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Behavioural and Systemic Factors Influencing the Adoption of Reusable Primary Packaging for Raw Meat in the Food Service Industry

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Abstract

Reducing single-use plastic packaging is an environmental priority and reusable packaging is often promoted as a sustainable solution, yet little is known about the feasibility of reusable packaging systems for meat delivered to food service venues. This study explored stakeholder perspectives prior to planned implementation of a reuse scheme through semi-structured interviews with food service operators and supply chain stakeholders ($n = 23$). The qualitative data were analysed using framework analysis informed by the COM-B model. Four key themes were identified: (1) *Operational readiness in kitchens*, reflecting limited understanding of reuse and resource constraints; (2) *Appropriate design of reusable packaging for effective practice*, relating to compatibility with workflows and food safety, (3) *Power dynamics and fragmentation across the supply chain*, highlighting coordination challenges and unclear responsibilities, and (4) *Making a business case for reuse*, with cost neutrality as a minimum condition. Overall, barriers were primarily operational and systemic rather than technical. Findings highlight the need for coordinated infrastructure, regulatory clarity and financially viable reuse models.

Keywords: reuse; packaging; business-to-business; foodservice; COM-B model; Theoretical Domains Framework; sustainable packaging; reusable packaging

1. Introduction

Packaging accounts for 46% of global plastics manufacture [1]. The management of waste plastic is a global concern: it has been estimated that 9 billion tonnes of plastic have been produced, with only 10% having been recycled, 14% incinerated, and the balance still present in dumps, landfill sites, or the natural environment [2].

Reducing the amount of plastic packaging that is produced is therefore a critical environmental goal [3,4] and is preferable in most cases to recovery and recycling [5]. Reusable packaging systems (RPSs) have been proposed as a more sustainable alternative to single-use packaging, with growing policy and industry efforts across Europe to expand their scope through economic and legislative measures [4,6]. A wide range of RPSs have been trialled and implemented across a diverse range of products and settings [3], including



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both reusable primary packaging (i.e., packaging that is in direct contact with the product) and secondary packaging (i.e., packaging that bundles, protects, and displays multiple primary packages together for retail or transit). However, one application that has not yet been explored is reusable primary packaging for meat in the food service sector, despite this sector accounting for approximately 26% of all commercial and industrial plastic packaging placed on the market [7]. Notably, food service supply chains already rely on forms of reusable secondary packaging, such as pallets, canisters, kegs, and crates, suggesting that reuse is not inherently incompatible with commercial operations.

Implementing RPSs presents well-documented challenges, such as guaranteeing returns, ensuring hygiene and establishing efficient logistical systems [8–15]. These challenges may be particularly pronounced in food service contexts, where commercial kitchens operate under time pressures and tight margins and with strict regulatory oversight. Consequently, the feasibility of reusable primary packaging for raw meat may depend not only on technical performance (i.e., the packaging's capacity to maintain hygiene, durability and sealing integrity) [16], but also on how such systems align with existing organisational routines and regulatory frameworks.

RPSs for raw meat in food service settings have not previously been studied, despite their potential benefits. Modelling research indicates that reusable secondary packaging systems can compare favourably with disposable alternatives environmentally and reduce product losses due to damage [17]. These contexts do not capture the specific technical and institutional challenges associated with reusable primary packaging in direct contact with raw meat (e.g., shelf life, product quality, washing, hygiene and logistics), which has been identified and discussed in research on reusable packaging for foodservice customers (e.g., [18–24]).

However, based on cursory literature searches it is clear that there has been little research on reusable business-to-business primary packaging for use in the commercial foodservice sector. This gap is particularly significant in the United Kingdom (UK), where commercial kitchens operate under strict food safety regulations set by the Food Standards Agency (FSA), enforced by local environmental health teams [25]. Much compliance activity undertaken by food service businesses in the UK involves anticipating and managing risks in a systematic way, determined through the Hazard Analysis and Critical Control Points (HACCP) system [26]. While single-use packaging can help businesses to meet their legal obligations around food safety within this system, there is currently no guidance on how reusable packaging can be incorporated into these established procedures.

In practice, this may create potential operational and regulatory frictions. For example, Bingham and Lavau [27] described various operational problems recorded as part of a visit by an environmental health officer to a restaurant kitchen which could complicate the adoption of an RPS, such as problematic labelling and storage of meat. This suggests that even minor procedural changes can have compliance implications. More broadly, the adoption of sustainability and circularity measures in commercial kitchens is likely to require adjustments to workflows, responsibilities and staff practices (e.g., [28,29]).

In this context, the BUDDIE-PACK (2025) project aims to support the large-scale commercial introduction of reusable packaging across a range of use cases, including a primary RPS for meat in food service settings. In the proposed system (outlined in Figure 1), raw meat products (e.g., beef steaks) are vacuum sealed to a reusable tray with disposable film ('skin packs'); delivered to food service customers (e.g., cafes and restaurants), where they are unpacked, washed and stored on-site before being returned for industrial washing, refilling and redistribution.

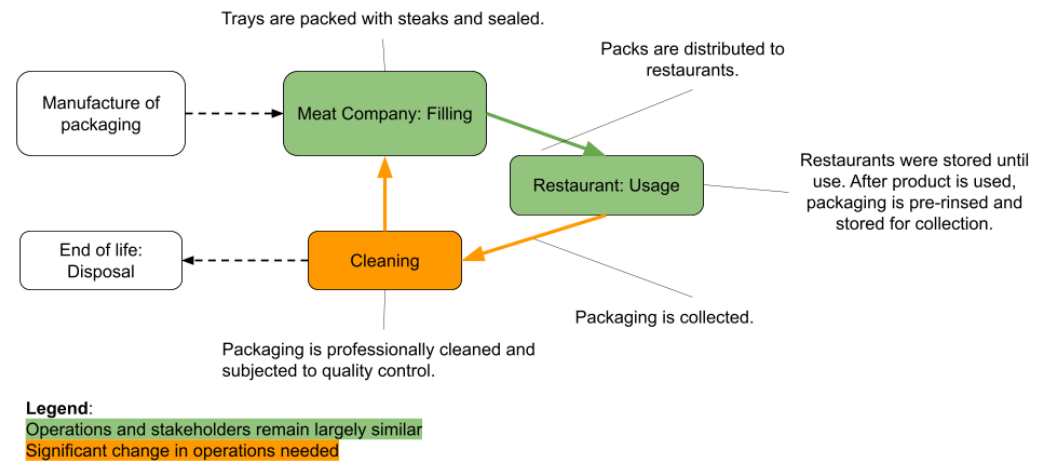


Figure 1. Diagram of the proposed primary reusable packaging system for meat (adapted from Huybrechts & Littner [30]).

Figure 2 illustrates the supply chain for the proposed primary reusable packaging system for meat and shows that the implementation of reusable packaging systems in food service settings involves multiple actors that engage in interdependent practices within strict regulatory constraints. In this context, behaviour is shaped not only by individual capabilities, but also by organisational and environmental conditions. A framework is therefore required that can account for these interacting influences on behaviour in applied settings.

The Capability–Opportunity–Motivation–Behaviour (COM-B) model [31] provides a structured way to analyse how and why sustainability innovations such as reusable packaging for meat may be adopted or resisted in practice. Behaviour is conceptualised as arising from interacting conditions of capability, opportunity and motivation. Capability consists of both physical (e.g., operational skills) and psychological capability (e.g., knowledge), while opportunity includes physical factors (e.g., infrastructure and resources) and social influences (e.g., norms and expectations). Motivation refers to both automatic (e.g., emotional responses) and reflective (e.g., beliefs about costs and benefits) motivating factors that drive behaviour.

The COM-B model has been widely used to examine influences on behaviour across applied health (e.g., [32,33]) and sustainability domains [14]. Its extension through the Theoretical Domains Framework (TDF; [34]) provides more fine-grained categories for capturing contextual and organisational influences. Together, these frameworks offer a theoretically grounded approach for examining the behavioural and contextual factors shaping the feasibility of adopting RPSs in regulated food service settings.

The Present Research

The present study was conducted ahead of a large-scale trial of reusable packaging for raw meat in the food service sector and aimed to provide insight into the behavioural and systemic factors influencing its potential adoption. Semi-structured interviews were conducted with stakeholders across the value chain and analysed using a framework analysis that was informed by the COM-B and TDF. Raw meat represents a particularly challenging test case, given the scale of the food service sector, the food safety risks associated with contamination, and more obvious applications for RPSs, at least from the perspective of consumers [35]. The study therefore extends research on reusable packaging systems beyond consumer-facing and secondary packaging contexts by providing a systematic, pre-implementation analysis of behavioural and systemic factors affecting feasibility of adoption in a regulated, high-risk business-to-business food service environment.

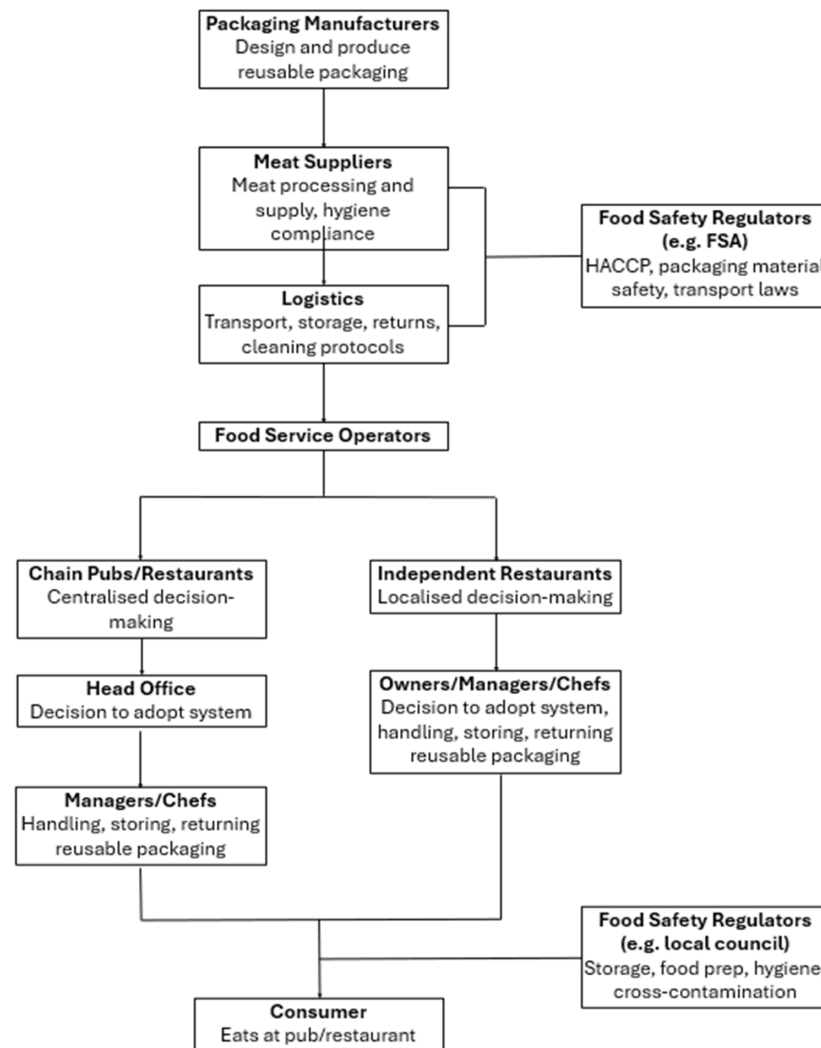


Figure 2. Illustration of the supply chain for the proposed primary reusable packaging system for meat.

2. Materials and Methods

2.1. Design

Semi-structured interviews were conducted with participants from five groups of stakeholders involved in different stages of the supply chain for reusable packaging: (1) staff at food service venues (e.g., kitchen staff, managers and owners); (2) meat processors; (3) packaging developers; (4) providers of commercial cleaning for reusable packaging; and (5) food hygiene inspectors. The research design and proposed methods were approved by the research ethics committee at the University of Sheffield on 13 July 2023 (reference: 055810).

2.2. Theoretical Position

The study was informed by a contextual constructionist epistemology, which recognises that people's behaviours and perceptions are shaped by the material, social and professional environments in which they work [36,37]. Since the reuse system for raw meat was not yet operational, the study focused on how participants imagined it working in their context and how this compared with current practices. This positioning guided attention not only to individual accounts but also allowed comparison of the contextual influences across stakeholder groups.

2.3. Recruitment

Participants were recruited using purposive sampling to capture perspectives from key stakeholder groups across the supply chain. Recruitment was conducted through project partners, industry networks, direct outreach by the research team and flyers advertising the study. The sample size was guided by the aim of achieving sufficient breadth across stakeholder groups while capturing in-depth perspectives where possible, recognising that some groups (e.g., food service operators) are likely more heterogeneous and so require greater representation, while others (e.g., those in technical or regulatory roles) are likely to exhibit more convergent perspectives. The final sample also reflected practical considerations, including participants' availability and their willingness to take part.

Food service participants were primarily recruited from South Yorkshire, with additional participants from the East Midlands and the North East of England. Other stakeholder groups were recruited from across the UK and Ireland. Further details of participant characteristics, including geographical location, are provided in Table 1.

Table 1. Characteristics of the sample.

Participant ID	Type of Organisation	Country (Region †)	Role(s) of Participant(s) Within Organisation
Food Service Operators			
P1	Independent pub	UK (East Midlands)	Head Chef
P2	Independent restaurant	UK (East Midlands)	Owner/Head Chef
P3a, P3b	Independent restaurant	UK (South Yorkshire)	Owner, Head Chef
P4a, P4b	Chain pub	UK (South Yorkshire)	General Manager, Head Chef
P5a, P5b	Independent restaurant	UK (South Yorkshire)	Owner, Head Chef
P6	Independent caterer	UK (South Yorkshire)	Owner
P7	Chain pub	UK (South Yorkshire)	Head Chef
P8	Chain pub	UK (South Yorkshire)	General Manager
P9	Chain pub	UK (South Yorkshire)	Head Chef
P10a, P10b	Chain pub	UK (South Yorkshire)	General Manager, Chef
P11	Independent restaurant	UK (North East)	Owner
Environmental Health			
P13	Local Authority	UK	Environmental Health Officer
Washing Provider			
P12	Commercial Washing Company	UK	Development Director/Manager
Meat Processors			
P14	Local catering butcher	UK	Logistics Manager
P17 *	International meat processor and supplier	Ireland	Innovation Manager
P18	International meat processor and packer	UK	Head of Packaging
P19	International catering butcher/meat supplier	UK	Commercial Director
Packaging Developers			
P15 *, P16 *	University	Ireland	Research Fellow, Director of Research

† Region is reported for food service operators only in order to preserve the anonymity of stakeholders from other groups. * Recruited from the project partner organisation.

All participants provided informed consent and were offered a £50 voucher for taking part. We initially approached representatives of chain and independent pubs and restaurants in the Yorkshire and East Midlands regions of the UK, differentiating between chain and independent venues to account for potential differences in the formality of policies and interaction with suppliers. The research team then extended the study and approached four additional groups of stakeholders: meat processors, packaging developers, cleaning and logistics providers, and food hygiene inspectors. Three participants were recruited from organisations who were partners on the BUDDIE-PACK (2025) project.

2.4. Sample

A total of 23 participants from 18 organisations were interviewed. Participating organisations comprised food service operators (n = 11), meat processors (n = 4), packaging developers (n = 1), commercial washing providers (n = 1) and environmental health (n = 1). Table 1 summarises the characteristics of the sample.

2.5. Setting

Interviews took place either in person at participants' workplaces (n = 11) or remotely via video conferencing (n = 7), depending on participant preference. In some cases, two participants from the same organisation were interviewed together. The four instances where this occurred are indicated in the Participant ID column in Table 1.

2.6. Data Collection

Semi-structured interviews were conducted by one or two members of the research team. Interviews lasted between 30 and 60 min (mean = 53.03 min) and were audio-recorded with participants' permission and transcribed verbatim.

2.7. Interview Topic Guides

Interviewers followed a semi-structured topic guide informed by the COM-B model and developed by the research team with input from the wider project team. After an introductory section where participants were asked about their professional roles, responsibilities and current practices with respect to packaging for raw meat, each domain of the COM-B model was explored through tailored sets of questions adapted to each stakeholder group. The topic guides were structured to support cross-group comparison and are provided in Supplementary Materials S1.

For example, to assess psychological capability, food service operators were asked about their confidence in using reusable trays and prior experience with reusable packaging, while packaging developers were asked about their knowledge of designing packaging for repeated use. Physical capability was explored through questions on operational skills such as handling, sealing and cleaning. Social opportunity was examined by asking how relevant others (e.g., staff, customers and other stakeholders in the supply chain) might feel about a reusable packaging system for meat. Physical opportunity was investigated through questions on environmental and logistical constraints, including the availability of infrastructure and equipment, regulatory requirements, and how reusable packaging would integrate into existing workflows. Motivation was explored in both automatic and reflective terms: Participants were asked about their immediate emotional responses to the idea of reusable meat packaging (e.g., how they personally feel about it), as well as perceived costs, potential benefits and challenges, and the conditions under which they would consider adoption.

Participants were also shown three prototype trays designed for packaging raw steaks using a vacuum skin pack: a typical single-use plastic tray, a thicker clear plastic tray designed for reuse and a larger, dark-coloured 3D-printed prototype to demonstrate possible

variations in material colour and size (see Supplementary Materials S2). They were asked to provide their views on each, including what they believed would be the advantages and disadvantages of using these trays in their operational context. The interviewers also used open-ended probes to explore specific issues in greater depth where appropriate.

2.8. Data Analysis

Interview transcripts were analysed by SLP and JP using a hybrid framework analysis approach [38,39], combining deductive coding based on the Theoretical Domains Framework (TDF; [34]) with inductive coding to capture novel and context-specific insights [40]. This analysis was conducted using Nvivo 15 software. Full details of the data analysis process are presented in Table 2.

Table 2. Analysis process.

Step 1: Familiarisation	Two researchers independently read one transcript from each of the five stakeholder groups to become familiar with the data, making preliminary notes on both deductive (i.e., observations related to the COM-B and/or TDF) and inductive observations.
Step 2: Developing the coding framework	The same subset of transcripts was independently coded by both researchers using the COM-B and TDF domains as deductive categories. Within each domain, inductive subcodes were generated to capture the specific beliefs, concerns and contextual factors described by participants. Inductive codes were also created outside of the COM-B/TDF structure to capture factors that were deemed not to be adequately represented by existing domains. Inter-coder reliability on the initial subset was assessed at the level of each code within each transcript, showing an overall average agreement of 94% (range 60–100%) *. The two researchers compared coding decisions and resolved discrepancies through discussion, refining both the definitions of each domain and the structure of subcodes to agree on a shared coding framework.
Step 3: Indexing (applying the framework)	The remaining transcripts were split between the researchers and coded to the shared framework. To confirm ongoing coding consistency, a further subset of transcripts was double-coded, showing an overall average agreement of 95% (range 76–100%) *.
Step 4: Charting	Summarised data were organised into a framework matrix, with columns representing stakeholder groups and rows representing COM-B components, TDF domains, and inductively derived subcodes. This structure enabled systematic comparison within and across the stakeholder groups.
Step 5: Mapping and interpretation	The matrix was reviewed collaboratively to identify key domains, recurrent beliefs and points of convergence or divergence within and across stakeholder groups. Particular attention was given to cross-cutting themes that spanned multiple domains of the COM-B (e.g., food safety involving knowledge, opportunity and motivation), as well as perspectives that were specific to certain stakeholders. This iterative process linked descriptive summaries to higher-level explanations about the behavioural and contextual factors affecting the adoption of reusable packaging for raw meat.
Step 6: Producing the report	The labels for the final themes and sub-themes were reviewed and refined to ensure that they accurately reflected the data. The researchers collaboratively drafted the findings, selected quotes and refined the narrative to ensure clarity and alignment with the research aims.

* Inter-coder reliability was calculated using the built-in coding comparison query in NVivo, which reports percentage agreement between coders. Percentage agreement was calculated as the proportion of coding decisions on which the two researchers assigned the same code to the same segment of text, relative to the total number of coding decisions.

2.9. Reflexivity

To account for potential effects of the personal beliefs and experiences of the interviewees on the data analysis, the authors followed the TACT framework (Trustworthiness, Auditability, Credibility, Transferability; [41]). The majority of interviews and all data analysis were conducted by SLP and JP, who brought expertise in psychology and human geography, respectively. KD conducted 2 interviews with JP before leaving the project and has similar expertise to JP. We also note that prior relationships with some participants through the project may have influenced openness and rapport, likely in a positive way.

3. Results

The themes that emerged from the interviews were organised into four superordinate categories reflecting barriers and enablers to the adoption of reusable packaging for raw meat in the food service industry: (1) Operational capability in kitchens; (2) Appropriate design of reusable packaging for effective practice; (3) Power dynamics and fragmentation across the supply chain; and (4) Making a business case for reuse. Table 3 summarises the identified themes and sub-themes, as well as the components of the TDF and COM-B that they reflect and areas of agreement and divergence between the different stakeholder groups.

Across themes, barriers and enablers appeared to influence three interrelated behavioural outcomes relevant to implementation of reusable packaging in this context: (1) correct use of reusable packaging (e.g., appropriate handling and cleaning); (2) return of packaging within the system; and, (3) willingness to adopt the reusable packaging system. These outcomes were discussed implicitly within accounts of routine practices, constraints and decision-making. Each theme is described below with illustrative quotes.

Theme 1: Operational capability in food service kitchens

The feasibility of reusable packaging in food service settings was closely tied to the operational capability of kitchens. Meat processors, environmental health officers and food service operators highlighted several factors shaping this capability, including limited understanding of reusable packaging systems, potential challenges with staff compliance and constraints in space, equipment and staffing within food service venues. These issues were frequently discussed in relation to how kitchens would manage the cleaning and handling requirements necessary for reusable packaging to be used safely and efficiently.

Sub-Theme 1.1. Confusing reuse with repurposing

Many participants, particularly those working in pub and restaurant kitchens, described having a limited understanding of reuse or how a RPS would operate. Volunteered examples of “reuse” referred mostly to repurposing single-use containers within the kitchen; for example, washing and reusing ice cream tubs to store sauces or chopped vegetables. Such practices were commonplace and typically framed as environmentally minded: “Reusable packaging is something we use all the time in the restaurant. . . for example, the coffee bags when we’re buying beans. . . we use the same bag to store the ground coffee. . . the container of milk, we will use to store our fresh orange” [P11].

However, these practices differed from the proposed system of returning packaging for controlled, industrial cleaning and redistribution. For example, some kitchen staff suggested that they might use the proposed reusable meat trays for other storage purposes once empty, rather than returning them for industrial cleaning and redistribution: “It would mean that I had useful containers that I can use for stuff, basically.” [P7].

Table 3. Thematic analysis of stakeholder perspectives mapped to TDF and COM-B domains.

Theme	Sub-Theme	TDF Domain(s)	COM-B Domain(s)	Stakeholders Contributing	Summary
1. Operational Capability in Kitchens	1.1 Confusing reuse with repurposing	Knowledge	Capability	FSOs (Independent & Chain); EHO	<ul style="list-style-type: none"> Strong evidence that reuse is misunderstood by FSOs as in-kitchen repurposing. EHO emphasised need for education.
	1.2 Habits and workplace culture	Memory, Attention and Decision processes; Skills; Social Influences; Beliefs about Consequences; Perceived Capability of Self or Others	Capability; Opportunity; Motivation	FSOs (Independent & Chain); EHO; Meat Processors	<ul style="list-style-type: none"> Widespread agreement that habits, time pressure and staff behaviour are key barriers to adoption of reusable meat packaging in food service kitchens. Chain FSOs were more confident in training/compliance to address resistance; EHO and meat processors had little trust that reusable packaging would be used safely/properly by FSOs.
	1.3 Space, equipment and resource constraints	Skills; Environmental Context and Resources	Capability; Opportunity	FSOs (Independent & Chain); EHO	<ul style="list-style-type: none"> Space, staffing and equipment constraints widely recognised. Chain FSOs were generally better resourced, while independent FSOs were more variable; EHO emphasised limitations of smaller businesses.
2. Appropriate Design of Reusable Packaging for Effective Practice	2.1 Handling and workflow compatibility	Beliefs about Consequences	Motivation	FSOs (Independent & Chain); Meat Processors; Washing Provider; Packaging Developers	<ul style="list-style-type: none"> Agreement that reusable packaging must align with existing workflows FSOs prioritised ease/speed; chain FSOs focused on system integration; upstream stakeholders focused more on industrial compatibility.
	2.2 Visual cues for hygiene, food safety and quality	Beliefs about Consequences	Motivation	FSOs (Independent & Chain); EHO; Packaging Developers	<ul style="list-style-type: none"> Visual cues important for safety/usability. EHO prioritised colour-coding to align with existing food safety conventions; some FSOs prioritised transparency for visual inspection of meat.
	2.3 Advantages over current single-use packaging	Beliefs about Consequences	Motivation	FSOs (Independent & Chain); Meat Processors	<ul style="list-style-type: none"> Current packaging seen as problematic by many. FSOs (especially independents) more positive about reusable packaging; meat processors more cautious (quality/safety risks).

Table 3. Cont.

Theme	Sub-Theme	TDF Domain(s)	COM-B Domain(s)	Stakeholders Contributing	Summary
3. Power Dynamics and Fragmentation across the Supply Chain	3.1 Interdependency without collaboration	Environmental Context and Resources; Social Influences; Perceived Capability of Self or Others	Opportunity; Motivation	FSOs (Independent & Chain); Meat Processors; Washing Provider; Packaging Developers	<ul style="list-style-type: none"> Adoption of reusable packaging system depends on multiple interdependent actors. Chain FSOs described top-down dependency; independents retained some flexibility but were still dependent on suppliers; upstream actors prioritised commercial concerns; washing provider called for more collaboration.
	3.2 Unclear responsibility and regulatory uncertainty	Behavioural Regulation; Environmental Context and Resources; Beliefs about Consequences	Capability; Opportunity; Motivation	FSOs (Independent & Chain); EHO; Meat Processors; Washing Provider; Packaging Developers	<ul style="list-style-type: none"> Widespread uncertainty around responsibility and regulation. FSOs feared inconsistent enforcement from EHOs; upstream stakeholders focused on liability and lack of standards.
4. Making a Business Case for Reuse	4.1 Cost neutrality as the baseline for buy-in	Environmental Context and Resources; Beliefs about Consequences; Reinforcement	Opportunity; Motivation	FSOs (Independent & Chain); EHO; Meat Processors; Washing Provider	<ul style="list-style-type: none"> Additional costs for reusable packaging viewed as widely unacceptable. Some FSOs (especially independents) wanted cost savings; meat processors resistant to using penalties due to risk of harming customer relations.
	4.2 Sustainability as Reputational Currency	Beliefs about Consequences; Goals	Motivation	FSOs (Independent & Chain); EHO; Meat Processors; Washing Provider; Packaging Developers	<ul style="list-style-type: none"> Sustainability recognised as a potential, albeit modest reputational benefit. Chain FSOs already embed in strategy; independent FSOs less driven by sustainability; upstream stakeholders linked sustainability goals to strategy/funding.

When discussing the reusable meat trays, some participants likened them to the stainless steel “gastro trays” already used for storage and service in kitchens, further indicating that reuse was primarily understood as an “in-house” practice rather than a process that operated across a supply chain with users returning packaging to be washed and refilled: *“It’s something that can be used again and again, that we can clean.”* [P3a].

Environmental health framed this as a knowledge gap, emphasising the need for clearer guidance or education around how reuse systems operate beyond in-kitchen practices. *“I think there needs to be a lot of education around what it’s meant for and how it can be reused again.”* [P13].

Without such intervention, food service operators’ lack of understanding relating to reuse may have implications for both correct use and return of reusable packaging, increasing the risk that packaging would be repurposed or retained rather than prepared for redistribution within the wider system.

Sub-Theme 1.2. Habits and workplace culture

Resistance to change was widely anticipated among stakeholders, with washing practices expected to be interpreted by kitchen staff as additional work. Workload and ingrained habits were also seen as potential barriers. Participants described how, during busy periods, staff might neglect additional tasks such as cleaning or returning packaging, with one manager comparing it to the difficulties that they already experience with recycling: *“You’ve got to wash it out before the recycling, which on a quiet day you can do, but then when you’re in the height of summer and it’s really busy and you’re doing 300 covers in a day, some of it tends to get forgotten.”* [P6].

Concerns about trays being misplaced, discarded or deliberately misused were also raised. In particular, environmental health and some food service operators questioned whether packaging would be returned, or whether it might simply end up in general waste: *“So I think a lot of these, because it’s plastic, it’ll just get chucked in the bin, it’ll never get reused”.* [P13].

Some meat processors also expressed concern about careless or inappropriate behaviour in kitchens, particularly among less experienced staff: *“You get some kid who’s on minimum wage. . . he might think it’s funny to do something stupid with them. . . some people are just going to do stupid stuff”* [P17].

While some chain food service operators expressed greater confidence in their ability to address staff resistance through training and compliance systems, environmental health and meat processors were generally more sceptical that reusable packaging would be used safely and consistently in practice. These accounts suggest that established routines, time pressures and workplace norms may contribute to risks of improper use and non-return of packaging in food service kitchens, while also shaping perceptions of feasibility, and in turn, willingness to adopt the system among other stakeholder groups.

Sub-Theme 1.3. Space, equipment and resource constraints

Physical space, available equipment and wider resource limitations were also viewed as key determinants of whether reusable packaging could work in commercial kitchens. Small kitchens and limited space to store trays awaiting collection were frequently mentioned, while even in larger kitchens, layout and workflow influenced perceived feasibility: *“My only concern would be if it goes above two boxes, or a larger amount, where to store these boxes.”* [P11].

Cleaning infrastructure was also considered to be a potential barrier. Some kitchens could wash trays through commercial dishwashers, but others lacked suitable machines or questioned whether their dishwashers would achieve temperatures required for disinfection: *“Our pot wash is only set to 86 degrees, not 100. We wouldn’t be able to say it was sterile.”* [P10a].

While larger, better-resourced businesses were generally viewed as more adaptable, environmental health noted that smaller businesses in particular may lack the time, staffing and capital to safely adopt the reusable packaging system for meat. *“They don’t have time, they don’t have manpower, they don’t have space, and they don’t have the equipment to disinfect this properly.”* [P13].

These constraints were often discussed in relation to feasibility, suggesting that limited space, equipment and staffing would restrict opportunities for both correct use and return of reusable packaging, and may also shape willingness to adopt the system in the first place, particularly among smaller or independent businesses.

Theme 2: Appropriate design of reusable packaging for effective practice

The design of reusable packaging shaped how easily it could be integrated into existing workflows and food safety practices. Participants evaluated the prototypes in relation to current practices, highlighting both desirable features and areas of concern, and revealing different needs and priorities of stakeholders across the supply chain.

Sub-theme 2.1: Handling and workflow compatibility

Four food service operators and one meat supplier expressed a preference for the reusable packaging to be larger than the prototypes. Only participants with very small kitchens appreciated the current size of the prototypes. A few participants discussed the issue of nesting in relation to size when unopened. The current prototypes allow nesting, but this would result in the weight of the stack resting on the meat directly which was considered to change the texture of the meat. Participants did however propose alternative approaches: *“If you could create a thing for them to go in with ridges in [. . .] [if we stack them on edge]. The problem is, the top ones are going to be rough, and the bottom ones are going to be tender. [. . .] we currently stack our meats that way in packaging. So we lay them like they’re on the side, like books”.* [P10a].

A washing service provider made similar observations around compatibility between the design of industrial dishwashing machines and the proposed reusable packaging, noting that available racks were typically designed to handle pint cups. Large industrial washing machines have inflexible designs, and the participant reported already having to improvise to be able to include different types of packaging (e.g., lids for coffee cups). Racks of different sizes and scales for different points in the supply chain may need to be designed and provided to accommodate a transition to reusable packaging.

These findings suggest that alignment with existing workflows may support correct use of the packaging, while misalignment may introduce additional steps or workarounds that could negatively impact both use and return practices, as well as reduce perceptions of the practical feasibility of adoption.

Sub-theme 2.2: Visual cues for hygiene, food safety and quality

Participants frequently emphasised the importance of visual cues for supporting safe and efficient handling of reusable packaging. One participant from a chain pub proposed colour coding corresponding to days of the week to indicate collection schedules, although they equally highlighted the burden of managing multiple existing coding systems within kitchens.

Environmental health suggested aligning visual cues with established food safety practices. For example, the Hazard Analysis and Critical Control Points (HACCP) system categorises products by colour to prevent cross-contamination of containers and surfaces like chopping boards: *“You know, most people in the food industry would recognise, if it’s red, it’s had raw product on it at some point in its life cycle.”* [P13].

In contrast, transparency was valued across multiple stakeholder groups, including food service operators, packaging developers and meat processors, particularly in relation to product visibility for safety and quality assurance. For some food service operators,

transparency facilitated rapid inspection of high-value products at the point of delivery: “I want to be able to see the steak on all sides. So I can tell my driver, “This is not good enough quality to serve.” [P7].

These accounts highlight differing priorities across stakeholders, with environmental health emphasising standardised visual cues for hygiene and risk management, and others prioritising visibility for quality assurance within existing workflows. Visual cues therefore appear to be important for supporting correct use, particularly in fast-paced environments, while the need to balance hygiene signalling with product visibility may also shape willingness to adopt.

Sub-theme 2.3: Advantages over current single-use packaging

Participants compared the proposed reusable packaging with current single-use packaging, particularly vacuum-sealed bags which were reported to be commonly used for meat. These were often described as difficult to handle due to leakage and the release of fluids, increasing the risk of contamination: “The packaging is not great. It leaks all the bloody time.” [P10b].

Removing high-value or delicate cuts of meat from vacuum packaging was also described as difficult without causing damage, particularly where knives were required to open it. Reusable trays were therefore viewed by some food service operators as offering practical advantages in terms of ease of handling and reducing the risk of product damage: “If I can get to it without having to damage the meat. Like sometimes when you’re using a vac-seal you might use a knife on it and it’s going to damage the meat. So that’s a positive thing there”. [P7].

These accounts suggest that dissatisfaction with current packaging among food service operators may support willingness to adopt, particularly where reusable options are perceived to address existing operational challenges.

Theme 3: Power dynamics and fragmentation across the supply chain

The broader feasibility of reusable packaging was shaped by dependencies and fragmentation across the supply chain. Participants described how decision-making authority, commercial priorities and coordination challenges shaped the potential for implementation of the reusable packaging system.

Sub-Theme 3.1. Interdependency without collaboration

The participants repeatedly described how decisions on whether to adopt reusable packaging for meat would be dictated by stakeholders at other levels of the supply chain. For example, packaging developers described being dependent on external funding to develop packaging, while meat processors described being limited by what packaging developers or manufacturers were willing and able to develop, as well as by what their customers would find acceptable. Representatives of independent pubs and restaurants noted that the adoption of reusable packaging would depend on what their suppliers decided to offer, and participants from chain pubs and restaurants noted that they were dependent on what the respective parent company decided to do, which, in turn, was understood to be influenced by what other chain foodservice businesses were doing: “The bigger companies. . . if they decided to do it, then we have to just follow suit. There’s not a lot we can do about it.” [P4a].

Upstream actors also strongly emphasised commercial considerations, including competition and intellectual property, which limited collaboration. For example, some meat processors stated that they were unwilling to share knowledge due to competition with other large companies and wanting to have first-mover advantage on innovations in packaging: “I would want to develop IP and lock it away and license it exclusively for a period of time to stop other people having it” [P17].

Expressing frustration with this disconnected system, a washing service operator called for sector-wide forums and shared standards to promote collective change: “You need

some sort of forum body up at a national level where everybody's involved. [. . .] So we all get an opportunity to feed into these products to get some coherent process going on that could be adopted nationally". [P12].

These accounts suggest that adoption depends on coordinated action across interdependent actors, which may influence both willingness to adopt and how return systems are organised and maintained.

Sub-Theme 3.2. Unclear responsibility and regulatory uncertainty

Participants also pointed to ambiguity over responsibility and a lack of regulatory clarity as key sources of hesitation over adopting reusable packaging for meat. Uncertainty about who would be accountable for hygiene, lost trays or a lack of compliance with regulations created widespread caution. However, some larger meat processors selling to larger food service businesses were more positive about the B2B system: *"I think we would consider being, you know, an early adopter of something like this. [. . .] To me focusing on a B2B is a lot more achievable with the meat side of it"* [P18].

Packaging developers and the washing provider also described operating within a regulatory vacuum, where formal standards and mandatory testing do not currently exist for reusable packaging in meat contexts. This lack of clarity raises the possibility of uneven enforcement for other stakeholders too. Food service operators feared that compliance in kitchens would currently depend on the interpretation of individual environmental health officers: *"You could come up with the best thing in the world [but] if an EHO walked in and went, "I'm not happy with that," then it wouldn't matter a jot whether it was the best thing for the environment or not."* [P2].

Overall, uncertainty appeared to contribute to increased perceptions of risk among stakeholders across the supply chain, suggesting potential implications for willingness to adopt the reuse system, as well as for consistency in correct use of the packaging where expectations remain unclear.

Theme 4: Making a business case for reuse

Adoption of reusable packaging was consistently framed as a business decision, requiring clear economic justification. Stakeholders across the supply chain emphasised that reuse must at least be cost-neutral and ideally generate savings relative to single-use packaging. Sustainability was generally viewed as a secondary reputational benefit.

Sub-Theme 4.1. Cost neutrality as the baseline for buy-in

Participants across the supply chain were generally unwilling to pay more or absorb additional labour costs to support reuse. Food service operators in particular typically described operating under tight margins and rigid cost controls: *"You're adding another process into your job and into your working day that needs to be done, and somebody needs to be paid to do that"* [P2].

Despite recognising the need to ensure return of trays for the reuse system to be financially and practically feasible, penalties for non-return of trays were generally viewed unfavourably. One meat processor explicitly stated that they would be unwilling to penalise food service customers due to the risk of harming customer relations: *"We talk about penalties, etc. That's just a no-no. I am not in a position to go to our clients and say, "And if you don't give me my trays back, you owe me X""* [P17].

Several food service operators accepted the idea of deposit systems to promote return of reusable packaging. However, they stressed that such mechanisms would have to be integrated into existing invoicing: *"If it was just put onto that invoice and then at the end of the month. . . it gets deducted from the invoice, then yes. . . That would be fine. But if we had to pay it upfront, it wouldn't work"* [P9].

Beyond maintaining cost neutrality, participants also evaluated reuse systems in terms of their capacity to create savings. For many food service operators, the potential reductions

in waste disposal charges from participating in RPS offered a visible cost saving that may drive the adoption of RPS: *“I’m a numbers person, so if you come to me and say, “This will save you X amount of money per year on X amount of waste collection per year.” . . . that’s how you’d get them on board”* [P4a].

These accounts suggest that cost considerations may play a central role in shaping willingness to adopt the system across the supply chain, while also influencing engagement with fundamental system processes such as return that are necessary for the system to be viable.

Sub-Theme 4.2. Sustainability as reputational currency

Although participants’ main motivation for engaging in a reuse system seemed to be financial, sustainability still had some reputational value. For example, food service operators stated that sustainable practices were useful for generating publicity or increasing customer satisfaction *“it could create a whole bit of buzz. . . it would create a bit of good publicity.”* [P9].

For chain pubs and restaurants, sustainability was more commonly embedded within broader corporate strategies and valued for brand protection rather than direct profit, except where efficiency savings could also be achieved. Further up the supply chain, reuse was similarly framed as an opportunity to demonstrate progress in response to external scrutiny: *“[the meat sector] is always targeted as needing to do more. . . reuse is a route to show progress and reduce that pressure”* [P15].

Drawing on experience from another sector, a commercial washing provider also described how sustainability initiatives could sometimes have indirect business advantages, such as access to funding or favourable finance terms linked to corporate carbon targets: *“Sometimes there are benefits available to you from business loans from the government and other areas that you can tap into”* [P12].

Overall, while sustainability was widely viewed as desirable, it was generally positioned as secondary to financial and operational considerations. As such, it appeared to have a more limited influence on willingness to adopt the reuse system, particularly in the absence of clear economic or practical advantages.

4. Discussion

This study explored stakeholders’ perspectives on implementing a reusable packaging system (RPS) for raw meat in the food service industry. While participants generally supported reuse in principle, this support was highly contingent on how the system would function in practice. Across themes, barriers and enablers appeared to interact in shaping three interrelated outcomes necessary for the reuse system to be viable: correct use of reusable packaging, return of packaging within the RPS, and stakeholders’ willingness to adopt the RPS.

Barriers and enablers mapped across all three domains of the COM-B model [31] and often interacted. For example, limitations in capability (e.g., misunderstanding of reuse, time pressure) combined with constraints in physical opportunity (e.g., space, staffing) appeared to increase the perceived risk of incorrect use and non-return of packaging. These risks, in turn, appeared to shape motivation to adopt the system, particularly through heightened concerns about food safety and liability. Notably, food safety functioned as a cross-cutting lens through which risks were interpreted, potentially amplifying the perceived consequences of improper use, non-return and wider system failure. Likewise, uncertainty around responsibility appeared to reduce both perceived capability (knowing what to do) and motivation (confidence in the system), which further reinforced reluctance to adopt.

Taken together, the findings suggest that barriers to implementation are less about the technical feasibility of reusable packaging itself, and more in how reuse systems align with existing practices, responsibilities and incentives across a fragmented supply chain. In this context, small sources of friction or uncertainty may accumulate across stages of use and return, with potential to disrupt system performance and reduce viability. As an exploratory study, these findings provide important insight into stakeholder perspectives and perceived conditions for feasibility; further research is needed to examine how these mechanisms operate in practice.

4.1. Operational Capability in Food Service Kitchens

Many food service operators lacked a clear mental model of formal reuse systems, often conflating “reuse” with ad hoc repurposing of single-use containers. This reflects a gap in psychological capability that has also been observed among the general public [42]. This is perhaps unsurprising given that RPSs are still in their infancy and may indicate an underlying willingness to move away from single-use packaging, albeit in ways that do not reduce overall material output.

In addition to this limited understanding, participants highlighted time pressures in daily operations as a key barrier to participation in reuse systems in food service venues, echoing research describing high workloads in commercial kitchens [24]. In such environments, additional actions required by reuse (e.g., rinsing, sorting and storing reusable trays) would require changes to existing routines and habits (e.g., from dispose and move on). Evidence suggests that intentional efforts to change have a smaller impact on behaviours performed frequently in relatively stable contexts (i.e., habitual actions, see [43]), suggesting that changing behaviour in food service kitchens may be challenging.

These behavioural challenges were closely linked to practical constraints in kitchens. Participants noted that small or independent kitchens often lacked adequate storage space and staffing to accommodate reuse. The environmental health officer expressed concern that such operators would struggle to comply with existing hygiene standards if reuse systems were introduced.

Taken together, these concerns indicate that operational capability is shaped not only by practical feasibility, but also by the ability of kitchens to maintain consistent food safety practices with existing conditions. Successful implementation will therefore depend on both physical infrastructure and psychological capability, with training and guidance supporting integration into everyday practice but unlikely to be sufficient in the absence of adequate resources and capacity.

4.2. Design of Reusable Packaging as an Enabler

Participants evaluated the design of the proposed packaging primarily in terms of how it would function within their existing practices, discussing features such as transparency, the size and format of the tray in relation to food safety procedures and kitchen workflows. Food service operators, in particular, valued transparency for enabling visual checks of hygiene and product quality on delivery, and some viewed the tray format as preferable to current single-use vacuum packaging. While the prototypes were not colour-coded, the environmental health officer suggested that aligning trays with HACCP colour conventions (e.g., red for raw products; [25]) could support correct handling by providing a clear visual distinction between product types. This suggestion is consistent with evidence that colour-coding and labelling can improve visual search efficiency and reduce cognitive load in operational tasks (e.g., [44]).

Although design elements of the packaging did not emerge as the primary concern overall, different stakeholder groups notably prioritised different design elements according

to their roles within the supply chain. Food service operators emphasised speed and ease of use, while other stakeholders tended to focus more on industrial compatibility and hygiene assurance. This indicates that reusable packaging design is unlikely to be optimally specified through a purely top-down approach, and would benefit from more collaborative refinement, informed by key stakeholders.

4.3. Coordination and Accountability Across the Supply Chain

Power dynamics and governance gaps across the food service supply chain emerged as key constraints on the adoption of RPS. Relationships between different actors were often described as uneven and fragmented, with decision-making authority often concentrated upstream. For example, small food service operators reported limited influence over packaging choices, which were largely determined by suppliers or parent companies. The introduction of a reuse system may therefore require a top-down commitment or coordination from larger actors within the supply chain. At the same time, participants described limited collaboration and sharing of information, particularly among larger commercial actors. Competitive pressures and the protection of proprietary knowledge were seen to restrict transparency, creating barriers to effective problem-solving. These findings align with broader research highlighting tensions between cooperation and competition in corporate sustainability initiatives [45–48].

A central concern was the question of clear accountability. Participants raised uncertainty, not only about who would be responsible for ensuring that trays are adequately cleaned, but also for managing their return, tracking and reuse across the supply chain. Meat processors in particular expressed concerns about legal responsibility for hygiene, while food service operators and the environmental health officer questioned whether the proposed reuse system could comply with existing food hygiene regulations. At the same time, participants highlighted practical uncertainties around whether trays would be reliably returned, or whether they might be lost, discarded or misused in busy kitchen environments. In the absence of clear standards and defined responsibilities, stakeholders are likely to remain cautious, particularly given the potential consequences of contamination, non-compliance or system failure. This lack of regulatory clarity also appeared to reduce confidence in how responsibilities would be managed across the supply chain, further constraining adoption.

4.4. Establishing the Commercial Motivation for Reuse

Economic considerations were central to stakeholder decision-making. Across the supply chain, reuse was considered acceptable only if it remained cost-neutral or generated measurable efficiencies. However, this did mean that the potential for reusable packaging to lower costs by reducing the volume and cost of waste collections was motivating because it could contribute to profits. The emphasis on financial considerations is understandable given recent financial strains on the food service sector [49]. Previous research also indicates that small firms in the restaurant sector tend to perceive environmental initiatives as costly, making them unlikely to act without clear economic benefit [50,51]. Given these motivations, penalties for non-return of trays were generally viewed as unacceptable, both by meat processors and food service operators, echoing research showing that financial penalties are perceived as more commercially risky compared to reward-based approaches [52] and may not be an appropriate way to address concerns about lost or damaged packaging.

Sustainability, while valued, functioned primarily as a secondary or symbolic motivator. Food service operators described the potential for reputational “buzz” of being early adopters of reusable packaging for meat. However, participants did not expect this benefit to translate into increases in sales, which is again consistent with Revell and Black-

burn's [51] findings that restaurant owners rarely expect environmental improvements to be commercially advantageous. This suggests that efforts to promote reuse in this context are likely to be most effective when framed in terms of operational and financial benefits, rather than environmental messaging alone—a conclusion that echoes evidence that emphasising environmental benefits does not necessarily motivate consumers [53].

Considering the future, emerging Extended Producer Responsibility Schemes (EPR) for packaging [6,54] are intended to ensure the 'producer pays' for the recycling of the packaging that they place on the market. Under such schemes, reusable packaging will only be liable for the charge on the first use. It is yet to be determined if this is enough to effect systems change without further investment, e.g., there has been some success in France where a percentage of EPR funds are ring-fenced for the development of reuse systems [55]. Existing charges in the UK, Packaging Recovery Notes (PRNs), and Packaging Export Recovery Notes (PERNs) [56] and the Plastics Packaging Tax [57] have done little to incentivise reuse to date.

4.5. Strengths and Limitations

This is the first study to explore stakeholders' perspectives on the feasibility of reusable packaging for raw meat in the food service industry and it had a number of strengths. For example, the simultaneous exploration of the perspectives of packaging developers, meat processors, environmental health, commercial washing and food service operators permitted a more comprehensive view than focusing on the accounts of one group of stakeholders alone would have allowed. The COM-B model [31] seemed to provide a useful framework for understanding barriers and motivations (as it has done with respect to other approaches for reducing waste, see [58]) and the researchers applied a systematic, framework-based analysis to enhance rigour.

However, several limitations affect the transferability and interpretation of findings. For example, some stakeholder groups were under-represented in the sample, including environmental health ($n = 1$), commercial washing providers ($n = 1$) and packaging developers ($n = 1$ organisation, 2 participants). While stakeholders in these roles may have more convergent perspectives due to shared regulatory and technical frameworks, the limited number of participants restricts the extent to which variation within these groups could be captured. This issue is particularly relevant for environmental health, as several food service operators noted that enforcement of hygiene regulations can vary between local authorities and individual environmental health officers. A larger and/or more geographically diverse sample of participants with roles in environmental health might have provided greater insight into whether and how regulatory variation influences the feasibility and acceptability of a reuse system for raw meat. In addition, some participants were recruited from project partner organisations and may have had greater engagement with the topic, as well as potential interest in positive outcomes. More broadly, many participants expressed a degree of personal concern for sustainability and these factors may have shaped participants' perspectives and introduced a degree of positive bias toward reuse systems.

4.6. Implications

In terms of implications of the present findings, the finding that many food service operators were unfamiliar with reusable packaging systems and lacked suitable on-site infrastructure to support reuse indicates that site-level training and clear implementation protocols are likely needed. These protocols should be co-designed with relevant stakeholders across the supply chain to build trust, support regulatory compliance, and ensure sensitivity to variation in business size, kitchen workflows and existing washing capacity.

More broadly, the findings suggest that adoption is unlikely to occur voluntarily, highlighting the need for system-level coordination. National standards and government-endorsed regulations may be required to normalise reuse and support interoperability across the supply chain [59]. Mandatory targets and associated single-use plastic bans (e.g., EUROPEAN, 2025) [60] may not be appropriate in this context given the constraints that food service venues operate under [49]. Policy interventions should focus instead on supporting businesses to develop infrastructure, such as shared washing facilities or return logistics, in addition to providing incentives for early adopters.

From a behavioural perspective, such measures may strengthen opportunity and motivation by reducing operational risk and increasing confidence in implementation. Social influence could also be leveraged through leadership by major food service groups and businesses that process meat, whose visible participation may help to legitimise reuse as a credible and expected practice across the sector. Finally, given that decisions to adopt reuse appear largely motivated by financial considerations, communication and policy efforts to promote uptake should prioritise cost savings and operational benefits rather than sustainability messaging alone. Increasing the relative cost of single-use meat packaging may further support the uptake of reusable alternatives [30].

5. Conclusions

The findings of this exploratory study suggest that the feasibility of implementing reusable packaging systems (RPSs) for raw meat may be constrained by a combination of operational, systemic and commercial factors, with food safety as a central concern shaping how risks are interpreted. While packaging design may support implementation where it fits existing workflows, feasibility is unlikely to be achieved through design alone. Instead, adoption is likely to depend on broader system-level conditions, including appropriate infrastructure, clearer accountability and a viable business case. Future work should therefore focus on developing and testing coordinated, system-level interventions that address these constraints and support the practical integration of reuse within food service settings.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/su18083849/s1>, Supplementary Materials S1: Theme development table. Supplementary Materials S2: Interview guides by stakeholder type. Supplementary Materials S3: Prototype images. Supplementary Materials S4: Coding framework.

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