The global plastics treaty: What is the role of bio-based plastic, biodegradable plastic and bioplastic? *(possible core obligation 8)*

Alternatives to conventional, durable fossil-based plastics include a) those derived partly or wholly from renewable resources ("*bio-based plastics*") and b) those composed of renewable or fossil-based carbon sources, but which can undergo biodegradation ("*biodegradable plastics*"). These materials are often described as being sustainable alternatives to conventional plastics, and while in restricted applications they may bring some advantages over conventional plastics,[1] their contribution as a solution to global plastic pollution is limited. Caution is required to ensure these materials do not become regrettable substitutions, presenting hazards to organisms and human health,[2, 3] or contributing to social, economic and environmental burdens.[4] Critically, the use of bio-based carbon and of biodegradable plastics must not compromise the necessity to reduce the production of all plastics.[5] It is therefore essential that the Global Plastics Treaty makes a distinction between bio-based plastics and biodegradable plastics and incorporates a comprehensive assessment of their potential advantages and disadvantages in comparison to conventional plastics.

Key terms: *There is a lack of consistency regarding the use of the terms below which can result in considerable confusion.*

- **Bio-based plastic**: composed or derived in whole or in part of renewable, biological products (including plant/forestry, animal and marine biomass). They are not necessarily biodegradable or compostable *(Fig 1-in green)*.[6]
- **Biodegradable plastic**: These can be made from renewable or fossil carbon sources, and are intended to biodegrade more rapidly than conventional plastics but require specific conditions (*Fig 1- in blue*).[1]
- **Biodegradation of plastic** is a 'system property' requiring: a) material properties that allow for microbial conversion into carbon dioxide, water, mineral salts, new microbial biomass, and in some cases methane, and b) suitable conditions in the receiving environment (microorganisms, temperature, pH, moisture etc.) such that biodegradation can take place.[1]

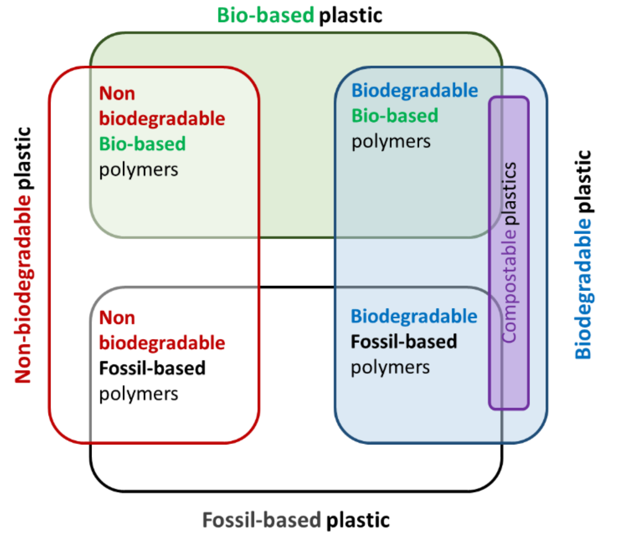

Fig 1. Categories of bio-based, fossil-based, biodegradable and non-biodegradable plastics. The conflated term 'bioplastics' comprises i) fossil-based biodegradable polymers, ii) bio-based biodegradable polymers and iii) bio-based non-biodegradable polymers.[1]

- **Compostable plastic**: a subset of biodegradable plastic (*Fig 1- in purple*). While some are intended to be 'home compostable', most need to be collected and transferred to appropriate industrial facilities.[7] This distinction may not be adequately labelled on products.
- **Bioplastic:** a term that subsumes plastic materials made of biodegradable polymers (including those from fossil carbon sources) and plastics composed of bio-based polymers (*Fig1- in blue and green*).[1] The term is not used consistently leading to confusion, therefore its use is not recommended.[8]

Why is it important for the Treaty to address this topic?

1. **Absence of consistent definitions and product labelling**: The terms "bioplastic", "bio-based", "biodegradable" and "compostable" plastics are not used consistently due to a lack of universally adopted definitions. This results in ambiguous product descriptions and/or labelling, and confusion relating to material properties, disposal pathways and potential benefits.[9-11]
2. **Ecological effects:** As with conventional plastics, bio-based and biodegradable plastics may contain a variety of chemicals including those shown to adversely affect human health and the environment.[12-14]

There is also concern that if biodegradable plastics accumulate in the environment they may generate microplastics and/or release chemical additives more rapidly than non-biodegradable plastics.[15]

3. There is a necessity to **reduce plastic production; this cannot be achieved by substitution of fossil-based carbon with that from bio-based sources.**[5]
4. The **infrastructure needed for industrial degradation of bio-based and biodegradable plastic waste is lacking** in most locations. Separating biodegradable from non-biodegradable plastic can be challenging, leading to contamination which can compromise the recycling of conventional plastics.[16, 17]

Specific considerations relating to biodegradable and compostable plastics:

a. **In certain applications the property of biodegradability could offer advantages over conventional plastics**, provided that complete mineralization is achieved within an appropriate product-specific timescale, and that chemicals and intermediate degradation products such as particles, do not result in environmental harm. Examples include where it is difficult i) to separate plastic from organic material that is destined for a composting waste stream (e.g. fruit labels, tea bags), or ii) to remove or collect a particular plastic product or its fragments from the environment after use (e.g. agricultural mulch films).[1, 18] Any benefits of biodegradability must be contextualised within the zero waste hierarchy.[19, 20]

b. **Standards for biodegradability and compostability**: Biodegradation is an essential part of natural biogeochemical cycles, and rates vary considerably according to the physical, chemical and biological properties of the receiving environment (e.g., soils or oceans compared to industrial facilities).[21] Most plastic biodegradation standards rely on laboratory tests and/or relate to degradation in industrial facilities which may not be relevant where the plastics are used or disposed of in natural environments.

Specific considerations relating to bio-based plastics:

a. **Resource use**: In principle, renewable carbon sources are preferential to non-renewable petroleum-based sources,[22] however, renewable production requires water, land, and chemicals such as pesticides and fertilizers, which have environmental implications. Plant feedstock cultivation for plastics can compete with food production and use of agricultural 'waste' diverts this resource from being returned to the soil as organic enrichment. Hence, depending on the type of feedstock and how it is generated, bio-based plastics can ultimately have a higher socio-economic and environmental impact than conventional plastics.[4, 23]

The role of the Global Plastics Treaty

1. Within the plastics treaty**, all plastics must be regulated (regardless of carbon source)**
2. **Establish an independent, multidisciplinary expert body** to develop safety, sustainability and essentiality criteria for all plastics, including the extraction of feedstocks intended for bio-based plastics production, and chemicals associated with bioplastic polymers and products.
3. **Mandate clear, consistent definitions** of bio-based, biodegradable and compostable plastics, and **accurate labelling** based on International independent standards including information on renewable feedstock content, transparency regarding associated chemicals, and disposal.
4. **Promote the use and development of robust and harmonised life cycle assessment** (LCA) tools to evaluate the environmental impacts of bio-based and biodegradable plastics throughout their life, including associated chemicals and persistent particles.[24-26] The outcomes of LCAs can vary according to the type and weight of assessment criteria, therefore robust and harmonised approaches are required.[27]

Specific considerations relating to biodegradable and compostable plastics:

a. **Require international, independent biodegradation standards appropriate to the potential end-of-life environment**: Standard tests should demonstrate environmentally relevant biodegradability without the release of toxic chemicals, across environments with differing biological-physical-chemical conditions (e.g. in different soil types, at the sea surface, marine and freshwater sediments), and waste management (e.g. sewage, digester and composter).

Specific considerations relating to bio-based plastics:

a. **Design products for reuse and recycling** while making sure that they do not interfere with existing recycling schemes.

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