ENVIRONMENTAL INVESTIGATION AGENCY

Ocean

Fields of plastics: The growing problem of agriplastics

What are agriplastics?

Agriplastics (also known as 'plasticulture' or 'ag plastics') are plastic products, films and packaging used in agricultural production and sales. Examples include mulch and greenhouse film, silage covers and bags, irrigation systems, tunnels and covers[1]. They have a variety of purposes, including weed suppression, protecting produce from insects, shielding from harsh weather conditions, and for storage and transportation. They are commonly used in vegetable and berry production. Microplastics (plastic pieces 5mm or less in size) are also used in agricultural applications, including in nutrient prills (granules) and soil conditioners.

Front cover:Agriplastic waste on beach of Marina de Cope, Spain

Above: Plastic mulching used to cover soil, southern coast of Spain

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The scale of the issue

Plastic mulching – used to cover the surface of soil to suppress weeds, conserve water or fumigate chemicals – is the most common agriplastic, comprising 40 per cent of the total agriplastic market[2]. The global agricultural films market was valued at $7.48 billion in 2016 and is projected to reach $10.57 billion by 2022[3].

Plastic coverage is mainly concentrated in East Asia (almost 80 per cent) particularly China, Japan and Korea[4]. The Mediterranean basin contains about 15 per cent of the world's covered area. Rapid growth in agriplastic usage has been reported in China, the Middle East and Africa[5].

In Europe, data indicates Spain is the largest user of mulching (120,039 hectares), followed by France (100,000 ha)[6]. Spain accounts for nearly half of Europe's plastic greenhouses and large tunnels, covering 53,235 ha. Italy was Europe's largest user of low plastic tunnels (26,000 ha). This is relevant for UK retailers with supply chains which include products grown in these regions.

What is the problem?

Despite performing a variety of purposes, there are problems associated with the intensification of plastic materials in agriculture. An overview of these is provided below.

- **Agriplastics are difficult to recycle and inappropriate disposal is regularly reported.** Globally, the fate of used plastic mulches is largely unknown, but recycling levels are likely to be very low. Recycling is only possible if contaminants make up five per cent or less of total weight, but contamination is often up to 40–50 per cent[7]. Soil contamination makes films bulky and adds to transportation costs, which can make it uneconomic for small and medium holdings to ensure an environmentally secure disposal[8]. In the EU, recycling rates are around 28 per cent, with 30 per cent incinerated and 42 per cent sent to landfill[9]. Recycling rates vary between countries, with Ireland achieving 63 per cent, whereas Bulgaria, Romania, Slovenia and Slovakia report zero per cent. Where plastics are not recovered, they are often buried in the soil, abandoned in fields or watercourses[10] and even illegally burnt[11]. This leads to leakage into the environment.
- **Soil degradation and reduced crop productivity.** Scientists have raised concern that the intensified use of agriplastics could pose a long-term risk through soil degradation, which in turn could reduce crop productivity[12]. Residual plastic film can have detrimental effects on soil structure, salt levels, nutrient transport and crop growth[13]. Plastic mulches risk altering soil quality, depleting soil organic matter stocks, increasing soil water repellence and releasing greenhouse gases[14]. These concerns are particularly relevant for polymers which are not designed to biodegrade in the soil, but may also be applicable for some products marketed as biodegradable but which do not fully break down within a rapid timeframe (see below).
- **Concerns whether all 'biodegradable' agriplastics fully break down in soil.** Through microbial activity, biodegradable agriplastics break down into carbon dioxide, water and biomass, with the advertised benefit that they can be tilled into the soil after use. However, scientists have raised concern that the widely used ASTM D5988-12 and ISO 17088 standards for plastic biodegradation do not adequately account for diverse soil and weather conditions encountered in fields, hindering biodegradation rates[15]. Where polymers do not fully break down but fragment into micro- and nanometre-sized plastics, there is concern of the potential long-term consequences for soil quality and fauna[16].
- **Concerns about photodegradable plastic mulches.** Photodegradable plastics are those that degrade by photo-initiated chemical reactions. Their ability to fully break down without sufficient light exposure (i.e. if they are buried) has been challenged,[17] with micro- and nanometre-sized plastics remaining in soil.
- **Impact on marine life.** Leakage of agriplastics into the marine environment can occur through wind or riverine transport, and can lead to injury and death of marine species through entanglement and ingestion There have been repeated cases of agriplastics correlating to cetacean deaths. On the southern Spanish coast of Granada in 2013, a dead sperm whale was found to have digested 17kg of plastic greenhouse waste[18]. In February 2018, a severely underweight sperm whale was found with 29kg of plastic in its stomach on a Spanish beach in the Murcia region[19] - an area where data indicates that the majority of marine plastic pollution relates to agricultural activity[20]. Furthermore, when agriplastics fragment into microplastics, they can be ingested by species throughout the marine food chain. These microplastics absorb, transfer and release contaminants which can then be transferred up the food chain[21].
- **Contamination of agricultural land with microplastics and impacts on terrestrial ecosystem.** Microplastics have been recognised as an emerging threat to terrestrial ecosystems, posing risks to organisms that perform essential ecosystem services such as soil-dwelling invertebrates, fungi and plant pollinators[22]. Earthworms and collembolan species can transport plastic particles from surface soils through the soil profile, which could leave other soil biota exposed to risks of contamination[23]. There is growing evidence that microplastics used in fertilisers may be entering the food chain[24].

Case study: Marine agriplastic pollution in southern Spain

In Spain, plastic greenhouses and mulching coverage is concentrated in the southern regions of Murcia, Canarias and Andalucía. Andalucía has the highest concentration, with over 50 per cent of its 113,897 ha covered with agricultural plastics[25]. Within the Andalucia region, Almería is thought to have the highest greenhouse coverage in the world[26].

Between 2010-15, University de Deusto and Asociación Ambiente Europeo studied the correlation between agriplastics and marine pollution, analysing 47,682kg of marine plastic pollution from shorelines across Murcia, Andalucía, Canarias and other regions[27]. They found an eightfold increase in plastic items related to intensive agriculture between 2014-15, with the highest concentration in the Punta Calnegre-Cabo Cope Regional Park, in Murcia. Other studies have also identified this area as a hotspot. Between October and November 2015, four areas were sampled in Marina Cabo de Cope. More than 10,000 units of agricultural plastics were recovered, making it the largest identifiable source of pollution (22 per cent of total plastics)[28]. In 72 per cent of cases, the origin could not be verified, making the likely total contribution of agriplastics potentially up to about one-third of the total.

The impact this is having on marine species is becoming increasingly clear, with correlation between sperm whale mortalities and agriplastic hotspots[29]. Studies also indicate the emerging threat of ingestion of plastics by birds in inland Spanish agricultural landscapes[30].

Below: NASA photo of agriplastic coverage approx. 20,000 ha of the Campo de Dalías, Almería, Spain

Bottom left: Sperm whale stranded on Spanish shore, 2018

Bottom right: Plastic retrieved from stomach of dead sperm whale, 2018

Legislation and standards

Some EU countries have national legislation, schemes and guidance to encourage greater collection rates, including Ireland, Iceland, Sweden, France, Spain, Norway, the UK and Germany. For countries with national collection schemes, collection rates average 75 per cent, whereas areas without them achieve an average collection rate of 30 per cent[31]. There is no common EU regulation on the recovery of agriplastics. The European Strategy for Plastics in a Circular Economy encourages national and regional authorities to introduce Extended Producer Responsibility schemes to provide incentives for greater recycling of agricultural plastics[32].

Some regions have already established producer responsibility systems and where implemented these have helped reduce inappropriate disposal and increase recycling[33]. In regions without producer responsibility systems, inappropriate disposal of agriplastics continues to be reported – with plastic mulching left in the soil[34] and in some cases burnt[35]. Incorrect disposal in coastal regions in turn contributes to marine pollution[36].

In 2018, a new European standard EN 17033 on biodegradation of plastic mulch films was published, specifying test methods and evaluation criteria for the biodegradation, ecotoxicity, film properties and constituents[37]. It uses the existing certification "OK Biodegradable soil" as a basis, which requires 90 per cent CO_2 conversion within 24 months in a soil biodegradation test. It also includes a new ecotoxicity testing and evaluation scheme, which considers the impact on plants, invertebrates (e.g. earthworms) and microorganisms. The standard defines restrictions on potentially harmful constituents such as regulated metals and substances of high concern.

The introduction of this standard is a welcome step, as other standards for biodegradable plastics (such as ASTM D5988-12 and ISO 17088) were found to inadequately consider how diverse soil and weather conditions might slow biodegradation rates[38]. Nonetheless, the new standard does not include criteria or testing for degradation in the marine environment and plastic conforming to this standard could still pose threats to marine life if it enters the ocean. As such, legislation focused on ensuring collection, recycling and eco-design remains paramount for reducing the possible environmental impact of agriplastics.

Voluntary standards

Voluntary standards exist to provide guidelines on agricultural practices. These include the GLOBAL G.A.P. Certificate, which provides 'Good Agricultural Practices' for crops, aquaculture, livestock and horticulture production[39]. Created by European supermarket chains, it is one of the largest certification schemes, with over 188,000 certified producers in more than 125 countries[40]. Compliance criteria for the GLOBAL G.A.P. Fruit & Vegetables Standard require producers to:

- identify waste products and pollution sources in all areas of the farm, including plastics
- have a farm waste management plan to avoid and/or minimise wastage and pollution, with provisions for waste management
- carry out an annual risk assessment of physical and chemical pollution of water used for pre-harvest activities, including risks posed by plastics bags
- have written procedures for handling clear hard plastic.

The standard for crops includes the same criteria but does not require written procedures for handling clear hard plastics[41]. While the principles on waste identification and management should in theory cover agriplastics, it does not contain specific advice for the reduction, recovery or recycling of non-biodegradable agriplastics, nor does it cover microplastics used in agricultural applications.

Non-governmental organisations also provide standards for sustainable agricultural practices, including the Soil Association, Naturland and the International Federation of Organic Agriculture Movements. While organic standards do not prohibit agriplastic use, the Soil Association prohibits packaging that contains the most hazardous chemicals such as PVC and phthalates[42]. Structures with plastic covering, such as polytunnels, must be based on polyethylene, polypropylene or other polycarbonates[43]. The Soil Association also encourages organic companies to use the least amount of packaging possible and to use recycled or recyclable materials.

What are the alternatives and solutions?

Addressing the problems associated with agriplastics will require a focus on reduction, redesign and waste management. These changes might be brought about by legislative solutions as well as private and voluntary initiatives.

Reduction and redesign

In some instances, it may be possible to bypass the problem entirely by adopting plastic-free alternatives. Cover crops can be grown during the winter and left in place to act as mulch. Other organic mulches, including wood chips, leaves, grass trimmings or straw, can be used for weed suppression. While there can be drawbacks (including short lifespan, weeds and pests), organic mulches can increase the organic content in soil and facilitate better root penetration[44]. In some climates, irrigation systems with plastic piping can be replaced with dry-farmed crops, which draw on a reserve of soil moisture captured from previous rainfalls[45].

Certain redesign options can also be considered to reduce plastic usage. Glass and recycled durable plastic are possible alternatives to greenhouse plastics. The initial cost outlay needed is higher, but they last longer and are the most stable option[46].

Where plastics cannot be designed out of applications, using products which conform to the highest biodegradation standards will reduce certain environmental issues, as long as safeguards are in place to minimise the potential for leakage into the natural environment. Principles such as reusability and recyclability should also be incorporated into design guidelines.

Waste management and recycling

Robust waste management is required to minimise used agriplastics leaking into the environment, with a focus on increasing recycling rates from their current low levels. Lessons could be learnt from national collection systems – such as the Irish Farm Film Producers Group – where high recycling rates have been achieved. This might require investment in facilities to transport, clean and recycle agriplastics, the costs of which might be covered through Extended Producer Responsibility (EPR) schemes. In 2018, a communication from the European Commission encouraged national and regional authorities to introduce EPR to provide incentives for recycling agricultural plastics[47].

In the absence of national legislation and collection schemes, there are steps companies can take to mandate and incentivise higher recycling rates. For example, Spanish supermarket Mercadona has created a range of items made from recycled agricultural plastic waste. This incentivised farmers to recover plastic materials, viewing them as resources rather than an unusable waste[48]. In line with the waste hierarchy, reduction should be favoured over recycling where possible.

Voluntary standards, such as the GLOBAL G.A.P. Fruit & Vegetables Standard, should be updated to cover all types of agriplastic use, ensuring that usage is minimised, recovery of agriplastics is guaranteed and that retailers establish auditing systems to ensure implementation of best practice, with routine inspections of suppliers.

Above: Photos of agriplastic waste on Southern coast of Spain

Microplastic use in agriculture

Despite concerns regarding the impacts of microplastics on terrestrial, marine and freshwater fauna, and on human health, microplastics are used in a number of agricultural applications, mainly in nutrient prills (granules) used to diffuse fertilisers into soil over a predetermined timeframe[50]. They may also be used in soil conditioners and pesticides.

There is limited information on the quantities of microplastics used in agriculture. Based on industry figures, it is estimated that approximately 8,000 tonnes of polymers are used in fertilisers in the EU, although due to inadequate information from industry, there is no estimate of what proportion of these polymers constitute microplastics[51].

Recommendations to supermarkets

- Engage with fruit and vegetable suppliers about reducing single-use agriplastics, considering redesign options where this is not possible
- Encourage and support innovation and development of alternative sustainable designs (with a focus on recyclability and/or biodegradability), re-usable initiatives and recovery systems
- Engage with suppliers about replacing polymer-coated nutrient prills (granules) with alternative fertiliser techniques, such as nitrification inhibitors or cellulose beads, support research into other alternative methods and work with suppliers and government to urgently phase out the use of microplastics in agricultural applications
- Work collaboratively with other retailers and industry organisations to establish best practices, engaging with standard-setters such as GLOBAL G.A.P. and Soil Association to prompt the inclusion of more robust criteria covering plastics and microplastics
- Conduct routine spot-inspections to ensure standards are being met
- Engage with local and national authorities with regard to introducing EPR and national collection schemes and work with existing schemes to ensure effective implementation.

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 campaigning to eliminate powerful refrigerant greenhouse gases, exposing related illicit trade and improving energy efficiency in the cooling sector.

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