

Environmental Forensics, Law and Policy

BIODEGRADABLE PLASTIC BAGS IN THE WASTE STREAM - PRACTICES, FAILURES, AND ENFORCEMENT CHALLENGES

Christian Zafiu ¹, Hannah Müller ², George K. Varghese ³ and Maria Pettersson ⁴

¹ Institute of Waste and Recycling Management, BOKU University, Vienna, Austria

² Environmental journalist profil Nachrichtenmagazin, Vienna, Austria

³ National Institute of Technology Calicut, Kerala, India

⁴ Department of Social Sciences, Technology and Arts, Luleå University of Technology, Sweden

1. INTRODUCTION

Plastic packages have become one of the most visible symbols of the global waste and pollution problem. Their low production cost, lightweight nature, high flexibility, and water resistance have made them convenient and widely used packaging materials, including in food packaging, while also contributing to their persistent and ubiquitous presence as environmental contaminants. Plastic bags made from polyethylene or polypropylene may remain in the environment for decades or centuries, fragmenting into microplastics. In soil systems, compost, rivers, agricultural land, and marine environments, such fragments may contribute to ecological disturbance, reduced environmental quality, impaired plant growth, and long-term risks to environment and human health (Thompson et al., 2024).

Widely used applications for plastic materials are food packages, carrier and waste collection bags, that often enter organic waste streams in countries with separate collections. In response to these findings, several countries introduced bans on certain applications of plastics. As an alternative, plastic items made from biodegradable polymers are introduced, that need to fulfil certain degradation profiles approved by certifying bodies.

In Austria, a ban on conventional plastic carrier bags was introduced in 2020 under the Austrian Waste Management Act (BGBL, 2002). Among other exceptions from the ban, plastic shopping bags are allowed to be placed on the market if they are home-compostable and consist predominantly of renewable raw materials. Across the EU, regulations are not uniform, with some countries promoting the use of biodegradable materials, while others adopt more restrictive approaches. The advantages for mandating biodegradable packages and carrier and collection bags include facilitating the separate collection of organic wastes and improving collection rates in the urban areas, while reducing the pollution of the waste stream by plastics. On the other hand, waste managers and environmental groups are particularly concerned that allowing biodegradable plas-

tics in the waste stream may encourage improper disposal practices, which could subsequently extend to other types of plastics.

At the EU level, harmonized rules for food packaging have been mandated by the Packaging and Packaging Waste Regulation (PPWR), which identified items such as tea bags, coffee pods, and carrier bags as applications for which compostable plastics may be required in the future, given that these items are frequently disposed of with organic waste and cannot be effectively removed from such waste streams (COUNCIL, 2024b). In addition, the PPWR allows Member States, under specified conditions, to require certain packaging applications to use compostable materials at the national level. However, implementing such measures may be challenging in practice, as food packaging is generally produced for the broader EU market, with only labels and printed information being adapted to individual countries and languages. Nevertheless, this open component of the PPWR allows for other food packages to be made of biodegradable materials that cannot be currently recycled.

However, the practical effectiveness of such legislation depends not only on the existence of a legal prohibition, but also on market compliance, reliable certification, consumer trust, enforcement capacity, and the ability of waste management systems to distinguish between genuine biodegradable products and misleadingly labelled conventional plastics, which are far cheaper than the biodegradable alternatives.

Recent evidence from Austrian composting facilities and local markets indicate that a substantial number of bags labelled as “bio”, “biodegradable”, or “compostable” are in fact conventional plastic bags. These products imitate compliant packaging while avoiding the higher production costs and quality controls associated with certified biodegradable materials. The result is a combination of environmental damage, consumer deception, unfair competition, and regulatory enforcement difficulty.

This column examines the practical problem of falsified biodegradable plastic bags in Austria. Drawing on ob-

servations from composting facilities, market inspections, expert material analysis, and the perspectives of producers, waste managers, testing bodies, and public authorities, it discusses how fake “bio-bags” enter the market, why they are difficult to trace, how they affect compost quality and legitimate businesses, and what this case reveals about the broader governance challenges of biodegradable plastics.

2. BIODEGRADABLE BAGS AND THE REGULATORY TRANSITION

The Austrian prohibition of conventional plastic carrier bags created a dedicated market for biodegradable and compostable alternatives. Retailers and supermarkets adapted relatively quickly to the legal requirements. At supermarket checkouts, consumers now commonly encounter reusable cloth bags, paper bags, or certified compostable lightweight bags for fruit and vegetables. In principle, this regulatory transition was intended to remove persistent plastic carrier bags from everyday retail use and to reduce problems when these products enter the organic waste stream.

Their environmental performance depends on chemical composition, processing conditions, certification standards, and the actual waste treatment pathway. Genuine biodegradable or compostable bags are generally made from materials such as starch-based polymers, polylactic acid blends, or other biologically degradable compounds. Such products are designed to break down under appropriate composting conditions within a limited period and to be converted into biomass, carbon dioxide, water, and mineral residues, rather than persistent plastic fragments.

Certification is essential in distinguishing genuine compostable products from ordinary plastic. In Europe, consumers and regulators often rely on visual marks such as the “Seedling” logo or “OK compost” certification issued by recognized testing bodies such as TÜV Austria (EN13432, 2008; TÜV-Austria, 2012). These labels are not merely marketing symbols; they are intended to indicate that the product has been tested according to defined standards. The presence of a certification number enables verification of the producer or license holder in certification databases. This traceability is particularly important because biodegradable plastics cannot be reliably identified by the consumer through visual inspection alone.

In practice, however, the regulatory system relies heavily on truthful labelling, functioning supply chains, and effective enforcement. If conventional plastic bags are printed with misleading phrases such as “bio”, “biodegradable”, “compostable”, or even counterfeit certification marks, many consumers and small retailers may be unable to identify the deception. This creates a loophole in which illegal products can circulate in markets while appearing to comply with environmental law.

3. FAKE BIODEGRADABLE BAGS AS AN ENVIRONMENTAL AND ECONOMIC PROBLEM

The problem of falsified biodegradable bags becomes visible most clearly in composting facilities. Vegetable res-

idues, fruit waste, coffee grounds, garden waste, and other organic materials are decomposed by microorganisms under warm and moist conditions until they form a dark, fertile compost mass. Ideally, only biodegradable material should enter this process.

However, compost operators increasingly observe white, green, and colored plastic fragments in the organic waste stream. These fragments do not decompose together with the organic matter. Instead, they remain visible in the windrows at the end of the composting process. Larger fragments are removed mechanically by screening, but smaller fragments remain in the compost (Binner et al., 2026). According to operators, such plastic contamination has increased despite the Austrian plastic bag ban (Muel-ler, 2026).

This contradiction reveals the central governance failure: legal bans may remove compliant retailers from the conventional plastic market, but they do not automatically eliminate illegal or misleading products distributed through informal or poorly controlled supply chains. In municipal organic waste, bags labelled as biodegradable are often disposed of by consumers in good faith. If the bag is made from conventional polyethylene or polypropylene, it becomes a non-degradable contaminant that is transferred to the environment.

The environmental implications are substantial. Non-biodegradable plastic fragments can remain in compost and eventually enter agricultural soils. Over time, larger pieces may break into smaller particles, contributing to microplastic contamination (Zafiu et al., 2023). Research showed that carelessly disposed plastic carrier bags account for a substantial share of non-degradable impurities in biowaste (Weithmann et al., 2018). Microplastics from packaging residues may affect soil organisms, impair plant growth, influence root development, and compromise the quality of compost as a soil amendment. Unlike natural organic matter, these plastic particles are not fully mineralized under ordinary composting conditions.

The economic consequences are also considerable. Composting companies must invest additional labour, equipment, screening, and quality control to remove plastic impurities. Lightweight plastic fragments may be blown from composting areas, requiring further collection and cleaning to prevent environmental dispersion. If contamination levels exceed quality thresholds, compost may lose value or become unsuitable for certain uses. Thus, the cost of illegal or misleading packaging is shifted from the producers and distributors of the fake bags to waste managers, municipalities, farmers, consumers, and the environment.

Legitimate biodegradable plastics producers are also affected. Companies producing certified compostable bags face higher material costs, certification expenses, and quality assurance requirements. Conventional plastic bags are substantially cheaper to manufacture. If counterfeit producers sell ordinary plastic bags under green claims, they gain an unlawful price advantage. In addition, when consumers or compost operators encounter non-degrading “bio-bags”, they may blame genuine biodegradable producers, thereby damaging trust in certified products and undermining the market for sustainable alternatives.

4. IDENTIFICATION OF GENUINE AND FAKE BIODEGRADABLE BAGS

An important practical challenge is that fake biodegradable bags are often designed to appear environmentally compliant. Some are printed with recycling symbols, green circles, plant motifs, or falsified certification labels.

However, the presence of the word “bio” does not prove biodegradability. In several observed cases, bags with green “bio” labelling also carried the material abbreviation “PEHD” or “HDPE”, indicating that they are made of conventional petroleum-based plastics and are not biodegradable under composting conditions. Other samples displayed TÜV-like certification marks without a valid serial number. Without such a number, the certification cannot be traced to an approved manufacturer or product. In these cases, the symbol functions as a misleading imitation rather than a verifiable quality mark (Figure 1).

Experts can sometimes distinguish suspicious bags through touch and sound. Starch-based compostable bags often feel softer, silkier, or more flexible, whereas conventional polyethylene or polypropylene bags tend to be stiffer and produce a louder rustling sound. However, such sensory impressions are insufficient for legal or scientific certainty. Material analysis is required.

This demonstrates the importance of combining visual inspection, certification verification, and material analysis. While consumers may rely on labels, regulators and waste managers require more robust procedures to identify and document violations. Without such methods, enforcement remains dependent on uncertain visual impressions and inconsistent market supervision.

5. MARKET PATHWAYS AND SUPPLY CHAIN OPACITY

The circulation of fake biodegradable bags is facilitated by opaque supply chains. Small market vendors frequently

obtain bags from informal distributors, private contacts, or local wholesale suppliers. During an investigation in Vienna (Austria) with field observations, market traders often stated that they purchased the bags from acquaintances, foreign contacts, or an unidentified “bag man” who visits markets early in the morning and sells bags directly to stand operators. Many sellers were unable or unwilling to identify the original supplier (Mueller, 2026).

Two categories of supply pathways can be distinguished. The first involves established wholesale businesses supplying food service and market vendors. Such wholesalers may import or purchase plastic bags from changing sources in countries of the European Union or outside, depending on price and availability. The second involves informal distribution through individual intermediaries who sell bags directly to market traders without transparent documentation.

The price difference between certified biodegradable bags and fake alternatives is the major driver. Certified starch-based bags may cost several times more than conventional plastic bags carrying misleading green claims. For small vendors operating with tight margins, low-cost bags are attractive, especially where enforcement risk appears low, or when they are unaware of the offence.

Tracing the origin of such bags is difficult. Some products carry barcodes or product numbers, that are fictitious or are leading to other products. In such circumstances, administrative authorities, certification bodies, and affected companies face serious obstacles when attempting to identify the legally responsible entity.

6. LEGAL AND ENFORCEMENT CHALLENGES

In the Austrian case, the national legal framework prohibits conventional plastic carrier bags and permits only specific biodegradable alternatives. In principle, violations may result in administrative penalties. The competent ministry responsible for waste management may conduct

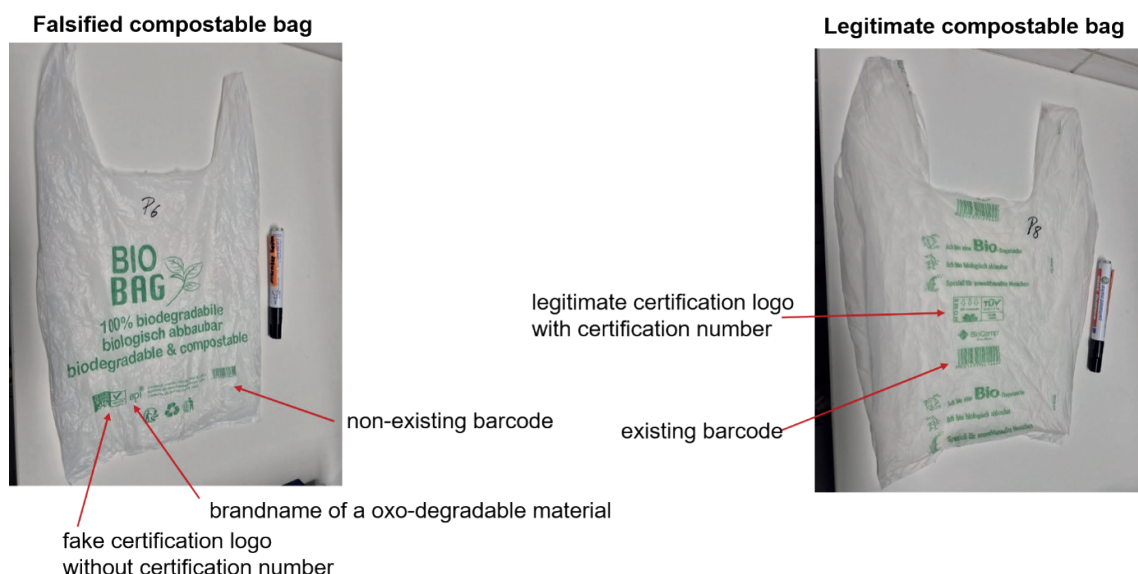


FIGURE 1: Hallmarks of falsified and legitimate compostable bags.

checks following public reports and refer violations to district administrative authorities. Fines may reach several thousand euros. However, enforcement is difficult in practice for several reasons. First, the number of small distribution points is high. Individual market stands, snack bars, food shops, and small wholesalers may all carry suspicious bags. Systematic inspection of every vendor would require substantial administrative resources. Authorities therefore tend to focus on larger distributors or major sources rather than individual stallholders. While this is understandable from an enforcement efficiency perspective, it may allow widespread small-scale circulation to continue.

Second, institutional responsibilities are fragmented. Waste management authorities may consider themselves responsible for the legal prohibition of plastic bags, while local market authorities may be responsible for general market supervision but not specifically for plastic bag compliance. In Vienna, the market authority indicated that it is responsible for many legal rules and ordinances, but not for waste management enforcement or technical bag inspection. Such institutional separation may create regulatory gaps in which products are visible in public markets but not effectively checked by the authority present on site.

Third, the technical distinction between legal and illegal bags is not always obvious. Inspectors require training to recognize certification labels, verify serial numbers, interpret material abbreviations, and identify suspicious claims. Without guidance, enforcement may be inconsistent. The planned development of informational material for market inspectors could therefore improve early detection, but it does not replace the need for laboratory confirmation in disputed cases.

Fourth, legal action by affected private parties is limited by the inability to identify defendants. TÜV Austria can act against misuse of certification marks if the producer or distributor is known. Similarly, legitimate producers may pursue legal claims for unfair competition, misleading labelling, or reputational harm only if the responsible party can be identified. Where the origin of the product remains hidden, enforcement shifts from ordinary civil litigation to investigative work.

Fifth, cross-border supply chains complicate jurisdiction. A bag may be produced in one country, printed in another, sold through a wholesaler in a third, and distributed informally in another country. If documentation is missing or fraudulent, the burden of investigation becomes disproportionate to the value of individual shipments. This creates an attractive environment for low-cost illegal products.

7. CERTIFICATION, CONSUMER TRUST, AND GREENWASHING

The fake biodegradable bag case is not merely a question of illegal plastic distribution; it is also a form of greenwashing. Greenwashing occurs when environmental claims are used to create the impression of sustainability without corresponding environmental performance. In this case, terms such as “bio”, “biodegradable”, “compostable”, or “100% degradable” are used to persuade consumers and

retailers that the product is environmentally responsible and legally compliant.

The damage caused by greenwashing is multi-layered. Consumers are misled into believing they are making an environmentally sound choice. Market vendors may be deceived into purchasing unlawful products. Composting operators receive contamination that consumers assumed to be biodegradable. Legitimate certified producers lose market share to cheaper fraudulent competitors. Certification bodies risk reputational harm if falsified logos circulate. Finally, policymakers may face public skepticism if a legal ban appears ineffective.

Certification systems are therefore central to market integrity. A credible biodegradable bag should display a recognized certification mark, a valid license or serial number, and clear information about the applicable composting conditions.

It is important to distinguish between industrial compostability and home compostability. A product certified for industrial composting may require higher temperatures and controlled conditions that are not present in ordinary garden compost. A product certified for home composting must meet more demanding degradation requirements under lower-temperature conditions. Consumers and vendors often do not understand these differences, which reinforces the need for clear labelling and public education (EN13432, 2008; TÜV-Austria, 2012).

However, certification alone cannot solve the problem if labels can be copied without verification. Enforcement agencies and retailers should therefore treat the absence of a valid certification number as a sign of warning. Public databases maintained by certification bodies can support verification, but only if inspectors and purchasers know how to use them.

8. IMPACTS ON COMPOSTING AND CIRCULAR ECONOMY OBJECTIVES

Composting is a key component of circular economy policy. Organic waste, when properly collected and treated, can be converted into compost and returned to soil as a nutrient-rich amendment. This reduces the need for landfill disposal, supports soil fertility, and closes biological material cycles. However, composting systems depend on input quality. If biowaste is contaminated with conventional plastics, glass, metals, or other impurities, the environmental value of compost is reduced (BMLFUW, 2001).

Fake biodegradable bags directly undermine the circular economy by introducing non-circular materials into biological cycles. Unlike genuine compostable materials, conventional polyethylene and polypropylene do not become part of the biological nutrient loop. Instead, they create persistent residues requiring removal, disposal, or, if not removed, eventual dispersion into soil systems.

This has practical implications for waste management operators. Composting facilities must invest in pre-treatment, screening, manual sorting, windrow monitoring, and post-treatment quality control. Even advanced screening systems may not remove all small plastic fragments. The smaller the fragments become, the harder they are to sep-

arate (Binner et al., 2026). Thus, prevention at the source is more effective than downstream removal.

The issue also reveals a tension in biodegradable plastics policy. Compostable bags can help collect organic waste and may reduce contamination from conventional plastic liners if they are genuinely compostable. However, the market presence of fake bags can lead waste operators to distrust all bags, including certified ones. Some composting facilities may prefer to exclude all plastic-like bags from biowaste streams because the practical burden of distinguishing certified from falsified products is too high. This could weaken the intended role of biodegradable bags in improving biowaste collection.

9. ADDRESSING THE CHALLENGE OF MISLABELLED BIODEGRADABLE BAGS

Several actors play a crucial role in removing falsified compostable plastic bags from the market (Figure 2). At the end of the product lifetime, falsified compostable plastic bags will be disposed of in bio bins and can be observed in composting plants by operators that can collect and report their occurrence. Compost operators process organic waste and need to maintain compost quality and prevent environmental contamination. They bear operational costs

caused by illegal products placed on the market as such products can compromise compost quality, causing the resulting compost to lose its product status and requiring its subsequent disposal. Their experience provides important evidence for regulators because repeated contamination in composting facilities indicates systemic market failure rather than isolated consumer error.

Scientific institutions can contribute with analytical expertise through material characterization, contamination studies, and waste stream analysis. Researchers can distinguish genuine biodegradable polymers from conventional plastics and quantify the share of non-degradable impurities in biowaste. The information generated by these actors can help to identify sources by waste forensic frameworks and aid enforcement, policy evaluation, and public communication.

Companies representing the compliant segment of the biodegradable packaging market are severely harmed by falsified products through unfair price competition and reputational damage. These companies invest large budgets in material design, testing, certification, quality assurance, and intellectual property rights to create a market for compliant products. Their experience demonstrates that environmental regulation can support innovation, but only if enforcement prevents illegal competitors from undermining the market.

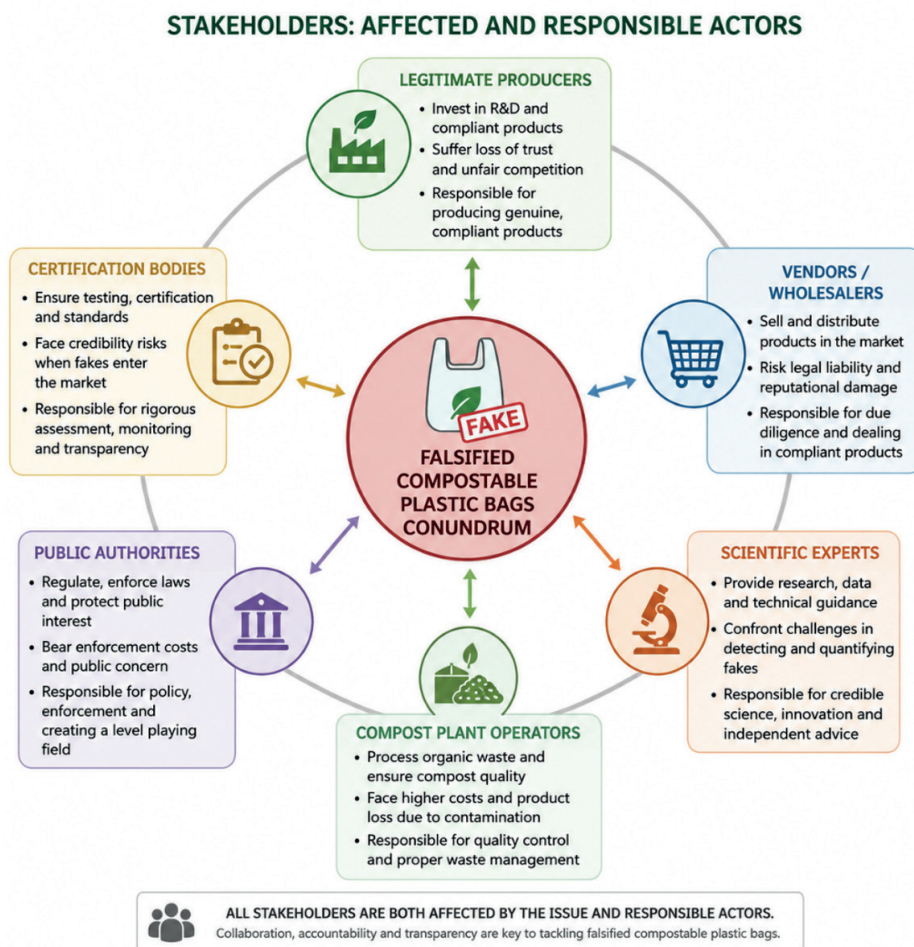


FIGURE 2: Stakeholders affected by and responsible for addressing the falsified compostable plastic bags conundrum.

Certification bodies provide certification, traceability systems and provide labels that allow consumers and authorities to identify compliant products. However, falsified certification logos weaken trust. Certification bodies can maintain public blacklists and pursue legal remedies, but their ability to act depends on identifying the responsible producer or distributor.

An important position is occupied by small vendors and wholesalers that distribute falsified products. Some may knowingly purchase cheap falsified bags, while others may be misled by suppliers and labels. In either case, they form the distribution network through which illegal products reach consumers. Their purchasing decisions are influenced by price, availability, lack of knowledge, and low perceived enforcement risk.

Public authorities are responsible for implementing and enforcing plastic bag regulations. They must balance limited resources, technical complexity, and fragmented institutional competencies. Effective governance requires cooperation between authorities of waste management, market, customs, certification bodies, environmental agencies, and possibly consumer protection.

The Austrian experience is particularly relevant considering broader European policy developments. As the European Union continues to restrict single-use plastics and strengthen circular economy legislation, biodegradable and compostable packaging will remain an important but contested product category. If regulation is not supported by strong verification and enforcement systems, markets may be flooded with misleading products that imitate environmental compliance and lead to a restriction of use of biodegradable products even if they offer in part a solution to environmental problems.

Recent discussions on green claims and environmental product labelling are therefore highly relevant. The misuse of terms such as “biodegradable” and “compostable” illustrates the need for stricter rules on environmental claims. Claims should be specific, evidence-based, verifiable, and linked to recognized standards. Vague green language should not be permitted as a substitute for certification, which is addressed by the EmpCo regulation (COUNCIL, 2024a).

In addition, the case suggests that regulatory requirements towards materials designed for certain End-of-life scenarios (e.g. compostability) should be closely coordinated with waste treatment infrastructure. A bag that is technically compostable under laboratory or industrial conditions may still create problems if it enters facilities that are not designed to process such materials or if it is indistinguishable from falsified bags. Therefore, product regulation, consumer information, and waste management practices must be aligned.

10. CONCLUDING REMARKS

The case of fake biodegradable plastic bags in Austria reveals a fundamental challenge of environmental regulation: a legal ban is only as effective as the enforcement, traceability, and market integrity mechanisms that support it. Austria’s prohibition of conventional plastic carrier bags

created an important regulatory signal and supported the development of legitimate biodegradable alternatives. However, it also created an economic opportunity for falsified products. By printing ordinary polyethylene or polypropylene bags with words such as “bio” or “compostable”, dishonest suppliers can exploit consumer trust, undercut certified producers, and shift environmental and financial costs onto composting facilities and the public.

The problem involves material science, waste management, consumer protection, certification governance, market surveillance, and environmental enforcement. Material analysis can identify fake products, even with portable devices. Publicly accessible certification databases can help to verify compliant products. Waste management facilities can reveal contamination hot spots. However, these tools must be integrated into a coherent enforcement strategy.

A central lesson is that biodegradable packaging requires credible traceability. Environmental claims must be verifiable, and certification marks must be protected against misuse. Products without valid certification numbers, transparent producers, and clear material declarations should not be treated as compliant. At the same time, consumers and small vendors cannot be expected to solve the problem alone. Responsibility should be directed toward the actors who manufacture, import, wholesale, and knowingly distribute misleading products.

If fake biodegradable bags continue to circulate, they will undermine public confidence in compostable materials and weaken circular economy policy. Conversely, if authorities, certification bodies, researchers, legitimate producers, and waste managers cooperate effectively, the Austrian case can become an example of how to close the gap between environmental law and market practice. The objective should not only be to remove illegal bags from markets, but to protect the integrity of organic waste management, ensure fair competition, and prevent persistent plastics from entering waste management facilities under the false promise of biodegradability.

REFERENCES

- Binner, E., Beigl, P., Vay, B., Schwarzl, R., Huber-Humer, M., & Zafiu, C. (2026). Impact of different screening technologies on the separation of plastic, metal and glass impurities from composts. *Detritus*, 35, 72-81. <https://doi.org/10.31025/2611-4135/2026.19590>
- BGBL (2002). Bundesgesetz über eine nachhaltige Abfallwirtschaft (Abfallwirtschaftsgesetz 2002 – AWG 2002), Pub. L. No. 102, 2002 989–1051.
- BMLFUW (2001). Verordnung des Bundesministers für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft über Qualitätsanforderungen an Komposte aus Abfällen (Kompostverordnung), 292. <https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20001486&Fassung-Vom=2021-11-22>
- COUNCIL (2024a). Directive (EU) 2024/825 of the European Parliament and of the Council of 28 February 2024 amending Directives 2005/29/EC and 2011/83/EU as regards empowering consumers for the green transition through better protection against unfair practices and through better information (Text with EEA relevance), EmpCo. <https://eur-lex.europa.eu/eli/dir/2024/825/oj?locale=de>
- COUNCIL (2024b). Regulation (EU) 2025/40 of the European Parliament and of the Council of 19 December 2024 on packaging and packaging waste, amending Regulation (EU) 2019/1020 and Directive (EU) 2019/904, and repealing Directive 94/62/EC, PPWR. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L_202500040

- EN13432. (2008). Packaging - Requirements for packaging recoverable through composting and biodegradation - Test scheme and evaluation criteria for the final acceptance of packaging (consolidated version). In EN 13432 (Vol. 13.030.99 |55.020).
- Mueller, H. (2026). Gutes Sackerl, Böses Sackerl. Profil, (33). <https://www.profil.at/wirtschaft/fake-bio-sackerl-im-umlauf/403162014>
- Thompson, R. C., Courtene-Jones, W., Boucher, J., Pahl, S., Raubenheimer, K., & Koelmans, A. A. (2024). Twenty years of microplastic pollution research—what have we learned? *Science*, 386(6720). <https://doi.org/10.1126/science.adl2746>
- TÜV-Austria. (2012). OK compost HOME: Home compostability of products. Retrieved 2.12.2021 from https://www.tuv-at.be/fileadmin/user_upload/docs/download-documents/CS/CS-OK02-EN_OK_compost_HOME.pdf
- Weithmann, N., Möller, J. N., Löder, M. G. J., Piehl, S., Laforsch, C., & Freitag, R. (2018). Organic fertilizer as a vehicle for the entry of microplastic into the environment. *Science Advances*, 4(4), eaap8060. <https://doi.org/10.1126/sciadv.aap8060>
- Zafiu, C., Binner, E., Beigl, P., Vay, B., Ebmer, J., & Huber-Humer, M. (2023). The dynamics of macro- and microplastic quantity and size changes during the composting process. *Waste management* (New York, N.Y.), 162, 18–26. <https://doi.org/10.1016/j.wasman.2023.03.002>