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Article

Food Waste Management Practices: The Case of Invercargill's Food and Beverages Sector in New Zealand

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ABSTRACT

This study examined food waste practices in Invercargill's food and beverages sector in New Zealand. Data was collected from 10 participants. who were invited through the email addresses found on the official websites of food and beverage organisations or through social networks. Follow-up emails, and face-to-face invitations were completed to secure the interviews. The research was conducted using a qualitative method approach. Data collected from the interviews was analysed. The interviews were conducted in participants' workplaces at convenient hours for the participants, avoiding busy hours or any interruptions in the workplaces. The data were collected and recorded using the Microsoft Teams transcription function and a mobile phone during interviews. Prior to each interview, a participant information sheet was provided for the participant to read, and participants were asked to read and sign a consent form. The interviews lasted for between 30 and 45 minutes.

Data collected were analysed using thematic analysis, a commonly used qualitative descriptive research method for analysing qualitative data. Findings from this study were based on the three objectives set for the study. 1—to define the situation relating to food waste generation by food and beverage organisations. The study found a significant level of food waste generation within the food and beverage industry in Invercargill. Participants claimed that food waste occurred during food preparation and because of consumer behaviour and resulted in environmental impacts. 2—to identify the main sources of food waste in the food and beverage organisations. The research found various sources of food waste and classified them into three main groups: non-avoidable, avoidable, and possibly avoidable. Non-avoidable food waste encompasses items such as eggshells, vegetable skins, and animal bones, considered inevitable by-products of food production. Avoidable food waste resulted from uneaten food on client plates and cooking errors. These categories were identified by participants, with leftover food being highlighted as the primary source

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of avoidable waste. Avoidable food waste includes among others expired food and overripe fruits, and participants believed that with improved management practices, these sources of waste could be minimised or repurposed. 3—to evaluate the effectiveness of food and beverage organisations' current food waste management practices in Invercargill. This study found three current food management practices which had been effective at Invercargill: offering discounts to discourage food waste, repurposing food items, segregating waste for collection by local farmers, and conducting training programs for staff. Emphasis was placed on portion control, inventory management, adherence to precise recipes, fostering a culture of waste reduction and encouragement of staff responsibilities in preventing food waste. Regular communication and discussion, along with training sessions and collaboration among key personnel to address food waste should be encouraged.

KEYWORDS: food; beverage; food-waste; circular economy; triple bottom line

INTRODUCTION

This study explores the current state of food waste management within the food and beverage sector of Invercargill, New Zealand. Food waste is a global predicament that threatens social, economic, and environmental sustainability. It occurs at various food supply chain stages, from agricultural production to household consumption [1]. Given the multifaceted nature of the issue, a comprehensive approach is required to comprehend and alleviate the waste. Mitigating food waste aligns with the United Nations' Sustainable Development Goal 12, which focuses on circular behaviours, waste reduction, and sustainable practices [2]. The food and beverage industry significantly contributes to waste generation, with millions of tons being discarded annually across the United States, the United Kingdom, and New Zealand [3]. This study endeavours to explore the management of food waste in Invercargill, New Zealand, by employing a qualitative research approach to determine the perspectives of managers, chefs, and waiters in relation to food waste reduction. To examine the management of food waste in Invercargill, this study begins with a review of theories and frameworks of food waste management. It then explores the relevant literature on food waste management.

Interview questions were used to collect data from 10 participants, and thematic analysis was used to analyse the data collected. The findings of the study are discussed along with the limitations and implications at the conclusion of the study.

Research Objectives

The primary objective of this research is to determine the extent of food waste through a qualitative investigation into the present state of food

waste management in the Invercargill, New Zealand, food and beverage industry. According to [4], qualitative research enables a more profound comprehension of the participants' experiences, attitudes, and thoughts.

The following three research objectives are determined based on a robust assessment of the empirical literature:

1. To describe the extent of food waste generation by the food and beverage organisations in Invercargill.
2. To identify the main sources of food waste in the food and beverage organisations in Invercargill.
3. To evaluate the effectiveness of food and beverage organisations' current food waste management practices in Invercargill.

Research Questions

This section of the study addressed the following research questions to achieve the objectives mentioned above.

1. What is the extent of food waste generation by the food and beverage organisations in Invercargill?
2. What are the main sources of food waste in the food and beverage organisations in Invercargill?
3. How effective are food and beverage organisations' current food waste management practices in Invercargill?

THEORETICAL CONSTRUCTS

The European Waste Framework

The European waste framework directive defines waste as any substance or object the holder discards, intends to discard, or is required to discard [5]. This definition highlights the importance of adequately managing waste to protect the environment and ensure a sustainable future for future generations. By taking action to reduce waste production, properly disposing of waste, and supporting recycling initiatives, we can all play a role in creating a cleaner and healthier world [5].

Furthermore, food loss (FL) in the food supply chain (FSC) is primarily caused by the functioning of the food production and supply system and the institutional framework [6]. Food waste (FW) is a significant part of food loss. It includes the removal of food that is not fit for consumption or has been left to spoil due to negligence by the actors, primarily at the household level [6]. Similarly, FW is recognised as a distinct part of food loss due to different reasons, economic frameworks, and motivations [6]. Moreover, 'food loss and waste' (FLW) refers to food wastage [7]. FLW is a significant FSC issue, affecting product quality from production to consumption. The FSC is complex due to logistic processes, manufacturing, processing, distribution, and consumption [8]. Food industry challenges include food security, waste, farming, public health, climate change, oil dependency, fair trade, and localism [9]. Food waste is a serious concern

as it contributes to food shortage, insecurity, and hunger while posing a significant environmental threat. Therefore, excessive natural resource consumption and greenhouse gas emissions throughout the FSC significantly impact the economy and environment [10].

Over the past few years, there has been a significant effort to find and implement solutions to prevent food waste at various supply chain stages [11]. These solutions prioritise waste management, with prevention being the primary focus, followed by reusing and recycling options [12]. First, the European Union (EU) developed the Waste Framework Directive, a set of guidelines for waste management in the EU, outlining principles such as waste, recycling, and recovery [13]. It ensures waste is managed without endangering human health, harming the environment, causing nuisance, or affecting the countryside. The directive also outlines when waste becomes a secondary raw material and distinguishes between waste and by-products [13]. The Waste Framework Directive is the foundation for EU waste management, establishing a five-step waste hierarchy (Figure 1).

Figure 1. Waste framework directive. Note: This figure has been adapted from [13] by authors. GHS = Gas Central Heating.

Accordingly, [12] designed a food waste prevention pyramid to address this issue, which follows a hierarchy that applies to all waste categories (Figure 2). They stated that to address food waste, focusing on reducing surplus food production at the upstream level of the food chain and avoiding disposal of avoidable food waste at the downstream level are recommended. When such measures are not feasible, it is advisable to repurpose surplus food for human consumption through redistribution initiatives [12]. Subsequent levels of the food waste hierarchy prioritise recycling and energy recovery of food waste to avoid the least desirable option of landfilling.

Figure 2. Food waste prevention pyramid. Note: This figure has been adapted from [12] by authors.

Moreover, significant steps taken by organisations such as the EU by implementing the Waste Directive to reduce food waste encourage member states to develop sustainable waste prevention programs that consider the environmental impacts and the entire lifecycle of products and materials [14]. For instance, the Circular Economy Package supports the EU's primary objective of reducing food production resources and minimising environmental impact [15]. The directive highlights waste prevention as the first step in waste management, and landfilling is considered the least preferred option due to its strong environmental impact perspective [15].

Circular Economy

The notion of Circular Economy (CE) has gained immense popularity and is being widely endorsed by the European Union, national governments, and businesses across the globe [16]. CE revolves around production-consumption systems built on a linear nature-society-nature

material and energy throughput flow to maximise service [17]. It operates on the principles of cyclical materials flows, renewable energy sources, and cascading-type energy flows. The success of CE lies in its ability to contribute to sustainable development by restraining the throughput flow within a limit that respects ecosystem cycles and natural reproduction rates [17].

Indeed, CE aims to establish a sustainable relationship between businesses and resources [18]. This involves reducing waste, promoting efficient resource consumption, ensuring worker and customer safety, developing innovative products, and making a profit. However, the main challenge lies in the lack of tools for sustainability-based decision-making [18]. To achieve sustainable economic growth and minimise environmental and societal impacts, commercially applicable environmental, social, and cost assessment methods must be developed [18].

Accordingly, CE has a relationship between waste generation and management, which plays a fundamental role. Ensuring that profit-driven waste generation does not obstruct environmental protection is critical [19]. While the research on CE has primarily focused on consumers and their consumption, it has overlooked the everyday food wastage practices in households [20]. A study by [21], which takes place in Finland, addresses this gap. Households in Finland generate a considerable amount of food waste annually, ranging from 120–160 million kilograms. The study adopts a practice-theoretical approach, which focuses on collective aspects of consumption and agency distribution among people, objects, and infrastructures [22].

Although social science research on sustainable consumption and food waste has been extensive, limited attention has been given to the transition towards CE, except for [20] work on domestic food provisioning. Moreover, practice-theoretical food waste research highlights the importance of social, material, and temporal contexts in understanding household food waste production, which requires diverse culinary skills and knowledge [23]. Additionally, it acknowledges the significance of nonhumans in reducing food waste. Overall, the approaches to food waste reduction as a social practice emphasise the dynamics between ethical action and persistent socio-material practices that limit transformation [19].

Triple Bottom Line

The Triple Bottom Line (TBL) is a concept John Elkington introduced in the mid-1990s to measure sustainability in corporate America [24]. It is a framework that encourages organisations to consider their businesses' social, environmental, and economic impacts. The TBL goes beyond just financial profits and emphasises a holistic approach to sustainability. Businesses, non-profits, and governments use the TBL to evaluate their performance and support sustainability goals. Unlike traditional reporting

frameworks, the TBL incorporates ecological and social measures, making it a comprehensive accounting framework with three performance dimensions: social, environmental, and financial [24]. The three dimensions of the TBL are often called the three Ps: people, planet, and profits [24]. By measuring the impact of an organisation's activities on profitability, shareholder values, and social, human, and environmental capital, the TBL captures the essence of sustainability [24].

The TBL framework applies to food waste in various ways. First, the environmental impact of food waste is significant, including resource depletion during production, transportation, and storage, as well as greenhouse gas emissions from rotting food in landfills, which produce methane, a potent greenhouse gas [25]. Overproduction and waste also harm ecosystems and lead to biodiversity loss [26]. Second, social food waste exacerbates hunger and poverty, and redirecting surplus food to those in need can address this issue [26]. Proper food management positively impacts public health and fosters community engagement [26]. Initiatives to reduce food waste involve communities and foster collaboration. Third, economically efficient food management reduces businesses' costs while repurposing food waste can create new revenue streams [27]. Responsible food sustainability practices also enhance a company's image and brand reputation [27]. Organisations can adopt TBL approaches to reduce food waste, such as collaborating with food banks for donation programs, implementing efficient logistics and inventory management for supply chain optimisation, and educating consumers about reducing food waste at home [28]. Addressing food waste through a TBL lens benefits the planet, people, and profits. Organisations can positively impact and contribute to a better world by adopting sustainable practices and minimising waste.

LITERATURE REVIEW

Experts have identified food waste as the most pressing issue in waste management. It is a significant problem that requires immediate attention. Food waste pertains to the squandering or discarding of food items at any stage of the food chain, including leftovers from home-cooked meals, unconsumed food at restaurants, and various other sources [1]. Notably, the concept of food waste encompasses multiple subcategories. Specifically, food loss denotes the agricultural, forestry, and fishery products that remain uneaten during production and distribution due to weather conditions or disruptions in the supply chain [29]. Conversely, food waste pertains to human-consumable food that goes to waste or expires, including spoiled food, plate waste, discarded peels, and rinds [29]. To capture effectively the full extent of inefficiencies arising from unused food in the food system, researchers utilise the term "food loss and waste" to describe both categories of this issue comprehensively [29–31].

Moreover, the twelfth objective of the United Nations' Sustainable Development Goals (SDGs) is to achieve "Sustainable Consumption and

Production Patterns" [32]. This objective recognises the significance of sustainable consumption and production (SCP) in enhancing social welfare, minimising environmental damage, and ensuring the efficient utilisation of resources and energy [2]. Goal 12 transforms consumption patterns and societal structure by promoting circular behaviour, reducing waste, and encouraging sustainable consumption [2]. It urges economies to ponder the extraction of natural resources, allowing ecosystems to flourish and supplement human life. The goal also emphasises the importance of early access to information on sustainable living and the introduction of recycling education in schools [33]. However, successfully implementing this objective is challenging, as many recyclables often end up in landfills rather than being disposed of properly [33]. Additionally, the goal is primarily aimed at developing countries already undergoing industrialisation and poverty alleviation and are responsible for the poorest consumption patterns worldwide. To achieve this goal, governments must implement efficient waste management systems, such as reducing food waste by 50% by 2030 [2].

Furthermore, the food and beverage sector assumes a pivotal role in the issue of food waste, with significant contributions arising from both the production and consumption facets within the industry [3]. According to the [34], the global annual waste of food amounts to one billion tons. Approximately 40% of all food in the United States goes to waste, with 66 billion pounds representing commercial leftover food waste [3]. Similarly, in the United Kingdom (UK), the hospitality and food service sector generates 1.1 million tons (12%) of the 9.5 million tons of food waste produced annually [3].

Correspondingly, restaurants throughout New Zealand contribute a staggering 24,375 tonnes of food waste each year [35]. On average, a single café or restaurant in the country generates roughly 2.8 tonnes of food waste annually [35]. Such alarming statistics underscore the need to implement collective efforts to reduce food waste in restaurant settings.

Similarly, effectively addressing the issue of food waste within the food and beverage sector requires a thorough identification of the underlying causes and contributing factors. One study found that food and beverage managers regarded staff performance as a significant factor in food waste [36]. For instance, newly recruited employees undergoing training were more prone to errors during food preparation, leading to food wastage. Moreover, food and beverage managers reported that employees required additional skills to peel fruits and vegetables properly and discard edible parts of fresh produce [36]. Conversely, employees expressed concerns about throwing away food for which guests have already paid, deeming it unethical [37]. Based on the study's findings, it is evident that employees consider food wastage unethical [37]. Thus, it is crucial to recognise the roles of managers, chefs, and waiters in reducing food waste.

The Issue of Food Loss and Waste in the Hospitality Industry

It has been demonstrated that the hospitality industry significantly contributes to food loss and waste (FLW) in many countries, primarily due to the rise in out-of-home food consumption and increased disposable income [38,39]. Wrap [39] reported that the UK and the US are among the highest producers of FLW, with the UK generating over 10.7 million tons annually and the US is potentially holding a world record [40]. According to [41,42], the hospitality industry, has had a significant environmental impact, and many businesses are exploring the feasibility of adopting environmental management practices to reduce their carbon footprints and improve their brand images. As a result, it has been suggested that one of the biggest challenges in this regard is FLW, which requires innovative solutions to reduce waste disposal costs, improve corporate image, and contribute to environmental conservation and social well-being [43].

Management Efforts in Reducing Food Waste

Star-rated hotels can ensure responsible environmental practices and promote sustainability by implementing effective food waste management procedures. Several studies have identified that star-rated hotels are working towards sustainable food waste management and practices [44–47]. For instance, [46] reported that five-star hotels significantly influence food waste management policies. Further, their study asserted that chain-owned hotels have specific waste management guidelines focusing on holistic sustainability. Moreover, their study showed that self-managed properties promote waste management policy, mainly influenced by awards recognition [45]. Additionally, [44] found that two five-star hotels in their study applied measures such as quality control (QC) and the first in, first out (FIFO) system in receiving and storage. Similarly, [45] reported that both four-star hotels in the analysis follow similar management styles based on three crucial pillars: guest attendance control, efficient departmental communication, and proper storage and management of perishable goods. Likewise, [47] revealed that twenty Sri Lankan star-class hotels use various techniques to reduce food waste and save money, including setting kitchen department targets, operating according to hotel front office instructions, forecasting guest numbers, and using live cooking to store uncooked raw materials. The literature indicates that properties in the hospitality industry are playing their role in integrating food waste policies in their operations, regardless of the size or scope of the effort.

Collaboration to reduce food waste can create a sustainable future. Research suggested different types of partnerships that are beneficial in reducing food waste [46,48,49]. De Visser-Amundson [48] showed through a food waste challenge (FWC) involving 172 restaurants in the Netherlands the significance of cross-sector associations in tackling societal issues such as food waste. The FWC involves interdisciplinary and outcome-driven

approaches, including behavioural interventions like social norms, block leaders, prime nudges, and pre-commitment manipulations. The study results reported a 21% decrease in food waste across 172 restaurants, resulting in an average reduction of 17.1 kg per week and 2.44 kg per day per restaurant, resulting in savings of 75.240 kg of food and 150.480 kg of CO_2 ([48], p. 11). Similarly, [49] suggested that the Cypriot hospitality sector should develop partnerships with charities to donate unsold food, and local authorities should provide support with free logistics to collect food from hotel units. Furthermore, [46] identified two hotels in the research that found that partnering with local farmers is necessary for food waste management, as hotels use fresh ingredients, reduce downtime and transportation costs, and reduce waste in food preparation and operation. Therefore, cooperation between stakeholders can be a helpful strategy in the fight against food waste.

The hospitality sector is prepared to take on the challenge of sustainable growth. According to [50], hoteliers are aware of the importance of sustainability, but their future perspectives are not aligned with systemic changes or radical innovations. Instead, they focus on applying advanced technologies for sustainable development, such as water, energy use, and minimising waste, but face barriers to implementation due to guest experiences, building structure limitations, and investment costs. Melissen et al. [50] study revealed that hoteliers prioritise human resources and social sustainability, focusing on training employees, providing career opportunities, and team building. Return on investment is vital for sustainability initiatives, but none of the interviewees recognised the need to adjust their business model or repurpose their company [50]. Although most sustainability initiatives focus on environmental aspects, some express positive experiences. Further research is necessary to understand guests' needs and preferences and the industry's alignment with environmental and sociocultural needs.

Staff Efforts in Reducing Food Waste

Adopting an ethical food waste approach by staff can lead to cost savings and promote sustainability in the food service industry. Min-Yen and Wen-Hwa [51] conducted a study that surveyed males aged 21–40, focusing on non-management positions in Taiwan's catering industry, including hotels, restaurants, and group meal companies. Their research found that ethical sustainability positively impacts professional competence in food waste prevention and self-efficacy. Additionally, the study concluded that females are more cognitively advanced, and self-efficacy is necessary for enhancing knowledge and skills [51]. In contrast, [52] examined factors influencing pro-environmental behaviour in luxury hotels and found that employees' approach to food waste prevention is primarily driven by financial interests rather than moral considerations. They also found that employees view waste prevention from a pragmatic-rational perspective, challenging traditional ethical perceptions. The study

suggests that understanding the interplay between attitudes and subjective norms is crucial for designing effective interventions for food waste reduction [52].

Training staff is crucial in reducing food waste and improving sustainability practices. For example, [53] interviewed chefs, store managers, and servers from a Taiwanese chain restaurant company. Their research revealed the importance of employees' awareness of food waste issues. As a result, the restaurants offer online training courses on food safety, waste management policy, and customer relations through a smartphone application. Moreover, participation is based on positions, and reducing food waste requires cooperation between management, employees, and customers [53]. Further, the results of a study by [54] reported that establishments providing employee training generate an average of 34.5% less mixed waste. Similarly, [37] found that training employees in food waste management improves their perception and implementation of related strategies, encouraging them to adopt a food waste reduction culture and maintain good practices. Mabaso and Hewson [37] concluded that staff training should focus on food waste practices and financial, environmental, and social responsibility aspects of the hotel's best practices.

Buffets are responsible for increased food waste, as reported by [36] in a study conducted with food and beverage managers, chefs and servers from the Mauritius hotel sector. The study stated that hotel buffets offer various food and culinary themes to satisfy customers during important events. Moreover, food and beverage managers emphasise freshness and appealing displays, prompting staff to refill the buffet, making this service a challenge in food waste reduction, as it is typically done until the end of the buffet, even when customer numbers decline [36]. Accordingly, [55] revealed that the most influential factors contributing to food wastage in buffets are consumers, promotions, unexpected factors, menu planning, food preparation, and purchasing. The research results showed that the top contributing factor to food waste was the amount of food taken by consumers. However, it is worth considering the impact of procurement practices on food wastage [55]. Hotels should adopt a multifaceted approach to combat this issue, including raising consumer awareness, optimising menu planning, and implementing stricter procurement and promotional controls.

Customers' Efforts in Reducing Food Waste

According to [56], the primary cause of food waste in the hotel industry is imprecise consumer demand forecasts, which are linked to the percentage of guests that check-in. Food waste generation is predicted to increase with a lower value of this ratio. Pirani and Arafat [56] stated that hospitality organisations prioritise precise forecasts of the number of guests to reduce food expenses. However, the forecasted customer volume did not always accurately align with the actual number of customers.

These businesses, however, are hesitant to take the chance of underestimating the amount of food required to satisfy patron demand; they would instead fall on the side of excess. [56] discovered that striking the right balance when determining how much food to prepare depends on variables, including prior visitor trends, the predictability of guest counts, menu size, and outside variables like nearby hotels and restaurants. Even though computational equipment can predict cooking portions, many chefs still rely on their experience. Similarly, buffet operations and preparing 30% more food than needed for reservations resulted in a food surplus, which contributed to excessive food waste, as identified by [38] through an interview with the restaurant's head chef. This highlights the significance of accurately predicting the number of customers to prepare food for, as it is essential to avoiding food surplus. Hotels need to enhance their guest show-up percentage because it is one of the key elements influencing the amount of food waste produced in a hospitality facility.

Consumer awareness regarding food waste is crucial in reducing it, as asserted by a considerable amount of literature [36,45,46,53,57]. For instance, [45] posited introducing an online platform for donating food and promoting awareness campaigns at various levels to reduce unsustainable behaviour among guests. Bhajan et al. [36] found that 40% of daily food waste occurs at the consumer's plate, indicating a lack of awareness and sensitivity to food waste's environmental, social, and economic impacts. Similarly, [53] showed that restaurants can reduce food waste by adjusting menus based on guest preferences and quality and educating customers on proper portioning since they are the primary contributors to food waste. Likewise, [46] suggested the need for awareness and practice in organisations to reduce food waste. Finally, [57] reported that visually engaging methods, such as using colourful illustrations that display the rights and wrongs of proper food consumption, effectively control guests' actions. Hence, customer education and aggressive sensitisation are essential to foster a zero-food wastage culture.

Effective communication strategies can encourage customers to participate in food waste reduction efforts. Olavarria-Key et al. [58] conducted a significant study that examined various interpretations of patrons' viewpoints regarding communication for food waste reduction in restaurants. Study 1 conducted focus groups with nine university students studying hotel management in the South of the United States [58]. The interview discussed topics such as communication techniques, ordering patterns, awareness, and possible results of successful food waste reduction communication. Accordingly, study 2 was built on the insights of study 1 that revealed the impact of communication modality, presentation order, and mindfulness on customers' intention to follow food waste reduction policies in airport food service settings. Olavarria-Key et al. [58] found that hunger, satiation, habits, and financial

consciousness influence food waste messages during the ordering stage. People with high mindfulness consistently supported food waste reduction efforts, irrespective of communication modality. Individuals with low mindfulness demonstrated intentions influenced by communication methods, showing decreased support for food waste reduction when messages were delivered verbally before meals. The studies suggested that the impact of hunger on attention to food-related information could explain increased support for food waste reduction in a food service context [58]. Moreover, [59] confirm that specific communication strategies can successfully encourage hotel customers at the all-you-can-eat sun and beach resort hotels to reduce food waste. Edible plate waste immediately decreased due to context modification, and the attitude-behaviour-context theory demonstrated that the tools' context alteration raised the total attitude-context combination above the behavioural threshold. The most effective point of contact was the guest table's tools, which many visitors thoroughly studied, demonstrating that lowering environmental impact was a deliberate and thoughtful choice [59]. The research indicated that by using specific written and graphic communication methods, customers can be persuaded to act more responsibly.

METHODOLOGY

The selected research methodology was qualitative, which is well-suited for investigating food waste management in the food and beverage industry of Invercargill, New Zealand. Qualitative methodology is well-suited to data on this thesis because it allows the researcher to assess the current attitudes and behaviours of food waste, reduction strategies and motivators to reduce food waste through the view of professionals' experiences in this sector, which is usually performed in the field, providing an understanding of the situation [60,61]. This approach will provide a comprehensive understanding of waste generation, considering socio-cultural, economic, and environmental factors. The qualitative data for this study was gathered through semi-structured interviews, covering topics such as knowledge of food waste, challenges, and approaches. Its holistic nature allows for exploring various aspects and comprehending the interconnected factors influencing food waste management practices. The rich data from qualitative research offers a deeper insight into food waste management issues in the industry.

Therefore, this study opted for a descriptive method to provide a comprehensive account of the events experienced by individuals or groups within Invercargill's food and beverage sector, specifically from the perspectives of managers, chefs, and servers. The choice of this method was deliberate and based on careful consideration. A well-structured, meticulously designed research framework is crucial for guiding the study's trajectory and offering a systematic path throughout the research process [62]. By using a descriptive approach, the study aims to deliver an

all-inclusive account of these experiences, ensuring thorough and detailed insights into the sector's dynamics [62]. As illustrated in Table 1, a detailed overview of the research methodology is presented.

Table 1. Overview of the research methodology.

Research Philosophy	Overall Approach	Design	Method(s)	Role of Researcher	Kind of data Collected	Intended Analysis
Interpretivism	Descriptive	Phenomenology	Interviews	Involved	Qualitative	Inductive

Method: Interviews

Interviews are a widely used method for researchers to gather qualitative data. Qualitative research interviews are preferred in order to understand individual perspectives rather than generalise about large groups [63]. The interview can be viewed as a form of communication, with both the interviewer and interviewee playing active roles [64]. Research interviews aim to comprehend individuals' perspectives, experiences, beliefs, and motivations on specific subjects, offering more profound insights into social phenomena than quantitative methods such as questionnaires [65]. Interviews are particularly appropriate when there is limited knowledge about the study phenomenon or when in-depth insights are required. Saunders et al. [66] highlighted the importance of asking targeted questions and actively listening to interview responses to explore a phenomenon effectively. Furthermore, creating an interview schedule involves formulating open-ended, neutral, and easily understood questions that can provide valuable insights into the study phenomenon and research objectives [65]. It is essential to begin with straightforward questions and gradually move to more complex topics to establish a good rapport with the interviewees and encourage them to share rich and detailed information, which can be further explored during the interview [65].

As a result, interviews were chosen as the preferred method for gathering information, enabling researchers to explore the meanings constructed by the participants themselves [67]. This method promoted empathy and understanding due to the open-ended and conversational nature of the interview process [67]. Moreover, interviews were well-suited for studying complex situations, enabling the interviewer to pose and elaborate on intricate questions in person [68]. They helped collect in-depth information, capturing non-verbal reactions and ensuring that questions were comprehensible to the respondent [68]. Therefore, interviews could uncover insights into the generation of food waste and current practices by Invercargill's food and beverage sector. In the field of social research, various types of interviews are commonly employed, including unstructured, semi-structured, and structured interviews [69].

The researcher employed a semi-structured interview design because it is a method widely used in development research that emphasises

specific themes through a conversational approach [70]. This method provides valuable insights into individuals' motivations, attitudes, beliefs, and the effects of policies or events on their lives, revealing unexpected information from diverse sources such as ministry officials, farm workers, and head teachers [70]. Semi-structured interviews were a powerful tool for gathering qualitative data. They combined the formal structure of structured interviews with the flexibility of in-depth interviews, making them great for collecting structured and unstructured information [71]. The interview schedule was similar to a structured interview, with closed and open-ended questions. During the interview, the interviewer recorded responses accurately, using prompts and probes to obtain spontaneous views from the interviewee [71]. Overall, this interview design allowed the collection of verbal statements from professionals in the food and beverage sector that revealed their knowledge of food wastage and strategies against food waste.

Procedure

The researcher initiated the approach to food and beverage organisations through a written invitation via the email address found on their official websites or social networks, follow-up emails, and face-to-face invitations where necessary to secure an interview. This is called purposive sampling, in which the researcher deliberately chooses individuals based on their judgment to collect the most pertinent information for a study [68]. This approach is valuable for uncovering historical facts or describing unfamiliar phenomena. Further, an invitation letter campaign was established, which relied on interpersonal relations and connections between people to connect with experienced professionals in the local restaurant industry, known as the snowballing sample technique [72]. Only those who accepted the invitations participated in the Invercargill interviews. The interviews were conducted in their workplaces at convenient hours for the participants, always avoiding busy hours or any interruptions for the participants. The data was recorded using Microsoft Teams and a mobile phone during interviews. It was password-protected, and the speech was transcribed using the Microsoft Teams transcription function. A participant information sheet provided details about the study, and a consent form was given to the participants before they began the interview. The researcher initiated the interview only after the participants had read the information sheet and signed the consent form. The target was to interview ten to fifteen participants. The researcher secured ten interviews at interview saturation.

Participants

Four women and six men from various backgrounds participated. Some had over ten years of experience in the food and beverage sector,

while others had worked in the industry for a year. Table 2 presents the demographic information of each participant.

Table 2. Demographic information.

Code	Gender	Age	Education Level	Role	Work Experience in the Food and Beverage Industry
1	Male	21–30	Diploma	Manager	One year
2	Male	41–50	Diploma	Owner/Chef	Twenty-five years
3	Female	41–50	Other	Owner	Fourteen years
4	Female	21–30	Undergraduate	Server	One year
5	Male	31–40	Postgraduate	Operation Manager	Three years
6	Female	41–50	Undergraduate	Manager	Seven years
7	Male	31–40	Postgraduate	Assistant Manager	Six years
8	Male	21–30	Diploma	Manager	Seven years
9	Male	31–40	Postgraduate	Co-owner	One year and a half
10	Female	31–40	Other	Co-owner	Fifteen years

Data Analysis

Analysing qualitative data typically involves a complex and time-consuming process, mainly due to the initial task of organising the data into a manageable format. Regardless of the form in which the data is presented, reorganising it is necessary. Various approaches to qualitative analysis encompass thematic analysis, grounded theory, narrative analysis, template analysis, and content analysis [66]. The chosen analytical approach for the study was thematic analysis, a commonly used qualitative descriptive research method for analysing qualitative data [73]. This method involves identifying, analysing, and interpreting recurring patterns or themes in the data. Thematic analysis typically consists of six stages: familiarisation with the data, coding, generating, reviewing, defining, naming, and writing up [73,74]. This method is particularly suitable for studies seeking insights into individuals' perspectives, opinions, knowledge, experiences, or values from various qualitative data sources, such as survey responses, social media profiles, or interview transcripts. Furthermore, the thematic analysis was conducted using an inductive or bottom-up approach. Inductive analysis is data-driven, with the identified themes strongly linked to the data and not driven by the researcher's theoretical interests [75]. Moreover, data collection was stopped after the 10th participant as no new information emerged from the interviews with the 10th interviewee. At this stage, the researcher recognised that data saturation had been reached. According to [76], saturation is often defined as the point at which no new

information, codes, or themes are obtained from data. It originates from the more precisely defined concept of theoretical saturation in grounded theory. Saturation has also been recognised as the most frequently cited rationale for sample size in qualitative research [76]. Further, data saturation has become closely associated with thematic analysis [76].

Ethical Considerations

An ethics application was submitted to the Human Research Ethics Committee of the Southern Institute of Technology | Te Pūkenga to obtain approval. The application comprehensively outlined the study, including its aims, objectives, and the type of participants involved in the research. The committee approved the research project Ref. 2024/53 after reviewing the information provided in the ethics application.

Ethical Interview Process

Before the interviews began, participants were provided with a participant information sheet containing a summary of the overall study. All participants were explicitly informed that they had the right to withdraw from the study at any time, even after providing informed consent. The researcher further clarified that participation was voluntary, and that refusal to participate or withdrawal from the study would not impact the quality of the research or the participants themselves. Once the participants understood the requirements, a consent form was provided, and each participant provided their signature before the interview commenced.

The study used pseudonyms to safeguard participant anonymity during data analysis, as the researcher was not authorised to publish private information.

RESULTS

The data was meticulously gathered through ten semi-structured interviews involving individuals from management, chef, and waiter positions in the food and beverage industry of Invercargill, New Zealand. The interviewees consisted of six men and four women aged 21 to 50. Hence, analysis and findings are attributed to Participants 1 through to 10. Furthermore, the study employed a thematic analysis model to identify the prevalent themes within the data. Thematic analysis is a systematic approach that allows researchers to spot recurring themes within the data through interpretation and analysis of theme frequency [75].

Theme: Understanding Food Waste

Participants were asked for their opinions on what is food waste. Participants' discussions started with their interpretations of food waste, which shed light on the various aspects of food waste, covering topics such as food preparation methods, consumer behaviour, environmental

impacts, and the difficulties in managing excess food. The insights shared by the participants offered valuable perspectives on the intricate nature of food waste in diverse settings, including food service establishments and individual consumer practices.

"I would say food waste is the disorganised food we make, and we do not forecast if it is going to be used in a particular quantity. The ones that are wasted are leftovers; you can say food leftovers usually are food waste. It could be vegetables or the whole meal. The rice could be anything. Basically, in my opinion, the leftovers are not used, and you do not know how to use them" (Participant 7).

"Food waste is anything that is part of the food that is wasted by whoever is consuming it. It can be waste off of the plate, waste from the kitchen, or waste from homes" (Participant 8).

"Things that have been harvested, grown and then ended up in landfills" (Participant 10).

Subtheme: perception of food waste

The subtheme from this question allowed the researcher to understand that each participant has unique perspectives and diverse viewpoints on food waste and their establishments. One participant emphasised the importance of minimising waste by preparing food only upon order, thus reducing waste at their end. Another participant expressed a strong aversion to food waste, highlighting efforts to keep waste to a minimum and disliking the idea of food being thrown away unnecessarily. In addition, a participant mentioned discarding food waste without considering the environment. This diversity of viewpoints adds depth and richness to our understanding of food waste management.

"There is no waste on our end because everything we make is by order, but there is on the customer's end" (Participant 2).

"I do not like it. Do not like food waste. We have personally been here trying to keep it to a minimum. Obviously, it can be a wee bit hard. But always try to keep it to a minimum. And, no, I do not like food waste" (Participant 3).

"I am close to beverage waste. If there were leftovers, I chuck it out to the basin. I never thought about the environment" (Participant 4).

Participants also delved into various aspects of food waste, including customers' disposal of leftovers, the potential reuse of food items such as carrots for soups, and the challenges of managing leftovers and forecasting food quantities to prevent waste. Furthermore, participants described instances of food waste occurring due to over ordering and excess consumption, leading to uneaten food being discarded.

"The customer here and then if they do not take like if the leftover usually, they take away they do takeaways, but if not, that also is food waste" (Participant 6).

"Ingredients like a carrot, and then we can still use them at the end, like the part and for making soup or something else" (Participant 3).

"Food waste would be the disorganised food we make, and we do not forecast if it will be used in a particular quantity" (Participant 7).

Overall, the analysis revealed a shared understanding of food waste as a significant issue that occurs at various stages, from production to consumption, and efforts are being made to address and reduce this waste.

Subtheme: identification of food waste in different categories

This interview question mainly focused on categorising the waste into non avoidable, avoidable, and possibly avoidable groups. The objective was to gain insights into the sources of waste, recognise any recurring patterns, and pinpoint opportunities for enhancing waste reduction initiatives.

Non avoidable Food Waste: This category comprises eggshells, vegetable skins, and animal bones. According to participants, these items are inevitable in food production and cannot be avoided.

"Most here probably like eggshells, vegetable and fruit peels, and things like that" (Participant 3).

"Non avoidable (eggshells, vegetable skins, animal bones)" (Participants 6, 9, and 10).

Avoidable Food Waste: Participants emphasised that avoidable food waste primarily stems from uneaten food on clients' plates and cooking mistakes.

"The food left by the client; you have to dispose of them" (Participant 2).

"Quite a lot of uneaten food" (Participant 5).

"I would say from our restaurants would be the extra food left by the customers" (Participant 7).

"It is avoidable that the customers do not finish their food from the place that's the most common" (Participant 8).

Possibly Avoidable Food Waste: This category includes expired food and overripe fruits. One participant acknowledged that these items could be minimised or repurposed with better management practices to reduce overall waste.

"Sauces, spices. Stuff is outdated" (Participant 5).

In summary, the insights provided by the participants indicate that the primary sources are avoidable food waste, which is leftover food on customers' plates, and non-avoidable waste, which is viewed as an inherent part of food preparation.

Theme: Awareness and Perception of Food Waste in the Restaurant

The theme determines the awareness and perceptions of food waste within the participant restaurants. It scrutinises the factors contributing to waste and potential strategies for waste reduction and promoting sustainable practices. Addressing these aspects aims to enhance the understanding of food waste dynamics in restaurants and facilitate the development of more effective solutions to address this pressing issue, as pointed out by two participants.

"I think we all do, really" (Participant 1).

"Always" (Participant 5).

Subtheme: recognition of the food wastage problem

This interview question mainly addressed how restaurant owners and managers perceive the issue of food wastage in their establishments. Some acknowledge and work to minimise the issue, while others appear to downplay its significance or deny its existence entirely.

"We are not too bad. I mean, we do have food wastage, but I would not say it is a problem. Minimal" (Participant 3).

"Many restaurants, including ours, as well, but we try to keep it to a minimum. But yes, we do face a problem every now and then" (Participant 7).

For example, one participant reflected on the early days of their restaurant operation and admitted to facing a substantial amount of wastage initially due to a need for knowledge on utilising all food items efficiently. However, the restaurant developed strategies to reduce waste over time, such as creating new menu items to use leftover ingredients effectively. This proactive approach demonstrates a clear recognition of the food wastage problem and a willingness to address it.

"We have been here for six years. At the beginning of the operation of this restaurant, we had a lot of waste because we did not know how to use them, and we then, you know, time goes on, and then we find that the way to use it for like properly like knows the without any waste" (Participant 6).

Further, some participants need to pay more attention to the extent of food waste in their establishments. One participant mentioned that they offer small portions of food, believing this mitigates the issue significantly.

"We offer small portions of food, so it is not too big a problem" (Participant 4).

Some restaurant participants claimed not to have a problem with food waste in their establishments.

"No, we do not have a problem with food waste" (Participant 8).

"No" (Participant 10).

Interestingly, there are also contrasting perspectives on customer behaviours impacting food waste. One participant observed that their customers consumed all the food on their plates, leaving minimal waste. This suggests that customer habits and preferences can influence restaurant food wastage.

"I believe my restaurant does not have that too much food waste from the kitchen, and sometimes I can see how much the customers eat on their menu but hardly leave any food. They squeeze all even the sauces and eat all of them" (Participant 9).

The analysis reveals various perceptions of food wastage recognition in the restaurant industry. It underscores the importance of recognising the varying degrees of awareness and actions taken towards food waste management. This recognition is crucial as it paves the way for a tailored

approach to promoting sustainable practices within the food service sector, considering the different engagement levels among stakeholders.

Subtheme: mealtimes where food waste is most observed

The question under this subtheme focused on mealtimes to identify a pattern on wasted food. There was a clear consensus among participants on the meal during which food waste was most prevalent. Some participants highlighted dinner as the meal with the highest food wastage due to the larger portion sizes served and the tendency of customers to overestimate their appetite, leading to leftovers that are often not taken home.

"Dinner. We are not busy enough; then the food can only be kept for a certain amount of time" (Participant 1).

"Dinner time. Because dinner is a bigger meal, and then, as I say, people cannot think it is a big food, and then they cannot finish it, and they do not want to take it home the next day" (Participant 2).

"Dinner time, the family is willing to have so much food because it is the end of the day; they will be hungry because it is six hours from lunchtime. They may be a little bit greedier to eat more" (Participant 9).

In contrast, one participant pointed towards lunchtime as the period when food wastage is most prevalent, attributing it to rushed eating habits and ordering more than necessary due to time constraints.

"From my experience, I have witnessed that most of the lunch. That causes food wastage. It could be because people are in a rush. They want to go back to work. They feel hungry. They order too much food, but they do not realise they can finish it" (Participant 7).

Moreover, breakfast was mentioned as a meal where food wastage occurs, primarily because the dishes are available until a specific time. This indicates a time-bound aspect contributing to wastage.

"Breakfast, because the chefs' dishes are available by 2:00 pm" (Participant 4).

Additionally, insights from another participant suggested that in their setting, lunch was identified as the meal with the highest wastage, which they attributed to serving more lunches than dinners.

"Probably lunch. I think here people order food but do not realise how big the meal is going to be" (Participant 3).

"I would say lunch, but I am only saying that because we serve more lunch than dinner" (Participant 8).

Interestingly, one participant highlighted that while uneaten food was minimal in their establishment, the food preparation stage generated the most waste, particularly in vegetable items, which were managed by segregating and repurposing the scraps for animal consumption, thus minimising landfill waste.

"We get very little uneaten food. It would be in the food prep area, where we probably have the most volume. However, all our food scraps go to bins,

so they do not go to landfills. It would be vegetable items for us that have the highest volume of waste and the preparation of them" (Participant 10).

Therefore, the analysis reveals that the meal during which food wastage is most prominent can be influenced by factors such as portion sizes, customer behaviour, time constraints, and kitchen operations. The findings underscore the importance of understanding these factors to implement effective strategies for reducing food waste in different meal settings.

Theme: Attitudes Towards Food Waste

This theme primarily focuses on attitudes towards food waste, which indicates a heightened awareness among restaurant owners and customers about the environmental and economic consequences of throwing away food. By emphasising creative solutions and nurturing a sense of responsibility, the restaurant industry can take significant steps towards minimising food waste and advocating for a more sustainable future. One participant expressed their level of concern internally and externally.

"It is only an area of concern from a larger environmental point of view. I feel like, from a macro point of view. I feel like if people take care not to waste food while going out or in their homes, it is just that there will be more food for us, you know, just globally to distribute among people. We can all be more mindful of how much food is, like making sure we only use as much as we consume. Yeah, but from a restaurant manager's perspective, it is not a problem for this cafe because we have ways to manage that. I wish our customers would finish their dishes, but we do not have an issue" (Participant 8).

Subtheme: concern level regarding food waste in the restaurant

This interview question was mainly about the issue of food wastage in restaurants, which is complex and multifaceted, as revealed through insightful discussions with various participants. Different perspectives emerged regarding the extent to which food waste is considered a critical issue within restaurant operations. The discussions highlighted contrasting attitudes and approaches toward addressing this challenge.

One prevalent viewpoint is the significance of minimising food waste in restaurants, which reflects a consensus among participants. They emphasised that reducing food wastage is connected to broader environmental and economic considerations. Participants recognised that food waste directly translates to food costs, highlighting the strategic imperative for restaurants to mitigate wastage. This financial perspective aligns with a broader view that emphasises the global implications of food conservation and distribution.

"We are always thinking about how to reduce the waste food waste we consider because it can connect to restaurant expenses. If we reduce, then we save more money" (Participant 6).

"I think to a very high extent, considering that people are very environmentally friendly these days. It could be, I will not say, that was the same case back ten years ago" (Participant 7).

"Food waste equals the food cost. We are really trying not to make food waste" (Participant 9).

On the other hand, individual perspectives highlighted the sources and impacts of food waste within restaurant settings. While some pointed out customer behaviours as a significant contributor to food wastage, others emphasised the role of internal processes and policies in waste management. The focus on customer behaviour signals a recognition of the need for enhanced consumer awareness and engagement in reducing food waste.

"It is but probably from customers. The customer's food waste, the leftovers and things" (Participant 3).

"It is from customers who have only 2 or 3 bites" (Participant 4).

Similarly, the internal focus on operational strategies and protocols reflects a proactive approach toward waste reduction from within the restaurant's sphere of influence. Furthermore, insights from these discussions revealed varying management practices concerning food waste in restaurants. Responses ranged from a minimalistic view of waste occurrence to a more proactive stance guided by structured policies.

"It is minimal, but it is something that we do look at all the time" (Participant 1).

"Minimising food waste is a high priority for us. It is in the area of concern of our waste. We have really good policies in place to minimise it. We have very minimal" (Participant 10).

Overall, the analysis highlights the multifaceted nature of food wastage as a concern in restaurants. It underscores the complex interplay of environmental, economic, and operational factors that shape attitudes and actions toward waste reduction.

Theme: Current Practices and Policies

This theme determined the current practices and policies aimed at reducing waste through strategic procedures at every stage of the food supply chain. Effective storage techniques help extend the shelf life of ingredients, while kitchen staff implement portion control and find creative ways to use leftovers. These coordinated efforts illustrate a comprehensive approach to food waste prevention, emphasising the significance of collaboration and innovation across all departments. For instance, one participant remarks on the importance of documenting and finding the issue's root cause.

"Anything that ends up in waste is recorded documentation and why it ends up in the bin. Sometimes, it might be an item that is not being sold enough; it might be a human error" (Participant 10).

Subtheme: existing policies and procedures to manage food waste

The question under this subtheme focused on the establishment's implementation of various policies and procedures to tackle food waste. The analysis indicates they take reactive and proactive approaches to address this issue. One notable strategy involves offering discounts to prevent food from being wasted and selling surplus food to the public before it needs to be discarded.

"We tend to do discounts to get rid of the food, to sell it to the public before it gets thrown out" (Participant 1).

Additionally, these establishments use targeted practices to repurpose food items that would otherwise be wasted, such as reusing vegetables and takeaway items. Proactive measures include structured processes for handling food waste, such as segregating it for collection by local farmers to feed their livestock. Training programs are also emphasised to educate staff on best practices to minimise waste, including proper food handling and portion control.

"Kitchen dates on everything rotate. Obviously, the oldest things get used first. We have people who drop off kindly pig buckets for their farm. That is just sort of our procedure. Any leftovers or food waste that we have always put into the pig bucket that can go in there so that the pigs and things can eat them; that is pretty much the process here" (Participant 3).

"We tried to focus on the training, and the other is the re-usage of the food" (Participant 7).

"We have a separate bucket in the kitchen, but we have a few separate buckets in the kitchen that's only for food waste and goes to farms around Southland" (Participant 8).

Monitoring and evaluation play a crucial role in food waste management. A participant mentioned documenting and analysing wasted items to identify trends and improve. These policies and procedures demonstrate a comprehensive and integrated approach to reducing food waste and promoting establishment sustainability.

"We document why things are ending up there or how they have ended up there so that we can review systems, processes and policies" (Participant 10).

Subtheme: staff role in food waste prevention

This interview question mainly focused on understanding the staff's role in preventing food waste, which is crucial in food establishment operations. They are vital in managing and minimising food waste through various strategies and practices. One significant approach highlighted in the interviews is the focus on portion control and standardisation. Staff members ensure consistent portion sizes and avoid excessive servings. This not only aids in reducing unnecessary waste but also maintains uniform serving sizes, enhancing customer satisfaction.

"I want to say portion sizing, making sure that all the portions are the same, not too much of things" (Participant 3).

Furthermore, the discussions underscore the staff's responsibility for efficient inventory management and stock rotation. Staff members actively monitor ingredient usage, calculate averages, and track expiry dates to prevent spoilage. By closely monitoring supplies and adopting a 'first in, first out' approach, staff significantly minimise food waste and ensure effective utilisation of fresh produce.

"I record how much I buy of the ingredients. Then, record in the Excel file and calculate the average amount used monthly or weekly" (Participant 9).

"We bring stock, and we rotate. Keeping an eye on expiry dates and setting and coming up to expiry date, making sure that they utilised before they're past those time periods" (Participant 10).

Moreover, staff training and adherence to strict recipes play a crucial role in waste reduction. It is highlighted that detailed recipes with specific ingredient quantities help mitigate the risk of errors that could lead to wastage. By following standardised recipes and maintaining consistency in food preparation, staff members contribute to efficient resource utilisation and minimise unnecessary food discard.

"We have particular recipes that are all written down. We have hard copies and files in the kitchen" (Participant 8).

However, the discussions also emphasise the importance of staff behaviour and attitudes towards food waste prevention. Staff members are encouraged to lead by example, avoid overproduction, maintain food presentation without causing waste, and actively participate in donation initiatives.

"We try to train our staff and lead by example by not burning food or anything. And we do not go for the presentation of the food as well. I think that causes a lot of food wastage. We still manage to make our plates pretty much presentable" (Participant 7).

In conclusion, the analysis emphasises that the staff play a multifaceted role in preventing food waste within the establishment. Through practices such as portion control, inventory management, recipe adherence, and promoting a waste reduction culture, staff members significantly optimise resources, reduce environmental impact, and encourage social responsibility.

Theme: Communication and Collaboration

The questions for this theme were primarily centred on the crucial role of effective communication and collaboration in food waste management. As one participant mentioned, open channels and staff involvement are essential. Managers should support strategies involving all staff members to ensure waste reduction and common goals are understood and achieved.

"Multiple times a week, because of their documentation process, which are required to be raised down. All the time, there is a constant narrative

around minimising waste. At the moment, we have roadwork, sales are slower, and we are having conversations about reducing batch sizes, so we do not get food wasted. Knowing that the sales are slowing down, we need to respond and make smaller amounts of each thing so that we do not have things that are not sold. Conversations like that are happening all the time for varying different reasons" (Participant 10).

Subtheme: interactions among staff regarding food waste

This subtheme highlights a consistent effort to address and prevent food waste within the organisations through staff interactions. Staff members engage in regular conversations and training sessions to ensure everyone understands the importance of minimising waste. They have developed a keen sense of responsibility towards managing food waste and addressing the environmental and financial implications for the business.

"We do talk about it. Kind of when we notice that it is becoming an issue because we try to deal with it, and if it starts coming and becoming an issue again, we look at it again" (Participant 1).

"Every day and every time. Check the quality; both shifts communicate with each other" (Participant 5).

"It would definitely be just a conversation that we have with the staff, just letting them know how to take the proper measurements and how to avoid that wastage in the future. And it will be the same thing in the kitchen as well, like if there is a particular staff member happens to waste a little bit of extra product in the process of base making something, it will just be like a teaching approach that we say, as in this is what you have to do next time. This is how you avoid that wastage" (Participant 8).

"Always every day. Because, for example, the food is really hard to take care of" (Participant 9).

Through continuous communication and training, they have established effective strategies for handling food waste. The staff interactions are collaborative and supportive, fostering a culture of open communication, feedback, and empowerment. Hence, the staff interactions demonstrate a proactive and holistic approach to preventing food waste within the organisation.

Subtheme: involvement of key personnel in addressing food waste

The other subtheme that emerged during the interview was the collaboration among key personnel, which is essential in addressing food waste within the organisation. The discussions highlight proactive measures taken by individuals in different roles to mitigate food waste effectively. The involvement of managers, kitchen staff, front staff, and external partners like farmers collecting food waste underscores a comprehensive approach to tackling the issue. There is a shared responsibility and understanding that each member plays an essential role in the process. Training and instilling a waste-reducing culture among

staff are evident throughout the discussions, emphasising a proactive approach to addressing the issue. Strategic coordination and scheduling of food waste collection demonstrate a structured and proactive approach to waste management, showcasing a commitment to upholding food safety standards and environmental consciousness.

"Everyone. And we teach it" (Participant 2).

"All the staff, because if the customer left the food and our part, just ask them to collect it, you know, for take away" (Participant 6).

"All the staff in the kitchen, including the chef and the manager. And as I said, the chicken or pig farmer who comes to collect our buckets is also involved in that. We have a rotating schedule" (Participant 8).

"The head chef and I, but all of our team because they all need to take responsibility for stock inventory and ensuring that products are utilised and at their freshest, but also making sure we can serve food safely, which means not letting food expire" (Participant 10).

Overall, the collaborative efforts and shared accountability among key personnel reflect a commitment to sustainability and a culture of responsibility and efficiency within the organisation, serving as a model for effective food waste management practices.

Theme: Strategies and Future Plans

The central theme is the urgent need to reduce food waste continuously, which requires innovative strategies and forward-thinking solutions. Participants have made significant progress in their establishments by implementing creative and resourceful approaches to minimising food waste.

"I am always looking at information where there might be better practices that we can adapt and adopt within our team. Wherever we see new ideas, we onboard and bring them in and integrate them as part of our processes where they apply to us" (Participant 10).

Subtheme: plans for addressing food waste

This subtheme emphasises that participants actively implement strategies to reduce food waste in their establishments. They have shown significant progress, with one participant noting a substantial decrease in daily food waste since the business started.

"We are trying our best at the moment. We are not doing too badly now. For example, when we first opened it, we had a lot of food waste. There was so much" (Participant 1).

One notable example of efforts in this direction is making vegetable broth from leftovers, demonstrating creativity in utilising food items that would have been wasted otherwise. This proactive approach indicates a shift towards sustainability and resourcefulness in operations, showing commitment to minimising wastage.

"We have just started making our vegetable broth with all our leftovers, like peels or vegetables" (Participant 3).

Moreover, the participants stress the importance of ongoing training and communication to address food waste issues effectively. They recognise the need for continuous improvement, such as regularly monitoring food quality and reinforcing proper handling practices among staff members. This commitment to training and attentiveness in daily operations demonstrates a proactive stance in maintaining food quality and reducing waste in their kitchen.

"The training is every day" (Participant 2).

"Good communication, journaling between shifts" (Participant 5).

The participants display a forward-thinking attitude by considering adjustments to portion sizes and exploring technological solutions like food management applications to track and minimise waste. This proactive approach to problem-solving and openness to innovation reflects their long-term commitment to sustainability and efficiency in their food management practices.

"There is one food-based management application. We have not worked on it officially, but we will discuss it with the higher managers and everything to download those and keep track of the food managed" (Participant 5).

DISCUSSION

This research explores the experiences of managers, chefs, and waiters in food waste management working in the food and beverage sector of Invercargill, Zealand. To delve deeper into their experiences, three research objectives were determined. Firstly, this study describes the situation of food waste generation by the food and beverage organisations in Invercargill. Secondly, the main sources of food waste in Invercargill's food and beverage organisations must be identified. Thirdly, the effectiveness of food and beverage organisations' current food waste management practices in Invercargill is evaluated. The discussion section discusses the study findings, considering the research objectives and the results of previous studies in the same field.

First Research Objective: To Describe the Situation of Food Waste Generation by the Food and Beverage Organisations in Invercargill

This study found that a comprehensive understanding of food waste within the food and beverage industry existed in Invercargill. Participants discussed various aspects of food waste, including food preparation methods, consumer behaviour, and environmental impacts. Accordingly, food waste-related studies have explored food service settings, including educational entities, domestic households and supermarkets [77–79]. Specific international studies have been undertaken regarding the food and beverage sector that address various aspects of food waste arising within this sector [38,55,56]. However, these studies lack consistency in methodology and quantification measures and may not apply to New Zealand's sector [80]. Until recently, new sources from the academic and

non-academic areas have emerged to acknowledge this growing issue of food waste in New Zealand [35,81,82]. The insights highlight that food waste occurs at multiple stages, from production to consumption. Participants emphasised minimising waste by preparing food only upon order and reusing food items, such as carrots, for soups. Similarly, several studies have mentioned an appropriate and practical approach, such as the food hierarchy pyramid, which discusses strategies for food management aimed at reducing food waste and repurposing discarded food [10,12,83]. These strategies are based on the waste hierarchy principles and highlight the most environmentally beneficial waste management options for each step. Hence, recognising food waste as a significant issue is evident, with efforts being made to address and reduce it among the participants.

Second Research Objective: To Identify the Main Sources of Food Waste in the Food and Beverage Organisations in Invercargill

The research findings reveal various sources of food waste, which have been classified into three main groups: non-avoidable, avoidable, and possibly avoidable. Firstly, non-avoidable food waste: this category encompasses items such as eggshells, vegetable skins, and animal bones, considered inevitable by-products of food production. Secondly, avoidable food waste primarily arises from uneaten food on client plates and cooking errors; this category was identified by participants, with leftover food being highlighted as the primary source of avoidable waste. This phenomenon often arises from the disparity between individual preferences and actual appetite, resulting in substantial leftover food [56]. However, it is important to note that consumer knowledge of ingredients significantly influences food waste [55]. When diners are familiar with the taste, characteristics, or proper preparation of specific ingredients, they can make more informed choices, reducing the likelihood of food waste. This should empower consumers to play a more active role in reducing food waste. Thirdly, possibly avoidable food waste: expired food and overripe fruits are included in this group, and participants expressed that with improved management practices, these sources of waste could be minimised or repurposed. Moreover, [35] reported that 61% of food waste is avoidable, while 39% is unavoidable. The smallest recorded amount of avoidable food waste was 13%, with the highest recorded amount reaching 96%. These findings indicate that certain New Zealand businesses have lower avoidable food waste levels than others. Furthermore, the study findings underline that dinner and lunch were the most susceptible to waste due to more significant portions and rushed eating habits. As a result, the total amount of food waste generated appeared to correlate with the business's size and the number of diners served [35].

Third Research Objective: To Evaluate the Effectiveness of Food and Beverage Organisations' Current Food Waste Management Practices in Invercargill

The research assessed existing practices and policies geared towards minimising food waste, outlining both reactive and proactive strategies:

- Current Policies and Procedures: The study participants detailed initiatives such as offering discounts to discourage food waste, repurposing food items, segregating waste for collection by local farmers, and conducting training programs for staff. Kattiyapornpong et al. [46] found that recreating new menus from leftovers, either from buffets or excess pre-cooked food, is a common practice.
- Staff Responsibilities in Food Waste Prevention: The emphasis was placed on portion control, inventory management, adherence to precise recipes, and fostering a culture of waste reduction. The results of a study by [36] showed that participants discussed preventive practices against food waste, including colour-coding systems and the FIFO approach. The colour-coding system tags products closer to expiry dates, ensuring timely use. The FIFO method prioritises products received earlier, reducing spoilage and minimising food waste.
- Communication and Collaboration: The importance of regular discussions, training sessions, and collaboration among key personnel in addressing food waste was highlighted. Diaz-Farina et al. [54] emphasised the importance of providing training since it was identified that establishments that offer employee training to prevent and manage waste produce 34.5% less mixed waste than those that do not offer training.

The effectiveness of these approaches is evident in their comprehensive involvement across all departments, from procurement to service. Furthermore, the study participants deliberated on plans to tackle food waste, including initiatives to create vegetable broth from leftovers, explore food management applications, and enhance training and communication efforts.

LIMITATIONS OF THE STUDY

Recruiting participants proved challenging due to the limited research on the topic and the small scale of the study. After ten interviews had taken place, data saturation was reached, limiting the findings and yielding no new themes. Several businesses declined to participate, resulting in a significant time burden on the researcher. The fast-paced nature of restaurants and cafes often made owners time-poor. Additionally, the Invercargill Licensing Trust (ILT), which oversees various businesses and is mandated to provide excellent hospitality, prioritises public well-being, and supports the community, did not participate in the study. However, the research was carried out independently and objectively, without affiliations to the industry or food waste organisations.

RECOMMENDATIONS FOR FUTURE RESEARCH AND PRACTICE

Future Research

Future research in food waste management within the food and beverage sector of Invercargill, New Zealand, could explore various potential pathways to expand on the current study's findings. This future research should address the limitations and the generalisability of the current study, offering hope for a more comprehensive understanding of the issue. Future research should broaden the geographical scope beyond Invercargill to encompass other regions in New Zealand in order to strengthen the applicability of its findings. A broader comparative investigation could be done between urban and rural areas or regions with differing economic activities and cultural norms. Such comparative analysis could uncover regional disparities in food waste management practices, offering a more comprehensive insight into the issue on a national level. Obviously, if all or some othese are done, it will help offset the current limitations and generalisability lacking in the current study.

Additionally, embracing mixed methods research could yield a more comprehensive and nuanced view of food waste management practices. While qualitative methods provide in-depth insights into individual experiences and attitudes, quantitative approaches could quantify the extent of food waste and the efficacy of various reduction strategies. Surveys and experiments could be used to gather data on the measurable impact of specific interventions, such as public awareness campaigns or technological innovations in waste reduction. In view of the fact that this study is geographically limited to Invercargill in New Zealand with recommendation for further studies in other region of New Zealand. This study further recommend for similar study in Australia from comparative studies perspective.

Future Practice

Firstly, enhancing staff training and regular communication is crucial to continuous improvement in food waste management in Invercargill's food and beverage sector. Regular training sessions on waste reduction techniques, such as portion control, inventory management, and precise recipe adherence, are essential. Open communication among staff members across shifts ensures consistent practices and effective knowledge sharing. This collaborative approach empowers staff to handle food more efficiently and to minimise waste.

Secondly, advanced food management technologies should be pursued to reduce waste significantly. Moreover, implementing food management applications that provide real-time inventory and waste data can help identify areas for improvement. Additionally, creative strategies for reusing leftover ingredients, such as creating new menu items from unused vegetables and other resources are being developed to promote sustainability and resourcefulness. Structured waste management

policies, like waste segregation for local farmers to use as animal feed, further enhance waste reduction efforts while supporting local agriculture.

Thirdly, promoting a culture of waste reduction within the establishment is considered essential. Involving key personnel in waste management discussions and ensuring that all team members understand their roles in reducing waste fosters a collective responsibility. Further, adjusting portion sizes based on customer consumption patterns and planning menus that utilise ingredients efficiently minimises leftovers and reduces waste from over-preparation. This proactive approach ensures that waste reduction becomes integral to the establishment's operations.

Finally, continuous monitoring and evaluation of waste reduction efforts are crucial to ensure ongoing progress. Regularly assessing the effectiveness of implemented strategies allows for timely adjustments and improvements. Educating customers about reducing food waste and encouraging informed choices is also significant. Further, informational campaigns, menu labelling, and promoting the option to take leftovers home are engaging customers in the establishment's waste reduction initiatives. By implementing these comprehensive recommendations, food and beverage establishments in Invercargill are achieving significant reductions in food waste, promoting sustainability, and enhancing overall operational efficiency.

CONCLUSIONS

In conclusion, this research comprehensively examines food waste management within Invercargill's food and beverage sector. It offers valuable insights into primary sources of waste, the effectiveness of current management practices, and the proactive measures taken to mitigate waste. The study highlights the significance of sustainability and responsible environmental practices in addressing food waste. Further, key findings emphasise the importance of staff training, policy implementation, and collaborative efforts within the industry, such as partnerships with charities and local farmers. Moreover, the research points out the crucial roles of management and customers in reducing food waste. It suggests that increased education and awareness campaigns can promote responsible consumption habits among customers. Additionally, the study identified gaps in existing literature, particularly in the context of Invercargill, and suggests that further research is needed to explore the complexities of food waste management across different industry levels and geographic locations.

When it comes to future research, the researchers should consider broadening the geographical scope to include other regions in New Zealand, increasing the sample size, and incorporating a more diverse population. This would help address representation limitations and provide a more holistic view of food waste management practices. Furthermore, adopting mixed methods research could offer a more

comprehensive understanding of the issue, combining qualitative insights and quantitative data to evaluate the effectiveness of various interventions. For practical applications, the research recommends enhancing staff training, implementing advanced food management technologies, and promoting a culture of waste reduction within establishments. Continuous monitoring and evaluation of waste reduction efforts are essential to ensure ongoing progress. Educating customers and engaging them in waste reduction initiatives can further contribute to significant reductions in food waste. By implementing these recommendations, food and beverage establishments in Invercargill can substantially reduce food waste, promoting sustainability and enhancing overall operational efficiency. This study provides a robust framework for future research and practice, aiming to develop more effective and sustainable food waste management strategies in the food and beverage sector.

DATA AVAILABILITY

The dataset of the study is available from the authors upon reasonable request.

AUTHOR CONTRIBUTIONS

Research Topic Title Conceptualization, YS; Ethic Form, YS; Literature Review, YS; Research Methododolgy, YS; Design and Drafting of Interview Questions, YS; Data Collection, YS, OMO; Data Analysis, YS, OMO; Sourcing of Research Findings, YS; Gaining Ethical Approval, OMO; Graphic Themes Design, Development; OMO; Writing—Original Draft Preparation, OMO; Writing—Review & Editing, OMO.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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