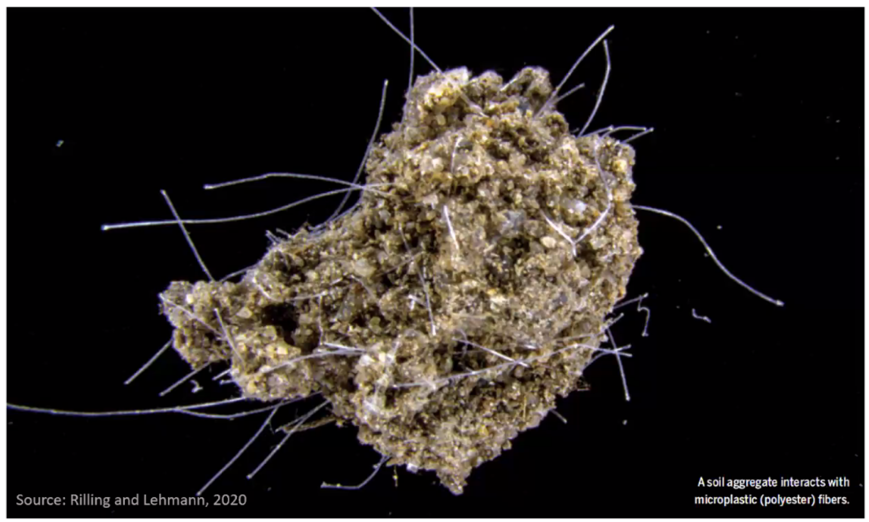
Microplastics in the Agricultural Environment – new perspectives



Some Definitions – Some New?

Microplastics – a definition of particle size

Persistent Microplastics – a definition of end of life

Farmer – Soil Manager

Soil has a value – it is not the cost of an acre

Soil is not free – Soil can become worthless

Soil Carbon as the Measure of Fertility – Soil Structure & Community w/ Organic Carbon

Microplastics will persist in the environment – and may end up in us!

FIELD DESCRIPTOR	RELATIVE SIZE	COMMON SIZE DIVISIONS
Mega	Very large	> 1 m
Macro	Large	25 – 1000 mm
Meso	Medium	5 – 25 mm
Micro	Small	< 5 mm
Nano	Extremely small	< 1 µm

Contamination affects soil directly - Structure

Plastic Pollution has been studied, it is easier to see

Ex. China and Spain – Soils no longer fertile

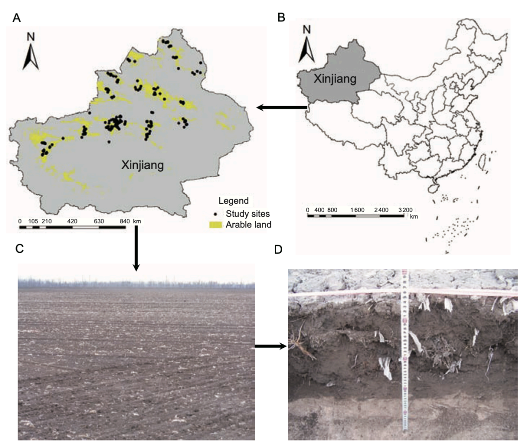
New Studies link soil health to plastic pollution – Microplastics Follow

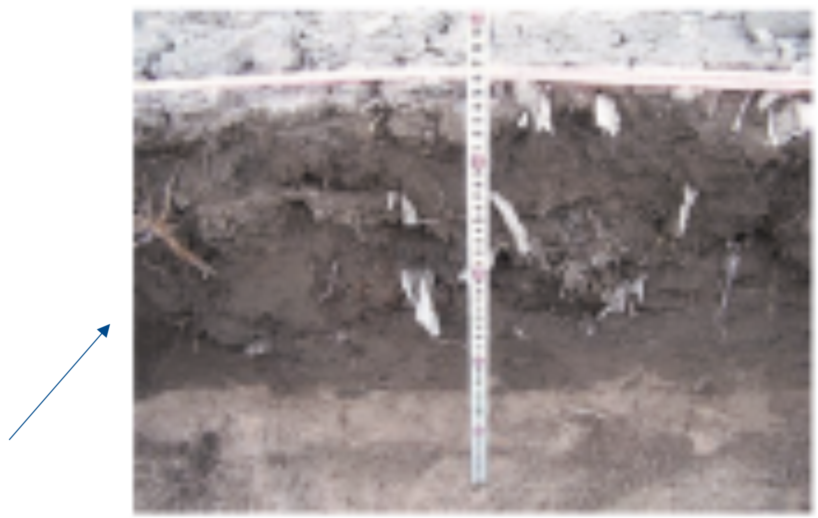
What Well Aggregated Soil Looks Like

Plastic Pollution Affects Soils

There is a problem in the community:

- Bacteria
- Fungi
- Insects
- Cover Crops
- Root Structures
- Organic Carbon
- Worms





Three Factors affect Plastic Contamination levels:

- Thickness of the materials
- Years of Use - Time
- Types of Crops

It's the Materials, not the products - we need to look deeper

- Created plastics to be indestructible – stand up to nature
- Will weather and fragment, get smaller– this makes collection harder
- Will never be seen as food for microbes – not biodegradable
- Will persist and will travel by air-land-sea
- Will end up in you and me

Let's look at some numbers – just to baseline

Agriculture sector = 3.5% of Global Plastics

- 12.5 million tons used
- 80% of Ocean Plastic originates on land
- Compared to Ocean – Soil is up to 30% more contaminated
- At the Micro Level – Oceans create fastest way into the food chain
- Microplastics Travel

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If Agri is only 3.5% why be alarmed?

- It's the proximity to soil
- Soil's community relationship to food
- It's the water cycle

Plastics in Agriculture has gained Common Knowledge status – Why?

This article is more than **3 months old**

'Disastrous' plastic use in farming threatens food safety – UN

Food and Agriculture Organization says most plastics are burned, buried or lost after use

Ocean Plastic Is Bad, but Soil Plastic Pollution May Be Worse

PUBLISHED BY Mallory Daily 6 DAYS AGO

MATERIALS PLASTIC

UN REPORT LAYS OUT 'STARTLING' IMPACT OF AGRICULTURAL PLASTICS

By Emma Love | 7 December 2021 | Add a Comment

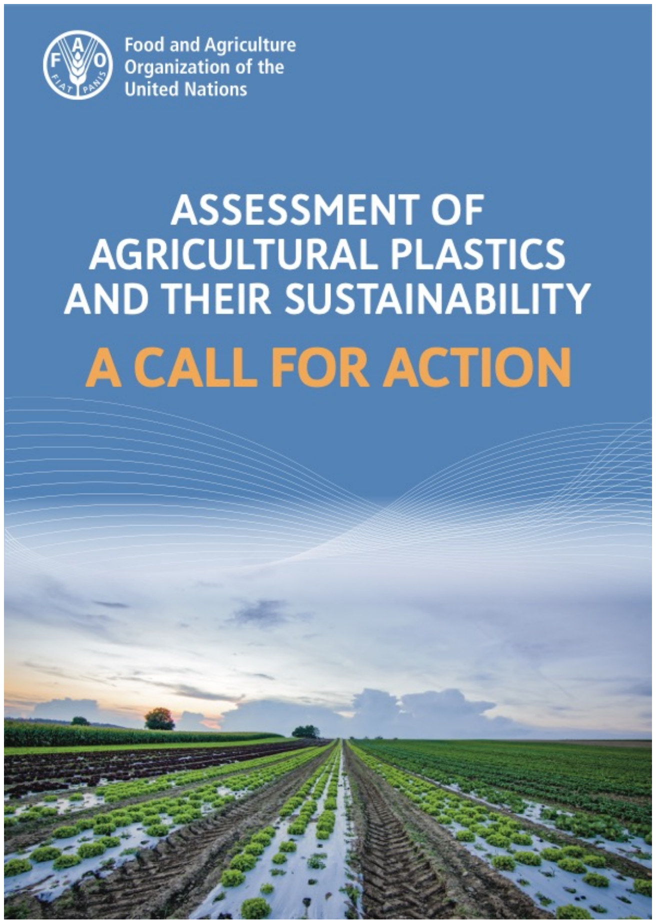
PRINT E-MAIL SHARE

In a report published today, the UN Food and Agriculture Organisation (FAO) has laid out the serious implications of agricultural plastics, urgently calling for 'coordinated and decisive action'.

Agricultural plastics emerging as major threat to sustainability

BY JOSEPH MAINA

JANUARY 20, 2022



A Call for Action

A comprehensive study of the current situation

International – Academic - Industry

Why and How

Identifies risk and opportunities

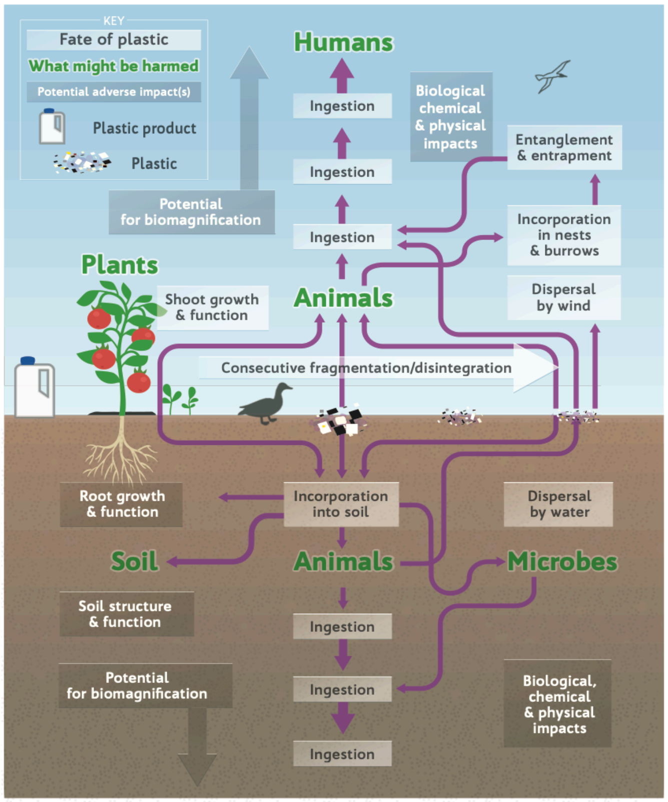
Acknowledges GAPS

Promotes changes to the current model

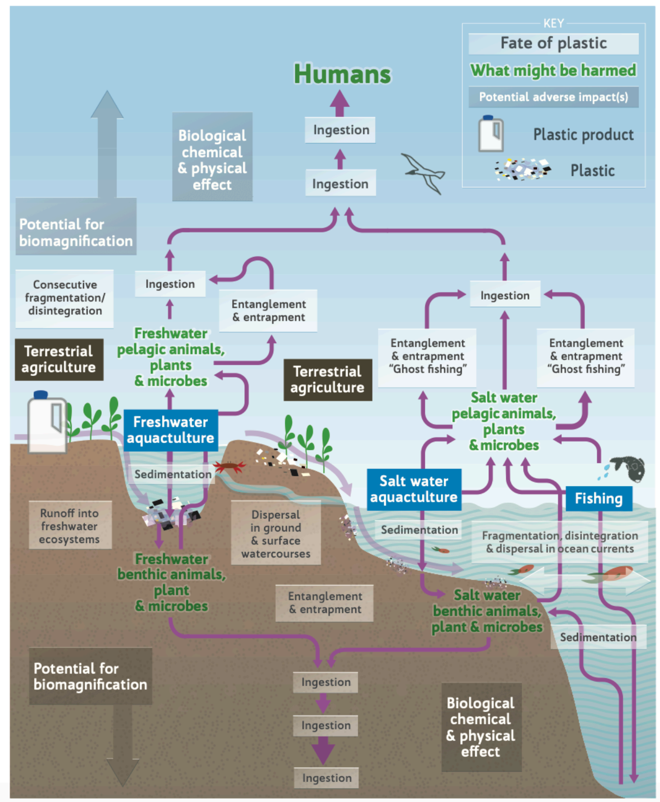
Does not tell you what to do

Not a Ban List

Fate of Microplastics in Land and Sea – Humans?



Source: FAO, 2021.



Source: FAO, 2021.

Ranking Risk Assessment by products

Product	Priority/ Representative	Relative risk score	Value chain	Durability
Polymer coated slow release fertilizer	Priority	10,5	Food crop Non-food crop	Single-use
Mulching films	Priority	9,8	Food crops Non-food crops	Single-use
Pesticide containers	Priority	9,5	Food crops; Non-food crops Livestock; Fisheries; Forestry	Single-use
Bale films and nets	Priority	9,3	Non-food crops	Single-use
EPS boxes	Priority	9,0	Fisheries	Single-use
Irrigation drip tape (single-use, on-soil applications)	Priority	8,8	Food crops Non-food crops	Single-use
Fishing nets and ropes	Priority	8,7	Fisheries	Durable
Cages	Priority	8,7	Fisheries	Durable
Plastic bags (bananas)	Priority	8,7	Food crop	Single-use
Net float	Priority	8,5	Fisheries	Durable
Fertilizer containers – bags and rigid	Representative	7,8	Food crops Non-food crops	Single-use
Plant pots, seedling plugs	Representative	7,8	Food crops Non-food crops	Single-use
Plastic ties, ropes, twines	Representative	7,5	Livestock, fisheries	Single-use
Bags for feed	Representative	7,5	Food crops Non-food crops; Forestry	Single-use
Bale twine	Representative	7,4	Food crops Non-food crops	Single-use
Silage clamp films	Representative	6,8	Food crops Non-food crops	Durable
Greenhouse films	Representative	6,7	Food crops Non-food crops	Durable
Tree guards	Representative	6,4	Food crops; Non-food crops Forestry	Durable
Pond liners	Representative	6,4	Food crops Non-food crops	Durable
Irrigation tubes and drips (semi-permanent)	Representative	5,8	Food crops Non-food crops	Durable
Ear tags	Representative	5,1	Livestock	Durable
Crates for harvesting	Representative	4,0	Food crops Non-food crops	Durable

Source: FAO, 2021.

A quick look

Polymer Coated Fertilizer #1

Films in general are a Higher Risk

Durable goods are Lower Risk

Immediate environment contact - Higher risk

Relationship to Polluters?

- Thickness of the materials
- Years of Use - Time
- Types of Crops

Pathways to Improve or change the impacts - 6Rs

REFUSE	**DEFINITION:** Intentionally avoiding use of the product. **EXAMPLE:** Not using labels and stickers on single fruit items that are packaged in a larger retail box.
REDESIGN	**DEFINITION:** Modifying a product in order to enhance its retrieval and waste management options; the redesign is intended to maintain/enhance the current agricultural benefit and/or health and safety performance the product. **EXAMPLE:** Using thicker gauge mulch films to enhance retrieval from the field following use.
REDUCE	**DEFINITION:** Minimising the quantity of plastic products used to deliver the same benefit, resulting in reduced need for raw materials, less plastic waste produced per batch of product and fewer amounts of plastic waste that need to be collected for recycling or disposal. **EXAMPLE:** Adopting a stronger polymer for twines, allows a thinner cross-section.
REUSE	**DEFINITION:** Intentionally switching from using single-use plastics to more durable items that can be reused a number of times along the value chain, thus reducing the quantities of plastics used. **EXAMPLE:** Adopting reusable, reconditionable insulated boxes for transporting fish.
RECYCLE	**DEFINITION:** Reprocessing plastic waste into new materials or products of the same or lower quality. **EXAMPLE:** Recycling broken plastic crates or used containers into secondary materials such as plastic pellets.
RECOVER	**DEFINITION:** Extracting energy from plastics; it should only be carried out if the previous 5Rs cannot be applied for technical or economic constraints and life assessments indicate it is more sustainable than landfilling. **EXAMPLE:** For mixed plastic residues, such as thin films contaminated with organic residues, soil and chemical products.

Change is multi-faceted

Goals need to be defined

All parties represented

Common buy-in for end-result

Solutions Welcomed

We are in TOO DEEP at this point.

How would the 6 Rs apply to the Risk Assessed Products

Figure 22: Alternatives for polymer coated fertilizers

Alternatives and interventions		Biodegradable coatings	Ban
6R options	Refuse		•
	Redesign	•	
	Reduce		
	Reuse		
	Recycle		
	Recover		
3D consequence	Damaged		
	Degraded	Reduces harm (intentional microplastics) in soil	Reduces harm (intentional microplastics) in soil
	Discarded		

Source: FAO, 2021.

Products Assessed

Consequences are Assessed

Opportunities to mitigate RISK?

Refuse – Redesign – Recycle?

New Technologies are also new Opportunities

Refuse = expect and demand better

Can consumers influence?

Note the definitions and be aware of materials, not products

BOX 8: DEFINING BIODEGRADABLE AND COMPOSTABLE PLASTICS

There are many different definitions of "biodegradable", "bio-based", "bioplastic", "compostable" and "degradable". Some are functional definitions, whilst others are set out in international standards or legislation (European Union, 2020; Kjeldsen et al., 2019; WRAP, 2020).

The following definitions have been derived from different sources on the basis of their relevance to agricultural plastics, primarily (Defra, 2021; Gilbert *et al.*, 2015):

Bio-based plastics – These are made out of polymers derived from non-petroleum, biological sources. They include plant and microbial-based polymers and can be engineered to be either biodegradable or non-biodegradable.

Biodegradable plastics – These are broken down by naturally occurring microorganisms – such as bacteria and fungi – into water, biomass, and gases such as carbon dioxide and methane. The rate of biodegradation depends on environmental conditions such as temperature, humidity, the consortia of microorganisms present and the presence or absence of oxygen (Degli Innocenti and Breton, 2020). Biodegradable plastics can be made from bio-based and fossil-based precursors, and sometimes a mixture of the two.

Compostable plastics – These are a subset of biodegradable plastics that break down into water, biomass, and gases under composting conditions. Industrial composting conditions are the most optimal, with temperatures in excess of 55 °C, high humidity and the presence of oxygen.

Degradable plastics – These undergo significant changes in their physical structure under specific environmental conditions resulting in loss of structural properties. Degradable plastics generally disintegrate into smaller fragments; however, these fragments may, or may not, be biodegradable, depending on the polymer type. Non-biodegradable polymers that disintegrate into small fragments in situ can lead to microplastic contamination of the environment (see Chapter 4). Oxo-degradable plastics fall in this category.

The term 'bioplastic' – Literature often refers to 'bioplastic' – an imprecise term that is used interchangeably to mean either bio-based, biodegradable, or both (see Figure 39). The International Union of Pure and Applied Chemistry has discouraged the use of this term (Vert *et al.*, 2012).

Note: Degradable Plastics

- Generally Traditional Plastics that fragment
- Go from Macro to Micro quickly
- Are not Biodegradable
- Are unseen, but not gone
- Can have confusing labeling
- Are banned from Ag in France
- Will EU legislation following

"Simply put, plastic is killing our soils. Much talk revolves around plastic polluting the world's oceans, but it's crucial we stop it from desecrating our soils, which are vital to our existence.

"We call on all governments around the world to act urgently to address the issues in this report, and bring forward real action, at pace, which will stem the flow of plastic into the earth. We must not ignore these findings, the future of generations to come depends on it." - A Plastics Planet

But what can we do?

Acknowledge

Educate

Take an action – Make a comment

A small step forward is progress

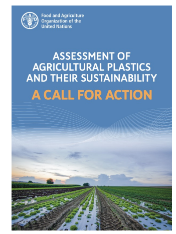
Engage in the discussion

Give something new a try

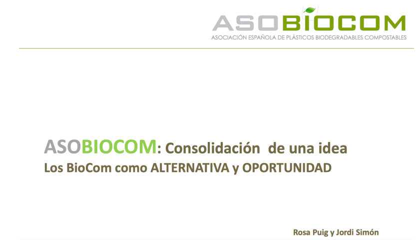
Let's not wait on the world to change first!

“Dig in” for more information & Thank You!

FAO Assessment Report – PDF download



Status and Risk of Residential Mulching in China



Recruiting Soil to Tackle Climate Change

Published Papers practical information BDMs – UConn, UTenn, Washington State

https://smallfruits.wsu.edu/plastic-mulches/soil-health/

https://biodegradablemulch.tennessee.edu/basic-information-resources-biodegradable-mulch/

https://www.youtube.com/watch?v=kyvB1QxHAtE