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

Envisioning A Chemical-Safe World

Chapter 12 of 12

Transformative actions to minimize the adverse impacts of pesticide and fertilizers

Contents

1 Global drivers, actors and policies affecting pesticides and fertilizer use

2 Status and trends of pesticide use

3 The regulatory and policy environment for pesticide management

4 Environmental and health effects of pesticide use

5. The environmental, human health and economic impacts of pesticides

6 Current pesticide risk reduction and risk management

7 Status and trends of fertilizer use

8 The regulatory and policy environment of fertilizer management and use

9 Environmental and health effects of fertilizer use

10 The impact of fertilizer use

11 Current fertilizer risk reduction and risk management

About ii

12 Transformative actions to minimize the adverse impacts of pesticide and fertilizers 1

12.1 Transformative actions are needed and within reach 1

12.2 Priority transformative actions 4

12.3 Ambitious collaborative action by all stakeholders is needed 8

References 10

List of Tables

Table 12.1 The interface between the 2030 Agenda and sustainable management of pesticides and fertilizers 2

About

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

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

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

This chapter on "Transformative actions to minimize the adverse impacts of pesticide and fertilizers" is the 12th in a series of 12 chapters that make up a comprehensive compilation of scientific information. The chapters were developed to both inform and further elaborate on the information provided in the synthesis report. Please note that the disclaimers and copyright from the synthesis report apply

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

Transformative actions to minimize the adverse impacts of pesticide and fertilizers

12

"Business-as-usual is not an option" also applies to scaling up incremental changes

The previous parts of this report have proposed various types of incremental change to strengthen pesticide and fertilizer management schemes, methods and practices. The proposed interventions focus on strengthening and building upon existing policy and management frameworks. They are often technical in nature. Options for incremental changes are described in Chapter 6 for pesticides, and in Chapter 11 for fertilizers. Such options are mainly addressed to the technical and policy communities working on pesticide and fertilizer management.

12.1 Transformative actions are needed and within reach

Current and projected patterns of pesticide and fertilizer use are not sustainable

This report assesses the current situation with regard to global use patterns of pesticides and fertilizers, as well as existing policy and regulatory frameworks that address their manufacture, distribution and use. The report also evaluates the prevailing scientific understanding of the environmental and human health impacts of pesticides and fertilizers and identifies important knowledge gaps.

Despite the international, regional and national management approaches used to minimize the adverse impacts of pesticides and fertilizers, evidence presented in Parts II and III of the report suggests that reducing these impacts presents many challenges. Moreover, as the use of pesticides and fertilizers increases their impacts also increase. For a summary of these impacts, see Chapters 4, 5, 9, and 10.

The projected growth of pesticide and fertilizer markets, together with prevailing deficiencies in management systems, will result in greater adverse impacts and more inefficient nutrient use in coming years unless a fundamental change takes place. Business-as-usual is not an option.

There is a need for transformative actions and for scaling up incremental changes

This chapter, which is the final chapter of the report, emphasizes that both transformative actions and the scaling up of incremental changes are needed to achieve a chemical-safe world with regard to pesticides and fertilizers. To ensure

that the transition to this chemical-safe world is fair and leaves no one behind, transformative actions should be coupled with supporting ones. Joint commitment by all stakeholders is required in order to achieve sustainability scenarios for pesticide and fertilizer use, in contrast to a business-as-usual scenario that perpetuates an unsustainable status quo.

Transformative actions seek to increase demand for more sustainable agricultural products that minimize unsustainable pesticide and fertilizer use and fundamentally change a range of management practices. This chapter describes such transformative actions. Many of them target actors in the value chain beyond those working directly on pesticide and fertilizer management.

The proposed transformative actions may not be applicable globally. In addition, specific conditions in countries and regions need to be considered. These include, but are not limited to, differences in economic situations, agroecological conditions, past histories of sustainable pest and nutrient management, cultural and gender aspects, existing policies and legislation, and the effectiveness of their implementation.

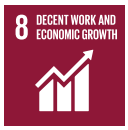
Using the 2030 Sustainable Development Agenda to engage new actors and foster transformative action

The 2030 Sustainable Development Agenda is a universal global framework that encourages action by all stakeholders to achieve sustainable development by the year 2030 (United Nations 2020). The 17 Sustainable Development Goals (SDGs) and their specific targets serve as a detailed reference framework and global compass to inspire and shape action by all relevant actors, particularly policymakers (Moyo 2016). Major global agreements and policies relevant to pesticides and fertilizers operationalize the SDGs in various ways with regard to the specific sectors or aspects to which they apply, creating synergies for implementation.

The SDGs are central to the identification in this report of options for actions which could be taken by governments and other stakeholders. Effective implementation of these actions can be expected to contribute to meeting several SDG targets (Table 12.1). For pesticide and nutrient management to become sustainable in the long run, the actions proposed in the report need to

Table 12.1 The interface between the 2030 Agenda and sustainable management of pesticides and fertilizers

SDGs	SDG targets	Pesticides and fertilizer linkages
	Eradicate extreme poverty for all people everywhere, currently measured as people living on less than USD 1.25 a day	Increased need for efficient, profitable and sustainable use of pesticides and nutrients
	2.2 End all forms of malnutrition 2.3 Double the agricultural productivity and incomes of small-scale food producers 2.4 Ensure sustainable food production systems and implement resilient agricultural practices	Increased need for effective pest and nutrient management Need to increase sustainable use of fertilizers and pesticides in certain parts of the world Wider adoption of sustainable agricultural production practices
	3.9 Reduce the number of deaths and illnesses from hazardous chemicals	Further reduction of death and illnesses mainly from pesticides Ensuring access to sufficient, safe and nutritious food
	6.3 Improve water quality by reducing pollution, eliminating dumping, and minimizing release of hazardous chemicals and materials	Minimization of water pollution from pesticides and fertilizers

SDGs	SDG targets	Pesticides and fertilizer linkages
	8.8 Promote safe and secure working environments for all workers	Reduction of the occupational risks of handling and using pesticides and fertilizers
	9.5 Enhance scientific research and upgrade the technological capabilities of industrial sectors in all countries, particularly developing countries, including encouraging innovation	Development of innovative and sustainable pest and nutrient management approaches and technologies
	12.2 Achieve the sustainable management and efficient use of natural resources 12.4 Achieve the environmentally sound management of chemicals and all wastes throughout their life cycle 12.6 Encourage companies, especially large and transnational ones, to adopt sustainable practices and to integrate sustainability information into their reporting cycle 12.8 Ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles	Wider adoption of sustainable pest and nutrient management practices Minimization of the impacts of pesticides and fertilizers on natural resources Further strengthening of the sound management of the entire life cycle of pesticides and fertilizers Further support for and implementation of sustainable pest and nutrient management technologies by the pesticide and fertilizer industries Improvement of information provision about the risks of pesticides and fertilizers and ways to minimize them
	13.2 Integrate climate change measures into national policies, strategies and planning	Minimization of greenhouse gas emissions associated with fertilizers use Saving forests and increasing carbon storage through judicious use of fertilizers Wider adoption of integrated practices in agriculture that enhance farmers' sustainable productivity as well as climate resilience
	14.1 Prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including nutrient pollution	Minimization of pollution of marine environments by nutrients and contaminants in fertilizers
	15.5 Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity, and protect and prevent the extinction of threatened species 15.8 Prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems, and control or eradicate the priority species 15.9 Integrate ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies and accounts	Minimization of the environmental impacts of pesticide and fertilizer use Ensuring the sustainable control of invasive pest species Mainstreaming of ecosystem and biodiversity values into national and regional pest and nutrient management policies
	17.6 Enhance North-South, South-South and triangular regional and international cooperation on and access to science, technology and innovation and enhance knowledge sharing	Improvement of sharing of pest and nutrient management knowledge among relevant stakeholders Enhancing partnering among UN organizations active in sound management of chemicals

be integrated effectively into the implementation of relevant SDGs. Just as the SDGs should be addressed in an integrated, indivisible manner, the actions proposed in this report cannot be implemented in isolation. They require a unified approach.

12.2 Priority transformative actions

The following options for priority transformative actions have been identified through consultations with government experts, independent scientists, experts from intergovernmental organizations, and other stakeholders from the public and private sector. Identification of these transformative actions is based on the impact they are expected to have on the sustainability of pesticide and fertilizer use, the degree to which they would minimize adverse impacts, and their interconnection with the SDGs and associated global policies.

While they are relevant to all regions in the world, implementation of these actions needs to take account of local contexts and situations, as appropriate. In certain cases actions proposed in other chapters may partly overlap with the proposals below, given the scope and complex nature of the transformative actions.

12.2.1 Incentivize healthy and sustainable consumer choices and consumption

Consumer choices play a crucial role in fostering a sustainable food system and value chain. For example, increased household incomes may result in shifts from plant-based to animal-based diets. Animal-based diets are associated with higher demand for resources (e.g., land, pesticides and fertilizers) and, subsequently, more environmental pollution than plant-based diets. Making dietary changes towards more plant-based diets can contribute to minimizing the adverse impacts of pesticides and fertilizers and contribute towards sustainable food systems.

Governments may incentivize healthy and sustainable consumer choices and consumption by enacting policies that promote greater dietary reliance on sustainably produced grains, fruits, vegetables and dairy products, as well as mandatory use of certification systems and labels which address sustainability considerations throughout the value chain by creating full product transparency. These measures may be complemented by innovative communication campaigns and technologies (e.g., mobile phone apps) that synthesize complex information, so that consumers are able to make informed choices.

Options for transformative actions to incentivize *responsible consumption of food, feed and fibres* include:

- Promote consumption of food, feed and fibres which have been produced in a sustainable manner, for example by facilitating market access, labelling schemes and other economic incentives throughout the value chain;
- Make consumers more aware of the pollution and health footprints of agricultural inputs, so that they can make informed choices (e.g., choose diets or clothing with smaller pollution footprints);
- Create attractive environments for the marketing of sustainably produced food, feed and fibres;
- Encourage the food, feed and textile industries to systematically integrate sustainability into their core business strategies and adopt sustainability standards;
- Encourage governments, educators and non-governmental organizations (NGOs) to provide product sustainability information, for example through labelling or consumer campaigns;
- Ensure fair pricing systems for food, feed and fibres produced in a sustainable manner.

12.2.2 Fundamentally change crop management and adopt ecosystem-based approaches

Shifting from a traditional linear to a more holistic approach to address pest pressure and soil fertility issues in agricultural production is essential. This approach uses environmental knowledge and takes into consideration other plant management factors (e.g., germplasm, water)

that influence productivity. Examples of concepts that have proven effective include integrated pest management and integrated vector management, biocontrol, rotation of legumes and non-legumes, and combining cropping with livestock systems. These concepts already exist and have proven effective. However, their implementation should be scaled up.

Providing knowledge, and sharing it widely, will expand the solution base for farmers and allow the adoption of environmentally friendly and sustainable production systems. These fundamental shifts in agricultural production cannot be achieved without active support by the private sector, while governments need to create enabling environments and establish boundaries with regard to practices that will be considered undesirable in the future.

Options for transformative actions to *fundamentally change crop management* and move towards ecosystem-based approaches and solutions to manage pests and nutrients include:

- Make sustainable agricultural intensification the central objective of national policies; promote agroecological approaches for crop, fibre and livestock production; discourage unsustainable agricultural practices;
- Effectively implement integrated pest management (IPM), integrated vector management (IVM), biocontrol and agroecology as the principal approaches to pest management;
- Support the development, availability and affordability of non-chemical alternative pest and vector control products and methods;
- Promote cropping systems that reduce the need for application of fertilizers (e.g., rotation of legumes with non-legumes) and exploit synergies between cropping systems and livestock systems;
- Promote technologies and practices that reduce nutrient losses (e.g., integrated nutrient management, precision farming, enhanced efficiency fertilizers, biochar).

12.2.3 Promote circularity and resource efficiency

A large amount of the fertilizer nutrients used in agriculture are not recycled, creating opportunities to advance circularity through collaborations and partnerships of relevant stakeholders. For example, recycling nutrients in manure is often hampered by spatial separation of crop and livestock production. Taking advantage of synergies between the two systems can make pesticide and nutrient use more sustainable.

Options for transformative action to ensure *circularity and resource efficiency* throughout the life cycle of pesticides and fertilizers include:

- Implement more circular agricultural production systems that reduce the need for pesticides and synthetic fertilizers, based, for example, on crop rotation, nitrogen fixation, organic agriculture, crop varieties adapted to low-input agriculture, agroecology and conservation (zero-till) agriculture;
- Implement upstream quality control of fertilizers, pesticides and other pest management tools before they reach the market;
- Promote the use of modern technologies that contribute to improved pesticide and nutrient use efficiency, such as modelling to forecast pest development, adoption of economic thresholds, lure and kill and targeted application of pesticides, precision agriculture, improved pesticide formulations and application technologies, cloud-based tools for site-specific nutrient management, and enhanced efficiency fertilizers;
- Establish national systems for the collection and recycling of empty pesticide containers and environmentally sound treatment or disposal of other pesticide waste, particularly through public-private partnerships;
- Support recycling nutrients, for example through investing in the development of technology for nutrient recovery and treatment and in farmer training;

- Build consumer awareness of the safety of food grown using recycled nutrients (e.g., from household waste, treated sewage sludge) in countries where these nutrients are properly treated to ensure safety.

12.2.4 Use economic instruments and promote direct finance to create a level playing field for greener products and approaches

The environmental and human health costs associated with agricultural production are often not reflected in input and output pricing. Opportunities exist to progressively internalize the hidden costs of pesticide and fertilizer impacts in order to level the economic playing field for greener/lower-risk products and approaches. This goal may be achieved through the use of taxes or charges or by the elimination of certain subsidies. In some cases, special compensatory measures may need to be put in place to ensure that the transition to a chemical-safe world with regard to pesticides and fertilizers is fair and leaves no one behind.

Providing financial support to encourage the adoption of technologies and practices that improve the use efficiencies of pesticides and fertilizers can help achieve a shift to more sustainable agriculture. Funds may be mobilized, for example, through taxes that penalize polluters and reward non-polluters. Where subsidies are used to increase access to fertilizers (e.g., in some low and middle income countries), support for technologies that increase fertilizer efficiency may be more effective. A careful balance is needed between input and technology subsidies, taking regional conditions into consideration.

Options for transformative action to *incentivize and redirect finance* to more sustainable pest and nutrient management include:

- Sensitize policymakers about the importance of basic public funding as a requirement to ensure sustainable pesticide and nutrient management and to minimize indirect environmental, health and economic costs to society;
- Progressively internalize the environmental and human health costs of the use of pesticides and fertilizers in their pricing to level the economic playing field for greener/lower-risk products and approaches;
- Apply smart economic policies (e.g., pricing policies for inputs and outputs) to achieve the right balance between food security and environmental health;
- Establish smart subsidies and taxes to promote sustainable pest and nutrient management, and remove counterproductive subsidies and tax exemptions;
- Redirect revenues from economic instruments towards supporting farmers in shifting to more sustainable practices, as well as towards research and development (R&D) that supports such shifts;
- Facilitate the marketing and use of technology packages that contribute to sustainable use of nutrients, lower-risk pesticides, bioprotectants and pest management instruments through discriminatory smart subsidies.

12.2.5 Adopt integrated and life cycle approaches for sound pesticide and fertilizer management

The current practice of regulating individual pesticides and fertilizers could be transformed by promoting broader sustainable pest and nutrient management solutions. Alternative pest and nutrient management options should be evaluated as part of the decision-making process, together with an evaluation of the economic and environmental impacts of these options. Evidence-based and interdisciplinary decision-making should drive pest and nutrient management choices, while uncertainties and knowledge gaps are taken into account in a precautionary manner.

Options for transformative actions to move towards ***more*** *integrative approaches for the sound management* of pesticides and fertilizers include:

- Transform the current focus on the regulation of pesticides and fertilizers to the promotion of sustainable and holistic approaches in pest and nutrient management solutions;
- Include all relevant sectors of government in the authorization process of pesticides and fertilizers;
- In addition to evaluating biological efficacy and environmental and human health risks, assess local needs for individual pesticide and fertilizers, as well as risks compared with those of other pest and nutrient management approaches, in the registration process;
- Ensure evidence-based decision-making while taking account of the precautionary principle in situations where there are scientific complexity, uncertainty and knowledge gaps, in which case there may be a need to avoid or reduce potentially serious or irreversible threats to the environment and/or to human health;
- Give the results of monitoring the efficacy and environmental and human health risks of pesticides and fertilizers a more explicit place in their (re-)authorization;
- Facilitate registration of biological and other low-risk pesticides, for example by applying specific data requirements, reducing registration costs and fast-tracking their evaluations;
- Consider, in policy decision-making, the complexity of quantifying the contribution of fertilizer use to risks, as pollutants associated with fertilizers can also be from other sources.

12.2.6 Strengthen standards and adopt corporate policies for sustainable supply chain management

Advancing sustainability standards and sustainable supply chain policies by corporate actors in the value chain (e.g., retailers, food companies, textile companies) can be an important driver for sustainable transformation of upstream agricultural practices. Including targets for sourcing organically certified products, and taking a life cycle approach, can enhance the effectiveness of such measures.

Options for transformative action to *advance sustainability standards and sustainable supply chain policies* include:

- In the case of all actors in the supply chain, enhance information sharing to reveal information about upstream use of pesticides and fertilizers and harmonize approaches to sharing such information;
- In the case of all actors in the agro-food system, widely adopt sustainability standards which address the use and impacts of pesticides and fertilizers;
- In the case of all actors in the supply chain, adopt sustainable supply chain policies with attention given to minimizing unsustainable use of pesticides and fertilizers;
- In the case of producers of pesticides and fertilizers, adopt extended producer responsibility policies to minimize their adverse impacts throughout the value chain;
- Promote emerging good practices and initiatives with regard to sustainability standards and sustainable supply chain management where these ideas, practices and initiatives are less well known;
- Adopt proactive corporate measures aimed at making sustainable products and solutions available and becoming market leaders in this respect.

12.3 Ambitious collaborative action by all stakeholders is needed

The time is right to scale up action to advance the sustainability of pesticides and fertilizers

The trends and opportunities presented in this report point in one direction: advancing the sustainability of pesticides and fertilizers offers many benefits – environmental, social and economic. Governments (including regional and local authorities), private sector actors, research institutions and other stakeholders are therefore encouraged to scale up their commitment and actions to advance the sustainable use of pesticides and fertilizers through collaborative action. Putting such collaboration into practice throughout global agri-food and public health systems is essential in order to create the transformative market shifts needed to advance the sustainability of agricultural production, products and services and minimize the adverse environmental and human health impacts of pesticides and fertilizers.

The public sector has an important role to play not only in regulating pesticides and fertilizers, but also in putting in place enabling policies and actions to foster the required transformation. Relevant measures include phasing out pesticides that pose high risks; supporting green and sustainable chemistry research; promoting sustainable agriculture, integrated pest and vector management and agroecologically based approaches; raising awareness of the full cost of unsustainable practices; and providing fiscal incentives to foster market transformation.

Developing road maps for sustainable pesticides and fertilizer management

The road map approach to planning and decision-making has been used for a number of years, including applications to technology innovation (see, for example, Phaal, Farrukh and Probert 2004). Road mapping is a technique which brings actors and stakeholders together to develop a common vision and long-term planning to achieve that vision. Beyond identifying a common vision, road maps help to identify existing resources, describe gaps, define action, and obtain adequate funding to fill gaps. They are often used in the private sector, but are equally relevant for other stakeholder groups, including public bodies.

The road map approach has been used by several actors in the chemical sector and value chain to advance action to achieve the sound management of chemicals and waste (e.g., World Business Council for Sustainable Development [WBCSD]; Figure 12.1). One of these road maps, the WHO Chemical Road Map, adopted in May 2017 by the World Health Assembly, identifies actions in which the health sector has either a lead or an important supporting role to play in advancing the sound management of chemicals and waste (WHO 2017).

Road maps have also been developed taking a value chain approach that brings together different actors across the life cycle of chemicals and chemical products. For example, the European Union (EU) Roadmap for the Chemical Industry in Europe Towards a Bioeconomy (RoadToBio 2019) applies a value chain approach for a variety of products with the goal of increasing the use of bio-based feedstocks. Given the potential benefits of road maps, the 2019 Global Chemicals Outlook (GCO-II) encouraged the development of country- and stakeholder-driven road maps on specific topics and by different stakeholder groups to support the implementation of sound management of chemicals and waste beyond 2020 and to help monitor progress at all levels including the global level (UNEP 2019).

Consistent with the suggestion in the GCO-II, road maps should be developed by diverse stakeholder groups (e.g., producers, corporations, research institutions, the public sector) to advance concerted national and global action to achieve sound management of pesticides and fertilizers.

These road maps may be developed on specific topics or themes, such as advancing adoption of sustainability standards, minimizing the adverse impacts of Highly Hazardous Pesticides (HHPs) in a particular context, or reducing pesticide and fertilizer run-off in a single watershed. They may also be elaborated at the national level to set specific goals and targets that need to be achieved in a country on its path towards sustainable pest and nutrient management.

What is required is leadership within relevant organizations. Such leadership can come from the top through senior management or policymakers, or from the bottom up through interested and committed individuals from all stakeholder groups.

Together we can achieve a world without adverse impacts from pesticides and fertilizers by taking ambitious and urgent action

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