Factsheet

# Bioplastics

## What are bioplastics?

Bioplastics are plastics with:

- some percentage of **bio-based inputs**;
- and /or the ability to **biodegrade** under specific conditions (e.g. during an organic waste composting process in an industrial facility).

Bio-based inputs can be either:

- **monomers extracted from biomass** e.g. lactic acid derived from sugar cane or corn, and industrially synthesized into polylactic acid (PLA), a type of polyester polymer and one of the most common bioplastics on the market; or
- **polymers formed in nature** e.g. corn or rice starch, industrially extracted and blended with additives and other polymers - fossil or bio-based, biodegradable or not - to form thermoplastic starch (TPS), a type of blended bioplastic material [1].

**Polymer biodegradation** involves breakdown into carbon dioxide, water, mineral salts and biomass. Naturally-formed polymers typically biodegrade better than synthetic ones designed for biodegradation. Design (e.g. thickness) and chemistry (e.g. additives) are also relevant [2]. Additives may persist as pollution in compost and the open environment.

**"Biodegradable", "industrially compostable" and "home compostable" labelling claims are unregulated globally.** National, subnational or local rules are uneven, when they exist at all, while private sector certifications also vary in reliability. These gaps leave ample room for deceptive marketing practices including greenwashing and false advertising.

**Many composting facilities reject bioplastics** in order to protect compost quality. Even where bioplastics break down to the point of becoming invisible to the naked eye - which they often fail to do - microplastics and toxic chemicals remain a threat.

**Bioplastics recycling remains elusive**: while it is technically possible to mechanically recycle some bioplastics (e.g. PLA) separately from conventional plastics, dedicated sorting and recycling infrastructure are lacking. Most bioplastics are currently regarded as contaminants in plastic recycling streams and are not recycled [3].

## Microplastic problems

All plastics, including bioplastics, fragment into microplastics - and more so under certain conditions (e.g. ultraviolet exposure, oxidation, mechanical forces). **Even plastics labelled as "biodegradable" or "compostable" can cause microplastic pollution**, due to:

- absent or flawed biodegradability or compostability labelling regulations or certification schemes [4];
- the presence of non-biodegradable polymers blended with biodegradable polymers;
- real-life condition variation (e.g. temperature, moisture, ultraviolet exposure, microbiome, time windows) away from ideal conditions for which these plastics were engineered.

Revealingly, some bioplastics industry associations have opposed government action on secondary microplastic pollution [5].

Oxo-degradable plastics - sometimes misleadingly marketed as "oxo-biodegradable" - are plastics that do not biodegrade but have additives that accelerate their fragmentation into microplastics, driving pollution and harming health. For these reasons, oxo-degradable plastics must be banned across all jurisdictions.

## Toxics threaten soil, plant health

Any polymer, including bioplastics, can be intrinsically toxic. Toxicity may also stem from additives. Both intentional and non-intentional additives are present in bioplastics [6]. Many of these additives are toxic, while others lack safety data [7]. Research shows that PLA in compost undermines soil health and plant growth, and leads to significant earthworm mortality [8].

## Upstream harms

Mass-scale, industrial biomass production for bio-based plastics harms people and planet through deforestation, monoculture and use of pesticides and other toxic agrochemicals, triggering food insecurity, water stress, toxic pollution, climate harm and biodiversity collapse [9]. Traditional and Indigenous communities are particularly at risk of displacement and dispossession from mass biomass production.

Inflated climate claims: bioplastics including PLA are not always preferable to fossil-based plastics from a climate perspective. For instance, deforestation and land use change impacts can outweigh the carbon benefits of avoiding fossil inputs [10], while carbon sequestration claims often neglect that biodegradable polymers will release $CO_2$ when they degrade.

## Policy implications

**Don't greenwash single use:** "Bio" does not mean good or safe. Too often, focus on bioplastics greenwashes mass overproduction of single-use or short-lived plastics. Today's bioplastics are overwhelmingly single-use regrettable substitutes for conventional plastics, end up landfilled and perpetuate microplastic pollution.

**Avoid blunt policy support:** Current fossil fuel and petrochemical subsidies bias the materials market. Their removal is urgently needed and will benefit alternative, bio-based materials [11]. However, blunt pro-bioplastics policy including subsidies or broad targets could trigger deforestation, food insecurity and other significant harm.

**Regulate before scaling:** Establish harmonized controls to ensure that any scaling of alternatives to current conventional plastics does not happen at the expense of human and planetary health and rights, including:

- **Prioritizing prevention & reuse** by prohibiting single-use products, even single-use bioplastics, where these products can be avoided entirely or displaced by reuse and refill systems;
- **Protecting planetary boundaries** by keeping bioplastics within the global plastic production budget that respects the climate and other planetary boundaries [12];
- **Prohibiting deceptive claims** including "biodegradability" and "compostability" claims that do not match realistic local conditions;
- **Requiring transparency** of chemical composition and feedstock traceability.

## Criteria for material alternatives

- **Reduce** single-use products of all kinds first;
- **Prioritize** reuse, refill, repair, and redesign wherever possible;
- **Allow single-use** material alternatives **only for genuinely exceptional circumstances**, such as medical, emergency, disaster relief, or certain accessibility needs;
- **Require** any remaining single-use alternatives to be **plastic-free, toxic-additive-free, transparent** in composition (organic waste - derived/agroecology-sourced biomass preferred when needed), and governed by **strong public safeguards**.

# End notes

[1] Natural polymers (e.g. starch) usually biodegrade the best, while semi-synthetic polymers (e.g. viscose) biodegrade more quickly and completely than synthetic polymers (e.g. PLA). For more on the distinction between synthetic, semi-synthetic and natural polymers, see GAIA (2023) Defining plastic products, materials and polymers: a proposal

[2] Erdle L. & Eriksen M. (2023) Better Alternatives 3.0: A Case Study on Bioplastic Products and Packaging, The 5 Gyres Institute

[3] Eunomia & PPC (2025) Bioplastics Are Trash: The Unforeseen Environmental Consequences of PLA from Production to Disposal

[4] Fang C., Zhang X., Zhang Z. & Naidu R. (2024) Characterising fragmentation of compostable bioplastic: releasing microplastics or small bioplastic debris, *Environmental Sciences Europe*

[5] Biodegradable Products Institute (2025) Microplastics comments to the California Department of Toxic Substances Control (DTSC), 4 August 2025

[6] Pereira J. F., Barbosa M. L., Silva F., Nerin C., Cruz S. A., & Vera P. (2026) Assessment of IAS and NIAS in Plasma-Treated Biopolymer Films: Implications for Food Packaging Safety and Quality, *Foods*

[7] Zimmermann L. (2026) Antioxidants: hazards and exposure through biodegradable plastics, Food Packaging Forum

[8] Huerta-Lwanga E., Mendoza-Vega J., Ribeiro O., Gertsen H., Peters P., Geissen V. (2021) Is the Polylactic Acid Fiber in Green Compost a Risk for Lumbricus terrestris and Triticum aestivum?, *Polymers*; Liu R., Liang J., Yang Y., Jiang H. & Tian X., (2023) Effect of polylactic acid microplastics on soil properties, soil microbials and plant growth, *Chemosphere*

[9] Gerassimidou S., Martin, O.V., Chapman S.P., Hahladakis, J.N. & Iacovidou E. (2021) "Development of an integrated sustainability matrix to depict challenges and trade-offs of introducing bio-based plastics in the food packaging value chain", *Journal of Cleaner Production*

[10] Eunomia & PPC (2025) *op cit.*

[11] Eunomia & QUNO (2024) Plastic Money: Turning Off the Subsidies Tap

[12] GAIA (2024) Plastic Production Reduction: The Climate Imperative


# Acknowledgements

Author: Sirine Rached
Editor: Ana Rocha
Reviewer: Yayoi Koizumi

See GAIA's plastics publications at: www.no-burn.org/plastic/