



## PART 3

Read the text below and answer questions 27–40.

### BIOPLASTICS: A SUSTAINABLE SOLUTION OR A NEW PROBLEM?

A

Bioplastics are frequently promoted as a corrective to the environmental damage associated with conventional plastics, yet the term itself is notoriously elastic. It may refer to polymers derived partly or wholly from biological feedstocks, such as corn, sugarcane, or cellulose, or it may refer to materials that undergo polymer degradation under certain conditions. The difficulty is that “bio-based” and biodegradable are not synonymous: a plastic can originate from plants yet remain chemically durable for decades, while another may be fossil-derived but engineered to break down under controlled composting environments. This definitional overlap has reputational consequences. Consumers, confronted with reassuring labels and simplified marketing, often infer that any “bio” product will harmlessly disappear if discarded, a belief that can reshape disposal behaviour in ways that increase litter or mis-sorting. The dichotomy between environmental promise and practical disposal thus begins not in chemistry but in language, where ambiguous terms encourage mistaken expectations about what bioplastics can realistically achieve.

B

It is also frequently posited that bioplastics offer climate benefits because they incorporate carbon drawn from the atmosphere during plant growth, implying a form of short-term carbon sequestration. However, life-cycle assessments reveal that climate advantages depend less on the origin of carbon than on the entire production system. Feedstock cultivation may involve fertiliser inputs, irrigation, and mechanised harvesting, each carrying energy and emissions costs. Processing steps—fermentation, polymerisation, purification, and transport—can be energy-intensive, and the energy source (renewable or fossil-based) strongly affects the net footprint. Furthermore, the climate calculus changes when bio-based feedstocks drive land conversion, for example when forests or grasslands are replaced with industrial crops. The carbon released from soils and vegetation during conversion can outweigh any benefits derived from using plant carbon instead of fossil carbon. Bioplastics can therefore be compatible with climate goals, but they do not constitute an automatic route to net-zero materials; the balance hinges on agronomic practice, energy systems, and land governance.

C

A third layer of complexity concerns “drop-in” bioplastics—bio-based polymers designed



to be chemically indistinguishable from conventional plastics. Bio-based polyethylene (Bio-PE), for instance, can be manufactured from ethanol derived from sugarcane, yet the resulting polymer behaves like fossil-based polyethylene in processing and performance. This commercial compatibility is attractive because existing equipment, supply chains, and product specifications require minimal modification. Nevertheless, chemical similarity also implies environmental persistence. If such materials are littered or escape waste management, they may persist in soils and oceans in much the same way as their fossil counterparts, fragmenting into microplastics rather than mineralising into benign end products. The convenience of drop-ins, therefore, does not solve the waste problem by itself; it merely shifts the origin of carbon while leaving disposal risks largely unchanged. In practical terms, a bio-based polymer can be climate-relevant without being waste-reducing, a distinction that policy debates do not always maintain clearly.

#### D

The promise of biodegradable and compostable plastics is often framed as a response to litter and hard-to-recycle items, but here too the performance is context-dependent. Many compostable polymers are designed to break down reliably only under industrial composting conditions, where temperature, moisture, oxygenation, and microbial activity are managed to accelerate degradation. In laboratory tests these conditions can be specified precisely; in the real world they are frequently absent. Home compost heaps may be too cool or too dry, and natural environments such as beaches, rivers, and forests typically lack the consistent heat and microbial density needed for rapid breakdown. Consequently, products labelled “compostable” may remain intact for long periods when misplaced, undermining consumer trust and increasing contamination streams if they are treated as “disappearing” waste. The central issue is not whether polymer degradation is theoretically possible, but whether the disposal pathway that enables it exists at scale and is used correctly.

#### E

Recycling infrastructure introduces additional complications because some compostable plastics resemble conventional polymers closely enough to be mistaken in sorting. PLA, for example, can look similar to PET in bottles or clear packaging, and if even small quantities enter PET recycling lines they can reduce the quality of the recycled batch. The problem is partly technical—different melting points and chemical behaviours can create defects—and partly logistical, since many facilities lack reliable detection and separation technology, especially when bioplastics arrive in low volumes scattered across diverse products. From a systems perspective, the risk is infrastructure incompatibility: a material designed to behave well in composting may behave poorly in recycling, and vice versa. Waste managers may therefore face higher costs to preserve recycling quality, while



consumers face confusing guidance about what belongs in which bin. A well-intentioned shift to bioplastics can thus create reputational risk for sustainability claims if it inadvertently degrades the performance of established recycling streams.

## F

Feedstock sourcing raises the most politically charged concerns because it links packaging choices to land, water, and food systems. The familiar “food versus fuel” debate can be extended to plastics, as large-scale demand for plant-based polymers may compete directly with food production or indirectly raise prices by tightening land markets. Even where producers rely on agricultural residues or non-food biomass, the supply is not unlimited. Crop residues may already be needed to protect soil structure, maintain organic matter, or support livestock systems, so diverting them can shift environmental burdens rather than remove them. Scale is therefore decisive: what appears sustainable in niche applications may become problematic if the sector expands rapidly without governance. Feedstock competition also interacts with regional inequality, since land conversion and water extraction often fall on communities with limited political leverage. Bioplastics, in this sense, are not merely a materials question; they are an allocation question about how biological resources are used.

## G

Supporters of bioplastics argue that they are most defensible when deployed strategically, not indiscriminately. In medical contexts, controlled biodegradation can be a genuine advantage: sutures, drug-delivery carriers, or temporary implants that degrade safely may reduce the need for follow-up procedures and lower clinical risk. In food systems, compostable liners or packaging may make sense when they help collect organic waste for centralised composting, improving hygiene and increasing the capture of food scraps that would otherwise contaminate recycling. These cases rely on alignment between material design and waste pathway: the polymer is selected because it fits a defined end-of-life route, not because it carries a generalised “green” label. Such targeted deployment can reduce unintended consequences, but it also implies that bioplastics are unlikely to be a universal substitute for all conventional plastics.

## H

Policy increasingly shapes whether bioplastics function as environmental improvements or as another source of confusion. Jurisdictions may restrict certain single-use items, mandate clearer compostability standards, or require producers to finance collection and processing through extended producer responsibility (EPR) schemes. In principle, standards and enforcement can reduce mislabelling, improve consumer guidance, and encourage investment in sorting and composting capacity. In practice, regulatory



fragmentation can create further ambiguity: labels that are technically accurate in one region may be misleading in another if the required composting facilities do not exist or if collection systems differ. Policymakers must therefore manage not only material science but also communication, ensuring that claims about biodegradability correspond to real disposal routes. Without enforcement, “green” branding can become a low-cost marketing strategy that shifts responsibility onto consumers while leaving waste managers to handle contamination.

I

The central lesson is that bioplastics do not fit neatly into a narrative of simple substitution. The dichotomy between “sustainable solution” and “new problem” obscures the fact that outcomes vary across polymer types, end-of-life pathways, and governance contexts. Life-cycle assessments demonstrate that climate benefits depend on land use, energy inputs, and feedstock practices, while waste outcomes depend on sorting behaviour and system compatibility. A credible sustainability strategy therefore requires honest communication about limits, careful accounting of trade-offs, and disposal infrastructure capable of handling new materials without undermining existing recycling streams or transferring harms to land and water systems. Bioplastics may contribute to environmental goals when they are integrated into coherent policy and waste systems; when they are adopted as a label-driven shortcut, they risk becoming an additional layer of complexity in an already stressed global materials economy.

### **Questions 27–33**

Choose the correct heading for Paragraphs A–G.

#### **List of Headings**

- i How bioplastics can disrupt recycling systems
- ii “Drop-in” bioplastics: commercial compatibility but persistent waste
- iii Strategic uses where bioplastics may bring clear benefits
- iv Overlapping labels and mistaken expectations about disposal
- v Feedstocks, scale, and competition for land and resources
- vi Consumer disposal behaviour as the main source of plastic pollution
- vii Why climate advantages depend on full life-cycle accounting
- viii The importance of renewable energy in bioplastic production
- ix Biodegradation that requires specific composting conditions
- x Technical changes required to process “drop-in” polymers
- xi How misleading labels damage consumer trust
- xii The financial cost of separating different plastics



**27 Paragraph A**

**28 Paragraph B**

**29 Paragraph C**

**30 Paragraph D**

**31 Paragraph E**

**32 Paragraph F**

**33 Paragraph G**

**Questions 34–40**

Complete the summary below. Choose **ONE WORD ONLY** from the text for each answer.

**The Complexities of Bioplastics**

Although bioplastics are often championed as an eco-friendly alternative, public confusion persists because the term "bio-based" does not necessarily mean a material is

**34** ..... . Regarding climate impact, the overall benefit may be lost when forests or grasslands undergo land **35** ..... . Another challenge involves “drop-in” bioplastics; if they escape waste management, they may fragment into **36** ..... rather than mineralising into benign end products.

Industrial composting facilities regulate temperature, moisture, **37** ..... and microbial activity to accelerate degradation. Furthermore, if these bioplastics accidentally enter standard recycling streams, they can negatively affect the **38** ..... of the recycled material. Large-scale demand for plant-based polymers may indirectly raise food **39** ..... by tightening land markets. Finally, waste outcomes depend on sorting behaviour and system **40** ..... .

**Answer Key**

27. iv

28. vii

29. ii

30. ix

31. i

32. v



33. iii

34. biodegradable

35. conversion

36. microplastics

37. oxygenation

38. quality

39. prices

40. compatibility