

Global situation of **pesticide management** in **agriculture and public health**

Report of a 2018 WHO–FAO survey



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Foreword

Chemical pesticides are widely being used in agriculture and in public health for the control of pests and disease vectors. However, the harmful side-effects of pesticides are becoming increasingly clear, in terms of effects on human health and the environment, and the development of insecticide resistance in pest and vector populations.

The International Code of Conduct on Pesticide Management provides voluntary standards of conduct for all parties involved in the management of pesticides, from manufacture to application and waste disposal. The Code of Conduct, which was developed jointly by the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO), incorporates both agricultural pesticides and public health pesticides.

In support of the Code of Conduct, the FAO/WHO Joint Meeting on Pesticide Management (JMPM) has since 2007 prepared and reviewed a series of guideline documents pertaining to all aspects of the pesticide life-cycle, including but not limited to pesticide registration, risk assessment, efficacy testing, procurement, use and application, and pesticide waste disposal.²

Countries are strongly encouraged to adopt the standards set out in the Code of Conduct, and to implement strategies of integrated pest management for control of agricultural pests and integrated vector management for control of vector-borne diseases.

This report provides a contemporary overview of the situation of pesticide management in agriculture and public health across the globe. The results indicate various critical shortcomings. This suggests the need for countries, and programmes alike, to revisit their legal and operational framework for pesticide management in order to improve the efficacy of pesticides and minimize their harmful effects on humans and the environment.

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² For an overview of these documents, see: Managing pesticides in agriculture and public health: an overview of FAO and WHO guidelines and other resources. FAO and WHO; 2019 (<http://www.fao.org/3/ca5201en/ca5201en.pdf>).

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The preparation of the questionnaire, analysis of data, and drafting and revision of the report were conducted by Henk van den Berg (consultant, Wageningen University, the Netherlands), in close collaboration with Rajpal Yadav from WHO/NTD, and Beatrice Grenier, Baogen Gu and Eva Kohlschmid from FAO/AGP. Richard Brown, Carmen Bullon and Harold van der Valk are acknowledged for providing valuable comments and suggestions to the report. The study was conducted as part of a WHO project financially supported by the Bill & Melinda Gates Foundation.

Acronyms

EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GDP	gross domestic product
GHS	Globally Harmonized System of Classification
HHP	highly hazardous pesticide
IPM	integrated pest management
IRM	insecticide resistance management
IVM	integrated vector management
MRL	maximum residue limit
NGO	nongovernmental organization
OECD	Organisation for Economic Co-operation and Development
PPE	personal protective equipment
PPP	purchasing power parity
WHO	World Health Organization
WHOPES	WHO Pesticide Evaluation Scheme

Executive summary

Global pesticide use has steadily increased over the past decades. The need to implement strategies that reduce the reliance on chemical pesticides (e.g. integrated pest management, integrated vector management) is widely recognized. But where pesticides continue to be used for food production and in public health, the adverse effects on human health and the environment must be minimized. The International Code of Conduct on Pesticide Management provides a framework for the management of agricultural and public health pesticides, promoting best practices of regulation, use and management of pesticides. However, there are signs that the adoption of best practices of pesticide management has been slow, particularly in low- and middle-income countries.

A global survey was conducted by the World Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO) to describe the current situation regarding pest management in agriculture and public health. The survey questionnaire was developed in three parts, for distribution to the relevant authorities. Part I covered registration and regulation of both agricultural and public health pesticides. Part II covered pesticide application in agriculture. Part III covered public health pesticide application, specifically for vector-borne disease control. In total, 194 countries were targeted with each part of the questionnaire; 56 countries responded to Part I (29% response rate), 52 to Part II (27% response rate) and 94 to Part III (48% response rate).

Part I. Key findings on pesticide regulatory control

1. Pesticide legislation reportedly exists in 95% of responding countries (53 out of 56). However, in 40% of responding countries (32 out of 53), legislation does not cover public health pesticides. Also, 65% of countries lack special provisions for highly hazardous pesticides (HHPs), for example, to prohibit or restrict their use.
2. One-third of countries lack guidelines on the registration process and on data requirements for pesticide registration, which was particularly noted in the African Region. FAO's toolkit for pesticide registration is starting to play an important supportive role for pesticide registrars.
3. Most countries assess the relevant data types for pesticide registration, as supplied by the Applicant, but only part of the countries require locally-generated data.
4. Guidance on HHPs is used by few countries for their registration decisions.
5. Capacity for registration is very limited in 34% of responding countries (19 out of 56), with no more than 0–5 persons working on registration, which is particularly common in low-income countries and small countries.
6. Regional collaboration on registration was widely reported from some regions, with countries sharing registration procedures and data.

7. A significant fraction of countries, particularly in the African and Eastern Mediterranean regions, do not control pesticide retail or advertising; and 40% of responding countries (19 out of 48) reported that substandard pesticide products are readily available to the public.
8. Most countries in the African Region lack a national pesticide laboratory and adequate capacity for pesticide analysis.
9. Pesticide imports for emergencies reportedly bypass quality control in 36–50% of responding countries, particularly for donated pesticides.
10. A significant part of countries lacks legal provisions for safe storage (44% of countries), transport (53%) and disposal (49%) for all pesticides.
11. Implementation of pesticide legislation was monitored and enforced to a large extent in 47% of responding countries (26 out of 55), but monitoring and enforcement were weakest in the African Region.
12. Major shortcomings were reported in the collection and use of data on pesticide poisoning cases in countries across regions, particularly in the African and Eastern Mediterranean regions.

Part II. Key findings on pesticide management in agriculture

1. National integrated pest management (IPM) policy is reported from 69% of countries (35 out of 51), but most countries implement IPM only in specific locations. Particularly, in the African Region, 8 out of 17 responding countries reported the absence of a national IPM policy.
2. Two-thirds of countries face major problems with pesticide resistance in agriculture, but just over one-third of countries have adequate resources to manage resistance in agriculture.
3. Regarding personal protective equipment (PPE), 31% of responding countries (16 out of 51) indicated that PPE is available in agriculture, but it is not used; this problem is particularly common in the African Region. Most commonly reported reasons for not using PPE are cost, discomfort, and lack of awareness about health risks. Furthermore, 14% of responding countries (7 out of 51) reported that PPE is not available to pesticide applicators in agriculture.
4. Licensing or certification of agricultural pesticide applicators is required in 69% of responding countries (36 out of 52).
5. Two-thirds of responding countries lack guidance on safe disposal of agricultural pesticide waste or empty containers, and half of the countries lack a system to collect empty pesticide containers.
6. A system for monitoring pesticide residues in food/feed items, and in the environment, is in place in 58% and 26% of responding countries, respectively. Most countries

recognize the maximum residue limit (MRL) provided in the Codex Alimentarius; in addition, 29% of responding countries (15 out of 51) have national MRLs.

7. Significant incidents of environmental contamination with pesticides (within the past 3 years) were reported from 20% of responding countries (9 out of 45), but only one-third of responding countries have a mechanism for data collection on environmental contamination.
8. More than half of responding countries experience challenges with the implementation of the Rotterdam Convention, particularly in the African and Eastern Mediterranean regions. The most common challenges were the notification of final regulatory action, and the submission of import responses.

Part III. Key findings on pesticide management for vector control in public health

1. A national policy on integrated vector management (IVM) exists in 52% of responding countries (48 out of 93). For countries with a policy, 79% (43 out of 71) reported that IVM is implemented throughout the country.
2. A national vector control unit exists in 74% of responding countries (69 out of 93).
3. Capacity for insecticide resistance monitoring is highest in the African Region, following recent capacity-building efforts for malaria control, and lowest in the European Region.
4. An insecticide resistance management (IRM) strategy for disease vectors is in place in 41% of responding countries.
5. Some 82% of responding countries used insecticide susceptibility (75 out of 91) as criterium for pesticide selection, and 82% of responding countries used residual period (59 out of 72) as criterium for pesticide selection.
6. Some 61% of responding countries (54 out of 89) have a guidance document on procurement of vector control pesticides, and in 33% of responding countries (30 out of 90) the procurement methods are aligned with other countries.
7. After-sale stewardship commitments and quality control are requirements of procurement in 58% of responding countries (53 out of 92).
8. Procurement by the ministry of health is mostly through public tenders and includes quality standards. For procurement by other agencies, public tenders and quality standards are less common.
9. Many responding countries expressed difficulties estimating procurement amounts for vector control, particularly for emergencies.
10. Storage facilities for vector control pesticides are inadequate in 40% (36 out of 89) and 55% (50 out of 91) of responding countries at central and periphery level, respectively. Many responding countries lack trained storekeepers, and lack procedures for safe pesticide transport.

11. Guidance on disposal of vector control pesticides and empty containers exists in only 38–46% of responding countries.
12. Important gaps are evident in the training on vector control and pesticide management among decision-makers and implementors of vector control activities.
13. A certification scheme for vector control pesticide applicators is lacking in two-thirds of responding countries (61 out of 91), and a scheme for quality control of application equipment is lacking in 61% of responding countries (57 out of 93).
14. A programme for exposure monitoring of vector control pesticide applicators exists in 30% of responding countries (28 out of 92).

This report recommends that countries, particularly developing countries, revisit their legal framework for pesticide management, to ensure that public health pesticides and HHPs are covered by legislation. Legislation should also include provisions for the importation of unregistered pesticides for emergencies, HHP management, licenses for pesticide production and retail, pesticide advertising, and safe storage, transport and disposal of pesticides. Legislation should incorporate the main obligations resulting from the Rotterdam Convention. Finally, attention should be paid to the legal provisions that support the implementation, monitoring and control of pesticide legislation.

Countries with limited human capacity for pesticide registration should establish or strengthen (sub-)regional collaboration, where applicable, to share their registration procedures, data and decisions. Furthermore, donor or lending support for programmes on agriculture and disease vector control should incorporate commensurate investment in the capacity strengthening on best practices of pesticide management.

Particular investment is needed to establish pesticide laboratories and capacity for pesticide analysis in the African Region. Lastly, countries are urged to protect and monitor the health of pesticide applicators, and to monitor pesticide residues in food or feed and in the environment.

1. Introduction

According to the FAOSTAT database, global pesticide use (in tonnes of active ingredient) increased by 46% during the period 1996–2016 (1). The growing human population has put increasing demand on agricultural productivity per hectare and on public health, which contribute to intensified pesticide use.

There is widespread international consensus on the need to implement alternative strategies that reduce or even eliminate the reliance on chemical pesticides, notably integrated pest management (IPM) in agriculture and integrated vector management (IVM) in public health. However, forces which include persuasive pesticide marketing have kept pesticide use as the dominant practice for plant protection in most countries. In public health, available methods of vector control still depend largely on the action of insecticides.

Where pesticides continue to be used for food production and public health, it is imperative that their adverse effects on human health and the environment are minimized as much as possible by adopting best practices of regulation, proper use and management, while promoting IPM and IVM as use-reduction strategies.

The International Code of Conduct on Pesticide Management (“Code of Conduct”) provides a voluntary framework for governments and other stakeholders to manage agricultural and public health pesticides throughout their life cycle (2). Pesticide management covers all aspects of the pesticide life cycle, including production, registration, import, transport, storage, application and disposal of pesticides and their containers. Agricultural pesticides are defined as those used to control agricultural and forestry pests injurious to plants and plant products, whereas public health pesticides are those used for vector control, household use and for professional pest control.

The Code of Conduct, which complements the legally binding instruments of the Rotterdam Convention, the Stockholm Convention and the Basel Convention, promotes standards and best practices which ensure pesticide efficacy, and reduce risks to human health and the environment. In addition, the Code of Conduct promotes IPM and IVM as strategies to reduce pesticide use.

Despite broad support for the Code of Conduct, there are signs that the adoption of standards and practices of pesticide management has been slow, particularly in low- and middle-income countries. Agricultural and public health programmes generally prioritize targets of food production and disease control, but they are often unable or reluctant to address the risks caused by the pesticides used. Programmes in which pesticides are used should integrate the sound management of pesticides to reduce the adverse effects and waste.

The objective of this joint WHO–FAO survey is to describe the current global situation regarding the legislation, registration and management practices of agricultural and public health pesticides.

Previously, FAO published the results of surveys on the implementation of the Code of Conduct in 1993, 1996 and 2010 (3–5). WHO conducted global surveys on public health pesticide management in 2004 and 2010 (6, 7). The current survey is the first global survey combining both agricultural and public health pesticides; the survey was conducted jointly by WHO and FAO. The results are expected to inform future plans to optimize and prioritize global pesticide management practices.

2. Methods

A survey questionnaire was adapted from a previous questionnaire on public health pesticides by WHO, and modified in accordance with contemporary issues and recent developments. It was decided to expand the scope of the previous questionnaire to cover all pesticides – agricultural and public health pesticides. Consequently, the questionnaire was developed jointly by WHO and FAO.

At country level, the topics of pesticide registration, agricultural pesticide management and public health pesticide management are commonly dealt with by separate government entities. Consequently, the questionnaire was developed in three parts, for distribution to the relevant authorities. The draft questionnaire was shared for comments with experts from WHO, FAO and academic institutions. The revised questionnaire was formally translated from English into French and Spanish, and was sent as editable Word® documents.

Part I of the questionnaire on registration and regulation of both agricultural and public health pesticides was to be completed by the national pesticide registration authority. Part II on pesticide application in agriculture was to be completed by the director of the Agriculture Department and/or the national coordinator for IPM.

Part I and II were administered by FAO through its regional offices to country offices to the national focal point in the Ministry of Agriculture in targeted countries. However, some Member Countries do not have FAO country offices, particularly in countries of the Organisation for Economic Co-operation and Development (OECD). For those countries without FAO country offices, the questionnaires were sent at a later stage to the national focal point for the OECD, and followed up with ministries of countries with which FAO's Pest and Pesticide Management Team has an ongoing working relationship.

Part III of the questionnaire covered public health pesticide application, specifically for vector-borne disease control. Insecticides directly applied on humans, household pest control products and professional public health pest control products were not the main focus of this survey. This part was administered to the focal point in the Ministry of Health at country level, for completion by the director of the main national vector-borne disease control programme (e.g. malaria, dengue), or (where applicable) by the national manager for vector control (i.e. the person who has overall responsibility for entomological surveillance and vector control in the country). If there were separate national programmes for different vector-borne diseases, the malaria programme or vector control manager was requested to coordinate completion of this part of the questionnaire. Part III was administered by WHO through its country offices to the national focal point in the Ministry of Health in targeted countries.

In total, 194 countries were targeted, including all WHO Member States and all FAO Member Countries.

³ WHO and FAO have different schemes for allocating countries to their regions. For the presentation of results, it was decided to use the WHO scheme, which organizes countries according to six regions, as indicated in Table 2.1.

Table 2.1 Number of country responses (and response rates; RR) received to Part I, II and III of the questionnaires, with countries grouped, by WHO Region.

Regions according to WHO scheme	Targeted countries	Responses to questionnaire					
		Part I		Part II		Part III	
		Countries	RR	Countries	RR	Countries	RR
African	47	20	43%	17	36%	23	49%
Americas	35	10	29%	10	29%	27	77%
Eastern Mediterranean	21	9	43%	8	38%	19	90%
European	53	7	13%	7	13%	8	15%
South-East Asia	11	5	45%	5	45%	8	73%
Western Pacific	27	5	19%	5	19%	9	33%
Total	194	56	29%	52	27%	94	48%

By December 2018, responses to one or more parts of the questionnaire had been received from a total of 115 countries: 56 responses to Part I, 52 responses to Part II and 94 responses to Part III (Table 2.1). This implies a response rate of 29% (for Part I), 27% (Part II) and 48% (Part III).

All countries responding to Part II also responded to Part I; in addition, 4 countries responded to Part I but not to Part II. Some 35 countries responded to both Part I and Part III, and 31 countries completed Part I, II and III of the questionnaires (Annex 1). WHO coordinated the entry, cleaning and analysis of data and the reporting of results, in collaboration with FAO.

³ At the time of writing, WHO has 194 Member States. FAO has 194 Member Countries, one member organization and two associate members; the member organization and associate members were not targeted by the survey.

3. Pesticide regulatory control

3.1. Pesticide legislation

The definition of “pesticide”, as provided by the Code of Conduct, was reportedly used by 56% of the responding countries (n=55) (Table 3.1). A number of countries reported that their own definition of pesticides resembled that given in the Code of Conduct.

National or sub-national legislation (i.e. at federal or regional level) for registration and control of pesticides was reported to be present in the large majority (95%) of responding countries (Table 3.1). This result suggests that most countries have some form of legislation regarding pesticides, which is also reflected in FAO’s Indicator Map for Countries with Pesticide Legislation based on the Code of Conduct (8).

The majority of responding countries reported that national legislation requires pesticides to conform to relevant FAO or WHO specifications (Table 3.1).

Table 3.1 Definition of pesticides used in legislation; presence of pesticide legislation; and pesticides required to conform to FAO/WHO specifications. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World % n	African % n	Americas % n	E.Mediterr'n % n	European % n	S-E.Asia % n	W.Pacific % n
Pestic.definition as Code of Conduct	56% 55	65% 20	80% 10	38% 8	43% 7	50% 4	33% 6
Pesticide legislation in place	95% 56	95% 20	100% 10	89% 9	100% 7	75% 4	100% 6
Conform to FAO/WHO specifications	82% 49	93% 15	80% 10	100% 7	71% 7	100% 4	33% 6

Types of pesticides covered

According to the Code of Conduct, pesticide legislation should cover all types of pesticides, for all sectors in which pesticides are used. However, public health pesticides are not covered by pesticide legislation in 40% of responding countries, which indicates that legislation in many countries is clearly inadequate (Table 3.2). Public health pesticides are least commonly covered in the Eastern Mediterranean and European regions.

Biological pesticides, or biopesticides, are pesticides derived from natural materials, such as microorganisms or plants. Biopesticides have an important future role in controlling pests and diseases, because they provide a safer alternative to chemical pesticides. Biopesticides are regulated under the same legislation as other chemical pesticides in most (81%) responding countries (Table 3.2).

Table 3.2 Types of pesticides covered by pesticide legislation. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
PHPs covered by legislation	60%	53	63%	19	70%	10	38%	8	57%	7	67%	3	67%	6
Biopesticides covered by legislation	81%	52	74%	19	70%	10	88%	8	86%	7	100%	3	100%	5

Special provisions

Special provisions in the legislation could enact the need for re-registration or the periodic review of registered pesticide products; thus, periodically evaluating whether the pesticide should still be registered or not. Furthermore, provisions should enable the de-registration or banning of pesticide products, and restrict highly hazardous pesticides (HHPs)

⁴ that pose significant risk to human health or the environment (9).

Worldwide, the majority (84%) of responding countries have provisions in their legislation (primary or secondary legislation) for re-registration or periodic/regular review of pesticide products registered for agriculture; however, some countries, particularly in Africa and South-East Asia, do not have this provision (Table 3.3). Moreover, far fewer countries reported having this provision for public health pesticides – probably because in part of the countries public health pesticides are not covered under pesticide legislation (see Table 3.1). This shortcoming could influence the continued availability of persistent organic pollutant (POP) or HHP pesticides for public health in certain countries.

Table 3.3 Special provisions in legislation regarding agricultural (Agr.) and public health (PH) pesticides: (a) for re-registration, (b) de-registration and (c) highly hazardous pesticides (HHPs). Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Provision	Sub-item	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
a. Re-registering	i. Agr.pesticides	84%	75%	90%	89%	86%	75%	100%
	ii. PH pesticides	57%	50%	50%	44%	71%	75%	83%
	(n)	56	20	10	9	7	4	6
b. De-registering	i. Agr.pesticides	91%	90%	90%	100%	86%	75%	100%
	ii. PH pesticides	60%	60%	50%	33%	86%	75%	80%
	(n)	55	20	10	9	7	4	5
c. HHPs	Agr./PH pesticides	35%	35%	20%	33%	43%	50%	40%
	(n)	55	20	10	9	7	4	5

⁴ Pesticides that are acknowledged to present particularly high levels of acute or chronic hazards to health or the environment according to internationally accepted classification systems such as WHO or GHS (Globally Harmonized System of Classification and Labelling of Chemicals) 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.

Some 91% of countries have provisions in their legislation for de-registering or banning of agricultural pesticide products, but again, this figure is lower for public health pesticides (Table 3.3).

Conversely, only 35% of countries reported having special provisions in their legislation on the registration, production, distribution or use of HHPs; for example, to prohibit or restrict their use, or to mitigate their risks to human health and the environment (2) (Table 3.3). This suggests that much remains to be done to reduce risks from HHPs.

3.2. Registration process

Registration guidelines

The registration of a pesticide product should follow a nationally recommended process, using available guidelines. Less than half of the responding countries indicated that they have published national guidelines on the process of pesticide registration that cover all pesticides.

A substantial proportion of countries, particularly in the Americas and European regions, have guidelines only for registration of agricultural pesticides (Table 3.4). Of special concern is that one-third of countries reported that they do not have guidelines on the process of registration, notably in countries in the African Region.

Table 3.4 Availability of published national guidelines on the process of pesticide registration. “All pesticides” comprise agricultural and public health pesticides. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Guideline	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
For all pesticides	43%	30%	50%	44%	29%	100%	50%
Only for agricultural pesticides	25%	15%	50%	22%	43%	0%	17%
None	32%	55%	0%	33%	29%	0%	33%
(n)	56	20	10	9	7	4	6

Registration toolkit

FAO recently introduced a Pesticide Registration Toolkit as a decision support system to assist registrars in their evaluation and authorization of pesticides (10). Some 19% of responding countries reported that they use the toolkit regularly (Table 3.5). An additional 22% of countries indicated that they use the toolkit occasionally. FAO particularly targets the toolkit to low- and middle-income countries, which explains the results from countries in the European Region. These results suggest that the toolkit is starting to play an important supportive role for pesticide registrars.

Table 3.5 Use of the FAO Pesticide Registration Toolkit. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
On a regular basis	19%	15%	20%	25%	0%	50%	20%
From time to time	22%	40%	10%	13%	14%	0%	20%
(n)	54	20	10	8	7	4	5

When comparing countries according to the income classification of the World Bank, it appears that the toolkit is used most regularly by middle-income countries (Table 3.6).

Table 3.6 Comparison of low-, lower-middle-, upper-middle- and high-income countries regarding the use of the FAO Pesticide Registration Toolkit. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	Low income	Lower-middle	Upper-middle	High income
On a regular basis	12%	42%	30%	0%
From time to time	35%	17%	10%	20%
n	17	12	10	15

Ban, phase-out or restriction

Countries were asked what process is used for banning, phasing-out or restricting pesticides. The large majority of countries use the decisions contained in multilateral treaties such as the Rotterdam Convention or the Stockholm Convention (11, 12) (Table 3.7). Also, countries reported the use of a review process to assess suitability and risk of a pesticide, although this process is less commonly reported from the African Region. Countries also commonly use the example of other countries, or use other, unspecified mechanisms for banning, restricting or phasing-out pesticides.

Table 3.7 Mechanism for banning, phasing-out or restricting pesticides. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Process	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
Based on international conventions	92%	90%	89%	100%	86%	100%	100%
Assess suitability and risk	64%	35%	78%	88%	86%	50%	100%
Based on other countries	43%	45%	22%	75%	29%	50%	40%
Other mechanism	30%	25%	22%	75%	29%	25%	0%
(n)	53	20	9	8	7	4	5

Decision-making on bans

Decisions on whether to continue, restrict or ban the use of a registered pesticide are taken by one or more authorities, depending on the type of pesticide. For agricultural pesticides, the Ministry of Agriculture most commonly makes these decisions, but other agencies (most commonly environmental agencies) also play a major role (Table 3.8).

Table 3.8 Agency deciding on whether to continue, restrict or ban the use of a registered pesticide. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Pesticide type	Agency	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
a. For agricultural pesticides	Ministry of Agriculture	71%	80%	50%	100%	43%	100%	60%
	Ministry of Health	15%	15%	40%	0%	14%	0%	0%
	Other agency	37%	30%	70%	0%	43%	33%	40%
	(n)	52	20	10	7	7	3	5
b. For public health pesticides	Ministry of Agriculture	34%	47%	13%	43%	14%	50%	33%
	Ministry of Health	55%	67%	75%	57%	43%	25%	0%
	Other agency	36%	27%	38%	29%	43%	50%	67%
	(n)	44	15	8	7	7	4	3

For public health pesticides, the Ministry of Health most commonly decides on the continuation, restriction or ban, but in many countries, the Ministry of Agriculture and other agencies play a major role.

Vector control unit consulted

The unit or body in charge of vector control in vector-borne disease control programmes should have an advisory role when a pesticide used in public health is being banned or restricted. A pesticide's risk to human health and the environment should be evaluated vis-à-vis the benefits in protection of humans against pathogen transmission, while also considering safer alternative products or strategies available for vector control. More than half of the countries responded that they consider the comments or views of the vector control unit, or body, when banning or restricting the use of a public health pesticide (Table 3.9). This suggests the need for better coordination between registration and vector control authorities, particularly in regions with a high burden of vector-borne diseases.

Table 3.9 Comments or views of the vector control unit/body being considered when banning or restricting the use of a public health pesticide. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Consults Vector Control unit	54%	46	53%	19	33%	9	67%	6	40%	5	100%	3	75%	4

Pesticide lists

Most, but not all, countries keep a list of registered pesticides and banned agricultural pesticides (Table 3.10). For public health pesticides, lists are less commonly kept, probably because in part of the countries public health pesticides are not covered under pesticide legislation. Furthermore, in a significant number of countries, these lists are not publicly available, suggesting that the public in many countries may be unaware of which pesticides have been banned.

Table 3.10 List kept for registered and banned pesticides. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	Sub-item	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
a. List kept of registered pesticides	i. Agr.pesticides	87%	90%	80%	89%	100%	75%	80%
	ii. PH pesticides	65%	65%	40%	56%	86%	100%	80%
	iii. List published	73%	70%	80%	56%	86%	75%	80%
	(n)	55	20	10	9	7	4	5
b. List kept of banned pesticides	i. Agr.pesticides	80%	79%	80%	89%	71%	75%	80%
	ii. PH pesticides	44%	53%	10%	33%	43%	75%	80%
	iii. List published	65%	68%	60%	56%	57%	100%	60%
	(n)	54	19	10	9	7	4	5

Registration of highly hazardous pesticides

The Code of Conduct provides guidance on HHPs (9). Some 61% of countries indicated that they use these FAO/WHO guidelines on HHPs when reviewing and taking registration decisions on agricultural pesticides, but only 38% of responding countries use the same guidance for public health pesticides (Table 3.11). There is a large variation between regions in the use of this guidance on HHPs.

Table 3.11 Guidance on highly hazardous pesticides used for decisions on registration. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Guidance used	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
Agricultural pesticides	61%	75%	30%	78%	57%	75%	33%
Public health pesticides	38%	40%	10%	33%	43%	100%	33%
(n)	56	20	10	9	7	4	6

Guidance on data requirements

The pesticide registration process should have specific requirements for data to be provided, or locally generated. These data are needed to assist the registrar in evaluating whether a pesticide product is effective for its intended purposes, and whether it poses an unacceptable risk to human or animal health or the environment. The evaluation leads to the decision whether the product should be allowed for a specific purpose of use. Guidelines on data requirements are vital to streamline the evaluation, especially because data requirements depend on the type, group and purpose of a pesticide product.

Worldwide, one-third of responding countries reported not having any published national guidelines on data requirements for pesticide registration (Table 3.12). Particularly, African countries lack such guidelines. Moreover, part of the countries has such guidelines for agricultural pesticides, but not for public health pesticides. The absence of such guidelines will negatively affect the evaluation of a pesticide product.

Table 3.12 Published guidelines on data requirements for pesticide registration. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Guideline	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
For all pesticides	41%	30%	40%	56%	38%	100%	29%
Only for agricultural pesticides	22%	10%	40%	22%	25%	0%	43%
Only for PH pesticides	3%	0%	0%	0%	13%	0%	14%
None	33%	60%	20%	22%	25%	0%	14%
(n)	58	20	10	9	8	4	7

When comparing countries according to the income classification of the World Bank, it becomes apparent that guidelines on pesticide registration are lacking particularly in low-income countries (Table 3.13).

Table 3.13 Comparison of low-, lower-middle-, upper-middle- and high-income countries regarding available guidelines on the process and data requirements for pesticide registration. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	Low income	Lower-middle	Upper-middle	High income
Guideline on the process	18%	50%	64%	50%
Guideline on data requirements	29%	33%	64%	50%
n	17	12	11	16

WHO recommended products

Until 2017, the WHO Pesticide Evaluation Scheme (WHOPES) published recommendations on the accepted use of pesticides for vector control. Since late 2017, the WHO prequalification unit has assumed this role to prequalify pesticide products. Some countries in several regions use these WHOPES⁵ recommendations as the sole basis for registering vector control pesticides (Table 3.14). More commonly, however, the WHOPES recommendations are accepted to support the registration of vector control pesticides (Table 3.14).

Table 3.14 WHOPES recommendations on pesticide use accepted by countries as the basis for registration of vector control pesticides. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
Sole basis	20%	25%	17%	33%	0%	33%	0%
Supportive	44%	40%	67%	33%	33%	67%	50%
(n)	45	20	6	6	6	3	4

⁵ At the time of the survey, WHOPES was still functioning and hence country responses are reported as such.

Data required

The pesticide registration process depends on a number of types of data (13). Countries were asked to identify, among the data types proposed under the Code of Conduct, which data and information is assessed during the process of pesticide registration. Most data types, such as the identity, physical and chemical properties, and details of use and efficacy, are reportedly assessed for registration purposes in the large majority of countries across regions (Table 3.15).

Table 3.15 Data and information assessed for pesticide registration regarding agricultural or public health pesticides. Presented is the number (and %) of countries answering the question positively, and the total number of responding countries (or, n).

Pesticide type	Data type	World	African	Americas	E.Mediter'n	European	S-E.Asia	W.Pacific
Agricultural	Identity	50 (98%)	16	10	8	7	3	6
	Physical & chemical properties	48 (94%)	15	10	8	7	3	5
	Details of use	49 (96%)	16	9	8	7	3	6
	Classific., packaging, labelling	48 (94%)	15	10	7	7	3	6
	Methods of analysis	46 (90%)	14	10	8	7	2	5
	Impact on human health	49 (96%)	16	9	8	7	3	6
	Residues	44 (86%)	12	9	7	7	3	6
	Fate, behaviour in environment	49 (96%)	16	9	8	7	3	6
	Effects on non-target species	48 (94%)	15	10	8	6	3	6
	Efficacy	49 (96%)	17	10	8	6	2	6
	Safer alternative products	31 (61%)	12	4	6	5	2	2
	Safer alternative practices	29 (57%)	9	5	6	5	2	2
	(n)	51	17	10	8	7	3	6
Public health	Identity	32 (97%)	11	5	4	6	3	3
	Physical & chemical properties	30 (91%)	10	5	4	6	3	2
	Details of use	32 (97%)	11	5	4	6	3	3
	Classific., packaging, labelling	32 (97%)	11	5	4	6	3	3
	Methods of analysis	30 (91%)	10	5	3	6	3	3
	Impact on human health	32 (97%)	11	5	4	6	3	3
	Residues	27 (82%)	10	5	3	5	3	1
	Fate, behaviour in environment	29 (88%)	11	5	3	6	3	1
	Effects on non-target species	27 (82%)	10	5	3	5	2	2
	Efficacy	31 (94%)	12	5	3	5	3	3
	Safer alternative products	20 (61%)	10	3	2	3	2	0
	Safer alternative practices	17 (52%)	7	3	2	3	2	0
	(n)	33	12	5	4	6	3	3

This was reported for both agricultural and public health pesticides. Other data types, such as residues, safer alternative products and practices, were less commonly assessed for registration purposes. These results suggest that the assessment in countries covers the relevant data types in most cases. However, the soundness of the assessments remains unknown.

The registration process relies to a large degree on the assessment of the dossier; extensive data are provided by the applicant, which in most cases is the manufacturer.

Consultation with the manufacturer can assist the registrar in answering questions about the data, and thus benefit the evaluation. The survey results show that 63% of responding countries worldwide consult manufacturers, as the applicants of products to be registered, during the registration process of an agricultural pesticide, ranging from 44% in the African Region to 86% in the European Region (Table 3.16). For public health pesticides, manufacturers are less commonly consulted, particularly in the African and Eastern Mediterranean regions.

Table 3.16 Manufacturers consulted during the registration process of an agricultural or public health pesticide. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
Agricultural pesticides	63%	44%	80%	56%	86%	50%	83%
Public health pesticides	43%	28%	50%	22%	71%	50%	67%
(n)	54	18	10	9	7	4	6

Coordination between pesticide manufacturers, for example, on pesticide assessments and dossier submissions, could benefit the quality and efficiency of pesticide registration. Just over half of the countries worldwide reported that a national association has been established or exists regarding agricultural pesticides (Table 3.17). For public health pesticides, fewer countries reported a national association. A national association is least common in the Eastern Mediterranean Region.

Table 3.17 National association of pesticide manufacturers in place for agricultural or public health pesticides. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
Agricultural pesticides	52%	40%	90%	11%	86%	25%	67%
Public health pesticides	32%	15%	50%	0%	71%	50%	50%
(n)	56	20	10	9	7	4	6

Data generated locally

A dossier with necessary data must be provided to the registrar by the pesticide Industry, as Applicant, in accordance with the Code of Conduct.⁶ These data have often been generated in other countries or regions. However, countries may require certain types of data to be generated locally, for example, to test risks or efficacy under local conditions, or to verify the data provided by the Applicant.

Table 3.18 presents the data types that countries reported as needed to be generated locally (read: nationally) in support of pesticide registration. For agricultural pesticides, product efficacy is the data type for which local data are most commonly required (74% of countries

⁶ A known shortcoming of this arrangement is the inherent conflict of interest of the pesticide Industry (see reference 14).

worldwide). Furthermore, 43–44% of countries require local data on human and environmental assessment, ranging from 14% in the European Region to 58% in the African Region. Local data on residues are required in half of the countries. Local data on quality analysis are mostly required by countries in the African, Eastern Mediterranean and South-East Asia regions. The low reported rates from the European Region can be partly explained by the registration by EU countries at zonal level, not country level.

For public health pesticides, requirements for local data are rather similar to those for agricultural pesticides, except that for efficacy, quality analysis and environmental assessment, the requirements of local data are more common for agricultural than for public health pesticides.

Table 3.18 Locally generated data to be submitted in support of pesticide registration. Presented is the number (and %) of countries answering the question positively, and the total number of responding countries (or, n).

Pesticide type	Data type	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
Agricultural	Human health assessment	23 (43%)	11	3	4	1	1	3
	Environmental assessment	24 (44%)	11	2	5	1	2	3
	Product efficacy	40 (74%)	16	7	6	4	3	4
	Residues	27 (50%)	10	5	5	1	2	4
	Quality analysis	30 (56%)	14	4	6	1	3	2
	Other data	5 (9%)	1	0	2	0	1	1
	(n)	54	19	10	8	7	4	6
Public health	Human health assessment	18 (43%)	10	3	4	0	0	1
	Environmental assessment	15 (36%)	8	2	3	0	1	1
	Product efficacy	21 (50%)	12	2	3	0	3	1
	Quality analysis	20 (48%)	11	3	3	0	2	1
	Other data	5 (12%)	1	0	2	0	1	1
	(n)	42	15	7	6	6	4	4

Situation on HHPs

Highly hazardous pesticides (HHPs) are pesticides known to present high levels of hazard to human health or the environment. The urgency of addressing these hazards is well recognized by all global chemical agendas. In 2015, the fourth International Conference on Chemical Management (ICCM4) declared HHPs as one of its emerging policy issues that need resolution in order to achieve the 2020 goals. Goals and targets in the area of food security, health or sustainable cities, for example, cannot be reached without sound chemical management (9). HHPs require urgent attention by national authorities to limit the risks they pose, which may include restriction or prohibition of their distribution and use.

Worldwide, 62% of responding countries have identified HHPs among registered pesticides, or HHPs in use, indicating that many remaining countries still have to start addressing the problem of HHPs (Table 3.19). So far, 41% of responding countries have assessed the needs and risks associated with HHPs in use, but in the African Region only 20% of countries assessed the needs and risks (Table 3.19).

The portion of countries that formulate and implement a risk-reduction plan for each HHP is relatively small (21% worldwide), particularly in the African and Eastern Mediterranean regions (Table 3.19). In the African Region, assistance on HHPs has reportedly been requested from international organizations (e.g. FAO or WHO) by 45% of countries, but in the Eastern Mediterranean Region, only a few countries requested assistance on HHPs (Table 3.19). Consequently, despite recent progress, HHPs remain a critical issue to be identified and addressed in many countries.

Table 3.19 Situation on highly hazardous pesticides (HHPs). Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Identified HHPs registered or in use	63%	54	55%	20	60%	10	67%	9	57%	7	100%	3	80%	5
Assessed needs/risks of HHPs	42%	55	20%	20	50%	10	44%	9	57%	7	75%	4	60%	5
Implemented HHP risk-reduction	22%	55	10%	20	30%	10	11%	9	14%	7	75%	4	40%	5
Assistance requested on HHPs	31%	55	45%	20	40%	10	11%	9	14%	7	0%	4	40%	5

Registration authority

Countries commonly have one central authority for pesticide registration, but some countries have separate authorities that control specific types of pesticides.

Countries were asked to identify the executive body, or the responsible government authority, that issues registrations for five types of pesticides or products: (i) agricultural pesticides, (ii) pesticides for vector control, (iii) professional public health pest control products (pesticides applied by professional operators against public health pests), (iv) insecticides directly applied on humans (e.g. insecticides used for lice or scabies control and repellents), and (v) household pest control products (e.g. mosquito coils, vaporizing mats and aerosol dispensers). Table 3.20 summarizes the questionnaire responses for all regions combined.

Table 3.20 Responsible government authority for issuing registrations several types and products of pesticides. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n). Some countries reported more than one responsible authority.

Pesticide types or products	Government ministry or agency					n
	Agri-culture	Health	Enviro-nment	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

For agricultural pesticides, the Ministry of Agriculture is, in most countries (56%), the responsible government authority for issuing registrations – in the remaining countries other

agencies deal with agricultural pesticides. For vector control pesticides, the situation differs, with 40% of countries having the Ministry of Health as the registration authority. This implies that a considerable portion of countries have separate registration authorities for agricultural and vector control pesticides.

Professional public health pest control products, insecticides directly applied on humans and household pest control products are most commonly registered by the Ministry of Health, followed by other agencies and the Ministry of Agriculture.

Table 3.21 demonstrates the marked differences between regions in what is the registration authority for agricultural pesticides; similar differences are evident for vector control pesticides (Table 3.22).

Table 3.21 Executive body or the responsible government authority for issuing registrations of agricultural pesticides. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n). Some countries reported more than one responsible authority.

Authority	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
Ministry of Agriculture	56%	65%	38%	70%	29%	80%	50%
Ministry of Health	9%	9%	15%	0%	29%	0%	0%
Ministry of Environment	6%	4%	15%	10%	0%	0%	0%
Other Govt. authority	25%	17%	31%	10%	43%	20%	50%
Not regulated	3%	4%	0%	10%	0%	0%	0%
(n)	64	23	13	10	7	5	6

Table 3.22 Executive body or the responsible government authority for issuing registrations of pesticides for vector control. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n). Some countries reported more than one responsible authority.

Authority	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
Ministry of Agriculture	28%	35%	11%	30%	14%	50%	29%
Ministry of Health	40%	22%	67%	70%	43%	50%	14%
Ministry of Environment	3%	4%	11%	0%	0%	0%	0%
Other Govt. authority	23%	26%	11%	0%	43%	0%	57%
Not regulated	5%	13%	0%	0%	0%	0%	0%
(n)	60	23	9	10	7	4	7

Capacity for pesticide registration

Pesticide registration involves the assessment of the applicants' dossiers with extensive datasets and field and laboratory tests for any new pesticide, or pesticide product, as well as monitoring the use and management of registered pesticides. The rigour of the assessments, field testing and monitoring depends to a large degree on the human capacity within the registration agency.

A minority (7%) of countries reported having no persons working on registration, thus relying on assessments and testing done elsewhere (Table 3.23). The majority of countries (66%) have small or relatively small human capacities of 1–20 persons working on registration.

African countries particularly have a small number of personnel working on registration. Some 27% of responding countries have more than 20 persons working on registration, some countries reportedly having hundreds of staff working on pesticide registration.

Table 3.23 Number of persons working on pesticide registration. Presented is the percentage of countries answering the question in each category, and the number of responding countries (or, n).

Number of persons	World	African	Americas	E.Mediter'n	European	S-E.Asia	W.Pacific
None	7%	10%	0%	11%	14%	0%	0%
1-2	11%	20%	0%	0%	0%	25%	17%
3-5	16%	30%	10%	11%	0%	0%	17%
6-10	23%	20%	60%	22%	0%	25%	0%
11-20	16%	15%	10%	33%	0%	50%	0%
More than 20	27%	5%	20%	22%	86%	0%	67%
(n)	56	20	10	9	7	4	6

Closer analysis of the countries in each category of human capacity (i.e. none, 1–2, 3–5 persons, etc.) shows that the countries with a small workforce for pesticide registration are generally lower-income countries (measured by the GDP per capita, PPP), whilst those with large workforces are generally richer countries (Table 3.24). Also, there is a pattern between the pesticide registration workforce and a country's population size. Those countries with a small workforce are generally smaller countries than those with a large workforce for pesticide registration. The pattern becomes very clear when considering total GDP per country.

The implication of this result is that low-income countries as well as small countries (e.g. small island states) generally have a small workforce to address the demanding task of pesticide registration. The difference across the spectrum of countries is striking, and underscores the vital importance of assisting countries with no or few pesticide registration staff through capacity strengthening or regional collaboration.

Table 3.24 Number of countries, and average GDP and population, in each category of pesticide registration capacity.

Number of persons	Countries	GDP per capita, PPP	Population (mln)	GDP total, PPP
None	4	2,090	7.55	12,477
1-2	6	7,811	4.63	8,700
3-5	9	16,635	8.33	97,570
6-10	13	12,357	22.54	230,511
11-20	9	14,145	56.74	752,092
More than 20	15	35,013	164.26	4,377,869

By comparison, when FAO conducted a survey of 109 low- and middle-income countries in 2011, 97% had fewer than six people working in pesticide registration and regulation, of which 77% had no more than two technical staff dealing with pesticide

registration (E. Kohlschmid, personal communication). It is unclear whether the situation has improved, because the current survey also included high-income countries.

Regional collaboration on registration

Given the demanding tasks of pesticide registration agencies at country level and the small workforce for pesticide registration in many countries, it is vital that low-income countries and small countries collaborate with other countries on pesticide registration at sub-regional or regional level.

More than half of the countries worldwide reported that they participate in a regional (i.e. collaborative) pesticide registration scheme (Table 3.25). However, it is probable that some respondents interpreted this question as their having regional collaboration on elements of pesticide registration, rather than being part of an operational regional scheme for pesticide registration.

In the African and European regions, the majority of countries collaborated on pesticide registration. Regional collaboration is least common in the Eastern Mediterranean Region.

A prominent example of a regional registration scheme is the Sahelian Pesticides Registration Committee (Comité Sahélien des Pesticides; CSP). Other examples provided include the Southern African Pesticide Regulators Forum, the Central Africa Inter-State Pesticides Committee, the technical committee on pesticides in the Andean region, and programmes of the European Union (EU) on plant protection products and biocides.

Table 3.25 Participation in regional collaboration on pesticide registration. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Regional collaboration	55%	55	75%	20	60%	10	13%	8	86%	7	25%	4	17%	6

A precondition for effective regional collaboration on pesticide registration is that technical requirements, procedures and guidelines for pesticide registration are aligned between countries in the (sub-) region. Worldwide, 58–62% of countries indicated that their technical requirements, procedures and guidelines are (at least partially) aligned with those of other country(ies) in their (sub-) region (Table 3.26). Alignment with other countries is most common in the European Region (namely, between EU countries); it is least common in the South-East Asia and Eastern Mediterranean regions.

Table 3.26 Alignment of technical requirements, procedures and guidelines for pesticide registration with other country in the (sub-) region. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
Technical requirements	60%	55%	75%	38%	86%	33%	75%
Technical procedures	62%	65%	63%	38%	86%	33%	75%
Technical guidelines	58%	65%	63%	25%	86%	33%	50%
(n)	50	20	8	8	7	3	4

Countries reportedly share several types of pesticide registration data (e.g. raw or supporting data; country assessments) with one or more countries in the (sub-) region (Table 3.27). For agricultural pesticides, various countries share data on human health assessment, environmental assessment, product efficacy, residues and quality analysis with other countries. Data sharing was highest in the European Region, namely between EU countries due to the harmonized European Union pesticide registration process. There is no reported data sharing between countries in the South-East Asia Region. Data sharing on public health pesticides is slightly less common, on average.

Table 3.27 Countries sharing pesticide registration data with one or more countries in the (sub-) region. Presented is the number (and %) of countries answering the question positively, and the total number of responding countries (or, n).

Pesticide type	Data type	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
Agricultural	Human health assessment	22 (41%)	8	5	1	6	0	2
	Environmental assessment	22 (41%)	9	4	1	6	0	2
	Product efficacy	24 (44%)	10	4	3	5	0	2
	Residues	20 (37%)	8	3	2	5	0	2
	Quality analysis	20 (37%)	8	4	2	5	0	1
	Other data	3 (6%)	1	0	0	2	0	0
	(n)	54	20	10	9	7	2	6
Public health	Human health assessment	15 (36%)	7	1	0	6	0	1
	Environmental assessment	15 (36%)	7	1	0	6	0	1
	Product efficacy	16 (38%)	8	1	1	5	0	1
	Quality analysis	14 (33%)	7	1	0	5	0	1
	Other data	2 (5%)	1	0	0	1	0	0
	(n)	42	15	7	7	6	4	3

3.3. Pesticide manufacture and trade

Pesticide manufacture

Specific legislation on the authorization of pesticide manufacturing or formulator facilities was reported from 69% of countries worldwide, ranging from 53% in the African Region to 90% in the Region of the Americas (Table 3.28). Consequently, a significant fraction of countries does not have such legislation in place to exercise control over pesticide manufacturing.

Table 3.28 Legislation on the authorization of pesticide manufacturing facilities. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Legislation on manufacturing	69%	54	53%	19	90%	10	78%	9	67%	6	75%	4	67%	6

Pesticide retail

It is important that country governments develop legislation on licensing schemes relating to the sale of pesticides, for example in street shops, to help ensure that retailers provide sound advice on pesticides to buyers (2). In 45% of countries, legislation (acts, laws or regulations) to control retailers is reportedly present for all pesticides (Table 3.29). An additional 34% of countries, however, reported that such legislation covers only agricultural pesticides. In 19% of countries worldwide, legislation to control retailers was reportedly absent. This suggests a critical shortcoming in many countries.

Table 3.29 Legislation in place to control retailers of pesticides. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
For all pesticides	45%	47%	50%	44%	67%	0%	33%
Only for agricultural pesticides	34%	26%	40%	44%	33%	0%	50%
Only for public health pesticides	2%	0%	0%	0%	0%	0%	17%
None	19%	26%	10%	11%	0%	100%	0%
(n)	53	19	10	9	6	3	6

Pesticide advertising

It is also important that pesticide advertising in the media adheres to the conditions of registration such as label directions and precautionary measures. The Code of Conduct recommends that countries have legislation to regulate the advertising of pesticides (2).

Only 40% of countries worldwide reported having legislation (act/law/regulations) to control the advertising of all pesticides (Table 3.30); an additional 30% of countries have such legislation for agricultural pesticides only. This leaves 25% of countries without any legislation to control pesticide advertising, which is a concern to be addressed.

Table 3.30 Legislation in place to control the advertising of pesticides. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Sub-item	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
For all pesticides	40%	47%	30%	33%	50%	33%	33%
Only for agricultural pesticides	30%	26%	30%	44%	33%	0%	33%
Only for public health pesticides	6%	0%	10%	0%	17%	0%	17%
None	25%	26%	30%	22%	0%	67%	17%
(n)	53	19	10	9	6	3	6

Pesticides are increasingly advertised and sold over the Internet, and the Code of Conduct calls on advertising organizations to require that online advertising and marketing be conducted in accordance with the laws of the country from which the message originates (15). Only a quarter of countries worldwide reportedly have legislation regarding the online sales of pesticides (Table 3.31).

Table 3.31 Legislation on online pesticide sales. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Legislation for on-line sales	24%	51	6%	17	40%	10	13%	8	29%	7	33%	3	50%	6

Substandard products

Illegal trade in substandard and counterfeit pesticide products can compromise pest control efforts and can have severe adverse effects on human health and the environment. Countries were asked to what extent substandard or counterfeit pesticide products are of concern. In 40% of countries, substandard or counterfeit products are of "major or moderate" concern, which is defined as these products being readily available to the general public. Apparently, the concern is widespread (Table 3.32). The remaining countries reported substandard or counterfeit products as a minor problem or no problem; that is: these products are occasionally, rarely or not available to the general public.

Two-thirds of countries worldwide reported having policies or methods established to prevent and prohibit the production, sale, distribution or use of substandard or counterfeit pesticides (Table 3.32). However, in the African Region, such policy is mostly lacking.

Table 3.32 Substandard and/or counterfeit pesticide products reported as a major or moderate concern (see text); and policy (or methods) available to prevent and prohibit substandard or counterfeited pesticides. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Substandard products of concern	40%	48	65%	17	22%	9	57%	7	17%	6	25%	4	0%	5
Policy on substandard pesticides	67%	51	24%	17	100%	10	71%	7	100%	7	100%	4	67%	6

Countries reported that they addressed the problem of counterfeiting and illegal trade of pesticides through national cooperation, international cooperation or another mechanism (namely, inspection or enforcement). The most common mechanism is cooperation at national level. International cooperation to address this issue is common only among countries in the European Region (Table 3.33).

Table 3.33 Mechanisms used to address counterfeiting and illegal trade of pesticides. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Mechanism	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
National cooperation	69%	59%	50%	88%	86%	100%	67%
International cooperation	31%	24%	40%	13%	71%	0%	33%
Other mechanism	13%	6%	40%	0%	0%	0%	33%
None/not applicable	8%	12%	10%	13%	0%	0%	0%
(n)	52	17	10	8	7	4	6

3.4. Quality control

After a pesticide product has been registered, the quality of the pesticides offered for sale (or for export) should be verified and controlled by governments, as specified in the Code of Conduct (2). Quality control involves determination of the quantity of active ingredient(s), relevant impurities and the suitability of their formulation, in accordance with FAO/WHO-recommended specifications, or national specifications. Consequently, it is vital that countries have, or have access to, suitable laboratory facilities for analysing pesticides.

Laboratory capacity

Some 59% of responding countries reported having a national pesticide quality control (testing) laboratory (Table 3.34). However, in the African and Western Pacific regions, only 33% of countries have such a laboratory. Some countries (16% worldwide) reported sending pesticide samples regularly to a laboratory in another country for analysis of active ingredient, physical-chemical properties or relevant impurities (Table 3.34).

Table 3.34 National-level pesticide quality control laboratory in place, and samples regularly sent abroad for analysis of active ingredient, physical-chemical properties or relevant impurities. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
National quality control laboratory	59%	54	33%	18	80%	10	78%	9	86%	7	75%	4	33%	6
Samples sent abroad for analysis	16%	56	20%	20	0%	10	22%	9	14%	7	25%	4	17%	6

More specifically, countries were asked whether they have adequate laboratory capacity (public or private sector) to process and analyse the active ingredient of pesticide samples. The analysis could involve laboratories other than the national-level pesticide quality control laboratory. Most countries across regions reported having this specific capacity, with the exception of the African Region, where 70% of countries lack this capacity (Table 3.35). Laboratory capacity to analyse the physical-chemical properties (including relevant impurities) of pesticide samples is less common among countries across most regions (Table 3.35).

Table 3.35 Adequate laboratory capacity to process and analyse the active ingredient and physical-chemical properties (including relevant impurities) of pesticide samples. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Analysing active ingredient	66%	56	30%	20	90%	10	89%	9	86%	7	75%	4	83%	6
Physical-chemic.properties	54%	54	35%	20	33%	9	67%	9	83%	6	75%	4	83%	6

Pesticide imports for emergencies

Imported consignments of pesticides that enter a country for emergency purposes should always be submitted to quality control. Also, pesticides imported for emergencies might not be registered in the country. Quality control is best conducted both before and after the shipment. Pre-shipment quality control enables timely cancellation of low-quality consignments, whilst post-shipment quality control serves to verify that the correct product was received.

A distinction is made between non-donated and donated pesticides. Non-donated pesticides that are imported for emergencies do not always go through quality control. In 36–39% of countries, no quality control of non-donated pesticides was reported (Table 3.36). In 27–28% of countries, quality control is reportedly conducted both before and after shipment for agricultural and public health pesticides.

Table 3.36 Quality control of non-donated pesticides imported for emergencies for agriculture (Agric.) and public health (PH). Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Pesticide type	Timing of quality control	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
Agric. pesticides	Only pre-shipment	15%	15%	25%	0%	33%	33%	0%
	Only post-shipment	21%	5%	50%	50%	0%	33%	0%
	Pre plus post shipment	28%	25%	25%	25%	0%	0%	80%
	None	36%	55%	0%	25%	67%	33%	20%
	(n)	47	20	8	8	3	3	5
PH pesticides	Only pre-shipment	15%	19%	25%	0%	0%	33%	0%
	Only post-shipment	18%	13%	25%	20%	0%	33%	25%
	Pre plus post shipment	27%	19%	25%	40%	0%	0%	75%
	None	39%	50%	25%	40%	100%	33%	0%
	(n)	33	16	4	5	1	3	4

For donated pesticides imported for emergencies, half of the countries indicated that no quality control is conducted, neither pre- nor post-shipment (Table 3.37); this figure is higher than for non-donated pesticides (Table 3.36). The quality of donated pesticides should not be taken for granted, because of risks that low-quality pesticides are used for emergency operations in agriculture and public health. Only 19–26% of countries conduct quality control both before and after shipment for donated agricultural or public health pesticides (Table 3.37).

Table 3.37 Quality control of donated pesticides imported for emergencies for agriculture (Agric.) and public health (PH). Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Pesticide type	Timing of quality control	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
Agric. pesticides	Only pre-shipment	13%	10%	22%	0%	20%	33%	0%
	Only post-shipment	11%	10%	11%	25%	0%	33%	0%
	Pre plus post shipment	26%	25%	11%	50%	20%	0%	60%
	None	50%	55%	56%	25%	60%	33%	40%
	(n)	46	20	9	4	5	3	5
PH pesticides	Only pre-shipment	16%	14%	17%	0%	50%	33%	0%
	Only post-shipment	16%	7%	17%	40%	0%	33%	0%
	Pre plus post shipment	19%	21%	17%	20%	0%	0%	50%
	None	50%	57%	50%	40%	50%	33%	50%
	(n)	32	14	6	5	2	3	2

Hence, in many countries pesticide imports for emergencies bypass quality control, and this problem is worse for donated than for non-donated pesticides. This concern should be addressed in efforts to improve emergency responses in agriculture and public health.

3.5. Packaging and labelling

Packaging and labelling are an important aspect of a pesticide product, intended to minimize risks of the product to users, the public and the environment. Pesticide labels should clearly present instructions about permitted use, dosage and methods of application. In addition, labels should present warnings as well as instructions on precautionary measures and safe disposal of used containers. Pesticide labelling must be regulated in pesticide legislation. Labels must comply with national legislation and conform to relevant international standards (16).

In the majority of responding countries (89% worldwide), labelling requirements are included in national pesticide legislation, as far as agricultural pesticides are concerned (Table 3.38). For public health pesticides, however, far fewer countries reported having labelling requirements included in legislation. This appears to be a gap in legislation that needs to be addressed at national and international levels.

Table 3.38 Labelling requirements for agricultural and public health pesticides included in pesticide legislation. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
Agricultural pesticides	89%	84%	100%	89%	86%	75%	100%
Public health pesticides	56%	53%	60%	33%	71%	100%	50%
(n)	55	19	10	9	7	4	6

The Globally Harmonized System of Classification and Labelling of Chemicals (GHS) is the accepted international standard for labelling of pesticides (17). WHO maintains a classification system (the WHO Recommended Classification of Pesticides by Hazard) from which FAO has recommended a labelling system with colour bands for pesticides. In 2015, FAO–WHO guidelines on good labelling practice for pesticides were harmonized with the GHS (16), and classification and labelling according to the GHS is recommended. However, many countries still apply the WHO Recommended Classification of Pesticides by Hazard, which is why both systems are discussed in the guidelines.

Worldwide, 55% of responding countries reported that their national requirements for pesticide labelling for agriculture correspond with the GHS (Table 3.39a). For public health pesticides, only 43% of responding countries aligned their labelling to the GPS.

The FAO–WHO labelling standard continues to be widely used by countries worldwide. In 71% of responding countries, the labelling requirements for agricultural pesticides accord with the FAO–WHO guidelines (Table 3.39b). For public health pesticides, 46% of countries aligned their labelling to these FAO/WHO guidelines (16).

Table 3.39 Pesticide labelling requirements in line with the Globally Harmonized System of Classification and Labelling of Chemicals (GHS), and pesticide labelling in line with FAO/WHO guidelines. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Labelling	Sub-item	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
In line with GHS	i. Agr.pesticides	55%	56%	30%	56%	86%	75%	40%
	ii. PH pesticides	43%	50%	20%	22%	71%	100%	20%
	(n)	53	18	10	9	7	4	5
In line with FAO/WHO guidelines	i. Agr.pesticides	71%	83%	78%	67%	43%	75%	60%
	ii. PH pesticides	46%	61%	22%	22%	29%	100%	60%
	(n)	52	18	9	9	7	4	5

3.6. Storage, transport and disposal

Pesticide storage

In 85% of countries worldwide, pesticide legislation includes provisions on the safe storage of pesticides; in 56% of countries these provisions covered all pesticides but in 27% of countries these provisions cover only agricultural pesticides (Table 3.40). The remaining 15% of countries worldwide reported that no legislative provisions of safe pesticide storage are in place. This is particularly a concern in the African, Eastern Mediterranean and Western Pacific regions.

Table 3.40 Safe storage of pesticides included as provision in pesticide legislation. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
For all pesticides	56%	42%	50%	33%	100%	100%	67%
Only for agricultural pesticides	27%	37%	40%	33%	0%	0%	17%
Only for public health pesticides	2%	0%	0%	11%	0%	0%	0%
None	15%	21%	10%	22%	0%	0%	17%
(n)	55	19	10	9	7	4	6

Pesticide transport

At country level, pesticide transport takes place between stores, or from stores to distributors, retailers or operations. It is imperative that precautionary measures for pesticide transport are followed to avoid damage or spills that could cause human exposure and environmental contamination.

Safe transport of pesticides is included as provisions in pesticide legislation in the majority of countries: in 47% of countries, the provisions cover all pesticides, and an additional 27% of countries reported these provisions cover agricultural pesticides only (Table 3.41). The remaining 25% of countries reported that no provisions to ensure safe pesticide transport are included in legislation, which is an issue of concern.

Table 3.41 Safe transport of pesticides included as provision in pesticide legislation. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
For all pesticides	47%	33%	50%	38%	83%	67%	50%
Only for agricultural pesticides	27%	33%	30%	38%	17%	0%	17%
Only for public health pesticides	0%	0%	0%	0%	0%	0%	0%
None	25%	33%	20%	25%	0%	33%	33%
(n)	51	18	10	8	6	3	6

Pesticide disposal

Obsolete pesticides and pesticide waste must be disposed of in an environmentally sound manner and be controlled under national legislation.

In 51% of countries worldwide, pesticide legislation includes provisions to ensure proper disposal of all obsolete pesticides, and in an additional 18% such provisions are in place for agricultural pesticides only (Table 3.42). In 31% of countries, special provisions for disposal are not included under pesticide legislation. Possibly, in some countries, pesticide disposal may be covered under separate legislation for hazardous waste disposal rather than under pesticide legislation.

Table 3.42 Proper disposal of obsolete pesticides included as provisions in pesticide legislation. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
For all pesticides	51%	39%	44%	56%	100%	33%	50%
Only for agricultural pesticides	18%	17%	22%	11%	0%	0%	50%
Only for public health pesticides	0%	0%	0%	0%	0%	0%	0%
None	31%	44%	33%	33%	0%	67%	0%
(n)	51	18	9	9	6	3	6

Empty pesticide containers are hazardous to both mankind and the environment, unless these containers are managed correctly (18). Legislation to manage and prevent the re-use of empty pesticide containers was reported from 42% of countries for all pesticides, and in addition, from 20% of countries for agricultural pesticides only (Table 3.43). In 38% of countries, no legislation is in place to prevent re-use of empty pesticide containers. The problem is accentuated in the African and South-East Asia regions, where the larger part of countries lacked such legislation.

Table 3.43 Legislation in place to manage and prevent the re-use of empty pesticide containers. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Sub-item	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
For all pesticides	42%	33%	44%	56%	50%	25%	50%
Only for agricultural pesticides	20%	11%	44%	11%	50%	0%	17%
Only for public health pesticides	0%	0%	0%	0%	0%	0%	0%
None	38%	56%	11%	33%	0%	75%	33%
(n)	50	18	9	9	4	4	6

3.7. Compliance monitoring and enforcement

The effectiveness of pesticide regulatory control depends not only on having the appropriate enforcement provisions in legislation but also, to a large degree, on compliance monitoring and enforcement activities to ensure that only registered pesticides are available and used, that these products are used for their approved purposes only and that all stages of the pesticide life cycle are duly regulated.

For agricultural pesticides, 47% of responding countries monitor legislation "to a large extent" (Table 3.44a). Hereby, "a large extent" is defined as "routine monitoring exists which enables problems to be detected at an early stage". For public health pesticides, only 31% of countries monitor legislation "to a large extent".

Similar results were obtained with regards to enforcement. For agricultural pesticides, 47% of responding countries enforce legislation "to a large extent"; for public health pesticides, 33% of responding countries enforce legislation "to a large extent" (Table 3.44b). The lack of

monitoring and enforcement is most widespread among countries in the African and Eastern Mediterranean regions.

Table 3.44 Pesticide legislation monitored and enforced “to a large extent” (see text). Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	Sub-item	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
Pesticide legislation to large extent monitored	i. Agr.pesticides	47%	21%	40%	56%	86%	50%	83%
	ii. PH pesticides	31%	16%	40%	22%	43%	50%	50%
	(n)	55	19	10	9	7	4	6
Pesticide legislation to large extent implemented/enforced	i. Agr.pesticides	47%	32%	50%	44%	71%	25%	83%
	ii. PH pesticides	33%	21%	40%	22%	71%	25%	33%
	(n)	55	19	10	9	7	4	6

Coordination between regulatory authorities and enforcement agencies is vital to the effectiveness of enforcement activities. For agricultural pesticides, 73% of responding countries reported that adequate coordination exists between regulatory and enforcement agencies in relation to pesticide regulations (Table 3.45). For public health pesticides, only 45% of countries reported adequate coordination. Coordination is least common in the African and Eastern Mediterranean regions. Some countries may not have separate agencies for regulation and enforcement activities.

Table 3.45 Adequate coordination existing between regulatory and enforcement agencies in relation to pesticide regulations. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
Agricultural pesticides	73%	55%	80%	78%	100%	75%	83%
Public health pesticides	45%	30%	50%	33%	71%	75%	50%
(n)	56	20	10	9	7	4	6

Moreover, these results reinforce the pattern throughout this report that public health pesticides receive less attention in regulatory control than do agricultural pesticides.

3.8. Pesticide poisoning

One of the deepest concerns about the distribution and use of pesticides, in general, is the risk of pesticide poisoning among those exposed. Countries should provide guidance on medical treatment of poisoning cases, collect reliable data and maintain statistics on health effects of pesticides and pesticide poisoning incidents, as recommended in the Code of Conduct.

Database on poisoning cases

A central database on pesticide poisoning cases or poisoning deaths is reportedly maintained in 42% of responding countries worldwide, but there is a large variation between regions. In the African and Eastern Mediterranean regions, a poisoning database is least common (Table 3.46).

The pesticide regulatory authority should have access to the database on pesticide poisoning cases to enable utilization of the data for regulatory decisions. Only in 27% of responding countries does the pesticide regulatory authority have access to these data (Table 3.46). This is particularly a concern in the African, Americas and Eastern Mediterranean regions.

Data on pesticide poisoning cases should be disseminated to the general public in order to inform them about the hazards that pesticides can cause. Again, only a few responding countries (25%) reported that data on pesticide poisoning cases are disseminated to the general public (Table 3.46). Hence, access to and dissemination of poisoning data require urgent strengthening in several regions.

Table 3.46 Data on pesticide poisoning: (i) database maintained on poisoning cases or poisoning deaths; (ii) pesticide regulatory authority has access to database; (iii) poisoning data are disseminated to the general public. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World % n	African % n	Americas % n	E.Mediterr'n % n	European % n	S-E.Asia % n	W.Pacific % n
Database on poisoning cases	42% 50	11% 19	56% 9	29% 7	100% 5	50% 4	83% 6
Authorities access to database	27% 49	5% 19	13% 8	14% 7	80% 5	50% 4	67% 6
Data disseminated to public	25% 51	16% 19	22% 9	14% 7	67% 6	25% 4	33% 6

Treatment of poisoning cases

For effective treatment of pesticide poisoning cases, appropriate guidelines should be available. Some 43% of countries reported having such guidelines; in the Americas and the African regions, such guidelines on treatment are least common (Table 3.47). Moreover, countries should have a specific training programme to teach medical and public health staff on how to treat pesticide poisoning cases. However, only 22% of countries worldwide responded that such a training programme is in place (Table 3.47). These are critical gaps in the system of pesticide management in most regions that require urgent attention.

Table 3.47 National guidelines and training programme in place for treatment of pesticide poisoning cases. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World % n	African % n	Americas % n	E.Mediterr'n % n	European % n	S-E.Asia % n	W.Pacific % n
Guidelines, treating poisoning cases	43% 49	28% 18	11% 9	43% 7	80% 5	100% 4	67% 6
Training, treating poisoning cases	22% 50	6% 18	22% 9	14% 7	33% 6	50% 4	50% 6

Use of poisoning data

Problems and incidents with locally-used pesticides should be reported to the Designated National Authority (focal point) for the Rotterdam Convention, for possible consideration as severely hazardous pesticide formulations. Only 43% of responding countries have procedures in place to report pesticide incidents to the Rotterdam Convention focal point (Table 3.48). In 68% of responding countries, the registration authority is also the Rotterdam Convention Designated National Authority for pesticides (Table 3.48).

Data on pesticide poisoning should be used to guide decision-making (e.g. regarding pesticide regulations or bans). In 45% of responding countries the poisoning data are reportedly used for decision-making.

Table 3.48 Reporting of pesticide incidents; Rotterdam Convention focal point; and use of pesticide poisoning data for decision-making. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World % n	African % n	Americas % n	E.Mediterr'n % n	European % n	S-E.Asia % n	W.Pacific % n
Pesticide incidents reported to RC	43% 54	25% 20	56% 9	50% 8	57% 7	25% 4	67% 6
Registration authority is RC-focal point	68% 53	67% 18	70% 10	50% 8	71% 7	75% 4	83% 6
Poisoning data used for decisions	45% 53	25% 20	56% 9	38% 8	71% 7	50% 4	80% 5

4. Pesticide management in agriculture

4.1. Agricultural policy

The majority of countries worldwide reported using, or making reference to, the Code of Conduct for the management of agricultural pesticides, suggesting that the Code of Conduct is quite widely accepted (Table 4.1).

Fewer countries reported having a national policy on IPM that accords with the Code of Conduct (Table 4.1). Notably, many countries in the African and Eastern Mediterranean regions do not have an IPM policy. This is a concern, especially because IPM is not a new concept.

Table 4.1 Use of Code of Conduct; and existence of national policy on IPM. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Code of Conduct used in agriculture	84%	51	100%	17	90%	10	57%	7	71%	7	100%	4	67%	6
National policy on IPM	69%	51	53%	17	78%	9	63%	8	100%	7	75%	4	67%	6

In terms of overall agricultural policy, 83% of countries consider IPM of high priority (Table 4.2). The approaches of agroecology and organic farming are considered a high priority in 54 and 56% of countries, respectively, particularly in the European Region (Table 4.2).

Table 4.2 Approaches considered a high priority in terms of agricultural policy. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
IPM	83%	65%	88%	100%	100%	100%	80%
Agroecology	54%	53%	38%	63%	83%	50%	40%
Organic farming	56%	35%	75%	75%	83%	50%	40%
(n)	48	17	8	8	6	4	5

4.2. IPM implementation

National IPM programme

The majority of responding countries reported the existence of a national IPM programme, but the implementation of the programme varied widely (Table 4.3). Countries in the European Region reported implementation throughout the country, whereas other regions reported implementation only in specific locations or no implementation. In the African Region, 47% of responding countries reported the absence of a national IPM programme.

Table 4.3 Implementation of national programme on IPM. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Level	World	African	Americas	E.Mediter'n	European	S-E.Asia	W.Pacific
Implemented throughout	31%	24%	22%	13%	100%	0%	33%
Implemented partially	43%	12%	78%	63%	0%	100%	67%
Not implemented	8%	18%	0%	13%	0%	0%	0%
No programme	18%	47%	0%	13%	0%	0%	0%
(n)	51	17	9	8	7	4	6

Target groups

Countries indicated that their governments commonly develop strategies that promote participation in IPM of farmers, extension agents, on-farm resources (e.g. workers, family) and nongovernmental organizations (NGOs) (Table 4.4).

Table 4.4 Strategies in place that promote participation in IPM by four target groups. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Target group	World	African	Americas	E.Mediter'n	European	S-E.Asia	W.Pacific
Farmers	82%	59%	89%	88%	100%	100%	100%
Extension agents	76%	65%	89%	75%	86%	75%	80%
On-farm resources	46%	35%	33%	50%	43%	75%	80%
NGOs	58%	47%	67%	75%	57%	50%	60%
(n)	50	17	9	8	7	4	5

Financial support

The support from lending institutions and donor agencies to improve IPM practices varies from full support to no support at all (Table 4.5). Half of the countries worldwide reported that financial support for IPM has been received only to a "small degree".

Table 4.5 Level of support by donor or lending agencies for IPM. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Level	World	African	Americas	E.Mediter'n	European	S-E.Asia	W.Pacific
Fully/completely	2%	0%	13%	0%	0%	0%	0%
To a large degree	22%	12%	0%	38%	33%	33%	50%
To a small degree	50%	71%	63%	38%	17%	67%	0%
Not at all	26%	18%	25%	25%	50%	0%	50%
(n)	46	17	8	8	6	3	4

Pesticide resistance management

Two-thirds of countries worldwide indicated that they have major problems with the resistance of agricultural pests (including insects, weeds and plant diseases) to available pesticides (Table

4.6). This problem appears to be widespread across all regions and underscores the vital importance of promoting strategies to prevent or manage the development of resistance in pest populations.

Adequate resources and expertise to manage problems with pest resistance in the agricultural sector were reported from a minority of countries worldwide (Table 4.6), and are lacking particularly in the African Region.

Table 4.6 Problems with pesticide resistance in agriculture; and resources to manage resistance. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Problems with pesticide resistance	66%	50	56%	16	80%	10	63%	8	71%	7	67%	3	67%	6
Resources to manage resistance	36%	50	6%	17	33%	9	38%	8	86%	7	67%	3	50%	6

Collaboration

Management of pesticide resistance can benefit from collaboration between the involved agencies to develop and promote resistance management strategies in agriculture. Government efforts to collaborate on this issue with other agencies (e.g. pesticide industry; national and international organizations) have reportedly been made to a small degree or large degree in most countries (Table 4.7).

Table 4.7 Extent of collaboration on resistance management in agriculture. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Level	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
Fully/completely	2%	0%	0%	0%	17%	0%	0%
To a large degree	36%	12%	50%	38%	50%	67%	50%
To a small degree	46%	53%	50%	50%	33%	0%	50%
Not at all	16%	35%	0%	13%	0%	33%	0%
(n)	50	17	10	8	6	3	6

4.3. Pesticide application in agriculture

Farmers and applicators

Pesticides applied on agricultural crops are used mostly by farmers themselves, particularly in the African, Eastern Mediterranean and South-East Asia regions (Table 4.8). In the Region of the Americas, pesticides are applied equally by farmers and applicators in most responding countries.

Table 4.8 Main group who applies pesticides on agricultural crops. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Group	World	African	Americas	E.Mediter'n	European	S-E.Asia	W.Pacific
Mostly farmers	52%	65%	20%	63%	57%	67%	40%
Mostly applicators	4%	0%	10%	0%	14%	0%	0%
Farmers / applicators equally	42%	35%	70%	25%	29%	33%	60%
Mostly others	2%	0%	0%	13%	0%	0%	0%
(n)	50	17	10	8	7	3	5

Personal protective equipment

Persons who handle and apply pesticides are at particular risk of pesticide exposure and poisoning. Personal protective equipment (PPE) denotes any clothes, materials or devices that provide protection from pesticide exposure during handling and application (2). The Code of Conduct recommends that Government and Industry promote the use of PPE, as appropriate to the prevailing climatic conditions and as affordable. Moreover, pesticides whose handling and application require the use of PPE that is uncomfortable, expensive or not readily available should be avoided (2).

PPE is reportedly available and used by pesticide applicators in 55% of responding countries worldwide (Table 4.9). However, 31% of countries indicated that PPE is available but not used; this problem is particularly common in the African Region. PPE was considered "available" if it was present in the market or if it was used by certain groups. Most commonly reported reasons for not using PPE are cost, discomfort, and lack of awareness about health risks. Further, 14% of countries reported that PPE is not available to pesticide applicators (Table 4.9).

Table 4.9 Availability and use of Personal Protective Equipment (PPE). Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Level	World	African	Americas	E.Mediter'n	European	S-E.Asia	W.Pacific
Available and used	55%	24%	60%	38%	100%	75%	100%
Available but not used	31%	59%	30%	38%	0%	0%	0%
Not available	14%	18%	10%	25%	0%	25%	0%
(n)	51	17	10	8	7	4	5

Pesticide advice

Several entities can provide advice to farmers on the use of pesticides. In just over half of the countries worldwide, advice is provided by agricultural (extension) workers (Table 4.10). A more dominant role in advising farmers on pesticide use is taken by the pesticide Industry (e.g. traders, distributors). This calls for more public extension services.

Code of Conduct recommends that the pesticide Industry should ensure that pesticide dealers are adequately trained, and hold appropriate permits or licences (where they exist), so that they are capable of providing buyers with advice on risk reduction as well as judicious and

efficient use (2). The vested interest of the pesticide Industry, however, poses a risk that their advice contributes to over-reliance and over-use of pesticides among buyers.

Table 4.10 Entities that provide advice to farmers on pesticide use. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Advisors	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
Agricultural (extension) workers	53%	65%	50%	50%	43%	75%	20%
Pesticide Industry	80%	65%	100%	75%	86%	75%	100%
Others	53%	41%	60%	75%	71%	0%	60%
(n)	51	17	10	8	7	4	5

Licensing of applicators

Code of Conduct recommends that governments should establish regulatory schemes such as licenses or permits for commercial pest control operators, or applicators (2).

In 78% of responding countries, agricultural pesticide applicators (i.e. not farmers spraying their own fields) are reportedly required to be trained (Table 4.11).

⁷ In addition, in 69% of responding countries, agricultural pesticide applicators are required to be licensed or certified (Table 4.11). These results suggest important gaps still exist in part of the countries regarding the requirements for pesticide applicators in agriculture.

Table 4.11 Agricultural pesticide applicators required to be trained or licensed. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Required training	78%	51	76%	17	90%	10	75%	8	100%	7	67%	3	50%	6
Required licensing	69%	52	65%	17	80%	10	63%	8	100%	7	50%	4	50%	6

Awareness on risk reduction

Awareness programmes on pesticide risk reduction are reportedly conducted in the majority of countries worldwide (Table 4.12). In 50% of responding countries, these awareness programmes are conducted jointly by government and industry. In 38% of responding countries, awareness programmes are conducted by government only, and in 20% of responding countries these programmes are by other entities (i.e. NGOs).

⁷ However, it is possible that some respondents interpreted this question to refer to farmers spraying in their own fields.

Table 4.12 Entities conducting awareness programmes on pesticide risk reduction for farmers. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Conducted by	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
Government only	38%	53%	10%	50%	43%	67%	0%
Industry only	4%	6%	0%	13%	0%	0%	0%
Government and Industry jointly	50%	24%	80%	25%	71%	33%	100%
Other entities	20%	29%	10%	38%	14%	0%	0%
Not implemented	2%	6%	0%	0%	0%	0%	0%
(n)	50	17	10	8	7	3	5

Disposal of pesticide waste

Governments and industry should work together to establish services for the collection and safe disposal pesticide waste, including left-over pesticides and empty pesticide containers (2).

A national guidance document on the safe and environmentally sound disposal of obsolete or unused agricultural pesticides was reported from only 38% of total responding countries (Table 4.13). Similarly, a national guidance document on the safe and environmentally sound disposal of agricultural pesticide containers (empty or used containers) was reported from only 32% of responding countries (Table 4.13).

Furthermore, 50% of responding countries reported a system in place to safely collect empty pesticide containers from farmers or cooperatives (Table 4.13). Such system is least common in the African and Eastern Mediterranean regions.

These results raise major concern over the practices of disposal of agricultural pesticide waste in many countries, particularly in the African and Eastern Mediterranean regions.

Table 4.13 Guidance document and system in place on the safe and environmentally sound disposal of agricultural pesticides and empty containers. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World % n	African % n	Americas % n	E.Mediterr'n % n	European % n	S-E.Asia % n	W.Pacific % n
Guidance on pesticide disposal	38% 47	18% 17	38% 8	29% 7	100% 6	33% 3	50% 6
Guidance on empty containers	32% 50	18% 17	50% 8	25% 8	71% 7	0% 4	33% 6
System to collect containers	50% 50	24% 17	89% 9	13% 8	100% 7	50% 4	60% 5

4.4. Pesticide imports

Statistics on imported agricultural pesticide products are available in 88% of responding countries worldwide (Table 4.14). Moreover, 92% of responding countries have customs measures in place to control the import of pesticides (Table 4.14). In the African Region, fewer countries have these measures in place.

A database to record data on import, export, sales, manufacture, and use of agricultural pesticides has reportedly been established in 87% of responding countries worldwide (Table 4.14). Some countries in the African and Eastern Mediterranean regions still lack a pesticide database.

Table 4.14 Pesticide data and imports. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Statistics, imported pesticides	88%	50	81%	16	90%	10	88%	8	83%	6	100%	4	100%	6
Customs control, pesticide import	92%	51	81%	16	100%	10	88%	8	100%	7	100%	4	100%	6
Database on pesticides	87%	52	65%	17	100%	10	88%	8	100%	7	100%	4	100%	6

4.5. Pesticide residues and contamination

Maximum residue limits

Pesticides leave traces on treated agricultural commodities that are called “residues”. The maximum residue limit (MRL) is the maximum concentration of a residue that is permitted or acceptable in or on a food or feed commodity (19).

As much as 96% of countries responded that they recognize, or partly recognize, the maximum residue limits (MRLs) as provided by the Codex Alimentarius for traded food and/or feed commodities (Table 4.15). Only very few responding countries in the African and Eastern Mediterranean regions do not recognize the MRLs of the Codex Alimentarius.

Table 4.15 Maximum residue limits (MRLs) of the Codex Alimentarius recognized, or partly recognized, and national MRLs established, or partly established. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Codex MRLs (partly) recognized	96%	47	94%	16	100%	10	88%	8	100%	5	100%	4	100%	4
Nat'l MRLs (partly) established	29%	51	0%	17	30%	10	0%	8	86%	7	50%	4	80%	5

In addition, 29% of countries worldwide reported having established national MRL's that differ from those provided by the Codex Alimentarius (Table 4.15). Reported reasons are that national (or EU-level) MRLs departed from Codex MRLs. National-level MRLs are not reported from the African and Eastern Mediterranean regions.

Monitoring of pesticide residues

Countries should have system in place for monitoring of pesticide residues. Some 58% of responding countries reported having a national system in place to monitor pesticide residues in food or feed items (Table 4.16), but such system remains mostly absent in the African Region.

Monitoring of pesticide residues in the environment is less common: only 26% of countries reported having such a system in place (Table 4.16). The exception is the European Region where most countries reported monitoring of pesticide residues in the environment. These results highlight the need to strengthen systems to monitor pesticide residues in order to protect human health and the environment.

Table 4.16 System in place to monitor pesticide residues in food and feed items; and in the environment. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World	African	Americas	E.Mediter'n	European	S-E.Asia	W.Pacific
In food or feed items	58%	18%	90%	71%	86%	75%	60%
In the environment	26%	12%	10%	14%	86%	50%	20%
(n)	50	17	10	7	7	4	5

Environmental incidents

The Code of Conduct recommends that Governments should collect data on environmental contamination and adverse effects, and report pesticide-related incidents (2).

Significant incidents of pesticide contamination of the environment (e.g. to wildlife or aquatic ecosystems) that occurred within the past three years were reported from 20% of countries worldwide (Table 4.17). Reporting was highest in the Americas and the European regions. The absence of incidents in other regions could be (partly) due to weak reporting systems.

In addition, 33% of countries reportedly established programmes, or mechanism, to collect data on pesticide contamination of the environment (for example, to monitor pesticide residues in water bodies) (Table 4.17). Collection of contamination data is least common in the African, Eastern Mediterranean and South-East Asia regions. Data on environmental incidents or contamination are disseminated to the general public in one third of responding countries (14 out of 42) (Table 4.17).

Hence, substantial effort is needed to establish reliable systems of data collection on pesticide contamination and incidents across all regions.

Table 4.17 Environmental incidents and contamination with pesticides. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Environm. contamination past 3y	20%	45	25%	16	43%	7	0%	8	33%	6	0%	3	0%	5
Contamination data collected	33%	46	18%	17	43%	7	25%	8	50%	6	33%	3	60%	5
Contamination made public	33%	42	18%	17	57%	7	40%	5	50%	6	0%	3	50%	4

Effects on ecosystems

More specifically, countries were asked about the types of data collected within the past three years on pesticide effects on ecosystems and non-target organisms. Some 30% of responding countries collect data on aquatic ecosystems, 23% on terrestrial ecosystems, 16% on endangered species, 14% on wildlife, and 25% on specific incidents that have harmed the environment (e.g., fish poisonings) (Table 4.18). Generally, data collection is least common in the African and Eastern Mediterranean regions. These results indicate major data gaps in the environmental effects of pesticides all regions.

Table 4.18 Data on pesticide effects on ecosystems and non-target organisms collected in the past 3 years. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
Aquatic ecosystems	30%	6%	43%	17%	67%	67%	40%
Terrestrial ecosystems	23%	6%	29%	17%	50%	67%	20%
Endangered Species	16%	6%	29%	0%	33%	33%	20%
Wildlife	14%	6%	29%	0%	33%	33%	0%
Specific incidents	25%	12%	43%	0%	67%	33%	20%
(n)	44	17	7	6	6	3	5

4.6. The Rotterdam Convention

Implementation

The Rotterdam Convention on the *Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade* calls for the sharing of information about traded hazardous chemicals, and regulatory actions to be taken (12).

In total, 92% of responding countries indicated that they are Party to the Rotterdam Convention (Table 4.19). More than half of countries (Parties only) expressed that challenges are faced with the implementation of the Rotterdam Convention, particularly by countries in the African and Eastern Mediterranean regions (Table 4.19).

Table 4.19 Implementation of the Rotterdam Convention (see text). Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Party to Rotterdam Convention	92%	51	100%	17	90%	10	88%	8	86%	7	75%	4	100%	5
Challenges with implementation	57%	47	65%	17	56%	9	71%	7	20%	5	50%	4	60%	5
Know how to request assistance	60%	43	53%	17	67%	9	67%	6	100%	3	67%	3	40%	5
Focal point details up-to-date	89%	46	88%	17	88%	8	100%	7	80%	5	75%	4	100%	5

Countries were asked if they know how to request technical assistance for the implementation of the Rotterdam Convention. Worldwide, 40% of responding countries indicated they do not know how to request assistance, particularly among countries in the African and Western Pacific regions (Table 4.19). Furthermore, 89% of Parties reported that their contact details of the Rotterdam Convention designated national authority and the official contact point are still up to date (Table 4.19).

Challenges

Some countries described the specific challenges they experienced with the implementation of the Rotterdam Convention. The notification of final regulatory action (e.g. to ban or severely restrict a chemical) is a challenge for 60% of countries; the submission of import responses is considered a challenge by 56% of countries; and the export and export notifications is a challenge for 20% of countries (Table 4.20).

Table 4.20 Type of challenges experienced with the implementation of the Rotterdam Convention. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Challenge	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
Notifications of final regulatory action	60%	50%	80%	40%	100%	100%	67%
Submission of import responses	56%	70%	60%	40%	0%	100%	33%
Export and export notifications	20%	20%	40%	20%	0%	0%	0%
Other	8%	10%	0%	20%	0%	0%	0%
(n)	25	10	5	5	1	1	3

FAO/WHO guidelines

The FAO and WHO have published a series of guideline documents regarding various aspects of pesticide management, intended to assist countries in their practices of pesticide management along the pesticide life cycle (20). One-third of responding countries worldwide reported a major use, 41% moderate use, and 18% minor use of these guidelines (Table 4.21). Major use is highest among countries in the Americas, African and Eastern Mediterranean regions. Another 8% of countries never uses the guidelines.

Table 4.21 The extent to which FAO/WHO guidelines on pesticide management are reportedly used. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Extent of use	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
Major use /often	33%	41%	44%	50%	0%	0%	20%
Moderate use	41%	29%	56%	25%	43%	100%	40%
Minor use	18%	24%	0%	13%	43%	0%	20%
Never	8%	6%	0%	13%	14%	0%	20%
(n)	49	17	9	8	7	3	5

5. Pesticide management for vector control in public health

5.1. Integrated vector management

Integrated vector management (IVM), defined as a rational decision-making process for the optimal use of resources for vector control, has been promoted by WHO as the preferred approach to increase the efficacy, cost-effectiveness, ecological soundness and sustainability of disease-vector control (21–23). In 2017, WHO launched the Global Vector Control Response 2017–2030, which repositioned vector control as a key approach to prevent and eliminate vector-borne diseases, while building on the concept of IVM with renewed focus on human capacity at national and subnational levels (24).

IVM policy

A national policy on IVM for vector-borne disease control reportedly exists in 52% of countries worldwide; IVM policy is least common in the European Region (Table 5.1). These results suggest a lack of progress in terms of countries adopting IVM policy since the previous survey conducted in 2010 (7).

To facilitate implementation of IVM, WHO recommends that the activities on vector control for all vector-borne diseases are coordinated (22). In 74% of countries worldwide, a national vector control unit, or body, with the responsibility for all vector control activities is present (Table 5.1). A vector control unit is least common in the European Region. The results indicate that some countries have a vector control unit but lack a national IVM policy.

Table 5.1 National policy of Integrated Vector Management (IVM) in place, and implemented. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
National IVM policy	52%	93	45%	22	52%	27	63%	19	25%	8	63%	8	56%	9
National vector control unit	74%	93	82%	22	81%	27	74%	19	38%	8	75%	8	67%	9

IVM implementation

For countries with an IVM policy, the majority (79%) reported that IVM is implemented at field level throughout the country (Table 5.2), which suggests an increase from the survey result obtained in 2010 (7). Another 11% of countries reported IVM implementation only in specific areas of the country, and 10% of countries reported that the policy is not implemented. This suggests that, where IVM policy has been established, the policy is being widely implemented. Details on how the policy is implemented are lacking.

Table 5.2 Implementation of national IVM policy. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Throughout the country	79%	47	90%	10	79%	14	75%	12	100%	2	50%	4	80%	5
Only in specific areas	11%	47	10%	10	14%	14	0%	12	0%	2	25%	4	20%	5
Not implemented	10%	47	0%	10	7%	14	25%	12	0%	2	25%	4	0%	5

5.2. Insecticide resistance management

Most vector control operations continue to rely on insecticidal action, which usually leads to the development of insecticide resistance. Particularly, insecticide resistance in malaria vectors is becoming more widespread and intensified (25–27). Detection of the development of resistance in vector populations is critical to timely inform intervention policies (28). Therefore, the insecticide susceptibility of target vectors should be regularly monitored and a strategy for insecticide resistance management (IRM) proactively implemented.

Insecticide resistance monitoring

Resistance monitoring depends largely upon the specialist capacity that exists at country level. The survey results indicate that expertise for resistance monitoring exists in 68% of countries worldwide; it is most common among countries in the African and Western Pacific regions (Table 5.3). Capacity for insecticide susceptibility testing (29) was reported from 68% of countries, whereas capacity for molecular and biochemical testing was reported from 27 and 26% of countries, respectively (Table 5.3). Furthermore, sentinel sites for routine monitoring purposes have reportedly been established in 44% of countries, and insectaries (necessary for keeping susceptible strains of target vector species) were reported present in 56% of countries.

Table 5.3 Capacity for insecticide resistance monitoring. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Type of capacity	World	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
Expertise for resistance monitoring	68%	86%	67%	68%	13%	63%	78%
Insecticide susceptibility testing	68%	64%	81%	68%	13%	63%	89%
Molecular testing	27%	41%	33%	16%	0%	25%	22%
Biochemical testing	26%	41%	30%	16%	0%	25%	22%
Sentinel sites established	44%	55%	37%	53%	0%	63%	44%
Insectaries in place	56%	59%	70%	42%	25%	50%	67%
(n)	93	22	27	19	8	8	9

Overall, capacity for resistance monitoring is most common among countries in the African Region, which could be attributed to recent capacity-building efforts in the context of the control and elimination of malaria, mainly with the support of the US President's Malaria

Initiative and the Global Fund to Fight AIDS, Tuberculosis and Malaria (30). Monitoring capacity was least common in the European Region.

Insecticide resistance management

A national strategy for IRM of vectors of human disease was reported present in 41% of countries worldwide (Table 5.4). An IRM strategy was most common in the African Region, in accordance with recent efforts to control or eliminate malaria.

In 62% of countries, the Ministry of Health was reported to use, or make reference to, the Code of Conduct in the management of public health pesticides (Table 5.4). Use of the Code for public health pesticides was most common in the African Region and least common in the European Region.

Table 5.4 Strategy for insecticide resistance management (IRM) of vectors of human disease; and Code of Conduct used for managing public health pesticides. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
National strategy for IRM	41%	93	64%	22	26%	27	42%	19	38%	8	38%	8	33%	9
Code of Conduct used	62%	89	81%	21	50%	26	67%	18	14%	7	63%	8	78%	9

5.3. Pesticide selection

Important considerations

The selection of pesticide products for vector control operations should take into account several important considerations, apart from a product's recommendation (according to minimum requirements) and their cost. The majority of countries worldwide (82%) used the insecticide susceptibility status of vectors as a criterion for selection of pesticides to be procured (Table 5.5).

Table 5.5 Considerations for selection of pesticides for procurement (see text). Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Susceptibility as criterion	82%	91	91%	22	85%	27	79%	19	50%	6	75%	8	89%	9
Residual period as criterion	82%	72	82%	22	100%	17	60%	15	100%	3	63%	8	100%	7
Int. conventions considered	82%	92	86%	22	81%	27	79%	19	50%	6	88%	8	90%	10

Also, 82% of countries use the residual activity (i.e. the effective period after application) of vector control products for indoor residual spraying (where applicable) as a criterion in the selection of pesticides to be procured. Moreover, the majority of countries make reference to

the international conventions on chemicals and pesticides (e.g. the Rotterdam and Stockholm conventions) when selecting a vector control pesticide (Table 5.5).

WHO recommended products

Until 2017, WHOPES issued recommendations for vector control products; this role has now moved to the WHO prequalification unit. In most countries in the African, South-East Asian and Western Pacific regions the ministry of health restricts the procurement of vector control pesticide products to those that have been recommended by WHOPES (Table 5.6).

For procurement of vector control pesticide products by other agencies (i.e. not by the ministry of health), the selection of products is less commonly restricted to those recommended by WHOPES (Table 5.6)

Table 5.6 Vector control pesticide products restricted to WHOPES-recommended products in the procurement by: (i) the ministry of health or (ii) other agencies. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Agency	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Ministry of health	75%	89	91%	22	63%	27	67%	18	40%	5	100%	8	89%	9
Other agencies	54%	63	88%	16	32%	19	42%	12	67%	3	83%	6	29%	7

5.4. Procurement

Vector control operations using insecticides require the timely procurement of quality-assured pesticide products in an efficient and transparent manner. Good procurement procedures and practices demand specialized skills, clear guidelines and a legal basis (31).

Procurement process

Some 61% of countries worldwide reported having a national guidance document, or informal guidelines, for the procurement of vector control insecticides (Table 5.7). Such documentation is partly lacking from countries in the European Region.

Apart from the national-level procuring agency, other agencies or authorities (e.g. at sub-national level, local authorities, private sector) could be involved in procuring vector control pesticides. In 70% of countries, other agencies or authorities procure pesticides for vector control (Table 5.7). This suggests the need for cooperation between procuring agencies to ensure that the procurement requirements are harmonized.

Alignment of procurement methods between countries can potentially improve the quality and efficiency of the procurement process. One-third of countries reported that the procedures, requirements and guidelines for pesticide procurement are aligned between the

national authority and another country in the (sub-) region, particularly in the Americas, Eastern Mediterranean and South-East Asia regions (Table 5.7).

Table 5.7 Details on the procurement process of vector control insecticides: guidance document in place; other agencies involved; and alignment with other countries. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Guidance on procurement	61%	89	55%	22	54%	26	68%	19	33%	6	63%	8	100%	8
Procurement by others	70%	91	68%	22	77%	26	72%	18	38%	8	75%	8	78%	9
Aligned with other countries	33%	90	19%	21	48%	27	41%	17	25%	8	50%	8	0%	9

Tender process

Procurement of large quantities of pesticides is best conducted through a public tender, which is an open request for bids, to ensure competitive prices and a transparent procurement process. Procurements of vector control pesticides by ministries of health is commonly carried out through public tenders (66% of countries worldwide), but procurements by agencies other than the ministry of health are less common through public tenders (Table 5.8).

Table 5.8 Procurement of vector control pesticides through public tenders: (i) procurement by ministries of health and (ii) procurement by other agencies. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Agency	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Ministry of health	66%	87	81%	21	44%	25	68%	19	60%	5	88%	8	67%	9
Other agencies	35%	77	47%	15	18%	22	47%	19	33%	6	25%	8	43%	7

Requirements

After-sale stewardship commitments (e.g. on labelling, training or monitoring) are reportedly incorporated as a condition for procurement of vector control pesticide products in 58% of countries worldwide (Table 5.9).

In only 51% of countries worldwide, procurements of vector control pesticide products require quality control (pre- and/or post-shipment) (Table 5.9). This leaves many countries in which these important requirements are not in place.

Table 5.9 Details on the procurement process of vector control insecticides: after-sales stewardship required; quality control required. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
After-sale stewardship	58%	92	50%	22	63%	27	47%	19	43%	7	88%	8	67%	9
Quality control	51%	91	57%	21	33%	27	63%	19	0%	7	100%	8	56%	9

Quality standards

WHO has developed quality assurance standards, or specifications, for public health pesticide products, which define the physical and chemical properties of a pesticide product. These WHO quality standards are reportedly included in procurement requirements by the ministry of health in 84% of countries (Table 5.10). For the procurement requirements by other agencies (i.e. not the ministry of health), however, WHO specifications are less commonly included (Table 5.10).

Table 5.10 WHO quality standards included in procurement requirements by: (i) the ministry of health or (ii) other agencies. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Agency	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Ministry of health	84%	89	86%	22	77%	26	89%	19	40%	5	100%	8	100%	9
Other agencies	52%	63	73%	15	35%	20	42%	12	67%	3	67%	6	57%	7

Central procurement

Most vector control pesticides are procured by ministries of health at national level. Central level procurement by the ministry of health for the purpose of malaria control is reported by 67% of countries; for arboviral control (e.g. dengue, chikungunya) by 51% of countries; and for other vector-borne diseases (e.g. visceral leishmaniasis, lymphatic filariasis, Chagas disease) by 51% of countries (Table 5.11). The remainder of procurements is presumably done by other agencies or at decentralized levels.

Table 5.11 Vector control pesticides procured by the ministry of health at national level, for three diseases: (i) malaria, (ii) arboviruses, and (iii) other vector-borne diseases. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Purpose	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Malaria control	67%	92	68%	22	78%	27	61%	18	25%	8	88%	8	67%	9
Arboviral control	51%	90	19%	21	81%	27	28%	18	14%	7	88%	8	78%	9
Other VBDs	51%	88	38%	21	71%	24	56%	18	13%	8	75%	8	33%	9

Procurement amounts

Accurate estimation of procurement amounts improves efficiency and reduces the risk of unused stocks becoming obsolete. Some 29% of countries reported problems with estimating the appropriate amounts of vector control pesticides to be procured for emergency situations (Table 5.12); this problem is particularly common in the African and South-East Asian regions. Some countries (17% worldwide) also encountered problems estimating the appropriate amounts of vector control pesticides to be procured for non-emergency (normal, routine) situations (Table 5.12).

Table 5.12 Problems encountered with estimating amounts of vector control pesticides to be procured for emergency situations, and non-emergency settings. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Emergencies	29%	91	41%	22	15%	26	26%	19	14%	7	50%	8	33%	9
Non-emergency settings	17%	89	19%	21	8%	26	21%	19	17%	6	50%	8	0%	9

5.5. Storage, transport and disposal practices

Storage facilities

Vector control pesticides are commonly stored at central level facilities and kept for operations at periphery level facilities. Worldwide, 60% of countries reported that adequate, safe and secure facilities for storage of vector control pesticides are available at central (government-controlled) level, with minor variation between regions (Table 5.13). Fewer countries (45% worldwide) responded that adequate, safe and secure storage facilities are available at periphery level (Table 5.13). This result raises the serious concern over the safety of stored vector control pesticides, particularly at periphery level.

Table 5.13 Adequate, safe and secure facilities for storage of vector control pesticides available at central level, and periphery level. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Central level	60%	89	55%	22	41%	27	67%	18	80%	5	100%	8	67%	9
Periphery level	45%	91	50%	22	26%	27	42%	19	71%	7	50%	8	75%	8

Store keepers

Store keepers require to be trained on stock management, both at central level and periphery level facilities (32). From 72% of countries, it was reported that central-level store keepers are adequately trained on stock management of vector control pesticides (Table 5.14). However,

only 59% of countries reported that periphery-level store keepers are adequately trained. Hence, stock management requires attention, particularly at periphery level.

Table 5.14 Store keepers of vector control pesticide stocks adequately trained on stock management at central level and periphery levels. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Central level	72%	89	76%	21	76%	25	63%	19	67%	6	75%	8	70%	10
Periphery level	59%	87	68%	19	64%	25	44%	18	71%	7	63%	8	40%	10

Transport

Whenever vector control pesticides are transported to stores or points-of-use, the transport should be accompanied by someone (e.g. driver, other staff) who is trained on safe transport and on emergency procedures, to prevent spillage, illegal trade and damage of pesticide products. However, in only a minority (38%) of countries worldwide, transport of vector control pesticides is reportedly required to be accompanied by someone trained on safe transport and emergency procedures (Table 5.15). This is clearly another weakness in pesticide management across the globe that needs urgent attention.

Table 5.15 Transport of vector control pesticides required to be accompanied by someone trained on safe transport and emergency procedures. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Accompanied transport	38%	91	45%	22	41%	27	28%	18	29%	7	25%	8	56%	9

Disposal of vector control pesticides

The safe and environmentally sound disposal of pesticide waste from vector control relies on the existence of a national guidance document. In total, 46% of countries indicated that such a guidance document exists (Table 5.16). In the Americas and the Eastern Mediterranean regions, fewer countries reported such a guidance document.

Table 5.16 Guidance on disposal of: (i) vector control pesticides, and (ii) empty containers of vector control pesticides. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Guidance, pesticide disposal	46%	91	59%	22	38%	26	37%	19	43%	7	50%	8	56%	9
Guidance, empty containers	38%	91	50%	22	22%	27	39%	18	29%	7	38%	8	67%	9

Moreover, 38% of countries reported that a national guidance document exists on the safe and environmentally sound disposal of empty pesticide containers (or sachets) from vector control operations (Table 5.16).

The accumulation of obsolete pesticides for vector control is considered to be an issue in 40% of countries, particularly in the Americas and the Eastern Mediterranean regions (Table 5.17). However, a policy to prevent the accumulation of obsolete stocks of pesticides was reported to be in place in only 32% of countries.

Table 5.17 Accumulation of obsolete vector control pesticides: (i) accumulation is an issue of concern; (ii) policy in place to prevent the accumulation of obsolete pesticide stocks. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Accumulation of obsoletes	40%	92	38%	21	48%	27	53%	19	0%	8	38%	8	33%	9
Policy to prevent accumulation	32%	92	36%	22	19%	27	47%	19	29%	7	38%	8	22%	9

5.6. Training

The use and management of pesticides for vector control depend to an important degree on the level of training of those responsible for decision-making and implementation of vector control activities.

Some 38% of countries indicated that all those responsible for decision-making and implementation of vector control activities have received certified training on vector control – with minor differences between regions (Table 5.18); 51% of countries responded that only a part of those responsible have been trained, while 11% of countries indicated that none have been trained.

Furthermore, only 29% of those responsible for decision-making and implementation of vector control activities have received training on sound management of public health pesticides (Table 5.18). Here, 49% of countries responded that only a part of those responsible have been trained, and 22% responded that none have been trained.

These results highlight a clear weakness in human capacity on vector control and pesticide management that should be addressed as a matter of priority.

Table 5.18 Those responsible for decision-making and implementation of vector control activities received certified training on: (i) vector control and (ii) pesticide management. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Trained on vector control	38%	89	45%	22	33%	27	39%	18	33%	6	29%	7	44%	9
Trained on pesticide mgt.	29%	91	36%	22	30%	27	37%	19	0%	6	13%	8	22%	9

5.7. Applicators of vector control pesticides

To promote effective and safe operations, the applicators (spray workers) in vector control operations should be regulated through certification and monitoring. Vector control applicators require practical training on the handling, application and clean-up of vector control pesticides, with special attention paid to safety precautions.

Precautionary measures

Some 69% of countries reported having national guidelines or training curricula available for safety precautions or risk reduction of pesticide applicators (spray workers) for vector control operations (Table 5.19). Appropriate PPE for vector control operations was reported as mandatory for spray workers (including from private sector operators) by 75% of responding countries. There are no striking differences in this respect between regions.

Table 5.19 Safety precautions of pesticide applicators for vector control operations: (i) guidelines in place; (ii) personal protective equipment (PPE) mandatory. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Guidelines, safety precautions	69%	91	73%	22	69%	26	68%	19	57%	7	75%	8	67%	9
PPE mandatory (vector control)	75%	93	86%	22	74%	27	74%	19	75%	8	50%	8	78%	9

Health monitoring

National guidelines for health monitoring of pesticide applicators in vector control operations are reportedly present in 30% of countries worldwide (Table 5.20). Similarly, a national programme to monitor the exposure of applicators (spray workers) to pesticides used in vector control operations is in place in 30% of countries worldwide. These results pinpoint a gap in monitoring the exposure and health of applicators in vector control programmes across all regions.

Table 5.20 Health monitoring of vector control applicators: (i) guidelines in place; (ii) pesticide exposure monitoring carried out. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Guidelines on health monitoring	30%	92	32%	22	41%	27	26%	19	14%	7	25%	8	22%	9
Applicator exposure monitored	30%	92	32%	22	44%	27	16%	19	0%	7	25%	8	44%	9

Spraying equipment

An important aspect of spray operations is the quality of application equipment. Poor quality or poorly maintained equipment will compromise the effectiveness and safety of spray

operations. Therefore, countries should have a scheme for quality control of application equipment (2, 33).

Only 39% of countries worldwide reported having a national scheme in place for the quality control of application equipment for vector control operations (including space spray equipment, where applicable) (Table 5.21). In the African Region, 64% of countries indicated having a quality control scheme, which is an increase from 27% reported in 2010 (7). This increase is possibly attributed to recent capacity-building efforts in the context of programmes to control or eliminate malaria.

Table 5.21 National scheme exists for the quality control of application equipment for vector control operations. Presented is the percentage of countries answering the question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Scheme for equipment	39%	93	64%	22	30%	27	42%	19	25%	8	25%	8	22%	9

Certification and monitoring of operations

Just one-third of countries worldwide reported having a certification scheme for pesticide applicators (spray workers) in vector-borne disease control programmes. Most countries reported not having a certification scheme, which is an important issue to be addressed.

Vector control operations are, in some countries, contracted or delegated by the ministry of health to the private sector or to NGOs. Where contracted operations are carried out, 59% of countries reported that these operations are regularly monitored by the ministry of health, which leaves many countries where contracted operations are not monitored (Table 5.22). This is a potential gap that should be addressed.

Table 5.22 Certification of vector control applicators, and monitoring of contracted operations carried out. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Certification of applicators	33%	91	41%	22	26%	27	26%	19	50%	6	13%	8	56%	9
Contracted operations	59%	46	69%	16	55%	11	57%	7	50%	4	33%	3	60%	5

5.8. Data on use of vector control pesticides

Data on the types and amounts of vector control pesticide products should be made available to the ministry of health to assist them in decision-making on resistance management. Some 74% of countries worldwide indicated that records on the use of vector control pesticides are available to the ministry of health at the national (or central) level (Table 5.23).

Table 5.23 Data on pesticide use for vector control: (i) records available to the ministry of health at the national (central) level; pesticide information available to the general public; public awareness programme in place on use of public health pesticides. Presented is the percentage of countries answering each question positively, and the number of responding countries (or, n).

Item	World		African		Americas		E.Mediterr'n		European		S-E.Asia		W.Pacific	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Pesticide use records available	74%	90	77%	22	78%	27	72%	18	43%	7	86%	7	78%	9
Pesticide information public	40%	92	43%	21	52%	27	21%	19	63%	8	38%	8	22%	9
Public awareness programme	40%	91	36%	22	33%	27	44%	18	14%	7	63%	8	56%	9

Information on the use of vector control pesticides should be made available to the public. Public awareness and understanding of vector control operations are vital to achieve optimal compliance with interventions, and to protect the public against pesticide exposure. In 40% of responding countries worldwide, information on the use of vector control pesticides is reportedly available to the general public (Table 5.23). A national information and awareness programme, for the public, on use of public health pesticides was reported from 40% of countries, ranging from 14% in the European Region to 63% in the South-East Asia Region (Table 5.23).

6. Discussion

6.1. Strengths and weaknesses in pesticide management

Pesticide regulatory control

A few strengths in pesticide legislation are that general pesticide legislation, and legislation on pesticide labelling, is reportedly in place in the large majority of countries (Figure 6.1).

However, weaknesses are that legislation in many countries does not include public health pesticides, while biopesticides are not covered in a number of countries. Moreover, important gaps in legislation refer to online pesticide sales; HHPs; safe storage, transport and disposal; and licencing schemes, including retail and advertisement of pesticides. Roughly half of the responding countries lack legislation on any of these important requisites for the sound management of pesticides.

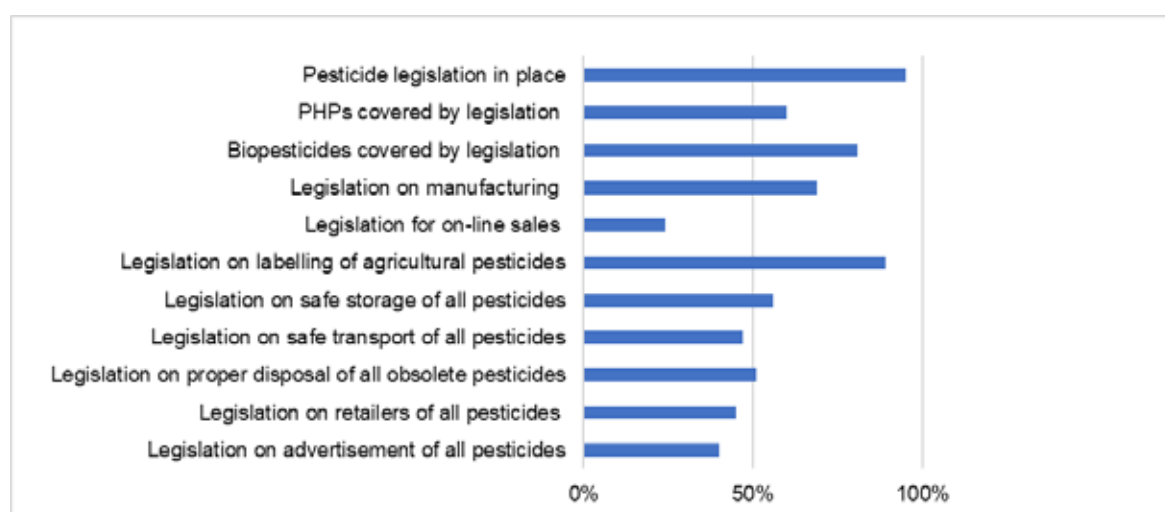


Figure 6.1 Summarized results of some key aspects of pesticide legislation. Presented is the percentage of positive responses from countries across all regions.

Regarding the regulation of pesticides, many gaps are evident. Although HHPs have been identified by most countries, strategies to reduce risks due to HHPs have been implemented by only a few countries (Figure 6.2). Availability of guidelines and databases on poisoning cases is another common weakness across most regions that demands urgent attention. Also, laboratory capacity is essential for pesticide quality control, but is lacking from many countries.

Furthermore, monitoring and enforcement of pesticide legislation are weak in more than half of the countries. Pesticide registration is another area of concern, because of missing guidelines and limited human capacity in the majority of countries.

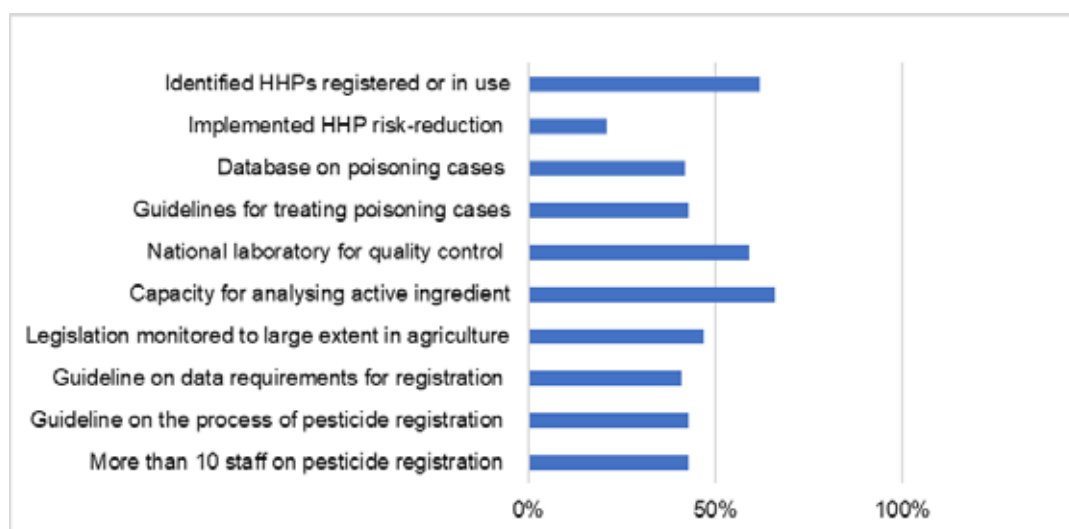


Figure 6.2 Summarized results of some key aspects of pesticide regulation. Presented is the percentage of positive responses from countries across all regions.

Pesticide management in agriculture

Some strengths in pesticide management in agriculture are that the Code of Conduct is reported to be widely used, and most countries apply customs control over pesticide imports (Figure 6.3). However, only a few countries collect data on environmental contamination, or have a system to monitor residues in the environment, suggesting that the environmental effects of pesticides deserve more attention in advocacy efforts. Substandard products are a major concern. Several other weaknesses are the lack resources to manage pesticide resistance in agriculture; the lack of a system to collect empty pesticide containers; and the lack of use of PPE to protect those applying pesticides in agriculture.

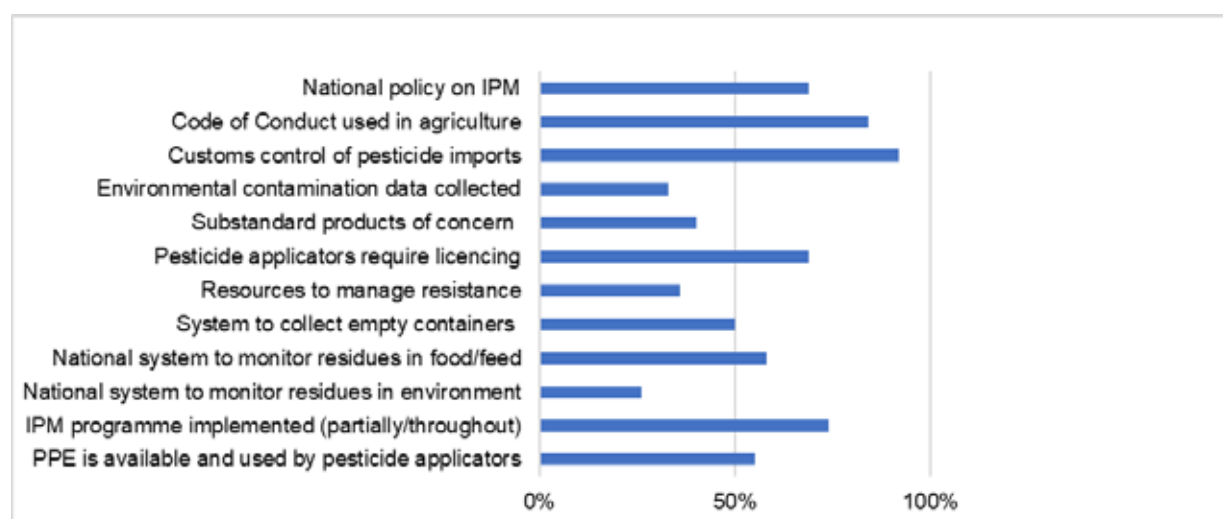


Figure 6.3 Summarized results of some key aspects of pesticide management in agriculture. Presented is the percentage of positive responses from countries across all regions.

Pesticide management for vector control in public health

Some strengths in pesticide management for vector control are that most countries now have a national vector control unit, to facilitate the efficient use of resources across vector-borne disease control programmes; and most countries reportedly consider insecticide susceptibility and the international chemicals conventions when procuring pesticides for vector control (Figure 6.4).

However, an important weakness is that a national strategy for IRM is still lacking from most countries. Also, various vital aspects of pesticide procurement, including guidance and requirements for public tenders and quality control, are lacking from many countries.

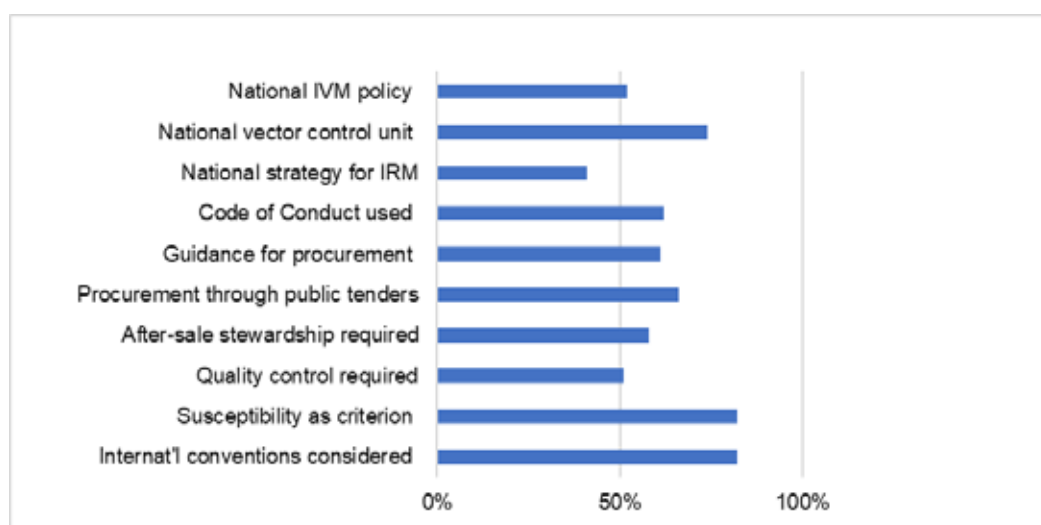


Figure 6.4 Summarized results of some key aspects of vector control policy and procurement of vector control pesticides. Presented is the percentage of positive responses from countries across all regions.

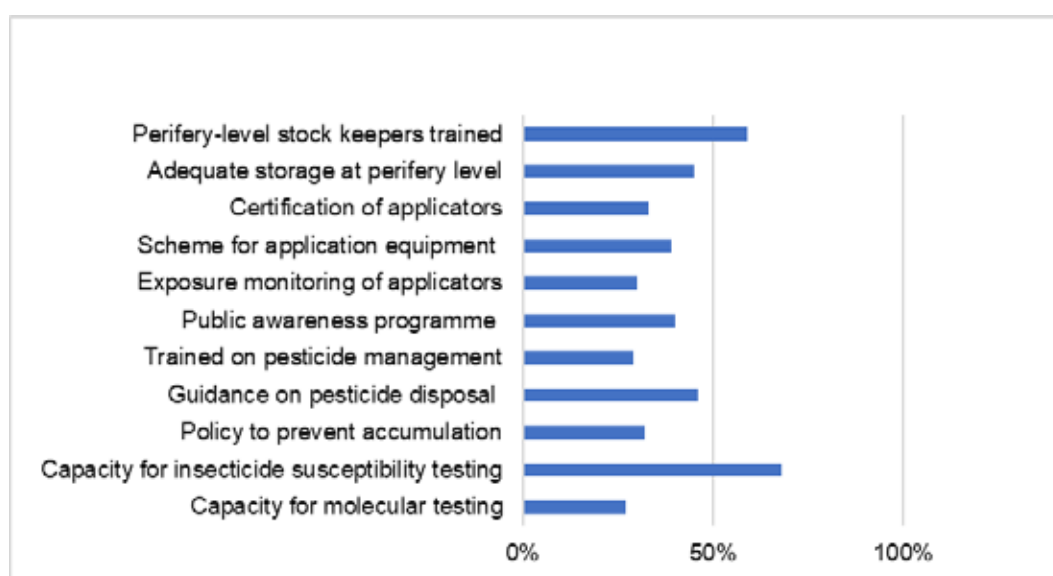


Figure 6.5 Summarized results of some key aspects of pesticide management in vector control. Presented is the percentage of positive responses from countries across all regions.

Moreover, a number of weaknesses are evident in the management practices of vector control pesticides (Figure 6.5). These weaknesses include pesticide storage; certification of applicators; quality control of application equipment; exposure monitoring; training; and disposal. The long list of weaknesses highlights the importance of prioritizing pesticide management in public health.

6.2. Regional differences

The regions demonstrated differences in various aspects of pesticide legislation and management. To summarize the regional differences with respect to parts I, II and III of the questionnaire, 10 quality indicators were identified from each part, as described in Annex 2. The average scores across the 10 indicators were calculated for each region, as presented in Table 6.1.

Table 6.1 Average score (0–10) for each of the three parts of the questionnaire, by region. Scores are based on 10 indicators identified for Part I, Part II and Part III of the questionnaire (see Annex 2).

Part of questionnaire	African	Americas	E.Mediterr'n	European	S-E.Asia	W.Pacific
I Pesticide legislation and regulation	4.3	6.1	5.7	7.4	5.5	6.7
II Pesticide management in agriculture	3.2	5.6	4.4	8.1	5.8	5.2
III Pesticide management for vector control	5.8	5.0	5.5	3.0	5.1	5.9

These summarized results show conspicuous differences between regions for pesticide regulatory control. The African Region scored lowest, followed by the South-East Asia and Eastern Mediterranean regions.

Pesticide management in agriculture scored lowest in the African Region, followed by the Eastern Mediterranean Region. The European Region scored highest.

Regarding pesticide management for vector control, a different pattern is evident. The African Region scored among the highest, which may be attributable to recent investment in vector control in the context of malaria control and elimination. Conversely, the European Region scored lowest, despite the recent threat of invasive mosquitoes that can transmit a number of vector-borne diseases.

6.3. Limitations of the study

The study had several limitations. The focal points to which the questionnaires were addressed, and those who completed each part of the questionnaire, may not have had access to information regarding all questions.

Another limitation was the response rate, particularly for Part I (29%) and Part II (27%) of the questionnaire; Part III had a higher response rate (48%). The main question is whether

these responses provide a representative sample for the situation in the targeted countries globally. Two general observations could be made in this respect. First, all targeted regions were represented in the sample, although some regions were better represented than others. Secondly, there are no indications of a clear reporting bias in the responses, for example, when countries with poor pesticide management practices were more likely to respond than countries with good pesticide management practices, or vice versa.

However, one factor that contributed to a low response rate in some regions was language, since the questionnaire was translated only into English, French and Spanish, which may explain the low response rate among Russian-speaking countries from the European Region.

As regards the human population, the countries responding to parts I, II and III of the questionnaire represented 46%, 45% and 77%, respectively, of the total targeted population (i.e. 7.43 billion). This suggests that the responses have a reasonable to good coverage of the global population.

7. Conclusions

This global survey has generated contemporary information about the multi-faceted subject of pesticide management, which has been a largely neglected subject in agricultural and public health programmes in which pesticides are used.

Pesticide legislation is found, to some degree, in most countries across the world, but the comprehensiveness of legislation varies greatly between countries. Notably, in 40% of responding countries, legislation does not cover public health pesticides, and 65% of responding countries lack provisions for HHPs. Also, there are important gaps across the regions in terms of legal provisions for safe licencing, storage, transport and disposal of pesticides.

Many countries lack guidelines and sufficient capacity for the arduous task of pesticide registration, particularly in low-income countries and in small countries (e.g. Small Island Developing States, or SIDS). However, regional collaboration on registration was widely reported from some regions. Technical capacity and sound legal basis for pesticide quality control is another concern. The FAO toolkit for pesticide registration is starting to play an important supportive role for pesticide registrars, particularly among low- and middle-income countries.

Most countries in the African Region lack a national pesticide laboratory and adequate capacity for pesticide analysis. Pesticide imports for emergencies bypass quality control in many countries, particularly for donated pesticides.

Pesticide retail and advertising remain unregulated in a significant fraction of countries, particularly in the African and Eastern Mediterranean regions; and substandard pesticide products are readily available to the public in 40% of responding countries worldwide. Compliance monitoring and enforcement of pesticide legislation are considered inadequate in half of the responding countries, particularly in the African Region. Moreover, there are major shortcomings in addressing pesticide poisoning cases across all regions, but particularly in the African and Eastern Mediterranean regions.

In agriculture, national policy on IPM is somewhat common among countries, but implementation of IPM is mostly restricted to specific locations only. In two-thirds of countries, agriculture faces major problems with pesticide resistance, but many countries lack adequate resources to manage resistance. Availability and use of PPE are a serious concern in many countries, particularly in tropical climates. Moreover, disposal of agricultural pesticide waste and empty containers is inadequately addressed in most countries.

A system for monitoring pesticide residues in food and feed items is common in most regions, but residues in the environment are less commonly monitored among responding countries. Most countries recognize MRLs provided by the Codex Alimentarius, but many higher-income countries also have developed their own MRLs. The majority of countries lack a

monitoring system of environmental contamination, despite extensive reporting of significant incidents of environmental contamination with pesticides.

Regarding vector control in public health, a national IVM policy exists in half of the countries. In most countries with the policy, IVM is reportedly implemented, which contradicts recent reports stating that the uptake of IVM has been poor. Moreover, a national vector control unit, as a coordinating mechanism between disease-specific programmes, exists in three-quarters of all countries.

Disease vectors are increasingly becoming resistant to available insecticide products. Capacity for insecticide resistance monitoring is highest in the African Region – following recent capacity-building efforts for malaria control – and is lowest in the European Region. A strategy for insecticide resistance management is still lacking in 60% of responding countries.

Procurement procedures are critical to acquiring vector control pesticides in an effective and transparent manner. Many countries still lack a guidance document on procurement. Yet, most countries are using insecticide susceptibility and residual period as criteria for pesticide selection. Procurement is mostly through public tenders and includes quality standards, but when procurement is by other agencies, these standards are less commonly used. After-sale stewardship commitments and quality control are requirements of procurement in just over half of the countries. Many countries have difficulties estimating procurement amounts for vector control, particularly for emergencies.

Most countries lack schemes for certification of vector control pesticide applicators, schemes for monitoring of pesticide exposure by applicators, as well as schemes for quality control of application equipment. Moreover, safe storage of vector control pesticides is deficient in many countries, particularly at periphery level for supply of operations, while many countries also lack trained storekeepers and procedures for safe pesticide transport. As for agricultural pesticides, the disposal of vector control pesticides and empty containers is inadequately addressed in most countries. These numerous shortcomings may partly result from poor awareness about pesticide risks, because important gaps are evident in training on vector control and pesticide management among decision-makers and implementors of vector control activities.

Despite the low to moderate response rates for parts I (29%), II (27%) and III (48%) of the questionnaire, the responses are considered to provide a reasonable to good sample representing the global situation. Nevertheless, Russian-speaking countries and countries without offices of FAO and WHO were under-represented in the sample.

8. Recommendations

To countries:

- a. Countries, particularly developing countries, are urged to revisit their legal framework for pesticide management, to ensure that public health pesticides, biopesticides and highly hazardous pesticides (HHPs) are covered by legislation. This may require an intersectoral approach. Also, care should be taken that legislation includes provisions for all stages of the pesticide life cycle, including implementing legislation on registration, licensing schemes and retail control mechanisms, advertising, safe storage, transport and disposal of pesticides.
- b. Countries with limited human capacity for pesticide registration should consider establishing or strengthening (sub-)regional collaboration, where applicable, to share their registration procedures, data and decisions.
- c. Countries should establish adequate mechanisms to protect and monitor the health of pesticide applicators, and to monitor pesticide residues in food or feed and in the environment.
- d. In agriculture, extension services should be reinforced to provide training to farmers on the implementation of IPM and, where applicable, on the use of personal protective equipment.

To funding agencies:

- e. Funding agencies should provide donor or lending support for programmes on agriculture, and disease vector control should incorporate commensurate investment in training and capacity strengthening on good practices of pesticide management.
- f. To support pesticide quality control, investment is urgently needed to establish pesticide laboratories and capacity for pesticide analysis, particularly in the African Region.

To WHO and FAO:

- g. Situation analysis should be conducted in selected countries to monitor progress and to provide lessons learnt.
- h. Strategies to enhance pesticide management should be tested and implemented at regional and country level, drawing on recent experiences (34).
- i. The critical importance of sound pesticide management must be advocated, to reduce risks of pesticides to human health and the environment.
- j. Contemporary information and data regarding the situation of pesticide use and pesticide management should be published.
- k. UN interagency collaboration and coordination should be reinforced for all activities to strengthen pesticide management.

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Annex 1 Details of responding countries

WHO Region	Country	Population (mln)	GDP per capita PPP*	Questionnaire responses received			
				PART I	PART II	PART III	Total
African	Botswana	2.25	17,354	1	1		2
	Burkina Faso	18.65	1,870	1	1		2
	Cabo Verde	0.54	6,831	1	1	1	3
	Cameroon	23.44	3,694	1	1	1	3
	Chad	14.45	1,941	1			1
	Congo	5.13	5,359			1	1
	Congo (DR)	78.74	887	1	1	1	3
	Eritrea	4.96	1,510	1	1	1	3
	Eswatini	1.34	8,496		1	1	2
	Ethiopia	102.40	1,899			1	1
	Gambia	2.04	1,715	1	1		2
	Ghana	28.21	4,641			1	1
	Guinea	12.40	2,195	1	1		2
	Guinea-Bissau	1.82	1,700	1	1		2
	Kenya	48.46	3,286			1	1
	Lesotho	2.20	3,130	1	1	1	3
	Liberia	4.61	826			1	1
	Madagascar	24.90	1,555	1	1		2
	Malawi	18.09	1,202	1		1	2
	Mali	18.00	2,211	1	1		2
	Mauritania	4.30	3,950	1		1	2
	Mozambique	28.83	1,247			1	1
	Namibia	2.48	10,476	1	1	1	3
	Niger	20.67	1,017	1	1		2
	Nigeria	185.99	5,861			1	1
	Senegal	15.41	2,712			1	1
	Seychelles	0.09	28,964			1	1
	Sierra Leone	7.40	1,526			1	1
	Togo	7.61	1,570	1	1		2
	Tanzania (UR)	55.57	2,946			1	1
	Uganda	41.49	1,864	1	1	1	3
	Zambia	16.59	4,050			1	1
	Zimbabwe	16.15	2,086	1		1	2
Americas	Antigua and Barbuda	0.10	23,594			1	1
	Argentina	43.85	20,787	1	1		2
	Bahamas	0.39	30,430			1	1
	Belize	0.37	8,590			1	1
	Bolivia (PS)	10.89	7,560	1	1		2
	Brazil	207.65	15,484			1	1
	Canada	36.29	46,705	1	1	1	3
	Chile	17.91	24,635	1	1	1	3
	Colombia	48.65	14,552			1	1

WHO Region	Country	Population (mln)	GDP per capita PPP*	Questionnaire responses received			
				PART I	PART II	PART III	Total
Americas	Costa Rica	4.86	17,044			1	1
	Cuba	11.48	21,409			1	1
	Ecuador	16.39	11,617	1	1	1	3
	El Salvador	6.35	8,006	1	1	1	3
	Grenada	0.11	14,924			1	1
	Guatemala	16.58	8,150			1	1
	Guyana	0.77	8,163	1	1	1	3
	Haiti	10.85	1,815			1	1
	Honduras	9.11	4,986			1	1
	Jamaica	2.88	8,995			1	1
	Mexico	127.54	18,258			1	1
	Nicaragua	6.15	5,842			1	1
	Panama	4.03	24,446			1	1
	Paraguay	6.73	9,691	1	1	1	3
	Peru	31.77	13,434			1	1
	Suriname	0.56	15,114			1	1
	Trinidad and Tobago	1.37	31,578			1	1
	USA	322.18	59,532	1	1	1	3
	Uruguay	3.44	22,562	1	1	1	3
	Venezuela (BR)	31.57	17,640			1	1
Eastern	Afghanistan	34.66	1,981			1	1
Mediterranean	Bahrain	1.43	47,527			1	1
	Egypt	95.69	11,583	1	1	1	3
	Iran (IR)	80.28	20,950			1	1
	Iraq	37.20	17,197	1	1	1	3
	Jordan	9.46	9,153			1	1
	Kuwait	4.05	71,943			1	1
	Lebanon	6.01	14,676	1	1	1	3
	Libya	6.29	19,631			1	1
	Morocco	35.28	8,217	1	1	1	3
	Oman	4.43	41,675	1		1	2
	Pakistan	193.20	5,527			1	1
	Qatar	2.57	128,378			1	1
	Saudi Arabia	32.28	53,845	1	1	1	3
	Somalia	14.32	541	1	1	1	3
	Sudan	39.58	4,904			1	1
	Syrian (AR)	18.43	1,100	1	1	1	3
	Tunisia	11.40	11,911	1	1	1	3
	Yemen	27.58	1,595			1	1
European	Cyprus	1.17	34,503			1	1
	Estonia	1.31	31,742			1	1
	Germany	81.92	50,639	1	1		2

WHO Region	Country	Population (mln)	GDP per capita PPP*	Questionnaire responses received			
				PART I	PART II	PART III	Total
	Hungary	9.75	28,108			1	1
	Ireland	4.73	75,648	1	1	1	3
	Italy	59.43	39,427	1	1	1	3
	Malta	0.43	39,535			1	1
	Montenegro	0.63	18,765			1	1
	Poland	38.22	29,026			1	1
	Sweden	9.84	50,208	1	1		2
	Tajikistan	8.74	3,180	1	1		2
	Turkey	79.51	26,505	1	1		2
	United Kingdom	65.79	43,269	1	1		2
South-East Asia	Bangladesh	162.95	3,869			1	1
	Korea (DPR)	25.37	1,700			1	1
	India	1,324.17	7,056			1	1
	Indonesia	261.12	12,284	1	1		2
	Maldives	0.43	16,669	1	1	1	3
	Myanmar	52.89	6,139	1	1	1	3
	Nepal	28.98	2,682			1	1
	Sri Lanka	20.80	12,811			1	1
	Thailand	68.86	17,871	1	1	1	3
	Australia	24.13	48,460	1	1		2
Western Pacific	Brunei Darussalam	0.42	78,836			1	1
	Cambodia	15.76	4,002			1	1
	China	1,411.42	16,807	1	1	1	3
	Cook Islands	0.02	16,700	1	1		2
	Japan	127.75	43,279	1	1		2
	Malaysia	31.19	29,431			1	1
	Philippines	103.32	8,343	1	1	1	3
	Singapore	5.62	93,905	1	1	1	3
	Solomon Islands	0.60	2,422			1	1
	Vanuatu	0.27	3,208			1	1
	Viet Nam	94.57	6,776			1	1
Total		6,572.21		56	52	94	115

* GDP per capita, PPP (2017 international \$) (World Bank, 2019)

Annex 2 Selected indicators

- | | |
|----------|---|
| Part I | <ol style="list-style-type: none">1 Pesticide legislation in place2 PHPs covered by legislation3 Legislation on labelling of agricultural pesticides4 Legislation on disposal of all obsolete pesticides5 Legislation on retailers of all pesticides6 Database on poisoning cases7 National laboratory for quality control8 Legislation monitored to large extent (agriculture)9 Guideline on the process of pesticide registration10 More than 10 staff on pesticide registration |
| Part II | <ol style="list-style-type: none">1 National policy on IPM2 Contamination data collected3 Substandard products of concern4 Applicators require licencing5 Resources to manage resistance6 System to collect empty containers7 System to monitor residues in food/feed8 System to monitor residues in environment9 IPM programme implemented (part/throughout)10 PPE is available and used by pesticide applicators |
| Part III | <ol style="list-style-type: none">1 National IVM policy2 National vector control unit3 National strategy for IRM4 Guidance for procurement5 Susceptibility as criterion6 Adequate storage at periphery level7 Scheme for application equipment8 Trained on pesticide management9 Guidance on pesticide disposal10 Capacity for insecticide susceptibility testing |

