



Hidden in plain sight – using a scoping review to reveal the neglected sachet economy crisis

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ABSTRACT

Single-portion, multilayer sachets are a popular packaging format for food, home and self-care products in low-income countries. Sachet waste is non-recyclable, and visibly litters land, freshwater and ocean environments, particularly in South East Asian countries described as having a 'sachet economy'. As annual global sachet sales exceed one trillion units, we ask whether low levels of research on sachets and the sachet economy could contribute to misinformation about environmental and socioeconomic damage and a lack of policy action to reduce sachet use. Based on the PRISMA-ScR method, our scoping review included novel comparative analyses of multiple exclusion screenings and development of a waste hierarchy for literature analysis to reveal how information available to stakeholders changes as criteria are tightened. We found little empirical research, with knowledge gaps often addressed by institutions and NGOs, particularly regarding alternatives to the sachet economy at the top of the waste hierarchy. Policymakers and consumers in the Philippines and Indonesia were the most common target audience and geographical context. A high proportion of grey literature and inconsistent terminology may introduce the potential for bias and reduced impact.

Our research highlights the urgency of further research into social and environmental impacts of the sachet lifecycle and alternatives such as refill. As sachet use rises and spreads globally, we assert that without robust research and practical guidance for decision makers, environmental and socioeconomic consequences of sachet use will continue to grow in South East Asia and spread quickly to other low-income economies, hidden in plain sight.

1. Introduction

Sachets are a small, lightweight, single-use, flexible packaging format typically containing up to 25g or 25 ml of dry or liquid product, and sometimes up to 50g or 50 ml. They consist of between two- and seven-layer combinations of plastics, metals and adhesives that fulfil various barrier, layer compatibility, sealant and display functions (Anukiruthika et al., 2020). Small sachets of dry products, such as salt or sugar, may be predominantly fibre, but plastics are forecast to remain the dominant material in sachet construction (Future Market Insights, 2025; Kyriakopoulos et al., 2024). Sachets can be bigger than is necessary to contain the product to increase brand visibility (N. Kumar et al., 2024) and allow enough space for brand and product information.

Consumers in high-income countries (HIC) will be familiar with

sachets containing single-dose medication, perishable products used in small quantities such as yeast, condiments in restaurants, or personal care and beauty samples or products either available for free or at a cost. In many low- and middle-income countries (LMIC), sachets are a common packaging format containing a huge variety of everyday products ranging from shampoo to coffee. Although affordable for poorer consumers, who may rely on daily wages, a poverty premium is paid as products are often, but not always, sold at a higher per unit volume price (Singh et al., 2009). Sachets have facilitated access to a wide range of branded groceries and products for consumers unwilling or unable to purchase products in larger packaging formats (Williams et al., 2019) and provide employment opportunities along the whole value chain (Clay et al., 2005).

Indonesia and the Philippines, identified by Jambeck et al. (2015) as

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the second and third biggest contributors to ocean plastics, are also locations where sachets and sachet waste are ubiquitous. These and other countries where single-use plastic packaging use is high and rising may have little to no producer responsibility requirements, poor waste management infrastructure and regulation for internal and imported wastes, and can have geographical features that facilitate the transition of mismanaged plastic waste to oceans (Liamzon et al., 2020; Meijer et al., 2021). Like all multilayer and multi-material post-consumer wastes, used sachets are of low value as a fuel source and are considered economically unfeasible to recycle (Kyriakopoulos et al., 2024). Sachets that are recycled at all are open loop/downcycled to produce lower-grade products such as eco-bricks or road construction materials (Liamzon et al., 2020; World Bank Group, 2021).

Pre- and post-consumer managed and mismanaged plastic waste, including sachets in LMICs, is typically littered, open burned, deposited in dumpsites or landfilled, incinerated without energy recovery, burned to recover energy in cement kilns or, less commonly, chemically recycled (Liamzon et al., 2020; Velis and Cook, 2021; World Bank Group, 2021).

The Philippines is described as having a 'sachet economy' owing to the culture of purchasing consumables in small, single-use quantities that predates sachet use (Ang and Sy-Changco, 2007; Sy-Changco et al., 2011; World Bank Group, 2021). An estimated 164 million sachets are used here daily (Liamzon et al., 2020). Similarly, sachet use in Indonesia is high, with sachet and pouch consumption estimated as being 4 kg per capita annually (Sisungkunon et al., 2024). Sachets and other multilayer flexible packaging comprise 16 % of Indonesia's plastic waste arisings and are the most abundant waste type found in beach litter audits (Cordova et al., 2022; Sisungkunon et al., 2024; World Economic Forum, 2020). Sachet use is also high in the original home of the sachet, India, and in Bangladesh. Of almost 41 billion shampoo units sold in India in 2021, 99 % were in sachets (N. Kumar et al., 2024), and research by the Environment and Social Development Organization (2022) calculated daily sachet use for people aged between five and fifty in Bangladesh to be 129 million. While sachet use is highest and rising fastest in South and South East Asia, global sachet sales are forecast to increase globally by up to 9.8 % each year to 2035 (Future Market Insights, 2025; Grand View Research, 2025). Annual sachet sales are reported to have exceeded one trillion units in 2023 (Gardiner, 2025) and forecast to reach 1.3 trillion units by 2027 (Greenpeace, 2019). Whereas plastics used in construction or machinery may last for decades, disposable products and the one-third of plastics used globally for packaging may be discarded within minutes of being used (Statista, 2025). The resource and environmental burden of current and forecast single-use plastics use is widely acknowledged as being unsustainable, with the high environmental burden from production and mismanagement (Chen et al., 2021; Diggle and Walker, 2022) disproportionately impacting poor and vulnerable communities (Cook and Velis, 2020; Williams et al., 2019).

Environmental campaign groups have mobilised anti-sachet campaigns with limited policy response. Indonesia passed a regulation (Waste Reduction Roadmap by Producers, 2019) banning sachets under 50 ml/50g from 1 January 2030, further requiring polypropylene sachets to be monolayer, containing 50 % recycled material and be recyclable until this date. The same implementation date applies to the ban on sachets in European hotel, restaurant and catering sectors except for takeaways (Packaging and Packaging Waste Regulation - EU, 2025/40, 2024). Indonesian and Philippine Governments have worked in partnership with stakeholders to produce roadmaps for sachet and other plastic waste pollution (Iacovidou and Gerassimidou, 2025; World Bank, 2024; World Economic Forum, 2020). Yet, despite the short time remaining to make changes along the entire sachet value chain to comply with the legal and moral urgency to reduce single-use plastics, the observation by Ang and Sy-Changco (2007) that there is little empirical research into the sachet economy still applies. As both a response to the needs of poorer consumers and a driver of poverty, the relationships between socioeconomic development and the

environmental crisis of sachets and other single-use plastics are complex and unquantified. As described above, sachet use and pollution are driven by factors including poverty, economic inequality, and inadequate waste-management systems. Environmental damage then further slows socioeconomic development through public health damage, clean-up costs, and reducing economic opportunities in, for example, fishing and tourism. The specific contribution of sachets to these relationships and the routes, methods and leadership responsibilities for the introduction of alternative affordable and equitable circular business models to replace sachets are unclear.

This, paired with interests from differing stakeholders and variances in technical and colloquial descriptive languages used to describe sachets, fragments the information available. We have identified an urgent need to isolate information available to all stakeholders on sachets and the sachet economy using a robust, repeatable and systematic process. In finding and prioritising knowledge gaps, we hope to inform policymakers and decision makers of what is, and indeed is not, needed to drive the change to circular business models that can replace current and prevent future sachet economies.

2. Aims and objectives

The overarching aim of this review is to assess the body of information and research about sachets and the sachet economy available to policymakers, consumers and the manufacturing and resource management sectors, and identify research gaps throughout the sachet life-cycle. In order to achieve our aim, we set the following objectives:

1. To establish, through literature, a definition of sachets and the sachet economy
2. Systematically map the source, literature type and geographical context of information on sachets, the sachet economy and the stakeholders targeted
3. Evaluate consideration of and solutions offered for sachet waste based on the waste hierarchy
4. Synthesise results, identify knowledge and research gaps to inform strategic roadmaps for policymakers, consumers and researchers

A scoping review is considered the most appropriate tool to answer these questions owing to the variety of academic and grey literature sources acceptable, and the overarching aim of producing a broad overview of information and evidence gaps available to wider stakeholders. No review addressing these or similar objectives has been found.

3. Methodology

The recommended Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) method was followed as it allows for a broad study scope, identification of research gaps and academically rigorous inclusion of grey literature sources. An iterative protocol guided by Peters et al. (2022) supported the review, ensuring the flexibility required by the broad scope was documented.

A comprehensive literature search was carried out from February 2023 to September 2024 to identify relevant studies. A table of search terms used is in Appendix A. Data collected were stored in Mendeley reference manager for document retrieval and exported to Microsoft Excel for Microsoft 365 for data extraction and analysis. Searches on the ABI/Inform database were restricted to 2015 onwards as it would be unlikely to find relevant material published prior to Jambeck et al.'s identification of country sources of plastics pollution (2015). No start date was specified for search engine facilitated searches, of which the first 150 results were assessed.

4. Screening methodology and inclusion criteria

Whereas a traditional scoping review may have a small number of defined inclusion and exclusion criteria following the removal of duplicates and irrelevant results (Arksey & O'Malley, 2005), our iterative approach to the methodology gave rise to a six-stage screening process. It became clear at an early stage that results could be directly about or relevant to the topics of sachets and the sachet economy without mentioning the word 'sachet'. It was further recognised that stakeholders, including decision makers, may not apply rigorous criteria when selecting information sources. Application of rigid criteria at an early stage could therefore hinder the real world assessment of knowledge and information.

As presented diagrammatically in Fig. 1, search results in English (excluding conference proceedings) were transferred to the first screening stage. Aside from the identification of duplicates, all screens were undertaken manually. Following the removal of duplicates, titles were assessed and irrelevant results removed at the first screen. At the second screen, abstracts were assessed so results could be categorised into sachet water, flexible multilayer plastics, flexible plastics potentially relevant to sachets, or grocery sachets, with the latter category moving to the third screen. Here, results were further categorised in accordance with the Population, Concept, Context approach (Joanna Briggs Institute, 2020) to ensure results were relevant to sachet stakeholders, the sachet packaging format, and to identify geographical contexts. The fourth screen removed advertisements, tenders or social media posts by individuals. Only results specifically concerning sachet

use and alternatives viable for low-income consumers remained after the fifth screen. Edible, biodegradable or compostable material alternatives to plastics were excluded at this stage owing to short shelf lives, possible unsuitability for hot and humid environments, potential unintended environmental consequences and for being unaffordable to low-income consumers. The final sixth screen removed reports of other results, articles based on the research of others and interviews, ensuring only original research and information remained.

5. Development of a waste hierarchy for literature analysis

The waste hierarchy has changed little since the concept of a preferred order for wastes management was presented in the EU Waste Framework Directive in 1975, followed by Lansink's ladder, the diagrammatic representation of the hierarchy we are familiar with today, presented to the Dutch Parliament by Ad Lansink in 1979. Whilst representing all options as equally better or worse than those adjacent, and taking no account of specific materials, locations or Lifecycle Assessments (LCA), the basic original hierarchy, designed to be a policy and operational decision-making tool, has struggled to remain relevant (Van Ewijk and Stegemann, 2016). Alternatives designed for production and manufacture, such as the seminal hierarchy by Potting et al. (2017) were also not satisfactory for classifying literature. Therefore, a waste hierarchy for literature analysis was developed to characterise the environmental focus of each result (Fig. 2). It contains eleven formal and informal waste management options observed in the results and a twelfth option that records when sachet waste is not mentioned.

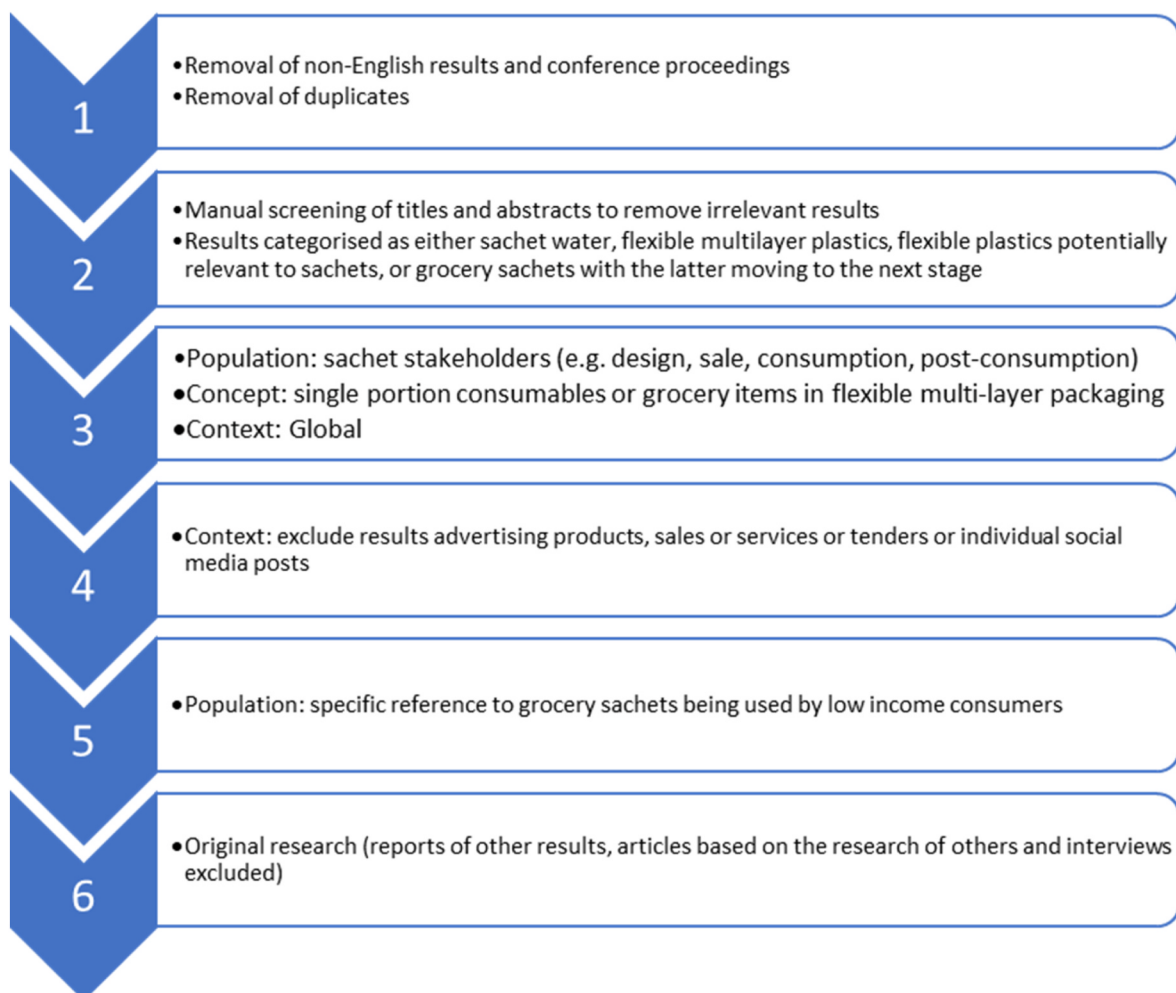


Fig. 1. Diagram illustrating the six-stage inclusion and exclusion screening process. Results were analysed following the fourth, fifth and sixth screens.

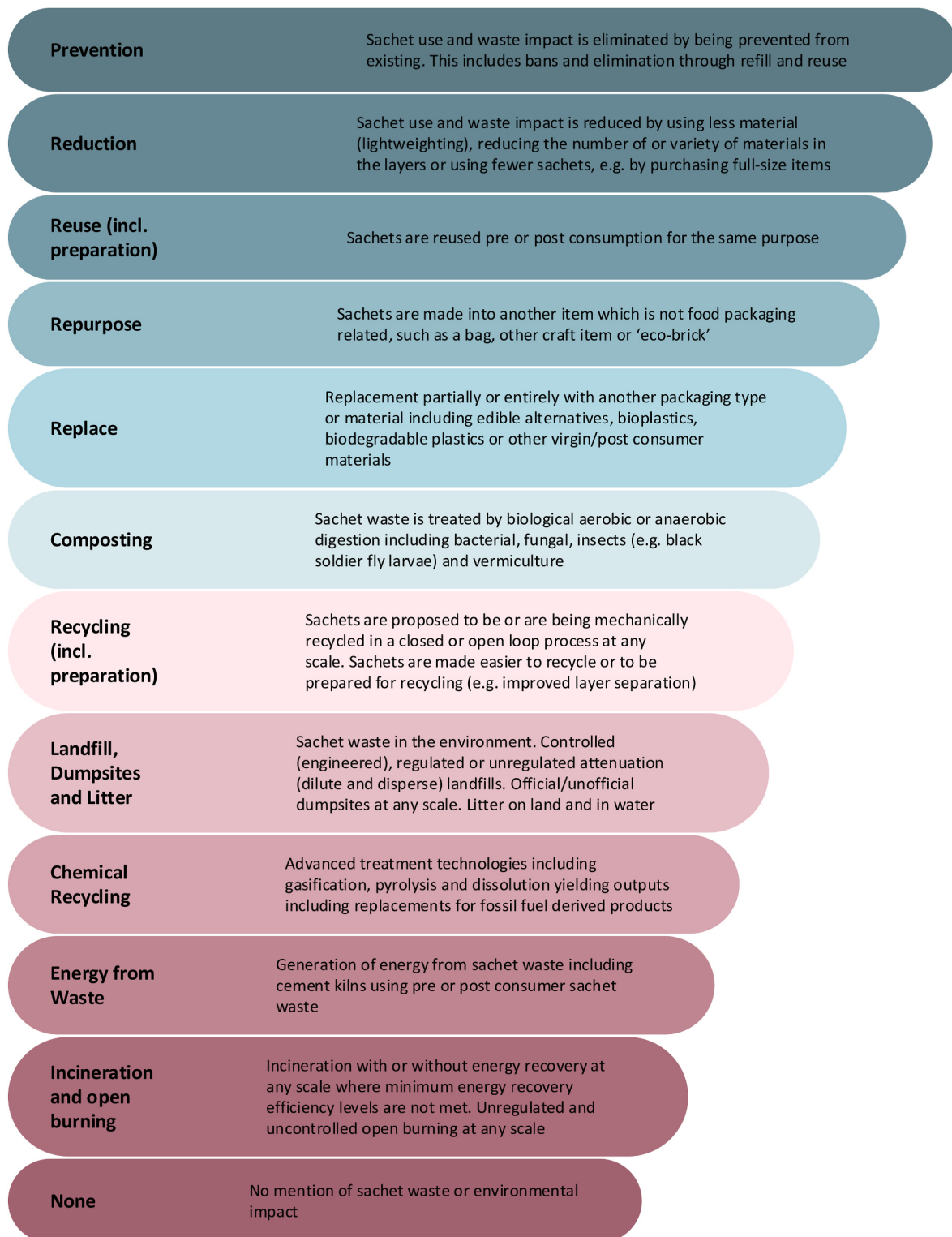


Fig. 2. A waste hierarchy for literature has been created to assess which waste sachet management options dominate the literature, with the least environmentally damaging option at the top.

Although based on LCA data for plastics (Meng et al., 2024), the most abundant material in sachets, it is designed to categorise how the topic of or solutions for problems associated with sachets and the sachet economy are presented in literature, rather than guide waste management decisions. For example, where reuse or refill business models are suggested as an alternative to sachet use, this is categorised as prevention, because the aim is to prevent sachets from being produced. A

proposal for sachets to be reused would be categorised as reuse. Furthermore, despite their different environmental, social and health implications, some options are categorised together. For example, landfill, open dumping and litter are presented together to represent carbon in sachet waste remaining in a solid rather than atmospheric form in the environment. Where multiple categories within the waste hierarchy for literature are discussed, results were categorised according

to the option discussed most. Where waste management options are covered equally, the option highest up the hierarchy was selected. The authors acknowledge that a level of simplicity and subjectivity in this part of the methodology may reduce the impact of the results, however, the purpose is to gain a high-level understanding of the direction of research and information.

6. Result origin, source and scale

To reveal how sources of information available to stakeholders and decision makers changed as criteria tightened, results were categorised according to whether they arose from academic, institutional (including global NGO) or grey sources. The scale and further details of sources were recorded. The first three categories in Table 1 are mostly from academic literature, with the remainder being institutional and grey. The media category can encompass a range of results, including a reproduction of an industry press release or a well-balanced article.

7. Assessment of bias

Bias is an acknowledged risk within a scoping review, owing to the Western bias of academic databases and the position and biases of the result author and researcher (Arksey & O'Malley, 2005). Whilst acknowledging that bias is inherent and can be subjective, it is assessed as a likelihood rather than a certainty and is not an indication of factual correctness. Results obtained via Scopus and Web of Science are considered less likely to be biased owing to the requirement for academic rigour and the peer review process. The methodology requires private funding to be noted. Trade and industry sources, small local organisations and NGOs are assessed as being more likely to be biased. Where NGOs worked in partnership with institutions or academia, results were assessed as less likely to be biased unless the content indicated otherwise.

All other results were assessed individually by checking each source on www.mediabiasfactcheck.com for a rating of political bias and factual credibility. Where no rating is available, results were read for balance, with assessment views recorded.

8. Geographical origin and study focus

As sachet use is more prevalent and forecast to grow in LMIC countries (ESRAG, 2021), we aim to highlight whether the source and focus of results is global, or restricted to where impacts are experienced. The country, region or, in some cases, global focus of the result was recorded in Excel alongside the location of the leading author, institution or business from which or whom the result arose.

Table 1
Categories used to categorise the scale and source of scoping review results.

Source of research	Description
Theoretical/proposed research	Research from secondary sources and scoping/systematic reviews. Usually but not always from an academic source
Bench scale and research based	Experimental or descriptive research using primary data on a small scale or in a limited location with or without the support of an industrial partner. Usually but not always from an academic source
Pilot scale and research based	As above but based on a large empirical dataset or multiple locations or technology at pilot scale
Institution	An institution such as the World Bank or government is the source of the material
Media	A media article or investigation that is, or appears to be, based on more than one source
Industry	A direct or indirect (through media) press release or article by a manufacturer, producer, retailer, waste management company or similar
NGO/Non-profit/Charity	A direct or indirect (through media) press release or article by an NGO, Not for Profit organisation or charity

Assessment of intended target audiences was undertaken by balancing the source, content and language complexity to ascertain the likely reader of each result. An intended industrial audience has been divided into manufacturers, retailers and the post-consumption or waste management sector to allow for tentative interpretation of the attention being given to each stage in the sachet value chain. Policymakers and consumers are the two final target audience categorisations.

The accuracy of this manual, and arguably subjective methodological approach, is potentially impacted further by recognising that individuals within all categories are also consumers.

9. Gap analysis assessment

Identification of knowledge gaps was undertaken by visually assessing sources (e.g. academic, institutional, grey), topics (e.g. business, environmental impacts etc), and waste management categories using Sankey diagrams generated in Microsoft Power BI. As most results are relatively recent, the publication year has been excluded, whilst recognising that certain topics were popular in specific years. Insights were revealed by switching off sections of each node (e.g. institutional and grey, with academic results remaining) and recording patterns and omissions. Sankey diagrams for the fourth to sixth screens were assessed.

10. Analysis

Results following the fourth, fifth and sixth screens were exported from Excel into Power BI in order to generate a visual understanding of the ways information available to stakeholders changes as criteria tighten, based upon the criteria described above.

11. Results and discussion

The searches undertaken for this review are presented in Appendix A. The PRISMA diagram (Fig. 3) summarises the refinement of results as further criteria were applied as described above.

The earliest result following the fourth screen dates from 2003, chastising Hindustan Unilever for taking credit for the sachet 'revolution' (Businessline, 2003). This predates Prahalad's seminal observations (2004) of the profitability of the sachet packaging format, which was closely followed by an exploration of the impact of sachets specific to the Philippines (Ang and Sy-Changco, 2007). The earliest unreferenced mentions of the term 'sachet economy' were observed outside of search results in trade journal articles from 1999 to 2005 (Arceo-Dumlao, 2005; The Financial Times, 1999).

Peak attention to sachets was first observed in 2017 (Fig. 4), when Unilever announced a forthcoming and ultimately short-lived chemical recycling plant for sachets in Indonesia (Ogleby, 2017). Further peaks in 2020, when the term 'sachet economy' begins to become prevalent, and 2022, predominantly focussed on prevention, followed the release of influential reports from The Global Alliance for Incinerator Alternatives, The Pew Charitable Trusts and Reuters (Brock and Geddie, 2022b; Liamzon et al., 2020; The Pew Charitable Trusts, 2020).

The results are presented and discussed as per the four proposed objectives outlined earlier.

1. To establish, through literature, a definition of sachets and the sachet economy

A significant barrier to identifying relevant results was revealed during the second screening phase. Whereas literature concerning any difficult to reuse and recycle composite packaging format is arguably relevant to this topic, a wide range of descriptive terms was used to describe them. Results were discarded unless unequivocally about sachets, which may have resulted in relevant research being discounted. Table 2 lists words other than 'sachet' identified during this study that either do or could feasibly refer to sachets.

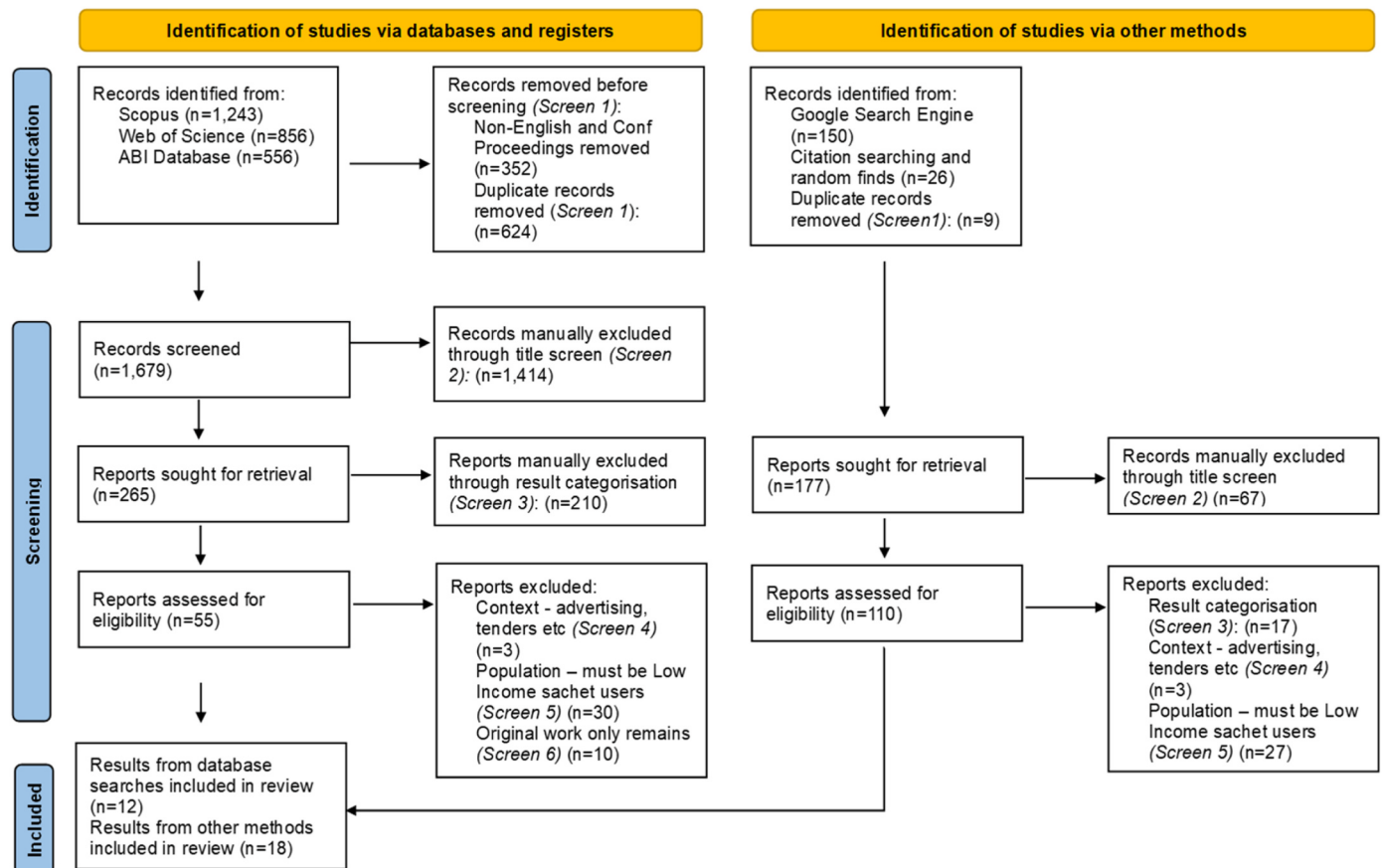


Fig. 3. PRISMA Diagram for this review.

A bar of chocolate, for example, could be packaged in thin, mono or multilayer plastic flow wrap packaging visually similar to a powdered chocolate drink, but would not be described as a 'sachet of chocolate'. Other consumables may be similarly packaged in single portions, such as pet food or potato crisps. Small stand-up pouches, similar in composition to sachets but generally larger, sturdier, of greater value when metalised and aimed at higher income consumers, may be colloquially referred to as sachets, for example, when they are sold alongside make-up sachets, which are a mixture of sachets and small stand-up pouches.

However, a key characteristic distinguishing sachets from other single-portion packaging formats is size, rather than the fact that it frequently contains one portion or use. This makes the systematic collection of information challenging as potentially useful research may be discounted because size is unclarified. The retrieval of relevant results was further hampered not only by authors omitting the word 'sachet', but also keyword choices. For example, the packaging format studied by Indonesian researchers *Irzalinda and Ardi (2020)* is described using language that describes sachets, and the paper contained relevant keywords, but fails to mention the word 'sachet'. Conversely, research by *Phelan et al. (2020)* contained broad keywords such as those mentioned below, but mentions sachets twenty-three times in the text. Furthermore, relevant research was also found within results concerning alternative retail business models using descriptive terms such as 'zero waste', 'bulk store', 'refill' or 'package free', further expanding broad search terms and keywords needed.

The selection of keywords used in searches for this study in [Appendix A](#) were identified from pre-searches prior to the formal data collection phase. Keywords in the final thirty results included words that would yield impossibly large and irrelevant results, such as plastics, ecosystem, human, plastic waste, sea pollution, circular economy, food storage and package size. Other keywords were specific enough that very few, or

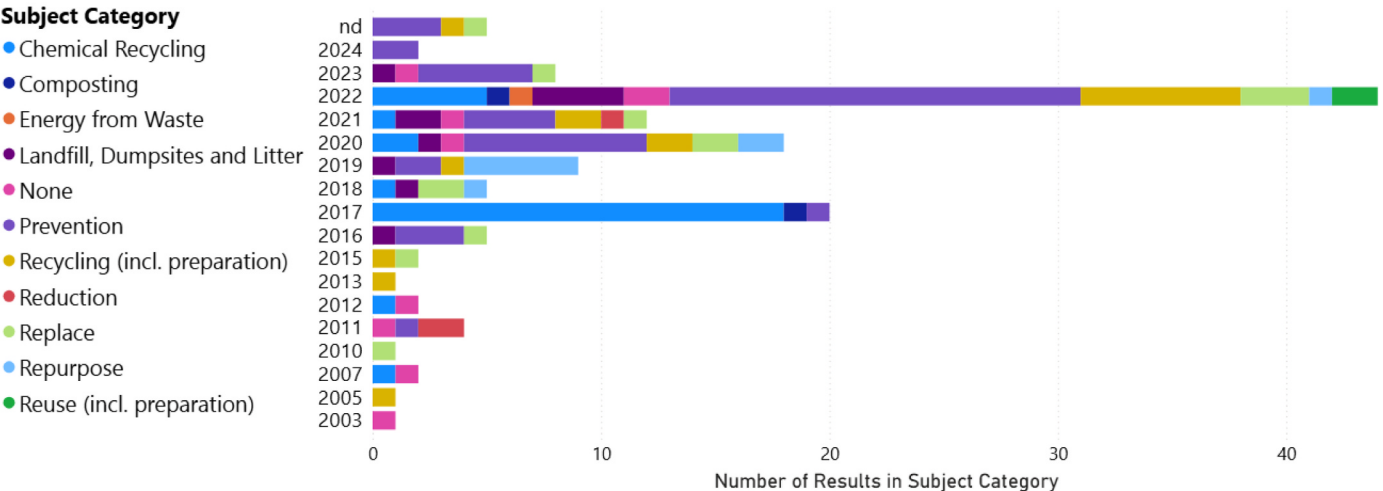
even single, results would be found, such as sachet marketing, plastic sachet waste and sachet economy. Whereas not all thirty final results had keywords, the word 'sachet' was present in only two.

Identification of agreed definitions must therefore acknowledge the broad colloquial, geographical and industrial descriptive terms used to describe sachets and materials used in sachet construction. Descriptions of sachets generally included their purpose of containing a single portion of a product, small size, multilayer construction and flexibility, but with some variance in addition to overlap with characteristics found in other packaging formats.

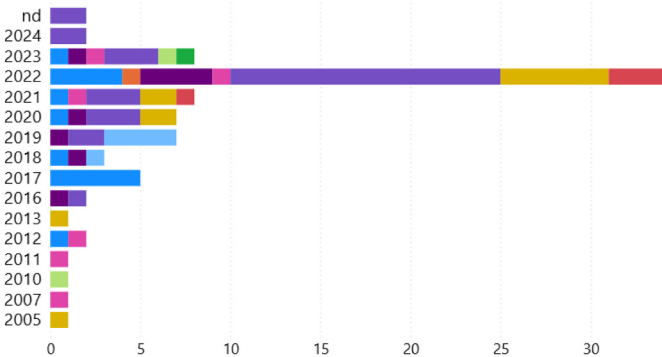
The small size and single portion purpose of sachets were found to be typical descriptive characteristics. To draw from many examples, *Nulkar (2016)* in recognising the option of monolayer sachets, omits reference to the multilayer aspect of typical sachet construction and describes them as 'small flexible plastic pouches which pack single use quantity of a product'. The India Plastic Pact describes sachets as containing below 10g or 10 ml of product, and calls packages of up to 50g or 50 ml 'small format' packaging (*N. Kumar et al., 2024*). This description excludes laundry detergent sales in 10–40g doses that would be described as sachets elsewhere. In addition to describing single-use, flexible, multi-layered sachets as 'palm sized' containing 'micro portions of everyday products' (*Brock and Geddie, 2022a*) or 'pocket sized', they are also defined in a brand audit by anti-sachet campaign group *Break Free From Plastic (2024)* as being available in a variety of sizes and no bigger than A4 (210 × 297 mm).

NGO *Waste4Change (2022)* differentiate between monolayer and three types of multilayer packaging formats (plastic x 2; plastic + metal; plastic + paper) and include sachets as an example of 'flexible plastic packaging'. *Nurani (2022, p. 15)* describe 'flexible packaging' as a 'sachet, pouch, single use bottle'. The typically used words 'flexible' and 'monolayer' are not used by *Liamzon et al.*'s description of 'a type of

Fourth Screen Results



Fifth Screen Results



Sixth Screen Results

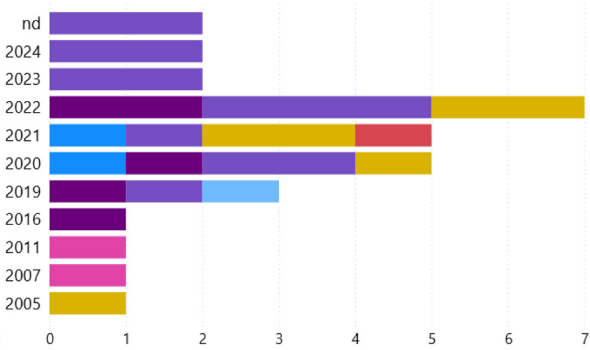


Fig. 4. Graphs showing sachet waste management options by year following the fourth, fifth and sixth screens, illustrating the proportionate increase in solutions higher up the waste hierarchy.

Table 2
Words other than 'sachet' used in included and excluded scoping review results that could be used to describe sachets.

Aluminium-plastic multilayer films	Mini packs
Flexible food packaging	Multilayer flexible packaging
Flexible multilayer food packaging	Multilayer laminate films
Flexible multilayer plastic packaging	Multilayer plastic packaging
Flexible packaging	Multilayered and mixed resin types of plastics
Flexible plastic packaging	Multilayered flexible plastics
Flexible plastic-laminated metal packaging waste	Multilayered plastic waste
Flex-pack	Packets
Foil and metallised film centre laminates	Plastic stick
Gutka pouch	Polymer laminated Aluminium Packaging (PLAP)
High-barrier flexible packages	Polymer-metal multilayer food packaging materials (PMM-FPM)
Highoxygen-barrier multilayer films	Pouch
Laminated flexible packaging	Sachet stick
Metal bonded multilayer plastic packaging	Stick packaging
Metal-polymer laminated packaging	Sticks

small, sealed packaging made of single or multiple layers of plastics, intended for one-time use' (2020). These and other broad terms can

feasibly describe many other flow-wrap packaging formats, such as a biscuit and crisp packets or noodle wrappers, and yield results that may or may not be relevant to the topic of sachets typical of those being used in countries described as having a sachet economy.

The term 'sachet economy' was less widespread and frequently accompanied by a description. A report by the World Bank Group on plastics circularity in the Philippines describes the country's sachet economy as arising from the 'high dependence on sachets to provide low-cost consumer goods to poor and middle-income families' (World Bank Group, 2021). Ang and Sy-Changco (2007) describe sachet marketing as the sale of products in single use quantities, including unpackaged goods such as single cigarettes, introducing the concept of a sachet economy not needing to include sachet use. A sachet economy mindset is described by Lu et al. (2019) as explaining a preference for single journey train tickets in Manila, above a more convenient option.

Our results highlight how global differences in sachet usage, content, availability and environmental impact leads to variance in definitive descriptions by context. Regardless of how sachets are described, our findings reveal the importance of increasing the accessibility and reach of research and information by simply using the commonly agreed word 'sachet' alongside colloquial and technical terms and descriptions. Furthermore, a so-called 'sachet economy' may be used to describe populations where products and services, such as mobile phone data, are available in micro quantities for the same reasons that sachets are purchased and not necessarily only to describe a population with high sachet use.

2. Systematically map the source, literature type and geographical context of information on sachets, the sachet economy and the stakeholders targeted

The most common geographical foci of the results remained unchanged through all screening phases, with Indonesia and the Philippines, described as having sachet economies, being the main countries studied or referred to. Research, opinions, information and media coverage about sachets most commonly arose from the country in question; however, in earlier screening phases containing proportionally fewer academic results, the main geographical origins were the UK and North America. Results concerning a proposed (briefly operational) Unilever chemical recycling or pyrolysis facility were classified as global when its location (Indonesia) was not mentioned, as this may not have been known by the general reader.

South Asia including India, where sachets were invented in the late 1970s by Chinni Krishnan, and have been in use the longest (Rajan, 2021) featured in only three of the final thirty results. Other low-income countries featured to a lesser extent in contexts that imply that problems of sachet use and pollution are under researched and spreading.

Use of the word ‘sachet’ in many African contexts, such as Ghana, Liberia, Sierra Leone and Nigeria, refers to ‘sachet water’; tied/sealed LDPE bags of drinking water or, less frequently as in Tanzania, alcohol (APA News, 2017). However, reference to the ‘sachetisation’ of the economy, not just through the sale of sachets most prevalent in South East and South Asia but also the selling of consumables in smaller or single-use sizes, such as a daily quantity of menstruation products, is reported to be increasing in Nigeria (BBC, 2022). Cleaning product sachets are a visible source of coastal pollution in Colombia (Rangel-Buitrago et al., 2024) and are prevalent in Laos (Homsombath et al., 2021). Furthermore, the use of milk and yoghurt in sachets is reported by Aguirre (2003) as increasing in Argentina as a cheaper alternative to other packaging formats.

A significant finding from our analysis of the geographical focus of the results is what we have not found: results from certain countries where products are known to be sold in sachets to low-income consumers. Poor waste management infrastructure persists to a greater or lesser extent in all LMICs (Cook and Velis, 2020), and it is highly likely that sachet waste is contributing to undocumented environmental and health consequences. This is of particular concern in light of a >5 % per annum forecast increase in global sachet use and prediction that ‘future growth in sachet sales will be driven by expansion in emerging markets, often displacing “refill and reuse” distribution systems’ (ESRAG, 2021).

A further observation is the inclusion of stand-up pouches as more likely in research arising from HICs. These are materially relevant to the study of sachets but more likely to contain high-value aluminium and be more attractive to recyclers.

12. Research source and bias

Sources considered in this study are by country of origin as discussed above, literature type or professional sector, such as industry, academia or institution. An assessment of bias was considered essential by the authors because of repeated unreferenced claims that, for example, sachets block drains and watercourses and contribute to flooding (Liamzon et al., 2020; Pannu et al., 2020) and are a microplastics source (Best, 2022; Break Free From Plastic, 2022, 2024; Rangel-Buitrago et al., 2024). Whereas these and other observations are probably accurate, they are not based on empirical evidence, which may affect the influence of data-based information presented alongside. Furthermore, evidence of low corporate commitment to plastic reduction (A. A. Phelan et al., 2022), accusations of oil producers intentionally slowing progress in plastics treaty talks (Landrigan et al., 2025), undermining evidence-based decision making (Carney Almroth et al., 2025; Gardiner, 2025; Mah, 2022) and lobbying decisionmakers to reconsider sachet bans (Brock and Geddie, 2022b), further justify an exploration of

potential bias.

As criteria tightened, the proportion of grey literature and sources more likely to be biased decreased (Fig. 5). Whereas this is an expected result in a scoping review undertaken according to PRISMA-ScR guidelines, it is notable that non-academic and potentially biased sources remained even after the final screen.

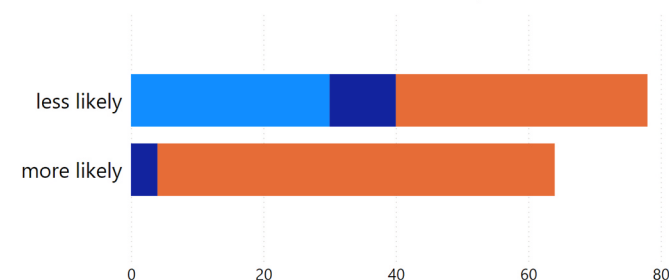
Bias does not, however, equate to factual inaccuracy, and non-academic sources were frequently written in partnership with academia or by persons with an academic background familiar with the concept of academic rigour. Some academic sources considered unbiased had a small number of references or relied heavily on grey literature. No conflicts of interest were detected in academic literature sources.

Amongst professional sources, the media, all industry sectors and the NGO sector were revealed to dominate the information sources available up until the final screen, when research from academia and some institutions and global NGOs became prevalent. This is significant because industry, and to a lesser extent media sources, overwhelmingly discuss options lower down the waste hierarchy that perpetuate linear consumption models. NGO sources are more likely to discuss the prevention of sachet waste through refill and reuse models.

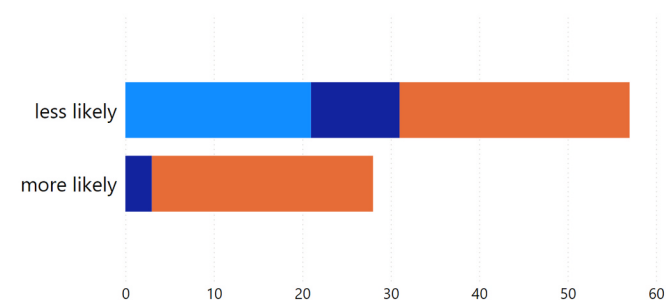
Results from media and industry arising from North America and the

Fourth Screen

● 1. Academic ● 2. Institution/Global NGO ● 3. Grey



Fifth Screen



Sixth Screen

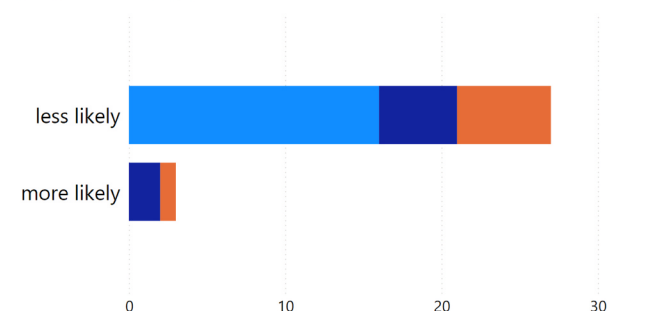


Fig. 5. The likelihood of bias decreased following each screen as criteria tightened.

UK dominated following the fourth and fifth screens, but countries in South East Asia were significant sources of information as criteria tightened. Only two of the final thirty results arose from the media or industry, with the industry report being a collaboration between an NGO and sachet manufacturer (Clay et al., 2005). Research was predominantly based on small or secondary sources of data, which is indicative of the large knowledge and research gaps highlighted in the introduction.

Our results draw attention not only to the risk of stakeholders accessing potentially biased information, but also that unbiased sources of information may be based on or repeat them.

13. Research targets

Assessing a primary intended audience for results required a subjective approach by the authors. Policymakers and retailers are also consumers, and aside from academic results using technical language, results were largely written for a wide-ranging audience. Policymakers and consumers were primary targets throughout, with results concerning sachet waste prevention, recycling and littered or dumped sachet waste increasingly directed towards policymakers, the stakeholders perhaps considered most likely to enable change, as criteria were constrained at the final sixth screen. Options in the waste hierarchy for literature analysis were found to be spread across target audiences, with the widest range aimed at consumers, which may reflect the conflicting interests of information sources.

Analysis of the results raised the further question of who sachet users are, and whether the general assumption that they have low and/or precarious incomes and are forced to pay a poverty premium, is correct. In the Philippines, purchasing items in small, single-portion, micro quantities is described as being a cultural phenomenon that pre-dates the invention of sachets (Sy-Changco et al., 2011). Results also point to consumers predominantly being younger and university students, office workers and housewives (ESDO, 2022; Homsombath et al., 2021; Manalo and Manalo, 2022). Sachet users are predominantly female, and one roadmap for phasing these and other plastics out of use suggests testing substitutions to ensure they do not disadvantage women and marginalised groups (World Economic Forum, 2020). Price is a recognised driver of sachet use, either because of income precarity from unpredictable wages or because they are, or are perceived to be, cheaper (Mahajan et al., 2005). However, consumers able to purchase full-sized products may prefer to purchase sachets, either singly or in bulk, demonstrating that sachet users can also be wealthier consumers. Sachets may be preferred for convenience, to enable portion control, for portability, to reduce space needed to store full-sized products, or to allay fears of products being fake or counterfeit (LESS& Ltd, n.d.; Singh et al., 2009), or because products are only available in sachets, or are indeed cheaper (Liamzon et al., 2020; Williams et al., 2019).

The focus on policymakers is indicative of the urgency with which a solution to increasing sachet consumption needs to be found. Detailed country or local area policy solutions that encompass the different reasons why consumers purchase a variety of or certain products in sachets may inform the viability of alternative options. Explorations of the socioeconomic consequences were not found for thousands of micro-scale and mobile sachet retailers for whom refill and reuse options or more expensive packaging formulations are unviable.

3. Evaluate consideration of and solutions offered for sachet waste based on the waste hierarchy

Preventing sachet use through replacement with refill and reuse business models, or where this was the highest of several options in the waste hierarchy proposed, featured strongly after each screen. Changing consumption models was, despite challenges, the predominant suggestion for reducing the impacts of sachet waste following the fourth screen. However, Nurani (2022) notes that reuse and refill can only be

alternatives to sachets if consumers are sachet users, concluding that refill has reduced potential as a long-term solution. Barriers to refill, and solutions for products unavailable in a refill format, would remain.

The feasibility of mechanical and chemical recycling was questioned in some results e.g. (Cook et al., 2022) and extolled in others (Pannu et al., 2020), with results supporting the latter technology arising predominantly from a single, short-lived facility in Indonesia. The elimination of small-scale and expensive edible and biodegradable sachets at the fifth screen removed results considered by the authors unlikely to be technically feasible or affordable to low-income consumers by the time existing sachet bans come into effect. However, this was potentially already recognised by authors, as most results had a global or HIC focus. After each screen, results remained that did not acknowledge or discuss sachet waste. These were generally marketing sources documenting the rise of sachets or efforts to increase sachet consumption.

In the waste hierarchy for literature analysis (Fig. 2), results were classified according to the highest sachet waste management option discussed or mentioned the most in the full text. Because many results discussed several options, this method of analysis results in options lower down the hierarchy appearing to be less dominant. Recycling of sachet waste either as it is now or through modifications to construction, such as monolayer, was mostly suggested within results from grey literature and institutions, including the World Bank Group (2021). A slight lack of consensus regarding whether sachets are recyclable was observed with some industry reports of downcycling (Business, 2015), and sachets included in a pie chart of recyclable wastes within Turner (2021). Most sources described sachets as non-recyclable (N. Kumar, 2024; Liamzon et al., 2020; Williams et al., 2019). This may arise from the discrepancies between the theoretical and financially practicable recyclability of mixed contaminated multilayer and multi-material packaging.

The prevalence of grey literature sources throughout the review meant that results more likely to be biased were present particularly within earlier screens. Results about chemical recycling and other advanced treatment technologies were more likely to be from industry or media sources and potentially biased, based on our analysis of content and source.

4. Synthesise results, identify knowledge and research gaps to inform strategic roadmaps for policymakers, consumers and researchers

Our scoping review identifies sachets and the sachet economy as a chronically under-researched area, with the importance of what was found matched by what was not. Sankey diagrams were used to systematically identify knowledge and research gaps following the fourth to sixth screens using several data categories (Fig. 6).

Nodes were switched off as shown in Fig. 7 a) and b), allowing for patterns to emerge. Owing to the large number of complex diagrams, these are available within supplementary documents.

Widely available information, feasibly accessible by decision makers at all levels, contained insufficient data and practical guidance, frequently giving false hope for solutions that may downplay the impacts of sachet use. Results from institutions and Global NGOs presented thorough and detailed information on impacts and solutions, but academic research that could provide empirical data to support decision-makers in putting ideas into action was lacking. This need is compounded by information from industry, amplified by the media, proposing mechanical and chemical recycling and edible/biodegradable sachet construction as environmentally sustainable alternatives that may not be based on balanced or scientific evidence, as discussed earlier.

Only two academic research results contained larger (pilot scale) data and analysis; both concerning the environmental impacts of discarded sachet waste (Behera et al., 2021; Cappa et al., 2023). Sachet waste prevention featured in only 3 academic results (Edoria et al., 2023; Purwanto et al., 2023; Rangel-Buitrago et al., 2024), with results at the sixth screen most likely to be about discarded sachet waste in

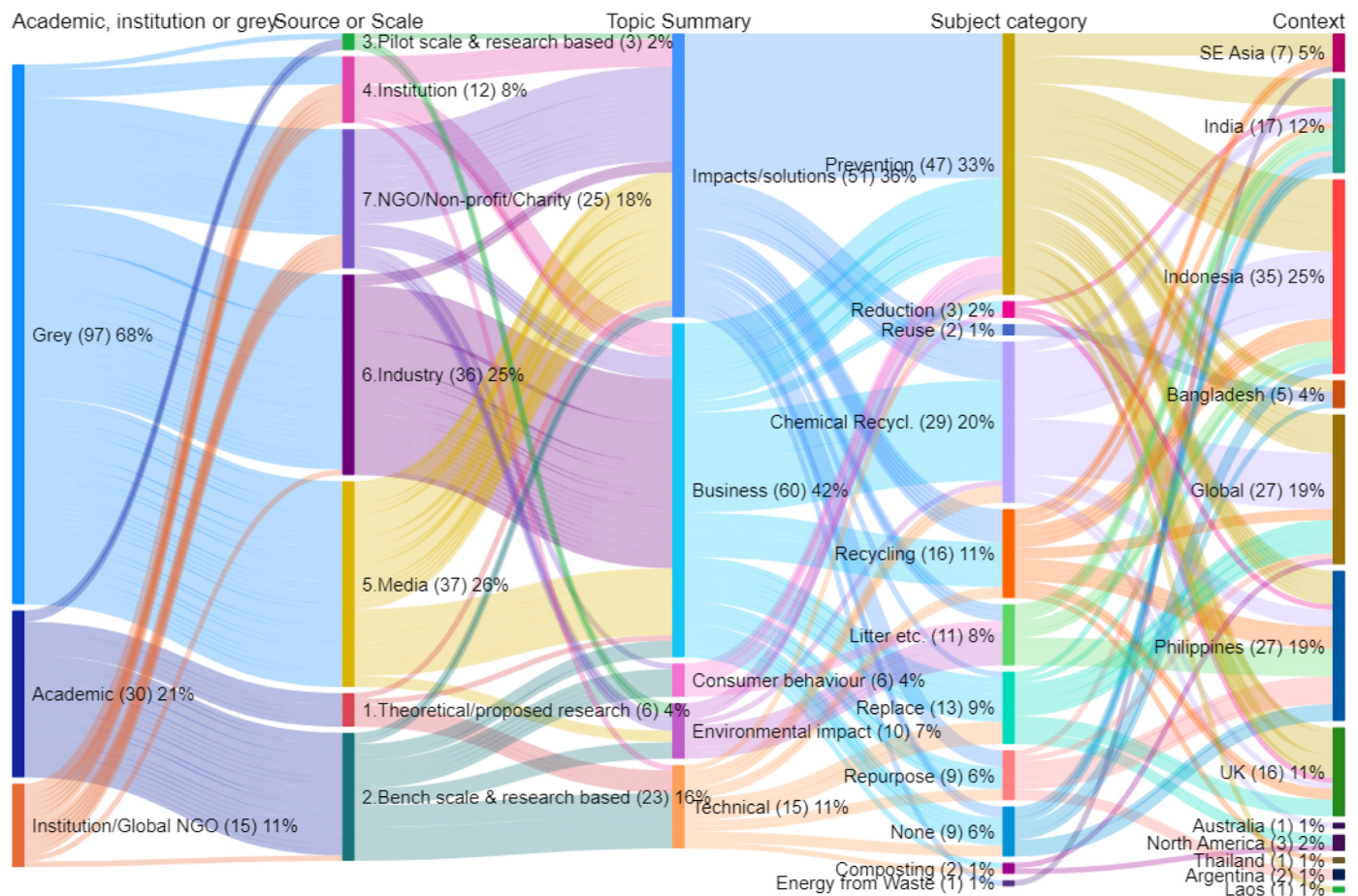


Fig. 6. Sankey diagram of the 4th screen illustrating the relationships between result sources, topics and waste hierarchy for literature options.

Indonesia and the Philippines. Replacement of sachets with degradable or edible alternatives featured in five academic results with a global or HIC focus subsequently screened out at the fourth stage (Ahuja et al., 2024; Fernandes et al., 2020; Pelissari et al., 2016; Siah et al., 2015; Sikorska et al., 2017), indicating that these are unlikely to be feasible for low income consumers in hot and humid environments in the short to medium term. Research into consumer behaviour changes required to facilitate separate recycling or treatment collections for sachets made from alternative materials was not found. Three academic business and marketing results remained after the sixth screening phase, with the two older results not considering sachet waste management challenges at all (Karnani, 2007; Sy-Changco et al., 2011).

Despite acknowledgement from The Pew Charitable Trusts (2020) and others that data is poor, enough is already known about impacts of sachets and other single-use plastic packaging to justify bold and disruptive policy, business and consumer behaviour changes. Roadmaps without clear mandates to normalise refill and reuse business models identified as being essential to reduce single-use packaging are unlikely to have the impact envisaged. We have identified short-term research gaps from our analysis that may increase the urgency of action.

14. Environmental research gaps

The contribution of sachets to plastics pollution is likely to be underestimated owing to sachets frequently being categorised with general flexible, multilayer or 'other' plastics. This could be addressed through retrospective reassessment of existing data, if possible, and the inclusion of sachets as a separate category in future research. Sachets are also used outside the home (Clay et al., 2005; Nulkar, 2016), for example, at shared water and sanitation facilities. Further research on

how sachet waste is managed by users outside the home and small retailers selling products in sachets, as well as use inside the home in urban and rural locations globally, would help inform waste collection solutions.

Stand-up pouches of detergent for consumers to refill bottles in the home is increasingly popular in some South East Asian countries, but it is not known whether this is reducing sachet consumption. Refillable sachets may be an attractive alternative for sachet users, and there are gaps in research that assesses and expands existing small-scale trials (Enviu, n.d.). Our review revealed no LCA of sachets used by consumers in low-income sachet economies, which is a clear knowledge gap for policymakers regarding the quantification of sachets to greenhouse gas emissions, freshwater pollution and other impact categories. Considering various aspects of research into alternative layer, adhesive and print technologies, a baseline LCA would aid comparative assessment of the impacts of alternatives and benefits of standardised construction, such as monolayer formats or elimination of metallised layers. The contribution of sachet waste to microplastic generation as part of or further to an LCA would be a useful contribution to emerging research on the prevalence and consequences of this relatively recently identified pollutant. We echo the calls by Nulkar (2016) who observes that the effects of product residues inside waste sachets on the environment have not been studied.

15. Social research gaps

Results focussed on South East Asia, the region most affected by plastic waste owing to high sachet use, poor waste management infrastructure and extensive riverine networks and coastlines (Meijer et al., 2021). Attention regarding sachet use in the region is needed and

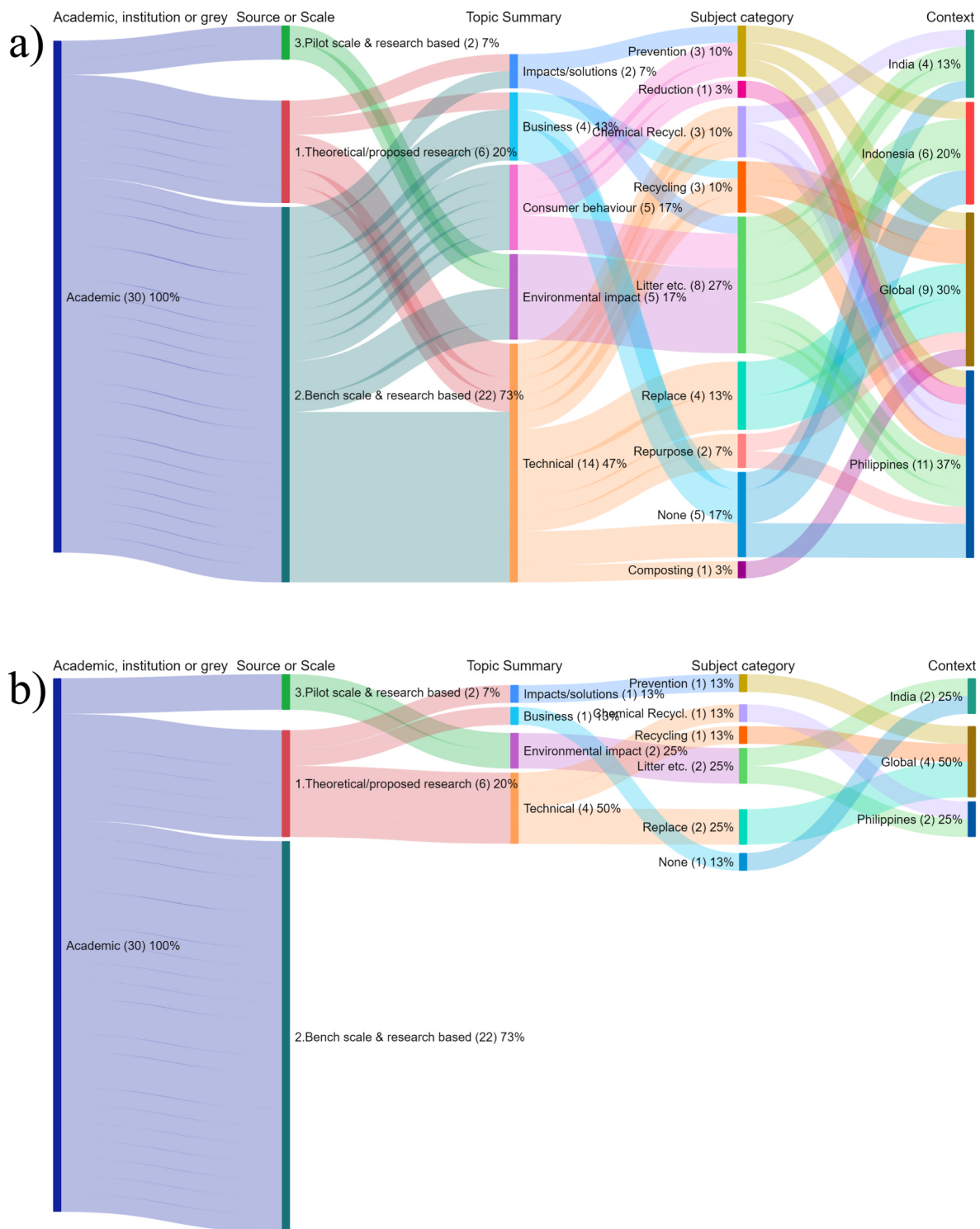


Fig. 7. Sankey diagram of the fourth screen with institutional/large NGO and grey literature results filtered out (a) and only Bench scale research remaining (b) highlighting that larger Pilot scale research focussed on the environmental impacts of littered and dumped sachet waste.

justified, but we propose that a lack of research in other LMICs, including an audit of global sachet prevalence, is likely to be hiding the true global impact of this packaging format.

Empirical data is needed to confirm anecdotal and observational reports of sachets blocking drainage channels and contributing to flooding and disease transmission from insects attracted by stagnant floodwater (ESDO, 2022). Similarly, the role of sachet waste in disease transmission pathways is needed, both around drainage channels and as

land-based litter, following currently unpublished identification by J. Phillips (personal communication, UNC Conference, 14/10/2024) of microbial contamination on sachet waste in Delhi.

Whereas detergent and personal care products are common sachet contents, consumables contained in sachets are typically ultra-processed foodstuffs (A. I. Phelan et al., 2020). Further research into the contribution of sachets to ultra-processed food consumption would add to knowledge and policy formation on both the packaging format and the

contents. Similarly, concern regarding chemical migration from packaging to food summarised by Zhang et al. (2025) is of particular relevance to sachets owing to the large packaging-to-product ratio and subsequent high level of food contact with packaging surfaces.

Further insight into the demographics of sachet product sales and sellers would help target alternative retail model formats and raise awareness of the socioeconomic implications for micro-retailers. In Indonesia, for example, these would include owners of small and micro retail units called 'wahrung' and 'warung kopi', sellers of sachet-based hot and cold drinks from pedal and motorbikes known as 'Starlings' (Fig. 8); and individuals who may otherwise be begging selling sachets by roadsides.

16. Financial research gaps

Whereas convenience and portion control influence sachet purchase decisions, sachet use is ultimately driven by poverty and inequality. Karnani (2007) suggested microcredit as a solution, to enable consumers to buy products in larger and better value quantities. We propose research into micro-saving as an alternative, whereby individuals, families or households could collectively save using a digital platform. The practicality of edible or biodegradable sachets in hot and humid regions, and affordability of alternative materials and monolayer construction, are areas of limited research that are not adequately informing some suggested solutions (A. V Kumar et al., 2022; The Guardian, 2014). Examples of manufacturers moving to monolayer packaging were not found for sachets possibly because aggressive product formulations may be unsuitable for monolayer sachets. Interest in monolayer flexible packaging was observed for pouches excluded in earlier stages of the review rather than sachets, possibly because pouches are targeted at higher-income consumers demanding greener packaging. Furthermore, unless a separate collection and recycling programme is in place, monolayer packaging is unlikely to be recycled. Research is needed into the feasibility of standardising sachet construction materials and making different sachet construction types visually or technically recognisable.

17. Conclusion

We observed general agreement that sachets are a small, flexible, single-use, multilayer and often multi-material packaging format, communicated using a range of descriptive language. We identified thirty words and terms used to describe sachets, highlighting a risk of research being overlooked.

Agreement on the size of a sachet (currently under 10g/10 ml in India and under 50g/50 ml in Indonesia) would provide clarity for consistent policy development.

Definition of the lesser researched sachet economy was found primarily with reference to the Philippines, Indonesia and Nigeria, despite the poverty and culture that drives small quantity purchasing being widespread. Sachet economies in the context of purchasing behaviours arising from cultural norms, habits, poverty and inequality in addition to sachet consumption are a growing, unsustainable and complex phenomenon calling for further research.

A preference for solutions based on linear consumption was observed from industry sources, whereas circular business models were prominent in results from academia and institutions.

Research most likely to drive the bold policy decisions required to meet and reduce the impacts of upcoming sachet bans should be prioritised, particularly a comparative LCA of sachets and alternative single-use/reusable packaging options and financial quantification of existing roadmap actions. Policy changes would benefit from being underpinned by a comparative Social Impact Assessment of sachet bans and alternative business models encompassing the whole value chain.

We conclude that low levels of research on sachets and the sachet economy are contributing to misinformation concerning environmental and socioeconomic damage and a lack of policy action to reduce use. The



Fig. 8. Photograph taken by the lead author of a hot and cold sachet beverage seller in Jakarta, Indonesia, known as a 'Starling'. The word arises from the local description of bicycle and motorbike sellers as 'circling around Starbucks'. The impact of sachet bans on micro retailers is a knowledge gap identified by our review.

authors hope that wider recognition and acknowledgement of sachets as a specific problematic packaging format will instigate action to halt the silent spread of sachet economies in low-income countries hidden from the sight and conscience of wealthy companies and countries profiting from them.

18. Limitations

An iterative methodological process was followed over an extended period by a sole researcher, which risks incorrect exclusions and inclusions (Affengruber et al., 2022). Despite the painstaking level of time and detail attributed to the review, any actual and potential subjectivity and bias may not have been negated by the views of others.

Variance in keywords and language used to describe sachets hindered the systematic retrieval of results and placed a high reliance on results found in bibliographies and speculative finds. This, alongside the low quantity of academic results, may further increase the risk of subjectivity and bias.

Non-English results were excluded owing to the language limitations of the authors, whereas policymakers and consumers in countries most affected by sachets are less likely to have English as a first language.

CRediT authorship contribution statement

Elizabeth Cullen: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Miying Yang:** Supervision, Writing – review & editing. **Georgios Pexas:** Supervision, Writing – review & editing. **May N. Sule:** Supervision, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix B. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.clrc.2025.100373>.

Appendix A

Search Tool	Date	Search Terms or Criteria	Number of items retrieved
Scopus	9/02/23	Abstract, Title, Abstract, Keywords: ((“flexible plastic*” OR “flexible packag*”) AND (environment)) OR ((sachet) AND (environment)) OR ((sachet) AND (waste OR recycl*))	566
Web of Science	09/02/23	As above	510
Scopus	16/03/23	(multilayer OR multi-layer) AND (plastic OR packaging) AND (waste OR recycl*)	501
Web of Science	16/03/23	As above	346
ABI Database	21/03/23	Search 1 (347 results): title((flexible plastic* OR flexible packag*) AND (Environment OR waste OR recycl*)) OR noft (sachet* AND (environment OR waste OR recycl*)) Search 2 (209 results): (noft(multilayer) OR noft(multi-layer)) AND (noft(plastic) OR noft(packaging)) AND (noft(waste) OR noft(recycl*)) Results limited to 2015 onwards	556
Google	11/07/23	‘sachet waste’	150
Scopus	08/09/23	“Sachet” and “Asia” (13 results) “Philippines” and “Asia” (9 results) “Indonesia” and “Asia” (12 results)	34
Scopus	25/08/23	“bulk store”	142
Bibliography Searches	Various	Found manually via other reports and identified using research rabbit, a citation-based literature mapping tool	12
Random Finds	Various	Various searches and accidental finds	14
Total			2831

Data availability

I have shared the link to my DOI in the attach file step.
Sachet Scoping Review (Original data) (Cranfield Online Research Data)

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