Biodegradable plastics: challenges and opportunities in food waste anaerobic digestion – a stakeholder analysis

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INTRODUCTION & STUDY RELEVANCE

How to minimise the negative environmental, economic and social impacts of plastic waste is one of the pressing questions of our modern society. The visual nature of plastic pollution and the projected increase in plastic waste in landfill and the natural environment have prompted a reconsideration of how plastics are made, used and disposed of. Biodegradable bioplastics (BBPs) represent an opportunity to tackle plastic pollution in the context of a circular economy, offering an alternative to hard-to-recycle plastics while aligning with organics recycling principles. With food waste being increasingly recognised as an untapped resource around the globe, reflected by the EU's incoming policy mandating separate collections for household and commercial food waste from 2023, designing BBPs that are compatible with the treatment of organic fraction of municipal solid waste appears as a sound strategy. In particular, anaerobic digestion (AD) has been promoted as the preferred and most circular waste treatment technology, which can make an important contribution to the transition to circular waste management practices. However, no industrial standard currently exists for 'digestible' BBP packaging. Our research addresses stakeholder attitudes towards the treatment of BBPs packaging in food waste AD. To our knowledge, this is the first study to address the suitability of BBPs in AD streams from a socio-economic, environmental and technological perspective.

AIMS & METHODOLOGY

So far, the literature has put emphasis on consumer awareness and perceptions on bioplastics, whilst stakeholder engagement at pre- and post-consumer stages as well as at governmental level remains poorly researched. Thus, our work poses the following research questions:

i. What are the attitudes towards the treatment of BBPs in AD among stakeholders?
ii. How suitable is the AD infrastructure to process BBPs and what are the barriers?
iii. How do various stakeholder groups' views relate to each other, in particular between the waste management industry and legislative/regulatory bodies?

We conducted 19 semi-structured interviews with a range of stakeholders, which included AD plant operators, waste contractors, representatives of trade associations related to the bioplastics and AD sectors, bioplastic food packaging manufacturers, retail, environmental charities, as well as civil servants and environmental regulators. Interview transcripts were analysed with the computer-assisted qualitative data analysis software NVivo 12 based on inductive and deductive strategies. Broad themes directly relevant to the research aims, or which emerged from transcript analysis, were further divided into child and grandchild nodes (see **Figure 1**). In-built interrogational tools were used for further analysis, to conduct word frequency searches, follow coding patterns based on stakeholder characteristics and explore relationships between nodes.

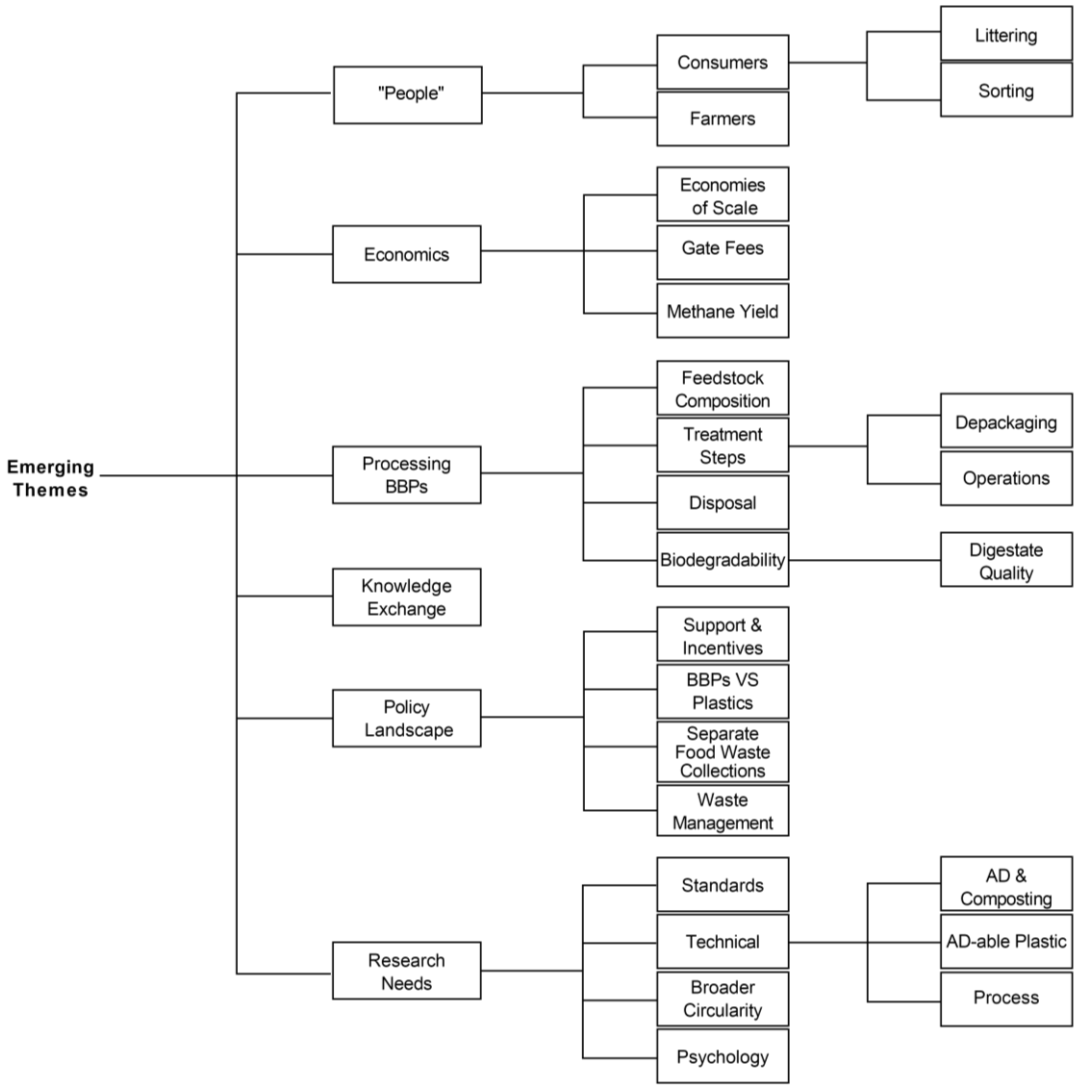

Figure 1. *Emerging themes from transcript analysis.*

RESULTS & CONCLUSIONS

Content analysis showed significantly divergent views on BBPs. Though most respondents acknowledged the merits of BBPs, concerns over their compatibility with the current AD infrastructure (e.g. systematic depackaging, retention times) and their ultimate biodegradability were raised. We found that BBPs are still perceived as a contaminant by waste contractors and plant operators. Impacts on digestate quality and downstream effects on soil health were identified are primary concerns for environmental charities and regulators. These issues highlight the need for the development of an industrial standard for AD-compatible packaging materials. Our research also highlighted the role of consumer education and providing consumers with simple and clear labelling could help households to be better informed and enable the system to capture their waste streams more consistently. The link between plastic substitution, increased food waste, environmental protection and the provision of clean energy was generally not articulated clearly by civil servants, which could lead to clashing policy priorities if left unaddressed in the near future.

This research will contribute to an improved understanding of the environmental impact of emerging plastic alternatives and will inform academia, industry and policy spheres. Ultimately, this research strives to ensure that the promotion of biodegradable plastics within a bioeconomy framework is based on environmentally sound evidence.