E

联合国粮食及农业组织 | Food and Agriculture Organization of the United Nations | Organisation des Nations Unies pour l'alimentation et l'agriculture | Продовольственная и сельскохозяйственная организация Объединенных Наций | Organización de las Naciones Unidas para la Alimentación y la Agricultura | منظمة الأغذية والزراعة للأمم المتحدة

COMMITTEE ON AGRICULTURE

Twenty-eighth Session

18 - 22 July 2022

Guidance on use of agricultural plastics

Executive Summary

Over the last 70 years, the use of plastics in agrifood systems and food value chains has become pervasive. Low-cost and adaptable plastic products have crept into every part of our food systems – from mulching films, tree guards to greenhouses in production; and crates and packaging in processing and marketing. The Organization's report *Assessment of agricultural plastics and their sustainability: A call for action (2021)*[1] (the Report) estimated that every year 12.5 million tonnes of plastic products are used in plant and animal production, and the additional 37.3 million tonnes in food packaging. The crop production and livestock sectors are the largest users, accounting for 10 million tonnes per year (2.8 percent of the global plastic production), followed by fisheries and aquaculture with 2.1 million tonnes, and forestry with 0.2 million tonnes. The Report confirmed that agricultural plastics have both positive and negative impacts on food security, food safety and nutrition, as well as on social and economic dimensions of sustainability. The widespread and long-term use of plastic products in agriculture, coupled with lack of systematic collection and sustainable management, leads to their accumulation in soils and aquatic environments, with potential for harm to ecosystems and human health. Significant knowledge gaps related to distribution, benefits, trade-offs, and risks of agricultural plastics and their alternatives remain.

There are currently no overarching international policy or legislative instruments that cover all aspects of the use of plastics in agrifood value chains and throughout their lifecycle. Similarly, at national level, only a few countries have governance measures that address limited aspects of agricultural plastics. Existing FAO guidance largely focuses on the benefits of agricultural plastics.

Agricultural plastics have to be addressed urgently in a holistic manner using life-cycle approaches and the principles of circularity. In addition to actions mainstreaming the sustainability of agricultural plastics throughout the existing FAO's instruments and guidance related to good agricultural practices, food security, food safety and nutrition, a comprehensive Voluntary Code of Conduct on agricultural plastics use and sustainability, which could cover the full life cycle of plastic use throughout agrifood value chains from its design, regulatory approval, manufacture, distribution, sale, use, and management at end-of-life could offer a solution to prevent plastic pollution in agriculture and its related risks to human health and adverse effects on human well-being and the environment. It should be developed recognizing the importance of cooperation, coordination and complementarity among relevant regional and international conventions and instruments, including

[1] https://doi.org/10.4060/cb785en

provisions of the Resolution *End plastic pollution: Towards an international legally binding instrument* of the Fifth United Nations Environment Assembly (UNEA-5.2), and the crucial role of science. A Voluntary Code of Conduct will support the goals of the FAO Strategic Framework 2022-31 in this regard, to achieve the *four betters* of agrifood systems transformation – *better production, better nutrition,* a *better environment* and a *better life* for all, leaving no one behind. It will also contribute to the outcomes of several of FAO's Programme Priority Areas (PPAs), including *better environment* "Bioeconomy for Sustainable Food and Agriculture" (BE2), and the achievement of the associated Sustainable Development Goal (SDG) 12 which targets supporting Members in formulating and implementing integrated evidence-based bioeconomy policies, and practices in micro and macro environments, using technological, organizational and social innovations.

Suggested action by the Committee

The Committee is invited to:

- *recognize* the need for improved intersectoral collaboration and governance to address issues relevant to agricultural plastic use;
- *take note* of the recommendations of the *Assessment of agricultural plastics and their sustainability: a call for action*, and *invite* FAO, subject to availability of resources, in collaboration with other relevant United Nations agencies, academia, non-governmental organizations, and the private sector, to undertake further assessments to fill the global and regional knowledge gaps related to distribution, benefits, trade-offs, and risks in agricultural plastics and their alternatives, and provide regular updates to COAG; and
- *encourage* FAO, subject to the resource availability, through inclusive consultations with Members, regional bodies, other international organizations, the private sector, civil society, and agricultural communities, to develop a comprehensive Voluntary Code of Conduct on agricultural plastics use and sustainability to be presented for consideration at the 29th Session of COAG.

Queries on the substantive content of the document may be addressed to:

Mr Lev Neretin
Workstream Lead, Environment
Office of Climate Change, Biodiversity and Environment (OCB)
Tel. +39 06 570 51083

I. Introduction

1. Plastics use in agriculture has grown exponentially since the mid-20th century in line with similar trends in other sectors. The increased use of plastic mulching films, drip irrigation, greenhouses, silage films, polymer coated fertilizer, weather and pest protection nets, and other plastic products has resulted in numerous benefits in agriculture: 10 percent to 60 percent increases in yields;[2] extended growing seasons;[3] reduction of herbicide and pesticide consumption; improved efficiency of nutrient take-up by plants and reduced emissions;[4] protection from weather events; and an average of 25 percent improved water use efficiency.[5] This has translated into significant savings and higher profitability for farmers.[6] Agricultural plastics products are also helping farmers to adapt to climate change.[7]

2. The total global use of plastics in terrestrial agricultural production in 2019 was estimated at 10 million tonnes, with a further 37.3 million tonnes used in food packaging.[8] Although this represents only 2.8 percent and 10.4 percent of global plastics production, respectively, because of the nature of the products and how they are used and disposed of, agricultural plastics have a disproportionately high impact on global plastic pollution levels. The global annual use of agricultural non-packaging films is expected to increase by about 40 percent, from 6.1 million tonnes in 2018 to 9.5 million tonnes in 2030.

3. There is a growing body of evidence showing that poor design, selection, usage, and end-of-life management of plastic in agriculture lead to adverse impacts in the source-to-sea continuum from terrestrial to marine ecosystems. Often farmers lack the capacity for selection, application, management, and retrieval needed for adequate plastic removal from the fields, nor do they have access to sound environmental end-of-life management. Other actors of the agrifood value chains, such as processors and distributors, do not have clear guidance or requirements to facilitate a sustainable management of the plastics life cycle.

II. Plastic pollution

Lack of circularity

4. Most agricultural plastics are single-use and become waste within a year. Durable products such as greenhouse films are typically warranted to remain effective for up to four years.[9]

5. Data suggest that only small fractions of agricultural plastics are collected and recycled, predominately in developed economies. There is evidence that elsewhere most plastics are burned, buried, or landfilled, although record keeping is generally non-existent.

6. At end-of-life, many agricultural plastics cannot be recycled due to high levels of contamination by soil, agrochemicals, plant residues and moisture. Typical increases in weight due to

---

[2] Bhattacharya, S., Das, S. & Saha, T. 2018. *Application of plasticulture in horticulture: A review.* The Pharma Innovation Journal, 7(7): 584–585. https://bit.ly/3ECU0GA

[3] Bartok, J.W. 2015. *Plastic Greenhouse Film Update. In: Center for Agriculture, Food and the Environment* [online]. [Cited 27 January 2021]. https://bit.ly/3k4tAni

[4] Gil-Ortiz, R., Naranjo, M.Á., Ruiz-Navarro, A., Atares, S., García, C., Zotarelli, L., San Bautista, A. et al. 2020. *Enhanced Agronomic Efficiency Using a New Controlled-Released, Polymeric-Coated Nitrogen Fertilizer in Rice. Plants, 9(9)*: 1183. https://doi.org/10.3390/plants9091183

[5] Gao, H., Yan, C., Liu, Q., Ding, W., Chen, B. & Li, Z. 2019. *Effects of plastic mulching and plastic residue on agricultural production: A meta-analysis. Science of the Total Environment, 651*: 484–492. https://doi.org/10.1016/j.scitotenv.2018.09.105

[6] Scarascia, G., Sica, C. & Russo, G. 2011. *Plastic materials in European agriculture: Actual use and perspectives. Journal of Agricultural Engineering, 42*. https://doi.org/10.4081/jae.2011.3.15

[7] Nikolaou, G., Neocleous, D., Christou, A., Kitta, E. & Katsoulas, N. 2020. *Implementing Sustainable Irrigation in Water-Scarce Regions under the Impact of Climate Change. Agronomy, 10(8)*: 1120. https://doi.org/10.3390/agronomy10081120

[8] https://doi.org/10.4060/cb7856en

[9] Bartok, J.W. 2015. *Plastic Greenhouse Film Update. In: Center for Agriculture, Food and the Environment* [online]. [Cited 27 January 2021]. https://bit.ly/3LgTU9K

contamination are, for example: mulching films (+200 percent); small tunnels and non-woven textiles (+100 percent); and silage films and wraps (+50 percent).[10] Contamination with hazardous materials, such as pesticides, also limits opportunities for sustainable end-of-life management.

Soil pollution and microplastics

7. Mulch films and drip irrigation are designed to be used in direct contact with the soil and become dispersed in the soil during use, and along with other products intentionally placed in the soil, such as the polymer coatings of fertilizer and seeds, break down into microplastics.

8. Another major source of microplastics in agricultural soils is biosolids from wastewater treatment plants, used directly as fertilizer and waste water for irrigation. A study on sewage sludge and biosolids used as a fertilizer in Australia, Canada, China, the United States of America and the European Union estimated the total annual emissions of microplastics to agricultural soils to range from 64 000 tonnes to 370 000 tonnes.[11]

Climate change impacts

9. As most plastics are made from petroleum-derived precursors, they are associated with significant greenhouse gas (GHG) emissions. Assuming that plastics used in terrestrial agricultural production represent 2.8 percent of global plastic production, it can be estimated that annual GHG emissions will be 38 Mt CO_2eq by 2030 and 78 Mt CO_2eq by 2050. Uncontrolled burning of agricultural plastic waste prevalent in many developing countries also contributes to the emissions of dioxins and furans, persistent organic pollutants regulated under the Stockholm Convention.[12,13]

Harm to ecosystems

10. Irrespective of their intended use, plastics cause harm when they leak into the environment.[14] Ecosystem harm may be indirect (for example, through emissions of greenhouse gases during manufacture and transportation) or direct (such as localized impacts on soil function and the health of grazing animals). Of increasing concern is the formation and fate of microplastics derived from agricultural plastic products, which have potential to transfer along trophic levels, with the possibility of adversely affecting human health.[15]

[10] Le Moine, B. et al. 2021. EIP-AGRI Focus Group: Reducing the plastic footprint of agriculture: *Minipaper B: The agri-plastic end-of-life management*. p. 11. EIP-AGRI. https://bit.ly/3EHek9B

[11] Mohajerani, A. & Karabatak, B. 2020. *Microplastics and pollutants in biosolids have contaminated agricultural soils: An analytical study and a proposal to cease the use of biosolids in farmlands and utilise them in sustainable bricks. Waste Management, 107*: 252-265. https://doi.org/10.1016/j.wasman.2020.04.021

[12] Ikeguchi, T. & Tanaka, M. 1999. *Experimental studies on dioxins emission from open burning simulation of selected wastes. Organohalogen Compounds, 41*: 507–510.

[13] Stockholm Convention Secretariat. 2001. Stockholm Convention on Persistent Organic Pollutants (POPSs): text and annexes. [Cited 24 April 2021]. https://bit.ly/3vyj39A

[14] WWF, Ellen MacArthur Foundation, & Boston Consulting Group. 2020. *The business case for a UN treaty on plastic pollution*. p. 37. https://bit.ly/3L5SpLK

[15] GESAMP. 2015. *Sources, fate and effects of microplastics in the marine environment: a global assessment (part 1).* p. 96. GESAMP Reports and Studies 90. London, International Maritime Organization.

11. The harm agricultural microplastics cause to terrestrial ecosystems is becoming increasingly evident,[16,17] and their entry into agrifood systems is concerning for food safety and food security.[18,19]

12. Global plastics pollution is a transboundary phenomenon impacting all countries, with pollution occurring along the whole life cycle of plastics use and in the source-to-sea continuum. For example, the global annual damage costs from marine litter (most of which comes from land) to the marine economy has risen eightfold since 2008 and were estimated to be USD 21.3 billion in 2020.[20] The social and health-related impacts of this are disproportionately felt by low-income communities exposed to hazardous chemicals linked to plastic production, waste dumps, and incineration and open burning of plastic waste.

III. Solutions

13. Solutions to plastics pollution in agrifood value chains require simultaneous mobilization of policies, technologies, sustainable practices, and multiple stakeholder efforts using principles of circular economy as a part of a transformation of agrifood systems across all three dimensions of sustainability. The Report identified alternatives and interventions to improve the circularity and sound management of agricultural plastics based on the 6R model (Refuse, Redesign, Reduce, Reuse, Recycle, and Recover).

14. Depending on the application, these could include: adopting agricultural practices that avoid the use of plastic; eliminating the most polluting plastic products; substituting plastic products with natural or biodegradable alternatives; promoting reusable plastic products; improving waste management practices; adopting new business models; establishing and enforcing mandatory extended producer responsibility schemes for collection and sound environmental management of agricultural plastic; and establishing fiscal measures and incentives to drive behavioural change within the supply chain, and among users and consumers.

IV. Knowledge gaps

15. Despite the overwhelming evidence of the urgent need to address agricultural plastics, there are knowledge gaps. Some areas for further research include:

a. The global flows and fates of agricultural plastics; their quantities, composition, where and how they are used, their environmental fate throughout the supply chain, during use and at end-of-life, and economic costs of plastic pollution.

b. Life cycle assessments of fossil-based and bio-based agricultural plastics (both biodegradable and non-biodegradable) and the alternative products and practices to determine and compare their risks and benefits for specific applications in agrifood value chains.

c. The pathways and impacts of plastics, micro and nanoplastics on agroecosystems, food safety and human health, including their potential for transference and accumulation along the food chain and in agrifood systems.

---

[16] de Souza Machado, A.A., Kloas, W., Zarfl, C., Hempel, S. & Rillig, M.C. 2018. *Microplastics as an emerging threat to terrestrial ecosystems. Global Change Biology*, 24(4): 1405–1416. https://doi.org/10.1111/gcb.14020

[17] Rillig, M.C., de Souza Machado, A.A., Lehmann, A. & Klümper, U. 2019. *Evolutionary implications of microplastics for soil biota. Environmental Chemistry*, 16(1): 3. https://doi.org/10.1071/EN18118

[18] GESAMP. 2015. *Sources, fate and effects of microplastics in the marine environment: a global assessment (part 1)*. p. 96. GESAMP Reports and Studies 90. London, International Maritime Organization. http://www.gesamp.org/publications/reports-and-studies-no-90

[19] Landrigan, P.J., Stegeman, J.J., Fleming, L.E., Allemand, D., Anderson, D.M., Backer, L.C., Brucker-Davis, F. *et al.* 2020. *Human Health and Ocean Pollution. Annals of Global Health*, 86(1): 151. https://doi.org/10.5334/aogh.2831

[20] McIlgorm, A, Raubenheimer, K., McIlgorm, M.E., Nichols, R. 2022. *The cost of marine litter damage to the global marine economy: Insights from the Asia-Pacific into prevention and the cost of inaction. Marine Pollution Bulletin* 174: 113167. https://doi.org/10.1016/j.marpolbul.2021.113167

d. The behaviour and rate of degradation of biodegradable products in different environments and conditions of temperature and humidity.

V. Governance

16. Based on a review of the existing global legal, policy and management frameworks and instruments, the Report concludes that there is no international policy or instrument that addresses all aspects of the use of plastics in agrifood value chains and throughout their life cycle.

17. In partnership with the University of Wollongong (Australia), FAO is currently undertaking an assessment of the gaps and opportunities within existing legal, regulatory and governance frameworks and instruments relevant to agricultural plastics[21].

Multilateral initiatives addressing the issue of agricultural plastics and FAO's role

18. The European Commission has just published a report that reviews the impacts of plastics used in terrestrial agricultural production and advocates for policies to improve their circularity and mitigate their impacts.[22] The UN Rapporteur on Human Rights has also recently published two reports related to plastics including from agricultural sources: the plastics cycle and their impacts on human rights;[23] and rights to science in the context of toxic substances.[24] The United Nations Environment Programme (UNEP) has also recently published the report *Plastics in agricultural soil: sources and impacts*, which highlights the issues and makes recommendations for research to fill the knowledge gaps and for solutions to address the most polluting products and practices.[25]

19. In February 2022, the Ministerial declaration of the United Nations Environment Assembly at its fifth session (UNEA-5.2) welcomed the decision by the Environment Assembly to establish an intergovernmental negotiating committee towards an international legally binding instrument on plastic pollution,[26] including in the marine environment.[27]

20. UNEA-5.2 Resolution 14 *End plastic pollution: Towards an international legally binding instrument* "*Calls upon* all Member States to continue and step up activities and adopt voluntary measures to combat plastic pollution, including measures related to sustainable consumption and production, which may include circular economy approaches, and to develop and implement national action plans, while fostering international action and initiatives under national regulatory frameworks, and, on a voluntary basis, to provide statistical information on the environmentally sound management of plastic waste, as appropriate, taking into account national circumstances".[i]

Voluntary Code of Conduct on agricultural plastics use and sustainability

21. In parallel with these negotiations and to complement the future Instrument, FAO could develop a comprehensive Voluntary Code of Conduct on agricultural plastics. The Committee on Agriculture is invited to determine the Voluntary Code of Conduct's application scope, which could cover the full life cycle of plastic use throughout agrifood value chains from its design, regulatory approval, manufacture, distribution, sale, use, and management at end-of-life.

---

[21] Expected in draft form to be available before COAG 28.
[22] Hann, S., Fletcher, E., Molteno, S., Sherrington, C., Elliott, L., Kong, M., Koite, A. *et al.* 2021. *Relevance of Conventional and Biodegradable Plastics in Agriculture.* p. 334. Brussels, European Commission. (also available at https://ec.europa.eu/environment/system/files/2021-09/Agricultural Plastics Final Report.pdf).
[23] Orellana, M. 2021. *Report of the Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes: The stages of the plastics cycle and their impacts on human rights*. p. 24. A/76/207. New York, UNGA. https://undocs.org/A/76/207
[24] Orellana, M. 2021. *Right to science in the context of toxic substances: Report of the Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes*. p. 20. A/HRC/48/61. New York, Human Rights Council, UNGA. https://undocs.org/pdf?symbol=en/A/HRC/48/61
[25] UNEP & GRID Arendal. 2021. *Plastics in agricultural soil: sources and impacts.* p. 28. https://bit.ly/3EOrthn
[26] UNEP/EA.5/HLS.1. https://bit.ly/36xWNE6
[27] UNEP/EA.5/Res.14. https://bit.ly/3v4Vqqc

22. It could become an integral part of FAO's Members efforts to transform agrifood systems to be more efficient, more inclusive, more resilient and more sustainable, while considering the benefits and trade-offs. The Voluntary Code of Conduct should be science-based and developed in an inclusive, participatory and transparent way with Members ad relevant stakeholders. Furthermore, it would be developed recognizing the importance of cooperation, coordination and complementarity among relevant regional and international conventions and instruments.

Mainstreaming

23. Apart from limited aspects of plastics management in the guidance on empty pesticide containers and fishing gear under, respectively, the *International Code of Conduct on Pesticide Management*,[28] the *Code of Conduct for Responsible Fisheries*,[29] and the *Voluntary Guidelines on the Marking of Fishing Gear*,[30] FAO does not provide any specific and overarching guidance on sustainable and circular use of agricultural plastics.

24. The existing FAO guidelines tend to focus attention on sustainability, the conservation of natural resources, and ecosystem health.[31] These might often encourage the increased use of agricultural plastics to take advantage of the benefits that have been discussed above. However, current guidelines do not specifically address the trade-offs or life cycle implications of plastics use, nor do they provide recommendations for the sustainable management of agricultural plastics.

25. The report *Assessment of agricultural plastics and their sustainability: A call for action (2021)*[32] recommends mainstreaming the sustainability of agricultural plastics throughout FAO's instruments and guidance related to good agricultural practices, food security, food safety and nutrition.

VI. Conclusion

26. Tackling agricultural plastic pollution will be a vital measure in helping to deliver the objectives of the United Nations Decade on Ecosystem Restoration 2021-2030, co-led by FAO and UNEP. It also responds to FAO Strategic Framework 2022-31 and its several PPAs, including on Bioeconomy for Sustainable Food and Agriculture, which has an emphasis on SDG 12 – Responsible Consumption and Production, including waste disposal (SDG 12.4).

27. Ultimately, tackling agricultural plastic pollution is paramount to achieving MORE efficient, inclusive, resilient and sustainable agrifood systems for *better production, better nutrition,* a *better environment*, and a *better life*, leaving no one behind. As a specialized agency of the United Nations leading international efforts to achieve food security for all, and ensuring that people have regular access to enough high-quality food to lead active and healthy lives, FAO has an important role to play in addressing the issue of agricultural plastics holistically within the context of global food security and nutrition.

---

[i] UNEA-5.2. 2022. *Resolution 14 End plastic pollution: Towards an international legally binding instrument*. Nairobi. https://bit.ly/3v4Vqqc

---

[28] http://www.fao.org/agriculture/crops/thematic-sitemap/theme/pests/code/en/
[29] http://www.fao.org/documents/card/en/c/e6cf549d-589a-5281-ac13-766603db9c03/
[30] http://www.fao.org/documents/card/en/c/CA3546T/
[31] The CFS Voluntary Guidelines on Food Systems and Nutrition (2021), The International Code of Conduct for the Sustainable Use and Management of Fertilizers (2019), Voluntary Code of Conduct for Food Loss and Waste Reduction (2021) and Voluntary Guidelines for Sustainable Soil Management (2017).
[32] https://doi.org/10.4060/cb785en