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Reusable Packaging Systems for Restaurants and Delivery Services: A Study of Consumer Preferences and Adoption Barriers to Promote Public Acceptance in Germany

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Abstract

Germany, the EU's top plastic waste contributor, sees rising demand for single-use packaging, especially in coffee-to-go, takeaway, and food delivery. To promote a sustainable circular economy, Germany amended its packaging law in 2023, mandating gastronomic businesses to offer reusable packaging alternatives. However, consumer acceptance of reusable packaging systems (RPSs), crucial for success, is relatively unexplored. This study examines drivers and barriers to RPS adoption in Germany, offering recommendations for improvement. It includes a literature review, market research, and a representative online survey of 405 participants. A binary logistic regression model identified key adoption factors. Sustainability-focused intrinsic motivations were found to drive acceptance, while time and effort to return packaging pose significant barriers. Overall, the findings emphasize the importance of prioritizing both sustainability and convenience in the design of RPSs to promote consumer adoption. These insights can guide gastronomic businesses, pool system providers, and policymakers to improve RPS design and implementation, fostering public acceptance and adoption in Germany.

Keywords: circular economy; consumer acceptance; gastronomic industry; reusable packaging system (RPS); sustainability

1. Introduction

Against the backdrop of climate change, sustainability has become a key issue on political agendas worldwide. One element to counteract global warming is the reduction of plastic waste which poses a serious threat to the environment. Not only because its combustion contributes to the greenhouse gas effect but also because its improper disposal pollutes land and water which has a dramatic impact on the world's ecosystem (Accorsi et al., 2014; Bradley & Corsini, 2023; Keller et al., 2021; Long et al., 2022; Njoku & Edokpayi, 2019; Singh et al., 2016; Tan et al., 2023).

A large source of plastic waste is generated from packaging where plastic has unparalleled benefits due to its chemical and physical characteristics (Evode et al., 2021). In the European Union alone, the waste of plastic packaging is projected to double between 2019 and 2060 (OECD, 2022) with Germany taking by far the lead in the annual generation of plastic waste (Eurostat, 2019). One reason for this is the demand for single-use packaging in the context of takeaways and delivery services that is immediately discarded after use (Tan et al., 2023). According to the Berlin Consumers' Office, German citizens are accountable for a substantial 770 tons of plastic waste generated daily through the utilization of takeaway packaging for food and beverages (Verbraucherzentrale Berlin, 2022). On top of this, there is an escalating demand for online food deliveries from platforms or restaurants which is almost twice as high in 2023 compared to 2017 (Statista, 2020).

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To address the problem of plastic waste generated through single use packaging in the gastronomic industry, the German government has set forth an amendment which obliges gastronomic businesses to provide reusable packaging as an alternative to single-use packaging effective since the beginning of 2023 (Bundesregierung, 2022). Thereby, the reusable alternative must be as accessible as the single-use packaging which implies that the price for food purchased in either packaging needs to be the same. To achieve this, businesses cannot just sell the reusable packaging along with the order. Considering their own price for purchasing or producing the reusable alternative, they would either have to increase the overall price which leads to a loss of customers and price competitiveness or make a losing bargain. Instead, they are challenged to come up with smart solutions for the implementation of RPSs or become part of one of the RPS networks offered by startups in this field.

Despite the financial penalty that gastronomic businesses have to pay if they do not adhere to the new amendment (Bußgeldkatalog, 2023), only few of them provided reusable alternatives in the beginning of 2023. One of the reasons is the lack of awareness both on the consumer and provider side that arises due to the novelty of the amendment (Schuster & Thürmer, 2023). Another reason could be the uncertainty of gastronomic businesses with regards to how and what type of RPS they can employ so that it is feasible and well accepted by customers (NDR, 2023).

However, research in this area currently provides little guidance. While the economics of such systems have previously been analyzed (Accorsi et al., 2014; Bortolini et al., 2018; Bradley & Corsini, 2023; Coelho et al., 2020; Dembek, 2020; González-Boubeta et al., 2018; R. Li et al., 2023; Lofthouse et al., 2009; Schuermann & Woo, 2022; Simoens et al., 2022; Singh et al., 2016; Wang & Zhao, 2022), consumer preferences and behavior linked to the usage of RPS have only been investigated in the UK (Greenwood et al., 2021; Lofthouse et al., 2009; Long et al., 2022), the Netherlands (Miao et al., 2022), Switzerland (Dorn & Stöckli, 2018), South Korea (Schuermann & Woo, 2022), China (Jiang et al., 2020) and Canada (Ertz et al., 2017). The preferences of German consumers who generate most plastic within the European Union remain underexplored with only two studies providing insights into consumer behavior towards RPSs with regards to lock-in effects and the transition to reusable drinking cups (Keller et al., 2021; Simoens et al., 2022).

To address the existing knowledge gap, this research presents a comprehensive examination of RPSs in Germany. The study encompasses an analysis of the political context, prevalent types of RPSs, and the current market landscape. Additionally, the research investigates German consumers' preferences for RPSs and the barriers hindering their adoption, aiming to formulate informed recommendations for designing such systems to achieve widespread public acceptance.

To achieve these objectives, an exploratory approach and quantitative methods were employed in this study. Initially, a systematic literature review was conducted to consolidate foundational knowledge and summarize the state-of-the-art research on RPSs in the gastronomic industry. Subsequently, extensive research was undertaken to assess the current status of RPSs in Germany. Lastly, a representative online survey was administered, and the data were analyzed using a binary logistics regression model to explore the factors influencing the adoption of RPSs in the German context.

It is anticipated that the findings will be of theoretical as well as practical relevance. Theoretically, this study advances the knowledge of how to improve RPSs in the gastronomic industry to promote public acceptance. Practically, the research findings hold relevance not only for gastronomic businesses but also for pool system providers and policy makers. Gastronomic businesses and pool system providers can utilize the insights to optimize their current systems and offerings, tailoring them to better align with consumer preferences and foster higher adoption rates. Likewise, policy makers can benefit from this research as they seek to enact future legislation to drive the adoption of RPSs. By understanding the key drivers and barriers identified in this study, policy makers can design and implement more effective and consumer-centric initiatives. This alignment with consumer preferences will not only facilitate the acceptance of reusable packaging but also support the government's environmental agenda in combatting climate change and reducing plastic waste in Germany.

This thesis is organized as follows: The second section encompasses the theoretical framework, which commences with an exhaustive review of the existing literature concerning RPSs in the context of the gastronomic industry. This involves a comprehensive evaluation of the overall sustainability of RPSs, an overview of the various existing types, and an examination of prior studies on consumer preferences. Furthermore, the section delves into the current state of RPSs in Germany, encompassing their political relevance, a description of the predominant types of RPSs, and an analysis of the RPS market in the country. Moving forward, Section 3 elucidates the research methodology employed in this study, providing insights into the approach adopted to investigate the subject matter. Section 4 offers a comprehensive exposition of the research findings. It encompasses a meticulous examination and analysis of consumer preferences and adoption barriers. The results are further discussed, and insightful design recommendations are presented based on the obtained data. The concluding Section 5 provides a comprehensive synthesis of the study's outcomes, highlighting its significant contributions to the field. Additionally, the section acknowledges any encountered limitations and offers suggestions for future research in this area.

2. Theoretical Background

This section is divided into two segments. Firstly, it provides a synthesis of the literature review findings, covering the origin and evolution of the RPS concept, an assessment of its environmental impact, and an exploration of the drivers and barriers affecting consumer and economic adoption. The

second part of this section outlines the findings derived from the market research. This includes an examination of the current status of RPSs in Germany, encompassing its political significance and consumer sentiment. Furthermore, the section addresses the prevailing types of RPSs in the market and analyzes the overall market configuration.

2.1. Literature Review

A systematic literature review was conducted to summarize fundamental knowledge as well as state of the art research on RPSs with focus on the gastronomic industry. Overall, the review is subject to 50 articles that were published in academic journals. The articles were identified using the databases Scopus, Web of Science and Google Scholar. Given the central emphasis on RPSs in the gastronomic industry within this study, the search query was crafted to encompass relevant aspects, employing the combined strings: "Reusable Packaging" and "Food," or "Beverages," or "Takeaway," or "Delivery Services," or “Gastronomy”, along with "Reusable Cups." Subsequently, the results were filtered according to their relevance with respect to the research topic.

In the next step, the snowball method was applied in which the citations and references of the most insightful papers were analyzed to discover more literature that is meaningful for this study. In the final stages, the collected literature was organized into clusters based on criteria such as the year of publication, country of origin, predominant industry of study, and underlying research methodologies employed, thereby facilitating a systematic and coherent analysis of the information acquired.

As a result, two notable aspects emerged regarding the composition and content of the literature body. Firstly, the discourse surrounding RPSs has strongly evolved over the last years (see Figure 1). While research on RPS dates back to the previous century, the topic gained considerable attention from 2018 onwards, where the academic output increased from one to five papers published per year. In 2022, a global optimum with 10 papers per year was achieved which highlights the rising importance of research in this area, particularly in the context of climate change and the imperative for sustainable solutions. Notably, the pandemic-induced surge in food delivery during 2020 further intensified interest in this area due to the corresponding increase in single-use packaging waste (Bitkom, 2020).

Secondly, a discernible geographic distribution of research on RPSs is evident, with Europe emerging as the most progressive continent in this field. Nearly 60% of all papers selected for this review focus on RPSs in Europe, while North America and Asia account for 18% and 16% of the research, respectively (see Figure 2). Within Europe, the United Kingdom stands as the primary locus for RPSs research in the gastronomic industry, followed by Italy. Among the limited studies on RPSs in Germany, two noteworthy contributions provide insights into consumer behavior. Simoens et al. (2022) offer a socio-technical analysis of systemic lock-in effects, while Keller et al. (2021) investigate the key factors influencing consumers' transition from single-use to reusable drinking cups.

2.1.1. Origin and Evolution of Reusable Packaging Systems

Product packaging plays a vital role in efficient storage, protection, hygiene, and distribution of goods (Rundh (2005) as cited in Miao et al. (2022)). Although the concept of reuse is not new, with evidence of repair and reconditioning practices dating back to ancient times (Muranko et al., 2021), the adoption of reusable packaging in the business-to-consumer market (B2C) has been limited. Historically, deposit systems for bottles and containers, such as those used for beer, soft drinks, spring water, and dairy products, have represented the major B2C experience with reusable packaging (Coelho et al., 2020).

Over the past few decades, there has been a shift towards single-use packaging which is designed to be used just once before being recycled or discarded, driven by simplified logistics for distributors and retailers (Coelho et al., 2020). Consumer lifestyles and preferences have also influenced the dominance of single-use packaging. Factors such as globalization, individualization, and urbanization have led to an increased demand for fast-moving and convenient products which predominantly utilize single-use packaging. Especially in Germany, demographic shifts such as the aging population and smaller households emphasize the importance of convenient and lightweight packaging as well as smaller portion packs (Coelho et al., 2020; Simoens et al., 2022). According to Ertz et al. (2017), these preferences create behavioral lock-in mechanisms that reinforce the use of single-use packaging over reusable alternatives.

Nowadays however, there is a growing concern for environmental sustainability. In the effort to stop climate change and preserve the planet, consumers realize the negative effects of their consumption habits and seek less wasteful and more eco-friendly packaging solutions. As a result, reusable packaging regained prominence. This is particularly true for Germany. In his study Herbes et al. (2018) found that Germans, unlike people from the US or France, consider reusable packaging as the most environmentally friendly option even before recyclable and biodegradable packaging. According to the author, the prevalence of reusability among German consumers can be attributed to the widespread adoption of the returnable bottle system. In 2015, reusable packaging accounted for 44% of the total beverages sold (Umweltbundesamt (2020), as cited in Herbes et al. (2018)).

The concept of reusable packaging entails the use of packaging materials or components that are specifically designed for multiple trips or rotations within a system of reuse (International Organization of Standardization (2013) as cited in Miao et al. (2022)). In literature, there are two types of RPSs. The first type is known as returnable packaging systems, wherein the businesses that provide the packaging undertake the responsibility cleaning and refilling. The second type is referred to as refillable packaging systems, in which consumers take care of the cleaning and refilling themselves (Greenwood et al., 2021; Muranko et al., 2021). In this

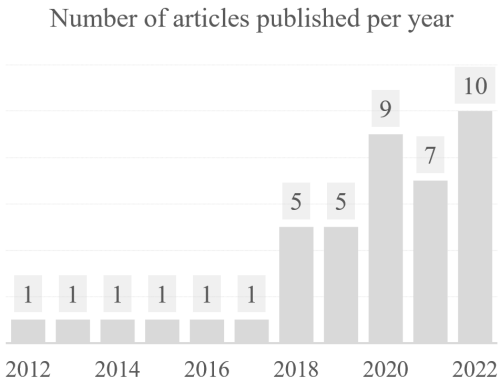

Figure 1: Frequency of Publishing

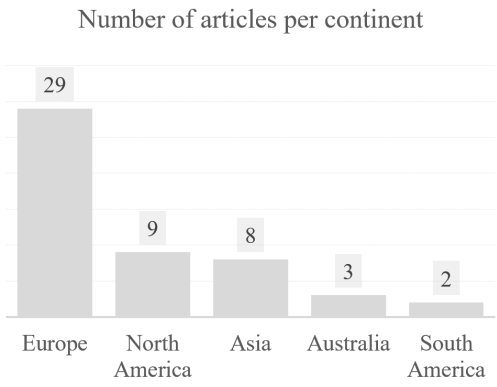

Figure 2: Geographic Distribution of Research

study, RPSs are defined as returnable packaging systems in which the food businesses manage the provision, cleaning, and refill.

2.1.2. Environmental Impact of Reusable Packaging Systems

Comparative studies on sustainable packaging have yielded conflicting results regarding the environmental superiority of reusable versus disposable packaging. While reusable packaging is widely recognized as a more sustainable alternative to single-use packaging, there are several studies stressing the trade-offs that need to be considered in the design of RPSs to leverage the environmental benefits. Although these studies examine food and beverage packaging within similar system boundaries, they differ in the specific types of packaging and their usage contexts, as well as supply chain configurations such as transportation distances, the number of reuse cycles, and recycling rates (Pålsson & Olsson, 2023). Taken this into account, Pålsson and Olsson (2023) found, that for takeaway there is either a preference for reusable packaging, or there is no discernible environmental impact difference between disposable and reusable packaging. Similarly, a study by Gallego-Schmid et al. (2019) showed that reusable food containers may exhibit higher energy consumption during their production, transportation, and cleaning. Consequently, the assessment of the sustainability of reusable and single-use packaging necessitates a comprehensive systems approach, considering various factors. Numerous life cycle studies have been conducted to analyse the sustainability of reusable versus disposable packaging.

Life cycle assessments (LCAs) encompass various factors, such as raw material production, energy consumption, transportation, reuse cycles, and end-of-life scenarios. These assessments consistently show that reusable packaging has a lower overall environmental impact compared to single-use packaging. For instance, Gallego-Schmid et al. (2019) conducted an LCA comparing single-use aluminium, polypropylene, and expanded polystyrene containers to reusable polypropylene containers. While polystyrene containers exhibited lower impact across some categories due to reduced material volume and processing energy, their negligible recycling rates, poor cost effectiveness, and negative implications as marine litter contribute to their overall environmental drawback. Overall, his findings suggest that reusable polypropylene containers are the best option under the condition that they are reused at least 3 to 39 times. In this case, the initial material and energy consumption needed for production are outweighed by the resources and energy that can be saved. In line with the aforementioned findings, studies show that the benefits of reusable packaging extend throughout its life cycle stages. Reusable containers have been found to reduce greenhouse gas emissions by up to 93% and embodied energy by up to 91% over a lifespan of 360 days (Baumann et al. (2018), as cited in Schuermann and Woo (2022)). Moreover, the environmental impacts of food delivery predominantly stem from packaging production (45%) and disposal (50%), emphasizing the substantial potential for sustainability improvements in packaging design (C. Li and Mirosa (2020), as cited in Schuermann and Woo (2022)). By adopting RPSs, the negative environmental consequences associated with landfills, such as air pollution and disease transmission, can be alleviated (Njoku and Edokpayi (2019), as cited in Schuermann and Woo (2022)).

To optimize the environmental performance of reusable packaging, it is important to consider factors such as transport distances, return rates, sorting and cleaning processes, maintenance, and product damage. These factors significantly influence the economic and environmental viability of RPSs (Bradley & Corsini, 2023; Coelho et al., 2020; Dubiel, 1996; Greenwood et al., 2021; Mahmoudi & Parviziomran, 2020; Simoens et al., 2022). By implementing efficient return models that incorporate recycled materials, recyclable designs, and optimized logistics, the environmental benefits of reusable packaging can be further enhanced (Greenwood et al., 2021).

In conclusion, the evidence from life cycle studies supports the assertion that reusable packaging is a more sustainable option compared to single-use packaging. Despite trade-offs, such as increased energy usage during specific stages, the reduction in waste, greenhouse gas emissions, and energy consumption achieved through reusable packaging outweighs these drawbacks. Only by adopting comprehensive

strategies that prioritize recycling, optimize logistics, and incorporate recycled materials, the environmental advantages of reusable packaging can be maximized. Moreover, it is essential to recognize that the successful implementation of reusable packaging solutions hinges upon the crucial factor of consumer acceptance. Therefore, this study explores consumer preferences and identifies the barriers to adoption, aiming to provide informed recommendations for the design and implementation of RPSs that effectively maximize consumer acceptance and pave the way for a more sustainable future.

2.1.3. Drivers and Barriers for the adoption of Reusable Packaging Systems from an Economic Perspective

The adoption of RPSs in the gastronomic industry holds the promise of economic advantages. However, the successful implementation of such systems requires careful consideration of several factors that may impact their feasibility and effectiveness in offering food and beverages in reusable packaging. This section of the literature review aims to summarize the key drivers and barriers that influence the acceptance and utilization of RPSs in the gastronomic sector starting with the drivers as summarized in Table 1.

Firstly, one notable advantage of RPSs over single-use packaging lies in the potential for long-term cost savings. (Coelho et al., 2020; Cottafava et al., 2019; Dubiel, 1996; Gallego-Schmid et al., 2019; González-Boubeta et al., 2018; Hitt et al., 2023; Jiang et al., 2020; Kunamaneni et al., 2019; R. Li et al., 2023; Lofthouse et al., 2009; Schuermann & Woo, 2022; Wang & Zhao, 2022). While the initial investment in reusable containers is considerably higher (Hitt et al., 2023; Wang & Zhao, 2022), the elimination of frequent purchases of single-use packaging can offset these costs (Cottafava et al., 2019; Gallego-Schmid et al., 2019; Jiang et al., 2020; Lofthouse et al., 2009). In the context of German businesses, the application of the Extended Producer Responsibility further contributes to potential cost savings (Maye et al., 2019). Under this approach, merchants and manufacturers bear full responsibility for a product's lifecycle, ranging from its design to disposal and recycling. As a result, businesses in Germany are obligated to cover the entire cost of packaging waste disposal. By adopting RPSs, businesses can reduce the financial burden associated with waste management (Coelho et al., 2020; Dubiel, 1996; Hitt et al., 2023; Kunamaneni et al., 2019; Lofthouse et al., 2009; Maye et al., 2019).

Another major advantage of RPSs for gastronomic businesses lies in their ability to significantly reduce material usage. By eliminating the constant need for the production and disposal of single-use packaging, businesses effectively reduce their reliance on virgin materials, leading to a minimized depletion of resources (Accorsi et al., 2022; Bortolini et al., 2018; Bradley & Corsini, 2023; Coelho et al., 2020; Ertz et al., 2017; Gallego-Schmid et al., 2019; Greenwood et al., 2021; Jiang et al., 2020; R. Li et al., 2023; Lofthouse et al., 2009; Miao et al., 2022; Muranko et al., 2021; Simoens et al., 2022; Tan et al., 2023). This shift towards reusable packaging aligns with the core principles of a circular economy, where the focus is on conserving resources, minimizing waste generation, and promoting the circulation of materials for extended periods (Coelho et al., 2020; Cottafava et al., 2019; Muranko et al., 2021; Pålsson & Olsson, 2023; Simoens & Leipold, 2021; Šuškevičė & Kruopienė, 2021). Furthermore, the conservation of resources achieved through the implementation of RPSs contributes to overall efficiency and resilience. By reducing the demand for raw materials, these systems help ensure the long-term availability of resources while simultaneously decreasing dependency on resource-intensive extraction processes (Bradley & Corsini, 2023; Coelho et al., 2020; Ertz et al., 2017; Jiang et al., 2020; Miao et al., 2022; Tan et al., 2023). Eventually, this not only offers economic benefits but also demonstrates a commitment to sustainable practices and responsible resource management.

From a marketing perspective, reusable packaging provides benefits that can enhance brand appeal and customer engagement. On the one hand side, reusable packaging allows businesses to open up opportunities for brand proliferation, expanded marketing strategies and competitive advantage based on the environmental benefits (Bradley & Corsini, 2023; Coelho et al., 2020; Cottafava et al., 2019; Herbes et al., 2018; Lofthouse et al., 2009; Miao et al., 2022; Schuermann & Woo, 2022). On the other hand side, the provision of user-friendly RPSs can improve customer satisfaction and loyalty (Bradley & Corsini, 2023; Coelho et al., 2020; Cottafava et al., 2019; Gallego-Schmid et al., 2019; Lofthouse et al., 2009; Schuermann & Woo, 2022). By utilizing digitized platforms, businesses can further gather valuable insights into consumer preferences, patterns, and usage habits. The collected data enables a deeper understanding of consumer behavior related to the adoption and utilization of RPSs. Such insights can inform strategic decision-making processes and facilitate targeted improvements to the system's functionality and design (Lendal and Lindeblad Wingstrand (2019), as cited in Schuermann and Woo (2022).

However, as depicted in Table 2, the adoption of RPSs also presents challenges for gastronomic businesses.

A primary economic impediment to the adoption of RPSs is associated with additional costs. Implementing RPSs entails expenses related to logistics, cleaning, refurbishment, and maintenance (Bradley & Corsini, 2023; Dubiel, 1996; González-Boubeta et al., 2018; Hitt et al., 2023; Jiang et al., 2020; R. Li et al., 2023; Lofthouse et al., 2009; Schuermann & Woo, 2022; Simoens et al., 2022; Šuškevičė & Kruopienė, 2021). The logistics of managing a system that involves the collection, transportation, and washing of reusable containers can add complexity and costs to the overall operations. Businesses need to invest in appropriate cleaning equipment and processes, refurbishing containers when necessary, and maintaining an inventory of reusable packaging. These additional costs can pose challenges for businesses, especially those with limited financial resources, potentially affecting the feasibility and cost-effectiveness of adopting RPSs.

Particularly in the gastronomic industry, safety and hygiene concerns represent important economic adoption bar-

Table 1: Summary of Economic Drivers derived from Literature (Table developed by author)

Economic Drivers	Evidence in Literature
Cost savings (e.g., production and waste management)	Coelho et al. (2020), Cottafava et al. (2019), Dubiel (1996), Gallego-Schmid et al. (2019), González-Boubeta et al. (2018), Hitt et al. (2023), Jiang et al. (2020), Kunamaneni et al. (2019), R. Li et al. (2023), Lofthouse et al. (2009), Schuermann and Woo (2022), and Wang and Zhao (2022)
Marketing	Bradley and Corsini (2023), Coelho et al. (2020), Cottafava et al. (2019), Herbes et al. (2018), Lofthouse et al. (2009), Miao et al. (2022), and Schuermann and Woo (2022)
Consumer satisfaction	Bradley and Corsini (2023), Coelho et al. (2020), Cottafava et al. (2019), Lofthouse et al. (2009), Miao et al. (2022), and Schuermann and Woo (2022)
Consumer loyalty	Bradley and Corsini (2023), Coelho et al. (2020), Cottafava et al. (2019), Gallego-Schmid et al. (2019), Lofthouse et al. (2009), and Schuermann and Woo (2022)
Reduced material use	Accorsi et al. (2022), Bortolini et al. (2018), Bradley and Corsini (2023), Coelho et al. (2020), Ertz et al. (2017), Gallego-Schmid et al. (2019), Greenwood et al. (2021), Jiang et al. (2020), Keller et al. (2021), R. Li et al. (2023), Lofthouse et al. (2009), Miao et al. (2022), Muranko et al. (2021), and Simoens et al. (2022)

Table 2: Summary of Economic Barriers derived from Literature (Table developed by author)

Economic Barriers	Evidence in Literature
Additional costs (e.g., logistics, cleaning, refurbishment, labor)	Bradley and Corsini (2023), Dubiel (1996), González-Boubeta et al. (2018), Hitt et al. (2023), Jiang et al. (2020), R. Li et al. (2023), Lofthouse et al. (2009), Schuermann and Woo (2022), Simoens et al. (2022), and Šuškevičė and Kruopienė (2021)
Safety/ Hygiene	Bradley and Corsini (2023), Lofthouse et al. (2009), and Long et al. (2022)
Additional labor	Bradley and Corsini (2023), Coelho et al. (2020), Schuermann and Woo (2022), and Simoens et al. (2022)
Storage Space	Bradley and Corsini (2023), Lofthouse et al. (2009), and Simoens et al. (2022)

riers for RPSs. Businesses must ensure that reusable containers are properly cleaned and sanitized to meet food safety standards and regulations. This requires establishing robust cleaning protocols and investing in suitable cleaning equipment and supplies. Failure to maintain stringent hygiene practices can lead to foodborne illnesses and reputational damage, potentially resulting in customer loss and financial losses. Addressing safety and hygiene concerns is crucial to gaining consumer trust and acceptance of RPSs (Bradley & Corsini, 2023; Lofthouse et al., 2009; Long et al., 2022).

The adoption of RPSs may also require additional labor resources. Managing the collection, washing, and restocking of reusable containers can demand additional staff members or a reallocation of existing labor resources. The need for personnel to handle the cleaning process and monitor the inventory can increase labor costs and impact overall operational efficiency (Bradley & Corsini, 2023; Coelho et al., 2020; Schuermann & Woo, 2022; Simoens et al., 2022). Businesses must carefully consider the impact of these additional labor requirements on their workforce and cost structure.

Finally, RPSs necessitate storage space for both clean and dirty containers, which can pose another adoption barrier for gastronomic businesses, particularly for those with limited physical space. Maintaining an inventory of reusable containers requires adequate storage facilities that are easily accessible and organized. Businesses may face challenges in finding suitable storage space within their premises, leading to additional costs associated with reconfiguring existing space (Bradley & Corsini, 2023; Lofthouse et al., 2009; Simoens et al., 2022).

Apart from the economic benefits and challenges, the current state of research stresses the significance of a high return rate and standardization for the overall feasibility of RPSs. Achieving a high return rate is crucial for optimizing the economic benefits of RPSs. Higher return rates allow for more efficient utilization of the containers, reducing the need for constant replenishment, lowering costs and increasing the environmental benefits (Bradley & Corsini, 2023; Simoens et al., 2022; Šuškevičė & Kruopienė, 2021). As indicated by several studies, implementing deposit fee systems can positively influence return rates by providing an incentive for customers to return the containers (Bradley & Corsini, 2023; Coelho et al., 2020; Hitt et al., 2023; Schuermann & Woo, 2022). Another important aspect is the need for standardization in RPSs. Standardization ensures compatibility and ease of use across different establishments, facilitating the collection, cleaning, and distribution of reusable containers. By establishing common standards for container sizes, materials, and labeling, the logistics and organization of the system can be streamlined, reducing costs and increasing efficiency (Coelho et al., 2020; Dubiel, 1996). To overcome these challenges, Coelho et al. (2020) highlights the significance of engaging with third-party organizations (e.g., pool systems) that specialize in RPSs. These external entities provide essential services including cleaning, maintenance, and transportation, which support gastronomic businesses in the adoption of RPSs. By collaborating with pool systems and adhering to standardized practices, businesses can benefit from their specialized expertise, thereby effectively overcoming implementation barriers.

In conclusion, the literature suggests that adopting RPSs in the gastronomic industry can yield economic benefits. Cost savings, reduced material usage and enhanced consumer loyalty make reusable packaging an attractive option. However, there are adoption barriers to consider, including additional costs, safety and hygiene concerns, labor requirements, and storage space limitations. Engaging with pool systems specializing in RPSs can help overcome these barriers. Moreover, achieving a high return rate and establishing standardization are important for optimizing the economic benefits.

2.1.4. Drivers and Barriers for the adoption of Reusable Packaging Systems from a Consumer Perspective

In the context of the gastronomic industry, the adoption of RPSs by consumers represents a crucial step towards sustainability and environmental responsibility. While the body of literature focusing on German consumers on this subject is relatively scarce, several studies from other countries have made significant contributions to understanding consumer preferences and the barriers influencing the adoption of RPSs. This section of the literature review synthesizes the available research findings, starting with the drivers that motivate consumers to embrace RPSs, and subsequently examining the barriers that may impede their widespread acceptance.

As presented in Table 3, consumer inclination towards adopting RPSs appears to be primarily driven by a combination of tangible and intangible benefits. Within the existing literature, a consensus is evident regarding the significant role played by financial incentives in stimulating consumer acceptance of RPSs. The provision of discounts, vouchers, free trials, or promotional offers has been identified as a compelling strategy to enhance the attractiveness of reusable packaging options. Research findings consistently demonstrate that the availability of financial benefits directly influences consumers' motivation to adopt and embrace these sustainable alternatives. Therefore, the incorporation of attractive financial incentives represents a potent approach to encourage widespread adoption of RPSs among consumers. (Bradley & Corsini, 2023; Ertz et al., 2017; Jiang et al., 2020; Lofthouse et al., 2009; Long et al., 2022; Miao et al., 2022).

Another significant driver for RPS adoption lies in highlighting the environmental advantages, such as mitigating plastic waste and safeguarding the environment (Coelho et al., 2020; Long et al., 2022; Miao et al., 2022). By accentuating these benefits and concurrently integrating features that acknowledge and incentivize customers' engagement, such as a mobile app scoreboard to monitor CO_2 or resource savings reached through packaging reuse (Long et al., 2022), consumers can be effectively motivated to actively participate in the adoption of RPSs. In addition, research indicates that consumers associate positive emotions with the usage of reusable packaging due to the engagement in sustainable behavior (Coelho et al., 2020; Keller et al., 2021; Long et al., 2022; Miao et al., 2022). In light of this, operators of RPSs should underscore the environmental merits of such systems and integrate mechanisms that acknowledge and appreciate customers' contributions to environmental preservation, into the design of their systems (Long et al., 2022).

Apart from this, the influence of social factors on consumer behavior regarding RPSs is noteworthy (Dorn & Stöckli, 2018; Keller et al., 2021; Muranko et al., 2021). In their experiment, Dorn and Stöckli (2018) observed that consumers were more likely to choose reusable takeaway boxes when they witnessed other customers doing the same. These findings suggest that social influence, particularly through observing others' behavior, can significantly impact consumer choices in favor of reusable packaging.

As analyzed by Greenwood et al. (2021), the material, type of packaging, and closure mechanism constitute other influential factors in consumers' willingness to reuse packaging. Through the conduction of a questionnaire, the author found that packaging made from glass was more preferred for reuse compared to films, flexible plastic, or foil and that the ability to reseal increased the willigness to reuse. In addition, the study by Greenwood et al. (2021) revealed that the durability and resistance to changes in appearance and ease of cleaning are key considerations for consumers when deciding to reuse packaging. Participants indicated that they were more willing to reuse packaging that remained durable and did not undergo significant changes in appearance with use. This finding highlights the need for containers that can withstand frequent reuse and industrial washing.

Table 3: Summary of Consumer Adoption Drivers derived from Literature (Table developed by author)

Adoption Drivers	Evidence in Literature
Financial Benefits	Bradley and Corsini (2023), Ertz et al. (2017), Long et al. (2022), Miao et al. (2022), and Šuškevičė and Kruopienė (2021)
Positive Emotions	Coelho et al. (2020), Keller et al. (2021), Long et al. (2022), and Miao et al. (2022)
Social Influence	Dorn and Stöckli (2018), Keller et al. (2021), and Muranko et al. (2021)
Environmental Value	Coelho et al. (2020), Long et al. (2022), and Miao et al. (2022)
User Experience	Cottafava et al. (2019) and Long et al. (2022)
Infrastructure	Ertz et al. (2017)
Type of packaging (material, design)	Greenwood et al. (2021)
Durability of packaging	Greenwood et al. (2021)
Complication of single-use consumption	Ertz et al. (2017)
Transparency of disposal	Ertz et al. (2017)

Besides the characteristics of the packaging, Ertz et al. (2017) emphasize the importance of creating situations that facilitate the use of reusable containers and complicate the recourse to single-use alternatives. By reducing the inconvenience associated with reusable containers and making single-use options more complicated to access, consumers perceive reusable containers as more convenient and are more motivated to engage in their consumption. Ertz et al. (2017) further recommends the establishment of transparent governance of recycling practices and providing evidence of recycling programs. According to the author, companies should communicate their recycling initiatives to the public, creating a context in which container reuse is valued. This increased transparency and positive perception of recycling efforts can enhance consumers' motivation to adopt RPSs.

Nevertheless, as summarized in Table 4, transitioning to RPSs is not without challenges. Despite a strong desire among consumers to purchase products in reusable packaging, the actual engagement with RPSs remains low (Poole (2019), as cited in Miao et al. (2022)). This discrepancy suggests that consumers encounter barriers when it comes to embracing reuse.

Hygiene is of paramount importance when it comes to the consumer adoption of RPSs in the gastronomic industry (Bradley & Corsini, 2023; Ertz et al., 2017; Jiang et al., 2020; Lofthouse et al., 2009; Long et al., 2022; Miao et al., 2022). Particularly during the COVID-19 pandemic, where hygiene practices and germ transmission prevention have gained significant attention, consumers had legitimate concerns about the cleanliness and safety of RPSs (Greenwood et al., 2021; Long et al., 2022; Miao et al., 2022). Research has identified key factors that contribute to consumer apprehensions regarding hygiene, which mainly arise from the inherent nature of reuse. Especially in the context of food and beverages, consumers express specific concerns about the potential contamination resulting from the repeated and shared use of the packaging by others (Bradley & Corsini, 2023; Long et al., 2022; Miao et al., 2022; Numata & Managi, 2012). Moreover, research reveals that visible signs of wear and tear, such as scratches and superficial damage, stemming from the repeated washing, transportation, and refilling processes, can serve as cues for potential contamination, which further exacerbates concerns about health and safety (Ertz et al., 2017; Miao et al., 2022; Numata & Managi, 2012). Effectively convincing consumers about the hygienic aspects of RPSs is found to be challenging, as endeavors to convey hygiene measures might be construed as marketing tactics (Long et al., 2022). Nonetheless, Long et al. (2022) proposes potential strategies to mitigate such concerns. Conducting live demonstrations that showcase the thorough cleaning processes of the packaging can alleviate consumer apprehensions. Additionally, incorporating information from trustworthy and credible sources can enhance the credibility and effectiveness of hygiene communication efforts.

Another important barrier to the adoption of RPSs by consumers can be attributed to their perception of inconvenience. Research indicates that the primary reasons for this perception are twofold: the lack of accessible reuse-enabling infrastructure and the additional time and effort required for the return process (Bradley & Corsini, 2023; Ertz et al., 2017; Jiang et al., 2020; Lofthouse et al., 2009; Long et al., 2022; Miao et al., 2022; Simoens et al., 2022). This is substantiated by Miao et al. (2022) who found that consumers are reluctant to seek such services if they are not readily accessible in their neighborhood. Therefore, RPSs need to be made widely available and designed in a way that minimizes consumer's effort.

In relation to this, it is important to consider that consumer behavior tends to be habitual, meaning that individuals are more inclined to engage in familiar activities (Green-

Table 4: Summary of Consumer Adoption Barriers derived from Literature (Table developed by author)

Adoption Barriers	Evidence in Literature
Safety (e.g., hygiene and contamination)	Bradley and Corsini (2023), Ertz et al. (2017), Jiang et al. (2020), Lofthouse et al. (2009), Long et al. (2022), and Miao et al. (2022)
Inconvenience (extra time and effort required for return)	Bradley and Corsini (2023), Ertz et al. (2017), Jiang et al. (2020), Lofthouse et al. (2009), Miao et al. (2022), and Simoens et al. (2022)
Packaging deterioration	Bradley and Corsini (2023), Ertz et al. (2017), Miao et al. (2022), and Numata and Managi (2012)
Habits	Greenwood et al. (2021) and Simoens et al. (2022)
Availability	Long et al. (2022) and Miao et al. (2022)
Complexity	Long et al. (2022) and Miao et al. (2022)
Lock-in effects	Lofthouse et al. (2009) and Long et al. (2022)
Refundability	Long et al. (2022) and Miao et al. (2022)
Unwillingness to pay deposit fee	Miao et al. (2022)
Skepticism about environmental impact	Miao et al. (2022)
Privacy	Long et al. (2022)
Financial penalty	Long et al. (2022)
Contextual hindrance	Ertz et al. (2017)

wood et al., 2021; Simoens et al., 2022). However, when it comes to RPSs, which are relatively new concepts, many consumers lack awareness and understanding of how to utilize them (Long et al., 2022; Miao et al., 2022). To address this issue, Long et al. (2022) proposes the provision of concise textual information that can be easily comprehended by consumers, coupled with the design of RPSs in a manner that is responsive to consumer inquiries and concerns. Additionally, the findings by Miao et al. (2022) highlight that some consumers struggle to grasp the environmental benefits associated with RPSs, particularly when the system still incorporates single-use packaging. It is therefore necessary to better educate consumers about the usage and advantages of RPSs.

Regarding the alteration of consumer behavior, the research by Ertz et al. (2017) further sheds light on the presence of contextual hindrances, specifically highlighting the perceived "inconvenience and awkwardness" associated with requesting refills from cashiers. To overcome this obstacle, Ertz et al. (2017) recommends businesses to employ more flexible operational approaches that provide consumers with greater freedom to utilize reusable containers. Furthermore, actively encouraging consumers to bring their own containers and introducing price incentives for those who opt for reusable alternatives when taking away meals or beverages can effectively drive behavior change. In addition, a shift towards offering reusable containers as a standard choice, rather than solely providing single-use options, is recommended. By implementing these strategies, as suggested by Ertz et al. (2017), contextual hindrances can be mitigated.

Research further identified barriers linked to the viability of RPSs. In literature, there are two approaches to incentivize consumers to return the packaging: the implementation of a deposit system (Bradley & Corsini, 2023; Coelho et al., 2020; Cottafava et al., 2019; Hitt et al., 2023; Jiang et al., 2020; Keller et al., 2021; Kunamaneni et al., 2019; Lofthouse et al., 2009; Long et al., 2022; Miao et al., 2022; Muranko et al., 2021; Numata & Managi, 2012; Pålsson & Olsson, 2023; Schuermann & Woo, 2022; Simoens et al., 2022; Šuškevičė & Kruopienė, 2021) or a penalty system (Long et al., 2022). In the deposit system, consumers pay a refundable deposit when obtaining the packaging, which is reimbursed upon returning the packaging. However, Long et al. (2022) found that consumers have concerns regarding the refundability of their deposits, fearing that businesses might use excuses, such as packaging damage, to refuse reimbursement. On the other hand, the penalty system involves consumers providing their financial information, and businesses charging a fee for late or non-return of the packaging (Long et al., 2022). According to Long et al. (2022) this system creates worries among consumers about potential financial charges if they failed to return the packaging on time. To address these concerns, Long et al. (2022) suggests employing RPSs that guarantee returns through deposits and emphasize the full refundability of deposits through the use of personified texts or rhetorical questions, aimed at dispelling doubts about refundability.

Finally, through the conduction of an online survey, Long et al. (2022) uncovered concerns pertaining to systemic lock-ins and the privacy of personal data, particularly in the case of digitized RPS that utilize mobile apps for borrowing and returning reusable packaging. The study revealed that some businesses tend to prioritize a simplified sign-up process while making the cancellation process more complex, leading to consumer dissatisfaction. Participants specifically

expressed concerns with email cancellation methods, perceiving them as inconvenient. To address this issue, Long et al. (2022) recommends streamlining the opt-out process to make it more user-friendly. Interestingly, when a mobile app was introduced to facilitate cancellations, no respondent raised objections, indicating that this approach would be more acceptable. Moreover, respondents deemed it inconvenient when RPSs collect personal data such as occupation, email address, or home address. To mitigate this concern, Long et al. (2022) advises against collecting consumer data unless it is essential for the service's functionality.

Overall, the investigation of the current body of literature highlights the drivers and barriers for consumer's adoption of RPSs. While financial incentives, environmental benefits, social influence, and convenience encourage the adoption of RPSs, hygienic concerns, inconvenience and accustomed habits stand out as prominent barriers that impede the widespread adoption of RPSs.

2.2. Reusable Packaging Systems in Germany

This section provides an in-depth analysis of the current state of RPSs in Germany. It encompasses an examination of the political significance of these systems and explores consumer sentiment towards their adoption. Furthermore, this section delineates the prevailing types of RPSs available in the market and presents an assessment of the overall market configuration for such systems.

2.2.1. Status Quo: Political Relevance and Consumer Sentiment

Germany has consistently held the highest packaging waste footprint within the European Union. In 2019, the quantity of packaging waste generated in Germany exceeded 3.2 million metric tons. This was followed by France and Italy, which generated 2.4 million and 2.3 million metric tons of plastic packaging waste, respectively (Eurostat, 2019). Notably, the utilization of single-use plastic packaging has experienced a continuous upward trend due to factors such as increased mobility, shifting demographics, and the impact of the Covid-19 pandemic. Studies have reported a surge in demand for takeaway and delivery food since the outbreak of the pandemic (Bitkom, 2020), as evidenced by the significant growth in turnover of one of Germany's largest food delivery platforms. For instance, Delivery Hero's yearly turnover increased from 1.5 million in 2019 to 6.4 million in 2021 (Rocket Internet, 2022). According to the reusable packaging startup reCup (2022), Germans presently consume 4.5 billion takeaway and delivery boxes for food annually, which equates to 8,500 boxes per minute and 142 boxes per second. Similarly, in terms of beverages, Germans use 5.8 billion single-use cups per year, equating to roughly 11,000 cups per minute or 184 cups per second. The environmental impact of such consumption patterns is significant, with disposable cups for hot beverages alone generating 23,500 tons of waste annually in Germany, alongside an additional 4,000 tons from plastic lids which adds overall up to the weight of over 22,000 VW Golfs (Deutsche Umwelthilfe e.V., 2021).

In response to the escalating packaging waste issue, achieving a circular economy for packaging has emerged as a highly debated topic in the German political, corporate, and societal spheres (Simoens & Leipold, 2021). The concept of a circular economy, particularly in relation to packaging, centers around the idea of retaining the functionality of materials and products through reuse (Coelho et al., 2020). Reusable alternatives have thus garnered significant attention as a key approach to achieving a more sustainable and circular packaging system.

At the European level, the United Nations' sustainable development goals and the European Commission's action plan for a circular economy have laid the foundation for addressing packaging waste (Pålsson & Olsson, 2023). On one side, the 12th sustainable development goal emphasizes sustainable consumption and production, aiming to reduce waste generation through prevention, reduction, recycling, and reuse (Bradley & Corsini, 2023; Keller et al., 2021; Pålsson & Olsson, 2023; Schuermann & Woo, 2022). On the other side, the European Commission's action plan focuses on sustainable products, services, and business models, promoting the reuse of products and packaging as part of its Sustainable Product Policy (Pålsson & Olsson, 2023). The implementation of the Disposable Plastics Directive 2019 further reinforces the EU's commitment to limiting single-use plastics, including packaging (Coelho et al., 2020; Pålsson & Olsson, 2023).

In Germany, the need for a plastics directive specifically targeting single-use packaging in the gastronomic industry stems from the persistent dominance of single-use packaging despite the stated ambition to increase the share of reusable alternatives. The German Packaging Ordinance of 1991, followed by its successor, the German Packaging Act of 2019, aimed to promote reusable alternatives but faced challenges in overcoming the existing dynamics favouring single-use packaging (Simoens et al., 2022). In the beginning of 2023 and in line with efforts to promote sustainability and circularity, an amendment has been introduced in Germany, obliging restaurants and delivery services to provide reusable packaging as an alternative to single-use packaging (Simoens et al., 2022). The primary aim of this compulsory measure is to facilitate the industry's transition towards more sustainable practices and mitigate the environmental impact associated with packaging waste. By making reusable packaging readily available, this measure encourages both gastronomic businesses and consumers to choose reusable alternatives over single-use options.

The consumer sentiment in Germany regarding reusable packaging seems to be favorable. Recent studies have consistently indicated a high level of willingness among consumers to switch to reusable alternatives. According to a survey conducted among German consumers, over 70 percent of respondents expressed support for the introduction of a mandatory obligation for reusable packaging in the gastronomic sector (OmniQuest, 2020). Furthermore, 36 percent of individuals who purchase coffee to go in Germany were found to already actively choosing reusable cups (Splendid

Research, 2020). The positive consumer attitude towards reusable packaging reflects a growing awareness and concern for environmental sustainability. Consumers are increasingly conscious of the impact of single-use packaging on the environment and are actively seeking ways to reduce waste and promote more sustainable practices.

In conclusion, Germany faces significant challenges in addressing packaging waste, with single-use plastic packaging presenting a persistent issue. However, efforts at national and European levels, including the promotion of a circular economy and the introduction of mandatory obligations for reusable packaging, provide a promising foundation for mitigating the environmental impact. Furthermore, consumers in Germany have shown a favorable attitude towards reusable packaging which provides a promising foundation for the adoption and success of initiatives aimed at the promotion of RPSs.

2.2.2. Types of Reusable Packaging Systems

According to the recent amendment, food sold in reusable packaging must be priced equivalently to its single-use counterparts. This regulation poses a challenge for RPSs that operate with a profit-oriented approach, such as those structured around subscription models. As a result, RPSs in Germany primarily rely on either deposit systems or digital systems as their foundational frameworks. Building upon the findings of Baumann et al. (2018) this section elucidates the fundamental aspects of each system and provides a concise overview of their primary economic advantages and disadvantages as summarized in Table 5.

Deposit systems represent a cost-effective and easily deployable solution, as they necessitate minimal infrastructure. When consumers purchase food or beverages in reusable containers, a deposit fee is seamlessly integrated into the overall cost. Subsequently, when customers return the containers, they either receive a refund of the deposit or are granted a discount on their subsequent food purchase. The underlying principle of deposit systems capitalizes on the psychological concept of loss aversion, assuming that individuals are more inclined to return the containers rather than forfeit their deposit. According to Baumann et al. (2018) it is therefore very critical to establish an appropriate deposit cost, which strikes a delicate balance between not discouraging initial food purchases and offering a sufficiently enticing incentive for container returns. Nonetheless, when compared to digital systems, deposit systems face a limitation whereby customers, upon receiving their deposit refund, lack further motivation to continue opting for reusable packaging. Furthermore, this system does not generate supplementary revenue to offset the expenses associated with procuring reusable containers (Baumann et al., 2018).

In comparison to deposit systems, digital systems offer the added value of container tracking and usage monitoring. These systems function through a combination of a mobile application and QR codes, which are typically affixed to individual containers (Baumann et al., 2018). To utilize reusable packaging within a digital system, customers are first required to download a designated app and complete the registration process. When they then purchase food or beverages in reusable packaging, the container is scanned upon receipt and return, with the data recorded in a centralized database managed by the system operator (Baumann et al., 2018). In contrast to deposit systems, digital systems do not involve the payment of a deposit. Instead, customers are obligated to return the packaging within a specified timeframe, or else they incur a penalty fee (Long et al., 2022). The primary advantage of digital systems lies in their ability to gather valuable data on usage patterns and environmental benefits. Research indicates that incorporating tracking of environmental savings within the mobile app enhances consumer awareness of their individual impact, fostering a positive sense of contribution (Coelho et al., 2020; Keller et al., 2021; Long et al., 2022; Miao et al., 2022). Consequently, this serves as an effective means to incentivize repeated purchases with reusable packaging. Notwithstanding the advantages of digital systems, they do present a noteworthy drawback in the form of significant capital costs, primarily arising from the establishment of dedicated components such as a customized mobile application and the installation of container scanning machines at collection and distribution points (Baumann et al., 2018). However, in Germany, a closely-knit collaboration between gastronomic businesses and pool system companies focused on reusable packaging is prevalent. This collaborative arrangement allows gastronomic businesses to leverage the existing mobile apps and infrastructure provided by the pool systems, effectively obviating the need for them to incur upfront setup costs. Instead, they can leverage the infrastructure of pool systems on a pay-per-use basis (Relevo, 2023b; Vytal, 2022).

2.2.3. Market for Reusable Packaging Systems

The German market for RPSs is characterized by a notable degree of fragmentation. Kleinhückelkotten et al. (2021) have identified three distinct types of RPSs, primarily differentiated based on network size. Some gastronomic businesses, such as McDonald's, have implemented their own proprietary RPSs. In contrast, others either participate in collaborative network systems or utilize pool systems provided by startups specializing in this field. Among these options, pool systems have emerged as the predominant form of RPS in Germany, owing to several advantageous features they offer. From an economic perspective, businesses can minimize both initial setup expenses and ongoing maintenance costs associated with such systems. From the consumer's standpoint, the size of the network significantly influences convenience, as a larger network leads to increased availability of collection and return points, positively impacting the ease and efficiency of utilizing RPSs.

At present, Recup, Vytal, and Relevo are the startups that have established the most extensive partner networks, encompassing restaurants, cafés, takeaways, and delivery platforms (reCup, 2023; Relevo, 2023a; Vytal, 2023). In southern Germany, the Swiss startup Recircle also holds a pres-

Table 5: Economic Advantages and Disadvantages of Deposit and Digitized Systems (Adapted from Baumann et al. (2018))

System	Advantages	Disadvantages
Deposit System	• Cheap and easy to set-up and administer • no system maintenance	• no tracking or data collection • no accountability other than deposit cost • does not enable memberships unless combined with phone app
Digitized System	• tracking of containers to calculate usage and environmental savings • tracking of individuals' containers lessens risks of loss or theft, and allows for retention communications • extensive data collection • provide customers with sustainability information	• high set-up costs • ongoing system maintenance costs • requires all users to have smart phones

Figure 3: Vytal Packaging Assortment

Figure 4: ReCup Packaging Assortment

ence, albeit with a considerably smaller reach compared to its three German counterparts (ReCircle, 2023). Notably, Recup stands out with an impressive partner count of over 20,800 (reCup, 2023), solidifying its position as the largest network in Germany. It is noteworthy that Recup is regarded as a pioneer in this domain, commencing operations in 2016 with a specific focus on reducing waste from single-use coffee-to-go cups (reCup, 2022). In contrast, Vytal and Relevo were founded in 2019 and 2020, respectively, with their primary mission being to curb waste stemming from single-use food packaging (Relevo, 2023c; Vytal, 2022). Despite sharing the common objective of reducing packaging waste in the gastronomic industry, the three RPSs adopt slightly different approaches.

Table 6 provides a summary of their key attributes, with the most significant difference being the type of RPS employed. While Recup relies on a deposit system, Vytal and Relevo utilize digitized systems. Another distinction pertains to their product offerings. Given Vytal's and Relevo's pronounced focus on reducing food packaging waste, they provide a wider range of reusable packaging options, including cups, bowls, pizza and burger boxes, and sushi trays. In contrast, Recup solely offers cups and bowls. Additionally, the digitized network of Vytal and Relevo facilitates the collection of consumption data, leading the companies to assert an impressively high container return rate of over 99%.

However, there are also some similarities between the different RPSs. Firstly, their packaging materials are largely consistent, predominantly composed of polypropylene (see figures 3 & 4). This material choice is common within the RPS realm due to its favorable environmental impact, durability, and lightweight properties. Secondly, all RPSs impose similar requirements on their partners. While the startups provide initial packaging supplies, partners are responsible for a nominal usage fee and the entire cleaning process. In return, partners benefit from enhanced visibility among potential customers within the network, cost savings associated with the elimination of new single-use packaging purchases, and an opportunity to bolster their brand image.

In summary, the German market for RPSs displays fragmentation, with pool systems provided by Recup, Vytal and Relevo, emerging as the prevailing form of RPSs. While these startups employ varying RPS types, they share common requirements for their partners. As sustainability becomes an increasingly prominent concern, the market and adoption of RPSs in Germany are anticipated to experience continued growth.

Table 6: Attributes of Reusable Packaging Systems in Germany (Source: See market research data collected in file "RPS_StartUps"on external CD)

Name	RPS Type	Number of Partners	Days to Return	Packaging Assortment	Packaging Material	Max. Rotation Number	Description of Borrowing and Return Process	Costs	App Features
ReCup	Deposit	>20.800	n.a.	bowls, cups	polyprophylen	Recup: <1000, Rebowl: <500	*Restaurant or Takeaway:* • consumer purchases food / beverage in RP and pays deposit • consumer returns RP gets reimbursed *Delivery service:* • consumer downloads Recup app to generate token • consumer copies the token in the comment section during check out • consumer receives order in RP • consumer returns RP to a partner and gets reimbursed	Recup = 1 € deposit, Rebowl = 5 € deposit	n.a
Vytal	Digital	>3.500	14	bowls, cups, pizza boxes, burger boxes, sushi trays	polyprophylen, thermoplastic elastomere, stainless steel, tritan	<200	*Restaurant or Takeaway:* • consumer downloads Vytal app and registers • upon purchase, consumer scans the QR code of the RP to take ownership of RP which gets linked to user account • consumer returns RP to partner who scans scans QR-code to transfer ownership back *Delivery Service:* • consumer downloads Vytal app to generate token • consumer selects Vytal RP during check out and copies the token • consumer receives order in RP • consumer returns RP to a partner and gets reimbursed	Loan extension (7 days) = 1 € , Financial penalty (in case of loss or failure to return) = 4-10 €	*From a business perspective:* • tracking of system usage / consumption patterns *From a consumer perspective:* • interactive map with partners and return points including opening hours and pictures • link to online delivery platforms • history of actions • reward system including impact measurement based on usage

Table 6 — continued

Name	RPS Type	Number of Partners	Days to Return	Packaging Assortment	Packaging Material	Max. Rotation Number	Description of Borrowing and Return Process	Costs	App Features
Releve	Digital	>3.000	14	bowls, cups, pizza boxes, burger boxes, sushi trays	SAN, PP, glass	<1000	*Restaurant or Takeaway:* • consumer registers via app / browser / QR-code (fast check-in) • upon purchase, consumer scans the QR code of the RP to take ownership of RP which gets linked to user account • consumer returns RP to partner who scans QR-code to transfer ownership back *Delivery Service:* • consumer downloads Vytal app to generate token • consumer selects Vytal RP during check out and copies the token • consumer receives order in RP • consumer returns RP to a partner and gets reimbursed	Loan extension (5 days) = 0 € Financial penalty in case of loss or failure to return = 5-10 €	*From a business perspective:* • tracking of system usage / consumption patterns *From a consumer perspective:* • interactive map with partners and return points including opening hours and pictures • history of actions • reward system including dashboard for individual impact measurement and community effort
ReCircle	Deposit	>550 in Germany	n.a.	bowls, cups	PBT, tritan	n.a.	• consumer purchases food / beverage in RP and pays deposit • consumer returns RP gets reimbursed	Cup = 5 € deposit, Box =10 € deposit	n.a.

3. Methodology

This section elucidates the data collection methodology, the profile of the acquired sample, the questionnaire design, and the data analysis techniques employed in this study.

3.1. Data Collection

Similar to previous studies in this area (Allison et al., 2021; Cottafava et al., 2019; Ertz et al., 2017; Greenwood et al., 2021; Herbes et al., 2018; Jiang et al., 2020; Keller et al., 2021; Lofthouse et al., 2009; Long et al., 2022; Numata & Managi, 2012; Schuermann & Woo, 2022; Stadlthanner et al., 2020; Wang & Zhao, 2022), a comprehensive consumer survey was conducted to address the existing knowledge gap regarding consumer preferences and barriers to adopting RPSs in the gastronomic industry of Germany.

To ensure the survey's credibility and representativeness within German society, measures were taken to mitigate potential selection bias and optimize participant outreach. To counteract selection bias, the survey was distributed through the online panel Cint, while the EFS based Unipark platform was utilized for survey programming. Additionally, participants were provided compensation, thereby broadening the spectrum beyond environmentally conscious individuals who may have a higher interest in the study (Miao et al., 2022). Moreover, to achieve a well-balanced and diverse participant pool, specific quotas based on sex and age were established in alignment with current statistical data on the demographics of the German population (Bundeszentrale für politische Bildung (BPB), 2020; Destatis, 2023). This approach aimed to encompass a representative range of individuals (Evans & Mathur, 2005; Herbes et al., 2018). The survey itself was conducted solely in the German language to cater to the target audience effectively, and a built-in feature was employed to halt participation once the predetermined quotas were satisfactorily met.

The survey's methodological rigor was fortified by a comprehensive testing phase, during which various stakeholders evaluated the survey's framework and assessed the time required and ease of completion (Evans & Mathur, 2005). While the time for completion was approximately 12 minutes, their feedback encompassed technical refinements, clarifying ambiguous aspects, and fine-tuning the formulation to ensure clarity and precision. Based on this scrutiny, the survey underwent revisions and enhancements, ultimately enhancing its reliability and effectiveness before its deployment (Ball, 2019; Ertz et al., 2017; Evans & Mathur, 2005; Long et al., 2022).

To address potential disengagement and ensure data quality, two attention checks were incorporated within the survey (Gummer et al., 2021; Shamon & Berning, 2020). The initial check required participants to confirm that they were attentively reading the questions and providing responses to the best of their knowledge. The subsequent check involved asking participants to accurately identify the year in which the amendment of the German packaging law was introduced, despite the answer being explicitly provided within the question itself. Additionally, participants who terminated the survey prematurely were filtered out from the dataset (Bosnjak & Tuten, 2001; Heerwegh & Loosveldt, 2002).

3.2. Sample Profile

The survey was made available on the 19th of June 2023 and remained open for a single day (for comprehensive details on the sample profile and demographic and gender quotas, refer to Table A1). It was completed by 405 individuals of whom 208 (51.4%) were male, 195 (48.1%%) were female and 2 (0.5%) identified as diverse.

The age distribution showcased a broad demographic range, with 20% falling within the 18 to 29 years category, 18.3% between 30 and 39 years, 19.3% between 40 and 49 years, 24% between 50 and 59 years, and 19% between 60 and 69 years. Notably, there was a slight emphasis on the older generation (50-59 years), which reflects the current largest proportion of the German population and could have implications for the adoption of RPSs.

The backgrounds of the respondents were diverse, covering different aspects such as education, employment status, and income. Educationally, participants had varied qualifications, ranging from secondary school diplomas (44.4%) to doctorate degrees (0.7%). In terms of employment status, the sample encompassed employees (51.6%), university students (4.7%), self-employed individuals (4.5%), and those actively seeking employment (3.7%).

Regarding monthly income, respondents reported a wide spectrum of earnings, with 25.9% earning between 1000 and 2000 EUR, 21.0% between 3000 and 5000 EUR, and 7.2% earning 5000 EUR and above. This diversity in income levels provided insights into the potential economic considerations influencing the adoption of RPSs.

Moreover, the survey took into account the participants' geographical locations, which represented a mix of urban and rural areas. Notably, 13.6% resided in cities with fewer than 5,000 inhabitants, 22.5% in cities with populations between 5,000 and 20,000, 29.9% in cities with populations ranging from 20,001 to 100,000, and 34.1% in cities with more than 100,000 inhabitants. This geographic diversity accounted for potential regional variations in attitudes towards and adoption of RPSs.

By considering a broad range of demographic factors, including gender, age, education, employment status, income, and city size, the survey's sample pool ensures a comprehensive and well-rounded perspective on consumer attitudes and behaviours towards RPSs in the gastronomic industry of Germany which enriches the study's findings and strengthens the reliability and validity of the research.

3.3. Questionnaire Design

The formulation of questions primarily drew upon existing literature to ensure the generalizability and comparability of the results. By incorporating established research findings and methodologies into the survey design, the study aimed

to achieve a robust and comprehensive understanding of the subject matter, thereby enhancing the applicability of the outcomes to broader contexts. The survey followed a structured format, whereby considerable care was taken in the formulation and sequencing of questions to minimize potential biases (Evans & Mathur, 2005).

First, participants were queried concerning their purchasing behaviour and adoption of RPSs in the areas of coffee to go, takeaway food, and food delivery. To investigate the purchasing frequency, participants had to indicate how often they purchase coffee to go, takeaway food or delivery food and what type of food they frequently buy, utilizing a scale adapted from a prior study by Schuermann and Woo (2022) as well as recent consumer statistics (POSpulse, 2019). Subsequently, closed questions were employed to detect the adoption of reusable packaging in the respective contexts as well as multiple choice and open-ended questions to investigate how frequently they bought reusable packaging or how long they needed for return.

Second, participants' political awareness and market knowledge were examined through a series of questions. Initially, a closed question was employed to assess whether participants were aware of the recent amendment to the German packaging law. Subsequently, a 5-point scale, ranging from "very important" to "very unimportant," was employed to quantitatively assess the level of importance they ascribed to this new amendment. To delve further into participants' market knowledge, multiple-choice questions were derived from the market research on RPSs in Germany. These questions focused on aspects related to pool system providers and the participants' own utilization of such systems. Moreover, participants were given the opportunity to elucidate their preferences for a particular pool system and to demonstrate their understanding of the distinctions between various systems by utilizing optional text fields.

The third section of the research focused on examining the factors that influence and impede the adoption of reusable packaging, encompassing aspects related to its design, material, and attributes. Following a methodological approach akin to the work of Greenwood et al. (2021) and Miao et al. (2022), participants were presented with a series of images depicting different container designs. They were then requested to rate each design independently of its material on a 5-point scale, indicating their likelihood of adopting such packaging. Subsequently, participants were prompted to express their preference for a specific material used in reusable packaging, particularly in the context of its suitability for the transportation and storage of takeaway food. This preference was recorded using a 4-point scale, ranging from "not at all suitable" to "very suitable," aiming to elicit a more decisive response in comparison to the 5-point scale utilized earlier. Additionally, participants were provided with the opportunity to offer further insights into their ratings through the optional text field accompanying each question. To delve deeper into participants' perspectives, 5-point matrix scales, spanning from "very unimportant" to "very important," were employed to assess the importance they attributed to various factors drawn from prior literature (Bradley & Corsini, 2023; Ertz et al., 2017; Greenwood et al., 2021; Jiang et al., 2020; Lofthouse et al., 2009; Long et al., 2022; Miao et al., 2022; Numata & Managi, 2012) when selecting takeaway food in reusable containers.

The fourth section of the study extended its focus to explore the drivers and barriers pertaining to the adoption of RPSs in their entirety. This section was divided into subsections, each addressing different aspects of these systems, including their general characteristics, the assessment of willingness to return and to pay, the perception of deposit-based systems versus digitized ones, and the factors that might impede the uptake of RPSs. At the outset, participants were prompted to indicate the level of importance they attribute to specific characteristics of RPSs using a 5-point matrix scale, spanning from "very unimportant" to "very important." These characteristics were drawn from factors previously identified as significant in relevant research studies. Subsequently, multiple-choice questions were utilized to investigate participants' preferred options for returns and the acceptable distance they would consider for return locations. Moreover, participants were presented with three successive images of generic maps, each illustrating a radius enclosing gastronomic businesses participating in an RPS. The first map displayed three partners within a 1km radius, the second depicted eight partners, and the third showcased 16 partners, all within the same radius. Participants were then asked to express, using a 4-point scale, their likelihood of adopting the RPS presented in each map and a multiple-choice question was utilized to query about an acceptable duration for the return period. Next, participants were requested to indicate the amount they would be willing to pay as a deposit or financial penalty. To facilitate this assessment, a slider with a range from 1€ to 20€ was provided. This approach aimed to glean insights into the pricing dynamics of deposit and digitized systems, while also offering hints regarding participants' preferences for a specific system type. The investigation into participants' preference for either a deposit-based or digitized system was continued with a subsequent question utilizing an extensive 5-point matrix scale (ranging from "completely disagree" to "strongly agree"). The scale encompassed various items that explored participants' perceptions of each system in terms of practicality, flexibility, and trust, as well as their willingness to pay a deposit or register for an app. Finally, the section on RPSs explored adoption barriers, which were derived from existing literature (Bradley & Corsini, 2023; Ertz et al., 2017; Greenwood et al., 2021; Jiang et al., 2020; Lofthouse et al., 2009; Long et al., 2022; Miao et al., 2022; Numata & Managi, 2012; Simoens et al., 2022). These barriers included factors related to the additional effort, time, and costs necessitated for the utilization of RPSs, as well as concerns regarding hygiene and privacy. The analysis of these barriers was carried out using a 5-point scale ranging from "completely disagree" to "strongly agree," allowing for a nuanced assessment of participants' perspectives.

Going more into detail on the adoption drivers, the fifth section first investigated what factors influence consumers' decisions when purchasing food in reusable packaging. before asking more precisely what kind of incentives consumers find particularly motivating to switch from single use to reusable packaging. In both instances, potential adoption drivers were drawn from existing literature (Bradley & Corsini, 2023; Coelho et al., 2020; Cottafava et al., 2019; Ertz et al., 2017; Keller et al., 2021; Long et al., 2022; Miao et al., 2022; Muranko et al., 2021; Šuškevičė & Kruopienė, 2021), and participants were requested to express their opinions using 5-point scales, spanning from "completely disagree" to "strongly agree." In addition, to obtain a nuanced understanding of participants' inclinations towards sustainability in their purchasing behaviour, an environmentalism scale was adapted from the work of Haws et al. (2014). This scale utilized a seven-point Likert scale (ranging from "does not apply at all" to "applies completely") to capture the extent to which individuals express their endorsement for environmental protection through their purchasing choices and consumption patterns.

The final segment of the survey addressed the prospective adoption of RPSs by the participants. Specifically, they were queried about their packaging preferences when buying takeaway food, and whether they favoured single-use or reusable packaging. In cases where single-use packaging was preferred, participants were further asked whether they would consider buying takeaway food in reusable packaging in the future.

3.4. Data Analysis

The analysis of the acquired dataset encompassed a variety of methods. Initially, descriptive statistics were employed to provide an overall understanding of the responses obtained from the survey participants. Furthermore, textual comments collected through optional survey fields were subjected to clustering and encoding. This process aimed to identify prevalent opinions among participants, particularly focusing on aspects within the survey that underscored the significance of certain items or brought attention to emerging elements deserving consideration in the context of RPSs.

To investigate the factors influencing consumer adoption of RPSs, a binary logistic regression was performed. This specific regression model is well-suited for situations where the dependent variable is dichotomous (in this study, it represented whether consumers preferred reusable or single-use packaging), while the independent variables can be either categorical or continuous. Notably, the application of binary logistic regression in previous studies (Dorn & Stöckli, 2018; Escario et al., 2020; Jiang et al., 2020; Numata & Managi, 2012), albeit in different cultural contexts, has proven its usefulness. However, its adaptation to the German context allows for valuable insights into the adoption impacts within Germany.

In accordance with the regression model proposed by Jiang et al. (2020), the binary logistic regression model with k independent variables was formulated as follows:

$$P_i = \frac{e^{\beta_0+\beta_1 x_1+\beta_2 x_2+\cdots+\beta_k x_k}}{1+e^{\beta_0+\beta_1 x_1+\beta_2 x_2+\cdots+\beta_k x_k}}$$

where Pi denotes the probability of consumers choosing a particular packaging mode. The regression coefficients β_0, β_1, ..., β_k signify the impact of the corresponding independent variables x_1, x_2, ..., x_k on the probability of choice. The logical probability distribution underlies the assumption for this model, considering the binary nature of the dependent variable. In this case, the error term of the logistic regression model adheres to a binomial distribution (Jiang et al., 2020).

Similar to Jiang et al. (2020) this research employed an inductive approach and used forward or backward and stepwise regression to objectively analyse the independent variables based on their significance to the overall model and their influence on the coefficient of determination (R^2). Central to the analysis was the assessment of the significance of each model parameter. A significance level of less than 0.05 was established as the criterion to determine the relevance of each variable in influencing consumer preferences and adoption barriers. To refine the model and improve its accuracy, effective parameter modification techniques were employed based on likelihood and Hosmer-Lemeshow tests (Demaris, 1995; Hosmer & Lemeshow, 2000; Jiang et al., 2020; Smith & Mckenna, 2013).

By adhering to an unbiased and comprehensive exploration of the relationships between the independent variables and the dependent variable, this inductive approach allowed to discern the most influential factors driving consumers' preferences between reusable and single-use packaging options.

4. Results

This section presents the descriptive analysis and regression model application applied to the survey responses obtained from the participants. The descriptive analysis provides a comprehensive overview of the collected data, highlighting key trends and patterns in the responses. Subsequently, a regression model is employed to examine the relationships between the variables and explore the factors influencing the consumer's adoption of RPSs.

4.1. Descriptives

The subsequent sections comprise the comprehensive descriptive analysis of the survey responses pertaining to the prevailing adoption status of RPSs, political awareness, and market knowledge, as well as the determining factors and hindrances influencing the adoption of reusable packaging and RPSs. Furthermore, these sections expound upon the factors motivating consumers to switch from single-use to reusable packaging and provides insights into participants' attitudes regarding future adoption upon completing the survey.

4.1.1. Current Adoption Status

The first part of the survey investigates current purchasing behaviours related to coffee to go, takeaway food, and delivery food, and examines the extent of reusable packaging adoption within these domains. The adoption of reusable packaging for coffee to go appears to be relatively higher compared to takeaway food and delivery food (please refer to Table A2 for a comprehensive overview of the results). As indicated by the survey results, approximately one third (39%) of the participants reported purchasing coffee to go at least once per week, while the majority (58%) had prior experience purchasing coffee to go in reusable packaging. However, it is important to acknowledge that the practice of buying coffee to go in reusable packaging has not yet become the prevailing norm. Even among those who are familiar with reusable cups, regular usage is not commonly observed. In terms of frequency, the data reveals that over the past half year, 49% of the participants purchased coffee in a reusable cup less than once a month. Additionally, 33% purchased it at least once a month and 18% at least once a week. It is noteworthy that there is a preference among consumers who opt for reusable cups to bring their own cup, emphasizing a proactive approach to reducing waste. However, there is also a tendency observed among participants to accumulate cups before returning them. The survey findings indicate that the majority of participants still had cups pending for return, with 81% needing to return between 1 to 5 cups. This suggests a certain level of cup accumulation among consumers, potentially attributed to factors such as convenience or logistical challenges in returning the cups promptly.

The adoption of reusable packaging for takeaway food appears to be relatively lower compared to coffee to go (please refer to Table A3 for a comprehensive overview of the results). Despite a considerable number of participants (41%) reporting purchasing takeaway food at least once a week, predominantly for dinner (50%) or lunch (44%), and primarily on weekdays (64%), this suggests that convenience and time constraints play a significant role in driving takeaway food consumption. However, it is noteworthy that the majority of participants (77%) had not yet engaged in purchasing takeaway food in reusable packaging. Merely one percent of participants reported regular usage of reusable packaging for takeaway food, ranging from 34 to 400 times over the past six months. The preference for fast food options among participants may contribute to the observed lower adoption of reusable packaging for takeaway food. Notably, 61% of participants expressed a preference for dishes such as Döner, pizza, or burgers as their preferred takeaway choices. Furthermore, participants highlighted their dissatisfaction with fast food served in regular takeaway containers, specifically mentioning that it negatively impacts the taste and texture of certain items, such as fries becoming sticky or slouchy.

The adoption of reusable packaging for delivery food is also relatively low (for a comprehensive overview of the results, please see Table A4). Participants indicated a relatively infrequent occurrence of ordering food online, with ordering frequencies ranging predominantly from once a month (29%) to less than once a month (25%). Merely 20% of participants reported having ever ordered their food in reusable packaging. Among those who did order in reusable packaging, their order frequency ranged from 1 to 10 times in the past six months, with only a few participants ordering food in reusable packaging on a frequent basis.

In summary, the findings demonstrate differing levels of adoption regarding reusable packaging across the categories of coffee to go, takeaway food, and delivery food. Reusable cups for coffee to go exhibit a relatively higher degree of adoption, although it has not become the prevailing norm. Conversely, the adoption of reusable packaging for takeaway and delivery food remains relatively low. Additionally, the results indicate that while consumers have shown occasional engagement in purchasing food or beverages with reusable packaging, such behaviour is not performed with frequency.

4.1.2. Political Awareness and Market Knowledge

The second part of the survey focused on assessing participants' awareness and market knowledge regarding reusable packaging. Specifically, respondents were queried about their familiarity with the amendment of the packaging law, which mandates takeaways, restaurants, and delivery services to provide reusable packaging as an alternative to single-use packaging, and their attitude towards this regulation. Additionally, participants were asked about their awareness of pool systems such as Recup, Vytal, Relevo, or Recircle, their preferences, and whether they could distinguish the differences between these systems (please refer to Table A5 for a comprehensive overview of the results).

Regarding political awareness, a notable majority (61%) of participants confirmed their knowledge of the amendment to the packaging law and perceives it as important (77%). Regarding market knowledge concerning pool systems, the findings revealed a lack of familiarity among the participants. 60.2% of the respondents stated that they were unaware of any pool-systems providing reusable packaging. Among those with knowledge of pool systems, Recup emerged as the most recognized (30%), followed by Recircle (11%). Remarkably, participants who engaged with pool systems predominantly favoured Recup or Recircle and indicated Recup as their preferred system. Optional comments provided by participants further elucidated the reasons for Recup's popularity. Not only is Recup widely known among consumers, but it is also appreciated for its extensive partner network and straightforward approach. This preference for Recup aligns with its longer establishment, considering both Recup and Recircle were founded in 2016, whereas Vytal and Relevo were established in 2019 and 2020, respectively. Moreover, since both Recup and Recircle operate on a deposit-based model, the inclination towards deposit systems may indicate a general preference among consumers. This finding aligns with previous consumer behaviour studies that show individuals are more likely to engage in practices they are already familiar with (Greenwood et al., 2021), which, in this case,

includes deposit systems widely utilized for bottles in Germany (Simoens et al., 2022).

The lack of market knowledge becomes further evident when considering participants' familiarity with the individual pool systems. The majority of respondents (93% vs. 7%) were unable to distinguish the differences between the four RPSs.

4.1.3. Drivers and Barriers for Reusable Packaging

In the third part of the survey, participants were presented with concrete questions concerning the design, material, and general attributes they perceive as significant for the adoption of reusable packaging (please refer to Table A6 for detailed results).

In terms of design preferences, no definitive consensus emerged among participants. While the box design is perceived as most suitable for a variety of dishes by 90% of the participants, it is closely followed by the bowl design (88%). Conversely, only 77% of the participants perceived the clamshell as suitable for a variety of dishes rendering it comparatively less favoured in the assessment. A more detailed analysis revealed that design preferences were contingent upon the type of dish. Specifically, participants perceived the box design as particularly suitable for noodle, rice, and potato dishes (86%), salads (84%), and bowls (80%). Meanwhile, the bowl design was considered especially suitable for salads (85%), noodle, rice, or potato dishes (81%), and bowls (79.3%). On the other hand, the clamshell design was perceived as particularly suitable for salads (80%), followed by noodle, rice, or potato dishes (86%), and fast food (63%). In light of previous survey results indicating fast food as the favoured choice for takeaway and the participant's inclination towards the clamshell design for such dishes, it is pertinent to consider its significance, despite its comparatively lower overall score in terms of suitability. Due to the contiguity between the type of dish and the design, businesses may enhance consumer receptiveness to reusable packaging options by selecting packaging designs that complement their takeaway dishes.

Regarding materials, polypropylene garnered the highest favourability, with 89% of all participants considering it particularly suitable for food transport and preservation. Stainless steel followed at 78%, then rice husk at 73%, and glass at 65%. A detailed analysis of participants' comments shed light on their evaluations and provided specific reasons for positive and negative attitudes toward the materials. Participants praised polypropylene containers for being lightweight, easy to clean, and practical, with some emphasizing economic advantages due to cost-efficiency and transportability. However, concerns were expressed regarding stains, hygiene, and sustainability, as polypropylene is a form of plastic, leading to fears of unsustainability and potential diffusion of microplastics into the food. For stainless steel, participants highlighted attributes such as durability, ease of cleaning, lightweight nature, insulation, and leak proofness. However, economic concerns were raised due to perceived high costs, and some participants opposed stainless steel containers due to potential metallic taste transfer to the food. Rice husk was considered sustainable and lightweight by some participants, but the majority expressed limited familiarity with the material and believed it to be less durable and challenging to clean, leading to stains and aesthetic concerns. In contrast, participants who favoured glass containers highlighted attributes such as ease of cleaning, durability in terms of washing and reuse, leak proofness, sustainability, taste neutrality, and aesthetics. However, concerns were raised about glass fragility and weight, making them unsuitable for delivery services due to increased costs and higher fuel consumption.

In terms of general attributes of reusable packaging, participants placed greater importance on functionality than sustainability. Hygiene was considered the most crucial criterion by 92.3% of participants, followed by leak proofness (92%) and durability (81%). In contrast, the design aspect was perceived as the least critical, with a mere 24% of participants attributing importance to it. In light of these findings, it is imperative for businesses to accentuate the aspects of hygiene and transportability in their packaging solutions, thereby reassuring consumers of their safety and reliability. By doing so, they can cultivate consumer trust and enhance the adoption of reusable packaging.

In conclusion, the third part of the survey provided insights into participants' perceptions regarding the design, material, and general attributes influencing their adoption of reusable packaging in the gastronomic industry. While no distinct preferences emerged concerning the design and material of reusable packaging, factors such as hygiene, leakproofness, and durability were found to play a crucial role in shaping participants' adoption decisions.

4.1.4. Drivers and Barriers for Reusable Packaging Systems

The fourth segment of the survey stands as the most pivotal component of this study, as it delves into the drivers and barriers influencing the adoption of RPSs in its entirety. This section examines the general attributes that hold significance for consumers, encompassing their preferences concerning container returns, acceptable pricing considerations, as well as their inclinations towards deposit and digitized systems, alongside factors either inhibiting or encouraging the adoption of RPSs.

The investigation into the general attributes encompassed several key factors, namely the density and diversity of the partner network, the distance to the next return point, and the variance of return methods and payment options (please refer to Table A7 and Table A8 for detailed results). The results demonstrate that a low distance to the nearest return location and a high density of partner networks are indispensable for the widespread acceptance and utilization of RPSs. A substantial proportion of participants, 86%, considered distance, and 78% considered density as decisive factors, while only 2% and 5% of the participants, respectively, perceived them as unimportant. Furthermore, consumers expressed the importance of partner diversity within RPSs, encompassing various types of gastronomic businesses such as restaurants, takeaways, or delivery services offering

different cuisines, with 69% of participants emphasizing its significance. Additionally, 69% of participants indicated that the option for different payment methods was essential. The survey findings also revealed that 67% of participants value the availability of various return methods, including self-return or pick up from home. In further detail, participants were inquired about their preferred return method, the acceptable distance to the return location, and the perceived density of the partner network required for the adoption of RPSs. Regarding the return method, a significant majority of participants (88%) expressed a preference for personally returning their reusable packaging, while only 12% favoured collection by the operator. In terms of the acceptable return distance, most of the participants (38%) indicated that they find a 1km distance acceptable. However, a significant proportion (32%) expressed a preference for the return location to be no farther than 500 meters. Consequently, to optimize consumer adoption, the next return location should be within a 500-meter radius. To explore the correlation between willingness to adopt and partner network density, participants were presented with three generic maps, each depicting a circled area with a 1 km radius. Within these areas, marks were placed to indicate different partners of a network. The maps varied in partner density, with the first map showing the lowest density and subsequent maps exhibiting increased density. The results clearly demonstrate that the willingness to adopt is indeed linked to the density of the partner network. Specifically, 68% of participants were willing to adopt a system with only 3 partners within the given area, and the willingness increased by nearly 10% with each subsequent map. For instance, when 16 gastronomic businesses participated in the reusable packaging system within a 1 km radius, the willingness to adopt reached 88% of the participants. Regarding the return period for the packaging, 41% participants indicated that they find a return period of two weeks acceptable.

In terms of pricing considerations, participants were asked to indicate on a scale ranging from 1€ to 20€ what price they find acceptable for a deposit or financial penalty within a digitized system that operates with specified return periods. Surprisingly, the acceptable price for both deposit and digitized systems was quite similar. For the deposit system, most participants (25%) indicated that they would be willing only to pay the minimum of 1€. This aligns with additional comments provided by some participants, expressing concern about the potential extra costs associated with RPSs. While one participant indicated a maximum willingness to pay 20€, the arithmetic mean was 3.41€. Therefore, it can be inferred that the deposit should not exceed 3.4€ to achieve the highest level of consumer acceptance. For digitized system, the reluctance to pay more than the minimum fee, contingent on the condition that the packaging was not returned within the designated return period, was even higher. 41% of the respondents indicated their unwillingness to expend an amount exceeding 1€ for such circumstances. However, since some of the respondents were also willing to pay more, the arithmetic mean amounts to 3.36€. Consequently, similarly to the deposit, the financial penalty should not surpass 3.4€ to attain the highest consumer acceptance.

Upon comparing consumer attitudes towards deposit and digitized systems, it becomes evident that consumers tend to favour deposit systems (please refer to Table A9 and Table A10 for an exhaustive summary of the results). A significant proportion of participants, 77%, expressed a positive sentiment towards deposit systems, finding them easy to comprehend (80%), practicable (70%), and flexible to use (59%). In contrast, only 38% of participants perceived digitized systems as easy to understand, 37% as practicable, and 34% as flexible in their utilization. This disparity may stem from consumers' perception that engaging with a digitized system requires committing to a single platform, resulting in systemic lock-ins and reduced flexibility. Furthermore, the survey responses shed light on the willingness of participants to pay a deposit on each reusable packaging item for takeaway food, with nearly 59% expressing no objections. In addition, 82% of participants expressed trust in receiving reimbursement for their deposits. Interestingly, 47% indicated a preference for foregoing reimbursement rather than facing financial penalties for failing to return the packaging within the specified period of a digitized system. The adoption barriers for digitized systems appear higher compared to deposit systems. While 39% of participants had no objections to downloading an app for the usage of RPSs, approximately 35% expressed reservations. Consequently, the willingness to embrace a digitized system is comparatively lower when juxtaposed with paying a deposit to engage with the system. This disparity is further evident in the responses provided by the participants when questioned about their inclination to either download an application or pay a deposit fee. Precisely, a majority of 61% expressed a preference for paying a deposit, while merely 14% indicated willingness to register for an application. Privacy concerns emerged as another relevant barrier to the usage of an app, with 36% of participants expressing reservations regarding app usage. In contrast, a mere 36% indicated having no privacy concerns. This aspect highlights the importance of addressing privacy considerations to facilitate the adoption of digitized systems. Despite the motivational aspect of digitized systems, which aims to engage consumers by showcasing the waste and energy savings resulting from the use of reusable packaging, the impact on consumer motivation appears limited. A significant majority of participants (47%) have expressed that the utilization of an application does not yield additional motivation for them to make food purchases in reusable packaging. This observation leads to the implication that the potential motivational advantages of employing an app in this context may be deemed negligible. Despite the benefits of avoiding upfront deposit fees and tracking environmental impacts, only 27% of participants believe that digitized systems offer significant advantages in comparison to deposit systems. A notable 34% of respondents do not perceive digitized systems as having many advantages, underscoring the general preference for deposit-based approaches. In response to a request for additional comments, some participants expressed reser-

vations towards digital systems due to factors such as lack of smartphone ownership or unwillingness to download another app. Besides privacy concerns, this raises the question of whether digitized systems are sufficiently accessible, particularly considering the demographic structure of Germany, where some older generations may face challenges in engaging with such technologies. In conclusion, the survey results strongly indicate a prevailing preference for deposit systems among consumers over digitized alternatives.

Regarding the drivers and barriers that influence the adoption of RPSs (please refer to Table A11 for a comprehensive overview of the results), convenience factors emerge as crucial determinants. Participants highlighted the time required to return the packaging and the ease of transport as the most critical aspects affecting their decision to engage with RPS. To encourage widespread adoption, it is essential to design RPSs that minimize the distance and time necessary for picking up and returning the containers. The higher the level of convenience, the greater the likelihood of consumer acceptance. Other factors that significantly impact the adoption of RPS include concerns related to additional costs and hygienic considerations. Participants also expressed reservations about committing to one specific RPS. On one hand, consumers expressed apprehensions about the possibility of not being fully reimbursed or facing penalties in case of loss or damage to the reusable packaging. To address these concerns, operators of RPSs may consider proactively informing consumers about the cleaning process and the specific circumstances that could lead to a denial of reimbursement, thus alleviating their concerns. On the other hand, participants availed themselves of the opportunity to provide comments, expressing a collective desire for a centralized RPS in Germany. They conveyed their preference for a system that does not necessitate choosing among various existing options. This indicates a desire for a more unified approach, similar to the deposit system for bottles, which could enhance consumer convenience and willingness to participate in reusable packaging practices. Conversely, certain factors, such as the willingness to pay a deposit, privacy concerns, and scepticism towards the sustainability of the RPS, did not yield significant results. In these cases, there was no substantial difference between the level of agreement and disagreement among participants, indicating a lack of consensus or a common opinion. In conclusion, addressing concerns related to additional costs, hygiene, and commitment to a particular system, along with exploring the potential for a centralized reusable packaging approach, may prove beneficial in encouraging broader acceptance and adoption of RPSs in the gastronomic industry.

Overall, the findings reveal a clear consumers preference for deposit systems over digitized systems. To achieve widespread adoption, several key attributes must be considered. These include minimizing the distance and time required for container returns to enhance consumer convenience. Additionally, addressing concerns related to additional costs and ensuring hygienic practices are crucial factors. The preference for a centralized system, expressed by participants, suggests the importance of offering a unified approach that does not require consumers to choose among various systems. By incorporating these attributes into the design and implementation of RPS, a broader consumer acceptance and participation in reusable packaging practices can be achieved.

4.1.5. Adoption Drivers

The fifth part of the survey focuses on consumer motivations for using RPSs. Participants were initially queried about their key considerations when purchasing food in reusable packaging, followed by an investigation into the factors that would encourage them to switch from single-use to reusable packaging, and their general attitude towards sustainability (please refer to Table A12 and Table A13 for detailed results).

Three crucial factors for consumers when purchasing reusable packaging are reducing plastic waste (83%), conserving resources (75%), and contributing positively to the environment (65%). Moreover, 57% of participants expressed the importance of being a role model in terms of sustainable behavior, and 54% stated their desire to reduce CO_2 emissions by using reusable packaging. These findings have implications for the design, material selection, and marketing strategies of RPSs. The packaging should be crafted from materials that minimize resource consumption, and marketing efforts should highlight the amount of resources saved and the positive environmental impact of RPSs to resonate with consumers.

When the participants were surveyed about the factors that would motivate them to switch from single use to reusable packaging, a majority (74%) expressed that financial incentives, such as discounts on food or beverage purchases, would serve as a motivating factor. Additionally, a considerable proportion of the participants (50%) found it motivating to track the amount of plastics saved, even if this necessitates the use of an additional application. Interestingly, the results indicate that tracking the amount of waste or CO_2 saved does not exert a significant impact on motivation. Specifically, only 37% of the participants find it motivating to monitor the amount of CO_2 they save through the adoption of reusable packaging. Consequently, to encourage the adoption of RPSs and taking the respondents sentiment towards digitized systems into account, it is most advisable to implement financial incentives, such as discounts on orders or increasing the price of single-use packaging.

In the context of assessing the level of support for environmental protection through purchasing and consumption behavior, a significant majority (73%) emphasized the importance of using products that do not contribute to environmental pollution. Similarly, 68% of the participants revealed concerns about the responsible utilization of the planet's finite resources. This concern for sustainability was further reflected in 62% of the participants describing themselves as environmentally conscious individuals. Moreover, many of the participants (61%) showed a conscious consideration of the potential environmental impact of their decisions, reporting that they actively consider the environmental consequences

of their actions in various aspects of their lives. This awareness highlights a willingness to make informed choices based on their environmental implications. Furthermore, the findings indicate that environmental concern influences participants' purchasing behavior. 60% reported that their environmental consciousness significantly influences their decision-making process when it comes to making purchases. Finally, a notable percentage of participants (54%) expressed a willingness to embrace inconvenience in favor of adopting more environmentally friendly measures.

In conclusion, the findings demonstrate that participants place great importance on sustainability with a focus on reducing waste and conserving resources when considering RPSs. Financial incentives, such as discounts on purchases, serve as effective motivators for consumers to switch from single-use to reusable packaging. Overall, these insights underscore the significance of incorporating sustainable practices and appealing incentives in the design and promotion of RPSs to foster broader consumer adoption and engagement.

4.1.6. Future Adoption

The final segment of the survey aimed to provide insights into the future adoption of RPSs based on consumer attitudes upon the completion of the survey. For this purpose, participants were asked to express their preference for either single-use or reusable packaging when purchasing takeaway food (please refer to Table A14 for a comprehensive overview of the results). Surprisingly, a majority of 70% indicated a preference for reusable packaging, while 30% favored single-use packaging. Notably, among those who preferred single-use packaging, only 57% could envision purchasing takeaway food in reusable packaging in the future, with 43% remaining opposed to the idea. These results suggest an increased awareness of RPSs among participants during the survey, leading to a higher inclination towards engaging with such systems. Consequently, improved consumer education on the availability and benefits of purchasing in reusable packaging is crucial. Furthermore, a small but distinct portion of participants may still be resistant to switching to RPSs due to personal aversions. These insights underscore the importance of strategic approaches to foster wider acceptance and participation in reusable packaging practices.

4.2. Regression Analysis

In order to examine the determinants impacting consumer adoption of RPSs, this study employed a binary logistic regression, with the preferred packaging choice (single-use or reusable) serving as the dependent variable. Following the methodology outlined by Jiang et al. (2020), SPSS was used to systematically evaluate the independent variables using forward or backward and stepwise regression techniques. The aim was to objectively assess the significance of these independent variables in relation to the overall model and their influence on the coefficient of determination (R^2). As a result, six distinct independent variables were identified. The regression coefficients and significances of these variables are shown in Table 7.

As suggested by Jiang et al. (2020), the goodness-of-fit analysis was conducted using the likelihood ratio test and the Hosmer–Lemeshow test, with their results reported in Table 8.

The -2 log-likelihood value of 160.6, coupled with the Cox and Snell R^2 of 0.4 and Nagelkerke's R^2 of 0.581, indicate a moderately strong fit of the model (Albert & Anderson, 1984; Backhaus et al., 2006; Demaris, 1995; Smith & Mckenna, 2013). This suggests that the model effectively explain the variances regarding the outcome variable. Furthermore, the Hosmer-Lemeshow test, which assesses the calibration of the model, yielded a non-significant p-value of 0.437. This outcome implies that the predicted probabilities of the model align well with the observed outcomes across various groups, indicating a satisfactory calibration of the model (Hosmer & Lemeshow, 2000). Overall, the statistical model exhibits a significant fit with the data, explaining a substantial proportion of the variance in the dependent variable. Additionally, the model appears to be well-calibrated, further enhancing its reliability.

The six independent variables can be classified into three categories: awareness for sustainability, concerns related to RPSs design and preferred takeaway options. Within the awareness for sustainability category, "Law Importance" assesses the level of significance attributed to the recent amendment to the German packaging law, while "Sustainability Inclination" represents the average responses obtained from a scale developed by Haws et al. (2014). This scale measures the extent to which individuals demonstrate support for environmental protection through their purchasing and consumption behaviours.

The concerns related to the design of RPSs are captured by "Time Concerns," which reflects the additional time required when utilizing RPSs, and "Privacy Concerns," which pertain to anxieties arising from data collection associated with the use of RPSs. The third category, preferred takeaway options, encompasses "Bowls Preference" and "Burger Preference," which indicate the preferences for bowls or burgers as takeaway dishes respectively.

While Table 7 shows that all independent variables significantly influence the adoption of RPSs, Figure 5 visualizes the impact of the variables on the adoption of RPSs based on their correlation coefficients.

On one side, "Bowls Preference", "Sustainability Inclination" and "Law Importance" positively impact the adoption of RPSs.

"Bowls Preference" exerts the most substantial positive influence on the likelihood of consumer adoption of RPSs. Consumers who prefer takeaway dishes in the form of bowls are more likely to adopt reusable packaging compared to those who do not express a preference for bowls. The coefficient value of 1.195 suggests that the log odds of adoption increase by approximately 1.195 times for individuals with a preference for takeaway bowls.

Likewise, "Sustainability Inclination" demonstrates a highly significant and positive association with consumer adoption of RPSs. Consumers who possess a stronger incli-

Table 7: Results of the Regression Analysis

Variables	Regression Coefficient	Standard Error	Wald	Degrees of Freedom	Significance
Bowls Preference	1.195	0.369	10.485	1	0.001
Sustainability Inclination	1.070	0.234	20.862	1	0.000
Law Importance	0.955	0.287	11.065	1	0.001
Burger Preference	-1.193	0.368	10.534	1	0.001
Time Concerns	-0.724	0.257	7.933	1	0.005
Privacy Concerns	-0.569	0.186	9.391	1	0.002

Table 8: Goodness-of-Fit Results (Adapted from Jiang et al. (2020))

-2 Log likelihood	Cox & Snell R^2	Nagelkerke R^2	Chi-square	Degrees of Freedom	Significance
160,600	0.400	0.581	7.967	8	0.437

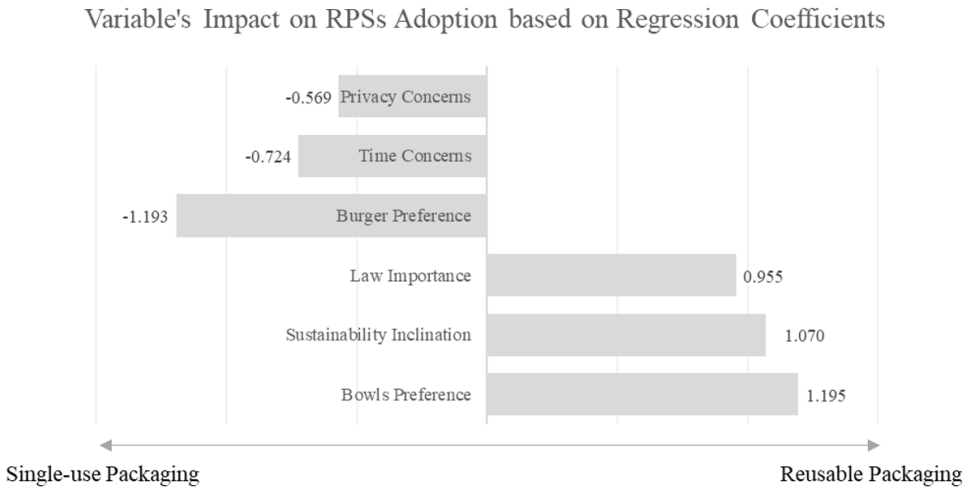

Figure 5: Impact of Independent Variables on RPS Adoption

nation towards sustainability, as evidenced by their support for environmental protection through their purchasing and consumption choices, are more likely to adopt reusable packaging. With each unit increase in Sustainability Inclination, the log odds of adopting reusable packaging rise by approximately 1.070 times.

Lastly, "Law Importance" exerts a relatively lower, albeit significant, positive impact on consumer adoption. This indicates that individuals who perceive the recent amendments to the German packaging law as more important are more inclined to adopt RPSs. For every unit increase in Law Importance, the log odds of adopting reusable packaging increase by approximately 0.955 times.

In contrast, burger preference and the concerns relating to time and negatively affect the adoption of RPSs.

The variable "Burger Preference" exhibits the most significant and negative association with consumer adoption of RPSs. Consumers who express a preference for takeaway dishes in the form of burgers are less likely to adopt reusable packaging compared to those without such a preference. Each unit increase in Burger Preference corresponds to a decrease of approximately 1.193 times in the log odds of adopting reusable packaging. These findings align with the results from the descriptive statistics, where consumers evaluated various design options of reusable packaging based on their suitability for different takeaway choices. Interestingly, all designs were perceived as least suitable for fast food items, such as burgers or currywurst with fries. Participants further utilized the opportunity to provide comments along with their evaluation of the packaging material, expressing their aversion to reusable packaging for fast food, referring to its negative impact on the texture of fries.

The variables "Time Concerns" and "Privacy Concerns" demonstrate a relatively milder impact on the adoption of reusable packaging. Consumers who perceive additional time requirements when using RPSs and those who harbour concerns about data collection linked to the use of RPSs are less likely to adopt them. Each unit increase in Time Con-

cerns results in a decrease of approximately 0.724 times in the log odds of adopting reusable packaging, while each unit increase in Privacy Concerns leads to a decrease of approximately 0.569 times in the log odds of adoption.

Overall, the results of the regression analysis reveal that the preference for bowls, sustainability inclination and the level of significance attributed to the amendment of the German packaging law positively influence the adoption of RPSs. Conversely, the preference for burgers, the additional time required for the utilization of RPSs, and privacy concerns negatively affect the adoption of RPSs.

However, it is crucial to acknowledge the potential impact of multicollinearity, which arises when two or more independent variables are highly correlated with each other (Farrar & Glauber, 1967). In this case, multicollinearity can lead to unstable coefficient estimates and complicate the interpretation of individual variable contributions to the dependent variable. The presence of multicollinearity can be assessed using statistical measures such as tolerance and the variance inflation factor (VIF) for the independent variables (Oke et al., 2019; Shrestha, 2020).

The tolerance measures how much of the variation in one independent variable can be explained by the other independent variables in the model. While the values for tolerance range between 0 and 1, a tolerance value close to 1 indicates low multicollinearity (Oke et al., 2019). The VIF is the reciprocal of the Tolerance and provides a measure of how much the variance of an estimated regression coefficient is increased due to multicollinearity (Oke et al., 2019). A VIF value greater than 1 indicates the presence of multicollinearity. Typically, a VIF value exceeding 5 or 10 suggest that the regression coefficients are poorly estimated due to strong multicollinearity among the independent variables (Oke et al., 2019; Shrestha, 2020). The collinearity statistics for the regression model are summarized in Table 9.

In the present regression model, the tolerance values for most independent variables are close to 1 and the VIF are lower than 5, which suggests that there is no significant multicollinearity among the independent variables. In other words, these variable's variances are not substantially explained by the other variables in the model. However, special attention is warranted for the variables "Bowls Preference" and "Burger Preference." The Tolerance values for these variables are exceptionally low at 0.001, while their corresponding VIF values are extremely high at 1762.412 and 1763.458, respectively. Such extreme values suggest the existence of multicollinearity between these two variables.

As a result, sustainability inclination, the perceived significance of the amendment to the German packaging law, and concerns related to time requirements and privacy are identified as the most meaningful determinants associated with the adoption of RPSs. On the other hand, the preferences for bowls and burgers should be treated with caution when considering them as predictors for the choice between single-use and reusable packaging.

4.3. Discussion of Results

A representative consumer survey was carried out to assess the current level of adoption of RPSs in Germany and to identify the drivers and adoption barriers that either facilitate or hinder the widespread acceptance of these systems among consumers.

Overall, the study revealed that the adoption of RPSs in Germany remains relatively limited. Despite a majority of the participants having previously purchased coffee-to-go in reusable cups, such behaviour is not habitual. Furthermore, when it comes to RPSs for takeaway and delivery food, the current level of adoption is even lower, with only a minority of respondents reporting utilization of reusable packaging in this context. One plausible explanation for this discrepancy could be that the establishment of RPSs for beverages preceded those for food, leading consumers to be more aware of the availability of coffee-to-go options in reusable containers.

In response to the need for enhancing the adoption of RPSs for food, the German government has implemented an amendment to the national packaging law. This amendment mandates gastronomic establishments to offer reusable packaging as an alternative to single-use packaging (Bundesregierung, 2022). However, despite this political initiative, the findings from the survey suggest that there is still considerable room for improvement in RPSs to ensure they align with consumers' preferences and thus achieve widespread adoption. The results highlight the need to improve awareness and understanding among consumers regarding both the legislative mandate for reusable packaging and the pool systems available. Enhancing consumer knowledge in these areas can play a pivotal role in fostering greater adoption of sustainable practices and encouraging more informed choices for reusable packaging solutions.

Based on the empirical findings, individuals with heightened awareness of sustainability demonstrate a higher propensity to opt for reusable packaging. The regression analysis conducted revealed that inclinations toward sustainability and perceived significance of the amendment to the German packaging law are influential predictors of the decision to embrace reusable packaging. These outcomes are consistent with the responses obtained from the general survey, which indicated that participants' primary motivations for utilizing RPSs stem from the desire to curtail plastic waste and conserve resources (Coelho et al., 2020; Long et al., 2022; Miao et al., 2022). Furthermore, scrutinizing the interrelationships between the assessed factors and their motivational impact on packaging selection demonstrated that intrinsic motivations hold greater sway over extrinsic ones in driving the adoption of RPSs. Despite nearly all respondents acknowledging the potential influence of financial incentives, as evidenced in prior research (Bradley & Corsini, 2023; Ertz et al., 2017; Long et al., 2022; Miao et al., 2022; Šuškevičė & Kruopienė, 2021), solely the motivation derived from environmental stewardship demonstrated a substantial impact on adoption (please refer to Table A15). Remarkably, the regression analysis suggested that a preference for bowls as a takeaway option emerged as another robust predictor

Table 9: Collinearity Statistics

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
Sustainability Inclination	0.113	0.022	0.336	5.049	0.000	0.553	1.807
Law Importance	0.121	0.031	0.267	3.960	0.000	0.539	1.856
Bowls Preference	0.119	0.036	6.903	3.319	0.001	0.001	1762.412
Burger Preference	-0.119	0.036	-6.896	-3.315	0.001	0.001	1763.458
Time Concems	-0.057	0.024	-0.118	-2.338	0.020	0.966	1.035
Privacy Concems	-0.045	0.018	-0.129	-2.587	0.010	0.982	1.018

of selecting reusable packaging. Notably, bowls represented the healthiest option that survey participants could choose from with regards to their most preferred takeaway dish, suggesting a plausible correlation between health-consciousness and a preference for sustainable packaging alternatives. This correlation aligns with the contemporary emphasis on sustainability and heightened health awareness triggered by crises such as the pandemic and climate change, reflecting prevailing societal sentiments. Building upon these findings, it is recommended to raise consumer awareness of RPSs through targeted marketing campaigns, specifically educating them on the sustainability benefits associated with such systems. Emphasizing the positive environmental impact of engaging with RPSs can serve as a persuasive motivator for consumers to adopt these eco-friendly alternatives. Moreover, embedding the concept of reusable packaging within the context of a healthy lifestyle can further enhance its appeal to consumers. By combining these strategies, targeted marketing can foster greater acceptance and uptake of RPSs, contributing to a more sustainable and ecologically conscious society.

On the contrary, the regression analysis revealed that the preference for burgers is a strong predictor for choosing single-use packaging. This aligns with the overall outcomes of the survey, where respondents perceived all the presented reusable packaging alternatives as less favourable for fast food when compared to other food options. Building on the hypothesis that consumers seek to embody their healthy and sustainable lifestyle choices through daily activities, including the selection of reusable packaging, the reluctance toward using reusable options for fast food might suggest that individuals who place less emphasis on environmental concerns are also less inclined to opt for reusable packaging. However, it is important to acknowledge that the survey participants explicitly voiced concerns about potential changes in texture and taste when fast food is transported in reusable packaging. This is particularly due to the airtight nature of such packaging, which hinders the escape of hot food vapours, resulting in a negative impact on the crispness of items like fries. Therefore, for reusable packaging to gain acceptance, it is crucial to devise designs that preserve the distinctive characteristics of the food items. In general, considering the findings, it was evident that the choice of packaging design is contingent upon the type of food being served. As a result, providers of RPSs may find it beneficial to offer a diverse assortment of packaging solutions tailored to suit the specific requirements of various food dishes. By doing so, they can enhance the appeal of RPSs and increase their overall adoption among consumers.

Regarding the prevalent types of RPSs in Germany, the study findings indicate a clear consumer preference for deposit systems over digitized systems. Several reasons contribute to this preference. Firstly, deposit systems are perceived as more practical and straightforward to comprehend. Secondly, consumers feel a greater sense of flexibility with deposit systems, which can be attributed to the convenience of borrowing and returning packaging at numerous locations, facilitated by the wider network of partners associated with these systems. Additionally, deposit systems do not engender lock-in effects, as consumers are not bound to a specific reusable packaging provider. Consequently, the survey responses reveal that consumers value deposit systems due to their unrestricted ability to engage in borrowing and returning packaging without the necessity of registering for a particular system.

Conversely, digitized systems encounter barriers to adoption. Consistent with the research conducted by Long et al. (2022), consumers express reluctance to expend extra effort in downloading applications and registering, while privacy concerns represent a critical factor impeding the adoption of RPSs. As a result, digitized systems may hinder the spontaneous decision-making process for selecting a reusable packaging system at the point of sale. Furthermore, digitized systems are less accessible compared to deposit systems. Notably, considering the demographic composition of Germany, the older generations currently constitute a significant proportion of the population (Bundeszentrale für politische Bildung (BPB), 2020). Given that many of them were raised in an era devoid of modern technologies like smartphones, their possession of such devices or familiarity with advanced technologies cannot be assumed.

Irrespective of the specific type of RPSs, this study underscores the necessity for political interventions to promote the widespread adoption of RPSs. Consumer habits and the prevailing convenience-oriented trend present obstacles to the uptake of reusable packaging (Greenwood et al., 2021;

Simoens et al., 2022), necessitating policy measures that render reusable packaging more appealing than single-use alternatives (Ertz et al., 2017). One viable measure could involve the imposition of taxes on single-use packaging (Accorsi et al., 2022; Cottafava et al., 2019; Schuermann & Woo, 2022; Wang & Zhao, 2022), thereby raising its cost relative to reusable alternatives. Such a pricing strategy could not only incentivize consumers to opt for reusable packaging on economic grounds but also provide an additional impetus for businesses to embrace reusable options, as they become more financially viable. Alternatively, the additional revenue generated through taxes could be allocated to marketing campaigns supporting RPSs (Schuermann & Woo, 2022). Another potent measure, proposed by Ertz et al. (2017) involves standardizing the sale of food and beverages in reusable packaging. Practically, this would entail providing consumers with their purchases in reusable packaging by default unless otherwise specified. By establishing this as the norm, consumers would be more likely to acclimate to the new packaging standard and may also observe fellow consumers engaging with the reusable packaging system. Notably, as elucidated by Dorn and Stöckli (2018), such social observation plays a significant motivational role in encouraging consumer participation with RPSs.

Furthermore, the survey respondents availed the opportunity to articulate their preference for a centralized system. Presently, the market for RPSs in Germany is characterized by fragmentation, with dominant players including ReCup, Vytal, Relevo, and ReCircle. However, consumers expressed a desire for a system that streamlines the process of returning packaging. Here, the convenience factor plays a pivotal role, as it both drives adoption when present and impedes adoption when lacking (Bradley & Corsini, 2023; Ertz et al., 2017; Jiang et al., 2020; Lofthouse et al., 2009; Miao et al., 2022; Simoens et al., 2022).

In the long term, the introduction of a RPS akin to the well-established bottle deposit system in Germany could prove beneficial on multiple fronts. Firstly, the implementation of one centralized system, complemented by effective measures such as taxes on single-use packaging, would significantly heighten consumer awareness regarding reusable packaging, thus standardizing engagement with such systems. Secondly, a centralized system would facilitate the establishment of a wider network of return locations, considerably reducing the time and effort associated with engaging with RPSs, thereby enhancing the overall consumer experience. Thirdly, insights from prior research underscore that individuals tend to adhere to their established habits when making decisions (Greenwood et al., 2021; Simoens et al., 2022). Given that a centralized deposit system for food would merely extend the already familiar bottle deposit system (Herbes et al., 2018; Simoens et al., 2022), the psychological barriers to adopting such systems would be reduced. This familiarity and continuity may serve as a compelling incentive for consumers to readily embrace the new system, as it aligns with their existing behavioural patterns.

Finally, the study revealed two noteworthy observations. Firstly, consistent with previous research, the survey responses indicate that functional characteristics of reusable packaging such as hygiene, leak proofness and durability are critically important for consumers to accept reusable packaging (Bradley & Corsini, 2023; Ertz et al., 2017; Jiang et al., 2020; Lofthouse et al., 2009; Long et al., 2022; Miao et al., 2022; Numata & Managi, 2012). Although participants did not indicate a clear preference for a specific material, most of them highlighted that the packaging needs to appear and remain hygienic (free of stains or wear and tear), leak-proof and easy to transport. However, since these aspects did not emerge as significant predictors within the regression analysis, it can be derived, that such attributes are fundamental prerequisites for the acceptance of any packaging within the gastronomic industry.

Second, a significant proportion of consumers exhibit a tendency to postpone the return of their reusable cups following consumption. To fully realize the positive impacts of the circular economy concept, it becomes imperative for RPSs to be designed in a way that facilitates the direct return of packaging. To achieve this objective, an effective approach involves enhancing the density of the partner network, which entails optimizing the number and distribution of return locations. By reducing the distances to these locations, consumers will experience minimized effort and time required for the return process, thus incentivizing direct and prompt returns. In this context, the implementation of a centralized system presents a practical and viable solution. A centralized system can pave the way for an efficient and interconnected network of return locations, fostering seamless and convenient returns for consumers. By encouraging the direct and timely return of reusable packaging, such a design would enhance the efficacy of RPSs in aligning with the principles of a circular economy, ultimately fostering greater sustainability in the long run.

In conclusion, fostering the widespread adoption of RPSs in Germany necessitates a multifaceted approach. Key recommendations include augmenting consumer awareness and education on the sustainability advantages of RPSs, reducing the allure of single-use packaging, optimizing the network with a focus on centralization and a deposit system, and embracing a user-centric design. Additionally, it is crucial to ensure that the packaging meets high hygienic standards, possesses durability, leak-proofness, and ease of transport, as expected for any packaging within the gastronomic industry. By implementing these measures, the adoption of reusable packaging can be encouraged, leading to substantial contributions towards establishing a more sustainable future.

5. Conclusion

This section presents a comprehensive summary of the principal findings derived from the study. It also acknowledges the identified limitations of the research and offers an outlook for potential avenues of future investigation.

5.1. Summary of Results

The utilization of RPSs presents great promise as an effective approach to address the challenge of packaging waste, foster the establishment of a circular plastic economy, and contribute significantly towards achieving the sustainability goals set by both the European Union (EU) and Germany. Nevertheless, a crucial obstacle that demands attention for broader implementation is consumer adoption. Currently, there is a lack of literature concerning this matter, offering limited insights into the associated challenges and potential solutions. To shed light on this aspect, a comprehensive investigation was conducted in Germany, exploring consumers' adoption of RPSs. This study explored consumers' adoption of RPSs in Germany by identifying the consumer preferences and adoption barriers and presented design recommendations to address them.

This research makes three significant contributions to the field. Firstly, it offers a comprehensive overview of the state-of-the-art literature related to RPSs covering the concept's origin and evolution, an examination of the sustainability aspects of RPSs, and the drivers and barriers for the adoption of RPSs from both an economic and consumer perspective. Secondly, this study constitutes a pioneering effort in offering a thorough and all-encompassing analysis of the current status of RPSs in Germany, encompassing the political relevance, public sentiment, prevailing system typologies, and market configuration. Remarkably, the findings of this study reveal a disparity between the supportive stance of the German government towards the widespread integration of RPSs through legislative measures and the generally favourable societal sentiment towards these systems. Despite these encouraging factors, the actual adoption of RPSs by the public remains constrained. Moreover, the examination of the market for RPSs in Germany indicates a distinct fragmentation, characterized by the prominence of four major pool system providers. These providers employ either deposit or digitized system approaches, which contributes to the complexity and diversity of the RPS landscape in the country. Thirdly, this research investigates the drivers and barriers for the consumer's adoption of RPSs. It unveils that intrinsic motivations related to environmental consciousness are significant drivers for consumer adoption. Furthermore, financial incentives seem to motivate consumers to switch from single-use to reusable packaging. Conversely, concerns related to data collection, inflexibility or the inconvenience associated with the return process of the packaging hinder the seamless integration of RPSs into consumers' daily practices. Additionally, a prominent obstacle hindering widespread adoption is the general lack of awareness among consumers regarding the existence and benefits of RPSs. Drawing upon the findings, this study puts forth a series of design recommendations for RPSs that offer valuable applicability to various stakeholders. For small gastronomic businesses and pool system providers, these recommendations serve as a means to optimize and improve existing RPSs, aligning them with consumer preferences and enhancing their appeal in the market. In parallel, policymakers can incorporate these findings into future legislative processes, with the aim of fostering a centralized system or standardizing RPSs. Furthermore, the recommendations highlight the significance of making single-use packaging less attractive to consumers to encourage the widespread adoption of RPSs.

5.2. Outlook and Limitations

The research is subject to three limitations. Firstly, the utilization of an online survey as a data collection method is advantageous in achieving high representativeness and a diverse sample profile. However, it lacks the depth of insight obtainable from in-person interviews due to limited probing opportunities and contextual understanding. To overcome this limitation, future research could employ a mixed-methods approach, combining online surveys with in-person interviews or focus groups, thus enabling a more comprehensive understanding of participants' perspectives and capturing both quantitative trends and qualitative nuances. Secondly, the survey focused solely on exploring the drivers and barriers for consumer adoption, neglecting the aspect of incorporating the business perspective for assessing the overall feasibility of the design recommendations. To address this limitation, researchers should integrate interviews or case studies with industry experts and stakeholders to obtain insights into the business-related factors influencing consumer adoption decisions, thus providing a more comprehensive understanding of the phenomenon. Thirdly, the regression analysis utilized in this research follows an inductive approach. While this method has its merits, it may overlook potential underlying relationships and patterns that could be better explored using complementary analytical methods. To improve the robustness of the findings, future studies should consider adopting a multi-method approach, combining regression analysis with techniques such as conjoint analysis. This will allow for a deeper exploration of consumer preferences and decision-making processes, thereby enhancing the overall rigor of the study.

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