

International Code of Conduct for the Use and Management of Fertilizers

Zero draft prepared by FAO and the Intergovernmental
Technical Panel on Soils (ITPS)

Fertilizers are important and widely used inputs in modern agriculture contributing to global food security, farmer livelihoods and essential human nutrition however may have negative impacts the environment, human health and animal health if not used responsibly. As agrochemicals, fertilizers are subject to various legislation and regulations relating to production, trade, distribution, marketing, safety and use that can vary between countries or regions. Responsible use and management of fertilizers at the farm level requires careful consideration of many parameters including the crop to be grown, the soil, previous agronomic activities, water application, weather, access to fertilizers and farm economics. In addition, the use of fertilizers must be considered at the landscape and global levels due to potential nutrient losses to the environment and the negative effects of such losses.

This document is an International Code of Conduct for the Use and Management of Fertilizers. It has been prepared to support and implement the Voluntary Guidelines on Sustainable Soil Management and to assist countries to address the multiple and complex issues related to the responsible use and management of fertilizers in agriculture, from that at the farm level to the national level, while keeping in mind a global perspective.

Preamble and Introduction

Fertilizers make a significant contribution toward sustaining the population of the world by providing food security, enhancing farmer livelihood, providing essential human nutrition, and minimizing the conversion of land from native ecosystems to agricultural production. Fertilizers can dramatically increase the availability of nutrients to crops, thus improving soil ecosystem services that contribute, directly and indirectly, to 95% of global food production. However, impacts of fertilizer use can include contribution to global climate change and degradation of soil and water resources and air quality, particularly when not properly utilized. Overall, the intent of this document is to maximize the benefits from utilizing fertilizers while minimizing any negative impacts.

The UN Agencies and their Member Countries are working towards achieving the Sustainable Development Goals (SDGs) by responding with various actions and recommendations in relation to sustainable soil and nutrient management.

The Committee on Agriculture (COAG), during its 25th session held 26-30 September 2016, recommended that FAO intensify its food safety work and technical support to smallholders at the local level concerning the safe use of fertilizers and pesticides (FAO, 2016).

The recent Status of the World's Soil Resources (SWSR) report published by FAO and the Intergovernmental Technical Panel on Soils (ITPS) identified ten major threats to soils that need to be addressed if the SDGs are to be achieved (FAO and ITPS, 2015). The Global Soil Partnership (GSP) and FAO subsequently produced the Voluntary Guidelines for Sustainable Soil Management (VGSSM) as a first step to addressing these threats, two of which are 'nutrient imbalances' and 'soil pollution' and involve fertilizer applications that can be excessive, insufficient or polluting, none of which are sustainable (FAO, 2017). The relevant chapters in the VGSSM; 3.3 - Foster nutrient balances and cycles, and 3.5 - Prevent and minimize soil contamination, provide initial guidance on promoting sustainable nutrient use in relation to soils, agriculture and the environment, however further support is required to implement these recommendations.

In addition, a declaration on managing soil pollution to achieve sustainable development was adopted in the recent third UN Environment Assembly (UNEA 3) held in Nairobi in December 2017 (UN Environment, 2017).

During the seventh Intergovernmental Technical Panel on Soils (ITPS) working session, 30 October - 3 November 2017, FAO and the ITPS agreed to develop an International Code of Conduct for the Use and Management of Fertilizers, hereafter referred to as the 'Fertilizer Code', or 'Code':

- (i) in response to COAG's request to increase food safety and safe use of fertilizers;
- (ii) to facilitate the implementation of the VGSSM to address nutrient imbalance and soil pollution; and
- (iii) to respond to the UNEA3 declaration on soil pollution.

Inputs to, and feedback on the contents and objectives of the Fertilizer Code, was obtained from a broad range of stakeholders during an online consultation that was open to the public from 21 December 2017 to 11 February 2018. The feedback generated in the forum was used to produce a zero-draft Fertilizer Code with the support and guidance of the ITPS, as well as from various experts within FAO. The zero-draft was reviewed by an open-ended working group (OEWG) of experts in the field of fertilizer management and policy, 7-9 May 2018. The OEWG constituted persons selected by member countries to represent the regions, as well as representatives from the fertilizer industry, academia, the research community and civil society.

The Fertilizer Code is to be presented to the 6th GSP Plenary Assembly, 11-13 June 2018, requesting endorsement, and subsequent presentation by the GSP to the Committee on Agriculture (COAG) in September 2018 and FAO Council in December.

GOAL

The goal of the International Code of Conduct for the Use and Management of Fertilizers is to contribute to sustainable agriculture and food security from a nutrient management perspective. It will provide a framework under which governments, the fertilizer industry, agricultural extension and advisory services, supporting academic and research institutions, actors in the nutrient recycling industry, civil society and end-users can contribute to this goal by following or adhering to the guidelines and recommendations provided.

WHAT IS A FERTILIZER?

When using the term 'fertilizer' we refer to a chemical or natural substance or material that is used to provide nutrients to plants, usually via application to the soil, but also to foliage or through water in rice systems, fertigation or hydroponics or aquaculture operations. Thus, multiple nutrient types and sources are considered within this Fertilizer Code including: chemical and mineral fertilizers; organic fertilizers such as livestock manures and composts; and sources of recycled nutrients such as wastewater, sewage sludge and digestates.

1. Scope, Goals, and Objectives

- 1.1. The International Code of Conduct for the Use and Management of Fertilizers is a set of agreed-upon expectations for behavior by various stakeholders for the use and management of plant nutrients.
- 1.2. This Fertilizer Code is addressed to governments, policy makers, the fertilizer industry, academia, research, agricultural and analytical service laboratories, agricultural extension and advisory services, civil society and users of fertilizers, including farmers.
- 1.3. The intent of the Fertilizer Code is to assist countries in the establishment of systems for monitoring the production, trade, distribution, quality, management and use of fertilizers to achieve sustainable agriculture and the Sustainable Development Goals (SDGs) by promoting integrated, efficient and effective use of quality fertilizers with the following outcomes:
 - 1.3.1. Ensure global food production and food security while maintaining soil fertility, ecosystems services and protecting the environment;
 - 1.3.2. Maximize the effective and efficient use of fertilizers to meet agricultural demands and minimize nutrient losses to the environment, thus enhance sustainable agriculture;
 - 1.3.3. Preserve ecosystem services and minimize environmental impacts from the use of fertilizers including soil and water pollution, ammonia volatilization, greenhouse gas emissions and other nutrient loss mechanisms;
 - 1.3.4. Maximize the potential economic and environmental benefits accrued from using fertilizers, including reducing the need for additional land to be brought into production, increased carbon storage in soils, and improvements in soil health;
 - 1.3.5. Minimize the negative impacts of excess nutrients in ground and surface waters on human and animal health;

1.3.6. Minimize the negative effects and potential toxicity of contaminants in fertilizers on soil, soil biodiversity as well as animal and human health;

1.3.7. Maintain and improve food safety, diets, nutritional quality and human health.

1.4. The objectives of the Fertilizer Code are to:

1.4.1. Provide a set of voluntary standards of practice for all stakeholders involved in the use and management of fertilizers, including governments, the fertilizer industry, agricultural extension and advisory services, the private sector, academia and research, end users and other public entities.

1.4.2. Encourage cooperation and collaboration between all stakeholders involved in the fertilizer value chain for the responsible and sustainable development, production, use and management of fertilizers and reused and recycled nutrients.

1.4.3. Promote collaboration, partnership and information exchange among the fertilizer industry in the access to and use of fertilizers consistent with legal competition obligations.

1.4.4. Promote recycling of nutrients for agricultural and other land uses to reduce the environmental impacts of excess nutrients in the biosphere.

1.4.5. Inspire governments and the private sector to promote and fund innovation in sustainable agricultural nutrient technologies and management.

1.4.6. Assist countries and regions to control and enforce fertilizer quality through appropriate regulatory mechanisms and reducing economic losses to end users.

1.4.7. Improve fertilizer safety and reduce the risks to human and animal health.

1.4.8. Encourage the promotion and dissemination of knowledge, including comparable statistics, on all matters related to fertilizer use and management through appropriate mechanisms, institutions and outreach programmes.

1.4.9. Encourage Integrated Soil Fertility Management (ISFM) using nutrients from a range of sources.

1.5. This Code is a living document and should be reviewed and updated by FAO every five to ten years, or, when and where deemed appropriate by Member Countries and through the appropriate FAO governing bodies.

2. Terms and Definitions

Agricultural extension and advisory services (AEAS): refers to any organization in the public or private sectors (NGOs, farmer organizations, private firms, etc.) that facilitates farmers' and other rural actors' access to knowledge, information and technologies, and their interactions with other actors; and assists them to develop their own technical, organizational and management skills and practices, so as to improve their livelihoods and well-being. (Christoplos, 2010)

Advertising: the promotion of the fair sale and wise use of fertilizers by printed and electronic media, social media, signs, displays, gifts, demonstration or word of mouth.

Animal manure: materials from livestock production operations used for fertilization purposes, including manure, urine, straw and other bedding materials.

Application rate: the quantity of fertilizer applied per unit area. May include an element of time, for example per growing season or year.

Biodiversity: the diversity among living organisms, which is essential to ecosystems function and services delivery (FAO, 2018a)

Biofertilizer: a substance containing live microorganism which, when used for plant production, increase the supply or availability of primary nutrients to plants through nitrogen fixation, phosphorus solubilization and the stimulation of plant growth through the synthesis of growth-promoting substances.

Biosolids: organic solids from wastewater that have been treated so that they can be used as a soil conditioner to provide plant nutrients, carbon, and other beneficial substances. See sewage sludge.

Biostimulant: product that stimulates plant nutrition processes independently of nutrient content, with the aim of improving one or more of: the plants' nutrient use efficiency or uptake; tolerance to abiotic stress; or, crop quality traits.

Contaminant: substance contained within fertilizers that are not plant nutrients. May include, but is not limited to, heavy metals, pathogens and fillers.

Digestate: solid material remaining after various digestion processes have been used on waste products such as livestock manures.

Disposal: any operation to dispose, recycle, neutralize, or isolate fertilizers and fertilizer waste, containers and contaminated materials.

Distribution: the process by which fertilizers are supplied and transported through trade channels to local, national or international markets and lands.

Ecosystem services: the multitude of benefits that nature provides to society. (FAO, 2018a)

Fertigation: the application of a plant nutrient, soil amendment, or reclaimed water from food processing and wastewater treatment facilities with irrigation water.

Fertilizer: a substance that is used to provide nutrients to plants, usually via application to the soil, but also to foliage or through water in rice systems, fertigation, hydroponics or aquaculture operations.

Fertilizer additives: substances added to or modifications of fertilizers, or products added to the soil, designed to increase fertilizer use efficiency through a variety of actions including, but not limited to, reductions in solubility, coatings of fertilizer granules, inhibition of nitrification or urea hydrolysis, or stimulation of soil microorganisms.

Fertilizer application: unless specified otherwise, 'application of fertilizer(s)' or 'fertilizer application' refers to the application of nutrients for the benefit of plant growth in general, and not to any specific type of fertilizer. It includes applications for agricultural and other purposes, including recreational and sporting facilities, public and private gardens and lawns.

Fertilizer grade or plant available nutrient content: the total amount of a plant nutrient in a fertilizer that is considered available for plant uptake.

Fertilizer industry: the entire value-chain involved in producing fertilizers, including basic production or mining, processing into final products, transportation, storage, and ultimate delivery to the fertilizer user.

Fertilizer management: the regulation and technical control of all aspects of fertilizers, including production (manufacture and formulation), authorization, import, export, labeling, distribution, sale, supply, transport, storage, handling, application and disposal of fertilizers to ensure safety, quality and use efficacy and to minimize adverse health and environmental effects and human and animal exposure.

Fertilizer misuse: can involve, but is not limited to, the application of one or more plant nutrients to the soil, foliage or water that would not reasonably be expected to produce a positive response on crop growth and development, fertilizer spills, or the application of contaminants to the soil that might pose risk to human health or the environment.

Fertilizer user: persons who apply fertilizers for the specific purpose of making plant nutrients available for plant uptake. Fertilizer users can include farmers, land managers and food producers, public or private organizations maintaining parks, gardens and sporting facilities and persons using fertilizers for home gardening purposes.

Green manure: plants that are grown in order to provide soil cover and to improve the physical, chemical, and biological characteristics of soil. (FAO, 2011)

Inorganic fertilizer: a fertilizer produced industrially by chemical processes or mineral extraction. Note that though urea is technically an organic material, it is referred to within this Fertilizer Code as an inorganic fertilizer.

Integrated soil fertility management (ISFM): “the application of soil fertility management practices and the knowledge to adapt these to local conditions, which maximize fertilizer and organic resource use efficiency and crop productivity. These practices necessarily include appropriate fertilizer and organic input management in combination with the utilization of improved germplasm”. (Sanginga and Woome, 2009)

International Organization: includes intergovernmental organizations of the UN, UN Specialized Agencies and Programmes, Development Banks, International Agricultural Research Centers including CGIAR Member Centres, and international NGOs.

Marketing: the overall process of product promotion, including advertising, product public relations and information services as well as the distribution and sale on local and international markets.

National Agriculture Research System (NARS): cross section of stakeholders comprises of public agricultural research institutes, universities and other tertiary institutions, farmer groups, civil society organizations, private sector and any other entity engaged in the provision of agricultural research services.

Nitrification inhibitor: substance that inhibits biological oxidation of ammoniacal nitrogen to nitrate.

Organic fertilizer: a carbon-rich fertilizer derived from organic materials, including treated or untreated livestock manures, compost, sewage sludge and other organic materials used to supply nutrients to soils.

Plant nutrients: Elements essential for normal growth and reproduction of plants, generally not including carbon, hydrogen, and oxygen. The primary plant nutrients are nitrogen, phosphorus, and potassium. Secondary and micronutrients include sulfur, calcium, magnesium, boron, chlorine, copper, iron, manganese, molybdenum, zinc and others.

Public interest group: includes in this context (but is not limited to) scientific associations, farmer groups, civil society organizations, labour unions and non-governmental environmental, consumer and health organizations.

Recycled nutrient: plant nutrients applied to and taken up by growing plants that can be returned to the plant nutrient cycle after consumption by humans or animals, as by-products of food processing, or as plant residues returned to the soil.

Risk: the probability and severity of an adverse health or environmental effect occurring as a function of a hazard and the likelihood of exposure to fertilizers or to soil impacted by fertilizer applications.

Sewage sludge: solid materials removed from the wastewater stream originating from a public sewer system. May or may not be subject to additional treatment to reduce volume, pathogens, odors, and nutrient content. See biosolids.

Soil fertility: The ability of a soil to sustain plant growth by providing essential plant nutrients and favorable chemical, physical, and biological characteristics as a habitat for plant growth.

Soil health: is “the capacity of soil to function as a living system. Healthy soils maintain a diverse community of soil organisms that help to control plant disease, insect and weed pests, form beneficial symbiotic associations with plant roots, recycle essential plant nutrients, improve soil structure with positive repercussions for soil water and nutrient holding capacity, and ultimately improve crop production”. (FAO, 2011)

Struvite: a phosphate fertilizer used in agricultural production as an alternative source of rock phosphate, that also contains nitrogen and magnesium. Struvite can come from recycled sources or waste residues such as wastewater or urine.

Sustainable soil management (SSM): “soil management is sustainable if the supporting, provisioning, regulating, and cultural services provided by soil are maintained or enhanced without significantly impairing either the soil functions that enable those services or biodiversity. The balance between the supporting and provisioning services for plant production and the regulating services the soil provides for water quality and availability and for atmospheric greenhouse gas composition is a particular concern.” (FAO, 2017)

Urease inhibitor: substance that inhibits urease enzyme’s hydrolytic action on urea.

Wastewater: Water which is of no further immediate value to the purpose for which it was used or in the pursuit of which it was produced because of its quality, quantity or time of occurrence (FAO, 2018b).

3. Soil fertility and plant nutrition

- 3.1. In regards to fertilizer management decisions, strong consideration should be given to the capacity of soil to retain and supply plant nutrients and the ability to support plant growth, and crop demand for nutrients.
- 3.2. Soil considerations include its origin, composition and classification, as well as previous management practices that influence the chemical, physical and biological properties that contribute to its fertility.
- 3.3. Plant nutrition considerations include previous and anticipated crop demand for all nutrients, unique nutrient requirements of the crop and cultivar to be grown, and desired nutritional composition of the crop and cultivar to be grown. Further, the cultivar to be grown should be adapted to local environmental and soil fertility conditions.
- 3.4. There are many sources of plant nutrients available and they should be considered as complimentary rather than exclusive to one another. There are many benefits to providing one or more plant nutrients from multiple sources including, but not limited to, extended nutrient availability for plant growth and carbon additions to soil with the combination of organic and inorganic fertilizers.
- 3.5. Governments should:
 - 3.5.1. Encourage land use and land tenure policies that incentivize farmers to improve soil fertility and soil health and, in some situations, indirectly discourage conversion of land from native ecosystems into agricultural production.
 - 3.5.2. Encourage soil conservation through relevant policies and incentives to offset reductions in soil fertility due to the loss of fertile topsoil through erosion.

- 3.5.3. Ensure that the analytical means for assessing plant nutrient status and basic soil chemical properties such as pH and salinity, and other soil parameters, are available and utilized in making fertilizer recommendations based on the assessment of plant nutrient status and/or soil properties at a given location. Public and private laboratory services, or a combination, can be utilized to meet these needs. Analytical means can include traditional laboratory based (for example, wet-chemical) procedures, other field or laboratory-based modern methods, or properly calibrated field testing kits.
 - 3.5.4. Promote the use of soil and plant tissue testing, and other means of assessing soil fertility status, by farmers and farmer advisors to determine fertilizer needs before applying fertilizers. Public campaigns, educational materials, and demonstrations are example promotion methods.
 - 3.5.5. Develop and encourage the use of soil maps and other geospatial methods for efficient and effective use of fertilizers
 - 3.5.6. Where necessary, provide government support for extension/outreach activities that develop evidence-based fertilizer recommendations based on relevant soil characteristics, existing nutrient pools, crop and cultivar to be grown, nutrient considerations for previous crop grown, expected yield and quality, local experience and other site-specific information.
- 3.6. Through their NARS, universities and AEAS, in collaboration with international research centers, and other research organizations, governments should:
- 3.6.1. Encourage Integrated Soil Fertility Management (ISFM) through the use of all relevant sources of plant nutrients including animal manures, compost, crop residues, and other materials, particularly those that are locally available.
 - 3.6.2. Further through ISFM, encourage the use of crop rotations, legumes, cover crops, and other green manures as a means to enhance soil health and fertility.

- 3.6.3. Encourage the use of plant nutrition considerations such as the previous and anticipated crop demand for all nutrients, unique nutrient requirements of a crop and cultivar to be grown, and desired nutritional composition of the crop and cultivar to be grown in soil fertility management. Promote the use of cultivars that are adapted to local environmental and soil fertility conditions
- 3.6.4. Promote the correction or management of soil conditions that prevent crop response to plant nutrient additions. Such conditions would include extreme acidity or alkalinity, excessive salts or sodium, or lack of organic matter limiting nutrient cycling.
- 3.6.5. Establish evidence-based limits for phosphorus levels in soils above which additional phosphorus applications are prohibited or limited due to a low probability of a positive crop response and a high probability of negative environmental impacts on surface water resources.
- 3.6.6. Develop and refine evidence-based fertilizer recommendations at the local and regional levels based on relevant soil characteristics, crops to be grown, previous crops grown, expected yield and quality, and other site-specific information to promote balanced application of plant nutrients proportional to expected crop absorption and nutrient export from the production site.
- 3.6.7. Promote the use of soil and plant tissue testing, and other means of assessing soil fertility status, as a means for farmers and farmer advisors to make fertilizer application decisions.
- 3.6.8. Develop and refine adapted soil testing methods including local indicators of soil health in the interest of advancing the adoption and efficient use of fertilizers.
- 3.6.9. Develop and refine the use of geospatial methods and precision application equipment with the goal of advancing the efficient use of fertilizers.

3.6.10. Work with agricultural economists to define economically optimum fertilizer application rates and incorporate that information into outreach and extension programs.

3.7. The fertilizer industry should:

3.7.1. Encourage fertilizer recommendations that consider all nutrient requirements and that are based on site-specific information including relevant soil characteristics, crops and cultivars to be grown, previous crops grown, and expected yields, and if using soil test methods, that the methods are calibrated for the particular soil.

3.7.2. Promote the application of fertilizers at the proper time and amount, as well as use of the most appropriate fertilizer source and placement in accordance with global principles of plant nutrient management such as ISFM and 4R nutrient stewardship (IPNI, 2012).

3.7.3. Provide adequate training of retail sales and technical staff to promote proper soil testing and fertilizer best management practices that maximize the efficient use of plant nutrients while minimizing off-site environmental effects.

3.7.4. Develop and encourage the use of soil maps and other geospatial methods for efficient and effective use of fertilizers and identification of suitable fertilizer formulations.

3.7.5. Carefully develop and evaluate fertilizer additives (for example, nitrification inhibitors, urease inhibitors, biostimulants) and market only when demonstrated to be effective in increasing fertilizer use efficiency and/or for the reduction of off-site environmental impacts. Continue to seek innovations in fertilizers and technologies for providing adequate plant nutrition.

3.7.6. Promote the correction or management of soil conditions that prevent crop response to plant nutrient additions. Such conditions would include extreme acidity or alkalinity, excessive salts, carbonates or sodium, or lack of organic matter limiting nutrient cycling.

3.8. Fertilizer users should:

3.8.1. Correct or manage soil conditions that prevent crop response to plant nutrient additions. Such conditions would include extreme acidity or alkalinity, excessive salts or sodium, or lack of organic matter limiting nutrient cycling.

3.8.2. When available, utilize soil testing to identify soil conditions that might limit crop response to plant nutrient additions and for the determination of fertilizer recommendations.

3.8.3. Utilize fertilizer recommendations by local AEAS and outreach providers that are based on site-specific information including relevant soil characteristics, crop and cultivar to be grown, previous crop grown, and expected yields.

3.8.4. Apply fertilizers at the proper time and amount, as well as use of the most appropriate fertilizer source and placement in accordance with global principles of plant nutrient management such as ISFM and 4R Plant Nutrition.

3.8.5. Practice ISFM, as appropriate, through the use of all relevant sources of plant nutrients including animal manures, compost, crop residues, and other materials, particularly those that are locally available. Further through ISFM, encourage the use of crop rotations, legumes, cover crops, and other green manures as a means to enhance soil health and fertility.

4. Fertilizer use and management

- 4.1. Proper management and use of fertilizers is the responsible handling, storage, transportation, and application of fertilizers with the express goal of enhancing plant growth or attributes (nutritional content, color, flavor, and so on) to maintain or improve soil health and minimize any potential environmental impacts.
- 4.2. Fertilizer nutrients that are not taken up by plants or retained in soils may be transported to waterways, especially nitrogen and phosphorus, causing eutrophication and deterioration of water quality. Leaching of mobile forms of nitrogen to water used for human consumption has potential human health impacts. Excess nutrients may also be released from soils to the atmosphere through ammonia volatilization or as greenhouse gas emissions of nitrous oxide. In addition, excess fertilizer use and losses of nutrients due to the misuse of fertilizers can lower profits of farmers and in some cases can lead to crop failure.
- 4.3. Insufficient use of fertilizers entails adding nutrients at levels below crop requirement and results in opportunity costs for yield potential, nutritional content, return of carbon to the soil, and enhancement of soil health as well as net nutrient removal from the soil system.
- 4.4. A holistic approach must be taken when developing and implementing best management practices for fertilizer use recognizing that practices to reduce the negative impacts from one nutrient may increase the negative impacts from other nutrients. In this case, the best management practices that produce the most positive overall effect should be adopted.
- 4.5. Misuse of fertilizers can involve, but is not limited to:
 - 4.5.1. Over or excessive use, that is, the application of one or more plant nutrients to the soil, foliage or water that would not reasonably be expected to produce a

positive response in growth or composition for plants or crops growing in that soil, or to maintain soil health.

4.5.2. Improper or inappropriate use, such as the application of fertilizers to the soil surface when not appropriate, not suited to the soil type, soil properties or the landscape, crop requirement, or the prevailing weather and climatic conditions, thus resulting in nutrient losses to the environment;

4.5.3. Nutrient imbalance resulting from fertilizers composed of an incomplete or improperly balanced nutritional profile compared to what the target crop(s) in question requires for optimal growth and product quality;

4.5.4. The application of contaminants to the soil via fertilizers that might pose unacceptable risk to human health or the environment;

4.5.5. Improper storage of fertilizers; or

4.5.6. Fertilizer spills.

4.6. Entities addressed by the Code including governments, International Organizations, the fertilizer industry, academia, research organizations, agricultural extension and advisory services, civil society and end-users should consider all available facts on the negative impacts of the misuse of fertilizers and should promote responsible dissemination of information on fertilizers and their uses, risks and alternatives when available.

4.7. Governments should:

- 4.7.1. Develop policies that support sustainable soil management (SSM) and the responsible use of fertilizers in order to protect soil, improve degraded lands, optimize agricultural production on existing agricultural land, and minimize the conversion of land from native ecosystems into agricultural production.
- 4.7.2. Support and stimulate, through legislation and incentive measures, the development of holistic and integrated fertilizer solutions for a more balanced crop nutrition and make sure that these are available to the end users.
- 4.7.3. As needed, develop policies that facilitate affordable access to fertilizers by farmers and which are linked with appropriate and relevant fertilizer use policy, guidelines and rural AEAS programs.
- 4.7.4. Ensure that any fertilizer provided as a result of subsidies, direct or indirect, or donations are used in a responsible manner according to this code. Such fertilizers should not encourage or lead to excessive or unjustified use, cause the displacement of management practices or use of other fertilizers that offer greater efficiency and/or with lower environmental impact, and should provide a balanced mix of nutrients for the intended crops.
- 4.7.5. Draft appropriate legislation to minimize the negative impacts of fertilizer applications to agricultural or other lands, including from the misuse of fertilizers.
- 4.7.6. Establish evidence-based application limits for nutrients from fertilizers, including inorganic and organic fertilizers, sewage sludge, animal waste and organic residues to avoid damaging effects on the environment, and on human and animal health.
- 4.7.7. Maintain databases and statistics on the environmental effects of fertilizers, in coordination with industry and relevant international agencies, such as FAO (FAO, 2018c). Suitably trained personnel and adequate resources should be made available to ensure the reliability and accuracy of data and information collected.

4.8. Through their NARS and national universities, and in partnership or collaboration with international centers and other relevant research institutions, governments should:

4.8.1. Carry out appropriate research to determine responsible fertilizer and other agronomic management for major soils and crops in their regions.

4.8.2. Evaluate new and existing products sold as fertilizers to validate their effectiveness and seek advancements in nutrient use efficiency. When possible and appropriate, such information should be shared with relevant stakeholders in other countries.

4.8.3. Develop fertilizer management tools to help provide fertilizer users with the information necessary for usage in order to avoid overuse and misuse (source, rate, timing, and method).

4.8.4. Create soil maps for the purpose of managing and monitoring fertilizer applications, as well as to identify zones that are vulnerable to the impacts of fertilizer misuse and/or environmental impacts.

4.9. Through national and regional rural AEAS, governments should:

4.9.1. Provide locally or regionally relevant and recognized training to fertilizer users and retailers on fertilizer use with the goal of maximizing the balanced and efficient use of plant nutrients to enhance sustainable agriculture, food safety and nutrition, and, to maximize the potential environmental benefits accrued from using fertilizers including reducing the conversion of land from native ecosystems into agricultural production through increased yields, increasing carbon storage in soils, and improvements in soil health.

4.9.2. Provide local or regionally relevant and recognized training to fertilizer users and fertilizer retailers to minimize the environmental impacts from the use of fertilizers including pollution by loss of nutrients via runoff, leaching, gaseous

emissions, disruption of soil biological processes, and reducing the effects of contaminants on soil, animal, and human health.

4.9.3. Disseminate information on reducing risks to human and animal health associated with fertilizer handling and use.

4.10. The fertilizer industry should:

4.10.1. Develop strategies for more holistic integrated fertilizer solutions aiming at a more balanced crop nutrition, taking crop requirements and local soil conditions into account, and through improved fertilizer compositions and use of different fertilizer delivery mechanisms.

4.10.2. Develop, promote and distribute information on fertilizer best management practices to fertilizer retailers, salespeople, farmers and end-users that are based on the principles of nutrient stewardship and that maximize the efficient use of plant nutrients while minimizing off-site environmental effects.

4.10.3. Generate knowledge and provide information to fertilizer users on the health and safety aspects of handling and using fertilizers, and how to protect humans, and animals, from possible adverse effects including impacts of low-level chronic exposure.

4.10.4. Provide users and environmental authorities with information on appropriate remediation measures in case of fertilizer spills.

4.11. Fertilizer retailers, salespersons, farmers organizations, analytical laboratories, consultants, and/or end-users should:

4.11.1. Familiarize themselves and comply with locally applicable regulations and limits and follow guidelines relevant to fertilizer use.

- 4.11.2. Provide correct information and/or adhere to best management practices for fertilizer use including proper handling, storage, transportation, and disposal, and follow locally relevant fertilizer recommendations.

- 4.11.3. Keep records of fertilizer sales and/or fertilizer applications along with other agronomic practices, data and farm records to support governments for the purpose of statistical information on fertilizer use.

5. Nutrient reuse and recycling

- 5.1. Potential nutrient sources of reused or recycled materials include wastewater, sewage sludge, biosolids, animal manure, urban wastes, composts, digestates, biochar, inorganic or organic by-products such as struvite, ammonium sulfate and residues from food and agro-industries.
- 5.2. The use of nutrients from reused and recycled sources should be encouraged, however consideration should be given to quality, safety and environmental and biosecurity risks associated with managing and using recycled nutrients.
- 5.3. Governments should:
 - 5.3.1. Encourage, through advocacy, dialogue, policy, financial mechanisms and the provision of resources, cross-sectorial innovation and co-creation and sharing of knowledge in nutrient reuse and recycling technologies for use as fertilizers across relevant sectors including agriculture, water, energy and health to encourage the reuse and recycling of nutrients.
 - 5.3.2. Develop policies that encourage the reuse, recycling and utilization of locally-available sources of plant nutrients through the use of animal manures, compost, crop residues, and other materials suitable for application to soil as a source of plant nutrients and which may also contribute to soil quality in terms of organic matter or other soil benefits such as a liming effect.
 - 5.3.3. Set appropriate guidelines and limits on contaminants in reused and recycled nutrients sources that pose an unacceptable risk to human health and the environment.
- 5.4. Through their NARS, universities and rural AEAS, supported by collaboration with international research centers and other research organizations, governments should:

- 5.4.1. Lead and facilitate sharing of information and co-creation of knowledge on reusing and recycling nutrients for agricultural and other plant production purposes between actors in government, industry, academia, research organizations and end-users including land managers and farmers.
 - 5.4.2. Test sources of and products made from reused and recycled nutrients to ensure that they provide nutritional and other agronomic benefits to plants and soil without compromising human and environmental health and safety.
 - 5.4.3. Encourage and promote nutrient recycling and the use of reused and recycled materials for application to soil as a source of plant nutrients and to enhance soil health and fertility.
 - 5.4.4. Encourage and promote the use of crop rotations, legumes, cover crops, and other green manures as a means to enhance soil health and fertility.
 - 5.4.5. Ensure available and appropriate information, such as nutritive and non-nutritive contents, of reused and recycled nutrients sources for use as fertilizers is made available and accessible to the public, including to farmers and other end-users.
- 5.5. The fertilizer industry, and/or relevant entities from the private sector, should:
- 5.5.1. Encourage and drive innovation, as well as provide resources, to develop technologies for reuse and recycling of nutrients for use as fertilizers.
 - 5.5.2. Work with NARS, universities, research organizations and farmers in developing and testing innovative and safe methods, techniques and uses for reusing and recycling waste and other materials for use as fertilizers.
 - 5.5.3. Work with NARS, universities, research organizations to research and develop ways to decontaminate sewage sludge and other sources of recycled nutrients.

5.5.4. Actively engage in dialogue, co-creation of knowledge and knowledge-exchange with and between governments, industry, academia, research organizations and clients/end-users (land managers and farmers) on the reuse and recycling of nutrients as fertilizers.

5.6. Fertilizer users should:

5.6.1. Familiarize themselves and comply with locally-appropriate regulations and guidelines relevant to the use of reused and recycled materials for use as plant nutrients, including allowable limits on nutrient application rates and contaminant loadings.

5.6.2. Adjust application rates of inorganic fertilizers, as appropriate, in consideration of the nutrients that are being recycled.

5.6.3. Utilize application rates, timing, and placement that maximize the availability of recycled plant nutrients to growing crops and minimize potential negative impacts such as nutrient leaching, odors, runoff, or any other undesirable off-site effects.

6. Composition, limits and testing

6.1. The onus of testing and ensuring that fertilizers and sources of recycled nutrients are compliant with quality and safety standards lies with both the government, who should oversee, set standards and regulate, and the fertilizer industry who should ensure that fertilizers produced, marketed and sold are compliant, effective and safe.

6.2. Relevant intergovernmental bodies, in partnership with the government and the fertilizer industry, should assist development of harmonized fertilizer sampling and testing procedures.

6.3. Governments should:

6.3.1. Be responsible for regulating the composition of fertilizers in terms of:

6.3.1.1. nutrient content;

6.3.1.2. heavy metals linked to the production process and source of raw material;

6.3.1.3. harmful microbes;

6.3.1.4. other dangerous or toxic materials; and

6.3.1.5. additives such as sand, ground rocks and other materials used to dilute the original product.

6.3.2. Set and regulate evidence-based safety standards, limits and guidelines on harmful contents of fertilizer products, taking into consideration the different pathways of contamination and their impacts on humans and animals.

6.2.3 Ensure the availability and capability of testing facilities for quality control.

6.4. Through their NARS, universities and rural AEAS, supported by international research centers, other research organizations, and the fertilizer industry, governments should:

6.4.1. Oversee and support the field-testing of fertilizers for their efficacy in providing nutrients to match plant nutrient deficiencies and/or improve soil fertility.

6.4.2. Conduct appropriate testing of recycled nutrient sources and products intended for use in plant production to ensure they meet appropriate guidelines for nutritive quantity and quality, as well as safety in terms of limits on contaminants such as heavy metals, harmful microbes, and other dangerous or toxic materials.

6.4.3. Educate stakeholders and fertilizer users on the use of information pertaining to the composition, quality, and purity of fertilizers offered for sale, and on means to remain compliant with relevant regulations and guidelines.

6.5. The fertilizer industry, or relevant private entity, should:

6.5.1. Assist governments to set standards, regulations and guidelines on the composition and testing of fertilizer products.

6.5.2. Develop and adopt own company quality management to support self-regulation by the industry, where appropriate, and subject to legal obligations.

6.5.3. Test sources of products containing reused and recycled nutrients and marketed as fertilizers so that they comply with relevant quality and safety standards.

6.5.4. Ensure fertilizer products comply with government standards and that end-users are supplied with safe and high-quality products that have been tested by recognized standards and comply with appropriate regulations.

6.5.5. Ensure products marketed and sold as fertilizers are effective in providing nutrients for plant production purposes, based on scientific evidence.

6.5.6. Only market fertilizer additives for which scientific evidence supports enhanced crop response, nutrient use efficiency, soil health or environmental quality.

6.5.7. Verify the quality and purity of fertilizers offered for public sale.

6.6. Fertilizer users should:

6.6.1. Purchase or apply fertilizers that have evidence of appropriate and proper testing for composition, quality, and purity.

6.6.2. Follow appropriate guidelines and regulations, as well as application limits for nutrients and maximum allowable concentrations for contaminants.

6.6.3. Inform the relevant authorities when suspecting an issue with a fertilizer product.

7. Access, distribution and labelling

7.1. Governments should:

- 7.1.1. Have the overall responsibility for facilitating the access and availability, and regulating the distribution and use of fertilizers in their countries and should ensure the allocation of adequate resources for this mandate.
- 7.1.2. Implement a fertilizer policy, quality control, and registration system when appropriate, which includes penalties for non-compliance when deemed necessary and wherever possible. Governments are encouraged to harmonize policies at the global level, particularly in relation to quality assurance methods.
- 7.1.3. Ensure locally or regionally relevant and recognized training relating to the retail sale of fertilizers, so as to ensure that those involved are capable of providing end-users with sound advice on fertilizer use and management and on the environmental and health risks associated with the misuse of fertilizers.
- 7.1.4. Develop, and maintain transportation infrastructure to improve access and reduce logistical costs associated with fertilizer trade and distribution.
- 7.1.5. Ensure that the proposed use, label claims and directions, packages, safety data sheets, technical literature, and advertising of products sold as fertilizers is based on scientific evidence.
- 7.1.6. Ensure products sold as fertilizers are clearly, legibly and accurately labeled. Governments are encouraged to harmonize labelling requirements at the global level. At minimum, labels should include:
 - 7.1.6.1. net weight of the product;
 - 7.1.6.2. information on the fertilizer grade/content of plant available nutrients;

- 7.1.6.3. information on the content of contaminants as required by national regulations;
- 7.1.6.4. potential environmental and health impacts;
- 7.1.6.5. release date of the lot of batch of fertilizer and expiry date, if appropriate;
- 7.1.6.6. relevant information on the storage, safe handling, and where to find information on recommended rates, time of application and placement of fertilizers.

7.2. The fertilizer industry should:

- 7.2.1. Ensure that persons involved in the sale of fertilizers along the fertilizer value chain are trained adequately to be capable of providing relevant information to the related actors in the supply chain, such safety information, advice on risk reduction, and information on the responsible and efficient use of the fertilizer products.
- 7.2.2. Ensure that persons involved in the sale of fertilizers to users are trained adequately and are capable of providing sound advice on the use of the fertilizer products they are selling, and on the environmental and health risks associated with the misuse of fertilizers.
- 7.2.3. Ensure that technical literature provides sufficient information on adequate practices for different contexts consistent with nutrient stewardship, including the observance of right rate, right source, right placement, and right timing.
- 7.2.4. Provide fertilizers in a range of pack sizes consistent with national, sub-regional or regional requirements, and appropriate for the needs of small-scale farmers, households and other local users, in order to reduce costs as well as any environmental risks associated with misuse or inappropriate storage, and to

discourage sellers from repackaging products in unlabeled or inappropriate containers.

7.2.5. Clearly, legibly and accurately label fertilizers in line with Article 7.1.6 and according to relevant regulations/guidelines on good labelling practices and that are consistent with those of the relevant authorities in the country of sale.

7.2.6. Ensure that advertising materials, statements and promotional activities:

7.2.6.1. are technically justifiable and ethically correct;

7.2.6.2. do not encourage the use of the fertilizers for uses other than those specified on the approved label;

7.2.6.3. do not contain recommendations other than/or varying from any existing applicable regulations;

7.2.6.4. make no guarantees or imply results unless explicit evidence to authenticate such claims are available;

7.2.6.5. do not include any inappropriate incentives or gifts to encourage the purchase of fertilizers.

7.3. Fertilizer users should:

7.3.1. When and where possible, obtain fertilizers from officially recognized or licensed dealers and that are properly and clearly labelled.

7.3.2. Follow appropriate guidelines and instructions regarding the safe handling and use of fertilizers according to the labelling and other technical materials and advice from suitably recognized and qualified individuals providing the product.

7.3.3. Recycle and/or dispose of fertilizer containers where appropriate.

7.3.4. Contact the relevant authorities when the quality of the product does not correspond to the claims made on the label, or when they experience issues with the product.

8. Information, Extension and Outreach

8.1. Governments should:

- 8.1.1. Encourage collaboration and coordination between NARS, rural AEAS, NGO's, farmer cooperatives and organizations, and universities to provide education programs, technology development and technology transfer as needed within a country without creating underserved areas.
- 8.1.2. Provide support for extension/outreach activities for farmers, to provide advice and assistance in the responsible use of fertilizers and other sources of plant nutrients.
- 8.1.3. Provide government funded research, extension and outreach programs to meet needs not covered by NARS, NGO's, farmer cooperatives and organizations, and universities.
- 8.1.4. Facilitate the importation, co-creation and adoption of new technologies that will enhance soil fertility, farm productivity and quality, improve fertilizer use efficiency, or minimize off-site impacts of fertilizers.
- 8.1.5. Promulgate appropriate safety regulations for the storage, handling, transport, and application of fertilizers.
- 8.1.6. Use science-based regulations and guidelines to regulate new technologies (that will enhance soil fertility, farm productivity and product quality, improve fertilizer use efficiency, and/or minimize off-site impacts of fertilizers).
- 8.1.7. Collaborate with industry, NARS, NGO's, universities, farmer cooperatives and organizations, and AEAS to facilitate the use of appropriate machinery and technology to support the enhancement of soil fertility, improvement of fertilizer use efficiency, and/or the minimizing of off-site impacts of fertilizers.

8.1.8. Governments, whose programs for regulating fertilizers are well developed should, to the extent possible, provide technical assistance, including training, to other countries in developing their infrastructure and capacity to manage fertilizers throughout their life-cycle.

8.1.9. Ensure that all analytical laboratories doing soil and crop testing and analysis have proper quality controls to ensure that they provide reliable results in a timely manner.

8.2. The fertilizer industry should:

8.2.1. Collaborate with governments, NARS, public extension service providers, farmer cooperatives and organizations, and NGOs to provide education programs and technology transfer as needed within a country without creating underserved areas.

8.2.2. Collaborate in sharing relevant information and data to governments, NARS, NGOs, public extension service providers, farmer cooperatives and organizations, and universities to facilitate the delivery of complete and objective education programs that promote fertilizer best management practices that maximize the efficient use of plant nutrients while minimizing off-site environmental effects.

8.2.3. Work with governments, NARS, NGOs, public extension service providers, farmer cooperatives and organizations, and universities voluntarily to take corrective actions when problems occur with fertilizers, and when requested by governments, help find solutions to difficulties.

8.2.4. Collaborate with other industries, NARS, NGOs, governments, farmer cooperatives and organizations, universities and public extension services to develop and facilitate the use of appropriate machinery and technology to support the enhancement of soil fertility, improvement of fertilizer use efficiency, and/or the minimization off-site impacts of fertilizers.

8.3. Agricultural extension and advisory services and outreach providers (NARS, NGOs, farmer cooperatives and organizations, and universities) should:

8.3.1. Commit to continual professional development to remain current on technological advances and innovation processes that encourage co-creation and sharing of knowledge aiming to maximize the impact of educational and research efforts.

8.3.2. Collaborate with governments, NARS, public extension service providers, farmer cooperatives and organizations, and NGOs to provide educational programs on adherence to safety regulations for the storage, handling, transport, and application of fertilizers at the local level, compliance with national legislation as regards children's involvement, and work toward identifying and solving safety issues for which regulations have yet to address.

8.3.3. Collaborate with governments and fertilizer industry to provide education programs and technology transfer as needed within a country without duplication of efforts or creating underserved areas.

8.3.4. Seek out collaborations with other disciplines such as economics, engineering, sociology, plant breeding, plant pathology and other relevant areas to identify and overcome barriers to the responsible use of fertilizers and the adoption of practices that maximize the efficient use of plant nutrients while minimizing off-site environmental effects.

8.3.5. Work with governments and industry to take corrective actions when problems occur with fertilizers, and when requested, help find solutions to difficulties.

9. Monitoring and Observance

- 9.1. To ensure the accessibility and availability of the Fertilizer Code and any relevant supporting materials, it is made available on the FAO website in the six official languages of the United Nations, and as required translated into other languages.
- 9.2. FAO, and all other relevant international organizations, should give their full support to the Fertilizer Code and its objectives, and supporting guidelines.
- 9.3. The Fertilizer Code should be made available and brought to the attention of all stakeholders referred to within: governments, the private sector, actors in the fertilizer supply chain, actors in the nutrient recycling industry, supporting academic and research institutions, analytical laboratories, farmer organizations and end-users.
- 9.4. Governments are encouraged to take on the responsibility for overseeing the implementation of the Fertilizer Code within their countries and promoting its objectives regarding the sustainable and responsible use of fertilizers and other nutrient sources for agriculture and other plant production purposes in order to avoid negative impacts on human and animal health and the environment.
- 9.5. The stakeholders addressed in this Code, and all others dealing directly or indirectly with fertilizers should understand their responsibility in adhering to and promoting its objectives.
- 9.6. Governments and policy makers should consider the Fertilizer Code when drafting regulations, laws, policies or other instruments related to fertilizers used for agriculture and other plant production purposes.
- 9.7. Governments and other entities addressed by this Fertilizer Code, including the private sector, NGOs and supporting academic and research institutions, with the help of FAO, are strongly encouraged to monitor their progress on the observance of this Code and

report back all relevant information on their progress to FAO within 4 years of the launch of this Code, if applicable.

9.8. As stated in Article 1.5, this is a living document, and any changes to the Fertilizer Code due to new information or developments related to fertilizers and their impacts will be made by FAO through consultation with relevant technical experts and approval of the appropriate FAO governing bodies. Any changes and their implications will be communicated to all the entities addressed by this Code.

9.9. This Fertilizer Code of Conduct should be reviewed, and if necessary, revised every 5 years in order to keep up with any emerging needs and advances in technology.

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