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Innovation for Sustainable Development: Assessing Sustainability-Oriented Innovations in the UK Palm Oil Supply Chains

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ABSTRACT

This research evaluates the adoption of Sustainability-Oriented Innovations (SOIs) by UK food manufacturers, particularly in the palm oil sector. Despite the global palm oil industry's environmental and social impacts, such as deforestation and labour exploitation, empirical studies on SOIs are limited. This paper addressed this gap by mapping current SOI adoption patterns and assessing the effectiveness of the framework proposed by Adams et al. (2016). Findings indicate that larger organisations demonstrate engagement with advanced SOIs, driven by legislative pressures and corporate sustainability mandates. The study highlights the need for a nuanced approach within the assessed framework to better capture diverse sustainability practices and recommends enhancing transparency and incentivising SOI adoption across all business sizes. This research contributes to theoretical discourse and practical applications, offering insights for policy-makers and industry leaders.

1 | Introduction

As global sustainability concerns intensify, manufacturers procuring palm oil are increasingly turning to sustainability-oriented innovations (SOIs) to mitigate the environmental and social impacts of their operations. We aim to enhance our understanding of how SOIs are adopted by UK food manufacturers, focusing specifically on the palm oil industry. Utilising the SOI framework developed by Adams et al. (2016), this research not only maps the current adoption patterns but also critically evaluates the framework's effectiveness in addressing the unique sustainability challenges within the palm oil sector. Furthermore, the paper will present targeted policy recommendations designed to foster the broader implementation of SOIs, thereby promoting improved sustainability standards across this critical industry.

In 2017, global palm oil consumption exceeded 65 million tonnes, driven by its affordability, versatility and superior crop yields (Ostfeld et al. 2019). The food sector was the most significant procurer, consuming 72% of total supply, followed by personal care and cleaning products at 18% and biofuel at 10% (Voora et al. 2019). While palm oil is a key ingredient in many of our day-to-day products, its production and consumption significantly contribute to global ecological issues, including deforestation, greenhouse gas emissions (GHG), and biodiversity loss (Gottwald 2018; Cooper et al. 2020). From a social justice perspective, worker exploitation remains a continuing and prevalent issue, driven by poor supply chain transparency, implicating major household brands with labour standards violations (Amnesty International 2016; Puder 2021). It is these consequences of production and consumption that make it important to progress our understanding of how major procurers of palm oil are innovating to address these issues.

A substantial research discourse has arisen since the mid-2010s aiming to understand innovation activity in the palm oil

industry. Sustainability and innovation researchers have looked to address topics such as sustainable practices in palm oil production (Ayompe et al. 2021), certification and standards (Jose and Lee 2007), supply chain innovation (Wolf 2014), social innovation (Barth et al. 2021), and policy and governance innovations (Cainelli et al. 2011). Despite the depth of research in this area, there have been limited studies that have specifically built on the ideas of SOI in the context of palm oil production and consumption. From a macro- SOI perspective, many research streams have emerged such as drivers and barriers (Garcia-Granero et al. 2020), defining types of innovation (Demirel and Kesidou 2011), and framework development (Adams et al. 2016). When assessing SOI literature from an agribusiness perspective, research has often focused on agribusiness models and strategies (Ulvenblad 2021), SOI in value chain innovation (Mol 2015), costs and benefits of SOI (Depetris-Chauvin et al. 2023), and inter-organisational collaboration for SOI (Garcia-Granero et al. 2020), leaving significant developmental gaps.

From the existing literature at the nexus of SOI and agribusiness, it is evident that conceptual and theoretical developments have taken precedence, with less emphasis on empirical studies that investigate organisational adoption of SOIs. Empirical study is critical to ensure a robust practical assessment of theoretical developments. To address this gap, this research aims to empirically test the SOI framework created by Adams et al. (2016) to further understand its nuanced applicability in real-world scenarios. Crucially, while numerous studies address SOI within the broader agribusiness context, research specifically focusing on the palm oil sector is limited and often lacks a solid theoretical foundation in SOI. As a result, studies situated in the palm oil sector have often focused more on ecological problems rather than those of a social nature, and so we adopt SOI as the mechanism to fully engage with sustainability from both an ecological and social perspective (Adams et al. 2016).

We examine the use of SOIs by UK food manufacturers for two key reasons. First, in 2022 the UK became the 27th largest importer of palm oil, spending $497M on palm oil (OEC 2022), demonstrating the nation to be one of the leading importers of palm oil, and thus also a major player in propagating its negative impacts. Second, the UK stands as one of the world's leading proponents of sustainability (Sachs et al. 2023) and has developed an equivalently progressive regulatory environment. Specifically, the UK's Environment Act (2021) introduced a due diligence system for forest-risk commodities including palm oil, which is being expanded through the Forest Risk Commodities Regulation to improve due diligence requirements, scope, and sanctions for UK businesses that do not comply with improved procurement standards (UK Parliament 2023). Regulations of this nature have underpinned the legislative pressures fuelling a manufacturer focus on SOI across the nation (Diaz-Garcia et al. 2015), which, coupled with its large consumption, makes the UK an effective jurisdictional context against which to map and assess SOI in relation to the landscape of global palm oil consumption. We examine SOIs in the context of food manufacturing as it provides an informative lens through which to map and assess SOI adoption in the UK in relation to palm oil. Food product manufacturing constitutes the majority of palm oil used for consumption in the UK (DEFRA 2011; Figure 1). Consequently, assessing SOIs in the UK food industry enables deeper insight into the scope and influence of these innovations on sustainable consumption of palm oil in the UK. Furthermore, as manufacturing firms are key buyers of raw materials, including palm oil (Voora et al. 2019), these firms are constrained by the legislative pressures imposed by the aforementioned UK regulations on sustainable procurement and so act as a refined target to assess and map SOI adoption.

Our contributions are sixfold. First, we introduce a novel methodology to map the UK food-manufacturing landscape and associated palm-oil use, extending DEFRA (2011). Second, we

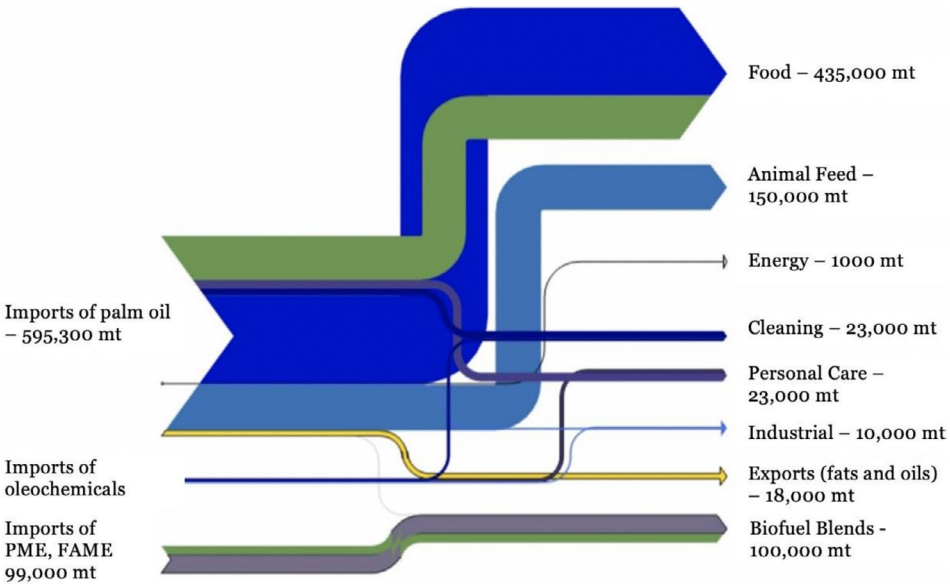

FIGURE 1 | Palm oil use by sector in the UK (DEFRA 2011). (A figure showing estimated use of palm oil by sector in the UK (2009/10), not including import of finished products or palm kernel meal. Food accounted for the majority of palm oil use. PME is an abbreviation of palm oil methyl ester and FAME stands for fatty acid methyl esters. Esters are any class of organic compounds that react with water to produce alcohols and organic or inorganic acids. A metric ton (mt) denotes the weight of palm oil imported.)

provide an up-to-date view of palm oil usage and sustainability practices among leading UK food manufacturers. Third, we offer a critical empirical assessment of Adams et al.'s (2016) SOI framework in the palm-oil context. Fourth, we advance the Adams et al. framework through the theoretical addition of an external-influences module that recognises regulatory pressure, technological availability, and consumer salience as extra-firm drivers of SOI maturity. Fifth, we propose the framework include a tiered engagement schema that differentiates levels of engagement and stringency within each SOI category, enabling more detailed assessments of social and ecological ambition. Sixth, we make a contribution to innovation policy through recommendations to stimulate the adoption of SOIs in UK food manufacturers. Our research reveals the intricate interplay between the competing motivations for ecological conservation, social responsibility, political mandates, and economic imperatives within the palm oil industry, and provides a foundation for future inquiry for policymakers, researchers, and practitioners looking to assess and implement SOI.

2 | Theoretical and Analytical Approach

2.1 | Innovation to SOI

Innovation, first characterised by Schumpeter (1911), has become a cornerstone of neoclassical economic development and a strategic objective for organisations worldwide (Pacheco et al. 2017). While traditionally associated with radical and risky changes, innovation encompasses a broad spectrum from incremental to transformative changes, each playing a crucial role in sustainable development (Kahn 2018). This expanded view of innovation challenges the narrow focus on radical changes and highlights the potential pitfalls of neglecting the broader impacts of innovation practices, as noted by Kuratko et al. (2014). The significance of integrating sustainable practices in innovation was notably emphasised at the 1992 United Nations Earth Summit. Since then, 'eco-innovation' has emerged as a pivotal concept, defined by the European Commission (2006, 310/17) as 'innovation aiming at significant and demonstrable progress towards the goal of sustainable development, through reducing impacts on the environment or achieving a responsible use of natural resources, including energy'. The importance of eco-innovation lies in its dual benefit: advancing environmental goals while also delivering economic advantages (Afshari et al. 2020), thus aligning manufacturing processes with broader sustainability objectives (Lee and Schmidt 2017).

Building on the foundation of eco-innovation, SOI has evolved to address a wider array of sustainability goals, integrating environmental, social, and economic dimensions into a holistic framework (Adams et al. 2016). This evolution is critical as it extends the scope of innovation beyond environmental concerns to include social inequalities and community well-being (Hansen and Grosse-Dunker 2012). The work by Boons and Ludeke-Freund (2013) further underscores the necessity of designing business models that not only mitigate environmental degradation but also generate social and economic value, highlighting the transformative potential of SOIs. Adams et al. (2016) have significantly contributed to the development of this discourse by illustrating how SOIs can foster economic sustainability, not merely through incremental enhancements but by fostering radical systemic changes. These include green product differentiation, supply chain optimisation, and the promotion of circular economy models, which collectively offer new market opportunities and enhance economic efficiency without compromising environmental and social standards. Recent studies like that by Harsanto et al. (2024) reinforce the importance of these frameworks, arguing that SOIs facilitate a comprehensive integration of sustainability into business operations, thus transforming the very fabric of organisational and systemic practices. This body of literature is crucial as it provides empirical and theoretical support for the vital role of SOIs in driving sustainable development across various sectors, particularly in contexts as challenging and impactful as the palm oil industry. By examining and critiquing these frameworks and their applications, we not only contribute to academic discourse but also guide industry practices towards more sustainable and ethically responsible business strategies.

2.2 | Types of SOI

Innovation typology has been extensively explored to support analysis on how innovations influence industrial growth and sustainability (Ortiz-Avram et al. 2023), a theme that builds directly upon the foundational discussion of innovation's role in sustainable development. As outlined by Freeman et al. (1982), understanding the distinct impacts of product and process innovations is crucial for tailoring management and resource allocation strategies to foster industrial advancement. Product innovations, which focus on enhancing the environmental and social attributes of products—such as improved recyclability, reduced resource consumption and the substitution of harmful materials—offer direct paths to more sustainable consumer products. These innovations not only respond to increasing regulatory demands and consumer expectations but also open new market opportunities by aligning product attributes with sustainability goals.

Similarly, process innovations target operational improvements, aiming to increase efficiency and reduce the environmental footprint of production processes. Techniques such as waste minimisation, energy efficiency improvement, and the adoption of cleaner technologies are central to reducing operational costs and mitigating environmental impact. Work by Pavitt (1984) and Rennings (2000) further expands this discussion by examining sector-specific impacts and the environmental benefits of innovations, respectively. Pavitt's taxonomy of technological change provides insights into how different sectors can harness specific types of innovations, highlighting the tailored approaches needed for effective innovation strategies across diverse industries.

Meanwhile, Rennings emphasises the concept of eco-innovations, linking them explicitly to environmental benefits and setting the stage for a deeper understanding of how sustainability can be embedded within traditional innovation models. Kemp and Foxon (2007) explore the necessary technological shifts towards environmental sustainability, stressing the importance of organisational innovations in achieving sustainable outcomes. Organisational innovations, which involve transformative changes in structures or business models, such as the integration of sustainability in corporate governance, are pivotal. They enable

a holistic incorporation of sustainable practices across all operational levels, ensuring that sustainability becomes a core aspect of organisational strategy rather than a peripheral concern. These innovations are essential for industries facing strict environmental regulations and those looking to improve cost-efficiency under competitive pressures. Our understanding of the definition of product, process, and organisational can be found in Table 1.

This detailed exploration of innovation typology is essential as it underpins the theoretical framework developed by Adams et al. (2016), which is used to analyse the adoption of SOIs by the organisations examined in this research. Adams et al. (2016) introduce the Organisation Optimisation, Organisation Transformation, and System Building categories, which serve as a scaffold for integrating product, process, and organisational innovations, respectively (Table 2). By distinguishing between product, process, and organisational innovations, we can more accurately assess how each type contributes to sustainable development and guides industry practices towards more comprehensive sustainability strategies. The distinctions outlined by Adams et al. also facilitate a clearer understanding of where gaps in current practices might lie and how they can be addressed through targeted SOIs, setting a critical foundation for the subsequent discussion on policy and strategic industry changes.

TABLE 1 | SOI classifications (Adams et al. 2016).

SOI classification	Definition and operationalisation
Product	The development of new or improved products and services that also benefit environmental or social factors. Innovation is typically technological and internally focused. Lack of integration with wider organisational systems
Process	The introduction of a more integrated environmental and social strategy including processes that integrate with product development and external stakeholders
Organisational	The institution of organisational methods and management systems that result in a shifting perspective towards systemic external collaboration for market transformation

Note: A table detailing the definition and operationalisation SOI classifications used in this research.

2.3 | SOI Applications in Palm Oil

Understanding the intricate challenges of palm oil sustainability is essential to evaluating the pivotal role of SOIs in enhancing the sector's sustainability. The Roundtable on Sustainable Palm Oil (RSPO), established in 2004, represents a critical effort in this direction, offering a globally recognised certification system that categorises sustainable palm oil into Identity Preserved (IP), Segregated (S), and Mass Balanced (MB) standards, each differing in traceability and separation methods throughout the supply chain (Morgans et al. 2018). Despite the classification, the palm oil industry continues to face severe criticism for contributing to climate change, deforestation, and worker exploitation (Pye and Bhattacharya 2013; Padfield et al. 2019), issues that are exacerbated by the complexity and opacity of the supply chain. This complexity is notably highlighted by EFECA (2019), which outlines the six key stages of the UK's palm oil supply chain, illustrating the lengthy and intermediated nature of these chains, as shown in Figure 2. This complexity makes it difficult to trace raw materials back to their sources, underlining a critical need for enhanced transparency (Duijn 2013; Ramli et al. 2020). In this context, transparency doesn't merely pertain to the clarity of information but involves three critical dimensions as identified by Gardner et al. (2019): naming the suppliers, disclosing the sustainability conditions of these suppliers and revealing the purchasing practices of firms. This broader understanding of transparency, evolved through innovations in technology and new systems, plays a foundational role in the implementation of SOIs.

As the nature of transparency evolves, driven by technological advancements like geospatial tools and social media (Padfield et al. 2025), it fosters what has been termed 'radical transparency'—the ability to disclose information without requiring permission from the source (Lipschultz 2015; Gardner et al. 2019). Such transparency is crucial not only for maintaining environmental and social systems but also for empowering consumers and investors to make informed decisions that could pressure companies towards

TABLE 2 | SOI model.

	Operational optimisation—'eco-efficiency'	Operational transformation—'new market opportunities'	Systems building—'societal change'
Innovation objective	Compliance, efficiency—doing the same things better	Novel products, services, or business models—doing good by doing good things	Novel products, services or business models that are impossible to achieve alone—doing good by doing good things with others
Innovation outcome	Reduces harm	Creates shared value	Creates a net positive impact
Innovation's relationship to the Firm	Incremental improvements to business as usual	Fundamental shift in firm processes and purpose	Extends beyond the firm to drive institutional change

Source: Taken From Adams et al. (2016). (The SOI framework developed by Adams et al. (2016), derived from a systematic review of literature).

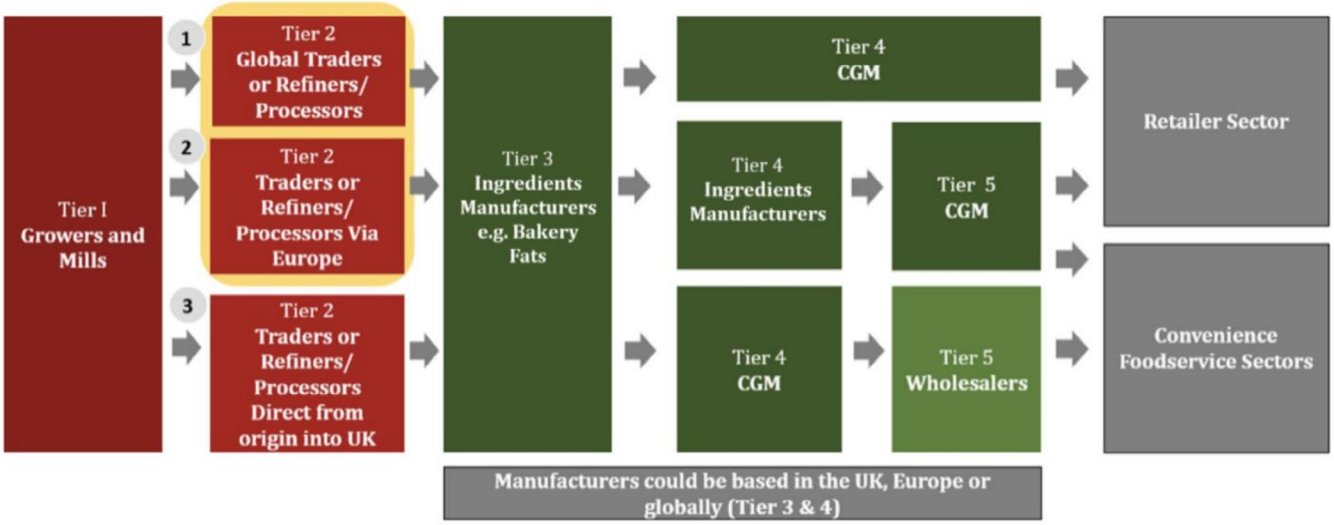

FIGURE 2 | An illustration of the palm oil supply chain. *Source:* Taken from EFECA (2019). (The figure illustrates the flow of palm oil and palm kernel oil into the global market via several sources. Tier 2 illustrates that palm oil is traded and refined/processed via three key supply chains: globally (1), via Europe (2), or directly in the UK (3). Supply chain 3 portrays the imports of palm oil into the UK directly from growers and mills in producer countries, which are then refined, transported to manufacturers, CGM, and/or wholesalers, before entering the food service and/or retail sector.)

more sustainable practices (Rueda et al. 2016; Gardner et al. 2019). This, in turn, challenges firms to consider how their engagement with SOIs can be a strategic response to these demands, enhancing their sustainability credentials and potentially transforming consumer behaviour (Egels-Zanden and Hansson 2015; Shao and Ünal 2019). However, the question remains whether the increased transparency and the adoption of SOIs in the palm oil industry are merely tactical moves or genuine strides towards sustainable development. This emphasises the importance of SOIs not just in addressing the operational challenges posed by the palm oil industry but also in fostering a deeper, systemic change that aligns with broader sustainability goals. Thus, by addressing the unique challenges in the palm oil sector through the lens of SOIs, we highlight the transformative potential of integrating comprehensive sustainability practices into the industry's core operations.

3 | Research Design

We conducted this research using a novel three-phase sequential analytical approach (Figure 3). Firstly, we identified manufacturing parent organisations; secondly, we isolated their SOIs; and thirdly, we integrated and analysed both the firms and SOIs through Adams et al. (2016) SOI framework. Our research subjects were organisations of varying sizes that manufacture a range of food products. The objective of the first phase of this approach was to map and identify the key food manufacturers in the UK's palm oil supply chain. To do this, we conducted a supermarket analysis. The supermarket analysis used the following seven-step process, as also illustrated in Figure 4.

3.1 | Defining the Scope

Firstly, the analysis aimed to identify as many brands as possible of biscuits, margarines and spreads, chocolates and breads, across five supermarkets (Tesco, Sainsbury's, Waitrose, Asda and Morrison's)—we visited all listed supermarkets. We selected the product types chosen as they account for the largest proportion of palm oil consumption of any food products in the UK (DEFRA 2012). We also selected the reviewed supermarkets to represent a majority market share, ensuring a sufficient scope for the analysis. In May 2021, the selected supermarkets represented 72.1% of the market (Blázquez 2021).

3.2 | Setting the Inclusion and Exclusion Criteria

The inclusion and exclusion criteria were developed to reflect the requirements of the study and the defined scope (Table 3). To be included in the study, products had to: (1) be situated within one of the four product categories—biscuits, margarines and spreads, chocolate and bread, (2) only products found at one of the five supermarkets visited were included and (3) products must have contained any amount of palm oil. Biscuits were defined as small, flat cakes that are dry and usually sweet (Goubgou et al. 2021). Products such as Jaffa Cakes were not included. Margarines were defined as products that are likened to butter but have different fat contents—a minimum of 80% by weight (Young and Wassell 2008). Spreads were defined as products with a variety of fat contents—often between 25% and 70% fat content (Young and Wassell 2008). Chocolate was defined as products that contained no vegetable fat other than cocoa butter and with a minimum cocoa content of 30% (Katz et al. 2011). Any chocolate desserts and non-confectionary type products were excluded. Bread was defined as being made with yeast, prepared from one or more cereal flours, including sliced loaf breads, rolls and bagels Trevena et al. (2014).

3.3 | Developing Tracking Rules

Similar to the methodology employed by Wu et al. (2015), duplicate brands found at multiple supermarkets were only recorded once, and similarly, matching brands presented in different sized

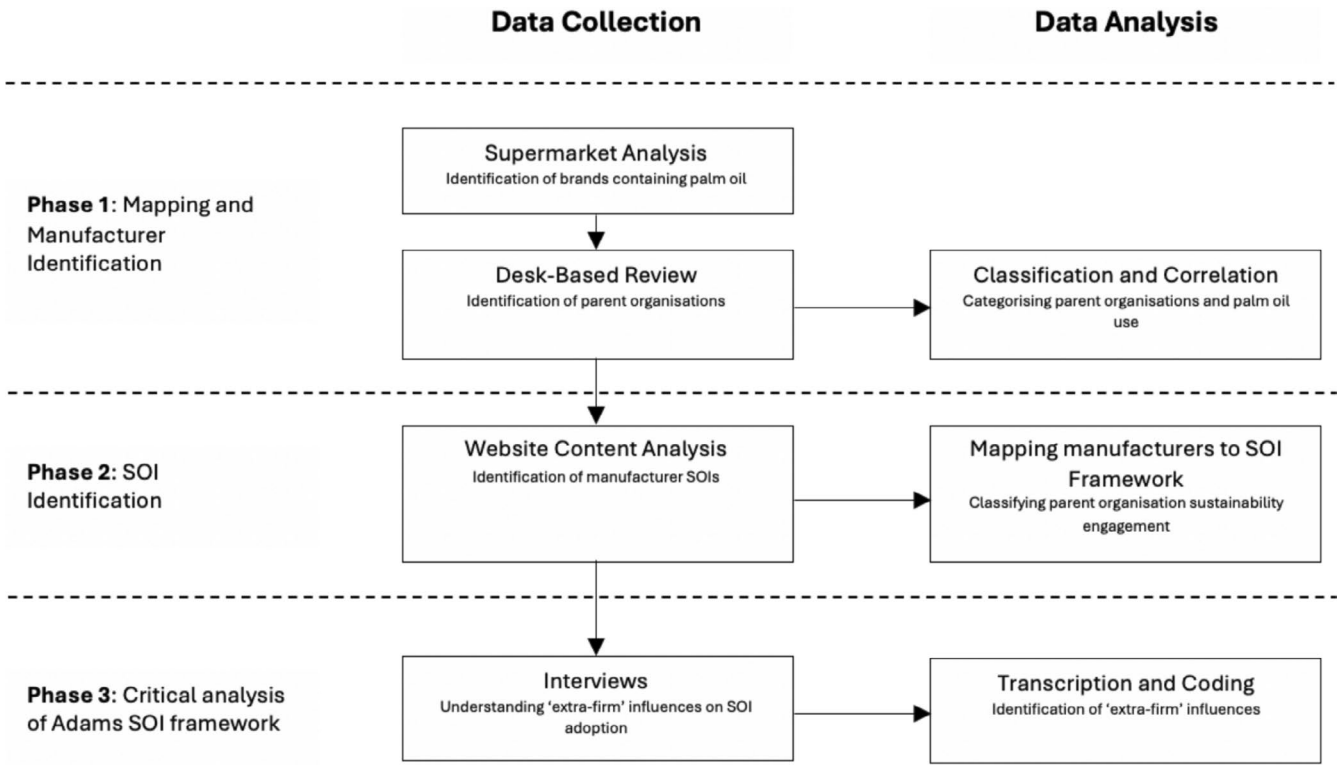

FIGURE 3 | Workflow of methods. (The figure illustrates the methodological process taken to conduct the research presented in this paper. In Phase 1, a supermarket analysis was conducted, the results of which were reviewed and analysed through a desk-based review and a classification and correlation exercise. Phase 2 consisted of a website content analysis to identify the SOIs that would then be integrated with the framework developed by Adams et al. (2016). Finally, Phase 3 focussed on conducting interviews to enrich the previously conducted field and desk-based research.)

packaging were only recorded once. This approach was taken as the supermarket analysis was not examining the frequency by which any product appeared in a supermarket. The purpose was for a binary identification (was it or was it not present) to create a sample for the subsequent desk-based analysis and mapping to the Adams SOI framework only that they were present. We follow a holistic understanding of the term 'brand', which firstly follows the notion that brands are a useful tool to help differentiate between manufacturers (Gardener and Levey 1995).

3.4 | Recording Data

Next, all brands meeting the supermarket analysis parameters were recorded. They were then tested according to the inclusion and exclusion criteria outlined above, with only products meeting the inclusion criteria being used in the desk-based review (Table 3). All visits to the scoped supermarkets occurred within 1 week, and each supermarket was only visited once due to project time constraints.

3.5 | Desk Based Review

Using brands adhering to the inclusion criteria, we conducted a desk-based review to investigate and map brand ownership back to the parent organisations. This process was similar to that used by Bruyaka et al. (2012) and Al-Tabbaa et al. (2021), who use a purposive sampling approach to examine subsidiary websites to identify their parent organisations. Similarly, we examine the official websites of each of the brands identified at each supermarket to find out the parent company to which they belong. From this step, we produced a complete list of all parent organisations that were operating within the study scope (Table 4).

3.6 | Categorisation of Parent Organisations

Next, we recorded company turnover information from 2019 to support the categorisation of each organisation by size and to enable insights into variations of SOI adoption correlated with financial capability. We placed parent organisations into three categories: small, medium, and large (Appendix A). Significant turnover intervals, as informed by the data, were coordinated with a base 10 logarithmic scale to dictate the parameters of each category: small (£0–£99.9 m), medium (£100–£999.9m) and large (£1 bn–£99.9 bn). This metric was used for two reasons: (1) to create a point of differentiation to aid analysis and the identification of correlations between company size, of which turnover is a useful measure (Claudia and Lusmeida 2020). (2) Because a logarithmic scale is able to compact data sets with wide-ranging values, such as that collected in this research, reducing the disproportionate representation of large values (Mahajan 2018).

3.7 | Analysing Organisational Palm Oil Consumption

Finally, the RSPO database was used to gather the tonnages of palm oil used by each organisation in 2019, as this would enable

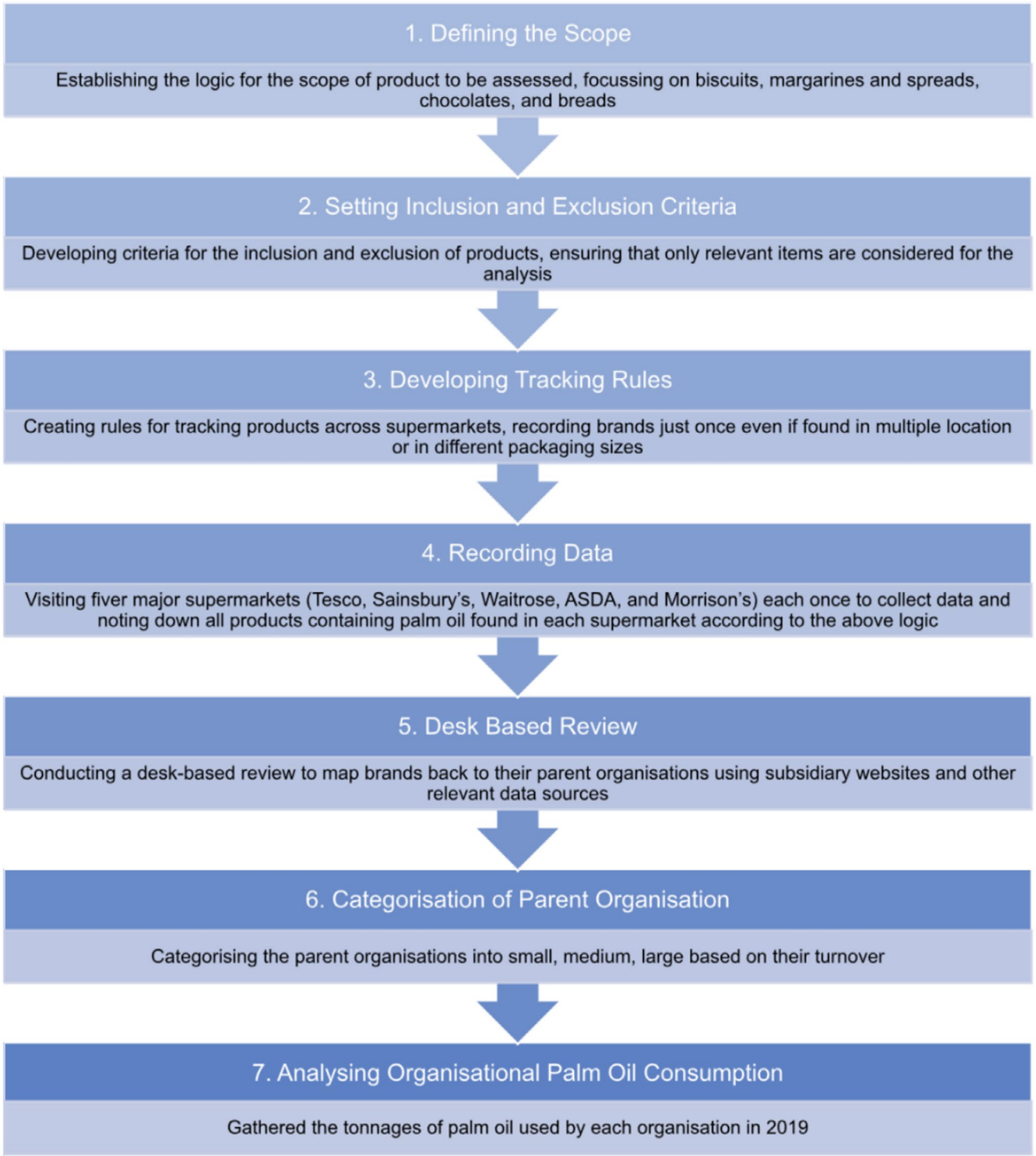

FIGURE 4 | Illustration of the seven-step supermarket analysis process. (Figure 4 illustrates the seven-step process taken to identify parent organisations and analyse palm oil consumption.)

insights into the scope of impact for the SOIs adopted by each organisation. The year 2019 was used as the baseline date because the RSPO database provided the most complete and recent dataset across all organisations identified at this point. We then used Python to conduct Pearson's r test to discern a correlation between turnover and palm oil use.

To develop this method, we used the approaches by Trevena et al. (2014) and Wu et al. (2015) to form the foundations of our design. However, to ensure that the method addressed the outlined objective, adaptations were made to the scope and inclusion and exclusion criteria, as well as creating additional steps for the categorisation of parent organisations and analysing organisational palm oil consumption. As a result, the methodology employed enabled access to a large number of up-to-date product ranges, while also ensuring a wide enough scope to capture key market players. As far as we are aware, this research has provided novel additions to this approach

TABLE 3 | Product inclusion criteria for supermarket analysis.

Product type	Definition	Inclusion criteria	Exclusion criteria
Biscuits	Biscuits were defined as small, flat cakes that are dry and usually sweet	Must contain palm oil—noted on product packaging as either sustainable palm (oil) or palm (oil)	Absence of palm oil in product—no indication that was used in the product on the packaging
Margarines and spreads	Margarines were defined as products, which are likened to butter, but have different fat contents—a minimum of 80% by weight Spreads were defined as products with a variety of fat contents—often between 25% and 70% fat content		
Chocolates	Chocolate was defined as products that contained no vegetable fat other than cocoa butter and with a minimum cocoa content of 30%		
Breads	Bread was defined as being made with yeast, prepared from one or more cereal flours, including sliced loaf breads, rolls, and bagels		

Note: A table showing the classes of products collected in this research, the definition applied to each class, which provided the scope by which each product was categorised, and the inclusion and exclusion criteria, which outlines the required characteristics for a product to be assessed in this research.

TABLE 4 | organisations mapped according to the SOI framework.

Company size	Operational optimisation	Organisational transformation	Systems building
Large	Allied Bakeries Saputo Lindt and Sprungli Pladis Kellogg's	Ferrero International Mars Kerry Foods	Nestlé Unilever Mondelez International The Hershey Company
Medium	Premier Foods Warburtons Lotus Bakeries Ecotone Weetabix Carambar & Co. Raisio Group	Bahlsen Foods	Upfield
Small	Merba Frank Roberts & Son's Tunnock's Sheldon's Border Biscuits Cartwright and butler Jim Jams ROKA Stockan's Bonn's and Co.	Lees of Scotland	

Note: A table showing the classification of the SOIs employed by the identified parent organisations according to Adams et al. (2016) SOI framework.

and provides a new methodological perspective, grounded in the palm oil industry, for identifying and analysing commercial products.

We identified and logged the sample of SOIs adopted by the manufacturing parent organisations (Appendix B). Then, employing a similar methodology used by Al-Tabbaa et al. (2021), we collected SOI data by gathering the published information from corporate websites, which, as stated by Al-Tabbaa et al. (2021) is an effective tool in assessing an organisation's long-term strategy. While the use of corporate websites may present potential bias due to the risk of greenwashing, this data collection leverages the increasing regulatory scrutiny, particularly under the UK Competition and Markets Authority's 'Green Claims Code' introduced in 2021, to underpin the credibility of the data collected. Accurate coding and categorisation of the identified SOIs were essential for a synergistic mapping within the SOI framework. To do this, the SOIs

were assessed and categorised according to the definitions for Operational Optimisation, Operational Transformation, and Systems Building defined by Adams, thus providing a clear synergy between SOIs in this research and the employed framework.

We conducted a small number of semi-structured interviews—a similar approach to that taken by Schouten et al. (2023)—which allowed for a deeper qualitative exploration of SOI adoption within the palm oil supply chain. We designed the interviews to facilitate detailed discussions while maintaining focus on the core themes of SOI adoption, such as the drivers of innovation, the barriers encountered, and the perceived impacts on both corporate performance and sustainability outcomes (Bryman 2016). The use of predominantly open-ended questions facilitated a rich, detailed collection of data, revealing the complexities and nuances of integrating sustainability practices into business models (Newing 2011). These narratives highlight how organisational leadership and cultural shifts towards sustainability are orchestrated and perceived internally, offering valuable insights that quantitative data alone could not provide. We conducted three interviews with representatives from Bahlsen Food Group, Lees of Scotland, and Sheldon's, all using Zoom. Standard consent and ethics practices were adhered to, and interviewees remain anonymous by condition of their participation. For the purposes of reporting, the interviews have been coded as follows: Bahlsen Food Group, I#1; Lees of Scotland, I#2; Sheldon's, I#3.

We tailored our methodology to meet the specific objectives of the study, ensuring rigorous data collection and appropriate sample identification. While this approach offers a novel perspective within the defined scope, it is important to recognise that it may not be universally applicable for all types of analysis. The reliance on supermarket analysis for initial data gathering was strategic, targeting market players available in major supermarkets. The selection of supermarkets provided comprehensive coverage, accounting for over 72% of market share at the time of analysis (Blázquez 2021), and was designed to capture both large and niche companies—those that focus on a specific, smaller segment of a larger market (Kvam et al. 2014) – for example, Stockan's oatcakes. However, our method may inadvertently exclude some smaller, niche manufacturers of those not retailing through these channels, potentially overlooking some innovative practices from entities outside traditional supermarket chains. Furthermore, the use of the RSPO database to assess palm oil consumption was predicated on the assumption of data accuracy and completeness. This method primarily captures information from companies registered with and compliant with RSPO standards and might not fully represent palm oil usage by all entities, especially those outside the RSPO system. Finally, categorising companies based on turnover for further analysis was a deliberate choice, simplifying the complex dynamics between financial turnover and innovation adoption or sustainability practices. It is recognised that turnover does not necessarily correlate directly with an organisation's capacity for innovation or its implementation of sustainable practices. Despite these limitations, the chosen methods were considered the most appropriate for addressing the research aims, providing a focused and detailed examination of the sector within the constraints of the study.

4 | Results and Discussion

This section presents the findings from the examination of SOIs among UK food manufacturers. We demonstrate how different-sized organisations adopt SOIs and provide an accompanying rationale for these results. By mapping these adaptations and critically analysing the effectiveness of the SOI framework developed by Adams et al. (2016), this section aims to enhance our understanding of the strategic implementation of SOIs, offer developmental lines of enquiry for progressing the Adams et al. framework, and provide insights into policy recommendations that could foster broader adoption of sustainable practices in the palm oil industry.

Figure 5 showcases the results from the manufacturer mapping and identification exercise, aimed at pinpointing parent manufacturers whose subsidiaries use palm oil in products supplied to the UK. The visualisation's outer layer identifies all palm oil-containing products identified in the supermarket analysis and groups them by their parent organisations. At the centre, all identified parent organisations are displayed, linked by arrows to their respective subsidiaries. Highlighted in a blue outlined square are independent manufacturers that produce only one brand and do not belong to any larger parent organisation. This mapping exercise, the first in over a decade, offers a current view of the major players in the UK food industry and their relationships, underscoring the strategic layout of the sector. We identified 230 brands, of which 94 contained palm oil, associated with 21 parent and 10 independent organisations. The consistency of these parent organisations with those previously identified by DEFRA in 2011 underscores their continued influence in the UK palm oil supply chain. Building on this finding, Figure 6 shows two bubble charts that illustrate the size variations among the identified parent organisations; the left-hand grouping shows size by turnover in 2019, while the right-hand grouping represents size by palm oil tonnage consumed in 2019. The charts categorise parent organisations into small, medium, and large groups as defined in the methods. Notably, companies with the largest turnovers also source the most palm oil, while the data also shows, somewhat unexpectedly, that medium-sized organisations such as Upfield, Lotus Bakeries, Bahlsen and Premier Foods are substantial consumers relative to their financial size. Despite these anomalies, the macro trends observed across both charts suggest a positive correlation: as turnover increases, so does palm oil consumption. Given the non-normal distribution of the data, a Pearson's r test was conducted to verify this correlation, resulting in a correlation coefficient of 0.651 and a significant p-value of 0.001. This significant positive correlation is visually represented in Figure 7 through a regression line and confidence intervals, clearly illustrating the aligned movement of the two variables. Detailed figures for turnover and tonnage are available in Appendix A.

Our comprehensive mapping exercise reveals that despite the extensive range of brands on the market, there are 10 dominant palm oil consuming organisations in this sector: Nestlé, Unilever, Mars, Mondelez International, Allied Bakeries, Ferrero International, Kerry Foods, The Hershey Company, Lindt and Sprüngli, and Kellogg's. Isolating these organisations provides valuable context when considering the significance and scale of their commitments to SOI. Furthermore, the correlation

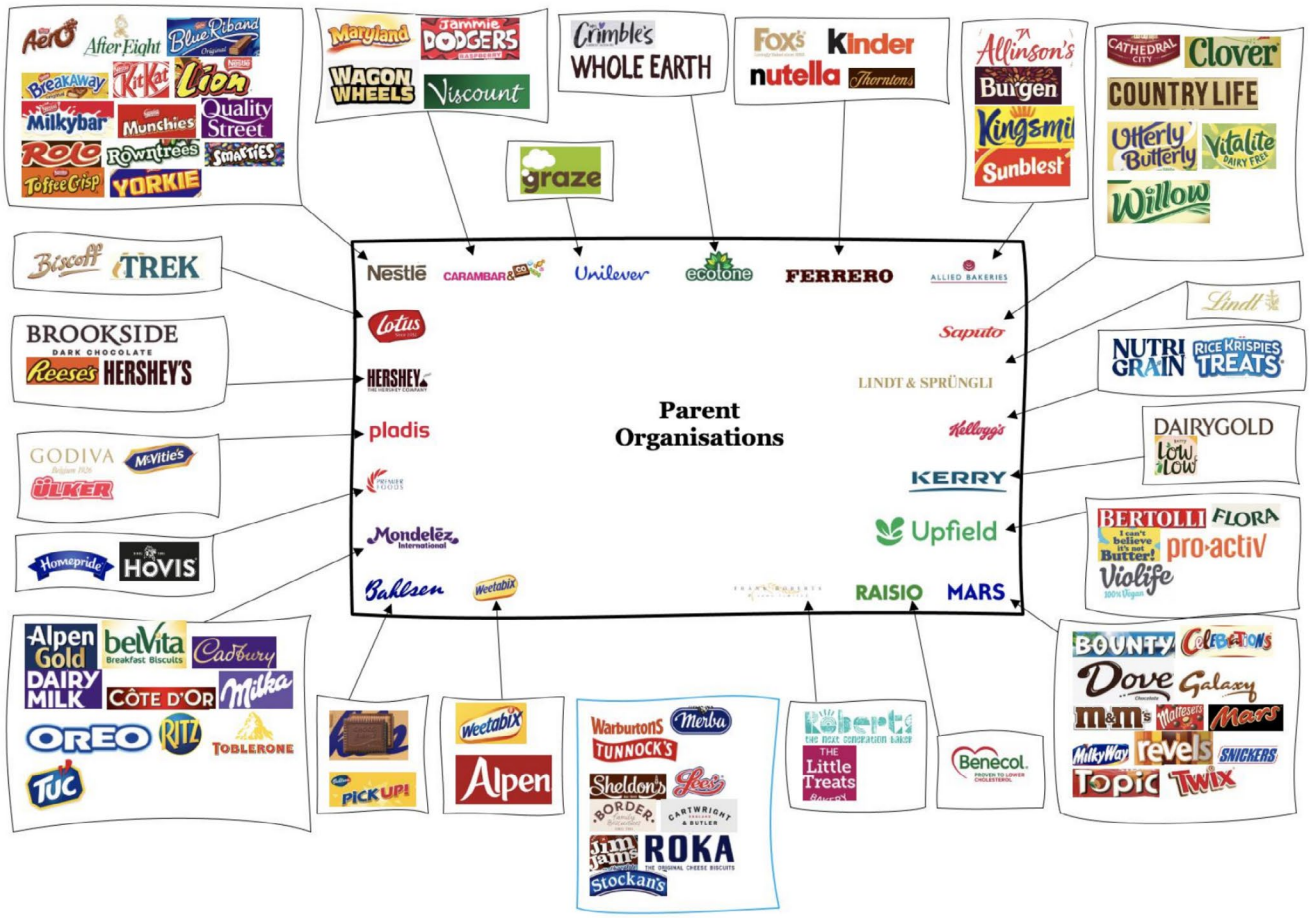

FIGURE 5 | Identification of parent organisations. (Figure 4 illustrates the results of the parent organisation identification. The subsidiary manufacturers that produced the products found to have contained palm oil were traced back to their parent organisations, then grouped and mapped as shown.)

demonstrated in Figures 5 and 6 elucidates the relationship between palm oil consumption and organisational growth and emphasises the importance of large firms in implementing SOIs that separate economic growth from adverse ecological and social impacts (Xue 2012).

From the SOI mapping exercise, our findings show that large firms demonstrate higher rates of advanced SOI adoption relative to small and medium-sized firms. Our analysis shows that large parent organisations documented more SOIs that correlated most commonly with the systems building approach—the most mature organisational phase of Adams et al.'s framework. Notably, many companies categorised as having a systems building approach were developing SOIs with external partners, highlighting the approach's external engagement criteria. For instance, Nestlé has partnered with Airbus to build the Starling Monitoring System that uses satellite technology to visualise deforestation, while Unilever's development of a geo-spatial tool that integrates blockchain and AI for improved resource traceability underscores a proactive approach to inter-organisational collaboration to enhance transparency in palm oil sourcing. This observation challenges the assumption that larger consumption directly correlates with higher negative impacts. In fact, the substantial engagement of these large entities in SOIs could mean that their impact per tonne of palm oil is less detrimental compared to smaller organisations. Souto (2021) provides rationale for this observation, suggesting that as a result of the relatively large levels of economic presence of large firms, there are greater external pressures on improved sustainability practices and so more of a need to be seen taking action to innovate. In addition to revealing a dominance of large firms in terms of palm oil consumption and market influence, the dataset also revealed notable cases of medium-sized firms demonstrating disproportionately high palm oil consumption. For example, Upfield, a medium-sized firm by turnover, reported higher consumption than some large firms. This outlier behaviour suggests that size alone may not predict SOI engagement or impact. However, the relatively limited number of medium firms at this scale precluded in-depth analysis.

In light of these findings, the results from our assessment of SOIs within parent organisations reveal a notable trend: larger organisations have implemented more advanced SOIs when compared to small and medium-sized firms. Using the Adams et al. (2016) framework in this assessment has provided a useful tool to map SOI adoption and derive our findings. However, we found there to be a distinct focus on innovations within corporate structures, with little consideration being given to the external determinants of adoption, potentially leading to overemphasising corporate agency in driving sustainability. Consequently, the use of the Adams et al. framework may downplay the crucial

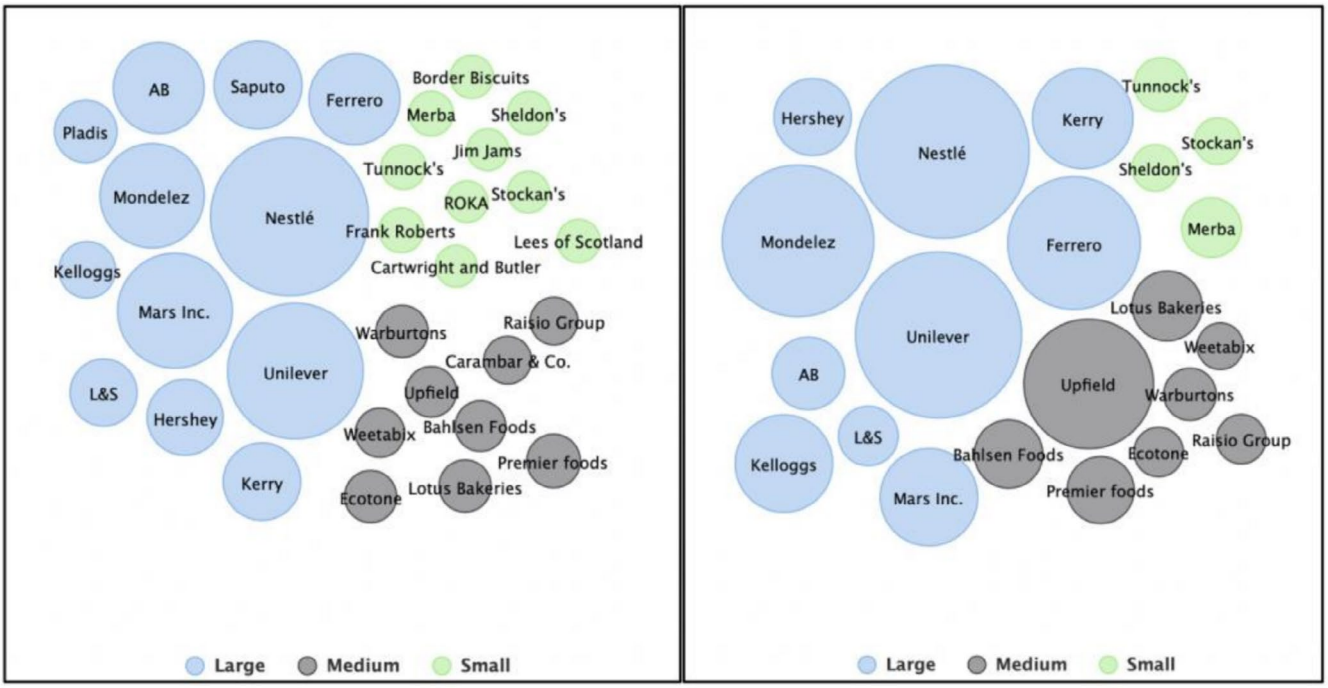

FIGURE 6 | Company comparison by turnover in 2019 (left) and tonnes of palm oil used in 2019 (right). (The figure illustrates the size differential between these identified parent organisations, showing relative size, measured by turnover in 2019 (left), and relative palm oil consumption, measured in tonnes used in 2019 (right). Both bubble charts show the parent organisations sorted according to their small, medium, and large categories, with the left-hand chart providing greater insight into the distribution of turnover within each category, while the right-hand chart shows the correlations between turnover and palm oil use.)

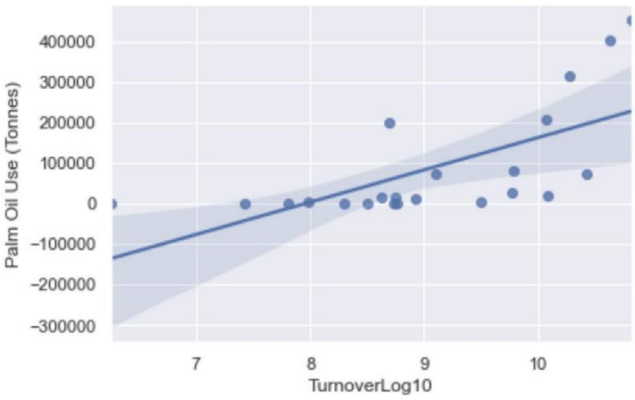

FIGURE 7 | Scatterplot showing correlation between palm oil use (tonnes) and turnover. (The figure illustrates the correlation between palm oil use and company turnover. The correlation coefficient between palm oil use (tonnes) and log of turnover is 0.651, while the *p*-value equals 0.001. This indicates a significant positive correlation. The regression line and confidence intervals show the two variables move together.)

roles that non-firm actors including governments, consumers, and technological processes can play in shaping sustainable practices. While corporate initiatives are vital, the sustainability challenges we face today are complex and interdependent, requiring a collaborative approach that extends beyond individual corporate boundaries. For instance, regulatory bodies and legislative frameworks can set the groundwork for sustainable practices by defining legal standards and compliance mechanisms that all corporations must follow, thereby levelling the playing field and ensuring minimum standards are met across the board. Regulatory pressure is renowned for being the strongest determinant of SOI development and adoption (Diaz-Garcia et al. 2015) as found in our supplementary interviews:

> *On one side there are responsible companies who try to do the right thing by sourcing sustainable palm oil and get the benefits from it, but on the other side you have players in the market who don't care – they have different values. The playing field is not level, and you know we're in business to make a living, so the policy is important to set a framework, to riddle out unsustainable behaviour, and you need legislation to do this.* (I#1, Technical Director, 14 July 2021)

Similarly, technological availability plays an important role in a firm's capacity to implement SOIs (Horbach 2016). Segarra-Oña et al. (2011) observe that the acquisition of technology is a core influencer of SOI activities, and engagement requires the availability of the technologies before certain SOIs can be adopted (Kemp and Foxon 2007). In interviews, this also appeared true from a palm oil perspective:

> *Developing technology is making things more transparent. We will see more tools that will really help us to monitor potential deforestation, and the plantations to help us see what is going on in different areas. It will limit the risk of palm oil. This is the key thing.* (I#3, Technical Director, 12 July 2021).

Next, consumer salience plays a pivotal role in incentivising SOIs by demanding and being willing to pay for goods produced ethically and sustainably, which can shift market dynamics towards greener alternatives. In developed nations, pressure is being increasingly applied to the corporation to provide more ecologically and socially sustainable products; although, as previously discussed, this behaviour typically prioritises ecological issues (Kumar et al. 2013). During the interviews, it was apparent that this social pressure was a well-acknowledged phenomenon by corporate entities, evidenced by this explanation of the consumer/manufacturer relationship:

> *Consumers decide, ultimately, where to spend their money, and they're rightly able to do so, but we stand for palm oil sustainability, but also the consumers have now wanted to start knowing if the palm oil is sustainable, so, like I said, the communication between brand and consumer needs to be sharper.* (I#2, Technical Director, 6 July 2021).

In addition to the above deficiency, further assessment revealed that the Adams et al. framework is also not well enough developed to capture specific nuances of individual SOIs. We found this to be the case in two ways. First, the results found that compliance with an RSPO standard was the most commonly adopted SOI. This adoption represented both an engagement with ecological and social sustainability as a direct result of the terms of the RSPO standards, yet, when evaluating this SOI through the Adams et al. framework there was no mechanism to identify or represent specific ecological or social outcomes. This was particularly difficult where SOIs were dual-purpose, or the outcomes were ambiguous. Second, this research found the engagement with RSPO certified palm oil was treated homogeneously by the Adams et al. framework despite representing varying levels of commitment to sustainable outcomes. The RSPO certification system includes three categories: Identity preserved (IP), Segregated (SG) and Mass Balance (MB). IP offer the highest level of traceability, ensuring that certified palm oil originates from a single, identifiable source. SG allows certified plan oil from different certified sources to be mixed but kept separate from conventional palm oil. MB permits mixing of certified and non-certified palm oil. The Adams et al. (2016) framework, by treating RSPO engagement homogenously, may fail to reflect these meaningful distinctions in traceability, transparency and sustainability commitment.

Both of these examples demonstrate a significant challenge faced by the framework in capturing the nuanced variations in corporate engagement with SOIs. This high-level evaluation can lead to misleading representation of an organisation's true sustainability efforts, as companies fulfilling only the minimum RSPO requirements are categorised alongside those engaging in more stringent practices. This lack of granularity in the SOI framework may inadvertently encourage a 'check-box' approach to sustainability, where companies aim for the least demanding certification that will still be recognised under each of the framework's maturity levels. Such a scenario undermines the potential of the SOI framework to drive genuine and comprehensive sustainability efforts across industries.

Building on these findings, we formalise two extensions to Adams et al. (2016). First, we recommend that the Adams et al. Framework includes an external-influence module that brings regulatory, technological and consumer forces explicitly into the framework. This expansion could involve developing mechanisms within the framework that assess not only the internal innovations a company implements but also how it responds to external pressures and collaborates with other stakeholders in the sustainability ecosystem. The presence of this category would encourage companies to consider external sustainability initiatives and integrate broader societal and environmental considerations into their strategic planning and operational processes. Implementing these changes would require the framework to incorporate criteria that evaluate corporate responsiveness to regulatory changes, recognise the dynamic evolution of technology and engagement strategies with consumers advocating for sustainability. By doing so, the framework would promote a more holistic view of sustainability that acknowledges the interconnected nature of today's global challenges and the collective action required to address them.

Second, we recommended that the Adams SOI framework incorporate a tiered engagement schema that distinguishes levels of commitment and verifiability within each SOI category. This would involve defining explicit sub-categories or tiers that reflect varying levels of sustainability engagement within each of the high-level categories—Organisational Optimisation, Organisational Transformation and Systems Building. Such a modification would not only increase the accuracy of sustainability assessments but also encourage companies to pursue higher standards of certification. Implementing this would require collaboration with sustainability experts and stakeholders to define the criteria for each category, ensuring they align with the latest best practices and sustainability metrics. Ultimately, refining the SOI framework to capture these nuances can drive more meaningful and targeted engagements with sustainability standards and outcomes, pushing industries towards more substantial ecological and social improvements.

Beyond the practical inadequacies already identified, a deeper examination of the SOI framework's theoretical underpinnings reveals another fundamental challenge. As documented extensively by Adams et al. (2016) the foundations of the SOI framework are deeply embedded in sustainable development literature; in fact, the temporal parameters were specifically chosen to review literature during 'an era when business began seriously to engage in the sustainable development debate' (Adams et al. 2016, 181). However, many have highlighted the inherent contradiction of sustainable development. On one hand, it calls for the pursuit of harmony between the social, ecological and economic systems, while on the other, it still emphasises the need for continual resource consumption and economic growth (Pongiglione 2015; Hajer et al. 2015; Gupta and Vegelin 2016; Hickel 2019). This is central to ecological economic discourse, which holds the position that the actions required for sustainable development are not radical enough, proposing that society moves away from the current neoclassical model, replacing it with one that respects planetary boundaries and seeks to keep human development within a sustainable operating space (Hajer et al. 2015).

Studies such as that by Dietz and O'Neill (2013) have built on this idea, finding that even our most ambitious projections for sustainable development are not enough, and that in order to truly address modern ecological and social problems, we must set a pathway for a steady-state economy and even degrowth. Degrowth stresses the limitations placed on growth by the finite level of resources available and emphasises the intrinsic impossibility of infinite growth (D'Alisa and Kallis 2020). Degrowth can be defined as 'an equitable downscaling of economic production and consumption that enhances human well-being and ecological conditions' (Schneider et al. 2010, 511). The objective is not to reduce gross domestic product (GDP) but rather the material throughput and energy demand of world economies (Hickel 2019), although it is possible that GDP would decrease as a result. Evidence suggests that countries in the Global North are able to successfully maintain their developmental progress while implementing a degrowth structure (Jackson 2009; Kallis 2018), whereby economies are restructured to evenly distribute income, invest in social services, and improve wages (Hickel 2019).

Through the use of the SOI framework developed by Adams et al. (2016) and in light of this growing body of ecological economics literature, the SOI framework may not actually demand a standard of innovation that would result in what is understood by ecological economists to be sustainable development. If a systems building approach, the most radical standard of the SOI framework, does not require corporations to reduce their resource consumption to be considered for the classification, questions must be asked as to whether it is radical enough to effectively deal with and be used as a goal to ensure sustainable development is reached. Thus, while the SOI framework provides a valuable structure for analysing and implementing sustainability strategies, it might benefit from integrating principles that explicitly require reductions in resource consumption to align more closely with ecological economic theories advocating for sustainable and equitable growth.

4.1 | Policy Recommendations

Building on the insights derived from our comprehensive examination of SOIs among UK food manufacturers, we propose two targeted policy recommendations aimed at enhancing the sustainability practices within the palm oil sector. First, the implementation of enhanced transparency and traceability systems for all palm oil suppliers and manufacturers within the UK supply chain. This policy should require companies to use advanced technologies such as blockchain and AI-driven tools to track and report on every stage of the palm oil supply chain—from plantation to product. Our findings indicate a significant reliance on major corporations like Unilever and Nestlé, which have already begun implementing such systems. However, there is a need for industry-wide adoption to ensure that all stakeholders, including smaller and medium-sized enterprises, are part of a transparent supply chain (Cerullo et al. 2016). This approach will address critical issues highlighted in this research, such as deforestation and adherence to sustainable practices, by providing customers and regulators with verifiable and real-time data. This increased transparency and accountability across the supply chain would likely lead to higher compliance with sustainable practices, reduce illegal or unethical palm oil production, and move consumer trust in palm oil products.

Second, we propose developing a government-backed incentive program that supports and motivates all palm oil-using companies, regardless of size, to adopt and implement comprehensive SOIs. The incentives could include tax reductions, subsidies for sustainable practice implementation, or financial support for acquiring SOI technologies (Altenburg and Pegels 2016). Our research has indicated that while larger organisations are capable of implementing sophisticated SOIs, medium and smaller-sized enterprises may lack the resources to do so effectively. By providing financial and technical support, these companies can overcome barriers to implementing SOIs, which are crucial for achieving broader sustainability goals within the industry. This policy could democratise the ability to pursue sustainable innovations, leading to a more uniformly sustainable industry. It would not only help level the playing field for smaller players but also enhance the overall ecological and social impacts of the industry's shift towards sustainable practices.

5 | Conclusions

In this paper, we explored how SOIs are adopted within the UK food-manufacturing sector and with what implications for palm-oil sustainability. We make six contributions: (i) a novel mapping method and dataset; (ii) an updated view of UK palm-oil usage and sustainability practices; (iii) a critical empirical assessment of Adams et al.'s (2016) framework; (iv) an external-influences module that incorporates regulatory pressure, technology availability and consumer salience as drivers of SOI maturity; (v) a recommendation for a tiered engagement schema that differentiates levels of engagement and verifiability within each SOI category; and (vi) a contribution to innovation policy through recommendations to stimulate the adoption of SOIs in UK food manufacturers.

The integration of SOIs within the UK food manufacturing sector, specifically examining how these innovations influence palm oil sustainability. We make four important contributions to the literature. First, a novel methodology for identifying and measuring SOIs being used by current players in the food manufacturing sector, enabled by the Adams SOI framework. Second, we have provided an updated understanding of the current landscape of palm oil usage and sustainability practices among leading food manufacturers across the UK. Third, a critical evaluation of the Adams et al. (2016) SOI framework's effectiveness in addressing the unique sustainability challenges within the palm oil sector. Fourth, we have provided a contribution to innovation policy through recommendations to stimulate adoption of SOIs in UK food manufacturers.

Our findings underscore that a relatively small number of parent organisations control a significant portion of the palm oil used in UK-manufactured food products. Despite this concentration, larger organisations demonstrate a robust engagement with SOIs, suggesting that their scale provides both the resources and the framework necessary to implement substantial sustainability initiatives. This challenges the conventional assumption that larger consumption volumes correlate with greater negative

impacts, revealing instead that larger firms often lead in adopting impactful sustainability measures.

However, our evaluation of the Adams SOI framework, as applied in this context, revealed critical insights into its applicability and limitations. While the framework is able to provide a high-level categorisation of SOI types and provides a structured approach to advancing corporate sustainability practices, it falls short in many key areas. First, the framework's scope and depth. The research underscored the need for the SOI framework to adequately accommodate the role and impact of extra-firm actors such as governments through regulation, consumers through product preference or technological developments that expand SOI activities. Second, the current framework's homogenous treatment of RSPO certifications oversimplified the complex landscape of sustainability efforts and may not adequately differentiate between the degrees of commitment to sustainable practices exhibited by organisations. Third, the framework does not fully address the ecological economic perspective that calls for a significant reduction in resource consumption. The prevailing model supports ongoing economic growth and resource use, which may contradict the deeper ecological objectives necessary for genuine sustainability. We advocate for integrating principles that demand reductions in resource use into the framework to better align with sustainable development goals that respect planetary boundaries.

While Adams SOI framework provides a valuable foundation for analysing and fostering sustainability-oriented innovations, we highlight the urgent need for its evolution as a theorised, analytical framework to address the nuanced and dynamic challenges of sustainable development more effectively in the palm oil industry. By expanding the framework's capacity to differentiate between levels of sustainability and incorporating a stricter demand for reduced resource consumption, it can become a more potent tool in the global effort to achieve true sustainability in industrial practices.

We provide a cross-sectional analysis of SOI adoption in the UK palm oil supply chain. However, assessing the effectiveness of SOIs over time remains a vital next step. Future research should incorporate longitudinal studies to monitor whether SOIs deliver measurable social and ecological outcomes. Such research would help validate the long-term transformative potential of SOIs beyond initial adoption and inform both theory development and policy interventions.

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Appendix A

See Table A1

TABLE A1 | Included brands and parent organisation profiles.

Company	Turnover	Size classification	Palm oil use in 2019 (tonnes)	Brands meeting inclusion criteria
Nestlé	£66,243,046,496	Large	455071.0	Aero After Eight Blue Riband Breakaway KitKat Lion Milky bar Munchies Quality Street Rolo Rowntree Smarties Toffee Crisp Yorkie
Unilever	£43,621,321,881	Large	404,273	Graze
Mars Inc.	£26,659,943,000	Large	75257.0	Bounty Celebrations Dove Galaxy M&Ms. Maltesers Mars Milky way Revels Snickers Topic Twix
Mondelez International	£19,152,647,159	Large	316576.0	Alpen Gold Belvita Cadbury Cadbury Dairy Milk Cote d'Or Milka Oreo Ritz Toblerone Tuc
Allied Bakeries (AB)	£12,300,000,000	Large	20916.0	Allinson Burgen Kingsmill Sunblest
Ferrero International	£12,000,000,000	Large	209000.0	Fox's Biscuits Kinder Chocolate Nutella Thorntons Continental
Saputo Inc.	£10,767,734,816	Large	N/A	Cathedral City Clover Country Life Utterly Butterly Vitalife Willow
Kerry Foods	£6,173,601,986	Large	82150.0	Dairy Gold Low-Low

(Continues)

TABLE A1 | (Continued)

Company	Turnover	Size classification	Palm oil use in 2019 (tonnes)	Brands meeting inclusion criteria
The Hershey Company	£5,871,392,850	Large	28387.12	Brookside Chocolate Hershey's Reese's
Lindt and Sprungli (L&S)	£3,143,640,000	Large	6216.0	Lindt
Pladis	£2,100,000,000	Large	N/A	Godiva McVitie's Ulker
Kellogg's	£1,268,148,640	Large	74665.0	Nutri-Grain Rice Krispies
Premier Foods	£847,100,000	Medium	13374.0	Homepride Hovis
Warburtons	£574,400,000	Medium	1174.62	Independent
Lotus Bakeries	£568,647,790	Medium	17298.0	Biscoff Trek
Ecotone	£541,826,356	Medium	565.09	Mrs Crimbles Whole Earth
Upfield	£496,235,209	Medium	200077.0	Bertolli Flora I can't believe it's not butter Pro Activ Violife
Bahlsen Foods	£430,305,890	Medium	14327.0	Bahlsen Leibniz Pick Up!
Weetabix	£317,325,375	Medium	30.15	Weetabix Alpen
Carambar & Co.	£238,685,749	Medium	N/A	Maryland Jammy Dodger Wagon Wheel Viscount
Raisio Group	£200,905,772	Medium	349.0	Benecol
Merba	£95,650,000	Small	5306.0	Independent
Frank Robert's and Son's	£93,400,000	Small	N/A	Robert's Little Treats Bakery
Tunnock's	£64,500,000	Small	1871.0	Independent
Sheldon's	£26,614,285	Small	64.78	Independent
Lees of Scotland	£24,850,000	Small	N/A	Independent
Border Biscuits	£16,500,000	Small	N/A	Independent
Cartwright & Butler	£9,300,000	Small	N/A	Independent
Jim Jams	£2,463,147	Small	N/A	Independent
ROKA	£2,157,915	Small	N/A	Independent
Stockan's	£1,769,908	Small	59.0	Independent

Appendix B

See Table B1

TABLE B1 | Parent organisation SOI categorisation.

Company	Sustainability-oriented innovation (SOI) classification	Sustainability-oriented innovation (SOI)
Nestlé	Organisational	Partnership with airbus and earthworm to implement starling monitoring system
		Established a radar monitoring system for detecting deforestation (RADD)
		Directory of services for vulnerable children
	Process	Earthworm Foundation's rurality initiative for sustainable livelihoods
		Alternative livelihoods programme for farmers
		Action plan for labour rights
	Product	100% RSPO certified palm oil
Unilever	Organisational	Using satellite imagery, geolocation data, blockchain, and AI to map deforestation
		Working with orbital Insight and Google Cloud to map supply chains
		Founding member of the RSPO
	Process	Regenerative Agriculture Principles to help smallholders
		Through the consumer goods forum they aim to eradicate forced labour
	Product	99.6% RSPO certified palm oil
		NDPE policy
Mars Inc.	Organisational	N/A
	Process	Working with suppliers to streamline supply chain
		Working with partners such as Verité to help reduce forced labour
	Product	Sourcing 100% RSPO certified palm oil
		Updated human rights policy to improve supply chain conditions
Mondelez International	Organisational	Co-chair of the Consumer Goods Forum's (CGF) Forest Positive coalition task force
		Supported governing bodies to develop a national action plan for palm oil
		Supporting the development of the Coalition for Sustainable Livelihoods
	Process	Satellite monitoring covering all palm oil concessions supplying mills attributed to the company
	Product	Source 100% segregated RSPO palm oil
		Palm oil action plan requires traceable, forest-monitored palm oil from mills across our supply chain
		Mondelez cross-checks all monitoring processes and systems
		NDPE Policy
Allied Bakeries	Organisational	N/A
	Process	N/A
	Product	All palm oil and derivatives are certified as segregated by the RSPO

(Continues)

TABLE B1 | (Continued)

Company	Sustainability-oriented innovation (SOI) classification	Sustainability-oriented innovation (SOI)
Ferrero International	Organisational	N/A
	Process	Launched the Ferrero Farming Values Palm Oil Programme and Palm Oil Charter in 2013 to focus on social and ecological issues associated with palm oil
		Work closely with the European Palm Oil Alliance (EPOA) to educate stakeholders
		Contribute to national initiative through information sharing and collaboration
	Product	All palm oil and derivatives are certified as segregated by the RSPO
Saputo Inc.	Organisational	N/A
	Process	N/A
	Product	Member of the RSPO
Kerry Foods	Organisational	N/A
	Process	ILHAM program aims to support and improve production practices for smallholders
	Product	Source RSPO physically certified palm and use RSPO Next Credits
The Hershey Company	Organisational	Partnered with Verité to develop a heat map risk assessment tool
		Work with Earthworm to map their supply chain and now focus on Traceability, supplier engagement, transformation, Monitoring, and Verification.
	Process	All acquisitions are required to abide by company policy within 1 year
	Product	100% RSPO mass balanced certified
Lindt and Sprungli	Organisational	N/A
	Process	N/A
	Product	Source 100% segregated RSPO certified palm oil and derivatives
Pladis	Organisational	N/A
	Process	N/A
	Product	Some brands are achieving RSPO certification

(Continues)

Company	Sustainability-oriented innovation (SOI) classification	Sustainability-oriented innovation (SOI)
Kellogg's	Organisational	N/A
	Process	N/A
	Product	Source 100% RSPO certified palm oil
Premier Foods	Organisational	N/A
	Process	N/A
	Product	Achieve 96% segregated RSPO certified palm oil, using mass balanced certification where required
Warburtons	Organisational	N/A
	Process	N/A
	Product	Source 100% segregated RSPO certified palm oil

(Continues)

TABLE B1 | (Continued)

Company	Sustainability-oriented innovation (SOI) classification	Sustainability-oriented innovation (SOI)
Lotus Bakeries	Organisational	N/A
	Process	N/A
	Product	NDPE Policy
		Source certified RSPO palm oil
		Compliance with labour laws
Ecotone	Organisational	N/A
	Process	N/A
	Product	Source 100% RSPO certified palm oil
Upfield	Organisational	Partnership with Airbus and Earthworm to implement Starling monitoring system
	Process	N/A
	Product	Source 100% segregated RSPO-certified palm oil and derivatives
Bahlsen Food Company	Organisational	N/A
	Process	Regularly visit cultivation areas in Indonesia and Malaysia to improve processes
	Product	Source 100% segregated RSPO palm oil and derivatives
Weetabix	Organisational	N/A
	Process	N/A
	Product	Source RSPO certified palm oil
William Jackson Foods	Organisational	N/A
	Process	N/A
	Product	Source 100% RSPO certified palm oil
Carambar and Co.	Organisational	N/A
	Process	N/A
	Product	Follow a no deforestation policy
Burtons Foods	Organisational	N/A
	Process	N/A
	Product	The bulk of palm oil is purchased from sustainable RSPO segregated sources
Raisio Group	Organisational	N/A
	Process	N/A
	Product	Source RSPO certified palm oil
Merba	Organisational	N/A
	Process	N/A
	Product	Source 100% RSPO certified palm oil
Frank Roberts and Son's	Organisational	N/A
	Process	N/A
	Product	Source RSPO certified segregated and mass balanced palm oil
		Reducing palm oil consumption where possible

(Continues)

TABLE B1 | (Continued)

Company	Sustainability-oriented innovation (SOI) classification	Sustainability-oriented innovation (SOI)
Tunnock's	Organisational	N/A
	Process	N/A
	Product	Source 87% RSPO certified palm oil
Sheldon's	Organisational	N/A
	Process	N/A
	Product	Source 100% RSPO certified palm oil, currently both segregated and mass balanced
Lees of Scotland	Organisational	N/A
	Process	Members of the supplier ethical data exchange, promoting information sharing
	Product	Source 100% RSPO certified palm oil suppliers
Border Biscuits	Organisational	N/A
	Process	N/A
	Product	Source 100% RSPO certified palm oil
Cartwright and Butler	Organisational	N/A
	Process	N/A
	Product	Removal of palm oil from selected products, 93% now palm oil free
Jim Jams	Organisational	N/A
	Process	N/A
	Product	Source 100% RSPO certified palm oil
ROKA	Organisational	N/A
	Process	N/A
	Product	Member of the RSPO
Stockan's	Organisational	N/A
	Process	N/A
	Product	Source 100% segregated RSPO certified palm oil
Bonn's and Co.	Organisational	N/A
	Process	N/A
	Product	Source RSPO certified palm oil