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Food and Agriculture
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International Code of Conduct on Pesticide Management

Guidance on management of household pesticides



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World Health Organization
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International Code of Conduct on Pesticide Management: guidance on management of household pesticides

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The Inter-Organisation Programme for the Sound Management of Chemicals (IOMC) was established in 1995 following recommendations made by the 1992 UN Conference on Environment and Development to strengthen cooperation and increase international coordination in the field of chemical safety. The participating organizations are the Food and Agriculture Organization of the United Nations (FAO), the International Labour Organization (ILO), the Organisation for Economic Co-operation and Development (OECD), the United Nations Environment Programme (UNEP), the United Nations Industrial Development Organization (UNIDO), the United Nations Institute for Training and Research (UNITAR) and the World Health Organization (WHO).

The World Bank and the United Nations Development Programme (UNDP) are observers. The purpose of the IOMC is to promote coordination of the policies and activities pursued by the participating organizations, jointly or separately, to achieve the sound management of chemicals in relation to human health and the environment.

This publication was developed in the IOMC context. The contents do not necessarily reflect the views or stated policies of individual IOMC participating organizations.

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Foreword

This guidance is intended to help government authorities reduce the risks associated with the use of household pesticides – i.e. pest control products used in domestic settings – by non-professionals. The guidance focuses on strengthening the regulation and oversight of household pesticides and on educating the general public about effective pest and pesticide management in and around the home. The guidance is designed primarily for use by government authorities in charge of pesticide management and risk reduction but may also be useful to the pesticide industry and nongovernmental organizations.

The guidance adopts the FAO/WHO tiered approach in pesticide risk reduction outlined in the *FAO Guidance on pest and pesticide management policy development* (FAO, 2010). The approach comprises three main steps:

1. Reduce reliance on pesticides. Determine to what extent current levels of pesticide use are actually needed. Make optimum use of non-chemical pest management and eliminate unjustified pesticide use.
2. Select pesticides with the lowest risk. If use of pesticides is deemed necessary, select products with the lowest risk to human health and the environment from the available registered products that are effective against the pest or disease.
3. Ensure proper use of the selected products for approved applications and in compliance with international standards.

The guidance begins with steps 2 and 3, as it is intended to focus primarily on pesticide (and not pest) management. However, governments are encouraged to give high priority to step 1, addressed in the last section of the guidance – **reduce reliance on pesticides by preventing pest outbreaks**. This is where pest control should begin.

This guidance was prepared with the support of the [FAO/WHO Joint Meeting on Pesticide Management](#) (JMPM), which advises the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) in producing guidance to promote compliance with the International Code of Conduct on Pesticide Management. The document was peer reviewed by experts of the Working Groups on Biocides and Pesticides of the Organisation for Economic Co-operation and Development (OECD), and their contribution is gratefully acknowledged.

The internationally recognized “Code of Conduct” sets out a framework and voluntary standards of conduct for stakeholders in pesticide management, in particular governments and the pesticide industry. Endorsed by FAO, WHO, governments, pesticide producers, nongovernmental organizations and other stakeholders, the Code of Conduct emphasizes these stakeholders’ shared responsibility in promoting best practice and risk reduction throughout the pesticide life cycle. The Code of Conduct thereby establishes the commitment and moral obligation of the stakeholders to comply with the agreed standards of conduct and to assume

their respective responsibilities. This includes governments' responsibility to promote pesticide risk reduction and industry's responsibility to produce products that are adapted to the context of their use and to provide stewardship for those products throughout their life cycle.

FAO and WHO welcome readers' feedback

FAO and WHO consider that this guidance is a living document that could be improved. They therefore value any feedback from readers and welcome comments. They also value examples of how the guidance is used.

Please send your suggestions, comments and examples to pesticide-management@fao.org indicating the title of the guidance and the relevant section and page.

Abbreviations and acronyms

ECHA	European Chemicals Agency
EFSA	European Food Safety Authority
FAO	Food and Agriculture Organization of the United Nations
GHS	Globally Harmonized System of Classification and Labelling of Chemicals
HIC	high-income country
LMIC	low- and middle-income country
OECD	Organisation for Economic Co-operation and Development
ONIP	OECD Network on Illegal Trade of Pesticides
PPE	personal protective equipment
WHO	World Health Organization

1. Introduction

The use of household pesticides to control pests and disease vectors in homes and gardens is common in high-income countries (HICs) and is increasing in low- and middle-income countries (LMICs), where such pesticides are often sold in local shops and informal markets for use by the general public. The human and environmental risks from the use of these products should not be underestimated. The incorrect use and improper storage and disposal of household pesticides, often due to the absence of any training in pesticide use or risks as well as poor understanding of label information, results in many poisoning and self-harm incidents every year.

A number of factors increase the risks associated with the use of household pesticides. Principal among these are: the lack of regulation and control of household pesticides in many countries; the ready availability of household pesticides as over-the-counter products sold to the general public without advice; and the frequent lack of awareness among those who apply household pesticides – in close proximity to other members of the household – that the products can be toxic to people, to domestic pets and to beneficial organisms such as bees, birds and other wildlife found around homes. Very often, the situation is that:

- Label instructions are poorly read, and – if understood at all – are not always followed. This may be because the user is illiterate or simply does not take the time to read the label carefully. But a significant problem is that label instructions are often missing or are only available in foreign languages that are not understood in the countries where the products are placed on the market. The absence of a correct label or failure or inability to read it can result in applying an unsuitable product, using an incorrect amount or application method that results in unsafe exposures, treating at the wrong stage of the pest's life cycle and/or failure to take recommended safety precautions such as storing pesticides away from food in a place that is inaccessible to children and pets.
- Users often apply more than the recommended dose, thinking mistakenly that it will be more effective, or re-apply the product before it is necessary. Sometimes, users apply less than recommended, for monetary reasons or because they did not read the label. The former may increase the human and environmental exposure, while the latter promotes the development of resistance by household pests.
- Users may not be able to find the most suitable product to treat their pest problem, because it is not available in their location. The users may therefore feel obliged to choose a product that is not effective for their specific problem.
- Users often choose household pesticides as a “quick fix” rather than investigating the cause and eliminating the conditions – such as food and water sources – that allowed the pest problem to develop. In addition, users often fail to consider non-chemical methods of pest control that reduce or eliminate the need for a pesticide. This results in

a cycle of recurring infestation and retreatment and contributes to the development of pest resistance in target species as well as to health and environmental risks.

- Household pesticides are often stored for long periods of time as they are only partially used. Many users are unaware of expiration dates and that the product could be ineffective or more toxic.

2. Objectives and targeted audience

The objectives of this guidance are to help government authorities improve the management of household pesticides and reduce the risks associated with their use by:

- strengthening the regulation and oversight of registered products, which includes promoting adherence with label directions;
- encouraging pesticide producers to make labels easier to understand and to develop effective low-risk household products that are adapted to use by non-professionals; and
- educating the general public to increase public confidence and awareness of effective pest prevention and management in and around the home, beginning with use of nonchemical methods that can eliminate or reduce the need for pesticides and only afterwards with correct use and storage of household pesticides should they be needed.

The guidance is directed primarily at pesticide regulatory authorities that do not have legislation and regulations in place for household pesticides, but those who do are encouraged to confirm that their pesticide policies and programmes support the same objectives.

3. Scope

This guidance addresses the non-professional use of household pesticides by the general public, that is, by individuals who receive no fee or reward for the pesticide application and who generally have no training in pesticide use or in pest management. The guidance does not cover pesticide use in domestic settings by professional pest control operators, which is addressed in separate WHO guidelines (e.g. WHO, 2003; WHO, 2006; WHO, 2007).

This guidance defines “household pesticides” as pest control products that are intended for use in and around the home, including public health pesticides (identified in the European Union as “biocides”¹) and garden pesticides. The types of products included in this definition vary from country to country, but they generally include insecticides, herbicides, miticides, termiticides, rodenticides, fungicides and molluscicides; they may also include insect repellents and disinfectants.

Household pesticides are commonly used indoors to control pests such as ants, cockroaches, houseflies, mosquitoes, fleas, ticks, bedbugs, termites, rodents, mites and microbes. They are commonly used outdoors, in ornamental and kitchen gardens and on terraces and patios, to control weeds, plant diseases, insect pests and other garden pests such as snails and slugs. In some countries, products used for disinfection of household water and surfaces, e.g. in swimming pools and spas or during floods or epidemics, may also be regulated as pesticides.

Household pesticide products come in a variety of forms including sprays, dusts, powders, baits, granules, mosquito coils, mats and heated liquid dispensers, smoke generators, flea and tick control products, pest strips, pet collars and ointments. Household pesticides may contain one or a combination of active ingredients of synthetic (chemical) or natural (plant or microorganism) origin.

All such products that are classified and regulated as pesticides nationally or regionally are covered by this guidance, except for: long-lasting insecticidal nets, which are covered by WHO guidance on vector control; antibiotics used for human and animal health that are not considered to be pesticides; and products applied to human or animal skin that are regulated as medicines or veterinary products.

¹ See <https://echa.europa.eu/regulations/biocidal-products-regulation/product-types>

4. Resources

The FAO/WHO resources listed below provide detailed instructions and advice to complement this guidance.

Pesticide registration toolkit

The FAO [*Pesticide registration toolkit*](#) (FAO, 2013; [FAO webpage](#) updated regularly) is an electronic tool to support government pesticide regulatory agencies in the day-to-day work of pesticide registration. Created in response to governments' demand for a practical, user-friendly and easily-accessible resource, the toolkit provides:

- an introduction to pesticide registration and regulation;
- lists of recommended data requirements for different types and uses of pesticides;
- links to the *Globally Harmonized System (GHS) of classification and labelling of chemicals* (UNECE, 2015) and other hazard classification systems such as the *WHO recommended classification of pesticides by hazard* (WHO, 2019a);
- modules for evaluating pesticide test data and conducting risk assessments;
- registration strategies that can be used depending on a country's resources;
- practical information on individual pesticides that can support a country review, including test results and conclusions, hazard classifications, scientific reviews, approved labels, and the status of pesticide registrations in other countries and regions;
- special sections on highly hazardous and public health pesticides; and
- links to technical guidelines and other resources.

The toolkit contains step-by-step instructions for users, and training sessions are organized periodically.

Technical guidelines

A series of more than 30 FAO/WHO technical guidelines on pesticide management has been published to assist government authorities in pesticide management. These guidelines explain the different steps in pesticide registration and regulation at all stages of the pesticide life cycle, provide examples of what others have done and address practical issues such as work sharing, regional cooperation and funding of pesticide regulation.

The current guidance does not repeat the detailed information and instructions in the toolkit and the technical guidelines, but highlights key considerations for household pesticides and directs

readers to the relevant resources. The latter are listed in the References section of this document and are available also on the following FAO and WHO websites:

<http://www.fao.org/agriculture/crops/thematic-sitemap/theme/pests/code/list-guide-new/en>

https://www.who.int/neglected_diseases/vector_ecology/pesticide-management/who_fao_guidelines/en/

The FAO/WHO [publication](#) *Managing pesticides in agriculture and public health: an overview of FAO and WHO guidelines and other resources* (FAO/WHO, 2019) provides an overview of these technical guidelines.

5. Regulation of household pesticides

5.1. Legislation

Household pesticides should be addressed in national pesticide legislation along with other pesticides and pesticide uses.

The legislation should set out the country's institutional framework and procedures for pesticide management. It should make household pesticide registration and regulation mandatory, and it should address the entire pesticide life cycle.

The FAO/WHO *Guidelines on pesticide legislation* (FAO/WHO, 2015a) provide instructions for drafting or revising national legislation.

The starting point for improving the management of household pesticides is to ensure they are addressed specifically under national pesticide legislation along with other pesticides and pesticide uses. The legislation should require product evaluation, registration and quality control, and should encompass management of the entire pesticide life cycle, including manufacturing, formulation, packaging, distribution, sale, storage, use, and disposal of leftover products and containers.

Countries wishing to develop new legislation that addresses household pesticides or to revise their existing pesticide legislation to better address household products are encouraged to consult the FAO/WHO *Guidelines on pesticide legislation* (FAO/WHO, 2015a) for detailed instructions for governments on how to draft or revise national legislation for the management of all pesticides. Of particular relevance to household pesticides is the discussion of criteria to be considered when reviewing a pesticide registration application. These criteria include, for example:

- risk factors associated with the expected conditions of use;
- hazards and risks to public health with special attention to vulnerable groups;
- the existence of lower-risk alternatives;
- the development of pest resistance; and
- packaging and labelling.

The guidelines also address the institutional structure needed to coordinate pesticide management in a country, notably when different authorities or services are involved. The guidelines stress the importance of having a law in place to make pesticide registration and

regulation mandatory, and they explain how to link the different sections of the law to national pesticide policies and regulatory programmes.

Some countries may face the following challenges in the regulation of household pesticides:

- More than one national law may apply to household pesticides – for example, a law for public health pesticides and another for plant protection (agricultural, horticultural and garden) pesticides.
- More than one regulatory authority may be responsible for applying the law or laws – for example, both the health and the agricultural and/or environmental ministries.
- It may not be clear which government authority is responsible and which regulatory system applies to pesticides that are registered both for professional use (e.g. in agriculture or in vector control by a professional service) and for household use by non-professionals.
- The regulatory systems already in place may fail to consider the real-life context, in which pesticides may be applied by untrained individuals without the label-specified equipment or personal protection.

To address these challenges, countries should:

- clearly identify the responsibilities of the different authorities and services that are responsible for implementing the national pesticide law or laws, and require them to work together or create one overarching pesticide control body. This will clarify the regulatory situation and make it easier for all concerned; and
- ensure that similar health and environmental protection objectives are applied under the different laws, if more than one address household pesticides.

5.2. Registration

Household pesticides should be registered like other pesticides before they are placed on the market. If not registered for non-professional use, a pesticide should be considered “banned” for use by non-professionals.

FAO/WHO resources guide governments step-by-step through the registration process, from the receipt of an application for pesticide registration to the evaluation of the data and the decision to accept or refuse the registration. The resources explain how to create, run and fund a registration programme, including through work-sharing or phased implementation if resources are limited.

Like other pesticides, household pesticides should be registered in the country of their use before they are allowed to be sold. Registration is the fundamental basis for pesticide management. It is the process whereby the relevant national or regional authority decides whether or not to approve the sale and use of a pesticide after evaluating comprehensive test data demonstrating that the product is effective for its intended purposes and does not pose an unacceptable risk to human or animal health or to the environment under conditions of use in the country or region. Registration enables government authorities to exercise control over the quality, use, claims of effectiveness, labelling, packaging and advertising of pesticides.

Registration should be an ongoing process, involving not only first-time product approvals but also regular or unscheduled reviews of already registered pesticides to determine whether they still meet the requirements, for instance after new information has become available or when criteria are adjusted. In addition, registration should be specifically adapted to the anticipated conditions of product use. The registration process for household pesticides should consider, in addition to the usual criteria for pesticides used by professionals:

- how these products are registered in other countries regionally and globally (i.e. reviewing risk assessment summary data from other countries);
- the ability of users to read and understand product labels, notably directions for correct use and disposal, and precautions to be taken;
- local weather conditions that could affect the dispersal of the pesticide in the environment or the wearing of work clothing such as long sleeves, long trousers, gloves, socks and shoes;
- whether products can be used safely by untrained individuals or should be restricted to use by professional operators, e.g. because of higher toxicity, likelihood of exposure, the need to apply risk mitigation measures, or the need for special application equipment or special personal protective equipment (PPE) such as coveralls, face shields or masks;
- where the products will be sold and if legislation includes requirements on access and placement of these products (e.g. not next to foodstuffs or available to children);
- the use of multiple household pesticides in a closed environment and the impact of multiple exposures to different active ingredients (e.g. the synergistic or additive effects);
- the level of resistance of target pest populations to certain active ingredients (as the general public is not expected to recognize a developing or already existing resistance phenomenon and, furthermore, is likely to apply an incorrect dose);
- whether proper disposal of leftover product and packaging (as hazardous waste) is feasible for the general public; and
- the availability of safer pest control alternatives, including non-chemical alternatives and preventive measures.

FAO/WHO resources for pesticide registration

The most all-encompassing tool for pesticide registration is the web-based FAO *Pesticide registration toolkit* (FAO, 2013) described above. The following guidelines provide detail in specific areas:

- *Guidelines for the registration of pesticides* (FAO/WHO, 2010a)
- *Guidelines on data requirements for the registration of pesticides* (FAO/WHO, 2013)
- *Revised guidelines on environmental criteria for the registration of pesticides* (FAO, 1989)
- *Guidelines for the registration of microbial, botanical and semiochemical pest control agents for plant protection and public health uses* (FAO/WHO, 2017)
- *Guidelines on highly hazardous pesticides* (FAO/WHO, 2016)
- *WHO generic risk assessment models for:*
 - *insecticides used for larviciding and mollusciciding* (WHO, 2010a)
 - *indoor and outdoor space spraying of insecticides* (WHO, 2018a)
 - *indoor residual spraying of insecticides* (WHO, 2018b)
 - *insecticide-treated clothing, skin-applied repellents and household insecticides* (WHO, 2019b)

5.2.1. *Evaluating the risks of household pesticides*

A conservative, protective approach should be followed in assessing the health and environmental risks associated with the use of household pesticides. Both active ingredients and formulated products should be assessed. Risks to vulnerable populations should always be considered.

Human health risk assessment

Hazard assessment

The human health risk assessment of a pesticide begins with a hazard assessment that addresses the potential toxic effects on human health of both the active ingredient(s) and the end-use product or formulation. A hazard assessment of the active ingredient alone is not sufficient, because inert ingredients, synergists and other components (e.g. solvents), collectively referred to as co-formulants, may contribute to the product's toxicity.

In addition, the hazard assessment must consider both acute and chronic effects, as adverse effects of pesticide exposure may occur soon after a single exposure (acute effects) or gradually after repeated low- or high-dose exposures over a period of time (chronic effects).

Acute effects may include eye, nose and/or throat irritation, allergic reactions, skin irritation, headache, dizziness, muscular weakness, nausea, vomiting, stomach cramps, diarrhoea, blurred vision, sweating, salivation, a tingling sensation, respiratory symptoms and, in some cases, muscle twitching. **Chronic effects** may include damage to the liver or kidneys, to the endocrine, reproductive, immune, metabolic and/or nervous systems and cancer. In addition, genotoxic and mutagenic effects may occur. Symptoms may occur gradually after repeated exposure over a period of time.

Exposure assessment

The human exposure assessment focuses on how a person could come into contact with the pesticide, for example through inhalation or ingestion or through dermal or ocular exposure. As defined in the WHO *Human health risk assessment toolkit: chemical hazards* (WHO, 2010b), the assessment is used to determine whether people are in contact with a potentially hazardous chemical and, if so, to how much, by what route, through what media and for how long.

Levels of exposure to household pesticides generally depend on whether products are used inside the home or in open or outdoor areas such as gardens and verandas. Pesticides break down more slowly indoors than outdoors where they are exposed to sunlight and to microorganisms in soil and water. Indoor exposure can therefore be much higher, as pesticide dust or spray droplets may remain for some time in the air and on floors, furniture and other surfaces and objects. Exposure can occur:

- through the mouth, by consuming contaminated food or drink, licking contaminated hands or objects, smoking a contaminated cigarette, or touching the mouth, notably in the case of children's hand-to-mouth behaviour;
- through the skin, eyes or mucus membrane, if pesticide spray is deposited on the body or by handling pesticides or touching treated surfaces; and
- by breathing in pesticide aerosols, vapours or powders or contaminated household dust.

The routes of exposure should be assessed as parts of a cumulative value that calculates combined exposure through different routes. Different types of exposure may occur during preparation (mixing and loading of products that are not ready-to-use), treatment, clean-up, or later, when a person comes in contact with product residues on treated objects. The exposure assessment should take account of the fact that the same person will conduct all operations with the product and then stay and live in the treated environment.

Important points to consider for household products to be handled by non-professionals:

- Dermal exposure is the primary route of exposure for most pesticides, including household products. Children playing on the floor where dust or spray droplets are present, and adults touching treated surfaces to prepare food and perform other household tasks, may be repeatedly exposed to residues for several days after the treatment. The level and duration of post-treatment exposure should be addressed in the *exposure assessment*.

- Exposure through inhalation should be carefully evaluated for the indoor use of aerosols, mats, liquid vaporizers, foggers, dust formulations and automatic release indoor insect control systems (which release regular bursts of pesticide mist until the batteries run out). Studies of sub-acute inhalation toxicity of sufficient duration to assess the hazard associated with indoor use should be required for registration of such products. Data on air or surface concentrations in an average room at various times may be needed to assess inhabitants' exposure.
- Exposure through ingestion of contaminated food or children's hand-to-mouth behaviour should be evaluated.
- Targeted studies and exposure scenarios may be needed to assess risks to fragile populations including young children, pregnant and nursing mothers, older individuals, people with compromised health and domestic pets.

Children are especially vulnerable because of developmental, dietary and physiological factors.

Their exposure may be considerably higher than that of adults because of:

- their hand-to-mouth behaviour, e.g. of toys and furniture
- their contact with floors and other surfaces, which may result in ingestion of residues on the items or of contaminated household dust
- their greater intake of food and fluids relative to body weight
- their greater skin-to-body mass ratio and higher breathing rate
- their exposure through contact with the mother while she is handling pesticides or through breastfeeding or during pregnancy.

Pesticide exposure is not always quickly identified as the cause of poisoning or other adverse effects because many symptoms are similar to those of other conditions or illnesses, such as the flu.

Assessment of toxicity, fate and behaviour in the environment

Household pesticides can be toxic to living organisms in a garden, including many that are very useful and might even be natural antagonists to the pests.

The assessment of a pesticide's environmental risks requires an assessment of both acute and chronic effects (hazards) which could be caused by the pesticide and the level of exposure likely to result from the use of the product. An assessment of both the active ingredient(s) and the product formulation is necessary, as not only the active ingredients but also certain co-formulants in products, such as organic propellants, may have adverse effects on nearby flora and fauna and on environmental components such as soil, water and air.

Acute effects of a pesticide on the living environment include the short-term death of organisms that were not targeted by the use of the household pesticide. ***Chronic effects*** can include reduced reproduction rates, effects on the endocrine system, or behavioural changes. As discussed in the *Revised guidelines on environmental criteria for the registration of pesticides* (FAO, 1989), studies may be needed to assess risks to soil macro- and micro-organisms, beneficial arthropods and pollinators, birds and other garden wildlife, and aquatic species, as well as to assess the risk of leaching and ground water contamination.

Pesticides with a long-lasting action should typically not be registered for home and garden use, as they can remain active and harmful in the soil, on the treated surface, or in wells and other water sources for many years. Registration of insecticides for use in gardens is also discouraged, as they are likely to affect bees and other beneficial insects and birds.

The environmental impacts of pesticide use can be devastating both locally and globally, and the assessment should take this into account. One of the most alarming long-term effects of pesticide use, widely acknowledged by scientific and technical experts, is the massive decline in insect populations worldwide and at such significant levels that food protection, dependant on pollination by wild insects, may soon be threatened.

Alternative methods that are safe and effective may be available to control garden pests, and vulnerable plants that are regularly subject to disease and insect invasions can be replaced with ones that are better adapted to local conditions and resistant to the pests and diseases.

Residues of highly persistent pesticides used in the past, such as persistent organic pollutants regulated by the Stockholm Convention, can still be found in the environment today even though most countries phased out their use years or even decades ago. Some of these pesticides were used in households.

Risk assessment resources

Before undertaking an independent national evaluation of a pesticide, governments are encouraged to consult the risk assessment resources available online, notably the *Pesticide registration toolkit* (FAO, 2013) and the *Guidelines on data requirements for the registration of pesticides* (FAO/WHO, 2013). These resources provide: lists of recommended data requirements; generic assessment models; the hazard classification systems of WHO, GHS and other international and national agencies; and links to the pesticide evaluations and, in some cases, the registration reports of other countries and supranational authorities. Support for pesticide assessment is also available online from bodies such as the European Chemicals Agency (ECHA), the European Food Safety Authority (EFSA) and EU-ConsExpo. In addition, governments are encouraged to consult the safety data sheets, from which the most relevant information on pesticide co-formulants can often be extracted.

Governments should be aware that a significant amount of information is required for a reliable human exposure assessment. The intended uses must be clearly described in detail, and the assessment can be complicated and resource intensive. A reasonable alternative for countries with limited resources and capacities may be to refuse the registration of all pesticides for non-professional use that do not have very low toxicity (based, for example, on their hazard classification), and to conduct a simple exposure assessment that uses simple generic models with very conservative parameters to assess human exposure. Only in cases where a risk is identified would additional information be required from the industry to refine the assessment.

Guidance and resources to support the assessment of environmental risks, notably for bees, soil and water, are provided in the Pesticide registration toolkit (FAO, 2013) and the Guidelines on data requirements for the registration of pesticides (FAO/WHO, 2013) and are also available online from EFSA and other sources.

5.2.2. *Decision-making*

The pesticide registration system should ensure that sound decisions are made. Safe use by non-professionals must be demonstrated in the registration dossier.

The decision to approve or deny a registration should be based on the outcome of the product assessment but should also consider the impact of the approval or denial, for example on public health in the case of vector-borne diseases. The ability of untrained users to read and follow pesticide label instructions should be considered. Products requiring protective work clothing that users are unlikely to buy or wear should not be registered.

If there is doubt about a product's short- or long-term safety, the product should not be registered. Where there is no alternative to address a public health imperative, registration should be time-bound and limited until the public health concern is under control. Products with higher toxicity but negligible exposure, e.g. in a sealed ant bait trap, may be considered acceptable for household use, but only on condition that a hazardous waste collection or disposal system is in place that users are aware of and are likely to use when they are ready to dispose of the used pest trap.

Pesticides with certain characteristics should not be registered for use in households by non-professionals, and they should not be available in shops or through the Internet. These include:

- Pesticides that have high acute or chronic toxicity, pesticides that are listed under the Stockholm or Rotterdam Conventions or the Montreal Protocol, and pesticides that would be considered “highly hazardous” as defined by the International Code of Conduct.

- ² *Highly acutely toxic rodenticides for household treatments should be registered only for use by professional pest control operators and not by the general public.*
- Persistent, bio-accumulative and toxic substances, as defined by the European Environmental Bureau, that persist over time (that is, do not break down easily in the environment) and are especially hazardous for human health and ecosystems. *Such products include anticoagulant rodenticides, whose risks include persistence, bioaccumulation, and primary and secondary poisoning of non-target animals.*
- Products that are identified as having medium or high toxicity to bees and other pollinators, as indicated by the test data needed for registration and as identified by recognized authorities (e.g. OECD countries and European agencies). *Such products should not be permitted for garden or outdoor use.*
- Products whose use directions cannot be easily followed by the general public, for example requiring special application methods or equipment.
- Products whose handling and application require the use of special equipment (PPE).³
- Products with high active ingredient content that require dilution. *Only ready-to-use products should be registered for household use.*
- Products already banned in other countries and regions due to human health or environmental risks. The experience and decisions of other countries should be considered a useful reference when evaluating a request for a new registration or re-registration.
- Nano-pesticides, due to the lack of sufficient safety data.
- Products with adjuvants or co-formulants that are of toxicological concern. *Health effects can result not only from active ingredients in household products but also from other ingredients, such as the solvents in aerosols and the pyrolysis products of organic fillers in mosquito coils. In some pesticide products, both active and formulant ingredients are volatile, and use of these products can increase levels of airborne organics inside homes.*
- Dust formulations for outdoor use. *With the exception of lower-risk pesticides, such as diatomaceous earth, dusts should be discouraged due to the risk of drift and environmental contamination, unless the risk assessment shows that human and environmental risks are acceptable and that the label direction and use are appropriate*

² As defined in the International Code of Conduct on Pesticide Management (FAO/WHO, 2014), highly hazardous pesticides are "pesticides that are acknowledged to present particularly high levels of acute or chronic hazards to health or environment according to internationally accepted classification systems such as WHO or GHS or their listing in relevant binding international agreements or conventions. In addition, pesticides that appear to cause severe or irreversible harm to health or the environment under conditions of use in a country may be considered to be and treated as highly hazardous." The *Guidelines on highly hazardous pesticides* (FAO/WHO, 2016) list eight criteria for identifying highly hazardous pesticides.

³ PPE is described in the *FAO/WHO Guidelines for personal protection when handling and applying pesticides* (FAO/WHO, 2020), and the issue is addressed in the International Code of Conduct, article 3.6.

for domestic use. For indoor use in covered locations and crack and crevice treatments, dust formulations may be preferable because of their prolonged residual efficacy against certain pests (e.g. ants, cockroaches, fleas, bed bugs).

- Slow-release chemical pesticides, unless they are considered essential for protecting public health (e.g. in the case of mosquito coils, mats and vaporizers) and unless it is determined that, in the given context, slow-release formulations will be safer for people and the environment because they minimize peak short-term exposure and maintain pest control at lower levels, reducing the need for reapplication. *Unless studies are provided that support the use of slow-release household pesticides, and the label directions and use are appropriate for domestic use by non-professionals, typically this type of product would not be registered. Such formulations contradict the integrated pest management approach and create a setting where exposure cannot be controlled, especially if the products are odourless, or if a pleasant scent has been added to mask the odour of the pesticide, and are likely to be left in place too long. If registered, slow-release pesticide products should have a highly-visible label warning to remove them after the designated time.*

5.2.3. *Review of registered products*

Regular or unscheduled reviews of already registered pesticides, conducted on an ongoing basis (e.g. every 5–15 years), are recommended to reassess the risks based on actual use experience, new testing results, new products or methods and/or monitoring data in homes. Such reviews allow registrars to determine whether the pesticides still meet their requirements. Resistance monitoring, as described in the Guidelines on prevention and management of pesticide resistance (FAO, 2012), should also be considered, as pest resistance to household pesticides has been observed to develop quickly, resulting in low efficacy and use of higher doses.

Case-by-case registration reviews, i.e. reviews that are ad hoc or unscheduled, should be undertaken when problems resulting from use of a particular pesticide – including family or pet poisoning and other adverse incidents, reduced efficacy, or development of pest resistance – are revealed through monitoring, post-marketing surveillance, new scientific information or reports from other countries. Registration reviews should also be undertaken when products are banned or severely restricted in other countries due to human health or environmental risks, and when safer products or methods of pest management become available.

If reports of adverse health or environmental incidents resulting from use of a product are received, the problem should be investigated and the product registration reviewed immediately. If the incident is indeed related to the use of the product, compliance and enforcement action should be taken. This may include stopping sales of the product. Cases of accidental ingestion, homicide and intentional self-harm should also be monitored and addressed.

5.3. Quality control

The availability of substandard and counterfeit pesticide products is an important problem in many countries. Such products can cause serious health and environmental harm as well as failing to control pests. To address the problem, household pesticides should be included in a regular national or regional programme of quality control through laboratory testing, as part of a national annual plan of pesticide compliance and law enforcement. Border controls should also be used to identify illegal products imported from other countries. Participation in the OECD Network on Illegal Trade of Pesticides,⁴ which helps countries work together to prevent such trade, is not limited to OECD countries. Non-OECD countries are also invited and are strongly encouraged to join the network.

If a poor-quality product fails to control the pest, non-professional pesticide users may make the mistake of increasing the dose, and the resulting risks, thinking more will work better.

The FAO/WHO *Guidelines for quality control of pesticides* (FAO/WHO, 2011) outline the basic procedures needed to control product quality in the registration process as well as in the post-registration surveillance of products on the market. The guidelines also cover the legislative, administrative, organizational and infrastructure requirements for quality control of pesticides, as well as practical considerations for the control of products submitted for registration and for post-registration surveillance of products on the market.

This is essential to correct the current situation in which many countries do not test the quality of household pesticides, although they have their own facilities or access to facilities elsewhere to test the quality of agricultural pesticides. Countries that do not have the capacity or facilities to control the quality of household pesticides should request related certificates from accredited laboratories in other countries.

It should be noted that substandard pesticides are not the only possible causes of inadequate pest control following treatment. It may not be a problem of pesticide quality or dosage but simply an illustration of the fact that pesticides cannot always produce the desired result, due

⁴ The OECD Network on Illegal Trade of Pesticides (ONIP) consists of inspectors, regulatory authorities, customs officials and other experts from OECD countries as well as “partners” from selected non-OECD countries. The ONIP seeks to raise awareness about the problem, to improve cooperation among countries through a “Rapid Alert System” (RAS) for informing others of illegal shipments, to develop best practices against the illegal pesticide trade and to develop training for inspectors. In an important development, the OECD Council has endorsed a Recommendation (available: <https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0446>) to encourage countries to fight illegal pesticide trade nationally and to cooperate internationally. The Council Recommendation includes best practice guidance (BPG) that describes how to identify and respond to illegal practices throughout the pesticide life cycle. An OECD Council Recommendation functions as a legal act, and both OECD and non-OECD countries are able to adhere to and to be associated with the different activities.

to the development of pest resistance, the difficulty of treating every crack and crevice where pests can hide, or failure to intervene early before the pests multiply. This underscores the importance of beginning with pest prevention and mechanical pest control methods.

5.4. Preventing and managing pest resistance

The development of pest resistance to pesticides is a serious and growing problem worldwide. It should be addressed by pesticide producers and registrars during the registration process, and in the advice given to pesticide retailers. The general public is unlikely to be aware of the problem, so pesticides to which target pests have already developed resistance or to which they have the potential to develop resistance should not be registered for household use.

Resistance is a genetically-based or behavioural avoidance characteristic that allows the target pest, through inheritance, genetic selection or behaviour modification, to avoid or survive exposure to a pesticide dose that would normally have killed it. If resistance spreads throughout the pest population, the pesticide is no longer effective.

To try to control the spread of pest resistance, applications for registration of new pesticides should include information such as data on the baseline susceptibility of target pests to resistance development, the results of resistance screening tests and data on cross-resistance of target organisms with other pesticides. Registration of the highly hazardous organophosphates and carbamates, which have been widely used in households, is strongly discouraged not only because of their high toxicity to people but also because a significant degree of pest resistance has already developed. For lower-toxicity products where resistance has developed, such as pyrethroids, prospective registrants should be required to prepare a resistance management plan and, if their products are approved, to monitor resistance development after registration. National and regional networks should also be established for resistance monitoring and data sharing.

The *Guidelines on prevention and management of pesticide resistance* (FAO, 2012) address the problem of pest resistance and how to limit its development while continuing to control pests. The guidelines advise governments to encourage the public to avoid chemical pesticides to the extent possible, and, where there is no other solution, to alternate products of unrelated chemical classes rather than using the same pesticide repeatedly, to use integrated pest control and to alternate chemical with biological products. Examples of existing resistance management plans for different pesticide types and uses are provided.

The guidelines are intended for scientific, technical and policy experts who prepare or evaluate pest resistance management plans, and for pesticide regulators who assess the risk of resistance development during registration of new pesticides or renewal of already approved products. Although the guidelines focus on pesticide use in agricultural crops, they are also relevant to household pesticides.

5.5. Packaging and labelling

The packaging and labelling of household pesticides should be designed to minimize human exposure and environmental contamination. This is the responsibility of pesticide producers but also of government authorities, who should use registration and inspection to ensure that packaging and labelling comply with national legislation and with the FAO guidelines on good labelling practices.

Strict requirements for the packaging and labelling of household pesticides should be imposed, to account for their handling and storage by non-professionals. The *Guidelines for retail distribution of pesticides with particular reference to storage and handling at the point of supply to users in developing countries* (FAO, 1988) and the *Guidelines on good labelling practice for pesticides* (FAO/WHO, 2015b) provide standards and criteria that pesticide producers should follow and governments should enforce. The *Guidelines for the inspection of pesticide producers, importers, distributors and retailers* (FAO/WHO, forthcoming) provide instructions and checklists for the control of packaging, storage, disposal and labelling during the inspection of companies that produce, import, transport or sell pesticides.

As discussed in the guidelines, basic requirements for the packaging and labelling of household pesticides are as follows.

Packaging

- Household pesticide packaging should be unopened and unattractive. Containers should be difficult to open and bottle caps difficult to remove, making them childproof.
- Technical measures to reduce exposure should be encouraged, such as: duck neck bottles, pre-packaged portions, water-soluble bags, the addition of thickening agents that minimize splashing during product application, and the addition of bittering agents to avoid accidental ingestion by children.
- Packaging features that reduce exposure (e.g. by minimizing splashes) should be promoted.
- Ready-to-use products should be promoted so as to minimize handling, and repackaging of product contents should be prohibited.
- Packaging should be available in sizes and quantities appropriate for home and garden use, i.e. for just one or several uses, to discourage unnecessary storage of surplus pesticide. Shelf-life, maximum number of applications per year and amount of product needed for one treatment should be considered.

- Products that require special conditions for storage, such as low temperatures, should be discouraged, as users are unlikely to have a separate facility (refrigerator) for them, and storage in the same refrigerator or other facility used for food would not be safe.
- Placement of a tactile warning sign on the packaging, to warn blind or handicapped people, is encouraged.
- Packaging that can be reused, such as for storing food or liquids or for children's toys, should be avoided.

“Pesticide industry should ... provide, consistent with national, sub-regional or regional requirements, a range of pack sizes and types that are appropriate for the needs of small-scale farmers, household and other local users, in order to reduce risks and to discourage sellers from repackaging products in unlabelled or inappropriate containers ...”

International Code of Conduct on pesticide management, Article 8.2.8

Labelling

Household pesticide labels should:

- provide clear instructions in easily understandable language. These should explain: how the product works, the amount to be applied (effective dose) and how to apply it, the target pest species, the time to take effect, the duration of residual efficacy and the frequency of use (if additional applications are needed);
- provide clear precautionary statements;
- be highly visible and easy to read;
- be in the local language(s);
- identify risks to humans, domestic animals and wildlife, beneficial organisms, water resources, and any other important environmental components;
- clearly indicate how to safely dispose of the empty container and any unused pesticide (usually packaging should not be reused for any other purpose, except recycling of uncontaminated pieces of packaging);
- clearly indicate the storage conditions of the product and its expiration or “best before” date, after which it should not be used;
- clearly indicate what to do in case of exposure and provide a telephone number for a poisoning information centre;

- provide pictograms, colour bands for acute and chronic toxicity, and other visual symbols for users who are unable to read the instructions, with information on the meaning of the pictograms and symbols provided at the point of sale;
- be physically durable and resistant to the normal wear and tear encountered in transport, storage and use, so that they remain complete and legible over time, as a considerable length of time may elapse between the manufacture and use of a product; and
- be pilot tested with prospective household users when new label formats and elements are developed, to ensure that the labels are well understood and to identify any needed changes.

5.6. Transportation, storage and sale

Government authorities should impose and enforce requirements for the safe transport, storage, handling, and display of household pesticides by distributors and retailers.

Aerosols and rodenticides should be transported by professional licensed entities with specific vehicles, as aerosols are explosive and most rodenticides are highly toxic.

Pesticide retailers should be trained and motivated to advise customers about pest prevention and best practice in pesticide use, as discussed in section 2 of this guidance.

Household pesticides should be transported, stored and distributed in keeping with the *Guidelines for retail distribution of pesticides with particular reference to storage and handling at the point of supply to users in developing countries* (FAO, 1988). Still relevant today despite their older publication date, the guidelines cover:

- general precautions and requirements such as safety and first-aid equipment and procedures for cleaning up spills;
- proper storage and display of pesticide products in warehouses and shops, notably: separation from food, medicine, toys, clothing and other such products; storage away from sunlight, heat and moisture; rotation of stock; management of damaged containers; and record-keeping;
- the location and structure of warehouses;
- transportation in different vehicles from those that transport food, medicine, toys, clothing, cosmetics, household furnishings and other cargo that could become a hazard if contaminated; and

- steps to prevent leaks or spills, and emergency response in case of accidents.

Informal markets and E-commerce

Controlling sales of household pesticides has become increasingly complex as they can now be bought in supermarkets, grocery stores, pharmacies, hardware stores, garden stores, petrol stations, roadside shops and informal markets and on the Internet.

To address this, countries are encouraged to adopt legal provisions that set conditions or requires licensing for the sale of household pesticides and that prohibits their repackaging, decanting, or sale in split or broken packaging (the latter to prohibit the practice, common in some countries, of selling individual mosquito mats out of their packaging as well as many other “street pesticides” in informal markets). In addition, self-service should be restricted for certain product types (e.g. disinfectants), so that customers must request them from the retailer rather than take them off the shelf. This will provide an opportunity for customers to be instructed by the retailer about the suitability and correct use of such products.

Street pesticides are readily accessible in many countries in the informal sector. These are often legal products registered for agricultural uses decanted illegally into unlabelled beverage containers or small pre-packaged household products not registered for use and illegally imported. To reduce the risks associated with these products, three elements are key: (i) reduce access to agricultural products, (ii) improve import controls and (iii) educate the public on the risks of using street pesticides.

Controlling sales of pesticides over the Internet, or E-commerce, is especially complex, as the market is continually changing and the sellers and buyers can be hidden behind false names in locations that are often unknown. E-commerce can make it easy to buy illegal pesticides, such as products that are banned in most countries, are not registered for use in the buyer’s country, or are fake or counterfeit.

Ideally, Internet sales should abide by strict national regulations governing the sale, transportation and distribution of pesticides regardless of where they are sold. The law should oblige pesticide sellers, including those who sell over the Internet, to ensure that any products sold are registered and labelled in accordance with requirements of the country where they are sold. Companies and shops should be licensed for Internet sales of pesticides in the countries where they sell the products, irrespective of the company’s or shop’s location.

Countries that have imposed such measures have been better able to reduce sales of illegal products. It is important, however, not to make licensing conditions for the sale of household products so rigid as to limit their availability to the general public, as customers may then purchase them elsewhere without the advice that a retailer can provide.

5.7. Storage of household pesticides in homes

Household pesticides should be kept under lock and key, away from food and out of the reach of children, people who are depressed and other fragile populations. Information on safe storage of pesticides should be posted and distributed to users at the point of sale.

The importance of good storage practices of household pesticides cannot be overstated. Users of household pesticides should be advised by retailers to buy only the amount needed for immediate use and to avoid accumulating stocks that may expire, degrade over time, leak or emit fumes if not properly closed, or cause harm if mistaken for another product or discovered by children or others who should not be handling them or may accidentally eat or drink them.

Household pesticide labels and/or instructions for use should clearly indicate how to store the product correctly, e.g. that it should:

- always be put in a secure and locked place away from food and water sources, away from sunlight, heat and humidity, and away from children, pets and others who should not have access to them;
- always be stored in their original container whose label has instructions for use, safety precautions, possible adverse effects, and instructions for treatment if poisoning occurs; and
- never be put in other containers where they may be mistaken for food, drink or medicine.

5.8. Disposal of pesticide containers and leftover product

Empty household pesticide containers and leftover pesticide should be considered toxic and disposed of correctly to prevent hazardous exposures or environmental contamination. Users should be alerted to the importance of proper disposal.

Pesticide producers should be encouraged by regulatory authorities to provide disposal options in communities where household pesticides are frequently used.

Household pesticide users are often unaware of how to properly dispose of empty pesticide containers and leftover product, and of why safe disposal is important. This is frequently the case even though instructions are provided on product labels. Information about disposal should therefore be provided at the point of sale of household pesticides. The instructions should emphasize that:

- pesticide containers and leftover product should not be burned or dumped into drains, toilets or trash/rubbish bins or any other place;
- empty containers should never be reused for storage of water, milk, honey or other food or household items, or for making children's toys; and
- both empty containers and leftover pesticide should be disposed of as indicated on the product label and in accordance with national regulations (these must be clearly stated on the label and checked during the registration process). They may also be collected during the household hazardous waste collection days held in some countries, or returned to pesticide suppliers/producers, supermarkets or national collection systems that offer disposal options. A good practice is for regulators to specify during the registration process that pesticide companies must indicate what collection systems will be put in place for household pesticide containers and leftover product.

The *Guidelines on management options for empty pesticide containers* (FAO/WHO, 2008) provide advice on the management of one-way pesticide containers (i.e. containers that should not be reused or refilled) such as those used for household pesticides. The guidelines underscore the advantages of having a container management scheme and of making it easy for users to return their empty containers to the scheme rather than reusing them. Examples of such schemes in different countries are provided.

5.9. Advertising

The advertising of household pesticides should be discouraged or forbidden. If advertisements are allowed, they should not exaggerate the benefits or safety of chemical pesticides or imply that the products are essential. They should include explicit warnings about potential risks and about problems that can result from overuse.

Advertisements that show children, that promote slow-release products resulting in continuous exposure or that promote products containing potentially toxic ingredients added to decrease an unpleasant odour should not be allowed.

The general public should not be encouraged to use chemical pesticides in and around the home. If advertisements of household pesticides are permitted, they should be approved by government authorities in advance and should make no statements or visual presentations that, directly or by implication or omission, exaggerate the safety or effectiveness of the product and are likely to mislead the buyer. Advertisements also should not encourage uses other than those approved by the authorities, and should not include any incentives or gifts that would encourage the purchase of more pesticides. The use of children, animals and food in advertisements for household pesticides should be prohibited.

The roles and responsibilities of governments and pesticide producers in pesticide advertising, and explicit instructions on what advertisements should and should not include, are addressed in article 11 of the *International Code of Conduct on pesticide management* (FAO/WHO, 2014) and in the *Guidelines on pesticide advertising* (FAO/WHO, 2010b). The guidelines also:

- provide advice on how to help ensure compliance and best practice,
- suggest a framework for monitoring pesticide advertisements,
- indicate steps to take when encountering non-compliance, and
- recommend best advertising practices.

6. Public education on pest and pesticide management

Public education is an essential part of household pest and pesticide management. Pest prevention should be emphasized, because safe and sustainable use of household pesticides starts with taking away the pest source.

Governments should take the lead in educating the general public about pest prevention and control, ideally with support from the country's pest control advisory services, from experts in universities and other institutions, from local nongovernmental organizations and from pesticide company representatives, who should be knowledgeable about their products and committed to helping users and reducing risks, e.g. through “product stewardship”. Public education can be undertaken in various ways, for example:

- initiation of community pest prevention programmes in public buildings, parks and neighbourhoods, with participation by members of the community. Such programmes can achieve better and longer-term results than individual home treatments, because pests like cockroaches, mosquitoes and rats move freely between houses. By eliminating pest-friendly habitats in public places, the community can reduce pest populations and breeding and provide an example of effective non-chemical or integrated pest control that community members can use in their own homes;
- education of pesticide retailers about pest prevention, observation, diagnosis (to clearly identify the pest) and non-chemical control, as well as about best practice in pesticide use. This is best achieved through retailer licensing and certification, which is addressed in the *FAO Guidelines on pesticide legislation* (FAO, 2015a) and the forthcoming FAO/WHO guidance on pesticide licensing schemes. Retailers should be not only informed but also motivated to advise customers about how to address their specific pest problem;
- distribution of posters, brochures and flyers on pest and pesticide management to local shops that sell household pesticides, for display and distribution to customers with any pesticide purchase or inquiry about pest control; and
- direct communication to the public through diverse media, e.g. television, radio, bill boards, Internet, social media and public service messaging.

The pest management hierarchy

Governments are encouraged to base public education programmes and materials on the three-step pest management “hierarchy” that follows, along with the suggested tips and advice for non-professionals.

Step 1. Pest prevention

The most effective way to control household pests is to prevent them from developing into a problem in the first place. Household pests need food, water and shelter to survive, so the first thing to do, before using a pesticide, is to:

- Remove all sources of food.
 - Boxes and bags of food should be sealed.
 - Open food such as cereal, flour and sugar should be sealed in plastic bags, glass or other containers. Ripe fruit should be kept in a covered container.
 - Spills, leftover crumbs and dirty dishes should be cleaned up immediately.
 - Trash/refuse should be taken out daily. Trash cans/refuse bins should have a tight lid and should be placed away from the entrance to the house.
 - Pet food should not be left out overnight.
- Keep the house clean and dry.
 - The house should be kept swept out, clean, dry and well-aired.
 - Water and other liquids should be wiped off the counter, and dishwater drained from the sink.
 - Leaky faucets and household appliances should be repaired.
 - Water should not be left to stagnate in wells, sinks, water coolers, etc. Standing water sources (buckets, old tires, etc.) near the home should be removed.
 - The house should be vacuumed frequently to prevent populations of fleas, ticks and mites from expanding.
 - Bedding should be washed regularly and dried in hot sun or a dryer.
- Block entrances into the home and remove shelters.
 - All entryways for insects into the home, such as cracks and openings along baseboards, behind sinks, and around pipes and windows, should be sealed, and mesh screens should be installed on doors and windows.
 - ⁵
 - Boxes and bags should be checked for insects before bringing them into the home.

⁵ See *Keeping the vector out: housing improvements for vector control and sustainable development* (WHO, 2017).

- Clutter such as stacks of newspapers, paper bags and cardboard boxes, which make good hiding places for pests, should be removed.

Step 2. Mechanical or environmental pest control

Mechanical methods of pest control should also be used before resorting to pesticides. Mechanical methods inside the home include:

- use of untreated mosquito nets, fly swatters, sticky papers and traps, electric fly traps, and vacuums for flies and mosquitoes (spiders should generally be left alone as they eat other pests);
- installation of curtain nets on doors and windows to keep out flying pests like mosquitoes;
- placement of bug lights and non-toxic plant extracts that deter insects near the entrance to the home (be aware that some plant extracts, such as neem and citronella, can be toxic to people and pets; these should be regulated and should have label warnings);
- use of white exteriors that can reduce mosquito entry, and bright, light colours indoors that can inhibit pest breeding;
- use of traps to control rats and mice, placed in an area where children and pets cannot touch them,
- use of weed trimmers, mowers, etc., to remove unwanted vegetation;
- manual removal of pests at all life stages (eggs, nymphs and adults); and
- use of inexpensive and effective homemade mixtures to trap, repel or kill pests.⁶ *Be aware that certain homemade pesticides can be toxic and are not recommended (for example, oxalic acid from rhubarb leaves).*

Mechanical pest control methods for a kitchen or ornamental garden include:

- mulching or use of a weed mat to prevent weeds,
- companion planting to reduce insect pest pressure,
- rotating vegetable crops to reduce pest and disease incidence and to maintain soil health,
- providing adequate ventilation for plants to reduce buildup of fungal diseases, and
- encouraging natural predators of pests by diversifying planting and growing plants that provide habitat and food for them.

⁶ See, for example, the University of Cape Town Division of Environmental Health booklet *Low danger pest control booklet for communities* (UCT, 2019).

Step 3. Best practice in pesticide use

Pesticides should only be used if pest prevention and mechanical pest control methods prove insufficient, and they should always be used in combination with prevention and mechanical methods (see, for example, WHO, 2012 and FAO, 2010). The pest should be clearly identified and the most appropriate pesticide product selected, *if possible with advice from the sales person or someone else who is knowledgeable about home and garden pests and pesticides.*

Product selection

The selection of a household pesticide should be based on:

- The *target pest*. The target pest should be clearly identified and only “selective” pesticides that specifically target that pest should be used. Broad-spectrum pesticides, which are likely to kill desirable organisms and garden plants as well as the target pest, should be avoided.
- The *type of formulation*. Preference should be given to formulations that reduce human, animal and environmental exposure. For example, solids remain confined to the area where they are placed, and aerosols and sprays are less dispersive than vaporizers. If the target pest can be controlled effectively by both baits and sprays, preference should generally be given to baits.
- The *availability of biological alternatives*. Biological pest control products such as botanicals, pheromones, natural enemies and microbial-based biopesticides, as well as products approved for organic farming or horticulture that have a non-toxic mode of action and do not harm pollinators and other beneficial organisms, should in general be preferred.

Product application

Household pesticides should always be applied in accordance with the label instructions. Before applying any product, the user should read the label carefully, or have someone else read it aloud if the user is not able to read it, to determine the recommended dose and application method, the recommended number and spacing of treatments if more than one is needed, and the recommended timing of treatment.

The following precautions should also be taken.

- Pesticides should not be overused or the recommended dose exceeded, as this will not give better pest control but will only increase the possibility of adverse effects. In addition, overuse of pesticides can hasten the development of resistance in the target pests. This is an important concern, as only a few pesticide active ingredients are currently available for use in public health, and few new ones are under development.

- Pesticides should be used outdoors only under appropriate weather conditions. They should not be used on windy days, so as to reduce spray drift, or before rain, so as to reduce run-off into soil and water sources and possibly the need for re-treatment. Some should only be used in the early morning or late evening to avoid killing bees or damaging plants.
- Pesticides should not be sprayed indoors with a fan blowing or when people or pets are present or food is uncovered.
- Traps and baits should not be put in places accessible to children, pets or wildlife, and any food debris or scraps lying around the home should be removed first, so that the pest is attracted only to the bait.
- Homes should be ventilated by opening windows and doors after applications.
- People and pets should be kept away from the home during and after treatment with an aerosol spray, and fish tanks covered, for the length of time indicated on the product label or, if not indicated, until after the smell is gone and the treated surfaces or areas have dried.
- Food, drink, utensils and other items should be removed or covered during the pesticide treatment.
- The person applying the pesticide should avoid eating, drinking and smoking during the treatment, and any other hand-to-face movements.
- Any objects exposed to spray drift should be wiped off and cleaned before being used again.
- From a precautionary and hygienic point of view, users should wash their hands and other exposed parts of the body thoroughly after handling pesticides, and should wash clothing worn during the treatment separately from other laundered items.
- Areas frequently touched by people or pets should not be treated unless such treatment is explicitly intended, e.g. in case of disinfection.

References

The documents cited below are either available on the FAO and WHO websites (<http://www.fao.org/agriculture/crops/thematic-sitemap/theme/pests/code/list-guide-new/en> and https://www.who.int/neglected_diseases/vector_ecology/pesticide-management/who_fao_guidelines/en/), or their specific weblinks have been provided against each reference below.

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World Health Organization
Avenue Appia 20
1211 Geneva - Switzerland
<https://www.who.int/teams/control-of-neglected-tropical-diseases>

Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00153 Rome - Italy
<http://www.fao.org/agriculture/plant-production-and-protection/en/>

