environmental investigation agency

Ocean

Cultivating Plastic

Part 4 - Caution with regards to the adoption of potential agriplastic alternatives

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ABOUT EIA

We investigate and campaign against environmental crime and abuse.

Our undercover investigations expose transnational wildlife crime, with a focus on elephants and tigers, and forest crimes such as illegal logging and deforestation for cash crops like palm oil. We work to safeguard global marine ecosystems by addressing the threats posed by plastic pollution, bycatch and commercial exploitation of whales, dolphins and porpoises. Finally, we reduce the impact of climate change by strengthening and enforcing regional and international agreements that tackle climate super-pollutants, including ozone depleting substances, hydrofluorocarbons and fossil fuels.

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Front cover: Microplastic contamination of soil has shown to impact soil quality and can also pollute other environmental compartments.

Above: Conventional agriplastic contamination of soil is of serious concern, and increasingly alternatives are being stated as solutions. However they are not without their own issues.

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Introduction

Whether it be the use of biodegradable plastics or increased use of organic fertiliser derived from sludge over petrochemical-derived synthetics, the uptake of potential agriplastic alternatives is not without environmental or human health issues.

As outlined in the first three reports of EIA's Cultivating Plastic series,[1] agriplastic use and waste cause significant environmental and human health harm, with long-term consequences for crop yield – the very reason for agriplastic use. Their negative impacts are further exacerbated by the high levels of agriplastic waste mismanagement present around the world, including in the UK, as well as a distinct lack of industry safeguarding policies or regulatory oversight.

As awareness of the issues brought about by agriplastic use are growing, the search for and adoption of alternative products or agricultural methods are too. However, solutions are not without their own environmental and human health impacts. These issues must be addressed before widespread uptake occurs, to mitigate the sector locking into other harmful production models and their consequences.

Non-conventional plastic alternatives – a focus on mulch

Within its recent assessment, the UN Food and Agriculture Organisation (FAO) itemised the different agriplastic products of most concern. After the application of polymer-coated slow-release fertiliser, mulching films are the highest risk agriplastic product and thus a priority to address; however, their biodegradable alternatives are not yet the solution.[2]

Fossil-based polyethylene mulch (conventional mulch) is considered to be one of the most problematic types of agriplastics,[3] in part due to the contamination of soils with microplastics throughout its use, which negatively impacts on crop yield[4] and also the high rate of (soil) contamination at end-of-life rendering it largely unrecyclable or very difficult and costly to recycle. It also happens to be the largest agriplastic product category – film mulches comprise an estimated 40 per cent of the global agriplastic intentionally-used agriplastic market.[5]

Some measures have been undertaken in different countries to address this, with the creation of design requirements (such as increasing mulch thickness to reduce breakage and subsequent soil contamination), bans on burning farm agriplastic waste as well as voluntary and mandatory extended producer responsibility (EPR) schemes to heighten collection of agriplastic waste, including mulch, at end-of-life.

Degradable mulch has also been touted as an alternative solution. Degradable mulch is created using biobased polymers derived from microbes, plants or fossil-sourced materials.[6] One example is biodegradable mulch, which was introduced in the 1980s[7] to mitigate the adverse effects of conventional mulch while preserving the short-term observable benefits of its use. Biodegradable plastic mulch at end-of-life can either be tilled back into the soil directly or collected and subsequently composted.[8]

The short-term advantages of their use and function for growing produce are effectively the same as conventional plastic mulches.[9] Not having to collect and manage mulch at the end of growing seasons also saves time and labour costs, as well as reducing pressure to pay for mulch collection at end-of-life and diverting highly contaminated plastic waste from already overwhelmed waste management infrastructure.[10] Subsequently, biodegradable plastic mulches are often considered a more sustainable alternative to conventional mulches.[11]

While at face value there is a strong argument for their increased use in current modern agricultural systems, low rates of biodegradation, soil contamination and higher financial costs have hindered their widespread use so far.[12] Despite this, however, their global use is expected to rise,[13] particularly in the face of growing regulation of the plastics sector, including taxes of virgin plastics and concerns about the production and use of fossil-based plastics.

The urgent need to ban oxo-degradable plastics, including mulch

Oxo-degradable plastics – oxo-biodegradable plastics being a sub-category – are said to be degradable polymers containing pro-oxidant substances. It has been argued that oxo-degradable materials undergo oxidative degradation, breaking them down and thus supposedly allowing them to be metabolised by microorganisms.[14]

However, it has been clearly established that oxo-degradable plastics, mostly consisting of low-density polyethylene (LDPE) with additives to enhance abiotic degradation, undergo low or no degradation by microorganisms and do not meet biodegradation requirements as outlined in current biodegradable mulch standards.[15] Contamination risks include plastic fragments, microplastics and longer-term accumulation of transition metals in soils.[16] Subsequently, it is now banned in the EU[17] and China has non-binding guidance against its use.[18]

Data on oxo-biodegradable mulch use in the UK is scarce. A Scottish Government review of evidence on oxo-biodegradable plastic products in 2022 found there was little evidence of the use of oxo-biodegradable mulching films in Scotland, which were found to be manufactured only on request, although they did state that a more exhaustive investigation would be required for confirmation.[19]

Although data on usage is unclear, publicly available information does indicate that these products are still sold on the UK marketplace.[20] Furthermore, two major manufacturers of oxo-degradable mulch (EPI TDPA and Wells Plastic Ltd, aka Reverte)[21] have both been lobbying to keep these products on the marketplace in both the UK and Europe.[22]

The UK, excluding Wales, has not yet[23] banned the use of oxo-degradable plastics (including mulch) despite calls from UK supermarkets, farmers and others to do so.[24] This includes the publication of an open letter in October 2020 calling for the UK Government to ban them, despite the British Standards Institution (BSI) publication of a new specification (PAS9017) for such materials around the same time.[25]

In April 2021, in a Government report outlining responses to its call for evidence on standards for bio-based, biodegradable and compostable plastics, the majority of respondents objected to the use of oxo-degradable and oxo-biodegradable plastics, with many supporting the introduction of a ban.

In response, the Government stated: "In the absence of further evidence, we are minded to introduce a ban on these materials, subject to a public consultation."[26] Two years later, no such consultation has yet been launched.

Above: Biodegradable plastic mulch film. Biodegradable and oxo-degradable plastics, despite both being alternatives to conventional plastics derived from fossil fuels, are not the same.

Biodegradable mulch standards are lacking

There are global standards in place with regards to biodegradable plastics. The EU, the largest exporter of produce to the UK, for instance, also recently adopted a standard for biodegradable mulch (EN 17033) in response to the developments previously cited.

The publicised advantage of biodegradable plastic mulch is that at end-of-life they break down into CO_2, water and minerals by the action of soil organisms. However, the true environmental consequences of using biodegradable plastic mulches have not been sufficiently studied and the international and regional[i] standards, including EN 17033, for validating their safeness[ii] are not rigorous enough.[27] For instance, while some degraded biodegradable mulch can be invisible to the naked eye, this does not mean it is safe and sustainable. This is because:

- **laboratory testing does not infer biodegradability in real-world conditions** – while there are extensive reports on the degradation of biodegradable mulches in laboratory conditions,[28] very little is known about the effects of biodegradable mulches on soil quality and their breakdown into micro- and nanometre-sized fragments.[29] There is very limited evidence that 'biodegradable' mulch consistently and predictably biodegrades in real-world conditions. This is because biodegradation depends on many factors, including polymer properties and thickness, soil characteristics and prevailing environmental conditions such as temperature, moisture, solar radiation and wind.[30]
- **micro- and nano-plastic residue determination not required** – standards used to assess the degradability of plastics in soil are based on macroscopic (i.e., visual by eye) disintegration and do not require the determination of micro- and nano-plastic residues, which can accumulate in soils.
- **additional toxic adsorption concerns** – these fragments can also adsorb agrochemicals used extensively in modern industrial agricultural such as pesticides and fertilisers, which act as a transport mechanism for toxic chemicals through soil and atmospheric environments.[31]

The global use of conventional plastic mulch has increased dramatically in recent years and is still rising. With this in mind, while there are possible benefits for the use of biodegradable plastic mulches in agricultural systems, they must first be thoroughly investigated and understood to ensure they are safe and sustainable. This would include, for example, more research into crop growth, microclimate modifications, soil biota, soil fertility and yields.[32] If biodegradable plastic mulches are to be tilled into the soil after use, their absolute biodegradation needs to be verified and ensured under the wide variety of soil conditions and environments where they are applied.[33]

Agroecology, permaculture and organic inputs

If our collective ambition is to create food systems that can function within planetary boundaries,[34] a detailed analysis and rethinking of agricultural plastic use and end-of-life management needs to be centre stage.

Agriculture, through intensive farming, is a driver of the increase in plastic production and consumption around the world.[35] Therefore, any recommendations for agriplastic alternatives, including biodegradable mulch, must also take into consideration the sustainability of current food production systems that by design require the use of high quantities of plastic. Simply replacing one single-use material with another as a blanket solution is a narrow response to a much more complex societal problem with regards to production systems.

For instance, intensive farming systems such as industrial monoculture are predicated upon the use of agriplastics, regardless of their source feedstock or polymer properties. Many existing plastic-intensive agricultural systems also exhaust natural resources by focusing on short-term gains rather than the long-term sustainability which works best for the land, wildlife, local communities and supply chain resilience. Simply focusing on substitution of an agriplastic product with the same functionality perpetuates a linear economic model where items are used once and have a short lifespan before being disposed of, contributing to the loss of valuable resources[iii] and to negative impacts throughout their life cycles.

More broadly speaking, while agriplastic product alternatives could potentially be a viable option in limited circumstances, we also need to take a broader view in pursuit of truly sustainable food production systems that do not require high inputs of agriplastics, whether petrochemical or biobased, to function. Many of the solutions lie in agroecology and permaculture, which adopt arrangements seen in natural ecosystems. When such principles are applied, the need for plastic use is significantly reduced.[36]

UK farmers paid by Government to apply microplastic and toxic-riddled fertilisers

Application of organic fertilisers has been cited as an agroecological method.[37] There is also growing awareness of how we need to move away from the application of chemical/synthetic fertilisers given their harm, which are also derived from petrochemical feedstocks,[38] with organic alternatives such as sludge being a viable alternative. This is further exacerbated by current shortages in fertiliser globally,[39] despite agrochemical companies reaping ever-increasing profits.[40]

However, in order for fertilisers derived from sludge, also known as slurry, to be a viable solution, wastewater treatment regulations and practice must be reviewed urgently,[41] given they require the removal of microplastics from sewage, but not necessarily microplastic particles in residual sludge.[42] This practice results in the dispersal of considerable amounts of microplastics in agricultural soils when used as fertiliser.[43]

For instance, in the UK it is estimated that 3.5 million tonnes (wet weight) of biosolids (sludge post-treatment) from wastewater are used each year on agricultural land. A recent study estimated that the microplastic content of biosolids could result in the equivalent of more than 20,000 bank cards worth of plastic being potentially applied to agricultural lands every month,[44] with another study citing that microplastic contamination from sewage sludge in the UK could be the highest in Europe.[45]

Furthermore, in 2020, a study commissioned but then not published by the Government found that the sewage sludge being spread across UK farmland contained toxic substances in addition to microplastics. Investigators commissioned by the Environment Agency found sewage waste destined for English crops contaminated with dangerous "persistent organic pollutants" such as dioxins, furans and polycyclic aromatic hydrocarbons at "levels that may present a risk to human health".[46]

The Environment Agency has acknowledged that current Sludge (Use in Agriculture) Regulations (SUiAR) do not control new hazards, including microplastics, and aims to submit a request for legislative change in mid-2023;[47] this revision must ensure the obligations in place are adequate.

Despite acknowledgement of this significant regulatory oversight, however, UK farmers have been paid by Government, including in 2022, to apply sludge to their lands as part of the Department for Environment Food and Rural Affairs (Defra) Sustainable Farming Initiative, despite guidance[48] for the attainment of the relevant arable and horticultural soils standard[49] making no reference at all to the issues surrounding microplastic contamination of sludge.[50]

Below: Domestic sewage treatment plant in UK. If farmers and growers are to continue to apply residual sewage sludge onto farmland as fertiliser, adequate policies ensuring that they are not contaminated with microplastics and heavy metals are necessary.

Conclusion

The current advertising of alternative agriplastic products is falling into the same trap as conventional agriplastics, not fully accounting for nor addressing environmental and human health impacts.

There are mounting calls for a significant review of our current global agricultural system, as a result of climate change, in order to feed a growing global population, in addition to the environmental degradation the current system is causing. The development of intensive agriculture in the 1950s happened hand-in-hand with the proliferation of agriplastics[51] and so the direct and indirect use of plastics in agriculture is a cornerstone of what needs to change.

Simply leaping into alternative modes of farming and growing, including replacing conventional fossil-based plastics with biodegradable alternatives or not accounting for microplastic-contamination, without addressing the issues they bring, will only serve to collectively lock us in other harmful modes of food production.

It is therefore imperative that products placed on the market are safe and sustainable and that safeguarding regulations are put in place.

Crucially, given the struggle to achieve true and non-toxic circularity for this waste stream, resources must be provided to identify viable and safe alternatives that can be adopted by the agricultural sector.

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Notes

i. EU Standards – ask for RPa positioning to be online to hyperlink

ii. ISO 17088, ASTM D6400, ISO 17556, ASTM D5988

iii. Through their production

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