimeform	1998
Chlorobenzilate	1998
Dichlorodiphényltrichloroéthane (DDT)	1998
Dieldrin	1998
Dinoseb and its salts and esters	1998
EDB (1,2-dibromoethane)	1998
Fluoroacetamide	1998
HCH (mixed isomers)	1998
Heptachlor	1998
Hexachlorobenzene	1998
Lindane (gamma-HCH)	1998
Mercury compounds, including inorganic mercury compounds, alkyl mercury compounds and alkyloxyalkyl and aryl mercury compounds	1998
Methyl-parathion (emulsifiable concentrates (ECs) at or above 19.5 per cent active ingredient and dusts at or above 1.5 per cent active ingredient	1998
Pentachlorophenol and its salts and esters	1998
Phosphamidon (soluble liquid formulations of the substance that exceed 1,000 grams (g) active ingredient/litre)	1998
Binapacryl	2004
Dinitro-ortho-cresol (DNOC) and its salts (such as ammonium salt, potassium salt and sodium salt)	2004
Dustable powder formulations containing a combination of benomyl at or above 7 per cent, carbofuran at or above 10 per cent, and thiram at or above 15 per cent	2004
Ethylene dichloride	2004
Ethylene oxide	2004
Monocrotophos	2004
Parathion	2004
Toxaphene (camphechlor)	2004
All tributyltin compounds	2008
Alachlor	2011
Aldicarb	2011
Endosulfan	2011
Azinphos-methyl	2013
Methamidophos	2015
Carbofuran	2017
Trichlorfon	2017
Phorate	2019

Only eight new pesticides have been included in Annex III since 2011 (Table 3.2-1). Adding new pesticides which will be subject to the PIC procedure has been slow for several reasons. Notifications of final regulatory actions to ban or severely restrict pesticides have been made to the Convention, but many did not meet the information requirements for consideration as a potential Annex III chemical. Specific attention has therefore been given to facilitating the submission of notifications through technical assistance and the development of a Final Regulatory Action Evaluation Toolkit, among other activities. Furthermore, there have been few proposals to include SHPFs in Annex III and only two of these proposals have reached the Conference of the Parties. No consensus was reached on including these SHPFs in Annex III at the most recent Conference of the Parties (COP-9) in 2019.

Decisions to list a chemical must be taken by consensus. In a number of cases Parties have been unable to agree unanimously that certain chemicals should be added to Annex III, although proposed new listings were recommended by the Chemical Review Committee (a subsidiary body of the Convention which reviews notifications from Parties of final regulatory actions) and the COP subsequently acknowledged that the criteria for listing set out in the Convention had been met. In 2015 this difficulty was formally recognized by the Parties, which mandated a search for options to enhance the effectiveness of the Rotterdam Convention (Rotterdam Convention 2015). Options to improve the PIC procedure all appear to have serious legal and operational implications, and so far no concrete measures have been adopted (Center for International Environmental Law 2018; Rotterdam Convention 2018).

Contribution to pesticide risk reduction

As explained above, the objective of the Rotterdam Convention is not explicitly to reduce the human health and environmental risks posed by hazardous chemicals. However, its various provisions have been established "in order to protect human health and the environment from potential harm" and "to contribute to the environmentally sound use" of such hazardous chemicals.

Reduced risks of continued use of pesticides listed under the Convention

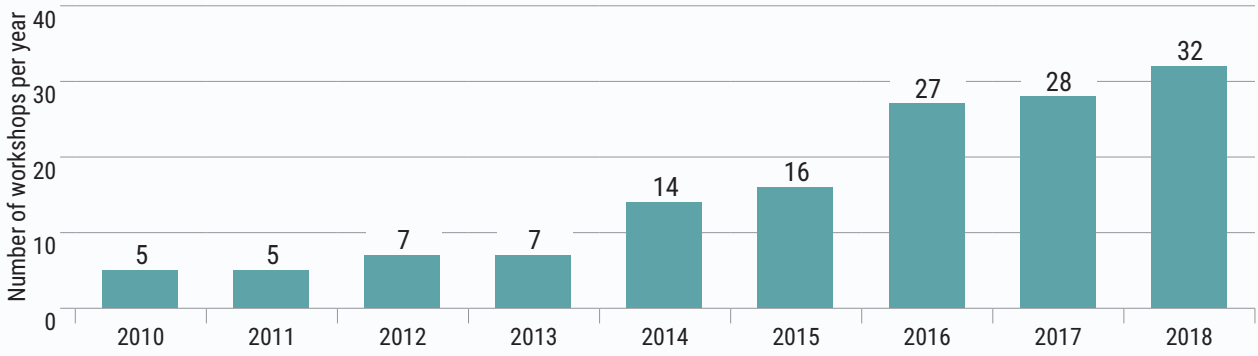
No reviews have yet been conducted to assess whether the pesticides listed in Annex III are used and managed more judiciously by Parties following their listing. However, the principal activity under the Convention is information provision and exchange on chemicals and their risks. This includes, among others, access to Parties' risk assessments and regulatory decisions; dissemination of Decision Guidance Documents (DGDs) and additional information on pesticides listed in Annex III; PIC Circulars (Rotterdam Convention n.d. c); databases on notifications of final regulatory actions and of import responses; and guidance documents on alternatives to certain pesticides within the scope of the Convention.

Capacity-building to support implementation of the Rotterdam Convention has always been an important activity under the Convention. An extensive resource kit, an e-learning tool, training materials, webinars, presentations and workshops have been developed. Some of these activities, such as workshops, have intensified in the last few years (Rotterdam Convention 2020b) (Figure 3.2-2).

Initially, much of this capacity-building focused on procedural matters related to the Convention, e.g., regarding Designated National Authorities (DNAs) or the Chemical Review Committee (CRC) and on building legal and administrative frameworks for implementation, including for transmission of information as set out in the Convention. More recently, technical assistance is also being provided on activities that are essential at the national/regional level to reduce risks posed by hazardous chemicals. Examples are surveying and monitoring pesticide use and impact, risk evaluation and assessment, import/export inspections, identification of alternatives to hazardous pesticides, and strengthening legislative frameworks on pesticide management.

Information exchange and capacity-building are cornerstones of the Convention. While there are always possibilities to further strengthen these activities, the Convention appears to have been successful in raising awareness about the trade

Figure 3.2-2 The Rotterdam Convention has greatly increased its capacity-building initiatives. Shown are the annual number of workshops organized by or with the Rotterdam Convention on pesticides and industrial chemicals combined between 2010 and 2018. Rotterdam Convention (2020b).



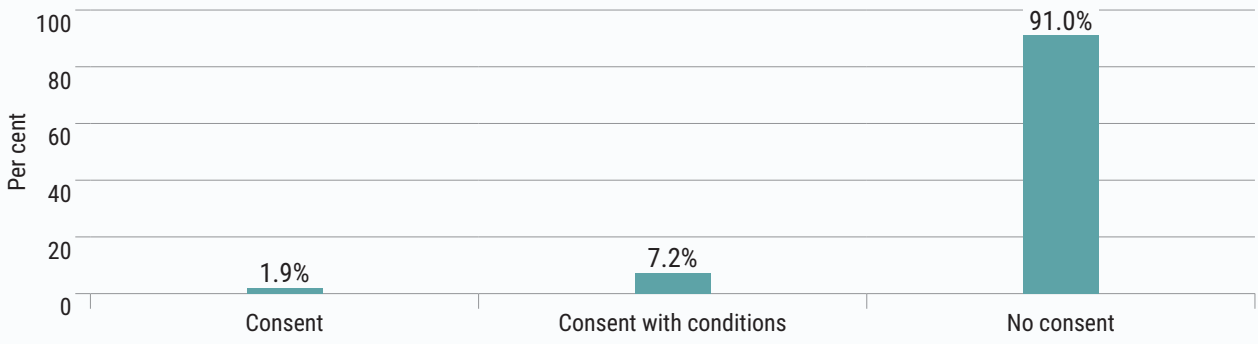
in hazardous chemicals and creating a basis for informed decision-making by Parties. In a review of the PIC procedure, Jansen and Dubois (2014) concluded that more information regarding regulatory decisions on banning and restricting the use of pesticides, together with scientific evidence of harm, had become available. Nevertheless, there are currently no data to show whether this has led, in turn, to reduced human health and environmental risks as a result of continued use of the pesticides listed under the Convention.

Reduced use of pesticides listed under the Rotterdam Convention

Slightly more information is available about the reduction or cancellation of the importation and use of pesticides within the scope of the Convention. It is assumed that reducing or cancelling the importation and/or use of a hazardous pesticide leads to a reduction of the risks it poses.

Through the PIC procedure, Parties are required to communicate a decision about whether to consent to future importation of pesticides listed in Annex III. If, as the result a pesticide being listed in Annex III, a Party decides not to consent to that pesticide being imported (or to consent to its importation only under certain conditions) and that pesticide was imported and used before listing, use of the pesticide in that country will likely be reduced. If, on the other hand, a Party's decision not to authorize the importation and use of a pesticide was taken before it was listed in

Figure 3.2-3 The large majority of responses received by the Rotterdam Convention regarding importation of the pesticides listed in Annex III were "no consent". Situation on 23 April 2019; total number of import responses was 4,404. Rotterdam Convention (2020c).



Annex III, the Convention will have no impact on reducing the use of the pesticide in that country.

By early 2019, 5,600 import responses for Annex III pesticides could in theory have been provided by Parties; slightly more than 4,400 were actually submitted (an overall response rate of about 79 per cent). Thus a large majority of import responses for pesticides listed in Annex III were submitted. More than 90 per cent of the import responses indicated "no consent" to future importation of these pesticides; 7 per cent required certain conditions for importation of the pesticide; and only 2 per cent consented to importation (Rotterdam Convention 2020c) (Figure 3.2-3). No consolidated information is available on whether these import decisions were submitted to the Secretariat of the Convention before or after a national decision on authorization to import or use was taken. While it is unclear whether listing of the pesticide in Annex III was the reason importation was halted or reduced, there are indications of the impact of listing pesticides in Annex III in other studies.

A partial evaluation was conducted by the Secretariat to assess whether listing a chemical in Annex III led to an increase in notifications of bans or severe restrictions (Rotterdam Convention 2017). Six pesticides listed from 2008 onwards were included in this study. No increase in notifications of bans or restrictions was observed following their listing. However, since many Parties had not submitted notifications of all regulatory actions to ban or restrict a pesticide, that result did not fully indicate whether such decisions had been taken by the Parties.

Another study, by the European Commission, assessed the effect of listing four pesticides (alachlor, aldicarb, monocrotophos and parathion) on trade volumes and prices (European Commission [EC] 2017a). It found there was no conclusive evidence of an impact on trade as a result of listing any of these pesticides. In three case studies both prices and trade were broadly similar before and after listing. In one case study, and in some countries, trends were identified suggesting possible effects of listing (e.g., price increase, decrease in trade, switching to alternatives).

Núñez-Rocha and Martínez-Zarzoso (2019) conducted a study of global trade flows of hazardous chemicals, identified through World Customs Organization (WCO) Harmonized Commodity Description and Coding System (HS codes) (World Customs Organization 2020) between 1995 and 2012. They concluded that when an exporting country became a Party to the Convention, and the flow was from an Organisation for Economic Co-operation and Development (OECD) country to a non-OECD country, a limited but statistically significant reduction in imports of hazardous chemicals was observed. The overall effect was a cumulative decrease in imports of about 7 per cent during the period studied.

The Stockholm Convention

The Stockholm Convention on Persistent Organic Pollutants (POPs) was adopted in 2001 and entered into force in 2004. As of the end of 2020, there were 184 Parties to the Convention (Stockholm Convention 2019a).

Objectives and provisions

The objective of the Stockholm Convention is, "mindful of the precautionary approach as set forth in Principle 15 of the Rio Declaration on Environment and Development, to protect human health and the environment from persistent organic pollutants" (Stockholm Convention 2017a).

The main provisions of the Stockholm Convention relevant to pesticides are:

- *Elimination*: Parties are required to take legal or administrative measures to eliminate the production, use, import and export of the chemicals listed in Annex A (Elimination).

- *Restriction*: Parties are required to restrict the production, use, import and export of the chemicals listed in Annex B (Restriction), in accordance with the conditions stipulated therein.

- *Importation*: Parties are required to ensure that importation of chemicals listed in Annexes A and B is only for the purpose of environmentally

sound disposal or for a use or purpose which is permitted for that Party.

- *Export*: Parties are required to ensure that a chemical listed in Annex A for which there is an exemption available, or a chemical listed in Annex B for which there is a specific exemption or an acceptable purpose available, is exported only:
  - for the purpose of environmentally sound disposal; or
  - to a Party permitted to use that chemical; or
  - to a State, not Party to the Convention, which has provided an annual certification to the exporting Party.
- *Authorization*: Parties that have regulatory and assessment schemes for new pesticides are required to prevent the production and use of new pesticides which exhibit the characteristics of persistent organic pollutants. They should also take into consideration the criteria for persistent organic pollutants when conducting assessments of pesticides currently in use.
- *Exemptions*: Parties that have a specific exemption under Annex A or Annex B shall take appropriate measures to ensure that any production or use under such exemption or purpose is carried out in a manner that prevents or minimizes human exposure and release into the environment
- *Stockpiles and waste*: Parties are required to identify stockpiles containing chemicals listed in Annex A or Annex B, as well as wastes containing such chemicals. Any wastes containing such chemicals should be handled, collected, transported, stored and disposed of in an environmentally sound manner.

The Stockholm Convention and pesticides

Of the chemicals listed in Annex A, 16 are pesticides (Stockholm Convention 2019b) (Table 3.2-2). The one pesticide listed in Annex B is dichlorodiphényltrichloroethane (DDT). DDT is only to be used for disease vector control, in accordance with the WHO recommendations and guidelines on its use and when locally safe, effective and affordable alternatives are unavailable. Few pesticides in current use have all the POPs characteristics and would meet the screening criteria which are set out in Annex D to the Convention. POPs characteristics are also considered at the early stage of development of pesticides by the pesticide industry. As a result, fewer pesticides may be listed in the future.

Table 3.2-2 Pesticides listed under the Stockholm Convention. Stockholm Convention (2019b).

Pesticide	Listed since	Pesticide	Listed since
Annex A: Elimination			
Aldrin	2001	Alpha-hexachlorocyclohexane (α-HCH)	2009
Chlordane	2001	Beta-hexachlorocyclohexane (β-HCH)	2009
Dieldrin	2001	Chlordecone	2009
Endrin	2001	Lindane	2009
Heptachlor	2001	Pentachlorobenzene	2009
Hexachlorobenzene	2001	Technical endosulfan and its related isomers	2011
Mirex	2001	Pentachlorophenol and its salts and esters	2015
Toxaphene	2001	Dicofol	2019
Annex B: Restriction			
DDT	2001		

Contribution to pesticide risk reduction

Eight of the 16 pesticides in Annex A were listed after 2004, the year the Convention entered into force. In all but one case (pentachlorophenol) listing of pesticides was done by consensus. All pesticides proposed so far by the POPs Review Committee, a subsidiary body that reviews chemicals nominated for inclusion under the Convention (Stockholm Convention 2019c), have been listed.

Evaluation of the effectiveness of protecting human health and the environment from POPs is an explicit requirement under the Stockholm Convention. The Convention provides a process for evaluating its effectiveness at intervals (Stockholm Convention 2019d). In practice this is done by evaluating, among other things, whether:

- releases from intentional production and use are eliminated or reduced;
- releases from unintentional production are eliminated or reduced;
- releases from stockpiles and wastes are eliminated or reduced;
- environmental levels of POPs are decreasing over time.

To monitor POPs in the environment, the Convention has adopted a Global Monitoring Plan (GMP) for persistent organic pollutants (Stockholm Convention 2017b; Stockholm Convention 2019e). As part of the GMP, POPs pesticides are monitored in air and human tissues. Although most POPs pesticides are no longer used, such monitoring helps to quantify "legacy risks" posed by those which are highly persistent.

The latest effectiveness evaluation was carried out in 2017 (Stockholm Convention 2017c; Stockholm Convention 2019e), while use of DDT was assessed in 2019 (Stockholm Convention 2019f). The main results of these assessments are:

- A decrease in the production, use, export and import was observed for all of the POPs pesticides initially listed in 2001 (Figure 3.2-4). However, most production and use of these pesticides had reportedly ceased before the entry into force of the Stockholm Convention in 2004 except in the case of DDT. No data were available on the continued production of more recently listed POPs pesticides. However, imports of lindane and endosulfan, listed respectively in 2009 and 2011, appeared to show a decreasing trend (Figure 3.2-4).
- Between 2010 and 2017 global DDT use for disease vector control declined by 60 per cent, from about 5,200 tons of active ingredient (a.i.) per year in the period 2003-2009 to about 2,000 tons per year in the period 2015-2017. India was the main user of DDT, primarily to control malaria and leishmaniasis. It was responsible for 95 per cent of global use in the period 2015-2017. Use of DDT for malaria control in sub-Saharan Africa was relatively minor compared to that in India, not exceeding 100 tons a.i. per year in 2015-2017. The number of Parties using POPs pesticides had greatly declined overall since 2001 (Figure 3.2-5). However, this was not the case for the number of Parties using POPs which were industrial chemicals.
- While considerable efforts had been made to dispose of stocks of obsolete POPs pesticides, particularly in Africa, significant stockpiles still existed in some low and middle income countries. These stockpiles could pose a continuing risk to the environment and human health owing to unintentional emissions and illegal use.
- For most of the POPs pesticides initially listed, concentrations in air had declined or remained at low levels due to restrictions that predated the Stockholm Convention and had been maintained at low levels since. The same was true for DDT/dichlorodiphenyldichloroethylene (DDE) levels in human tissues. For some of the more recently listed POPs pesticides, such as hexachlorocyclohexanes (HCHs), concentrations in air in some regions were beginning to show declining tendencies. However, concentrations of endosulfan in other matrices still appeared to be increasing (Stockholm Convention 2017b; Stockholm

Figure 3.2-4 **Changes in the quantities of POPs imported for use from before 2004 to 2014.** Stockholm Convention (2017c).

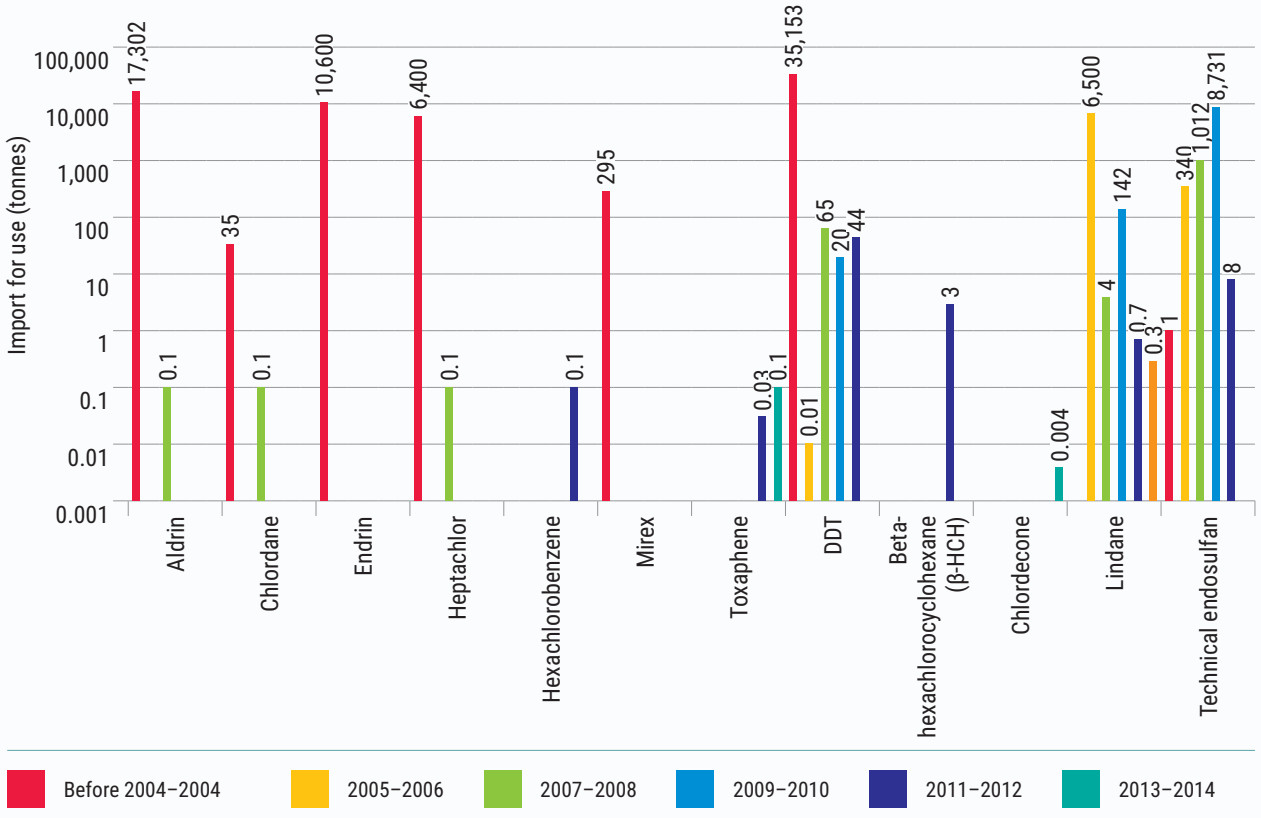
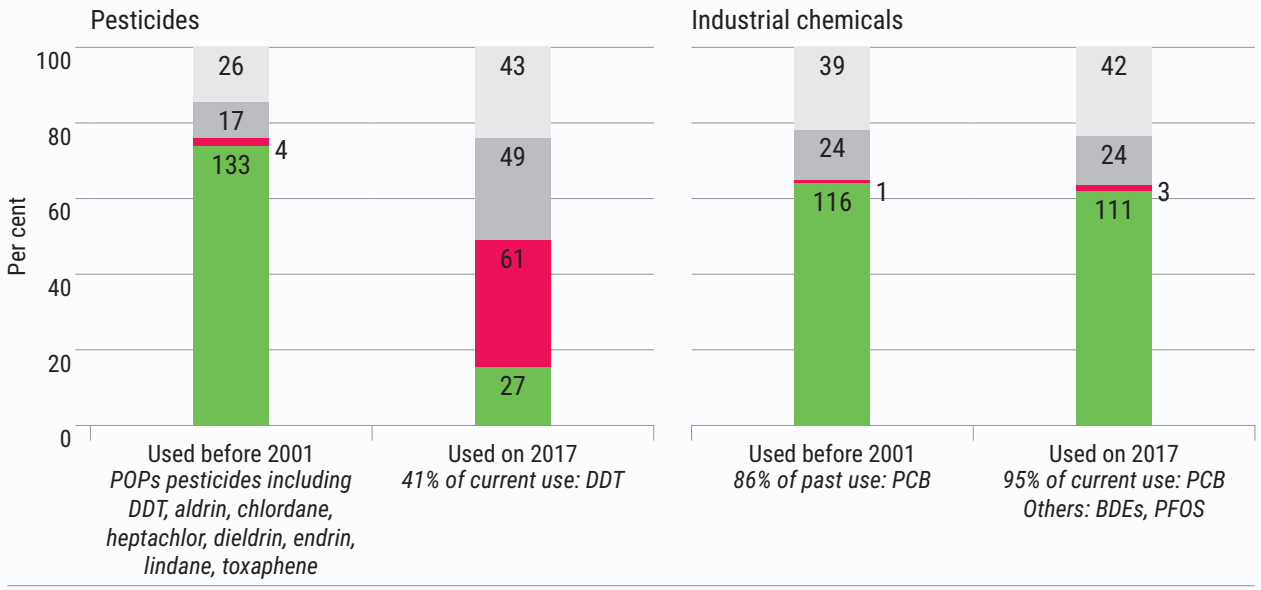


Figure 3.2-5 **74 per cent of Parties used POPs pesticides in 2001, compared with 15 per cent in 2017, but the number of Parties using industrial POPs scarcely declined during the same period.** Stockholm Convention (2017c).



Numbers in the bars are number of Parties.

Convention 2017c). (See Chapter 4.3.2 for more information on pesticide concentrations in the environment.)

The study by Núñez-Rocha and Martínez-Zarzoso (2019) of global trade flows of hazardous chemicals identified through Harmonized System (HS) Commodity Codes (World Customs Organization 2020) from 1995 to 2012 showed a reduction of about 16 per cent in the trade of POPs by importing countries which had ratified the Convention and in that of POPs shipped from OECD to non-OECD countries.

Another contribution to pesticide risk reduction by the Stockholm Convention is the progressive inclusion of (certain) screening criteria for POPs, set out in Annex D, in regional pesticide management policy and/or national pesticide legislation or decision-making procedures. Consequently, pesticides that have several POPs characteristics are less likely to be authorized for use in these countries. That is the case, for example, in member countries of the Permanent Interstate Committee for Drought Control in the Sahel (CILSS), member countries of the Southern African Development Community, Myanmar, and Member States of the European Union (EU), among others.

The Basel Convention

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal was adopted in 1989 and entered into force in 1992. As of late 2020, there were 188 Parties to the Convention (Basel Convention 2020a). An amendment to the Convention, often referred to as the Ban Amendment, was adopted in 1995 and entered into force on 5 December 2019 (Basel Convention 2020b). A Protocol on Liability and Compensation for Damage Resulting from Transboundary Movements of Hazardous Wastes and their Disposal, adopted in 1999, has not yet entered into force (Basel Convention 2019; United Nations Treaty Collection 2020).

Objectives and provisions

The overarching goal of the Basel Convention is to protect human health and the environment from the adverse effects that may result from the generation and management of hazardous and other wastes. The Convention regulates transboundary movements (imports and exports) of hazardous wastes and other wastes. It obliges Parties to ensure that such wastes are managed and disposed of in an environmentally sound manner.

The Convention applies to hazardous and other wastes. Annexes I and VIII list wastes that are classified as hazardous and are subject to the control procedures under the Convention. Annex II identifies wastes that require special consideration ("other wastes").

The provisions of the Convention centre around the following principal aims:

- reduction of hazardous waste generation and promotion of environmentally sound management of hazardous wastes, wherever the place of disposal;
- restriction of transboundary movements of hazardous wastes, except where these are perceived to be in accordance with the principles of environmentally sound management;
- a notice and consent regulatory system applicable to cases in which transboundary movements are permissible.

The Basel Convention and pesticides

Wastes from the production, formulation and use of pesticides (including pesticides which are off-specification, outdated or unfit for their originally intended use), as well as wastes from the manufacture, formulation and use of wood preserving chemicals, fall within the definition of hazardous wastes under the Convention.

For hazardous wastes, including pesticide wastes, the Convention stipulates, among many other measures, that Parties have obligations to:

- ensure that their generation is reduced to a minimum;
- ensure the availability of adequate disposal facilities for their environmentally sound management;
- ensure that the transboundary movement of hazardous wastes and other wastes is conducted in a manner that will protect human health and the environment against the adverse effects which may result from such movement;
- not allow the export of wastes to a Party which has prohibited all imports, or if it has reason to believe that the wastes in question will not be managed in an environmentally sound manner in the importing country. Furthermore, a Party shall not permit wastes to be exported to a non-Party or be imported from a non-Party (except in compliance with Article 11 of the Convention);
- when exporting a hazardous waste, including pesticide waste, notify the competent authority of the countries concerned of any proposed transboundary movement of this waste.

In addition, Parties listed in Annex VII (EU Member States, OECD member countries, and Liechtenstein) which have agreed to be bound by the Basel Convention have an obligation to prohibit all transboundary movements of hazardous wastes destined for final disposal operations from Annex VII States to States not listed therein, and to do the same with regard to certain hazardous wastes destined for recovery or recycling operations

The Parties to the Convention have adopted a series of technical guidelines, including on the environmentally sound management of wastes consisting of, containing or contaminated with POPs listed under the Stockholm Convention.

For hazardous wastes including pesticides, general guidance has been developed for their environmentally sound management as well as technical guidance for treatment and disposal that will also apply to some current use pesticide wastes.

Contribution to pesticide risk reduction

An evaluation of the Basel Convention's effectiveness is required at least every six years. To that end, the Conference of the Parties has adopted a number of indicators for measuring achievement and performance in regard to its Strategic Framework for the Implementation of the Basel Convention for 2012-2021 (Basel Convention 2011; Basel Convention 2020c). Most of these indicators measure the processes or outputs of the Convention, but none address the impacts of reducing hazardous waste generation, the degree of implementation of environmentally sound management of hazardous wastes, or the restriction of transboundary movements of hazardous wastes. Only 19 per cent of the Parties responded to setting a baseline for the indicators (Basel Convention 2014); the final evaluation is expected to be available in 2021.

A review of certain provisions of the Basel Convention was conducted by Kellenberg and Levinson (2014). Trade flows of hazardous wastes from 1988 to 2008 among countries that did and did not ratify the Convention or the Ban Amendment were assessed. The authors concluded that trade in hazardous wastes had greatly increased during the study period and that the Convention had had no effect on the growth of this trade. Reportedly, this may be due in part to the increasing quantities of used electronics and other materials being shipped for recycling, which are also classified as wastes under the Convention. Since no distinction was made in this study between pesticide wastes and other hazardous wastes, it is not clear whether the conclusions apply to pesticide wastes.

It should be noted, however, that the Convention does not aim to eliminate or reduce trade in wastes. Rather, it puts in place trade control measures for transboundary movements of the wastes within its scope.

The Montreal Protocol

The Montreal Protocol on Substances that Deplete the Ozone Layer was adopted in 1987 and entered into force in 1989. The Protocol has been ratified by 198 parties, and as at 4 February 2021

four of its five amendments had been ratified by 197 parties while the fifth one, the Kigali Amendment (adopted in October 2016), had been ratified by 113 parties (UNEP 2020a).

Objectives and provisions

The objective of the Montreal Protocol is to reduce and eliminate the production and consumption of man-made chemicals that destroy the stratospheric ozone layer and harm the climate. This is to be done by controlling (i.e., eliminating or strongly reducing) the production and use of these chemicals, researching and promoting alternatives, and assisting countries to implement such alternatives.

The Montreal Protocol and pesticides

The only pesticide covered by the Montreal Protocol is methyl bromide. This pesticide was used extensively in the past as a fumigant to control a wide range of pests and pathogens present in soils, in post-harvest storage of commodities and in structures. Since alternatives were available for most such applications, they were classified under the Protocol as "controlled uses" which needed to be eliminated (UNEP 2019a).

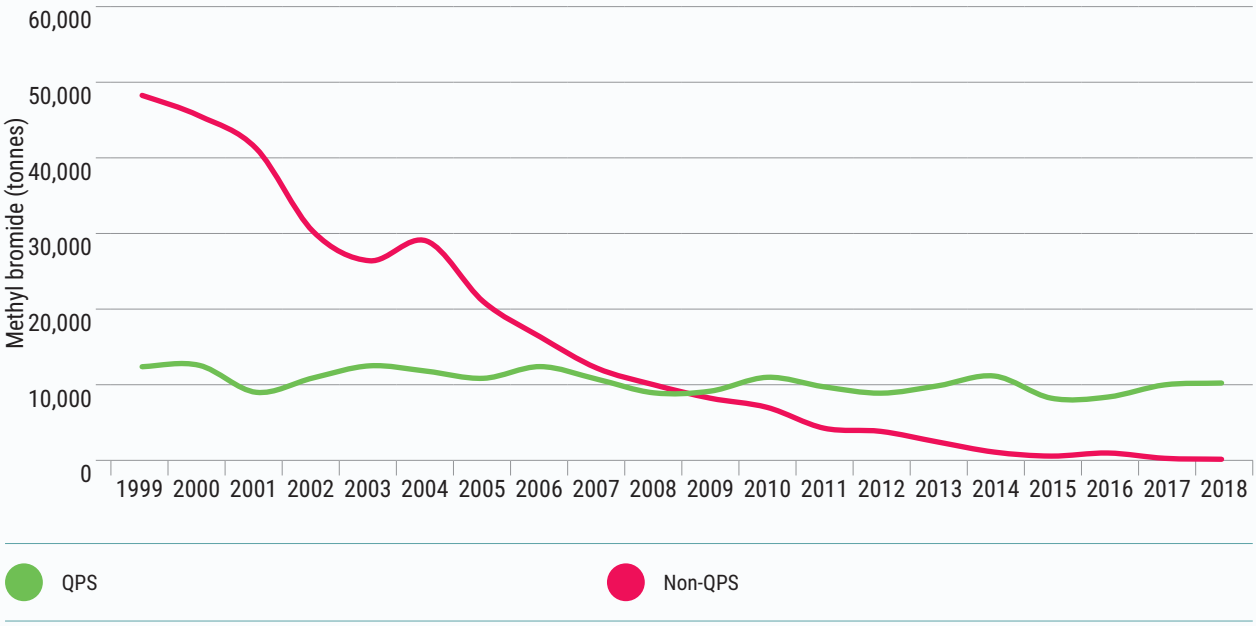
The Protocol includes a provision for "critical uses" which applies to specific cases in which technically or economically viable alternatives to methyl bromide are unavailable. Exemptions are granted annually under this provision on a case-by-case country basis, but requested amounts have fallen by 99 per cent since 2005 as alternatives have been adopted (the Ozone Secretariat, personal communication).

In addition, methyl bromide continues to be used on various traded goods as phytosanitary treatment to control pests and pathogens of quarantine importance. These treatments are known as "Quarantine and Pre-shipment" (QPS) uses. They usually take place before a country exports the traded goods or upon their arrival in the importing country. QPS uses of methyl bromide are not controlled under the Montreal Protocol, but there are annual data reporting requirements (UNEP 2019a).

Contribution to pesticide risk reduction

Global consumption of methyl bromide for controlled uses was reported to be 64,420 tons in 1991 and remained above 60,000 tons until 1998. By 2017 global consumption had fallen

Figure 3.2-6 Estimated global consumption of methyl bromide 1999-2018 for quarantine and pre-shipment (QPS) uses and non-QPS uses. Montreal Protocol (2018) and the Ozone Secretariat (personal communication).



to 245 tons for critical uses, a reduction of 99.6 per cent (Montreal Protocol 2018).

QPS uses of methyl bromide are exempted under the Protocol, but are closely monitored and accounted for. Exempted QPS uses of methyl bromide amounted to about 10,000 tons in 2017, a level that has remained stable during the last two decades (Figure 3.2-6).

Approximately 10,000 tons of methyl bromide are still produced on an annual basis, 86 per cent down from a peak of 74,000 tons in 1991 (Montreal Protocol 2018). The Montreal Protocol has thus been very effective in reducing controlled uses of methyl bromide. QPS uses, however, remain unchanged, representing about 15 per cent of production at the time of entry into force of the Protocol.

The Methyl Bromide Technical Options Committee has indicated that about 35-40 per cent of current QPS uses could be replaced with readily available chemical and non-chemical alternatives, and has provided lists of such alternatives to methyl bromide for QPS uses. Many of the alternatives have been approved by the International Plant Protection Convention, which in principle allows international trade to occur using these quarantine and pre-shipment treatments. However, it is not clear to what extent such alternatives will replace QPS uses of methyl bromide in the short term, as legal, economic and practical constraints still exist.

The Minamata Convention

The Minamata Convention on Mercury is a global treaty was adopted in 2013. It entered into force in 2017. By late 2020 there were 125 Parties to the Convention (UNEP 2020b).

Objectives and provisions

The objective of the Minamata Convention is to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds.

Pesticides and the Minamata Convention

Pesticides containing mercury are listed under "mercury-added products" in Annex A of the Convention. The Convention stipulates that such products should be phased out by all Parties unless a Party demonstrates that it has already reduced to a de minimis level the manufacture, import and export of the large majority of the product(s).

The manufacture, import or export of pesticides, biocides and topical antiseptics containing mercury is not allowed after 2020. So far, four countries have requested and received exemptions from the phase-out of mercury-containing pesticides until 2025.

A wide variety of mercury compounds have been applied in the past as fungicides, herbicides, insecticides and microbicides. Based on current inventories, however, pesticides are no longer a relevant source of mercury emissions (Minamata Convention 2013; Minamata Convention 2019).

Contribution to pesticide risk reduction

Mercury-based pesticides have been listed in Annex III of the Rotterdam Convention since 1998. More than 95 per cent of the Parties to the Rotterdam Convention have indicated that they did not consent to the importation of such pesticides (Rotterdam Convention 2020c), suggesting that significant risk reductions may no longer be reported in this product category in Annex A.

World Trade Organization agreements

Within the World Trade Organization (WTO) three agreements have a direct influence on pesticide management: the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement), the Technical Barriers to Trade (TBT) Agreement, and the Agreement of Trade-Related Aspects of Intellectual Property Rights (TRIPS).

The SPS Agreement

The Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) entered into force with the establishment of the WTO on

1 January 1995. It concerns the application of food safety and animal and plant health regulations, including pesticide residues in food (World Trade Organization [WTO] 2010).

The main objective of the SPS Agreement is to ensure that food is safe according to national levels of protection while, at the same time, avoiding the use of health and safety regulations as an excuse to protect domestic producers from foreign competition. To this end, the SPS Agreement recognizes the right of governments to take measures to protect human, animal and plant health as long as these measures are based on science, are necessary for the protection of health, and do not unjustifiably discriminate among foreign sources of supply. At the same time, it encourages governments to "harmonize" or base their national measures on international standards. For pesticides these standards are the maximum residue limits (MRLs) established by the Codex Alimentarius Commission.

On average, about a quarter of all notifications under the SPS Agreement are pesticide-related (i.e., related to MRLs), indicating the importance of pesticide MRLs under this agreement (Figure 3.2-7). There have been no SPS-related disputes concerning pesticide MRLs to date (WTO Agriculture and Commodities Division, personal communication).

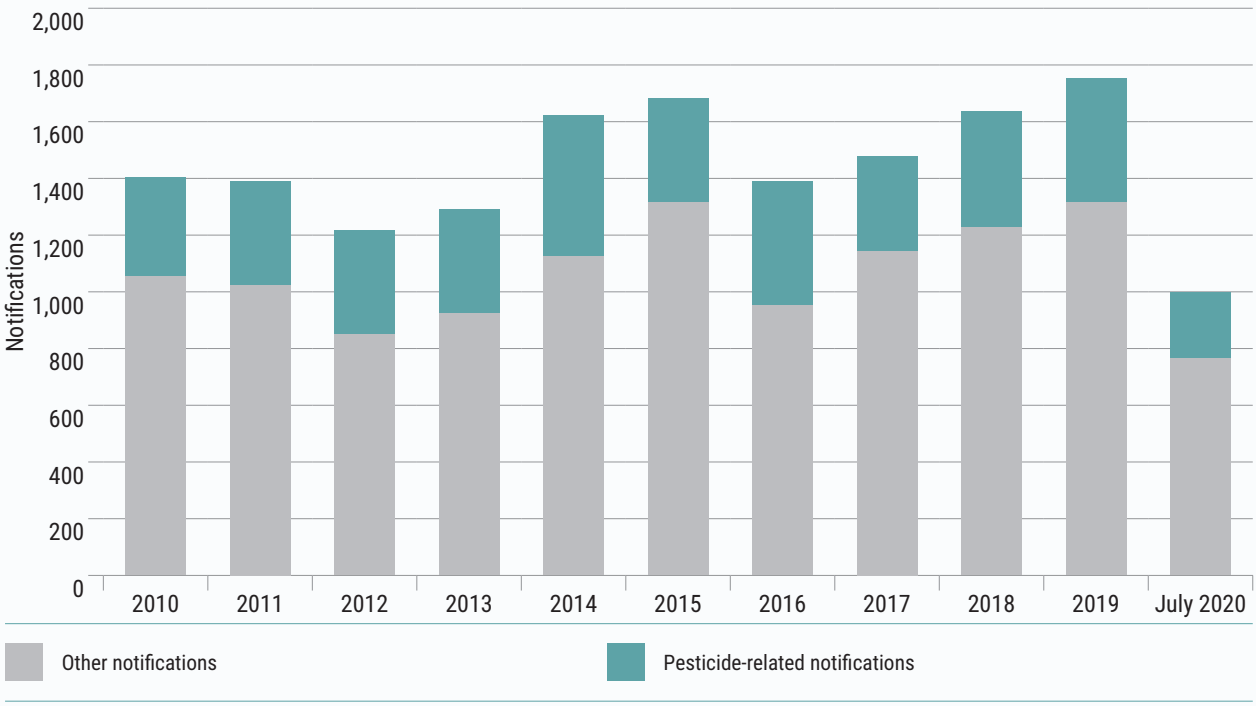
The SPS Agreement is accompanied by a Standards and Trade Development Facility (STDF) which provides technical support to developing countries to build their capacity to implement international standards and gain and maintain market access (Standards and Trade Development Facility 2020).

Figure 3.2-7 Pesticide-related notifications under the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) as a share of all SPS notifications, January 2010-July 2020. World Trade Organization (Agriculture and Commodities Division).

TBT Agreement

The WTO Agreement on Technical Barriers to Trade (TBT Agreement) entered into force with the establishment of the WTO on 1 January 1995.

Figure 3.2-7 **Pesticide-related notifications under the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) as a share of all SPS notifications, January 2010-July 2020.**
World Trade Organization (Agriculture and Commodities Division, personal communication).



The TBT Agreement aims to ensure that technical regulations, standards, and conformity assessment procedures are non-discriminatory and do not create unnecessary obstacles to trade. At the same time, it recognises WTO members' right to implement measures to achieve legitimate policy objectives, such as the protection of human health and safety, or protection of the environment (WTO 2014).

SPS or TBT?

If a measure is applied to protect human or animal life from risks arising from pesticides in food, beverages or feedstuffs (i.e., food safety issues), SPS applies. On the other hand, TBT applies to other technical regulations and voluntary standards issued to protect the environment or human health from risks posed by pesticides (i.e., not related to food safety). These include specifications to ensure that the pesticide works effectively, specifications to protect farmers from possible harm from handling pesticides (e.g., packaging requirements, usage labelling) and classification of substances, among others.

In some cases WTO members may have a single regulation which jointly covers food safety issues related to pesticides (i.e., SPS-related concerns) and other types of safety concerns, as indicated above (i.e., TBT-related concerns). These types of regulations are normally notified under both Agreements, since the single regulation covers multiple areas (WTO Agriculture and Commodities Division, personal communication).

TRIPS Agreement

The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement) also entered into force with the establishment of the World Trade Organization (WTO 2017). It sets minimum standards of protection for intellectual property rights. Another key objective of TRIPS is that intellectual property protection should contribute to technical innovation and the transfer of technology.

Of particular relevance to pesticide registration are the provisions on undisclosed information (e.g., trade secrets and test data) under Article 39. The TRIPS Agreement stipulates that test data submitted to governments in order to obtain marketing approval for new agricultural chemicals must be protected against unfair commercial use. In addition, such data must be protected against disclosure, except where necessary to protect the public, or unless steps are taken to ensure that the data are protected against unfair commercial use.

In principle, pesticide regulatory authorities from countries that are members of the WTO should put into place measures to implement TRIPS provisions for data protection.

Contribution to pesticide risk reduction

The contribution of the SPS agreement to pesticide risk reduction depends to a large extent on the level of acceptance by Parties of the Codex Alimentarius MRLs. A large number of countries indeed appear to adopt, or make use of, Codex pesticide MRLs (Chapter 3.2.3; Codex Alimentarius).

The contribution of the TRIPS agreement to pesticide risk reduction depends to a large extent on the level of protection and exclusive use of data submitted to national and regional regulatory authorities for the registration of pesticides. No global review of this aspect is available. So far, no disputes regarding the failure to protect against unfair commercial use of test data submitted for market approval of pesticides (TRIPS Article 39) have been treated by WTO.

OECD – Mutual Acceptance of Data (MAD)

The Organisation for Economic Co-operation and Development (OECD) developed the Mutual Acceptance of Data (MAD) system to avoid conflicting or duplicative national requirements, provide a common basis for cooperation among national authorities, and avoid creating non-tariff barriers to trade. The MAD system is based on three OECD Council Decisions (Organisation for Economic Co-operation and Development [OECD] 2020a):

- The 1981 Council Decision on the Mutual Acceptance of Data in the Assessment of Chemicals (revised in 1997), which states

that test study data generated in any member country in accordance with OECD Test Guidelines and Principles of Good Laboratory Practice (GLP) shall be accepted in other member countries for assessment purposes and other uses relating to the protection of human health and the environment.

- The 1989 Council Decision-Recommendation on Compliance with Principles of Good Laboratory Practices, which establishes procedures for monitoring GLP compliance through government inspections and study audits as well as a framework for international liaison among monitoring and data-receiving authorities.

- The 1997 Council Decision on the Adherence of Non-Member countries to the Council Acts related to the Mutual Acceptance of Data in the Assessment of Chemicals that sets out a step-wise procedure for non-OECD economies to take part as full members in this system.

The objective of the MAD system is to harmonize chemical health and safety testing (including of pesticides) and ensure sharing of such data among OECD member countries as well as non-member adherents. In addition to the 36 OECD member countries, six non-member countries are currently full adherents to MAD.

OECD member countries and adherents to MAD must mutually accept non-clinical health and safety study data if:

- the study has been conducted according to OECD Test Guidelines and OECD Principles of GLP; and

- the study has been conducted in a test facility which has been inspected by a national GLP compliance monitoring programme; and

- the national GLP compliance monitoring programme has undergone a successful evaluation by OECD.

This is the concept of "tested once, accepted for assessment everywhere". However, while the receiving government must accept the study, how it interprets study results is its own prerogative.

The OECD Test Guidelines have been developed for the determination of physico-chemical properties, ecotoxicological studies, environmental fate and behaviour, and human toxicology and health effects, as well as for other areas (e.g., biocides).

Contribution to pesticide risk reduction

The OECD Principles of GLP and Test Guidelines have become a global standard for generation of health and safety data for pesticide registration, including in countries that do not formally adhere to the MAD system. It has been estimated that by reducing duplication of testing, and creating a framework for the sharing of work, the MAD system saves governments and industry around 309 million euros each year, as well as reducing the number of animals used in such testing (OECD 2020b).

Furthermore, it can be argued that through the international review and harmonization of testing methodologies, and the application of the GLP system, pesticide studies are of higher quality, leading to better risk assessments. The MAD system also facilitates exchange of evaluations among regulatory authorities, as well as joint reviews.

3.2.3 Voluntary international instruments and mechanisms that directly address pesticides

International Code of Conduct on Pesticide Management

Objectives and provisions

The International Code of Conduct on Pesticide Management is one of the oldest international instruments addressing the sound management of chemicals (FAO and WHO 2014). Its elaboration started in the early 1980s and the first version was adopted by the FAO Conference in 1985, then under the name International Code of Conduct on the Distribution and Use of Pesticides (Table 3.2-3).

Table 3.2-3 History of the Code of Conduct.

Year of adoption	Version	Main modifications
1985 (FAO Conference)	International Code of Conduct on the Distribution and Use of Pesticides	
1989 (FAO Conference)	Amended version	Inclusion of the prior informed consent (PIC) procedure
2002 (FAO Council)	Revised version	Deletion of the PIC procedure due to the adoption of the Rotterdam Convention Strengthening of the life cycle concept Strengthening of monitoring and observance provisions
2013 (FAO Conference) 2014 (WHO Executive Board endorsement)	International Code of Conduct on Pesticide Management	Incorporation of public health pesticides and vector control Strengthening of health and environmental aspects Introduction of the concept of Highly Hazardous Pesticides (HHP) Co-published by WHO

Table 3.2-4 Outline of the Code of Conduct. (FAO and WHO 2014).

Article		Article	
1	Objectives of the Code	7	Availability and use
2	Terms and definitions	8	Distribution and trade
3	Pesticide management	9	Information exchange
4	Testing of pesticides	10	Labelling, packaging, storage and disposal
5	Reducing health and environmental risks	11	Advertising
6	Regulatory and technical requirements	12	Monitoring and observance of the Code

The Code of Conduct was originally elaborated to establish standards of conduct for public and private entities engaged in the distribution and use of pesticides. It was aimed, in particular, at countries that had no or inadequate pesticide legislation. Subsequent revisions have included the prior informed consent (PIC) procedure, which later developed into the Rotterdam Convention; strengthening of the life cycle concept for pesticide management; and inclusion of public health pesticides and enhanced health and environmental protection. The title of the latest version of the Code of Conduct was broadened to cover all aspects of pesticide management and was published jointly by FAO and WHO.

From a tool to assist countries with inadequate pesticide legislation in the 1980s, the Code of Conduct has developed into a broad voluntary framework for the sound management of pesticides endorsed by all FAO member countries, WHO, and key pesticide industry and civil society organizations.

The provisions of the Code of Conduct are organized around 12 articles covering the main aspects of pesticide regulation, use and management (Table 3.2-4).

Implementation

Since the Code of Conduct was first adopted, FAO has spearheaded its implementation through a variety of activities. A large number of technical assistance projects have been implemented over the years in all parts of the world, focusing on specific provisions of the Code such as strengthening pesticide legislation, capacity-building for pesticide evaluation and registration, improving and harmonizing pesticide

efficacy and residue testing, reducing health and environmental risks, disposing of obsolete pesticides, and management of empty containers.

Furthermore, a considerable number of technical and policy guidelines have been published by FAO and WHO to support the implementation of specific provisions of the Code of Conduct (FAO 2020a; WHO 2020c). FAO has also developed an on-line Pesticide Registration Toolkit to support pesticide registration staff in countries with limited resources (FAO 2020b).

A Panel of Experts has advised FAO on the implementation of the Code of Conduct since its inception. From 2007, WHO has nominated experts to join these discussions, leading to the establishment of the FAO/WHO Joint Meeting on Pesticide Management (JMPM).

Other stakeholders have also taken actions to implement the Code of Conduct. Adherence to the Code is a requirement for membership in CropLife International (CLI). This organization has developed a guide and an e-learning tool for its members (CropLife International [CLI] 2017). It also has a product stewardship programme focusing on responsible distribution and use of pesticides (Chapter 3.5.2).

Shortly after the Code of Conduct was first issued, the International Organization of Consumers Unions (IOCU) and the Pesticide Action Network (PAN) developed a Citizens' Action Guide to the Code of Conduct (Goldenman and Rengam 1987). PAN also published a consolidated guide to the chemical tools and conventions (Goldenman and Pozo Vera 2008) which provided a checklist for implementation of the Code of Conduct. A dedicated Code monitoring module has been developed to help concerned organisations to monitor compliance with the Code of Conduct by governments and industry (Pesticide Action Network Asia and Pacific and Pesticide Action Network UK 2016). In addition, PAN carries out projects that promote implementation of parts of the Code of Conduct, in particular on alternatives to more hazardous pesticides.

Contribution to pesticide risk reduction

The status of implementation of the Code of Conduct has been evaluated several times since its original adoption in 1985. A baseline survey was conducted in 1986 by FAO, and subsequently several surveys have been organized by FAO and/or WHO (Table 3.2-5). All surveys targeted government bodies responsible for pesticide management, generally those responsible for agriculture and for public health.

While the first two surveys were practically identical, later surveys targeted different government bodies and included a variety of aspects and questions, which makes comparison of the outcomes difficult. Despite this variability, however, some trends can be distinguished for certain key provisions of the Code that were included in most of the surveys (Table 3.2-6).

The number of countries that have legislation concerning the marketing, distribution, sales and use of pesticides has significantly increased during the last 30 years. On the other hand, such legislation is clearly lagging behind in the case of public health pesticides. Pesticide

Table 3.2-5 Surveys conducted by FAO and WHO on implementation of the Code of Conduct.

Survey year	Number of responding countries (response rate)	Responding government bodies	Reference
1985	119 (75%)	Agriculture	FAO (1993)
1993	91 (51%)	Agriculture	FAO (1996)
2003	71 (57%)	Health	WHO (2004)
2008	39 (21%)	Agriculture	FAO (2010)
2010	113 (80%)	Health	Matthews *et al.* (2011); WHO (2011a)
2018	52-94 (27-48 %)	Agriculture, health	FAO/WHO (2019c); van den Berg *et al.* (2020)

Table 3.2-6 **Trends in the implementation of certain key provisions of the Code of Conduct (percentage of responding countries agreeing with these statements)** (for sources, see Table 3.2-5).

Statement on implementation of provisions of the Code of Conduct	Percentage of positive responses						Trend
	1985	1993	2003	2008	2010	2018	
National legislation for marketing and use of agricultural pesticides is in place	80	96	95	97	84	95	Unchanged since 1993
National legislation for marketing and use of public health pesticides is in place	[1]		13	32	74	60	Improved
Pesticides must be registered before they are placed on the market	66	78		96/100[2]			Improved
Pesticide distributors and retailers are regulated	53	57			80 (ag)/ 65 (ph)[3]	79 (ag)/ 47 (ph)	Improved?[4]
Pest control operators are regulated			62		70		Improved?
Pesticides are labelled adequately	52	51		77/94			Improved
The quality of pesticides on the market is inadequate (i.e. substandard, counterfeit)	50	48		68/32	67	40	Unchanged
Regulators have access to pesticide quality control laboratories	11	22	49	37/78	50	59	Improved, but stagnated
IPM/IVM successfully promoted	50	55		32/63	62	76	Improved
Monitoring of pesticide residues in food and feed is in place				21/89		58	Unchanged?
Monitoring of pesticide residues in the environment is in place	42	11		21/75		26	Unchanged
Pesticide import and/or use statistics are collected	45	65	68	100/94	78	88	Improved

1 = data unavailable
2 in red: low and lower middle income countries; in green: upper-middle and high income countries (according to World Bank classification, at the time of the survey)
3 ag = retailers of agricultural pesticides; ph = retailers of public health pesticides
4 ? = trend not clear

labelling appears to have improved over time. Pesticide quality, on the other hand, is still considered inadequate in about half of countries, while access to quality control laboratories has stagnated since the early 2000s. The successful promotion of IPM and IVM as preferred pest management approaches is reported from upper middle and high income countries, but much less so from lower middle and low income ones. More governments throughout income groups are collecting statistics on the importation and/or use of pesticides. However, monitoring of pesticide residues in food and feed does not seem to have improved much, especially in lower income countries, while surveillance of such residues in the environment is only conducted in a quarter of all countries, with no significant improvement over the last three decades.

Implementation of Article 3.6 on avoiding the use of pesticides that require personal protective equipment that is unsuitable for small-scale users in hot and humid climates – an important provision for minimizing occupational exposure to pesticides – has not been assessed by any of the surveys.

The surveys conducted so far by FAO and WHO are self-reporting: government representatives are asked to provide information on implementation of the Code of Conduct. No comprehensive independent evaluation of the effectiveness of the Code of Conduct in improving sound pesticide management has ever been conducted. An independent and comprehensive impact assessment of the main provisions of the Code of Conduct could provide valuable insights on

achievements and constraints regarding sound pesticide use and management. Given the breadth of the Code of Conduct, certain of its provisions have, however, been reviewed separately.

Orozco *et al*. (2009) reframed certain articles of the Code of Conduct in terms of farmers' rights and assessed through surveys, farmer focus groups and direct observations the extent to which these rights were respected in Ecuador and Peru. In particular, they evaluated access to information and training about pesticides and alternatives, availability of good quality products, and PPE. Their assessment was that adherence to provisions of the Code by pesticide companies and the government was far less than adequate.

Member organizations of the Pesticide Action Network (PAN) conducted community monitoring in 13 countries in Africa, Asia and Latin America between 2007 and 2009 (PAN 2010). They assessed pesticide use practices, use of personal protective equipment and self-reported symptoms of pesticide poisoning. Based on this survey, their assessment was that 25 years after initial publication of the Code of Conduct, pesticides in these regions were still exposing farmers to significant health risks.

Monitoring observance of the Code of Conduct is explicitly included in its Article 12. Governments are invited to monitor observance and report on progress on implementation of the Code; pesticide industry to report on stewardship; and non-governmental organizations (NGOs) and other interested entities to monitor activities related to the implementation of the Code. (FAO and WHO 2014). FAO further published Guidelines on Monitoring and Observance of the Code of Conduct to facilitate monitoring by third parties (FAO 2006a). This publication describes a procedure for submission and treatment of both regular and ad hoc monitoring reports.

According to the Code of Conduct, monitoring reports can be addressed to the Directors-General of FAO and WHO and the Executive Director of UNEP. In practice these reports are reviewed by the FAO Panel of Experts on Pesticide Management (FAO 2006), which has been superseded de facto by the FAO/WHO Joint Meeting on Pesticide Management (JMPM).

Since these guidelines were published, three formal submissions of ad hoc monitoring reports have been made by a university and several NGOs and reviewed by the JMPM in 2007 and 2017 (FAO and WHO 2007; FAO and WHO 2017). The latest monitoring report indicated non-adherence to several provisions of the Code by certain multinational pesticide companies. The JMPM heard arguments from submitters and the implicated pesticide companies. However, the submitters subsequently argued that the JMPM response was not concrete enough and would allow such practices to continue (Public Eye 2017). The JMPM began a revision of its guidance on this topic in 2019 (FAO and WHO 2019b).

Because the Code of Conduct is a voluntary instrument, no legally formalized procedures exist for reporting and treating alleged non-observance of the Code; only guidance has been published by FAO. However, to stimulate monitoring by third parties and ensure that outcomes of such activities can be translated into concrete actions that strengthen effective implementation of the Code, the manner in which these reports are reviewed and published by FAO and WHO will require further attention.

It may be concluded that the contribution of the Code of Conduct to pesticide risk reduction is variable, with advances in some aspects of pesticide management and stagnation with regard to many others. Overall, low income countries have the highest incidence of gaps in pesticide life cycle management when compared to the provisions covered by the Code of Conduct (van den Berg *et al*. 2020).

Highly Hazardous Pesticides

Objectives and provisions

The International Code of Conduct currently defines Highly Hazardous Pesticides (HHPs) as "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 or their listing in relevant binding international agreements or conventions. In addition, pesticides that appear to cause severe or irreversible harm to health or the environment under conditions of use in a country may be considered to be and treated as highly hazardous" (FAO and WHO 2014).

While there is no formal international instrument or mechanism specifically addressing HHPs, various initiatives have been taken to reduce the risks posed by HHPs. The main justification for national governments to consider more strict regulation of HHPs is that they consist of a limited number of pesticides which are estimated to cause a disproportionate portion of human health and environmental adverse effects, particularly in lower income countries.

International criteria to identify HHPs were established by the FAO/WHO JMPM in 2007 and formally published by FAO and WHO in 2016 (Table 3.2-7). Their main objective was to identify a limited number of pesticides that were most likely, under use conditions in lower income countries, to cause a major share of adverse effects on human health and the environment.

Criteria for the toxicity of pesticides go back to the first Recommended Classification of Pesticides by Hazard adopted by WHO in 1975, which recognized the classification of pesticides as extremely or highly hazardous to human health (Copplestone 1988). Although the designation of pesticides as HHPs takes into account both their human health and environmental aspects, current FAO and WHO criteria still mainly cover human health hazards. A broader set of HHP criteria, which includes more human health and environmental aspects, is being applied by the Pesticide Action Network International (Pesticide Action Network 2021). The pesticide industry, on the other hand, has long promoted a narrower set of criteria for HHPs than FAO and WHO although it now follows the FAO and WHO criteria (CLI 2020a).

For many years NGOs and a number of scientists have called on national governments to consider stricter regulation or prohibition of HHPs as a way to reduce the risks of pesticide use (Reeves *et al*. 1999; Dinham and Malik 2003; Konradsen *et al*. 2003). In the mid-2000s prohibition of highly toxic or hazardous pesticides also appeared on the agendas of international platforms such as the Intergovernmental Forum on Chemical Safety (IFCS) and the FAO Council (Table 3.2-8).

HHPs were subsequently identified as an "issue of concern" by the 4th International Conference on Chemicals Management (ICCM) in 2015 (Strategic Approach to International Chemicals Management [SAICM] 2015a). A strategy to address these pesticides was developed by FAO,

Table 3.2-7 Highly Hazardous Pesticides (HHPs) are defined by FAO and WHO as having one or more of the following characteristics (FAO and WHO 2016).

1.	Pesticide formulations that meet the criteria of classes Ia or Ib of the WHO Recommended Classification of Pesticides by Hazard;	or
2.	Pesticide active ingredients and their formulations that meet the criteria of carcinogenicity Categories 1A and 1B of the Globally Harmonized System of Classification and Labelling of Chemicals (GHS);	or
3.	Pesticide active ingredients and their formulations that meet the criteria of mutagenicity Categories 1A and 1B of the Globally Harmonized System of Classification and Labelling of Chemicals (GHS);	or
4.	Pesticide active ingredients and their formulations that meet the criteria of reproductive toxicity Categories 1A and 1B of the Globally Harmonized System of Classification and Labelling of Chemicals (GHS);	or
5.	Pesticide active ingredients listed by the Stockholm Convention in its Annexes A and B, and those meeting all the criteria in paragraph 1 of Annex D of the Convention;	or
6.	Pesticide active ingredients and formulations listed by the Rotterdam Convention in its Annex III;	or
7.	Pesticides listed under the Montreal Protocol;	or
8.	Pesticide active ingredients and formulations that have shown a high incidence of severe or irreversible adverse effects on human health or the environment.	

Table 3.2-8 History of relevant international policy for the identification and risk reduction of Highly Hazardous Pesticides (HHPs).

Year	Entity	Policy proposition	Reference
1975	WHO	Adoption of *The WHO Recommended Classification of Pesticides by Hazard*, which included the classes of extremely and highly hazardous pesticides	Copplestone (1988)
2003	4th Session of the Intergovernmental Forum on Chemical Safety (IFCS)	Recommended prohibiting or restricting the availability and use of acutely toxic pesticides … and/or those pesticides associated with frequent and severe poisoning incidents	IFCS (2003)
2006	131st Session of the FAO Council	Regarding FAO's contribution to SAICM, the Council suggested that FAO activities could include [pesticide] risk reduction, including the progressive ban on Highly Hazardous Pesticides (HHPs), promoting good agricultural practices …	FAO (2006b)
2007	1st FAO/WHO Joint Meeting on Pesticide Management (JMPM)	Recommended criteria for HHPs Recommended priority activities for risk reduction of HHPs	FAO/WHO (2007)
2008	2nd JMPM	Recommended minor amendments to the criteria for HHPs	FAO/WHO (2008)
2013	FAO and WHO	The International Code of Conduct on Pesticide Management includes a definition of HHPs Article 7.5 stipulates that "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."	FAO/WHO (2014)
2015	4th International Conference on Chemicals Management (ICCM)	ICCM Resolution IV/3 identifies HHPs as an "issue of concern" FAO, UNEP and WHO, in consultation with stakeholders, develop a Strategy to Address HHPs in the Context of SAICM	Strategic Approach to International Chemicals Management (SAICM) (2015a; 2015b)
2016	FAO and WHO	FAO and WHO publish *Guidelines on Highly Hazardous Pesticides*	FAO/WHO (2016)
2017	WHO	The 70th World Health Assembly approves the Chemicals Roadmap, which recognizes HHPs as a priority health issue and calls for actions focused on risk management WHO lists HHPs as one of 10 chemicals or groups of chemicals of major public health concern	WHO (2017; 2020a)
2020 - 2021	FAO	FAO, in collaboration with WHO and UNEP, elaborates an Action Plan on HHPs	

UNEP and WHO in consultation with stakeholders (SAICM 2015b). This strategy outlines ongoing work by intergovernmental organizations, identifies responsibilities and inputs from key stakeholders, and lists a number of gaps in HHP risk reduction. Based on an assessment carried out, the strategy identified the following main focus areas for concerted action:

- raising the awareness of different stakeholders about the risks of HHPs, and sharing information about risk reduction measures and viable alternatives;
- facilitating the identification of HHPs;

- capacity-building with regard to regulatory control;
- piloting and mainstreaming alternatives.

This was followed in 2016 by the publication by FAO and WHO of the Guidelines on Highly Hazardous Pesticides (FAO and WHO 2016). These guidelines aim to help national or regional pesticide regulators with limited resources design a process to address HHPs that follows three steps: identification, assessment and mitigation.

More recently, an action plan on HHPs is being elaborated by FAO in close collaboration with WHO and UNEP .

Contribution to pesticide risk reduction

HHP risk reduction is not a formal international mechanism, but rather a set of policy provisions and recommendations under various frameworks and codes. Therefore, a comprehensive review of its effectiveness has not been conducted so far.

The WHO Recommended Classification of Pesticides by Hazard (WHO 2019) has been widely used in Africa, Asia and Latin America both to classify pesticides (e.g., for labelling) and as a decision-making tool. Classes Ia and Ib (extremely and highly hazardous) pesticide products have been strictly regulated or are not allowed to be registered in many low and middle income countries.

Countries continue to take regulatory actions to restrict or cancel the registration of pesticides considered to pose unacceptable hazards and/or risk for human health or the environment. Such measures are often taken independently of the above mentioned policy recommendations concerning HHPs. However, on the basis of

Table 3.2-9 Examples of recent restrictions and bans in low and middle income countries of pesticides considered to pose unacceptable risk to the environment and/or human health.

Country	Year	No. of pesticides cancelled	No. of pesticides otherwise more strictly regulated
Mozambique	2014	61 products containing 31 a.i.'s	52 products containing 11 a.i.'s
Sri Lanka	2016	Registration cancelled of all pesticides containing carbaryl, carbofuran and chlorpyrifos	
Permanent Interstate Committee for Drought Control in the Sahel (CILSS)	2017	Registration cancelled of pesticides containing hexazinone and acetochlor	
Viet Nam	2017	Registration cancelled of plant protection products containing paraquat and 2,4-D	
Argentina	2018	Ban on all agricultural pesticides containing dichlorvos and trichlorfon	
Myanmar	2018	Products containing 15 a.i.'s	Products containing 4 a.i.'s
Malaysia	2019	All products containing paraquat	
Pakistan	2019	WHO class Ia and Ib pesticides will no longer be registered	
Viet Nam	2019	Registration cancelled of plant protection products containing chlorpyrifos-ethyl and fipronil	
India	2020	Prohibition to import, manufacture, sell, transport, distribute and use 27 pesticide active ingredients	
Peru	2020	Registration cancelled of pesticides containing methamidophos	
Turkey	2020	Withdrawal from the market of pesticides containing 16 pesticide active ingredients	

FAO and WHO guidance several countries (e.g., Botswana, Costa Rica, Malawi, Tanzania, Zambia and Zimbabwe) have identified HHPs still in use within their territories while others (e.g., Mozambique and Myanmar) have also taken concrete actions to reduce their risks (FAO 2016; ter Horst *et al*. 2018) (Table 3.2-9).

In 2015-16 CropLife International member companies conducted a portfolio review to assess their production of and trade in HHPs. The focus was on realistic conditions of use in low income countries. Of the approximately 6,400 crop protection products evaluated, 85 per cent were not HHPs; 10 per cent were HHPs which companies considered can be used safely and responsibly; 2.5 per cent required risk mitigation measures or were withdrawn from the market; and 2.5 per cent are under further evaluation (CPI 2020a). This corresponds reasonably well with experiences in countries in Africa and Asia where, on average, 5-10 per cent of registered pesticide products were identified as HHPs (FAO 2016; ter Horst *et al*. 2018).

It is not possible currently to determine the impact that global attention to HHPs has in reducing the risks associated with these pesticides. However, an increasing number of countries have recently banned or severely restricted the use of pesticides which in many circumstances meet HHPs criteria (Table 3.2-9).

For measures to reduce the environmental and human health risks posed by HHPs to be effective, they often need to be far-reaching (e.g., prohibition or severe restriction of the pesticide). This requires high-level national policy support. However, sound pest and pesticide management competes with many other national priorities, and policymakers may not see the urgency of reducing the risks posed by HHPs.

A further major obstacle to the phase-out or restriction of HHPs appears to be the apparent lack of cost-effective lower risk alternatives. Regulators are hesitant to take measures unless alternatives are available for farmers or other pesticide users. Experience shows that such alternatives are often available, in both high and lower income countries, that will not adversely affect production or farmer revenues. Examples are the bans of monocrotophos, methamidophos and endosulfan in Sri Lanka (Manuweera *et al*. 2008), coffee production without endosulfan in Latin America (FAO 2015), and bans of WHO class I pesticides in Bangladesh (Chowdhury *et al*. 2018).

In a recent review, Jepson *et al*. (2020) conclude that certain pesticides which pose a high risk in particular to the environment are not identified as HHPs by the current FAO and WHO criteria. They therefore call on these organizations to broaden the HHP definition to account for effects of concern with regard to important ecological services as well as to human health.

However, it has also been argued that care should be taken not to consider a large number of pesticides as HHPs, as this could hamper effective risk management by national regulators. Such a development could counteract the original objective of identifying a limited number of pesticides which require urgent risk mitigation, as they are very likely to cause undeniably unacceptable risks under conditions of use in lower income countries.

The Codex Alimentarius

Objectives and provisions

The Codex Alimentarius is a collection of internationally adopted food standards and related texts which aim to protect consumer health and promote fair practices in the food trade by setting international, science-based food safety and quality standards (FAO and WHO 2019c).

Codex standards are globally agreed recommendations for voluntary application by members, but in many cases they serve as a basis for national legislation. Furthermore, Codex standards are identified under the Word Trade Organization's (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS) as benchmarks against which national measures and regulations are evaluated (FAO and WHO 2018) (Chapter 3.2.2).

The inaugural meeting of the Codex Alimentarius Commission was held in Rome in 1963.

A joint FAO/WHO Food Standards Programme was also established. Currently the Codex Alimentarius Commission has 189 members made up of 188 Member Countries and one Member Organization (the European Union). In addition, over 200 non-Member governments and intergovernmental and nongovernmental organizations are accredited observers of the Commission; consumers' organizations have been represented at its sessions since 1965 (Codex Alimentarius 2020).

The Codex operates under the umbrella of FAO and WHO, and the Secretariat of the Codex Alimentarius Commission is hosted at FAO headquarters in Rome. Codex committees prepare draft standards for submission to the Commission.

The Codex Alimentarius and pesticides

The Codex Committee on Pesticide Residues (CCPR) is responsible for establishing Codex Maximum Residue Limits (MRLs) for pesticide residues in specific food items or in groups of food or feed that are traded internationally.

Before a Codex MRL can be established, human health risk assessments must be conducted to ensure the food supply is safe. It is the responsibility of the Joint FAO/WHO Meeting on Pesticide Residues (JMPR) to review the appropriate toxicology and data obtained from pesticide residue trials which reflect approved pesticide use in accordance with "good agricultural practice", and to conduct dietary risk assessments. JMPR then recommends specific MRLs to the CCPR which, if considered acceptable, forwards them to the Commission for adoption (Codex Alimentarius 2020).

The Codex has established more than 5,000 pesticide MRLs for over 300 different active ingredients (FAO and WHO 2018).

Contribution to pesticide risk reduction

The globally harmonized Codex MRLs can be considered effective if a majority of countries use them. In recent years there have been concerns that an increasing number of countries are moving away from using the Codex pesticide MRLs and are establishing their own (Yeung *et al*. 2018). Indeed, major economies such as Australia and the United States (as well as the European Union) do set their own MRLs, which are regularly different from those of the Codex (Handford, Elliott and Campbell 2015).

Berry (2016) showed that many countries continue to make use of Codex MRLs and that, even in the case of countries with national standards, Codex MRLs continue to play a role. Ninety-six per cent of countries responded in a recent survey that they recognized, or partly recognized, the MRLs provided by the Codex; 29 per cent of countries reported having established national MRLs that differ from the Codex MRLs (FAO and WHO 2019c). Since most countries use Codex MRLs as a reference point, the Codex process for setting food safety standards and the resulting pesticide MRLs remain very relevant.

There are concerns about the capability of the Codex to harmonize MRLs on a global scale. It has been argued that developing countries, in particular, are adversely affected by the stringent MRLs set by certain countries/regions which create unnecessary trade barriers (Handford, Elliott and Campbell 2015; Yeung *et al*. 2018).

Frustration has also been expressed by Codex members and observers regarding the slow pace of establishing new MRLs by the CCPR and the difficulty of that process, leading to a limited increase in the number of evaluations and in the frequency of JMPR meetings. Nevertheless, it may be several years before Codex MRLs are established for new active ingredients.

The advantages of globally harmonized standard setting for pesticide residues are generally considered to outweigh the difficulties encountered. Science-based pesticide MRLs and associated dietary risk assessments, as established by the CCPR, provide a thorough basis for national food safety regulation, especially in countries with limited resources.

The Globally Harmonized System of Classification and Labelling of Chemicals (GHS)

Objectives and provisions

The main objective of the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) is to ensure that information on the physical hazards and toxicity of chemicals is available in order to enhance the protection of human health and the environment during the handling, transport and use of these chemicals (United Nations Economic Council for Europe [UNECE] 2020a). The GHS also provides a basis for harmonization of rules and regulations on chemicals at national and international levels.

The GHS includes the following elements:

- harmonized criteria for classification of substances and mixtures according to their health, environmental and physical hazards; and
- harmonized hazard communication elements, including requirements for labelling and safety data sheets.
- The first edition of the GHS was adopted in December 2002. It has been updated every two years.

The GHS and pesticides

The International Code of Conduct on Pesticide Management (FAO and WHO 2014) and the FAO and WHO Guidelines on Good Labelling Practice for Pesticides (FAO and WHO 2015) recommend that the GHS classification and labelling provisions be applied to pesticides. Moreover, the GHS classification criteria for carcinogenicity, mutagenicity and reproductive toxicity (CMR) are among the criteria used to identify Highly Hazardous Pesticides (FAO and WHO 2016).

Contribution to pesticide risk reduction

The GHS website lists 72 countries that have implemented (part of) the GHS in national legislation or policy (UNECE 2020b). However, certain countries which are not listed there are applying GHS to the labelling of pesticides, e.g., through national guidelines.

A review by Persson *et al*. (2017) found that, as of 1 April 2017, 50 countries (26 per cent of UN Member States) had fully implemented the GHS in national legislation, 15 countries (8 per cent) had partially implemented it, and 128 countries (66 per cent) had not yet implemented it (these percentages were for the GHS in general, not specifically pesticides). This review noted that the African region was still mainly outside the GHS system, although the Southern African Development Community (SADC) had agreed to implement the GHS by the latest in 2020.

SAICM progress reports, on the other hand, indicate that countries reporting that they labelled pesticides in conformity with the GHS increased from 41 per cent in 2011 to 82 per cent in 2017 (SAICM 2011; SAICM 2019). A recent survey by FAO and WHO (FAO and WHO 2019a) found considerably lower adoption of GHS: 55 per cent of countries reported that pesticide labelling for agriculture was in line with the GHS, and 43 per cent reported that this was the case for public health pesticides.

These somewhat contradictory figures may be partly explained by different survey methods and data sources, but further clarification would be helpful given the role of pesticide labelling in communicating risks and good practices.

GHS criteria have also been used for decision-making for the authorization of pesticides. The European Union generally does not approve pesticide active substances that meet GHS criteria 1A and 1B for carcinogenicity, mutagenicity and reproductive toxicity (EU 2009). Similarly, Myanmar uses criteria for Highly Hazardous Pesticides, which include the GHS CMR criteria, as a decision-making element in its first screening of new pesticide active ingredients (ter Horst *et al*. 2018). This has been criticized by some as not being risk-based, and therefore less relevant for regulatory decision-making. However, the GHS does provide a sound international system to help decision-making in countries that have insufficient resources to conduct extensive local risk

assessments. It has not been assessed to what extent GHS criteria are used in decision-making for pesticide registration around the world.

Persson *et al*. (2017) assessed factors affecting the level of adoption of the GHS by different countries. They conclude that government effectiveness (i.e., the ability to formulate and introduce legislation) was the strongest predictor of GHS implementation, followed by political globalization and commitment to occupational safety. On the other hand, a country's GDP or general commitment to the sound management of chemicals (as measured through participation in international chemicals conventions) were not significantly associated with GHS adoption.

The Strategic Approach to International Chemicals Management (SAICM)

Objectives and provisions

The Strategic Approach to International Chemicals Management (SAICM) is a policy framework to promote chemical safety around the world (SAICM n.d.). Its objective has been to achieve sound management of chemicals throughout their life cycle, so that by the year 2020 they were produced and used in ways that minimized significant adverse impacts on the environment and human health.

Focal points from more than 175 governments are registered with SAICM, as are about 125 non-governmental organizations and 18 intergovernmental organizations. The implementation of SAICM is periodically reviewed by the International Conference on Chemicals Management (ICCM).

SAICM and pesticides

Pesticide risk reduction was proposed from the start as a possible work area in the SAICM Global Plan of Action (GPA) (SAICM n.d.). A large number of pesticide-related activities were identified under three topics:

- risk management and reduction of highly toxic pesticides and promotion of safer pest control measures;
- establishment of pesticide management programmes to regulate the availability, distribution and use of pesticides;
- reduction of health and environmental risks of pesticides.

In addition to work under the GPA, HHPs were identified as an "issue of concern" by SAICM's 4th International Conference on Chemicals Management (ICCM-4) in 2015 (SAICM 2015b). ICCM also identified two "emerging policy issues" which relate to pesticides: endocrine disrupting chemicals and nanotechnology.

Several groups of pesticides have been identified as likely to affect the endocrine system (Chapter 4.3.4). Therefore, risk assessment and reduction activities under this emerging issue may also impact on pesticide use. Nanomaterials are increasingly being used in pesticide formulations (Chapter 2.6.4).

SAICM established a Quick Start Programme (QSP) to support initial enabling capacity-building and implementation activities to meet the SAICM objectives. Additional funding for SAICM-related activities has come from a Global Environment Facility (GEF) project on Global Best Practices on Emerging Policy Issues of Concern, as well as from the UNEP Special Programme on Institutional Strengthening for the Chemicals Cluster (the Special Programme). Nevertheless, SAICM has remained chronically short of funding.

Contribution to pesticide risk reduction

The QSP consisted of a trust fund which supported 184 small-scale projects in 108 countries. Only 17 of these projects concerned agriculture and pesticides; however, some other projects (e.g., those concerned with implementation of the Basel, Rotterdam or Stockholm Conventions) are likely to have had an impact on pesticide management.

SAICM-related activities are currently being funded under the GEF Project and the Special Programme, but neither supports specific activities on pesticide risk reduction although broader

chemicals management initiatives may support pesticide risk reduction.

Progress in the implementation of SAICM was last assessed for the period 2014-2016 (SAICM 2019). The percentage of countries with risk management programmes for pesticides increased from 66 per cent in 2011 to 82 per cent in 2017 (SAICM 2011; SAICM 2019). Pesticides were considered among the top five highest priority risks in 2017. Activities concerning pesticides have usually shown a high response rate in SAICM surveys, with more than 77 per cent of respondents in 2017 reporting activities on pesticides under almost all the SAICM indicators (SAICM 2019).

Regarding HHPs, a few QSP projects have resulted in the identification of HHPs (Costa Rica) or even the banning/restriction of HPPs (Mozambique). SAICM has not established a multi-stakeholder platform to advance work on HHPs, as it has with some other Issues of Concern and Emerging Policy Issues (e.g., lead in paint). No coordinated action has been taken on HHPs through SAICM, but individual stakeholders have made some progress. A Global Plan of Action on HHPs is being elaborated (Chapter 3.2.3, section on HHPs). Slow progress in formal recognition of HHPs as an issue of concern has been a cause of frustration for several SAICM stakeholders (Nurick 2019).

Thus while the period during which SAICM has operated can be associated with certain positive developments regarding pesticide risk reduction, these results cannot be directly related to SAICM activities. This is, to a certain extent, inherent in the policy-oriented approach taken by SAICM, which makes it difficult to quantify the effectiveness of its contributions to pesticide risk reduction. In this respect the independent evaluator of SAICM (Nurick 2019) concluded that the indicators of progress on the GPA had critical limitations as an effective monitoring system to track SAICM's performance over time. He stressed the need for outcome and impact focused indicators to complement existing indicators of progress (i.e., results-based indicators to measure tangible reductions in the environmental and health impacts of chemicals use).

WHO Prequalification of Vector Control Products

Objectives and provisions

The WHO prequalification programme aims at ensuring that vector control insecticides are effective, safe and of good quality, in order to prevent transmission of vector-borne diseases (WHO 2020b). This programme performs the following functions:

- assess the efficacy, safety and quality of vector control products based on dossiers submitted by manufacturers and according to well-defined methods and procedures;
- conduct inspections of the corresponding manufacturing sites;
- build the capacity of national regulatory authorities and quality control laboratories;
- undertake post-qualification market surveillance.

The outputs of this process are:

- a list of prequalified vector control products supported by a positive public health evaluation from WHO;
- a list of prequalified manufacturing sites, that have been and will continue to be inspected by WHO.

WHO pre-qualification and pesticides

The WHO prequalification evaluations cover vector control products, primarily insecticide-treated nets, indoor residual sprays (IRS), space sprays and larvicides.

The WHO prequalification programme for vector control products is the only international assessment addressing the efficacy, quality, human health and environmental risks of a specific group of pesticides (i.e., vector control products) at the global level.

Contribution to pesticide risk reduction

Lists of prequalified vector control products were originally intended to be used by WHO and other multilateral agencies to guide their procurement decisions. However, these lists have progressively become an important tool for many countries and organizations having to purchase vector control products.

In 2018, 20 per cent of surveyed countries used the WHO prequalified list as the sole basis for registering a vector control product, while another 44 per cent used it as supportive information (FAO and WHO 2019a). Therefore, the WHO prequalification assessments have de facto become a global evaluation and authorization tool for vector control products in the majority of countries affected by vector-borne diseases.

3.2.4 Legally binding international instruments indirectly addressing pesticides

The Convention on Biological Diversity

The Convention on Biological Diversity (CBD) was adopted in 1992 and entered into force in late 1993 (Convention on Biological Diversity [CBD] 1992). As of March 2020 the CBD had 196 Parties (CBD 2020a).

Three further protocols adopted under the CBD address specific issues related to biodiversity:

- the Cartagena Protocol on Biosafety;
- the Nagoya-Kuala Lumpur Supplementary Protocol on Liability and Redress to the Cartagena Protocol on Biosafety;
- the Nagoya Protocol on Access and Benefit-sharing.

Objectives and provisions

The CBD has three main objectives:

- conservation of biological diversity;
- sustainable use of the components of biological diversity;
- fair and equitable sharing of the benefits arising out of the utilization of genetic resources.

The Convention attempts to achieve these objectives through a variety of mechanisms, including National Biodiversity Strategies and Action Plans, cooperation and partnerships with other conventions and organizations, certain financial mechanisms to support developing countries in implementing the Convention and a Clearing-House Mechanism for scientific and technical information.

During the last decade the Strategic Plan for Biodiversity 2011-2020 and its Aichi Biodiversity Targets, adopted under the Convention in 2010, have served as a guiding framework for implementation of the CBD. Governments are in the process of developing a post-2020 global biodiversity framework that will guide actions in the decades to come.

The CBD and pesticides

Biodiversity, its components, and many of the Aichi Biodiversity Targets may be impacted by pesticide use. Three targets have indicators that directly address the use of pesticides (Table 3.2-4)

A number of thematic programmes have been established under the Convention, one of which is Agricultural Biodiversity. Issues addressed in this programme are conservation, sustainable use of pollinators and soil biodiversity, among others (CBD 2020b). The recently published The State of the World's Biodiversity for Food and Agriculture (FAO 2019) recognizes that pesticides are among the direct drivers reducing both agricultural and general biodiversity. (The effects of pesticides on biodiversity are further discussed in Chapter 4.)

Contribution to pesticide risk reduction

Much of the work of the CBD deals with biodiversity assessments and inventories, compilation and dissemination of best practices for conservation of biodiversity or its sustainable use, and facilitating financial support to developing countries for the implementation of the Convention. Several of these activities can

Table 3.2-10 **Aichi Biodiversity Targets that directly address the management and use of pesticides and selected recommended specific indicators** (CBD 2016).

Aichi Biodiversity Target	Specific indicators relevant to pesticide management and use
Target 3	
By 2020, at the latest, incentives, including subsidies, harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socioeconomic conditions.	• Trends in potentially harmful elements of government support to agriculture (e.g. pesticide subsidies or tax exemptions) • Number of countries with national instruments on biodiversity relevant taxes, charges and fees (e.g. risk discriminating pesticide taxes)
Target 7	
By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.	• Areas of agricultural land under organic production (expected to reduce pesticide use and risks) • Areas of agricultural land under conservation agriculture (may increase herbicide use and risks) • Proportion of agricultural area under productive and sustainable agriculture (expected to reduce pesticide use and risks)
Target 8	
By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.	• Trends in pesticide use • Mortality rate attributed to unintentional poisoning

be expected to have an indirect positive effect on pesticide risk reduction.

The Global Biodiversity Outlook (GBO) is the CBD's flagship publication. It is a periodic report that summarizes the latest data on the status and trends of biodiversity and draws conclusions relevant to further implementation of the Convention. The most recent version (Global Biodiversity Outlook 5) was launched in September 2020 (CBD 2020c).

Table 3.2-11 shows progress towards the three Aichi Biodiversity with the information provided in that report. The targets mentioned above insofar as they address pesticide management and use. It may be concluded that, by 2019-2020, generally only limited progress has been made towards achieving relevant indicators for these three targets. In the case of pesticide use and unintentional pesticide poisoning, trends are moving away from achievement of the target.

The International Plant Protection Convention

The International Plant Protection Convention (IPPC) was originally adopted in 1951. The currently applicable New Revised Text of the IPPC was adopted in 1997 and came into force in 2005 (International Plant Protection Convention [IPPC] 1997). As of late 2020, the IPPC had Contracting Parties (IPPC 2020).

Objectives and provisions

The IPPC aims to protect the world's plant resources from the spread and introduction of pests and to promote safe trade. It has introduced International Standards for Phytosanitary Measures (ISPMs) as the main tool to achieve its goals, making it the sole global standard-setting organization for plant health. The IPPC standards are one of three recognized by the World Trade Organization's (WTO) Sanitary and Phytosanitary Measures (SPS) Agreement (Chapter 3.2.2)

Table 3.2-11 Progress towards Aichi Biodiversity Indicators 3, 7 and 8 made by 2020 (with particular reference to pesticide risk reduction), based on information provided in the Global Biodiversity Outlook 5 (GBO-5) and the reviews conducted in this report.

Aichi specific indicators	General progress towards achieving the indicator by 2020, as stated in GBO-5[1]	Specific progress towards achieving the indicator with respect to pesticides[2]	Chapter in this report
Target 3			
Trends in potentially harmful elements of government support to agriculture (e.g. pesticide subsidies or tax exemptions)	Little overall progress during the past decade	Limited progress Direct pesticide subsidies have become rare, but tax exemptions are still quite common.	5.3
Number of countries with national instruments on biodiversity relevant taxes, charges and fees (e.g. risk discriminating pesticide taxes)	Some progress towards target but at an insufficient rate	Limited progress Only few countries have established pesticide taxes; however, discriminating taxes based on hazards/risks are common for those countries that do. Some countries facilitate the registration of biopesticides and low risk pesticides.	5.3
Target 7			
Areas of agricultural land under organic production (expected to reduce pesticide use and risks)	There has been a substantial expansion of efforts to promote sustainable agriculture. Progress towards target but at an insufficient rate.	Limited progress Increased, but still minor fraction of total cropland	2.4
Areas of agricultural land under conservation agriculture (may increase herbicide use and risks)		Not assessed in this report	--
Proportion of agricultural area under productive and sustainable agriculture (expected to reduce pesticide use and risks)		Not assessed in this report	--
Target 8			
Trends in pesticide use	Rate of use (per area) of pesticides has stabilized during this decade, globally and in most regions, but rates are higher than for the previous decade by about 14 per cent.	Moving away from target Increase both in global use and in use intensity	2.3
Mortality rate attributed to unintentional poisoning		Moving away from target While global mortality due to unintentional pesticide poisoning has decreased, all cases of unintentional occupational pesticide poisoning have likely significantly increased.	4

1 GBO-5 = Global Biodiversity Outlook 5 (CBD 2020c). Progress towards meeting the targets was assessed in general, rather than with a specific focus on pesticides
2 Specific progress based on data from this report, i.e. for the period 2019-2020

In addition to the establishment of standards, the IPPC focuses on information exchange on, for example, pest status, phytosanitary measures and regulations, as well as on capacity development by national plant protection organizations (NPPOs).

The IPPC and pesticides

IPPC standards indirectly influence pesticide use, especially where they establish principles for the protection of plants, guidelines for pest eradication and recommended phytosanitary treatments.

The IPPC Guidelines for the Export, Shipment, Import and Release of Biological Control Agents and Other Beneficial Organisms (ISPM 3) (Food and Agriculture Organization of the United Nations and International Plant Protection Convention 2017) address biological control agents capable of self-replication and include those packaged or formulated as commercial products. Certain biopesticides are regulated under these guidelines.

Contribution to pesticide risk reduction

Through its programmes for strengthening national plant protection organizations, the IPPC has contributed to sound pest and pesticide management in many countries. However, no specific information is available concerning the IPPC's impact on pesticide use or risk reduction.

The IPPC Guidelines (ISPM 3) are used in many countries. These guidelines indicate that the scope of this standard does not include issues related to registration of biopesticides. However, confusion exists in some countries regarding how the guidelines relate to national regulations and requirements for biopesticide registration. This may lead to unnecessary impediments to the authorization of biological control products.

The ILO Worst Forms of Child Labour Convention

The International Labour Organization (ILO) Convention concerning the Prohibition and Immediate Action for the Elimination of the Worst Forms of Child Labour (No. 182) was adopted in 1999 and entered into force in 2000. As of the end of 2020, it had been ratified by 187 countries (International Labour Organization [ILO] 2020a)

Objectives and provisions

The main objective of the Convention is to prohibit and eliminate of the worst forms of child labour. This comprises, among others, "work which, by its nature or the circumstances in which it is carried out, is likely to harm the health, safety or morals of children" (ILO 1999).

The Worst Forms of Child Labour Convention and pesticides

Handling and use of pesticides by children is likely to harm their health and should therefore be prohibited and eliminated.

Contribution to pesticide risk reduction

The most recent global estimates of child labour indicate an overall reduction of children's involvement in child labour from 16 per cent in 2000 to 9.6 per cent in 2016. The share of children doing hazardous work declined from 11.1 per cent in 2000 to 4.6 per cent in 2016 (ILO 2017a)

Agriculture is the most important sector for child labour by a considerable margin, accounting for 71 per cent of the total. There are no global statistics on the number children handling and applying pesticides, but it is known to be common in certain parts of the world including in some high income countries. For example, children applying pesticides in the production of cocoa, cotton and sugarcane is widespread (ILO 2007; ILO 2016; ILO 2017b) although not limited to these crops.

The ILO Occupational Safety and Health Convention

The ILO Convention concerning Occupational Safety and Health and the Working Environment (No. 155) was adopted in 1981 and entered into force in 1983 (ILO 1981). As of the end of 2020, it had been ratified by 69 countries (ILO 2020b).

Objectives and provisions

The main objective of this Convention is to prevent accidents and injury to health arising out of, linked with or occurring in the course of work. It does so by requiring from Parties that they implement and periodically review a coherent national policy on occupational safety, occupational health and the working environment.

The Occupational Safety and Health Convention and pesticides

The Convention applies to all branches of economic activity, including agriculture and others where pesticides may be handled and

applied. However, Parties are allowed to exclude to particular branches of economic activity from the Convention.

Contribution to pesticide risk reduction

No information is available regarding extent to which the Convention has led to national regulations on prevention of the occupational risks related to the use of pesticides.

3.2.5 Voluntary international instruments and mechanisms indirectly addressing pesticides

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)

Objectives

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) was established in 2012 as an independent intergovernmental body to strengthen the science-policy interface for biodiversity and ecosystem services for the conservation and sustainable use of biodiversity, long-term human well-being and sustainable development (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES] 2020). The IPBES can be seen as a follow-up to the Millennium Ecosystem Assessment conducted in the early 2000s (Millennium Ecosystem Assessment 2005).

IPBES is not a United Nations body. However, at the request of the IPBES Plenary and with the authorization of the UNEP Governing Council in 2013, the United Nations Environment Programme (UNEP) provides secretariat services to IPBES.

The work of IPBES can be broadly grouped in four complementary areas:

- Assessments: conducting assessments on specific themes, methodological issues, and at both the regional and global levels;
- Policy support: identifying policy-relevant tools and methodologies, facilitating their use, and catalyzing their further development;
- Building capacity and knowledge: identifying and meeting the priority capacity, knowledge and data needs of the member States, experts and stakeholders;
- Communications and outreach: ensuring the widest reach and impact of the work of IPBES.

IPBES and pesticides

IPBES has conducted various regional assessments on biodiversity and ecosystem services. The overall scope of these assessments has been to assess status and trends with regard to biodiversity and ecosystem services, the impact of biodiversity and ecosystem services on human well-being, and the effectiveness of responses. A global assessment report on biodiversity and ecosystem services was published in 2019 (IPBES 2019).

IPBES assessments address direct and indirect drivers of change in ecosystems and biodiversity. Both the impact pesticides have on biodiversity and ecosystem services, as well as policies that increase or decrease their use, are discussed in the assessments, though in fairly general terms.

IPBES has also produced an assessment report on pollinators, pollination and food production. It provides a detailed evaluation of existing knowledge and knowledge gaps about the role that pesticides play as a driver of change of pollinators, pollination networks and pollination (Chapter 4.3.3).

Contribution to pesticide risk reduction

IPBES assessments on the state of the science on various aspects of biodiversity are considered authoritative and provide valuable suggestions for the protection and restoration of biodiversity.

The impact of these reports on national policy has not (yet) been measured.

3.2.6 Discussion – International instruments and mechanisms

A considerable number of international instruments and mechanisms address the

management of pesticides. They either directly influence the production, trade and use of pesticides (e.g., the Rotterdam and Stockholm Conventions, the International Code of Conduct on Pesticide Management, the Codex Alimentarius, WTO agreements) or affect the use and risks of pesticides indirectly, generally by establishing requirements for national environmental, health or trade policies and legislation (e.g., the Convention on Biological Diversity, the ILO Occupational Safety and Health Convention), see Figure 3.2-1 above.

Most international instruments, both legally binding and voluntary ones, have substantial provisions and programmes aimed at promoting information exchange, conducting training and awareness building activities, providing guidance on best practices, and strengthening technical and administrative skills. These instruments can therefore be expected to have contributed to the enhancement of the national capacities for judicious pesticide management and knowledge about associated environmental and human health risks. However, improving knowledge, awareness and attitudes with regard to sound pest and pesticide management does not necessarily mean that adverse environmental and health impacts will be significantly reduced in a given country, region or situation (Chapters 2.7.20 and 2.7.21).

Four legally binding instruments (the Rotterdam, Stockholm, Montreal and Minamata Conventions) address individual pesticides. However, at the time of listing of those pesticides under the respective conventions the use of a considerable number of them had already been greatly reduced or discontinued. The prospects of new listings of pesticides of concern have been shown to face constraints due to both technical and political limitations. For other pesticides, such as methyl bromide (under the Montreal Protocol) and endosulfan (under the Rotterdam and Stockholm Conventions), significant reductions in use have been noted after they were listed in the conventions. The risks of some of the pesticides more recently included under the Rotterdam Convention (e.g., methamidophos and carbofuran) may have been reduced due to their listing in Annex III, but data to support these are scant.

Another impact that participation in environmental multilateral agreements may have is a strengthening of national legislation. There are indications this may be the case for pesticides. Brandi *et al*. (2019) found that both environmental international agreements and preferential trade agreements (PTAs) with environmental provisions resulted in significant changes in national environmental legislation referring to pesticides. The positive link was strongest in developing countries: they noted that although this apparent effect of treaties on domestic legislative change does not mean new regulations will fully implement a treaty, the legislation is more stringent than previous legislation, is de facto enforced, or leads to better environmental outcomes. The adoption by developing countries of environmental international agreements and PTAs with environmental provisions appears to stimulate change in, and likely strengthening of, environmental legislation.

Several non-binding international instruments which address pesticides, such as the Code of Conduct, the Codex Alimentarius and the GHS, appear to have improved the way pesticides are evaluated, managed and used. This has occurred through strengthening of legislation and registration of pesticides, harmonization of standards such as MRLs, or improved evaluation and hazard classification of pesticides. Furthermore, an international mechanism, SAICM, has set the stage to globally address issues of concern including risks posed by HHPs.

Owing to the nature of many legally binding and voluntary international instruments, their contribution to pesticide risk reduction cannot always be well evaluated. Appropriate indicators and procedures to allow such evaluations are not in place. An exception is the Global Monitoring Plan of the Stockholm Convention. Implementation of the International Code of Conduct of Conduct on Pesticide Management has been evaluated several times, but the results are not very specific and do often not allow specific needs and actions for improvement to be identified.

The absence of broader impact assessments makes it difficult to quantify the extent to which these international instruments contribute to

reducing the risks posed by pesticides (or by chemicals in general).

It should be emphasized that the conventions discussed above cover only a limited number of pesticides. Even if they significantly reduce the risks of the listed pesticides, they will not be adequate to effectively minimize the adverse environmental and health impacts of all pesticides in a comprehensive and sustainable manner. Furthermore, effective implementation of codes and other voluntary instruments faces operational challenges in addressing important aspects of the management of all pesticides and minimizing their adverse impacts.

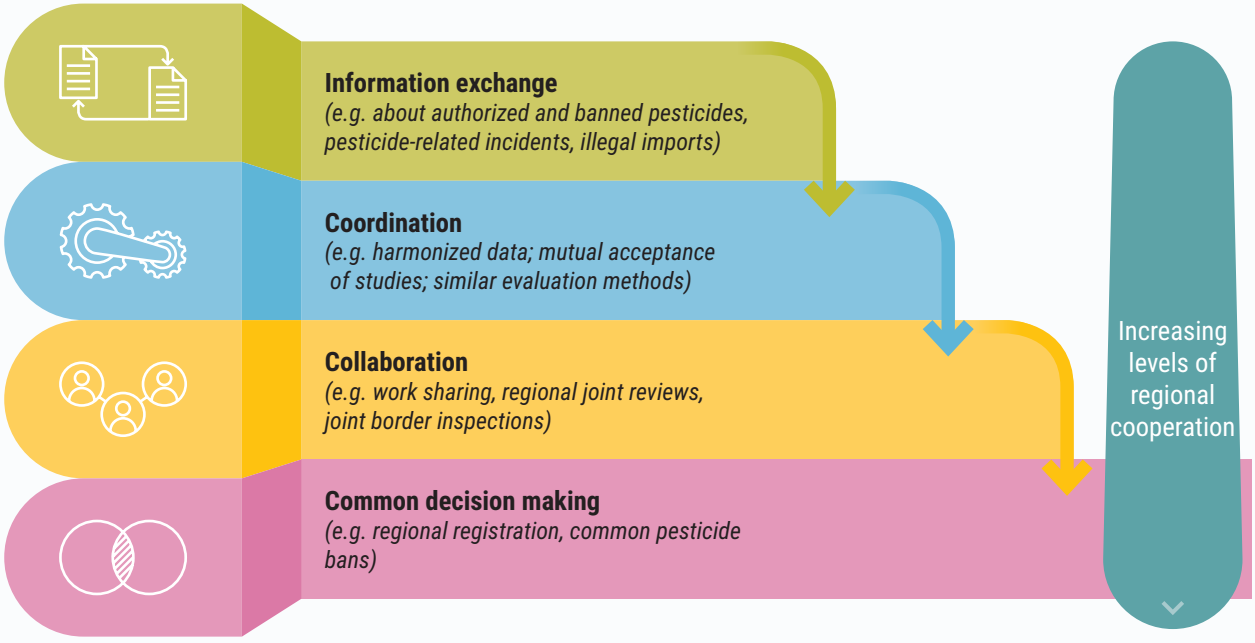
3.3 Regional collaboration on pesticide management

3.3.1 Introduction

The International Code of Conduct calls on governments to "promote the advantages of, and cooperate with other governments in, the establishment of harmonized (regionally or by groups of countries) pesticide registration requirements, procedures and evaluation criteria" (FAO and WHO 2014).

Regional collaboration on pesticide management can take different forms, ranging from simple information exchange mechanisms to more complex common decision-making systems (Figure 3.3-1). Regionalization of activities such as the evaluation, authorization, inspection and control of pesticides will often optimize the use of limited human and financial resources and strengthen the regulatory potential that comes with a larger geographical area. In addition, given the fact that borders are relatively porous in many parts of the world, regional collaboration can enhance the possibilities to control cross-border (illegal) trade in pesticides. Regional harmonization of registration and licensing requirements also facilitates the registration of new (lower risk) pesticide products that would not be economical to do in one country.

Figure 3.3-1 Cooperation on pesticide management and regulation can take many forms, with increasing intensity and complexity



Early examples of regional instruments for collaboration and harmonization of pesticide testing and regulation are the voluntary European and Mediterranean Plant Protection Organization (EPPO) Guidelines on the efficacy evaluation of plant protection products (first published in 1977), the South-East Asian pesticide bioefficacy protocols (published in 1990-92), the legally binding EU Council Directive 91/414/EEC concerning the placing of plant protection

Figure 3.3-2 Examples of legally binding regional legislation and agreements for the management of pesticides

Reglamentos técnicos centroamericanos

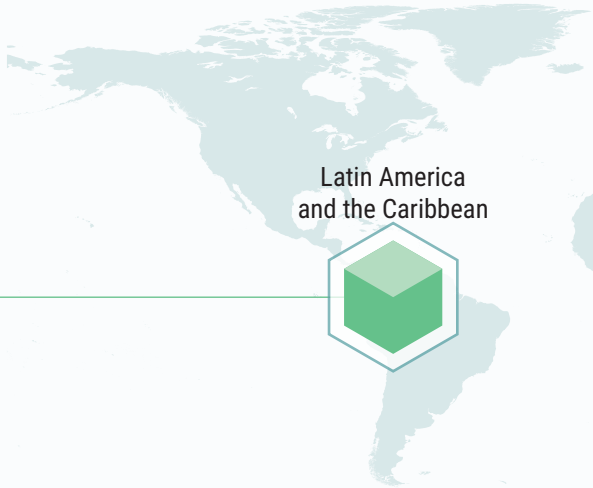
Year of adoption	various	*Number of countries*	5
Main objective	Harmonization of pesticide registration data requirements and labelling		

Manual Técnico Andino para el registro y control de plaguicidas químicos de uso agrícola (Comunidada Andina, Resolución 2075)

Year of adoption	1998 *(revised 2019)*	*Number of countries*	4
Main objective	Regional pesticide registration		

Common regulation for the registration of pesticides in CILSS member states

Year of adoption	1992 *(revised 1999)*	*Number of countries*	13
Main objective	Regional pesticide registration		



Bamako Convention on the ban of the import into Africa and the control of transboundary movement and management of hazardous wastes within Africa

Year of adoption	1998 *(entry into force)*	*Number of countries*	25
Main objective	Prohibit the import of all hazardous wastes into the African continent (including obsolete pesticides)		

Regulation on harmonization of the rules governing pesticide registration in ECOWAS region*

Year of adoption	2008	*Number of countries*	17
Main objective	Regional pesticide registration (not yet operational; will incorporate the CILSS system)		

Réglementation commune sur l'homologation des pesticides dans l'espace CEMAC

Year of adoption	2006	*Number of countries*	6
Main objective	Regional pesticide registration		

SADC Guidelines on pesticide management and risk reduction*

Year of adoption	2019	*Number of countries*	16
Main objective	Collaboration and harmonization on pesticide regulation and management (implementation just started)		

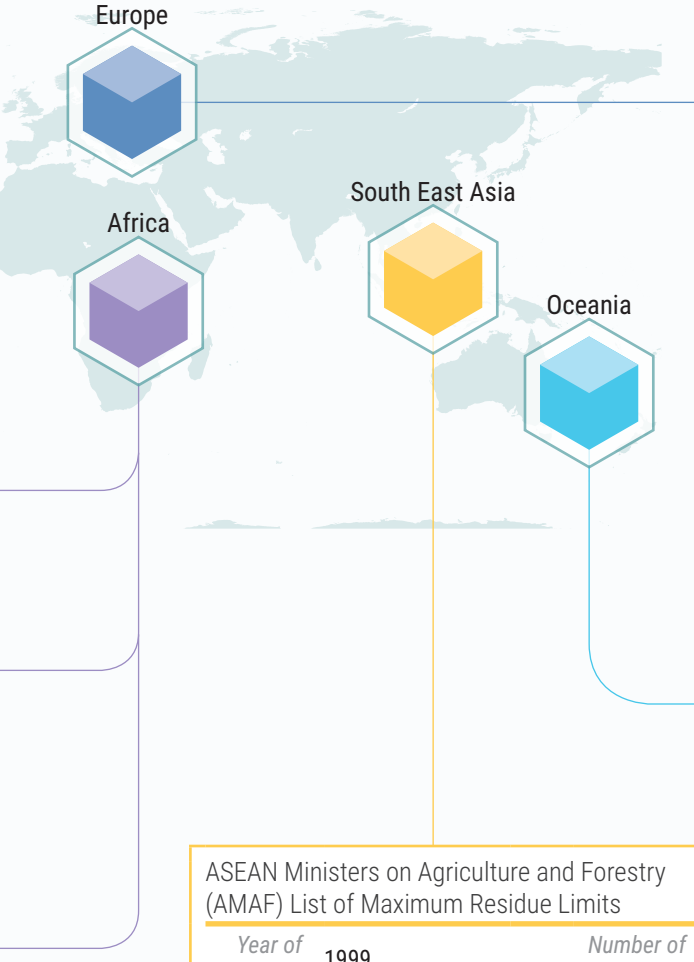
EAC regional pesticide registration guidelines

Year of adoption	2019	*Number of countries*	6
Main objective	Harmonization of pesticide registration data requirements and mutual acceptance of locally generated data		

ASEAN: Association of SouthEast Asian Nations; CEMAC: Communauté Economique et Monétaire de l'Afrique Centrale; CILSS: Permanent Interstate Committee for Drought Control in the Sahel; EAC: East African Community; ECOWAS: Economic Community of West African States; EU: European Union.

products on the market (adopted in 1991), and the Comité inter-État de lutte contre la sécheresse au Sahel (CILSS) Common Regulation for the registration of pesticides (adopted in 1992).

Many regional initiatives for pesticide management have since been initiated, ranging from harmonization of pesticide testing protocols and regional pesticide management action plans to regional pesticide registration. Several of these



EU Regulation 396/2005 on maximum residue levels of pesticides in or on food and feed of plant and animal origin

Year of adoption	2005	*Number of countries*	28
Main objective	Regional pesticide maximum residue limits		

EU Regulation 1107/2009 concerning the placing of plant protection products on the market

Year of adoption	2009 *(originally 1991)*	*Number of countries*	28
Main objective	Regional pesticide registration		

EU Directive 2009/128 establishing a framework for Community action to achieve the sustainable use of pesticides

Year of adoption	2009	*Number of countries*	28
Main objective	Pesticide use and monitoring		

EU Regulation 528/2012 concerning the making available on the market and use of biocidal products

Year of adoption	2019	*Number of countries*	28
Main objective	Regional biocides registration		

Waigani Convention to ban the importation into Forum island countries of hazardous and radioactive wastes and to control the transboundary movement of hazardous wastes within the South Pacific region

Year of adoption	2001 *(entry into force)*	*Number of countries*	12
Main objective	Ban the import and export of hazardous waste to and from the Convention Area		

ASEAN Ministers on Agriculture and Forestry (AMAF) List of Maximum Residue Limits

Year of adoption	1999	*Number of countries*	10
Main objective	Regionally harmonized pesticide maximum residue limits		

* Document not available online.

activities have been actively supported by FAO and WHO, especially in low and lower-middle income countries.

3.3.2 Legally binding instruments

Most legally binding regional instruments that address pesticides are operational in Africa and Europe (Figure 3.3-2). A large regional pesticide management instrument is represented by the EU systems for authorization of plant protection products and of biocides, in which pesticide active ingredients are evaluated and approved by all EU Member States. Subsequent authorization of pesticide products takes place at the national level, although attempts are made to rationalize this process through regional zoning (for plant protection products) or EU authorizations (for biocidal products).

Another long-standing regional pesticide registration scheme is that of the Permanent Inter-State Committee for Drought Control in the Sahel, or Comité Permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel (CILSS) in West Africa. Unlike the EU approach, all pesticide products rather than only active ingredients are registered by the Sahelian Pesticides Committee for all CILSS members. Originally covering nine countries, this system is now being extended to cover 17 countries in West Africa under the auspices of the Economic Community of West African States (ECOWAS).

So far, most regional agreements have focused on the authorization of pesticides. However, the EU framework to achieve sustainable use of pesticides also promotes the reduction of risks and impacts of pesticide use on the environment and human health, as well as the use of IPM and of non-chemical alternatives to pesticides. A similar broad approach to regional pesticide management has recently been adopted in the Southern African Development Community (SADC) region of southern Africa, but it is not yet fully operational.

3.3.3 Voluntary regional collaboration mechanisms

Several regional collaborative structures and mechanisms have been established which are aimed at optimizing or facilitating different aspects of pesticide management (Figure 3.3-3). In some cases regional institutions (e.g., regional plant protection organizations) may operate pesticide management activities as part of their broader mandate; in others dedicated structures have been established.

Many voluntary collaborative mechanisms function as platforms for information exchange among regulators in a given region. In some cases regional technical guidance documents and protocols are being developed.

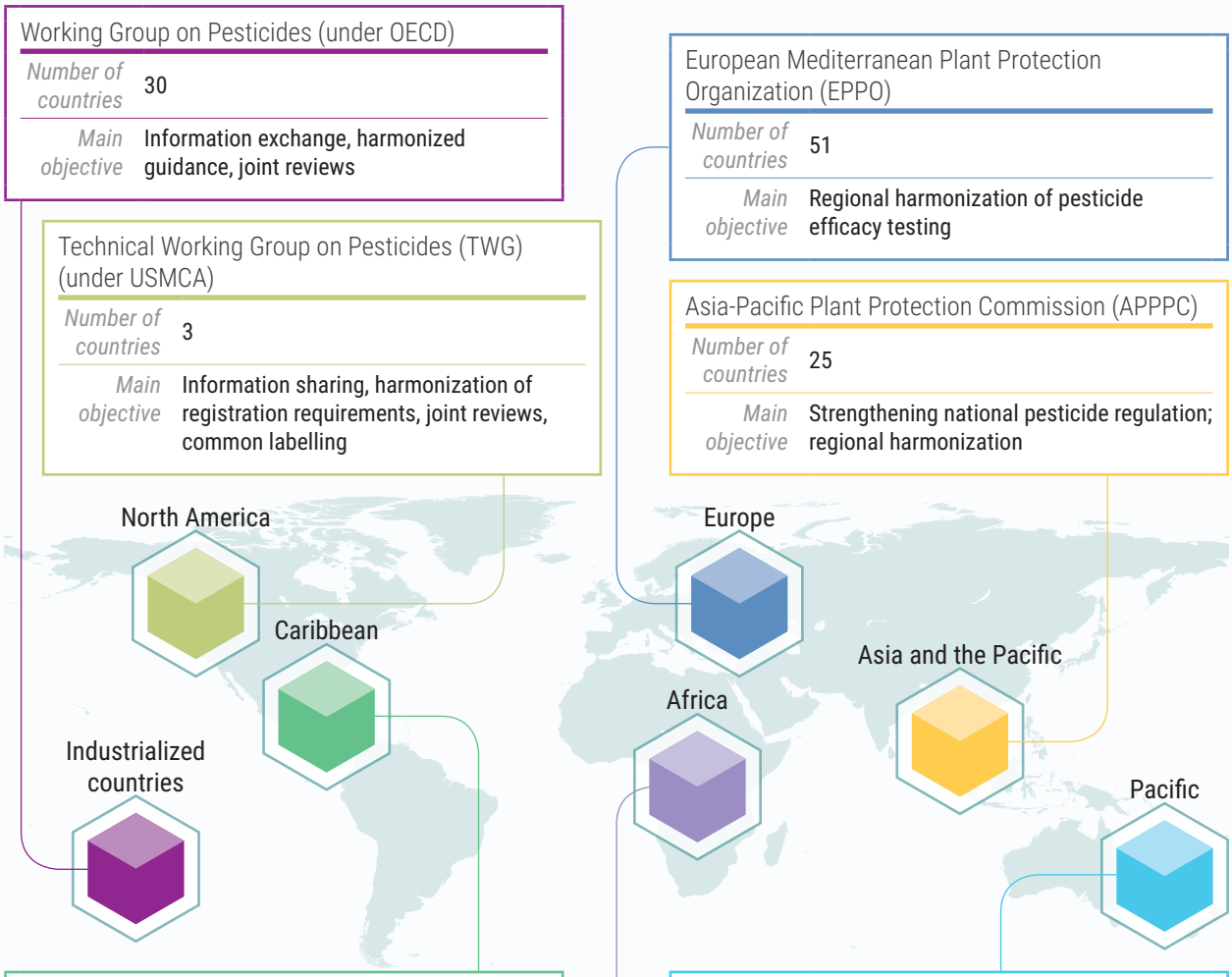
3.3.4 Discussion: Regional agreements and mechanisms

During the last decade there has been increasing interest in establishing or strengthening regional agreements and mechanisms on pesticide regulation and management. Recent initiatives include harmonization of data requirements and mutual acceptance of efficacy and residue data in East Africa, and the development of procedures for joint pesticide evaluations in the Pacific and the Caribbean, among others.

Regional cooperation is a potentially powerful approach for activities that can be conducted over larger geographical regions, such as efficacy and residue testing, or the evaluation, classification and authorization of pesticides, especially if resources are limited. However, regional collaboration has also proven to be effective in high income regions. It tends to be easier to implement in regions with similar administrative cultures, economic and agronomic conditions, and constraints.

The establishment or strengthening of regional collaboration is promoted by international organizations such as FAO. It may be the only effective way forward for resource-intensive aspects of pesticide management such as scientific evaluations, pesticide quality control and border inspections.

Figure 3.3-3 Examples of regional mechanisms for the management of pesticides



* Document not available online.

3.4 National policies and legislation on pesticides

3.4.1 Pesticide legislation

Legislation is intended to regulate the use and management of pesticides by defining the rights and obligations of the actors involved, and to establish measures designed to ensure the observance of these rights and obligations.

At the national level, pesticide legislation refers to legal instruments specifically designed to control pesticides. The term pesticide legislation may refer to a primary instrument, often a law, act or ordinance, as well as to a number of secondary or subsidiary legal instruments such as regulations, decrees, rules or notices (FAO and WHO 2020).

The International Code of Conduct on Pesticide Management prescribes that governments "should 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" (FAO and WHO 2014). Specific guidance on pesticide legislation has been published under the Code of Conduct, which includes recommendations for countries to regulate pesticides taking into consideration all stages of the pesticide life cycle (FAO and WHO 2020) (Box 3.4-1).

In principle, pesticide legislation should cover all types of pesticides and all aspects of the pesticide life cycle (Figure 3.4-1). In many countries, parts of the pesticide life cycle are regulated by dedicated pesticide legislation. This often includes the authorization, importation, storage and transport,

Box 3.4-1 Elements of pesticide legislation.

Governments regulate pesticides for many reasons. The main objective is to protect human health and the environment from risks associated with pesticide use. This includes protection of pesticide users, consumers, crops, livestock, wildlife, water bodies and many others. Other important objectives include ensuring the effectiveness of pesticide products for their proposed use and safeguarding a fair market for manufacturers, importers and distributors of pesticide products.

Legislation is one of the tools that countries use to achieve these objectives, by regulating the manufacture, registration, importation, transport, storage, sale, use and disposal of pesticides (FAO/WHO 2020). The International Code of Conduct on Pesticide Management recommends governments to regulate all pesticides through all stages of their life cycle (Article 6.1). *The Guidelines on Pesticide Legislation* (FAO/WHO 2020) identify the key elements that should be taken into consideration in pesticide legislation.

A key characteristic of dedicated pesticide legislation is that a pesticide can generally not be imported, traded or used in a country unless it has been explicitly authorized under the law (positive list). This contrary to much other chemicals legislation which often allow the use of an individual chemical unless it is restricted or prohibited (negative list).

Essential elements of pesticide legislation are (based on FAO/WHO 2020):

Scope and definitions	▸ a well-defined scope that makes clear whether the legislation covers all categories of pesticides and all stages of the pesticide life cycle. If not, the law should explicitly identify the groups of pesticides covered
	▸ definitions that are clear, not ambiguous, and aligned with the international reference definitions (e.g. Code of Conduct, Chemical Conventions)
Administration	▸ a competent authority designated to coordinate the implementation of the law, having the necessary powers, including the power to inspect, charge fees and elaborate regulations
	▸ a mandatory registration system for pesticides
	▸ a pesticide registration board composed of different public institutions representing the key regulatory interests, with safeguards in place to prevent conflicts of interest on the part of its members

Registration	key steps in the application procedure for pesticide registration, including information and data requirements to be included in the application and main criteria for decision making on registration
	a provision that a registration can be reviewed at any time when new information has become available and that a negative outcome of such a review can lead to cancellation of the registration
	provisions ensuring confidentiality and protection of intellectual property rights
Import and export	prohibition of the import of pesticides that have not been registered and specification of any exceptions to this provision
	a licensing and/or permit system for importation of pesticides
Licensing	specification of which pesticide-related activities (manufacture, sale, transportation, import, special applications) are allowed only by operators holding a valid license
	establishment of the necessary licensing schemes and designation of the responsible authorities for their implementation
	stipulation of the obligations of license holders and the consequences of noncompliance, while ensuring that licensing schemes are backed up with inspections
Packaging and labelling	requirements for the packaging and labelling of pesticides
Use	prohibition of the use of pesticides for a purpose or in a manner other than that prescribed on the label
	requirements for employers to implement necessary measures to protect worker health and to prevent use by children and other vulnerable groups
	prescription of the use of PPE, proper application equipment, responsible cleaning of application equipment and safe disposal of empty containers to protect users, the public and the environment
Advertising	specific requirements for pesticide advertising
Storage, transport and disposal	requirements for and designation of the authority responsible for overseeing storage, transport and disposal of pesticides
Information collection, monitoring and incident reporting	designation of the powers and responsibilities of the responsible body(ies) for information collection and monitoring with respect to pesticides, including the ability to impose reporting requirements on manufacturers, importers, distributors and sellers of pesticides
	mechanism for the reporting of pesticide-related incidents
Inspection	designation of national authority (or authorities) responsible for inspection
	definition the powers of inspectors and ensure that these are adequate to enable the inspectors to fulfil their duties
Offences and penalties	establishment of the offences under the law and outline of the applicable penalties
	rights and appeals related to enforcement procedures

distribution and sales, licensing, labelling and use of pesticides. Other parts of the pesticide life cycle, such as manufacturing and formulation, aspects to which environmental and health standards are applicable, or disposal, will often be regulated by other legislation.

The regulatory framework for control of pesticides therefore encompasses a much broader set of legislation than that which only directly addresses pesticides. It may, for instance, include legislation on environmental protection, public and occupational health, food safety, water, wildlife, plant protection and general chemicals management. The national regulatory framework also includes obligations under international instruments (Chapter 3.2).

Most countries have some form of dedicated pesticide legislation in place

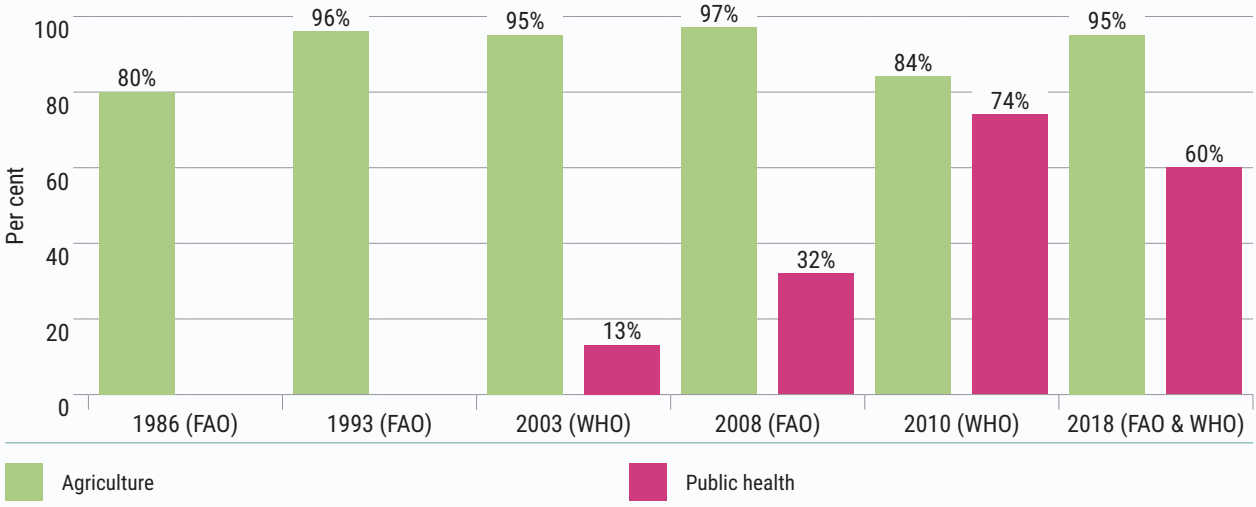
Figure 3.4-1 Elements of the pesticide life cycle and aspects in each step that are often regulated

(Figure 3.4-2). Traditionally, pesticide legislation covers agricultural pesticides. Shortly after the adoption of the first version of the International Code of Conduct on the Distribution and Use of Pesticides, in 1986, about 80 per cent of countries regulated at least agricultural pesticides. This increased to about 95 per cent in 1993 and has remained at that level ever since.

The almost complete global coverage of (agricultural) pesticide legislation provides an excellent legal basis to ensure judicious pesticide management. Public health pesticides and vector control pesticides, on the other hand, were covered by legislation in only 13 per cent of countries in 2003, although this steadily increased in the following decade to 60-70 per cent of countries (Figure 3.4-2). Still, according to the most recent global survey, 40 per cent of countries reported that the distribution and use of public health pesticides are not adequately regulated (FAO and WHO 2019a).

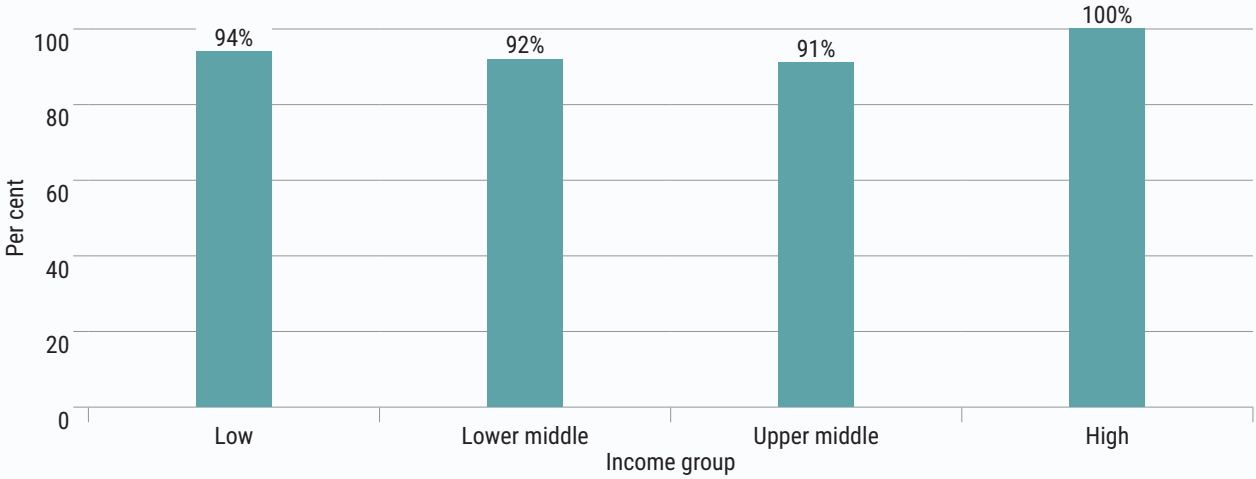
While all high income countries have dedicated pesticide legislation in place, an average of around 92 per cent of low, lower-middle and upper-middle

Figure 3.4-2 **Percentage of countries reporting that they have dedicated legislation for (primarily) agricultural pesticides, or for public health pesticides, based on surveys conducted during the last 30 years. The apparent reduction in 2010 is likely due to a different target being addressed by the survey: ministries responsible for public health vs. ministries responsible for agriculture.**



Sources: 1986 and 1993 = FAO (1996); 2003 = WHO (2004); 2008 = FAO (2010); 2010 = Matthews *et al.* (2011); 2018 = FAO/WHO (2019c).

Figure 3.4-3 **There is little difference in the percentage of countries that have pesticide legislation in place in low, lower-middle and upper-middle income groups.** FAO and WHO (2019a) (data re-analysed).



income countries regulate (some groups of) pesticides (Figure 3.4-3). The small overall difference in percentages in these income groups indicates that national income does not greatly influence the establishment of pesticide legislation.

Although many countries regulate pesticides, legislation does not necessarily cover all elements of the pesticide life cycle. Authorization (or registration) required in order to place pesticide products on the market is included in most pesticide legislation (Table 3.4-1). However, this is less true for other elements of the life cycle such as transport, storage, distribution and use, particularly in the case of public health pesticides. About 15-40 and 40-50 per cent of countries, respectively, responded that they do not adequately regulate these elements of the life cycle of agricultural pesticides and public health pesticides. Recycling and disposal of empty pesticide containers and unused pesticides is regulated in many countries through hazardous waste legislation rather than through pesticide laws. Empty pesticide containers remain an

Table 3.4-1 **Percentage of countries reporting that they regulate specific elements of the pesticide life cycle.** FAO and WHO (2019a).

Life cycle element	Percentage of countries regulating each element (n=59)	
	For agricultural pesticides	For public health pesticides
Manufacturing and formulation	69%	
Authorization (registration)	95%	60%
Importation	n.a.	n.a.
Storage and transport		
Storage	83%	58%
Transport	74%	47%
Distribution and use		
Pesticide retail sales	79%	47%
Online pesticide sales	24%	
Recycling and disposal		
Empty containers	62%	42%
Obsolete pesticides	69%	51%

n.a. = data not available. However, in countries that do not locally manufacture or formulate pesticides, but only import them, registration legislation automatically covers importation.

Table 3.4-2 **Responsible government authority which issues registrations for several types of pesticides. Shown is the percentage of countries answering each question positively, and the number of responding countries (n). Some countries reported there was more than one responsible authority.** FAO and WHO (2019a).

Pesticide types or products	Government ministry or agency					n
	Agriculture	Health	Environment	Other agency	Not regulated	
a. Agricultural pesticides	56%	9%	6%	25%	3%	64
b. Vector control pesticides	28%	40%	3%	23%	5%	60
c. Professional public health pest control products	26%	34%	5%	25%	10%	61
d. Insecticides directly applied on humans	18%	41%	2%	28%	11%	61
e. Household pest control products	24%	34%	3%	27%	12%	59

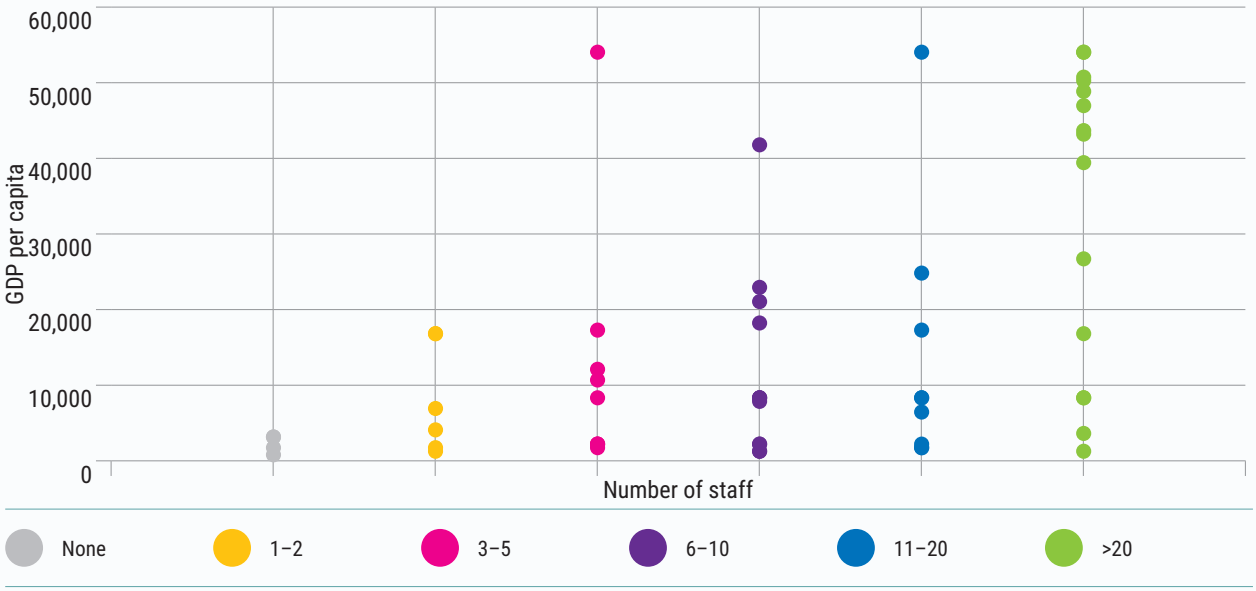
environmental and health problem in many low and middle income countries.

The presence or absence of pesticide legislation does not indicate its quality (i.e., the degree to which legislation allows sound management of pesticides in a country, and the possibilities it gives governments to limit dangerous practices and misuse). No global reviews are available assessing the content and quality of pesticide legislation, nor is there any systematic analysis of legal gaps. International guidance on the elaboration and content of pesticide legislation is however, available with which to assess the comprehensiveness of national pesticide legislation (FAO and WHO 2020)

3.4.2 Pesticide registration

Pesticide registration is the process whereby a responsible national government or regional authority approves the sale and use of a pesticide following the evaluation of scientific data aimed at demonstrating that the product is effective

Figure 3.4-4 Staff capacity for pesticide registration increases with countries' income levels. GDP is per capita purchasing power parity (PPP); 2017 international dollars. FAO and WHO (2019a) (data re-analysed).



for its intended purposes and does not pose an unacceptable risk to the environment, or to human or animal health, under the conditions of use in the country or region (FAO and WHO 2014).

Only 3-12 per cent of countries globally have indicated that they do not register (certain types) of pesticides; all other countries have systems in place to evaluate and authorize the use of pesticides (FAO and WHO 2019a). In many countries more than one government authority is in charge of pesticide registration. The ministry responsible for agriculture generally conducts the registration of plant protection products, while the ministry responsible for health registers public health and domestic pesticides (Table 3.4-2). This does not mean that decisions about the authorization of pesticides is made by only one sector ministry. Many countries have established intersectoral pesticide registration boards or committees that assess registration applications and either decide, or advise on, decisions to authorize the use of a pesticide.

In only one-quarter of countries (mainly in Europe, North America, and parts of Asia and the Pacific) do specialized pesticide registration agencies exist (FAO and WHO 2019a).

The evaluation of pesticides requires specialized staff in various scientific fields, including biology, chemistry, toxicology and environmental sciences. However, many countries do not have many staff dedicated to this task. Low and lower-middle income countries often only employ up to five staff who are involved in pesticide registration; registration authorities with larger pesticide registration bodies tend to be found in richer countries (Figure 3.4-4).

3.4.3 Compliance monitoring and enforcement

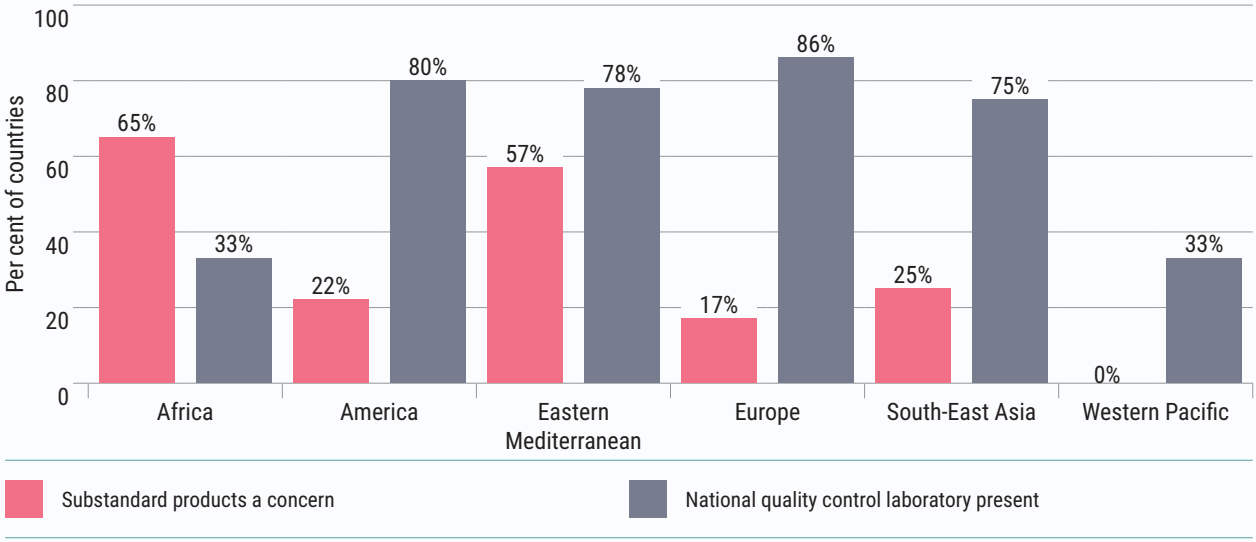
The existence of pesticide legislation, even if this legislation is well elaborated, is not enough to ensure that it will be respected. Legislation without effective compliance monitoring and enforcement tends to be a "paper tiger". On average, only 33-47 per cent of countries have indicated that they are able to routinely monitor the implementation of legislation, with countries in Africa, the Eastern Mediterranean and South Asia well below this average (FAO and WHO 2019a).

Lack of post-registration compliance and enforcement actions at the national level, resulting from a lack of government capacity, is well known to be a fundamental problem in pesticide management (FAO and

Table 3.4-3 **Some factors that could lead to non-compliance with pesticide legislation.** Adapted from OECD (2012) and UNEP (2019b).

By the regulated community	By regulators
Lack of knowledge or understanding of what is required for compliance	Lack of human and/or financial capacity to conduct inspections
High cost of compliance	Inadequate legal power for enforcement
Low likelihood of detection of violation or of prosecution	Lack of collaboration with other enforcement institutions (e.g. for fear of giving up power of control)
Low penalties, which can be internalized as a cost of doing business	Lack of clear responsibilities
Absence of a culture of compliance	High level of risk tolerance

Figure 3.4-5 **The percentage of countries in which substandard pesticide products are a concern is especially high in the African and Eastern Mediterranean regions. Laboratory capacity for quality control is low in the African and the Western Pacific regions.** FAO and WHO (2019a).



WHO 2019d). This problem is not limited to pesticide management. Inadequate compliance and enforcement is also a serious constraint with respect to most environmental legislation, even in countries with adequate resources (McClary and Goldstein 2017; UNEP 2019b).

There may be many reasons that lead to non-compliance, both for the regulated community and for governments (Table 3.4-3). They range from lack of knowledge of what is required for compliance to penalties that are too low to deter violations. Furthermore, if regulatory institutions are unable to effectively carry out inspections, and to prosecute and adjudicate violations of pesticide legislation, the regulated community may reasonably believe that violations will go punished (UNEP 2019b).

An important element of pesticide inspections is quality control of pesticide products at importation and sales. Such quality control should be conducted by dedicated laboratories that are equipped and experienced for the task. Fifty-nine per cent of responding countries reported having access to a national pesticide quality control (testing) laboratory (Figure 3.4-5). However, in the African and Western Pacific

regions only 33 per cent of countries had such laboratories (FAO and WHO 2019a). This is of particular relevance since, in 40 per cent of countries globally, substandard or counterfeit products are considered of "major or moderate" concern, defined as these products being readily available to the general public. The African and Eastern Mediterranean regions are well above this average (FAO and WHO 2019a) (see also Chapter 2.5).

Compliance, implementation and enforcement costs and modalities should always guide the design of regulatory frameworks to ensure successful performance of such frameworks in meeting regulatory objectives (FAO and UNEP 2020).

3.4.4 Other legislation relevant to pesticides

Because pesticide management is cross-sectoral, the way pesticides are authorized, managed and used is not only influenced by dedicated pesticide legislation, but also by laws, regulations and standards elaborated in other sectors.

Legislation on environmental protection, public health, occupational health, water, food safety, plant protection, general chemicals management, transportation and disposal of hazardous substances may be relevant (FAO and WHO 2020). For instance, environmental legislation may include requirements for the siting and construction of pesticide formulation plants or sales outlets, but it may also set surface water standards that need to be taken into account when a pesticide is registered; under food safety legislation pesticide maximum residue limits may be defined, which in turn influences both the authorization of a pesticide and good plant protection practices that should be followed by farmers; and occupational health legislation may set requirements for the protection of workers who apply pesticides or harvest crops. However, national standards (e.g., for pesticide labelling, packaging or PPE) may directly affect pesticide sales and use.

To avoid either potential legal conflicts or gaps in pesticide legislation, it is therefore important that the lead ministry responsible for the pesticide law coordinates effectively with other sector ministries. Multi-sector coordination and cooperation involves the (horizontal linkages) of, for example, health, agriculture, the environment and trade, as well as the (vertical) competences of various levels of administration (FAO and UNEP 2020). In many countries elaborating and operating comprehensive, well-coordinated legislation which effectively addresses all aspects of the pesticide life cycle has proved challenging.

3.4.5 Pest and pesticide management policy

Legislation is intended to regulate the trade, use and management of pesticides. Policy, on the other hand, is a set of principles that guide decision-making. A pest and/or pesticide management policy defines desired changes and is made in response to recognized problems or constraints, or to prevent problems arising in the future (WHO 2011b).

Stand-alone national pesticide management policies are developed and adopted to define how pesticides should be regulated, used and managed in a country. Pest management policies are broader than legislation, as they define how pests or disease vectors will be prevented, managed and controlled. Pest management policies will include pesticides, but also other approaches to pest management. It is important to note that countries without stand-alone pest management policies or strategies, elements of such policies may be incorporated into national legislation, regulations, or policies on related topics.

A recent global survey found that approximately 60 per cent of responding countries have adopted a national IPM policy, while about 50 per cent have a national IVM policy (FAO and WHO 2019a). These policies generally identify IPM/IVM as the preferred pest or vector management approach and define strategies and measures to promote this approach. WHO has developed guidance for public health pesticide management policy development (WHO 2011b).

During the last two decades several European countries have adopted pesticide use or risk reduction policies, recent examples of which are shown in Table 3.4-4. By 2014 EU Member States

Table 3.4-4 Examples of national pesticide management policies and strategies, and achievements insofar as these have been established.

Country	Year	Title	Targets	Results	Reference
China	2015	Action to achieve zero growth of pesticide use by 2020	Keep pesticide use per unit of land area below the average level in the years 2012 to 2014 Increase the use of biocontrol and physical pest control on main crops by 10 per cent compared to 2014	Not yet known	Jin and Zhou (2018)
The Netherlands	2013	Healthy growth, healthy harvest – Second policy for sustainable crop protection 2013-2023	Pesticide use: no target Exceedance of surface water quality standards: 50 per cent reduction by 2018; no exceedance by 2023 IPM: by 2014 all agricultural producers to apply IPM	By 2018: Use of chemical pesticides hardly decreased; fraction of low-risk pesticides remained very low, at 0.1 per cent of total use Fewer exceedances of surface water quality standards (30 per cent reduction for chronic exposure and 50 per cent for acute) Fewer exceedances of MRLs and dietary risk standards in food; target achieved 50 per cent of producers applying IPM	Ministerie van Economische Zaken (MEZ) (2013); Planbureau voor de Leefomgeving (PBL) (2019)
France	2015 2018	Ecophyto II - Ecophyto II+	25 per cent reduction in use of plant protection products by 2020 and 50 per cent reduction by 2025, compared with 2015	By 2018 an increase in use was observed, leading to Ecophyto II+	Government of France (2018)
Denmark	2017	Pesticide strategy 2017-2021	Pesticide Load Indicator (PLI, the Danish pesticide risk indicator) to be at most 1.96 by 2021	PLI reached 1.69 in 2017, an almost 50 per cent reduction compared with 2010-2011	Danish Environmental Protection Agency (EPA) (2017; 2019)
European Union	2009	Framework for Community Action to Achieve the Sustainable Use of Pesticides	All Member States should adopt and update National Action Plans (NAPs) for pesticide risk and impact reduction. All professional pesticides users should be trained and certified. Pesticides should only be sold to professionals by certified persons. IPM and organic farming shall be promoted under professional users	By 2020: 75 per cent of Member States reviewed/updated their NAP Majority of NAPs fail to identify high-level outcome-based target 20 per cent reduction in the EU harmonized risk indicator since 2017 50 per cent increase in risk from emergency authorizations Assessment of implementation of IPM is insufficient	EU (2009a; 2009b)
European Union	2020	Farm to Fork Strategy	Reduction of overall use and risk of chemical pesticides by 50 per cent, and those of more hazardous pesticides by 50 per cent, by 2030	Not yet known	European Commission (EC) (2020b)

were obliged to elaborate National Action Plans (NAPs) to achieve sustainable use of pesticides as a way to implement the Framework to Achieve Sustainable Use of Pesticides (Chapter 3.3). By 2016 all of the (then 28) Member States had drawn up NAPs, although not all of these countries had kept the NAPs up-to-date. Twenty countries had established pesticide risk reduction objectives and nine used defined pesticide use reduction objectives; some had a combination of both (EC 2017b; EC 2020a).

Although IPM is a cornerstone of the Framework, by 2016 countries had not yet set clear criteria to ensure that the principles of IPM were implemented, nor did they systematically verify implementation of IPM by growers. On the other hand, all Member States had established training and certification systems for pesticide users. It was reported that almost 4 million professional operators had been trained. A range of good practices to protect the aquatic environment from pesticides, reduce pesticide use in public spaces, and promote judicious handling and storage of pesticides were also implemented (EC 2017b).

While the EU Sustainable Use Framework did not establish specific pesticide risk reduction targets, the recently published Farm to Fork Strategy aims to reduce the overall use and risks posed by chemical pesticides by 50 per cent by 2030 (EC 2020b).

Stand-alone pesticide management policies are much less common in other parts of the world. Examples are the Pesticide Management Policy for South Africa (Department of Agriculture, Forestry and Fisheries of South Africa 2010) and the policy of zero growth in pesticide use in China (Jin and Zhou 2018). In other countries pesticide management policy elements may be incorporated in pesticide legislation. No global review of the content and implementation of pest or pesticide management policies is currently available.

Experience with pesticide risk/use reduction policies in Europe demonstrates that meeting ambitious pesticide use or risk reduction targets is not straightforward. Denmark achieved its target of 50 per cent reduction in pesticide risks, measured using a national pesticide risk indicator; the Netherlands only partly met its risk reduction targets; while France had to update and strengthen Ecophyto, its national pest and pesticide management policy, due to a lack of progress (Lee, den Uyl and Runhaar 2019). In this respect, Lee, den Uyl and Runhaar (2019) evaluated the effectiveness of public and private policy instruments in European or other high income countries which aimed to reduce pesticide use by farmers. These included regulatory, economic and informative policy instruments. They found that not one individual instrument is guaranteed to reduce pesticide use. Combinations of two, or better three, instruments were most effective in achieving pesticide use reductions.

The use of risk indicators to measure policy progress has become more prominent as they better reflect the potential adverse effects of pesticide use than volumes of pesticide consumption or sales. Risk indicators tend to combine a measure of pesticide exposure with the toxicity/hazard of the pesticides used. An example is the Pesticide Load Indicator (PLI) in Denmark (Kudsk *et al*. 2018). Another approach was taken in harmonized risk indicators established to monitor implementation of the EU Framework to achieve the sustainable use of pesticides, which are based on authorization categories of active substances in the EU (EU 2019).

3.4.6 Discussion – National legislation and policies

Most countries in the world have adopted dedicated pesticide legislation, which provides a national legal basis to manage the trade in and use of pesticides. However, not all aspects of the pesticide life cycle may be effectively covered by national legislation. In other cases, different parts of the pesticide life cycle may be shared across different pieces of legislation implemented by different government entities. While this does not need to pose problems in itself, it does require effective horizontal and vertical coordination within the government to ensure duplications and gaps are minimized. Legislation of domestic and public health pesticides is still inadequate in a large faction of countries. International guidance is available under the International Code of Conduct

on Pesticide Management for strengthening national pesticide legislation.

The majority of countries have put in place a pesticide registration system to evaluate and authorize the use of pesticide products. Especially in low and lower-middle income countries, however, human resources for sound evaluation of pesticides are very limited while the assessment of efficacy, hazards and risk is becoming increasingly complex (see Chapter 4).

Government inspection and control of pesticide-related activities are essential for effective implementation of national pesticide legislation. However, the capacity for enforcement is generally considered to be weak in many countries, often due to limited resources. As a result, illegal pesticides are sold and used, the quality of products on the market is not verified, pesticide sales and application are conducted by insufficiently trained staff, pesticides are disposed of in ways that are harmful to the environment, among others. Strengthening national capacity for inspection and control is therefore a high priority, especially in low and middle income countries.

Globally, the adoption of specific pesticide management policies has been rare so far. More policy instruments, based on regulatory, economic and informative approaches, will generally need to be implemented simultaneously, to successfully achieve pesticide risk reduction (Lee, den Uyl and Runhaar 2019). The elaboration of a comprehensive national pest/vector and pesticide management policy, adopted by all main stakeholders, would be an important first step in achieving that goal.

3.5 Corporate stewardship

3.5.1 Introduction

Within the framework of pesticide management, product stewardship has been defined as "responsible and ethical management of a pesticide product from its discovery through to its ultimate use and beyond". This definition in the International Code of Conduct on Pesticide Management (FAO and WHO 2014) explicitly recognizes that product stewardship is needed throughout the pesticide's life cycle.

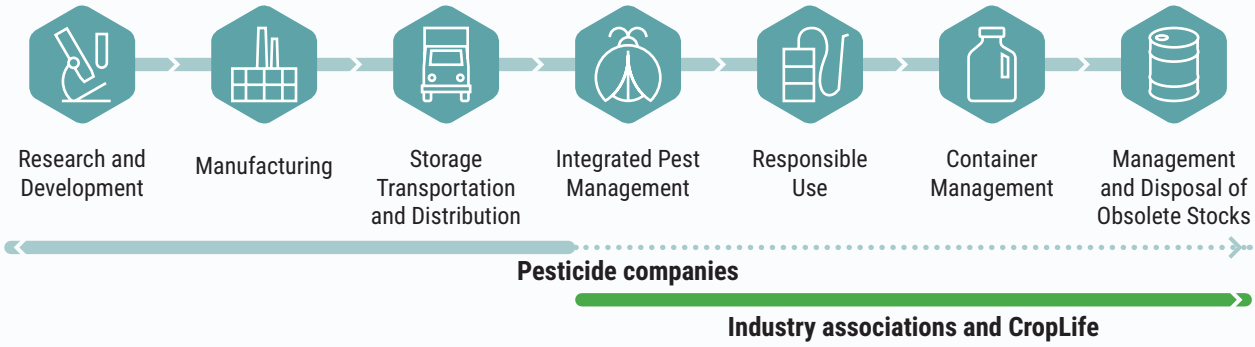
The terms product stewardship and extended producer responsibility (EPR) have been used interchangeably (Tasaki, Tojo and Lindhqvist 2018), while some consider EPR as a mandatory type of product stewardship (Product Stewardship Institute 2020). The OECD defines extended producer responsibility (EPR) as "an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle" (OECD 2016). However, OECD guidance on EPR primarily focuses on waste management.

Pesticide manufacturers, distributors and retailers have a primary responsibility to minimize adverse impacts. In this respect the Code of Conduct (FAO and WHO 2014) stipulates that pesticide industry and traders should:

- be capable of providing effective technical support, backed up by full product stewardship to end user level, including advice on and implementation of mechanisms for the effective management of unused and obsolete pesticides and empty pesticide containers;
- retain an active interest in following their products through the entire life cycle, keeping track of major uses and the occurrence of any problems arising from the use of their products, as a basis for determining the need for changes in labelling, directions for use, packaging, formulation or product availability.

In addition to the pesticide industry, pesticide product stewardship can be carried out by the food and commodity industries, particularly during the use of the products, as well as by major pesticide users.

Figure 3.5-1 **Key elements of crop protection stewardship as promoted by CropLife International ("CropLife"). Individual companies focus on the first part of the stewardship life cycle, while industry associations and CropLife International are mainly concerned with the second part.** CLI (2020c).



3.5.2 The pesticide industry

Stewardship is practised by individual pesticide companies and by industry associations.

Research-based pesticide companies

CropLife International (CLI), the association of research-based pesticide companies, has committed itself to promoting effective stewardship (CLI 2011; CLI 2020b; CLI 2020c). It underwrites the life cycle approach promoted by the Code of Conduct and considers that the overall aim of its stewardship approach is to maximize the benefits, and minimize any risk, from using crop protection products.

Stewardship of pesticides or crop protection products at CLI is broken down into seven interrelated elements going from research and development to management and disposal of obsolete pesticides (Figure 3.5-1). Pesticide companies are almost exclusively involved in stewardship at the research, development and manufacturing phases of the product lifecycle, but also conduct stewardship at the field level, where they concentrate on their own products. Regional industry associations and CLI, on the other hand deal more general aspects on stewardship principles that are relevant for all products. These are concentrated on the latter part of the life cycle, from use to waste management.

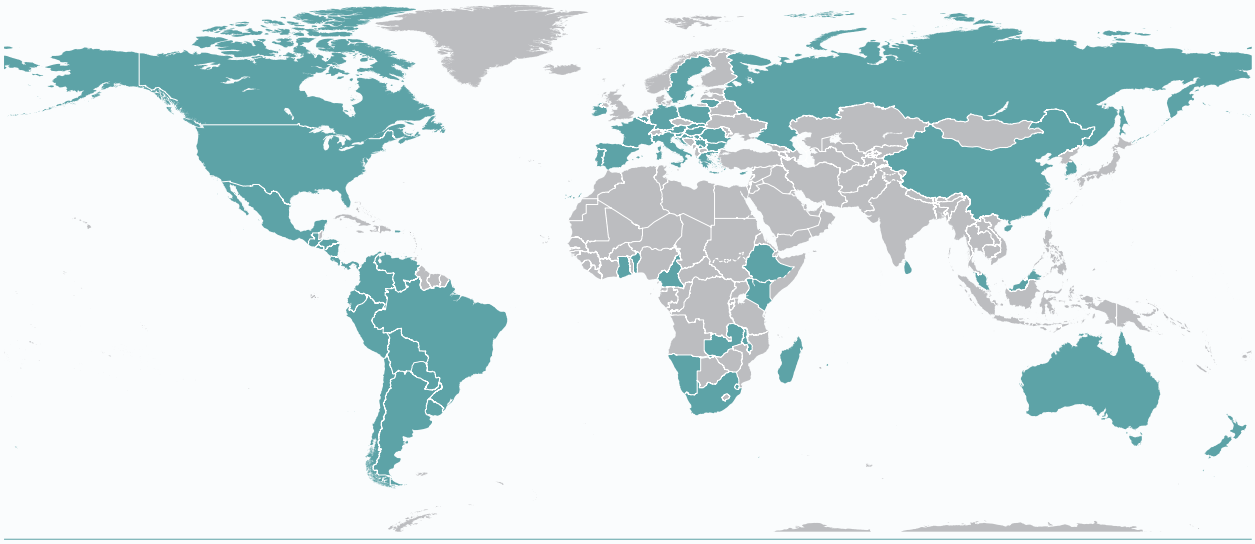
Training in good crop protection practices is considered a vital element of stewardship. CLI provides training on responsible use of crop protection products within the context of promoting IPM, with the underlying principle that a crop protection product should only be used when necessary: "as little as possible, as much as necessary". Training is often carried out in collaboration with sector ministries, farmer organizations and national or international development partners.

During the last decade the CropLife network reportedly trained between 100,000 and 500,000 extension agents, farmers and other pesticide users per year in 70 countries, mainly in Africa, Asia and Latin America (CLI 2020b). Moreover, in a single year (2018) CLI member companies recorded training over 22 million people. National CropLife Associations are also using various media, including the mass media, to reach large audiences with product stewardship information.

To minimize the development of pest resistance to pesticides, CLI member companies have committed themselves to include Mode of Action (MoA) codes on all their product labels by 2023 where this is permitted. Resistance management has been integrated into training programmes.

The management of empty pesticide containers is also part of the industry's stewardship life cycle approach. Its goal is to actively promote the expansion of container management programmes to new regions and countries, based on the lessons learned and "best practices" developed in regions where recycling is now the norm.

Figure 3.5-2 Countries with container management programmes (including pilots) supported by CropLife International and its members as of early 2020. Based on CLI (2020b) and personal communication.



Container management present

Container management programmes are typically undertaken in partnership with local authorities, recycling and/or disposal companies and the national government. Programmes supported by the pesticide industry were taking place in 58 countries in early 2020, an increase from 34 countries in 2010 (CLI 2020b) (Figure 3.5-2).

CLI has been actively involved over the last 25 years in projects to remove obsolete pesticides stocks. Its policy on obsolete stocks, adopted in 1995, is that member companies should consider providing assistance for the disposal of stocks they originally manufactured or supplied. Additionally, management practices and training have been introduced to help prevent future build-up of obsolete stocks, especially for private sector actors.

Work on obsolete stocks has been conducted through projects conducted by organizations such as FAO, the World Bank, the Africa Stockpiles Programme and bilateral donors. CLI has funded the disposal of pesticide stocks that originated from member companies.

CLI has extensively reported on its stewardship activities. Some individual activities have been externally reviewed, for instance if they were implemented through bilateral or multilateral donor programmes (CLI 2020b). However, no independent evaluation of the impact of product stewardship by CLI and its member countries on judicious pest and pesticide management has been conducted so far.

Generic pesticide producers

AgroCare, the association of generic pesticide producers, states that product stewardship is part of its mission (AgroCare n.d.). Nevertheless, no information was made available about stewardship activities by AgroCare or its member associations and companies despite of the fact that the largest share of the global pesticide market is now represented by generic, off-patent pesticides (Chapter 2.7.9).

3.5.3 Food and commodities industries

Pesticide stewardship is also conducted by the food and commodities industries. This primarily concerns the choice of pest management options and pesticides, occupational health precautions, and pesticide handling and application practices.

The most important way in which this stewardship is being shaped is through voluntary sustainability

standards developed by large producers of agricultural commodities, food processing industries and retailers, often in partnership with governments and NGOs. Examples are the Better Cotton Initiative, Fairtrade and Global G.A.P. (Chapter 2.7.12).

3.5.4 Pesticide users

Many pesticide users and their associations (e.g., farmer and grower associations and associations linking land managers (e.g., road, rail, municipalities) may also provide product stewardship. This often takes the form of technical guidance on pesticide handling and use, as well as container disposal.

3.5.5 Discussion: Corporate stewardship

Pesticide product stewardship by the private sector is an essential activity required to ensure optimal cost-efficacy of the pesticides being sold and to minimize health and environmental risks before, during and after their use. Extended producer responsibility for post-use aspects such empty container management as well as prevention and disposal of pesticide waste further contributes to the development of a circular economy.

Research-based pesticide companies conduct an important programme of product stewardship consisting primarily of information provision and training, resistance management, as well as contributions to empty container management and pesticide waste disposal. Companies producing mainly generic pesticides, on the other hand, do not seem to realize many stewardship activities, even though their market share has been significantly increasing.

Regarding information and training, friction may exist between product stewardship operated by pesticide industry and broader public or private objectives to reduce reliance on pesticides for pest and vector management. Pesticide manufacturers and distributors will logically focus their stewardship activities on proper use of the products that they market. This will not necessarily cover all elements needed to establish cropping systems that are less reliant on the use of pesticides.

Pesticide industry stewardship therefore needs to be balanced by independent advice on sustainable pest and pesticide management. This is especially important given the large number of farmers and public and private extension agents that are contacted by outreach activities of the pesticide industry on the one hand, and the decrease in public extension and advisory services observed in many countries on the other.

The food industry, commodity companies and (large) pesticide users conduct stewardship, mainly during the use stage of a pesticide, by ensuring good agricultural practices. Voluntary sustainability standards have become an important tool to promote such practices.

References

AgroCare (n.d.). Mission. https://www.agro-care.org/#mission. Accessed 15 November 2020.

Basel Convention (2011). *Strategic Framework for the Implementation of the Basel Convention for 2012-2021*. Decision BC-10/2. Conference of the Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, Tenth Meeting, 17-21 October 2011. http://www.basel.int/TheConvention/ConferenceoftheParties/ReportsandDecisions/tabid/3303/Default.aspx.

Basel Convention (2014). *Report on the Creation of a Baseline for the Mid-term and Final Evaluations of the Strategic Framework*. Document UNEP/CHW/OEWG.0/INF.3. Open-ended Working Group of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. Geneva, 16-19 September 2014. http://www.basel.int/Implementation/StrategicFramework/Evaluation/Midtermevaluation/tabid/3810/Default.aspx.

Basel Convention (2019). *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. Protocol on Liability and Compensation for Damage Resulting from Transboundary Movements of Hazardous Wastes and their Disposal. Texts and Annexes. Revised in 2019.* http://www.basel.int/theconvention/overview/textoftheconvention/tabid/1275/default.aspx.

Basel Convention (2020a). Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. http://www.basel.int/Countries/StatusofRatifications/PartiesSignatories/tabid/4499/Default.aspx.

Basel Convention (2020b). Basel Convention (2020b). Ban Amendment: Amendment to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. http://www.basel.int/Countries/StatusofRatifications/BanAmendment/tabid/1344/Default.aspx. Accessed 17 November 2020.

Basel Convention (2020c). Strategic Framework: Overview. http://www.basel.int/Implementation/StrategicFramework/Overview/tabid/3807/Default.aspx. Accessed 19 November 2020.

Berry, K. (2016). *Codex MRLs – Use and Trends*. White Paper. Seattle: Bryant Christie Inc. https://bcglobal.bryantchristie.com/downloads/whitepaper_Codex_MRLs_Use_and_Trends_globalmrl.pdf.

Brandi, C., Blümer, D. and Morin, J.-F. (2019). When do international treaties matter for domestic environmental legislation? *Global Environmental Politics* 19(4), 14-44. https://doi.org/10.1162/glep_a_00524.

Center for International Environmental Law (2018). *Promoting the Effectiveness of the Rotterdam Convention: Ways Forward and Procedural Implications*. https://www.ciel.org/wp-content/uploads/2017/11/RCEffectiveness_legal-implication-analysis_Final.pdf.

Chowdhury, F.B., Dewan, G., Verma, V.R., Knipe, D.W., Isha, I.T., Faiz, M.A. *et al*. (2018). Bans of WHO Class I Pesticides in Bangladesh – suicide prevention without hampering agricultural output. *International Journal of Epidemiology* 47(1), 175-184. https://doi.org/10.1093/ije/dyx157.

Codex Alimentarius (2020). Codex Alimentarius International Food Standards. http://www.fao.org/fao-who-codexalimentarius/home/en/. Accessed 15 November 2020.

Convention on Biological Diversity (1992). *Text of the Convention*. New York: United Nations. https://www.cbd.int/convention/text/.

Convention on Biological Diversity (2016). *Indicators for the Strategic Plan for Biodiversity 2011 2020 and the Aichi Biodiversity Targets. Decision XIII/28 of the 13th meeting of the Conference of the Parties to the Convention on Biological Diversity. Cancun, Mexico, 4-17 December 2016*. Montreal: Secretariat of the Convention on Biological Diversity. https://www.cbd.int/doc/decisions/cop-13/cop-13-dec-28-en.pdf.

Convention on Biological Diversity (2020a). CBD website. https://www.cbd.int/. Accessed 15 November 2020.

Convention on Biological Diversity (2020b). Agricultural biodiversity. https://www.cbd.int/agro/. Accessed 15 November 2020.

Convention on Biological Diversity (2020c). *Global Biodiversity Outlook 5*. https://www.cbd.int/gbo5. Accessed 19 November 2020.

Copplestone, J.F. (1988). The development of the WHO Recommended Classification of Pesticides by Hazard. *Bulletin of the World Health Organization* 66 (5), 545-551. http://europepmc.org/backend/ptpmcrender.fcgi?accid=PMC2491185&blobtype=pdf.

CropLife International (2011). *A Stocktaking Report: Crop Protection Stewardship Activities of the Plant Science Industry 2005-2011*. https://croplife.org/wp-content/uploads/2014/04/A-Stocktaking-Report-Crop-Protection-Stewardship-Activities-of-the-Plant-Science-Industry-2005-2011.pdf.

CropLife International (2017). International Code of Conduct e-learning tool. https://croplife.org/crop-protection/regulatory/product-management/international-code-of-conduct/international-code-of-conduct-e-learning-tool/. Accessed 15 November 2020.

CropLife International (2020a). A responsible approach to Highly Hazardous Pesticides. Blog by Dr. Christoph Neumann. https://croplife.org/a-responsible-approach-to-highly-hazardous-pesticides/. Accessed 15 November 2020.

CropLife International (2020b). CropLife stewardship report 2005-2018 (in preparation).

CropLife International (2020c). Stewardship. https://croplife.org/crop-protection/stewardship/. Accessed 15 November 2020.

Danish Environmental Protection Agency (2017). *Pesticidstrategi 2017-2021* (Pesticide strategy 2017-2021). https://mst.dk/media/141516/pesticidstrategi2017-2021.pdf. Accessed 15 November 2020.

Danish Environmental Protection Agency (2019). *Bekæmpelsesmiddel-statistik 2017* (Pesticide statistics 2017). https://www2.mst.dk/Udgiv/publikationer/2019/06/978-87-7038-077-5.pdf. Accessed 15 November 2020.

Department of Agriculture, Forestry and Fisheries of South Africa (2010). *Pesticide Management Policy for South Africa*. Government Gazette No. 33899 of 24 December 2010. https://www.nda.agric.za/docs/policy/pesticidemanag.pdf. Accessed 15 November 2020.

Dinham, B. and Malik, S. (2003). Pesticides and human rights. *International Journal of Occupational and Environmental Health* 9(1), 40-52. https://doi.org/10.1179/107735203800328867. Accessed 15 November 2020.

European Commission (2017a). *A Study on the Effect of Listing of Chemicals in Annex III to the Rotterdam Convention. Final Report.* http://www.pic.int/Implementation/EnhancingtheeffectivenessoftheConvention/Impactsoflistingchemicals/tabid/7649/language/en-US/Default.aspx. Accessed 15 November 2020.

European Commission (2017b). *Overview Report on the Implementation of Member States' Measures to Achieve the Sustainable Use of Pesticides under Directive 2009/128/EC*. Report DG(SANTE) 2017-6291. Brussels: Directorate-General for Health and Food Safety.

European Commission (2020a). Report from the Commission to the European Parliament and the Council on the Experience Gained by Member States on the Implementation of National Targets Established in their National Action Plans and on Progress in the Implementation of Directive 2009/128/EC on the Sustainable Use of Pesticides. https://ec.europa.eu/food/sites/food/files/plant/docs/pesticides_sud_report-act_2020_en.pdf.

European Commission (2020b). Farm to fork strategy – for a fair, healthy and environmentally-friendly food system. https://ec.europa.eu/food/farm2fork_en. Accessed 15 November 2020.

European Union (2009a). Regulation (EC) No 1107/2009 of the European Parliament and of the Council of 21 October 2009 concerning the placing of plant protection products on the market. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02009R1107-20181110. Accessed 15 November 2020.

European Union (2009b). Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides. https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:02009L0128-20091125. Accessed 15 November 2020.

European Union (2019). Commission Directive 2019/782 of 15 May 2019 amending Directive 2009/128/EC of the European Parliament and of the Council as regards the establishment of harmonised risk indicators. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019L0782. Accessed 15 November 2020.

Food and Agriculture Organization of the United Nations (1993). *Analysis of Government Responses to the First Questionnaire on the International Code of Conduct on the Distribution and Use of Pesticides*. Rome.

Food and Agriculture Organization of the United Nations (1996). *Analysis of Government Responses to the Second Questionnaire on the State of Implementation of the International Code of Conduct on the Distribution and Use of Pesticides*. Rome. https://www.fao.org/publications/card/es/c/CB5456EN/.

Food and Agriculture Organization of the United Nations (2006a). *International Code of Conduct on the Distribution and Use of Pesticides: Guidelines on Monitoring and Observance of the Code of Conduct*. Rome. http://www.fao.org/fileadmin/templates/agphome/documents/Pests_Pesticides/Code/Monitoring.pdf.

Food and Agriculture Organization of the United Nations (2006b). FAO Council Hundred and Thirty-first Session, Rome, 20-25 November 2006. http://www.fao.org/unfao/bodies/council/cl131/Index_en.htm. Accessed 15 November 2020.

Food and Agriculture Organization of the United Nations (2010). *International Code of Conduct on the Distribution and Use of Pesticides: Regular Monitoring Report – 2008*. Rome. http://www.fao.org/fileadmin/templates/agphome/documents/Pests_Pesticides/Code/Monitorin_questionnaire_2010.pdf.

Food and Agriculture Organization of the United Nations (2015). *Phasing Out Highly Hazardous Pesticides is Possible! Farmer Experiences in Growing Coffee without Endosulfan.* http://www.fao.org/publications/card/en/c/039416ce-83c5-424c-a6aa-25fecf999be9/.

Food and Agriculture Organization of the United Nations (2016). *Addressing Highly Hazardous Pesticides in Mozambique.* http://www.fao.org/publications/card/en/c/4bf666a3-a130-4c00-9184-824033417fe5/.

Food and Agriculture Organization of the United Nations (2019). *The State of the World's Biodiversity for Food and Agriculture*. Bélanger, J. and Pilling, D. (eds.). FAO Commission on Genetic Resources for Food and Agriculture Assessments. Rome. http://www.fao.org/3/CA3129EN/CA3129EN.pdf.

Food and Agriculture Organization of the United Nations (2020a). New list of guidelines. http://www.fao.org/agriculture/crops/thematic-sitemap/theme/pests/code/list-guide-new/en/. Accessed 2 May 2021.

Food and Agriculture Organization of the United Nations (2020b). Plant registration toolkit. http://www.fao.org/pesticide-registration-toolkit/en/. Accessed 2 May 2021.

Food and Agriculture Organization of the United Nations and International Plant Protection Convention (2017). *Guidelines for the Export, Shipment, Import and Release of Biological Control Agents and Other Beneficial Organisms*. https://www.ippc.int/static/media/files/publication/en/2017/05/ISPM_03_2005_En_2017-05-23_PostCPM12_InkAm.pdf.

Food and Agriculture Organization of the United Nations and United Nations Environment Programme (2020). *Legislative Approaches to Sustainable Agriculture and Natural Resources Governance*. FAO Legislative Study No. 114. Rome. https://doi.org/10.4060/ca8728en.

Food and Agriculture Organization of the United Nations and World Health Organization (2007). *Report: 1st FAO/WHO Joint Meeting in Pesticides Management and 3rd Session of the FAO Panel of Experts on Pesticide Management. 22-26 October 2007*. Rome. http://www.fao.org/fileadmin/templates/agphome/documents/Pests_Pesticides/Code/JMPM_2007_Report.pdf.

Food and Agriculture Organization of the United Nations and World Health Organization (2008). *Report: 2nd FAO/WHO Joint Meeting on Pesticide Management and 4th Session of the FAO Panel of Experts on Pesticide Management. 6-8 October 2008*. Geneva. http://www.fao.org/agriculture/crops/thematic-sitemap/theme/pests/code/panelcode/en/.

Food and Agriculture Organization of the United Nations and World Health Organization (2014). *The International Code of Conduct on Pesticide Management*. Rome. http://www.fao.org/agriculture/crops/thematic-sitemap/theme/pests/code/en/.

Food and Agriculture Organization of the United Nations and World Health Organization (2015). *International Code of Conduct on Pesticide Management: Guidelines on Good Labelling Practice for Pesticides (Revised). August 2015*. *Rome.* http://www.fao.org/3/a-i4854e.pdf.

Food and Agriculture Organization of the United Nations and World Health Organization (2016). *International Code of Conduct on Pesticide Management: Guidelines on Highly Hazardous Pesticides*. Rome. http://www.fao.org/3/a-i5566e.pdf.

Food and Agriculture Organization of the United Nations and World Health Organization (2017). *Report: 10th FAO/WHO Joint Meeting on Pesticide Management. 10-13 April 2017. New Delhi*. Rome. http://www.fao.org/fileadmin/templates/agphome/documents/Pests_Pesticides/Code/JMPM_2017_Report.pdf.

Food and Agriculture Organization of the United Nations and World Health Organization (2018). *Codex Alimentarius: Understanding Codex*. 5th edition. Rome. http://www.fao.org/3/CA1176EN/ca1176en.pdf.

Food and Agriculture Organization of the United Nations and World Health Organization (2019a). *Global Situation of Pesticide Management in Agriculture and Public Health. Report of a 2018 WHO-FAO Survey*. Rome and Geneva. https://apps.who.int/iris/handle/10665/329971.

Food and Agriculture Organization of the United Nations and World Health Organization (2019b). *Report: 12th FAO/WHO Joint Meeting on Pesticide Management. 19-22 November 2019, Geneva, Switzerland.* Geneva. https://apps.who.int/iris/handle/10665/331620.

Food and Agriculture Organization of the United Nations and World Health Organization (2019c). *Codex Strategic Plan 2020-2025*. Rome and Geneva. http://www.fao.org/3/ca5645en/CA5645EN.pdf.

Food and Agriculture Organization of the United Nations and World Health Organization (2019d). *Report: 11th FAO/WHO Joint Meeting on Pesticide Management.* Geneva. http://www.fao.org/agriculture/crops/thematic-sitemap/theme/pests/code/panelcode/en/.

Food and Agriculture Organization of the United Nations and World Health Organization (2020). *International Code of Conduct on Pesticide Management: Guidelines on Pesticide Legislation. Second edition*. Rome. https://doi.org/10.4060/cb0916en.

Goldenman, G. and Pozo Vera, E. (eds.) (2008). *International Tools for Preventing Local Pesticide Problems: A Consolidated Guide to the Chemical Codes and Conventions*. Brighton, UK: Pesticide Action Network. https://issuu.com/pan-uk/docs/consolidated_guide_to_chemical_code?e=28041656/64929590.

Goldenman, G. and Rengam, S. (1987). *Problem Pesticides, Pesticide Problems: A Citizens' Action Guide to the International Code of Conduct on the Distribution and Use of Pesticides*. Penang, Malaysia: International Organization of Consumers Unions and Pesticide Action Network.

Government of France (2018). Écophyto II+: Reducing and Improving the Use of Plant Protection Products. Ministère de la Transition écologique et solidaire. https://ec.europa.eu/food/sites/food/files/plant/docs/pesticides_sup_nap_fra-ecophyto-2plus_plan_en.pdf.

Handford, C.A., Elliott, C.T. and Campbell, K. (2015). A review of the global pesticide legislation and the scale of challenge in reaching the global harmonization of food safety standards. *Integrated Environmental Assessment and Management* 11(4), 525-536. https://doi.org/10.1002/ieam.1635. Accessed 15 November 2020

Intergovernmental Forum on Chemical Safety (2003). *Fourth Session of the Intergovernmental Forum on Chemical Safety, Bangkok, Thailand, 1-7 November 2003. Final Report, Executive Summary.* https://www.who.int/ifcs/documents/forums/forum4/final_report/en/.

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (2019). *Summary for Policymakers of the Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. Díaz, S., Settele, J., Brondízio, E.S., Ngo, H.T., Guèze, M., Agard, J. et al. (eds.). Bonn: IPBES Secretariat. https://doi.org/10.5281/zenodo.3553579.

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (2020). IPBES website. https://ipbes.net/. Accessed 15 November 2020.

International Labour Organization (1981). C155 - Occupational Safety and Health Convention, 1981 (No. 155). https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO:12100:P12100_INSTRUMENT_ID:312300:NO. Accessed 15 November 2020.

International Labour Organization (1999). C182 – Worst Forms of Child Labour Convention, 1999 (No. 182). https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO:12100:P12100_INSTRUMENT_ID:312327:NO. Accessed 15 November 2020.

International Labour Organization (2007). *Rooting Out Child Labour from Cocoa Farms. Paper No. 2: Safety and Health Hazards*. Geneva. http://www.ilo.org/ipecinfo/product/viewProduct.do?productId=6445.

International Labour Organization (2016). *Child Labour in Cotton: A Briefing*. Geneva. http://www.ilo.org/ipec/Informationresources/WCMS_IPEC_PUB_29655/lang--en/index.htm.

International Labour Organization (2017a). *Global Estimates of Child Labour: Results and Trends, 2012-2016*. Geneva. https://www.ilo.org/global/publications/books/WCMS_575499/lang--en/index.htm.

International Labour Organization (2017b). *Child Labour in the Primary Production of Sugarcane*. Geneva. http://www.ilo.org/ipec/Informationresources/WCMS_IPEC_PUB_29635/lang--en/index.htm.

International Labour Organization (2020a). Ratifications of C182 – Worst Forms of Child Labour Convention, 1999 (No. 182). https://www.ilo.org/dyn/normlex/en/f?p=1000:11300:0::NO:11300:P11300_INSTRUMENT_ID:312327. Accessed 19 November 2020.

International Labour Organization (2020b). Ratifications of C155 – Occupational Safety and Health Convention, 1981 (No. 155). https://www.ilo.org/dyn/normlex/en/f?p=1000:11300:0::NO:11300:P11300_INSTRUMENT_ID:312300. Accessed 19 November 2020.

International Plant Protection Convention (1997). *1997 – International Plant Protection Convention (New Revised Text).* https://www.ippc.int/en/publications/131/.

International Plant Protection Convention (2020). IPPC website. https://www.ippc.int/en/. Accessed 15 November 2020.

Jansen, K. and Dubois, M. (2014). Global pesticide governance by disclosure: Prior Informed Consent and the Rotterdam Convention. In *Transparency in Global Environmental Governance: Critical Perspectives*. Gupta, A. and Mason, M. (eds.). Cambridge, MA: MIT Press. 107-131. https://mitpress.mit.edu/books/transparency-global-environmental-governance.

Jepson, P.C., Murray, K., Bach, O., Bonilla, M.A. and Neumeister, L. (2020). Selection of pesticides to reduce human and environmental health risks: A global guideline and minimum pesticides list. *The Lancet Planetary Health*, 4(2), e56-e63. https://doi.org/10.1016/S2542-5196(19)30266-9.

Jin, S. and Zhou, F. (2018). Zero growth of chemical fertilizer and pesticide use: China's objectives, progress and challenges. *Journal of Resources and Ecology* 9(1), 50-58. https://doi.org/10.5814/j.issn.1674-764x.2018.01.006.

Kellenberg, D. and Levinson, A. (2014). Waste of effort? International Environmental Agreements. *Journal of the Association of Environmental and Resource Economists* 1(1/2), 135-169. https://www.journals.uchicago.edu/doi/full/10.1086/676037.

Konradsen, F., van der Hoek, W., Cole, D.C., Hutchinson, G., Daisley, H., Singh, S. and Eddleston, M. (2003). Reducing acute poisoning in developing countries – options for restricting the availability of pesticides. *Toxicology* 192(203), 249-261. https://doi.org/10.1016/S0300-483X(03)00339-1.

Kudsk, P., Nistrup Jørgensen, L. and Ørum, J.E. (2018). Pesticide Load – A new Danish pesticide risk indicator with multiple applications. *Land Use Policy* 70, 384-393. https://doi.org/10.1016/j.landusepol.2017.11.010.

Lee, R., den Uyl, R. and Runhaar, H. (2019). Assessment of policy instruments for pesticide use reduction in Europe; Learning from a systematic literature review. *Crop Protection* 126, 104929. https://doi.org/10.1016/j.cropro.2019.104929.

Manuweera, G., Eddleston, M., Egodage, S. and Buckley, N.A. (2008). Do targeted bans of insecticides to prevent deaths from self-poisoning result in reduced agricultural output? *Environmental Health Perspectives* 116(4), 492-495. https://doi.org/10.1289/ehp.11029.

Matthews, G., Zaim, M., Singh Yadav, R., Soares, A., Hii, J., Ameneshewa, B. *et al*. (2011). Status of legislation and regulatory control of public health pesticides in countries endemic with or at risk of major vector-borne diseases. Environmental Health Perspectives 119, 1517-1522. http://dx.doi.org/10.1289/ehp.1103637.

McClary, M.J. and Goldstein, J.B. (2017). FIFRA at 40: The need for felonies for pesticide crimes. *Environmental Law Reporter 9*, 10767-10785. https://www.eli.org/sites/default/files/elr/featuredarticles/47.10767.pdf.

Millennium Ecosystem Assessment (2005). Guide to the Millennium Ecosystem Assessment Reports. https://www.millenniumassessment.org/en/index.html. Accessed 14 November 2020.

Minamata Convention (2013). *Global Mercury Assessment 2013: Sources, Emissions, Releases and Environmental Transport*. Geneva: United Nations Environment Programme. https://wedocs.unep.org/bitstream/handle/20.500.11822/7984/-Global%20Mercury%20Assessment-201367.pdf?sequence=3&isAllowed=yhttps://wedocs.unep.org/handle/20.500.11822/7984.

Minamata Convention (2017). *Minamata Convention on Mercury. Text and Annexes.* http://mercuryconvention.org/Convention/Text/tabid/3426/language/en-US/Default.aspx.

Minamata Convention (2019). *Global Mercury Assessment 2018*. Geneva: United Nations Environment Programme. https://www.unenvironment.org/resources/publication/global-mercury-assessment-2018.

Ministerie van Economische Zaken (The Netherlands) (2013) Gezonde groei, duurzame oogst – Tweede nota duurzame gewasbescherming periode 2013 tot 2023. Ministerie van Economische Zaken, The Hague https://www.rijksoverheid.nl/documenten/rapporten/2013/05/14/gezonde-groei-duurzame-oogst-tweede-nota-duurzame-gewasbescherming. Accessed 16 November 2020.

Montreal Protocol (2018). *Methyl Bromide Technical Options Committee: 2018 Assessment Report.* United Nations Environment Programme, Ozone Secretariat. Nairobi. https://ozone.unep.org/sites/default/files/2019-04/MBTOC-assessment-report-2018_1.pdf.

Núñez-Rocha, T. and Martínez-Zarzoso, I. (2019). Are international environmental policies effective? The case of the Rotterdam and the Stockholm Conventions. *Economic Modelling* 81, 480-502. https://doi.org/10.1016/j.econmod.2018.04.013. Accessed 16 November 2020.

Nurick, R. (2019). *Independent Evaluation of the Strategic Approach from 2006-2015. Final Report.* http://www.saicm.org/Portals/12/Documents/reporting/FinalReport_Independent-Evaluation-SAICM-2006-2015.pdf.

Organisation for Economic Co-operation and Development (2012). *OECD Guidance on Pesticide Compliance and Enforcement Best Practices*. Series on Pesticides No. 71. https://www.oecd.org/env/ehs/pesticides-biocides/Pesticides_Compliance_Guidance.pdf.

Organisation for Economic Co-operation and Development (2016). *Extended Producer Responsibility – Updated Guidance for Efficient Waste Management.* https://doi.org/10.1787/9789264256385-en.

Organisation for Economic Co-operation and Development (2020a) Mutual Acceptance of Data (MAD). https://www.oecd.org/chemicalsafety/testing/mutualacceptanceofdatamad.htm. Accessed 18 November 2020.

Organisation for Economic Co-operation and Development (2020b). *Saving Costs in Chemicals Management: How the OECD Ensures Benefits to Society.* https://doi.org/10.1787/9789264311718-en.

Orozco, F.A., Code, D.C., Forbes, G., Kroschel, J., Wanigaratne, S. and Arica, D. (2009). Monitoring adherence to the International Code of Conduct – Highly Hazardous Pesticides in Central American agriculture and farmers' rights to health. *International Journal of Occupational and Environmental Health* 15, 255-268. https://doi.org/10.1179/oeh.2009.15.3.255.

Persson, L., Karlsson-Vinkhuyzen, S., Lai, A., Persson, Å and Fick, S. (2017). The Globally Harmonized System of Classification and Labelling of Chemicals – explaining the legal implementation gap. *Sustainability* 9, 2176. https://doi.org/10.3390/su9122176.

Pesticide Action Network (2010). *Communities in Peril: Global Report on Health Impacts of Pesticide Use in Agriculture*. Penang: Pesticide Action Network Asia and the Pacific. http://paninternational.org/wp-content/uploads/2013/12/PAN-Global-Report-communities-peril.pdf.

Pesticide Action Network (2021). *PAN International List of Highly Hazardous Pesticides (PAN List of HHPs). March 2021*. Hamburg: Pesticide Action Network International. http://pan-international.org/wp-content/uploads/PAN_HHP_List.pdf.

Pesticide Action Network Asia and the Pacific and Pesticide Action Network UK (2016). *FAO Code Monitoring Module: An updated users' guide to monitoring the implementation of the FAO/WHO International Code of Conduct on Pesticide Management, 2014*. Updated 2016. https://files.panap.net/resources/FAO-Code-Monitoring-Module.pdf.

Planbureau voor de Leefomgeving (The Netherlands) (2019). Geïntegreerde gewasbescherming nader beschouwd . Tussenevaluatie van de nota Gezonde Groei, Duurzame Oogst. https://www.pbl.nl/publicaties/geintegreerde-gewasbescherming-nader-beschouwd. Accessed 15 November 2020.

Product Stewardship Institute (2020). What is product stewardship? https://www.productstewardship.us/page/Definitions. Accessed 15 November 2020.

Public Eye (2017). UN Experts fail to deliver assessment of Bayer and Syngenta compliance with the International Code of Conduct on Pesticide Management. Press release, 23 November. https://www.publiceye.ch/en/news/detail/un-experts-fail-to-deliver-assessment-of-bayer-and-syngenta-compliance-with-the-international-code-of-conduct-on-pesticide-management. Accessed 15 November 2020.

Reeves, M., Schafer, K., Hallward, K. and Katten, A. (1999). *Fields of Poison: California Farmworkers and Pesticides*. San Francisco: Pesticide Action Network North America. https://www.panna.org/sites/default/files/FieldsofPoison2002Eng.pdf. Accessed 15 November 2020.

Rotterdam Convention (2015). *Report of the Conference of the Parties to the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade on the Work of Its Seventh Meeting. Geneva, 4-15 May 2015*. UNEP/FAO/ RC/COP.7/21. http://www.pic.int/TheConvention/ConferenceoftheParties/Meetings/COP7/Overview/tabid/4252/language/en-US/Default.aspx.

Rotterdam Convention (2017). *Study of Information on the Impacts of Listing Chemicals in Annex III to the Rotterdam Convention*. Conference of the Parties to the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade. Eighth meeting Geneva, 24 April-5 May 2017. UNEP/FAO/RC/COP.8/INF/21. http://www.pic.int/Implementation/EnhancingtheeffectivenessoftheConvention/Impactsoflistingchemicals/tabid/7649/language/en-US/Default.aspx.

Rotterdam Convention (2018). *Report of the Working Group on Enhancing the Effectiveness of the Rotterdam Convention on the Work of Its First Meeting*. Riga, Latvia, 4-6 June 2018. UNEP/FAO/RC/EFF.1/4. http://www.pic.int/?tabid=6306.

Rotterdam Convention (2019). *Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade. Text and Annexes. Revised in 2019.* http://www.pic.int/TheConvention/Overview/TextoftheConvention/tabid/1048/language/en-US/Default.aspx.

Rotterdam Convention (2020a). Status of ratifications. http://www.pic.int/Countries/Statusofratifications/tabid/1072/language/en-US/Default.aspx. Accessed 17 November 2020.

Rotterdam Convention (2020b). Workshops. http://www.pic.int/Implementation/TechnicalAssistance/Workshops/tabid/4637/language/en-US/Default.aspx. Accessed 16 November 2020.

Rotterdam Convention (2020c). Import responses. http://www.pic.int/Procedures/ImportResponses/Database/tabid/1370/language/en-US/Default.aspx. Accessed 18 November 2020.

Rotterdam Convention (n.d. a). Severely Hazardous Pesticide Formulations: Overview. http://www.pic.int/Default.aspx?tabid=1191. Accessed 18 November 2020.

Rotterdam Convention (n.d. b). Annex III chemicals. http://www.pic.int/TheConvention/Chemicals/AnnexIIIChemicals. Accessed 18 November 2020.

Rotterdam Convention (n.d.c). Rotterdam Convention. PIC Circulars. http://www.pic.int/Implementation/PICCircular/tabid/1168/language/en-US/Default.aspx. Accessed 16 November 2020.

Standards and Trade Development Facility (2020). STDF: Standards and Trade Development Facility. https://www.standardsfacility.org. Accessed 1 May 2021.

Stockholm Convention (2017a). Text of the Convention. http://chm.pops.int/TheConvention/Overview/TextoftheConvention/tabid/2232/Default.aspx. Accessed 18 November 2020.

Stockholm Convention (2017b). *Second Global Monitoring Report. Global Monitoring Plan for Persistent Organic Pollutants*. Document UNEP/POPS/COP.8/INF/38. Conference of the Parties to the Stockholm Convention on Persistent Organic Pollutants. Eighth meeting, Geneva, 24 April-5 May 2017. United Nations Environment Programme, Geneva. Accessed 17 November 2020.

Stockholm Convention (2017c). *Report on the Effectiveness Evaluation of the Stockholm Convention on Persistent Organic Pollutants*. UNEP/POPS/COP.8/INF/40. Geneva: United Nations Environment Programme. http://chm.pops.int/TheConvention/ConferenceoftheParties/Meetings/COP8/tabid/5309/Default.aspx.

Stockholm Convention (2019a). Status of ratification. http://chm.pops.int/Countries/StatusofRatifications/PartiesandSignatoires/tabid/4500/Default.aspx. Accessed 17 November 2020.

Stockholm Convention (2019b). All POPs listed in the Stockholm Convention. http://chm.pops.int/TheConvention/ThePOPs/AllPOPs/tabid/2509/Default.aspx. Accessed 17 November 2020.

Stockholm Convention (2019c). Persistent Organic Pollutant Review Committee: Overview and Mandate. http://chm.pops.int/Default.aspx?tabid=2806. Accessed 17 November 2020.

Stockholm Convention (2019d). Effectiveness evaluation: Overview. http://chm.pops.int/Implementation/EffectivenessEvaluation/Overview/tabid/369/Default.aspx. Accessed 17 November 2020.

Stockholm Convention (2019e). Global Monitoring Plan. http://chm.pops.int/Implementation/GlobalMonitoringPlan/Overview/tabid/83/Default.aspx. Accessed 15 November 2020.

Stockholm Convention (2019f). *Report of the DDT Expert Group on the Assessment of the Production and use of DDT and its alternatives for Disease Vector Control*. UNEP/POPS/COP.9/INF/6. http://www.pops.int/TheConvention/ConferenceoftheParties/Meetings/COP9/tabid/7521/Default.aspx.

Strategic Approach to International Chemicals Management (2011). *First Progress Report on Implementation of Progress in Implementation of the Strategic Approach: Results of Preliminary Data Collection for 2009 and 2010*. SAICM/OEWG.1/INF/2. http://www.saicm.org/Portals/12/documents/meetings/OEWG1/inf/OEWG1%20INF%202_first%20progress%20report-final.pdf.

Strategic Approach to International Chemicals Management (2015a). *Strategy to Address Highly Hazardous Pesticides in the Context of the Strategic Approach to International Chemicals Management.* http://www.saicm.org/Portals/12/Documents/EPI/HHP%20strategy%20English.pdf.

Strategic Approach to International Chemicals Management (2015b). Fourth Session of the International Conference on Chemicals Management (ICCM4). http://www.saicm.org/Meetings/ICCM4/tabid/5464/language/en-US/Default.aspx. Accessed 15 November 2020.

Strategic Approach to International Chemicals Management (2019). *Progress in Strategic Approach Implementation for 2014-2016*. SAICM/OEWG.3/INF/4. http://www.saicm.org/Portals/12/Documents/meetings/OEWG3/inf/OEWG3-INF-4-2014-16-third-Progress-Report-.pdf.

Strategic Approach to International Chemicals Management (n.d.). *Strategic Approach to International Chemicals Management: SAICM Texts and Resolutions of the International Conference on Chemicals Management.* http://www.saicm.org/Portals/12/Documents/saicmtexts/New%20SAICM%20Text%20with%20ICCM%20resolutions_E.pdf.

Tasaki, T., Tojo, N. and Lindhqvist, T. (2018). Differences in perception of extended producer responsibility and product stewardship among stakeholders: An international questionnaire survey and statistical analysis. *Journal of Industrial Ecology* 23(2), 438-451. https://doi.org/10.1111/jiec.12815.

ter Horst, M., Deneer, J., van der Valk, H., Aung, K.O., San Lwin, S., Raw, S. and Krook, J. (2018). *Risk Reduction of Pesticides in Myanmar: Interim Report of the Dutch-Myanmar Project of Pesticide Registration and Pesticide Risk Eduction 2016-2018*. Wageningen, the Netherlands: Wageningen University and Research. https://www.wur.nl/nl/Publicatie-details.htm?publicationId=publication-way-353337353338.

United Nations Economic Commission for Europe (2020a). *Globally Harmonized System of Classification and Labelling of Chemicals (GHS). Eighth Revised Edition.* https://www.unece.org/trans/danger/publi/ghs/ghs_rev08/08files_e.html.

United Nations Economic Commission for Europe (2020b). GHS implementation. https://www.unece.org/trans/danger/publi/ghs/implementation_e.html. Accessed 15 November 2020.

United Nations Environment Programme (2019a). Methyl bromide. https://www.unenvironment.org/ozonaction/what-we-do/methyl-bromide. Accessed 15 May 2020.

United Nations Environment Programme (2019b). *Environmental Rule of Law: First Global Report*. Nairobi. https://wedocs.unep.org/bitstream/handle/20.500.11822/27279/Environmental_rule_of_law.pdf?sequence=1&isAllowed=y. Accessed 15 May 2020.

United Nations Environment Programme (2020a). The Montreal Protocol on Substances that Deplete the Ozone Layer. https://ozone.unep.org/treaties/montreal-protocol. Accessed 17 November 2020.

United Nations Environment Programme (2020b). Minamata Convention on Mercury: Parties and Signatories. http://www.mercuryconvention.org/Countries/Parties/tabid/3428/language/en-US/Default.aspx. Accessed 18 November 2020.

United Nations Environment Programme (2020c). The Bamako convention. https://www.unenvironment.org/explore-topics/environmental-rights-and-governance/what-we-do/meeting-international-environmental. Accessed 19 November 2020.

United Nations Environment Programme (2022). *Synthesis Report on Environmental and Health Impacts of Pesticides and Fertilizers and Ways of Minimizing Them*. https://www.unep.org/resources/report/environmental-and-health-impacts-pesticides-and-fertilizers-and-ways-minimizing.

United Nations Treaty Collection (2020). 3.b. Basel Protocol on Liability and Compensation for Damage Resulting from Transboundary Movements of Hazardous Wastes and their Disposal. https://treaties.un.org/Pages/ViewDetails.aspx?src=IND&mtdsg_no=XXVII-3-b&chapter=27&clang=_en. Accessed 16 November 2020.

van den Berg, H., Gu, B., Grenier, B., Kohlschmid, E., Al-Eryani, S., da Silva Bezerra H.S. *et al*. (2020). Pesticide lifecycle management in agriculture and public health: Where are the gaps? *Science of The Total Environment* 742, 140598. https://doi.org/10.1016/j.scitotenv.2020.140598.

van den Berg, M., Kypke, K., Kotz, A., Tritscher, A., Lee, S.Y., Magulova, K. *et al*. (2017). WHO/UNEP global surveys of PCDDs, PCDFs, PCBs and DDTs in human milk and benefit-risk evaluation of breastfeeding. *Archives of Toxicology* 91(1), 83-96. https://doi.org/10.1007/s00204-016-1802-z.

World Customs Organization (2020). What is the Harmonized System (HS)? http://www.wcoomd.org/en/topics/nomenclature/overview/what-is-the-harmonized-system.aspx. Accessed 14 November 2020.

World Health Organization (2004). *Public Health Pesticide Management Practices by WHO Member States – Report of a Survey 2003-2004*. Geneva. https://apps.who.int/iris/handle/10665/68697/.

World Health Organization (2011a). *Public Health Pesticide Registration and Management Practices by WHO Member States – Report of a 2010 Survey*. Zaim, M./WHO Pesticide Evaluation Scheme (WHOPES) (eds.). Geneva. https://apps.who.int/iris/handle/10665/44542.

World Health Organization (2011b). *Guidelines on Public Health Pesticide Management Policy for the WHO African Region*. Zaim, M./WHO Pesticide Evaluation Scheme (WHOPES) (eds.). Geneva. https://apps.who.int/iris/handle/10665/97939.

World Health Organization (2017). *Chemicals Road Map: Road Map to Enhance Health Sector Engagement in the Strategic Approach to International Chemicals Management Towards the 2020 Goal and Beyond*. https://www.who.int/publications-detail/chemicals-road-map.

World Health Organization (2019). *The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification, 2019 Edition*. Geneva. https://www.who.int/publications/i/item/9789240005662.

World Health Organization (2020a). Ten chemicals of major public health concern. https://www.who.int/teams/environment-climate-change-and-health/chemical-safety-and-health/health-impacts/chemicals. Accessed 14 November 2020.

World Health Organization (2020b). Vector control product prequalifiction. https://extranet.who.int/pqweb/vector-control-products. Accessed 2 May 2021.

World Health Organization (2020c). Control of neglected tropical diseases. https://www.who.int/teams/control-of-neglected-tropical-diseases/vector-ecology-and-management/vector-control. Accessed 2 May 2021.

World Trade Organization (2010). *The WTO Agreements Series: Sanitary and Phytosanitary Measures*. Geneva. https://www.wto.org/english/res_e/booksp_e/agrmntseries4_sps_e.pdf.

World Trade Organization (2014). *The WTO Agreements Series: Technical Barriers to Trade*. Geneva. https://www.wto.org/english/res_e/publications_e/tbttotrade_e.pdf.

World Trade Organization (2017). TRIPS agreement (as amended on 23 January 2017). https://www.wto.org/english/docs_e/legal_e/31bis_trips_01_e.htm. Accessed 14 November 2020.

Yeung, M., Kerr, W.A., Coomber, B., Lantz, M. and McConnell, A. (2018). Declining harmonization in maximum residue levels for pesticides. *British Food Journal* 120(4), 901-913. https://doi.org/10.1108/BFJ-05-2017-0291.