Food and Agriculture Organization of the United Nations

World Health Organization

AD HOC FAO/WHO EXPERT MEETING ON WATER QUALITY IN AGRIFOOD SYSTEMS AND FOOD SAFETY IMPLICATIONS – FOCUS ON CHEMICAL CONTAMINANTS

20–23 MAY 2025, ROME

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Ad hoc FAO/WHO Expert Meeting on water quality in agrifood systems and food safety implications – focus on chemical contaminants

20–23 May 2025, FAO headquarters, Rome

SUMMARY REPORT

Issued in June 2025

The ***Ad hoc FAO/WHO Expert Meeting on water quality in agrifood systems and food safety implications – focus on chemical contaminants*** was organized jointly by the Agrifood Systems and Food Safety Division of the Food and Agriculture Organization of the United Nations (FAO) and the Department of Nutrition and Food Safety and Department of Environment, Climate Change and Health of the World Health Organization (WHO). The main objective of the meeting was to facilitate the finalization of the document *Prioritizing food safety issues related to chemical water quality in agrifood systems*.[1]

The meeting was attended by 11 experts from various geographic regions and with a wide range of expertise in areas related to water chemical contaminants and food safety, such as i) water use in agrifood production systems; ii) water quality, safety and environmental management; iii) food safety risk assessment and public health; iv) analytical chemistry and transfer of contaminants from water to food/feed; and v) exposure assessment. The experts were supported by the joint FAO/WHO Secretariat that provided additional knowledge and technical inputs to the discussions.

This document summarizes the key conclusions of the meeting. The full report, including the deliberations at the meeting, will be published later in 2025 under the Food Safety and Quality Series. The meeting participants are listed in Annex 1 of this summary report. Maged Younes served as Chairperson and Andrew Pearson as Rapporteur.

[1] The meeting focused on chemical contaminants as microbiological contaminants have already been assessed by the Joint FAO/WHO Expert Meeting on Microbiological Risk Assessment (JEMRA): https://doi.org/10.4060/cc4081en, https://doi.org/10.4060/cc4356en, https://doi.org/10.4060/cb7678en, https://doi.org/10.4060/CA6062EN

More information on FAO's and WHO's work on agrifood and water safety is available at:

www.fao.org/food-safety

www.fao.org/food-safety/scientific-advice/foresight

and

www.who.int/foodsafety

WHO | Chemical Safety and Health

WHO | Water Sanitation and Health

Background

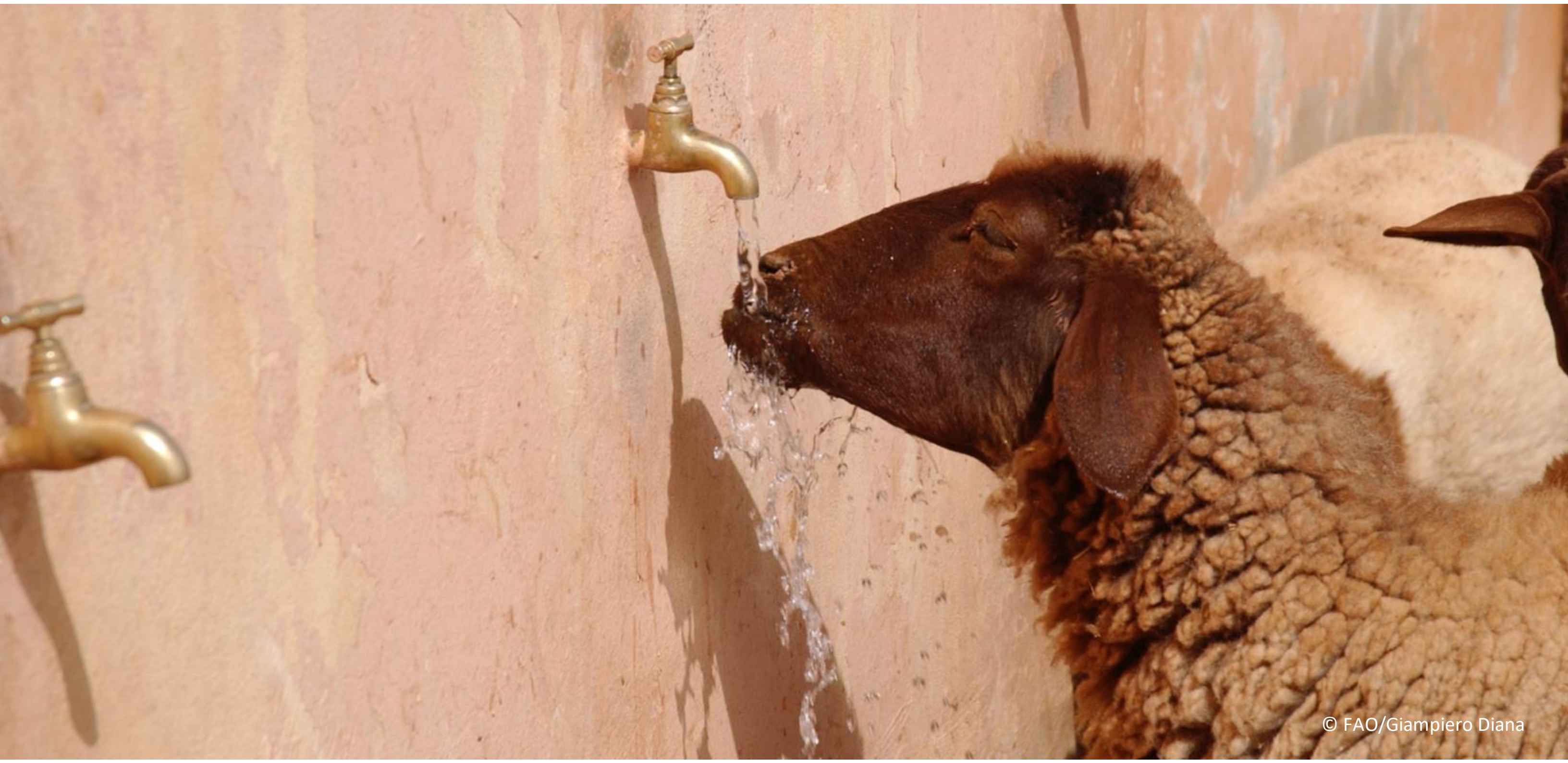
The use of good quality water at different stages of agrifood systems – from irrigation, animal farming, aquaculture, cleaning and food processing to drinking water – is crucial for food safety. Meeting the food demands of the growing global population will require increased water availability. To manage water demand in agriculture, innovative approaches and abstraction from alternative water sources are increasingly being adopted. Circular economy polices and processes are promoting the transformation to more sustainable solutions such as closed-loop water reuse and recycling of water as a value chain from waste sources.

Through natural and anthropogenic influences, agrifood water sources can contain a wide range of contaminants. While significant international advancements have been made in recent years in assessing the microbiological food safety risks related to agrifood water, the implications of chemical water quality on food safety are less well characterized. There is often limited knowledge related to the ability of emerged or emerging waterborne chemical contaminants to enter the food chain and their implications for food safety.

Prior to the meeting, the background document *Prioritizing food safety issues related to chemical water quality in agrifood systems* was prepared with the aim of presenting the current knowledge on the food safety issues related to chemical water quality in environmental and recycled waters that may be used in agrifood systems.

Scope and objectives of the meeting

The meeting gathered experts in areas related to water chemical contaminants and food safety to facilitate the finalization of the background document, specifically to i) finalize and validate the background document through peer review; ii) agree on the priority of specific waterborne contaminants for food safety; iii) draw final conclusions and make recommendations to Codex Alimentarius and/or other relevant stakeholders.



Executive summary

Reliable access to sufficient and safe water is critical to food security. Globally, agriculture is responsible for over 70 percent of freshwater withdrawals (FAO and WWC, 2015).[2] At the same time, water systems are under unprecedented pressure from climate change and increased demand for water driven by population growth and societal changes, leading to the exploitation of alternative water sources, sometimes of lower or unknown quality.

Natural and alternative water sources can contain a range of food safety hazards. When water becomes contaminated by a chemical, the use of this water in agrifood production can result in a food safety risk. However, to date, few waterborne chemical contaminants have been considered in detail for food safety risks. To improve the understanding of the possible implications of waterborne chemicals in agricultural water uses, a prioritization exercise was adopted to identify and qualitatively assess key chemical hazards in water of relevance for food safety. A global approach was taken presenting a framework to prioritize chemical contaminants. The prioritization process included three-stages, firstly compiling examples of reported chemical hazards in water sources, secondly qualitatively assessing these for uptake into different food production systems and finally compiling reported exposures from waterborne sources entering the diet.

Contaminants (including contaminant groups) assessed as a high priority based on reported dietary exposures resulting from agrifood water sources exceeding health-based guidance values were: anatoxin-a and analogues (assessed as anatoxin-a), arsenic, cadmium, cylindrospermopsins (assessed as cylindrospermopsin), fluoride, lead, microcystins and nodularins (assessed as microcystin-LR), perfluorooctanoic acid, perfluorooctane sulfonic acid, radium, saxitoxins (assessed as saxitoxin) and thallium. A further 11 contaminants were assessed as a medium priority based on reported dietary exposures from water sources approaching the health-based guidance values. Finally, 29 contaminants with a likelihood of entering the food chain from agrifood water sources, were rated as a low priority for food safety. It is important to note that a number of the example contaminants were considered unlikely to enter the food chain or had insufficient data to prioritize for food safety risk, however, this may change in the future with the availability of new data.

Many chemical contaminants in agrifood water sources lack food safety risk management and guidance and priority should be given to address this gap. Emerging issues and developing technologies impacting water use and recycling also have food safety implications, including climate change, advances in chemistry, sourcing from alternative water sources, new food production systems, chemical mixtures and antimicrobial resistance, thus driving the need for ongoing risk assessment.

Addressing challenges for identifying and managing waterborne chemical contaminant risk to food safety means improving and standardizing the assessment of dietary exposure from waterborne contaminants. The interdependencies of contaminant occurrence in water with water scarcity, food security and animal, crop, environmental and human health support risk management measures being integrated within a One Health approach.

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[2] **FAO & WWC (World Water Council).** 2015. *Towards A Water And Food Secure Future. Critical Perspectives for Policy-makers*. Rome, FAO & Marseille, WWC. https://www.fao.org/3/a-i4560e.pdf

Challenges and limitations

- The range of potential contaminants in agrifood water sources, both those previously reported and emerging is extensive. It is a challenge for any prioritization approach to capture all of the contaminants of potential concern; therefore, it is not anticipated that the example chemicals considered in this report provide an exhaustive and complete list of contaminants in water at a global level.
- The reporting of the global distribution of contaminants in agrifood water sources tends to be limited, with the result that this hinders a harmonized approach to identify, prioritize and characterize contaminants of food safety concern.
- Availability of reliable toxicity and environmental fate and persistence data differs considerably, with these data not readily accessible for some groups of chemicals such as pharmaceuticals.
- Transfer and uptake into food commodities is reported in multiple formats, with limited consistency, and hence comparability, between studies.
- Commonly stated assumptions are that only chemicals bioaccumulating are a concern. While in an environmental context this may be an appropriate benchmark, in terms of agrifood water use lower levels of transfer may still be a concern depending on the toxicity of the contaminant and whether the food is consumed regularly and in large quantities.
- The basis on which existing chemical guideline values for agrifood water quality are protective for food safety and human health is not usually presented.
- Many published exposure assessments only consider food from single crop species, animal species or occasionally individual production pathways. Aggregate exposure estimates for contaminants that may be widespread in agrifood water sources are limited.
- Risk assessment is typically conducted for individual contaminants, or closely related groups. Broader consideration of the interaction of mixtures of chemicals and implications for direct and indirect health outcomes are limited. For example, the role of chemical contaminants in agrifood water sources in the generation of antimicrobial resistance.
- The scientific understanding of the risk of the emerging issue of microplastics and nanoplastics is presently insufficient to allow for prioritization of the particles, and any absorbed contaminants, from waterborne pathways into the diet.


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Recommendations

It is important to address the chemical quality of water for agrifood systems within a One Health approach requiring cross-sectoral mechanisms of collaboration on ensuring chemical safety of water destined for the agrifood sectors. Such mechanisms should include at least the agriculture, health and environmental sectors.

To address the chemical quality of water for agrifood systems, competent authorities and other relevant organizations at a national or regional level can be supported at an international level by:

- Development of international guidance (e.g. by Codex Alimentarius) on prioritization and risk assessment approaches for chemical contaminants in agrifood water sources. This could include the prioritization method used in the present approach, as well as alternatives such as expert elicitation and qualitative risk matrices, allowing for flexibility in application to different water use scenarios. The prioritization method should remain dynamic to stay up to date with scientific developments.
- Development of new, and review of existing, Codex Alimentarius Codes of Practice.
- Promoting horizon scanning and foresight activities. Specific focus areas would be to ensure early detection and prioritization of emerging contaminants arising from issues like climate change, advances in chemistry or implementation of circular water reuse. Foresight activities could also include staying abreast of analytical and other technological developments, including artificial intelligence, as tools to support risk assessment, management and communication of chemical contaminants in agrifood water sources.
- Promoting more research on the transfer and uptake of waterborne contaminants into food commodities. Generating reliable data on food chains risks of new and established chemicals can also be supported through promoting or guiding the standardization of research methodology.

Competent authorities and other relevant organizations at a national or regional level should assess and manage the food safety risks associated with chemical contaminants in agrifood water sources as they can cause significant impacts to human health through dietary exposure. This could include by:

- Ensuring that food safety is addressed when guideline values are established for chemical contaminants in agrifood water sources.
- Developing monitoring strategies for chemical contaminants in agrifood water sources.
- Development, validation and accreditation of analytical capabilities to assess levels of priority chemicals in water used in agrifood systems.
- Development of standardized sampling and testing protocols, and monitoring plans, to evaluate the quality of agrifood water sources.
- Enhancing current chemical regulations by ensuring they capture fate, persistence and impacts on food safety for chemicals discharged into agrifood water sources.
- Collecting data to develop inventories/lists of priority chemicals and their chemical properties to be considered in managing water quality in agrifood systems.
- Adopting a “fit for purpose” approach for chemical water quality for agrifood sources, as well as implementing other risk management measures to ensure food safety, including mitigations at source and water treatment stages.
- Promoting such efforts through capacity and capability building in developing countries.

Annex 1: List of participants

EXPERTS

Adriana Arisseto-Bragotto, University of Campinas, Brazil

Mari Asami, National Institute of Environmental Studies, Japan

Timothy Harwood, Cawthron Institute, New Zealand

Kevin Hiscock, University of East Anglia, United Kingdom of Great Britain and Northern Ireland

Panagiota Katikou, Ministry of Rural Development and Food, Greece

Mesfin Mekonnen, University of Alabama, United States of America

Sheila Okoth, University of Nairobi, Kenya

Martin Rose, JEFCS, United Kingdom of Great Britain and Northern Ireland

Mark Sumarah, Agriculture and Agri-Food Canada, Canada

Hae Jung Yoon, Chung-Ang University, Republic of Korea

Maged Younes, Portugal

JOINT FAO/WHO SECRETARIAT

Vittorio Fattori, Agrifood Systems and Food Safety Division, Food and Agriculture Organization of the United Nations (FAO), Italy

Markus Lipp, Agrifood Systems and Food Safety Division, FAO, Italy

Magdalena Niegowska Conforti, Agrifood Systems and Food Safety Division, FAO, Italy

Maura di Martino, Agrifood Systems and Food Safety Division, FAO, Italy

Riccardo Siligato, Agrifood Systems and Food Safety Division, FAO, Italy

Andrew Pearson, Agrifood Systems and Food Safety Division, FAO, Italy

Akio Hasegawa, Department of Nutrition and Food Safety, World Health Organization (WHO), Switzerland

Moez Sanaa, Department of Nutrition and Food Safety, WHO, Switzerland

Virunya Bhat, Department of Environment, Climate Change and Health, WHO, Switzerland

Richard Brown, Department of Environment, Climate Change and Health, WHO, Switzerland

Jennifer De France, Department of Environment, Climate Change and Health, WHO, Switzerland

RESOURCE PERSONS

He Li, Land and Water Division, FAO, Italy