A case study analysis of food waste in the production kitchen of an airline catering company in Sweden

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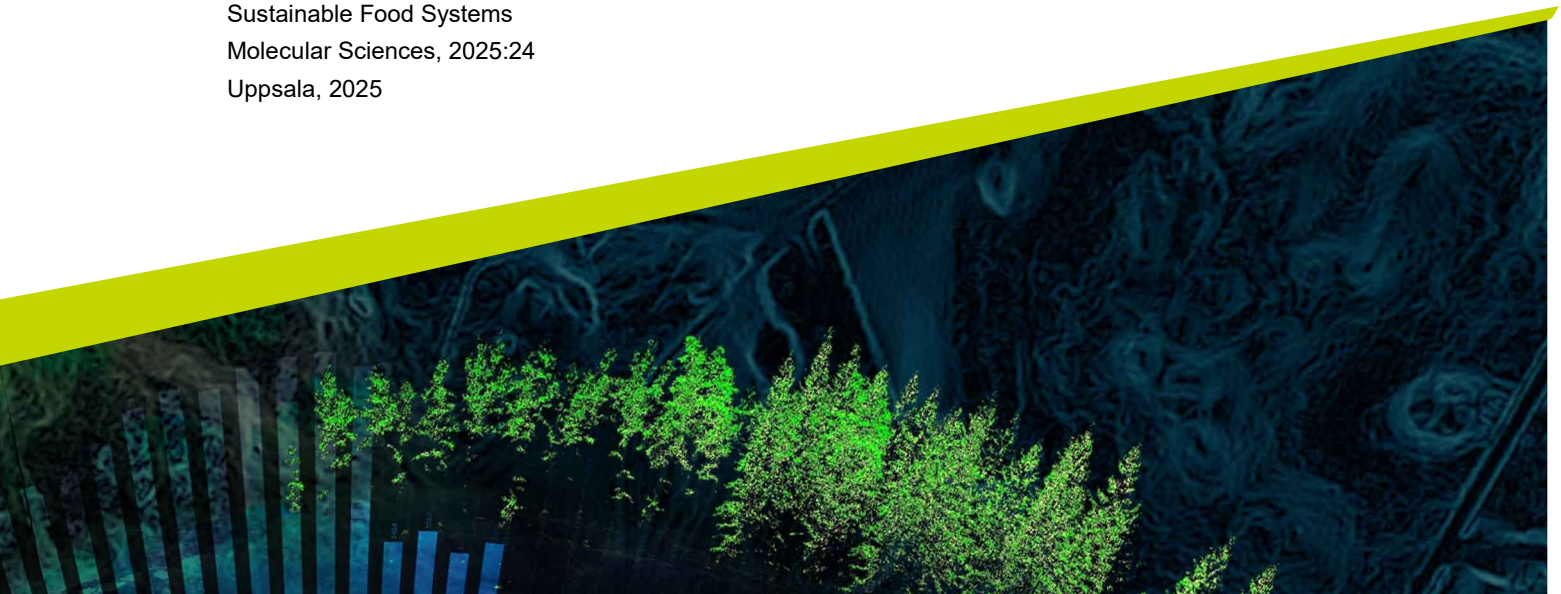

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Abstract

Food waste poses a major global issue with profound environmental, economic, and social consequences, exacerbating climate change, resource depletion, and ecological degradation. Within this context, the airline industry, as a resource-intensive sector, faces increasing scrutiny for its environmental footprint, particularly in relation to in-flight catering services, where food waste not only entails the loss of edible products but also the inefficient use of essential resources such as land, water, and energy. With the huge influence and potential to serve billion of airline passengers, there is a lack of adequate research in this area. Through a case study of airline catering food production, the study aims to address this gap by conducting a comprehensive analysis of food waste within the production kitchen to identify food waste hotspots and interview with the staff to investigate the factors enabling food waste generation. Employing a mixed-methods approach, the research integrates quantitative waste audits with qualitative thematic analyses of staff interviews to quantify food waste and identify its primary drivers. Findings revealed that vegetable waste constitutes 32% of total food waste, with crew and business class meals accounting for 78% of the waste generated.

Notably, the hot kitchen emerged as the predominant source of food waste in volume and edibility, with trolley waste accounting for 69% of the total waste recorded based on waste classification, and preparation and portioning accounted for 28% and 3%, respectively. These insights underscore the need for targeted interventions, such as optimising forecasting systems, standardising menus, and enhancing staff training to promote efficient resource utilisation. The study recommends a holistic, system-wide approach to food waste management, emphasising the most preferred approaches which aim at prevention and reduction at the source instead of the least preferred approach, which is solutions like energy recovery before landfill disposal. By illuminating the composition and drivers of food waste in airline catering, this research provides actionable recommendations for industry stakeholders aiming to implement sustainable food waste management practices and policies.

Keywords: Airline catering, Food waste management, Sustainability

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Abbreviation

FW	Food Waste
FEFO	First Expiry First Out
FIFO	First In First Out
ICAO	International Civil Aviation Organisation
UN	United Nations
UNEP	United Nations' Environment Program
SDG	Sustaianble Development Goals
GO	An airplane passenger class section after PLUS
PLUS	An airplane passenger class section in between Business and GO
SPML	Special Meal
EU	European Union

1. Introduction

Food waste is a critical global challenge that affects many aspects of sustainability. It contributes significantly to climate change, loss of biodiversity, overuse of land and freshwater resources, and pollution of both land and water systems due to the excessive use of fertilisers and animal waste (Campbell et al., 2017; Springmann et al., 2018). Food waste posses an enormous impact on sustainability issue: environmentally, it contribute to the overuse of both renewable and non renewable resources such as water, energy, and land, which consequently affect the quality of the soil, air and water; economically, a significant loss of about $940 billion annually is incurred through high cost and reduced efficiency in the supply chain (Clowes, 2018) and ; socially, food waste promotes food insecurity around the world, due to wastage of edible food that can be eaten by those in need globally.

Globally, a substantial amount of food is wasted at various stages of the supply chain, with households, food services, and retailers being the largest contributors. The 2024 UNEP Food Waste Index estimates that in 2022, 1.05 billion tons of food were wasted across these three sectors, with households accounting for 60%, food services for 28%, and retail contributes around 12%, which is similar to trends seen in countries with high income where a large portion of food waste happens during the final stages of distribution and consumption. In the European Union alone over 58 million tons of food are wasted each year (EU Commission, 2023), and Sweden's annual food waste is on the order of 1.2 million tonnes (Naturvårdsverket, 2022). Of Sweden's waste, households account for over half, but food services contribute about 10–12% (roughly 37,000 tonnes in large-scale catering, about 4 kg per person). Reducing such waste is critical: it helps achieve SDG 12.3, which calls for halving per-capita food waste by 2030 (UN, 2015; UN, 2024) and aligns with Sweden's own sustainability goals to cut food waste by one fifth by 2025 (Naturvårdsverket, 2022).

1.1 Food Waste in food service sector

Food waste has been researched in several settings within foodservice industry including hospitals (Sonnino and McWilliam, 2011; Dias-Ferreira et al., 2015 and Eriksson et al., 2020), households (van Geffen et al., 2019), restaurants and school canteens (Silvennoinen et al., 2012; Eriksson et al., 2017; Lagorio et al., 2018; Tromp, 2021; Lonska et al., 2025). Within food services, airline caterers are major actors but remained understudied. For example, studies across catering, hospitality and institutional foodservice consistently find that about 20% of prepared food is never consumed (Ross, 2014). The airline catering sector "stands out for its worldwide reach and potential to serve over a billion customers every year" and global demand for air travel is expected to continue rising steadily, with passenger numbers forecast to increase by around 2.8% each year

between 2019 and 2050, according to recent projections from ICAO (2024). This projected increase will consequently increase the number of competitive air travel. In addition, stringent food safety regulations inhibit the redistribution of surplus food, requiring meal surplus preparation acts as a precautionary measure against unexpected changes to flight itineraries, and standardised portion sizes often fail to correspond with passenger eating behaviours are some of the distinctive challenges unique to aviation industry (Law, 2011; Rajaratnam and Sunmola, 2021). These factors enable a systemic waste generation pattern that are not observed in other segment of food service industry, thereby rendering waste mitigation particularly difficult, requiring an urgent need to explore the food waste quantification and causation in its production kitchens.

1.2 Food Waste in the Airline Catering Industry

Food waste in airline catering has received relatively little attention compared to ground foodservice. Early studies by Kummu et al. (2012) and Ross (2014) documented that roughly one-fifth of food prepared in foodservice sectors including airlines goes uneaten. Research suggests that cabins often return a large fraction of prepared meals, and the global reach of airlines magnifies their waste generation. In 2014, International Civil Aviation Organisation (ICAO) projected passenger volume to double, influenced by the pandemic, the projection was cut-short, however, in 2022, post-pandemic, study by Chen reiterated the claim that "with air passenger traffic projected to double over the next two decades, the airline catering industry urgently needs to explore the underlying causes of food waste produced in their catering kitchens" and in 2024, ICAO reported passenger air traffic levels were around 2% higher than in 2019, indicating a recovery to pre-pandemic levels. In other words, as aviation expands, addressing food waste, both onboard and in production should be part of the broader goal to tackle the industry's sustainability and climate challenges.

Two streams of research have emerged. Much literature has examined cabin waste: the leftovers and packaging collected after flights (Li et al., 2003; Blanca-alcubilla and Alcubilla, 2021; Blanca-alcubilla et al., 2023) and behavioral drivers: passenger meal choice, satisfaction, pandemic effects (You et al., 2020; You, 2022; Hwang et al., 2023; You et al., 2024). For instance, You et al., (2020) study identify passenger preferences and anxiety (e.g., COVID-19 health concerns) as factors influencing onboard consumption. However, there is scarce data on in-flight production kitchen waste. That is, studies seldom analyse the raw waste generated when meals are prepared on the ground. Thamagasorn and Pharino (2019) explicitly notes "little examination of the waste composition analysis of inflight catering kitchen, causes and potential solutions" in the literature. This highlights a gap: the very stages where meals are cooked, portioned and packed may produce significant waste (trimmings, spoiled ingredients, unsent meals), yet most published work skips these details.

The airline catering context has unique features affecting waste. Strict food safety rules mean that even unopened meal trays must usually be disposed of if unused (You et al., 2020). Catering companies typically overproduce meals as a hedge against last-minute flight changes or cancelled flight (ICAO, 2014). Moreover, portions are often fixed by contract with airlines, so if a passenger eats less than the set serving, the remainder becomes waste. Some broader foodservice studies report that airline kitchens reuse unused items (e.g., condiments) less freely due to hygiene standards. All these factors: regulatory constraints, overproduction buffers, rigid portioning have been identified as distinct drivers of waste that create a systemic waste that is relatively not pronounced in other food service sectors. In short, airline kitchens tend to produce a high level of both edible and inedible waste unless targeted measures are taken.

1.3 Composition and Quantification of Food Waste

Food waste from airline catering is typically heavy in organic content (cooked meals, bread, salad, etc.) along with some packaging. Quantitatively, most airlines studies may report waste in kilograms per flight or per passenger. Studies from Chen, (2022); Ross, (2014); Thamagasorn and Pharino, (2019) reported that most airline catering waste by weight comes from production leftovers (trimmings, spoilage) and unused cooked meals, and report from aviation bodies reported that cabin plate waste also contributes but often in smaller proportion (IATA, 2024). Although detailed breakdowns are rare, common waste categories include bakery (bread, pastries), hot entrées (rice, pasta, protein items) and salads, reflecting menu composition. “Thus, unlike school or hospital kitchens, where serving and plate waste dominate, airline kitchens exhibit higher waste in kitchen waste.” Eriksson et al. (2017) and Malefors et al. (2019) – high plate waste in schools Dias-Ferreira et al. (2015) – hospitals.

Measuring this waste precisely requires careful methodology. In-flight catering studies often use weight-based audits: each meal component is weighed if discarded. Some researchers classify waste into subcategories (e.g., meats, dairy, vegetables, beverages) and track daily or weekly totals (Thamagasorn and Pharino, 2019). In Sweden, large catering operations are legal
y required to report organic waste amounts, which can be a guide. However, airlines seldom publish these figures, so literature estimates rely on case studies or aggregated data. In summary, while exact volumes vary by airline and service (e.g., long-haul vs short haul), compositions generally mirror menu variety, and waste is quantifiable by standard mass metrics (kilograms of food waste per number of meals).

1.4 Drivers of Food Waste in Catering Operations

Several key drivers underpin food waste in airline catering kitchens. Demand uncertainty is paramount: flights are booked weeks in advance but loads and special meal orders may change at the last minute (van der Walt and Bean, 2022). This unpredictability leads to significant food waste, as caterers often prepare more meals than necessary to ensure all potential dietary requirements are met. Airlines therefore produce extra meals as insurance; any surplus that cannot be boarded or is wrongly prepared becomes waste. For example, catering contracts typically stipulate a fixed number of meals, so last-minute cancellations mean unneeded meals. Missed flights or flight diversions similarly render already-prepared meals unusable (Jones, 2007).

In sum, overproduction to buffer scheduling variability creates food waste by design. Regulatory constraints also drive waste. Aviation food safety and security rules prohibit serving meals beyond certain holding times and bar donation or redistribution once sealed. This means kitchens cannot donate near-expiry meals; any excess or substandard batch must be discarded. Moreover, strict allergen and hygiene protocols mean that even unopened trays must be treated as waste if a flight is cancelled (You, Bhamra and Lilley, 2019). Portioning and standardisation contribute as well: meals are portioned by formula (often weight or volume) and rarely adjusted for passenger age, preferences or flight length. If passengers do not finish their standard portion, the leftovers go into the waste stream (Law, 2011).

On the operational side, meal forecast and the choices of menu during preparation methods can create waste, as reported by Megodawickrama and P.L. (2018). Complex menus with many component parts (e.g., fresh salads, chilled desserts) mean more preparation waste (peelings, trimmings), with less-popular items (e.g., certain vegetarian dishes) consistently have higher waste rates (Ross, 2014). In-flight service style can matter too: offering multiple meal choices or multi-course service increases chances of uneaten courses. Finally, behavioral factors – such as lack of awareness or training among kitchen staff – play a role, though these are less documented in airlines, an explorative study by Eleri et al. (2016) highlighted that while many airlines provide food safety training, these programs often lack customisation based on specific roles and are not grounded in thorough analysis of training needs. Though the research underscores that behavioral factors, such as insufficient awareness or training among kitchen staff, contribute to food safety challenges, same can be said for food waste control measure among airlines and catering companies, issues are less documented within the airline industry. Overall, the interplay of planning (forecasting), process (preparation) and policy (regulation) factors creates the bulk of waste drivers. As Betz et al. (2015) emphasise for catering broadly, collaborative efforts across the food system are needed: “significant reduction in food waste requires all food system actors to work together”, a point especially true for complex supply chains like airline catering.

1.5 Strategies and Solutions for Food Waste Reduction

Various strategies have been proposed or tested to cut catering waste. On the prevention side, better forecasting and lean production are critical. Airlines and caterers can use historical data and advanced analytics to match production to actual passenger loads more closely, reducing overproduction. Menu engineering is another tactic: replacing unpopular dishes with items historically less wasted or offering smaller portions by request. Some studies suggest redesigning food menus and improving service quality can curb waste (Thamagasorn and Pharino, 2019). Training kitchen staff on waste-avoidance (e.g., trimming vegetables judiciously, using full ingredients) also helps.

Collaboration with suppliers is a preventive measure: order smaller batch ingredients or more frequent deliveries of perishable items to avoid spoilage. Lean management principles – minimising inventory buffers and setting waste-reduction targets in the kitchen – have been applied in some caterer case studies (e.g., standardisation of recipes and portions to prevent errors) (Gładysz et al., 2020). In-flight, giving cabin crew flexibility to offer extra servings (rather than discarding) and gathering passenger feedback on meal satisfaction can adjust menus over time.

On the *reuse and recycling* side, leftover food can be valorised when prevention fails (Brancoli et al., 2020) or repurpose as food donation to banks and charity organisations (Sundin et al., 2022). However, due to strict rules, such options are often limited in airline contexts. In some cases, solid waste, for example, bread, peelings may be donated to animal feed or local biodigesters (though less common in Sweden due to regulation barriers), and wet waste can be sent to biogas plants. When composting or anaerobic digestion is available, it can significantly reduce the environmental impact of waste. Comparative analyses find that composting and biogas are among the more favorable disposal methods in terms of carbon footprint (Chaudhary et al., 2019; López-Rodríguez et al., 2021). Energy recovery (incineration with energy capture) is another option for residual waste, though it is less desirable than source reduction. As Betz et al. (2015) report for foodservice overall, “leftovers are commonly reused or recycled, with energy recovery and landfilling as last resorts”. In practice, many airlines simply compact and incinerate kitchen waste due to logistical ease (Hidalgo and Chen, 2022).

Industry-wide frameworks and policies also drive solutions. The EU is moving to impose legally binding national waste reduction targets (EU Commission, 2020), which will push airlines and caterers to monitor and cut waste. At the customer end, SDG 12.3 provides a public goal that companies align with. For example, a participatory design study by You, Bhamra and Lilley (2020) highlights behavioural interventions – such as onboard information campaigns or choice architecture changes – as promising, noting that many solutions require a holistic view of passenger behavior. Ultimately, a combination of lean operational changes, menu redesign and regulatory

flexibility (e.g., allowing safe meal donation) offers a multi-pronged approach to reduce food waste in airline catering.

1.6 Case Studies

Explicit case studies of airline catering waste are scarce in published literature. One example is an MIT-thesis project (Saragih and Ahmed, 2022) that analysed a global airline caterer: it found most waste was generated in the portioning/packing areas and recommended lean, standardised processes. In Sweden, limited public studies have been released on airline catering kitchen waste, but large ground-caterers (e.g., Menzies, LSG Sky Chefs) likely conduct internal audits. A few studies focus on cabin waste (leftovers after flight), such as a South African Airways audit that tracked individual food items from international and domestic flights (revealing high wastage of starter and dessert items) (Sambo, 2018). Another case is the design-led study by You et al. (2020) in the UK, which used passenger workshops to prototype waste-reduction strategies (e.g., meal preference reminders, waste feedback loops). Although detailed data are often proprietary, these cases show that large airlines and caterers have begun experimenting with interventions. For instance, several carriers now track onboard waste for internal targets and some caterers partner with biogas facilities. Yet published examples remain limited, underscoring the novelty of this case study.

1.7 Research gaps and objectives

Airline catering contributes notably to the foodservice waste stream, yet it faces unique challenges and has received limited research attention. While airline catering companies faces challenges similar to other segment of the food service, many are distinct are unique to the sub sector: stringent hygiene regulations limit surplus redistribution, meal overproduction buffers against last-minute flight changes, and standardised portions often mismatch passenger consumption (Rajaratnam and Sunmola, 2021). These factors create systemic waste drivers absent in other sectors and quantifying and addressing them is essential to develop context-specific solutions. Despite all of this, few studies have quantified or compositionally analysed waste in airline production kitchens. As noted, research has largely neglected the kitchen stage, focusing instead on qualitative drivers or onboard waste.

This gap is explicitly acknowledged: little examination of the waste composition analysis of airline catering kitchen exists and confirmed by studies from (Ross, 2014; Teoh and Inderjit Singh, 2018; Thamagasorn and Pharino, 2019; Chen, 2022). There is also a scarcity of Sweden-specific research: I found no academic studies quantifying and addressing food waste in Swedish airlines catering company. In summary, research is needed on real-world quantification of kitchen waste flows, targeted waste-reduction pilots in airlines, and context-

specific analysis for Sweden. Such work would help fill the identified gaps and inform both industry practice and policy.

Therefore, this study aims to investigate the composition, hotspots, drivers and potential solutions to food waste in an airline catering service company. Explicitly, the study aims to quantify the amount of food wasted and the types of food waste generated in the production kitchens of the partnered in-flight catering company, information which is typically kept private in the aviation industry.

1.8 Research Questions

Although food waste is widely acknowledged to be a serious issue, both at the global level as well as in specific sectors such as the aviation industry, there remains a knowledge gap. This study aims to contribute to this gap by assessing the food waste generated in airline catering production kitchen to provide verified data for improved waste management strategies and clearly outline the barriers, and potential solution for the partnered company and other airlines catering companies.

1. RQ 1: What is the volume and composition of food waste generated in the production kitchens of the partnered catering company?
   SUB RQ: Which sections and meal services contribute most to the generated food waste?
2. RQ 2: What are the underlying drivers influencing food waste in an airline catering meal production process, and how does the partnered company address them?
   SUB RQ: At which stage of the production do the key drivers manifest
3. RQ 3: What are the potential solutions that the partner company can pursue in lowering the amount of food waste during ailine catering meal production?

2. Materials and Methods

The research was carried out in partnership with an airline catering company, located in Sweden with focus on the production kitchens. Moreso, the unit is part of a larger global company producing in-flight food to airline customers for both domestic and international flights.
This study adopted a mixed-method case study to assess the composition of food waste generated in the production kitchen of an airline catering company. The study comprises of two components: Quantification of production kitchen food waste and employee interview session. A composition analysis of a production kitchen waste was conducted to understand how much food waste is generated using food waste audit (weight measurement of food waste separated into categories) while interview data was collected within the production department and supply department to determine the drivers influencing food waste generation. Photographic records of the type of the generated food waste were recorded.

2.1 Definition of key terms

In the study of food waste, the term 'food loss' often come up in the literature. Sometimes, the terms 'food loss' and 'food waste' are used interchangeably (Beretta et al., 2013). It is beneficial to understand the definitions and distinguish the difference between those two terms, if any, to determine what is being quantified and counted in research relating to food waste. The Food and Agriculture Organisation of the United Nations (FAO) has given the definition to the term 'food loss' as "the decrease in edible food mass at the production, post-harvest and processing stages of the food chain" and the term 'food waste' as "the discard of edible foods at the retail and consumer levels." (FAO, 2017). The distinction of the two terms is made at the stage of the food value chain at which the edible food is lost.

Considering this ambiguity, the scope of this project will focus on the food waste generation across production process. Thus, different definitions of food waste have been adopted globally. Due to the different regional perception of what constitute food waste, there are several discussions about what should be classified as food waste and what not. However, standardisation of food waste definition of food waste is an important step to achieve harmonisation of how food waste is quantified (FUSIONS, 2016). A standard definition of waste can be used as a common reference for global food waste quantifications, monitoring and reporting through the whole food supply chain. In 2014, the European Union-funded project FUSIONS (Food Use for Social Innovation by Optimising Waste Prevention Strategies) introduced a definitional framework aimed at creating a common standard for identifying and measuring food waste across Europe. This framework was designed to support consistent data collection and reporting of food waste throughout EU member

states (FUSIONS, 2016). This project has adopted FUSION (2016)'s definition which defined food waste as:

> "Food waste is any food, and inedible parts of food, removed from the food supply chain to be recovered or disposed (including composted, crops ploughed in/not harvested, anaerobic digestion, bio-energy production, co-generation, incineration, disposal to sewer, landfill or discarded to sea)" (FUSIONS, 2014).

FUSIONS claassified food waste based on edibility. Edible food is defined as "food products intended for human consumption" while Inedible parts is defined as "Component associated with a food that are not usually consumed by humans". Inedible parts of food typically include items such as bones, peels, and fruit stones. 'Inedible parts' do not include packaging.". The inclusion of inedible part into the FUSION's definition highlighted clarification and possibility to turn food componnets that are currently defined as inedible into edible. Moreover, omitting inedible parts from the definition may cause negligence from people, despite the opportunities for improvements in management methods for this resource flow (FUSIONS, 2014). However, wherever possible, it is best to quantify edible and inedible portions separately in order to have an extensive grasp of the quantified food waste and devise methods to reduce and manage food waste suitable to each category, hence aiding decision making in reducing food waste.

In Sweden, the National Food Administration, made specific definitions for the food waste that occurs in public catering units. According to Livsmedelsverket (2020c), food waste in this sector can be grouped into three main types: waste generated during food preparation, waste that occurs during serving, and leftovers from meals, however, the serving and plate waste are outside the scope of the present study, as meals produced are plated and packed for the airline company before being served to their passengers. Thus, I have preparation waste, trolley waste and portioning waste for the study.
Herein:

1. Preparation waste: This is the waste of food that occurs in the kitchen during preparation and cooking activities.
2. Trolley waste: This comprises of already cooked food in tray fitted in trolleys and stored in the fridge, yet to be plated (i.e. food leftover in trays in the fridge)
3. Portioning waste: This is the waste that occurs during food assembly and plating, comprised of already cooked and ready-to-eat food.

2.2 Site description

The Sweden branch of the company has one large centralised production kitchen, which includes three subsections: the hot kitchen that uses the cook-chill production method (Ross, 2014); the cold kitchen (including the plating room), where cold meals and confectionary are produced;

and the slicing room, majorly for decanting and production of all meal toppings and condiments. As shown in figure 1, the production process is broken down into steps to understand the activities involved in the production and to visualise the boundary of the study scope. Therefore, the steps include recipe development (development of the different menu and choice of food items), forecasting model (predictive model use to analyse quantity of meal to be produce for a given flight based on past available data), purchase order (ordering of food items and component), receiving and storage, kitchen order (internally, the kitchen makes order based on what they must cook a day before the cooking day), Production and plating (main cooking day and plating of the cooked meal), assembly (packing and arrangement of plated meal based on flight specifications), transport (delivery of packed meal to airline customers) and finally to the airline. These processes are all interactive, signifying that an issue at one point of the production steps may impact other processes. Additionally, external factors included on the side depict the openness in the system and its dependency on external actors, which include mainly the suppliers, airlines and regulatory bodies (both local and international).

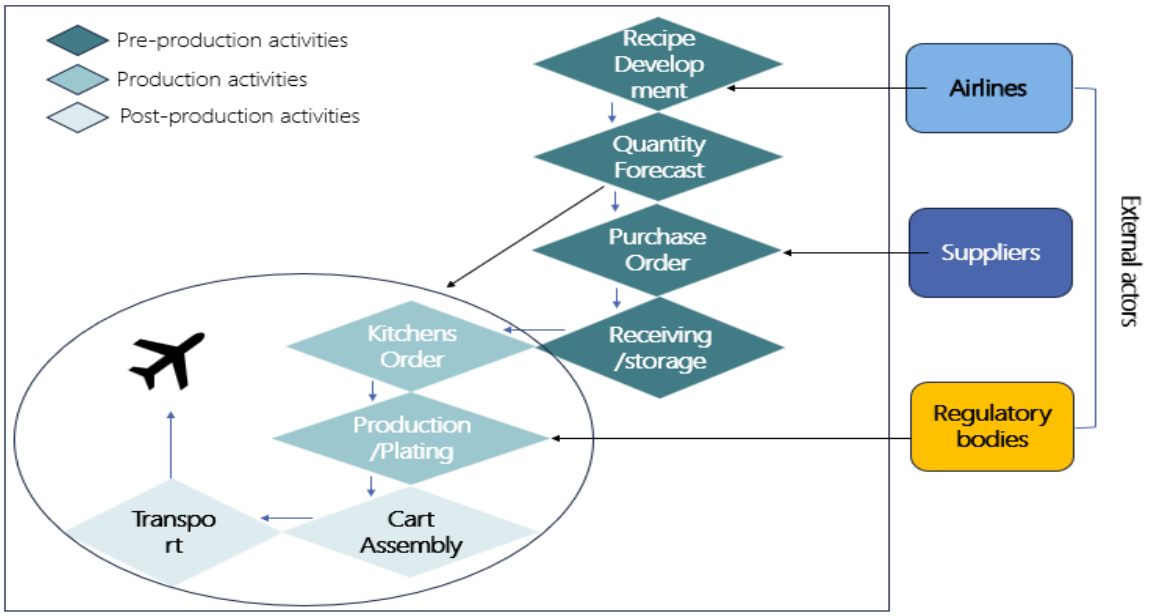

Figure 1. A breakdown steps of the production processes and their relationship involved for the partnered compoany

The unit production kitchen produces airline meals and food for the canteen specifically for staff meals. It was estimated this unit provides 12,000-15,000 airline meals per week, with 125 staff during the quiet season and additional temporary or casual staff hired during peak season (between May and July). The kitchen produces breakfast and hot meals for the crew, both for long-haul and short-haul flights; exquisite meals for the business class for intercontinental flights; and meals for the PLUS class, although meals for the economy class for intercontinental flights are frozen food produced outside of the unit. Occasionally, the unit serves chartered flights, which often include crew meals, PLUS meals and rarely business class meals.

2.3 Theoretical Framework

The research utilised the conceptual process framework established by Papargyropoulou et al. (2016) to combine both the quantitative and qualitative research data components into a unified analytical model (see figure 2). This framework incorporates feedback loops and control mechanisms while mapping the movement of food through the many stages of production, including all the steps as shown in figure 1. The framework aligns hard data on food volumes lost with the contextual "why" behind those losses by superimposing thematic insights from staff interviews over waste-audit measures at each stage. By doing this, the study's goal of quantifying and elucidating food waste in airline catering is achieved, as staff opinions of drivers and impediments are directly informed by the quantification of waste hotspots.

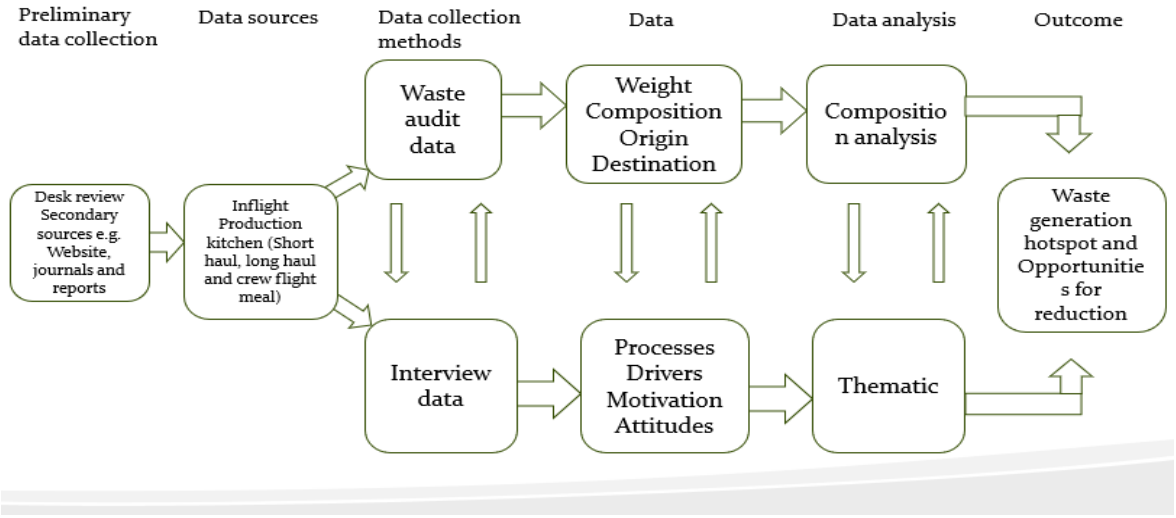

Figure 2. The conceptual process framework, adapted from (Papargyropoulou et al., 2016)

2.4 Study design

To evaluate the quantity of food waste in the production kitchen, the food waste was measured across the three different production department section including date and the time of the wasted food. The total measured food waste included the edible and nonedible food at every production process level, with the data collection carried out in March 2025, excluding the weekends (due to the time constraint as it will require the researcher to be present at all time for data collection). In analysing the quantitative data, an analytical process framework (see figure 2) adapted from Papargyropoulou et al. (2016) was adopted. The framework allows the synchronisation of the adopted mixed methodological approach, involving a waste audit for insight on weight, composition and origin of the waste and interviews as an ethnographical method to give deeper insight into drivers for the generated food waste.

A mixed-methods approach was imperative to quantify food waste and determine the motive behind the food waste generation. In the food service industry, qualitative research is a useful methodological research approach, as it allows exploration of the reasons for a quantitative result, particularly in the aviation industry with fewer research studies and publicly available data on the generated food waste. Understanding the study of Thamagasorn and Pharino (2019) emphasises the need to adopt a mixed method to have a clearer understanding of the food waste problem in an airline catering company, which is more reason why a qualitative approach was incorporated into the study design.

2.5 Methodology

Quantitative data on food waste were collected over a period of 21 consecutive weekdays in March, utilising an electronic weighing instrument (Minneapolis model) to measure food waste in grams across various operational sections of the department. Each instance of food waste was recorded and sometimes sorted, enabling a composition analysis that captured both the weight, proportion and typology (based on food categories and edibility) of the discarded food. This methodological approach allowed for precise quantification of food waste generation patterns within the production kitchen, offering a robust dataset for evaluating the operational inefficiencies and waste generated across the workflow.

In parallel, qualitative data were gathered through semi-structured interviews conducted with purposively selected personnel from four core departments: management, production, and supply teams. Interviews took place in a private setting within the unit to ensure confidentiality and encourage open dialogue. The interview guide was designed to elicit detailed insights into the perceived causes and departmental dynamics contributing to food waste, allowing participants to articulate both the “what” and the “why” of waste generation within their roles. To enable a profound and in-depth analysis of the interview data, an analytical framework was developed reflecting the kitchen’s operational processes, and thematic analysis was performed following the principles outlined by Braun and Clarke (2017).

2.5.1 Waste Audit

Data collection methods adopted, and tools developed for the waste audit w ere based on techniques employed by the EU commission project (FUSION, 2016). The waste audit form included a timeframe, food type, classification of food based on edibility. A designated area at the unit was used for weighing and recording the waste on a sheet before being transferred to an Excel sheet as shown in figure 2. The space, which includes a large table, medium-sized scales and paper bag for disposal, was separated from all food preparation and close to the designated waste disposal area within each of the sections. Following the company personal proctective equipment protocol, the

researcher wore long-sleeve overalls over warm clothing, a company reusable apron, a hairnet built with nose mask, gloves and production covered-in shoes. Three methods were used to collect waste data quantitatively. Three were required because of the large amount of waste, the difference in production activities across the different sections, the short time frame, and the researcher being the only person recording the waste, though all the staffs were brief by the managers about the process and cooperated with the researcher to get as much waste recorded as possible. The three methods used were:

1. Collection and weighing of all food tray to quantify all of leftover and overproduction waste: All trays with food waste from leftovers and overproduction were collected, and food waste was weighed (in grams) accordingly. For this method, 100% (all tray with leftovers that has passed used by date) of the waste was intercepted from the fridges. As shown in figure 2, each tray was weighed separately using an exact empty tray type for calibration to get the actual weight of the waste.
2. Interception and sorting of preparation waste at the point of discard: Preparation waste was mostly intercepted or sometimes kept in a tray close to the bin for the researcher to sort and measure before it was disposed of, although sometimes the food waste contents were required to be sorted, and the food waste calculated separately based on the established classification.
3. Retrieved mis-sorted bin waste: In some instances, food waste was retrieved directly from the bin (for plastics) by the researcher, as some of the staff may sometimes dispose of the waste in the wrong bin. For this method, about 50% (as the researcher check once a day though the bin is disposed twice or more in a day) of waste that is disposed to the bin was intercepted, sorted, calculated and disposed of properly.

During the data collection period, recyclable, non-food waste was noted, sorted but not weighed or calculated. A standardised procedure was followed for all food weighing while all non-food waste was removed and discarded. Remaining waste was sorted into different trays. Using the 'Food Waste Audit form (see appendix 1), the waste weight was recorded (in grams), a food name (e.g., cooked green beans), location of the waste (slice, hot kitchen and cold kitchen), reason for the waste (e.g., passed use by date, poor quality or leftovers/passed use by date), destination (organic bin or staff canteen). Additionally, food categories: vegetable, meat, seafood, dairy, poultry, grains/cooked meal, fruit, dessert, bread/sandwich, sauce and meat alternative, food status: ready-to-eat (already cooked and pre-pack food items e.g., butter, drinks etc.), in-house-prepared (food prepared within the production kitchen e.g., all hot meals and cold meals), fresh (food item used in preparing in-house meals e.g., vegetables), or pre-prepared (partially/fully cooked food items combined together with in-house meal e.g., cooked beef, salmon etc.), was also documented. When weighing and recording was complete, all food waste was transferred into a larger bin in a separate room, ready for compost or to be hauled by the contracted waste management company, a path

FUSION (2016) categorised as offsite hauling by another entity from where the waste was generated. Data from the hard copy printed forms was entered into a Microsoft Office Excel 2024 spreadsheet (see figure 3).

Date	Meal type	Food name	Food status	Edibility	Location	Loss reason	Type of waste	Weight (g)
March 3r	Crew	Semidried Tomato	Pre-prepared	Edible	Slicing	Not used/Passed use by date	Trolley	9000
March 3r	Crew	Lime leaf frozen	Pre-prepared	Edible	Slicing	Not used/Passed use by date	Trolley	3192
March 3r	Crew	Shallot Onion	Pre-prepared	Edible	Slicing	Not used/Passed use by date	Trolley	1500
March 3r	Crew	Spinach	Ready-to-eat	Edible	Slicing	Not used/Passed use by date	Trolley	2000
March 3r	Business	Pineaple peel	Fresh	Non Edible	Slicing	Specification/Preparation	Preparation	3100
March 3r	Business	Melon Peel	Fresh	Non Edible	Slicing	Preparation	Preparation	2860
March 3r	Business	Celerry	Fresh	Edible	Slicing	Leftover/Passed use by date	Trolley	2000
March 3r	Business	Orange peel	Fresh	Non Edible	Slicing	Preparation	Preparation	3100
March 3r	General	Orange Scrap	Fresh	Edible	Slicing	Specification/Preparation	Preparation	1620
March 3r	Plus	Gurka scrap	Fresh	Edible	Slicing	Specification/Preparation	Preparation	46
March 3r	Child	Pasta	In house prepared	Edible	HK	Leftover/Passed use by date	Trolley	3000
March 3r	Crew	Cauliflower Scrap	Pre-Prepared	Edible	HK	Specification/Preparation	Preparation	186
March 3r	Business	Dill Scrap	Fresh	Edible	HK	Specification/Preparation	Preparation	108
March 3r	Crew	Paprika Scrap	Fresh	Edible	HK	Specification/Preparation	Preparation	3946
March 4t	Crew	Pachoy scrap	Fresh	Non edible	HK	Specification/Preparation	Preparation	1122
March 4t	Plus	Creamy lentil sauce	In house prepared	Edible	Slicing	Leftover/Passed use by date	Trolley	7500

Figure 3. An Excel spreadsheet documentation for 3rd of March: Illustrating the waste composition process.

2.5.2 Interview

Semi-structured interviews were conducted with eight staff members in the unit due to its flexibility and opportunity for dialogue and order of change between questions during the interview phase, adopting the framework of (Kallio et al., 2016). Due to time constraint, eight participants were interviewed, which was justified as the interview were spread across all the deparement involving the whole production process, and including middle-level managers, chefs, general workers across the different sections of the department and staffs from the supply department. The interviewed were conducted during working hours. Interviewees were selected based on a recommendation from the manager, from each section of the production chain and across the scope of staffing levels to provide broad and rich data. Participation was voluntary, and signed consent was obtained before the interview. Most of the interviews were conducted at the unit board room, while a specific space was established to conduct interviews for the supply department staff to provide an atmosphere that allow the interviewee to respond independently, devoid of any external distraction. The researcher had a pen, name badge, interview protocol, question guide and audio recorder for each of the interviews, and the interview space was set up with a background information sheet, consent form and appropriate seating. Project information and objectives were provided to staff to read prior to the start of the interview, including the motive for the consent form and how the interview would be conducted (see appendix 2 and 3).

Once consent was gained, the audio recorder was turned on with the interviewee permission and the interview commenced. The interview was guided by seventeen predetermined questions with an additional six questions for managers. For example, some of the general questions were: What do you think makes it difficult to reduce food waste in the kitchen/your department? Has anything

been done to reduce food waste in the kitchen or in your section? What happened? Did it help? Are there any actions or habits that you think contribute to more food waste? while some additional questions for managers were: Has this kitchen/department ever conducted a waste audit? If so, what were the results? Are there any external pressures causing food waste? such as from airlines or suppliers and how do these pressures affect your decisions? (see appendix 4).

However, the flow of the interview often developed naturally based on interviewee responses, as the last question might sometimes be asked and addressed earlier during the interview, vice versa. The general format of questioning included three sections: first, with background knowledge about food waste and their perception of it; the second section involved questions about what and where they thought the most waste was being created, what contributes to the food waste and who was/did they think should be responsible for managing the food waste; the third section includes the current practices to reduce waste, the influence of other departments and possible ideas to address the challenges; at the end of the interviews, staff were thanked for contributing their time. Although there is an additional section for the middle-level managers to understand the existing management systems, potential intervention, company policy and the role of external influence. Interviews ranged from 30 minutes to 75 minutes due to the difference in the number of questions, for example, the managers took more time due to additional questions for more specific insight to the project goal. All interviews were transcribed using inbuilt Microsoft Office Word 2024 transcription, providing 275 pages of interviews transcript altogether for analysis.

In addition, the information collection through the interview were categorised based into four different broad themes with sub themes using codes, guided by the theory of food waste quantification, particularly in foodservice industry and the relationship between foodwaste quantification and drivers that influences the food waste generation. The four themes included: company challenges and barriers, current practices and waste processes, attitudes and motivations and perceived external influence. Although, some themes overlap in certain areas, for example, the theme company challenges and barriers could also be interpreted as perceived external influence, compared to the other two themes with different distinction and interpretation (see figure 4). The theme comprises internal driver and factors contributing to the generated food waste in the production different from the external drivers (i.e. from external industry actors). To separate the two, company challenges and barriers focuses on challenges associated with company operational activities (i.e. within its power to influence) and while external influence describe more of the external actors (Aviation industry, airline, suppliers etc.) influence on the operational activities as well as the food safety regulations compliance impact.

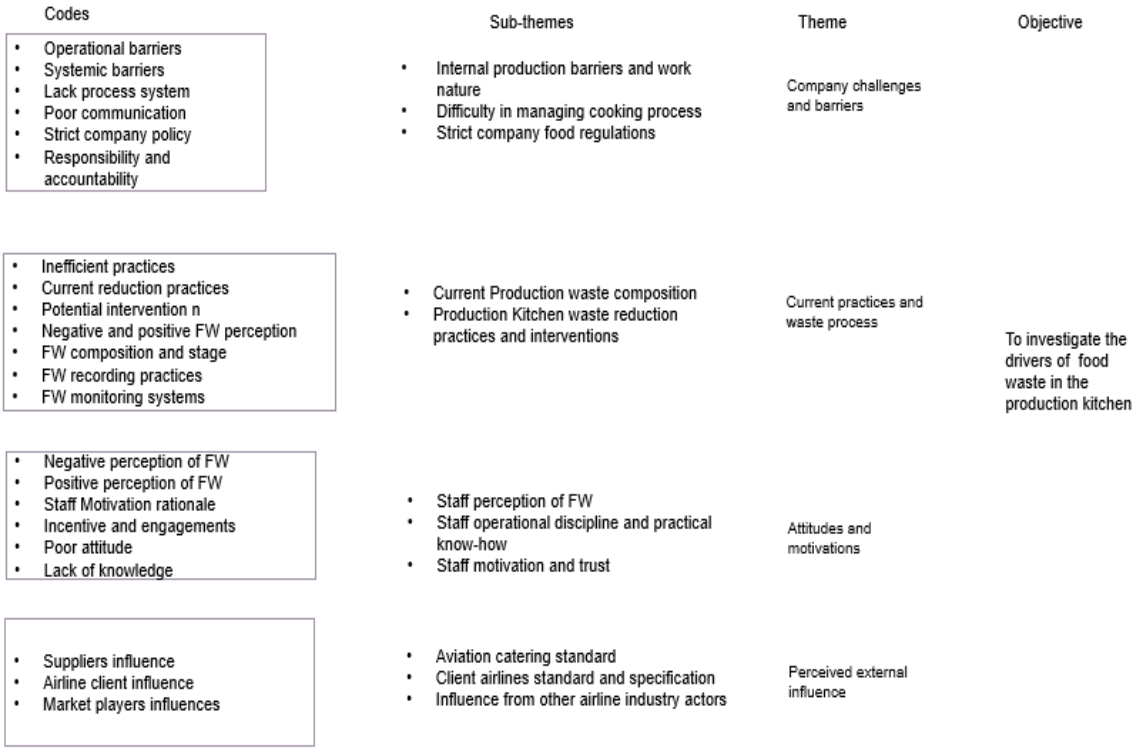

Figure 4. Illustrating the code, sub-themes, themes developed for the thematic analysis of the interview data including study objective.

2.6 Data analysis

2.6.1 Quantitative Analysis

The spreadsheet (Figure 3) was used to calculate results, which are depicted in graphical form (Section 3.6). Each food category weights were subsequently recorded, and the waste composition shares, and cumulative waste quantities were calculated using built in functions in accordance with the EU's uniform reporting guidelines (EU Commission, 2018). Descriptive statistical analyses were performed to characterise daily waste generation patterns from different section of the kitchen, thereby enabling rigorous intra site comparisons. Finally, results were visualised through different charts and pie diagrams (Section 5.0), adhering to the graphical presentation recommendations of the EU common methodology to ensure clarity and comparability of food waste reporting across member States.

2.6.2 Qualitative Analysis

Simultaneously, each interview was transcribed and transcriptions were true to record except for mention of people names or the company, which is coded anonymously for privacy, and to comply with the company's confidentiality requirement. Time stamps were also noted throughout the

transcript for future reference. The interviews were then analysed thematically (Braun and Clarke, 2006). First, a colour coding system was developed (Figure 4) based on the predetermined codes, embedded in a theme to capture the important data related to the research questions. This choice maps onto the generation of the data codes and enables the researcher to parse and organise similar codes into several themes.

The thematic analysis is more explicitly analyst driven as it was influenced by the researcher's project theoretical and analytic interest, similar to the principles outlined by Braun and Clarke (2006). This form of thematic analysis was adopted to provide more detailed analysis of some aspect of the data rather than a description of the data overall. Changing the colours of a section of 'food waste related' text was used to identify codes that reflect different drivers and factors influencing waste generation in the production kitchen as shown in figure 5. The results were interpreted to better understand what factors determined food wasting behaviour in the production kitchen, and to explore the pattern of employee' food wasting behaviour of in-flight catering.

Transcript excerpt	Codes	Sub Theme	Themes
00:01:57 Speaker 1 When you're telling a sort of food, so of course, yes, it depends on the sensitivity of the products such as we have, as you notice that we have some items that we need. **We have just 24 hours to use them.**	FW_Composition and Stage	Current Production waste co	Current practices and waste process
00:02:16 Speaker 1 Will be more waste on these items. #2 is the volume of that order and #3 matching the forecast and the volume. So the more volume you have of with that sensitive items the more ways you have and the less.	Operation barriers	Internal production barrier and	Company challenges and barriers
00:02:41 Speaker 1 The more difference between forecast and reality, so we makes more waste as well, especially these sensitive items. So these three essentially.	Systemic barriers	Difficulty in managing cookin	Company challenges and barriers
00:03:03 Speaker 1 You have volume is about crew food for example, so it is.	FW_Composition and Stage	Current Production waste co	Current practices and waste process
00:03:26 Speaker 1 Is it per? Is it not a standard? Imagine that it works so that we have 4-2 pilots and four crew crew and these four crew sometimes order based on what time of day they are flying.	Systemic barriers	Difficulty in managing cookin	Company challenges and barriers
So, till what time does the company receive order from the airline. 00:04:24 Speaker 1 30 minutes before departure for short haul yes, and for long haul 45.	Airline Influence	Aviation catering standard	Percieved external Influences

Figure 5. Displaying the coding sample for one of the interviews

3. Result

The following chapter describes the findings from the waste audit (section 2.5.1) and interviews (section 2.5.2) in the production kitchen of the partnered airline catering unit. The qualitative results are reported based on the processes framework.

3.1 Quatitiative data: Waste audit data

3.1.1 Total waste and Edibility composition

Over the 21 day audit period in March 2025, a total of 1 205.2 kg (see Table 1) of solid waste was recorded across the three sections of the production kitchen for total meals of 56 601 (14409 kg). This aggregate encompasses both edible and non-edible fractions intercepted at the point of disposal within the partnered in flight catering kitchens (excluding waste from the supply and transport department). As shown in table 1, disaggregation of the total waste generated reveals that 88% (1 058.4 kg) comprised food parts classified as edible namely, foodstuffs that were intended for human consumption whether fit or not while 12% (146.8 kg) were nonedible byproducts such as peelings deemed inedible and other unavoidable disposables.

3.1.2 Waste audit by Kitchen section

When broken down by functional unit within production section, the cold kitchen, hot kitchen, and slicing stations each exhibited distinct waste profiles. In the cold kitchen, all 41.6 kg of material discarded was edible, however, the hot kitchen generated 672 kg of total waste—of which 638.2 kg (95%) was edible and 33.8 kg (5%) nonedible (see table 1.0). The slicing station produced 491.6 kg of waste in total, comprising 378.6 kg (77 %) edible and 112.9 kg (23 %) nonedible fractions. The hot kitchen and slicing stations accounted for the largest volumes of edible food waste.

Table 1. The classification of food waste (kg) based on waste type and edibility across the three different locations within the production kitchen.

	Edible Food waste (kg)				**Non-edible (kg)**			**Grand Total**
Location	Trolley	Portioning	Preparation	Total	Trolley	Preparation	Total	
Cold Kitchen	10.7	30.8	0	41.6	0	0	0	41.6
Hot Kitchen	592.8	0	45.4	638.2	29.9	3.9	33.8	672
Slicing	203.3	0	175.3	378.6	0	112.9	112.9	491.5
Grand Total	806.9	30.8	220.7	1058.4	29.9	116.8	146.7	1205.2

3.1.3 Total waste by food classification

Among the edible foods discarded, vegetables were the largest single category at 341 kg (32.2% of all the total edible waste), followed by cooked grains/meals (228.4 kg, 21.6%), sauces and condiments (125.5 kg, 11.9%), and mixed food preparations (109.8 kg, 10.4%) as shown in figure 6. Lesser but still significant contributions were noted from poultry (66 kg, 6.2%), dairy (27.3 kg, 2.6%), seafood (33 kg, 3.1%), and bakery items such as bread and sandwiches (17.2 kg, 1.6%).

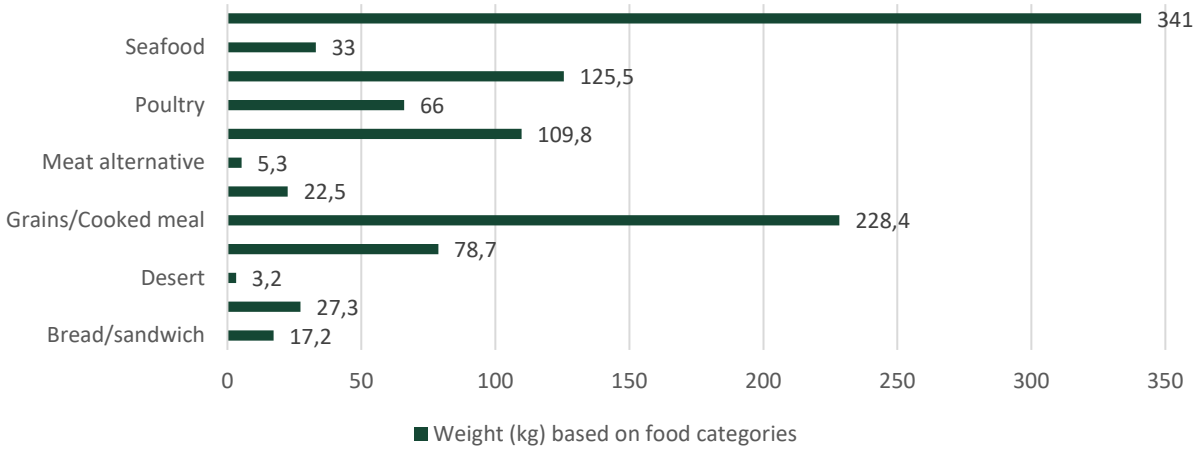

Figure 6. Illustrate the composition of food waste (kg) based on food categories.

3.1.4 Total waste by food status

Classification by preparation state further revealed that 51.7% of edible waste derived from in house prepared components (547.1 kg), 25.4% from fresh/raw ingredients (268.8 kg), 11.5% from pre prepared items (121.5 kg), and 11.4% from ready to eat products (120.8 kg) (see figure 7). Together, these breakdowns illuminate both the food types and the stages in production most prone to waste, thereby meeting the aim of characterising the composition of wastage.

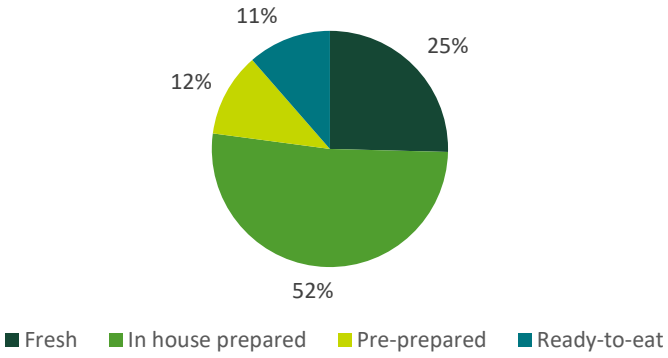

Figure 7. Displaying the categorisation of the edible food waste based on food status.

To contextualise the generated edible wastes, figure 8 illustrates the total food waste apportioned by meal or service type: crew meals accounted for 528.7 kg (50.0% of edible waste), business class for 299.3 kg (28.3%), and mixed food (which includes all meal service leftovers after tray wash) for 109.8 kg (10.4%). Smaller, but still notable, volumes arose from child meals (25.9 kg, 2.5%); special meals (which include meals such as vegan, low gluten, etc.) (2.1%); PLUS meals (i.e., the section between business and economy class at 35 kg, 3.3%); general meals, which include all the multipurpose food items (28 515 g, 2.7%); GO meals (i.e., economy class at 5.4 kg, 0.5%); and wet run samples (i.e., meal preparation for the next cycle at 3.8 kg, 0.4%). This classification demonstrates where the greatest absolute waste occurs, particularly in crew and business services, and further clarify the research question regarding "where" in the production kitchen the highest volumes of waste are generated.

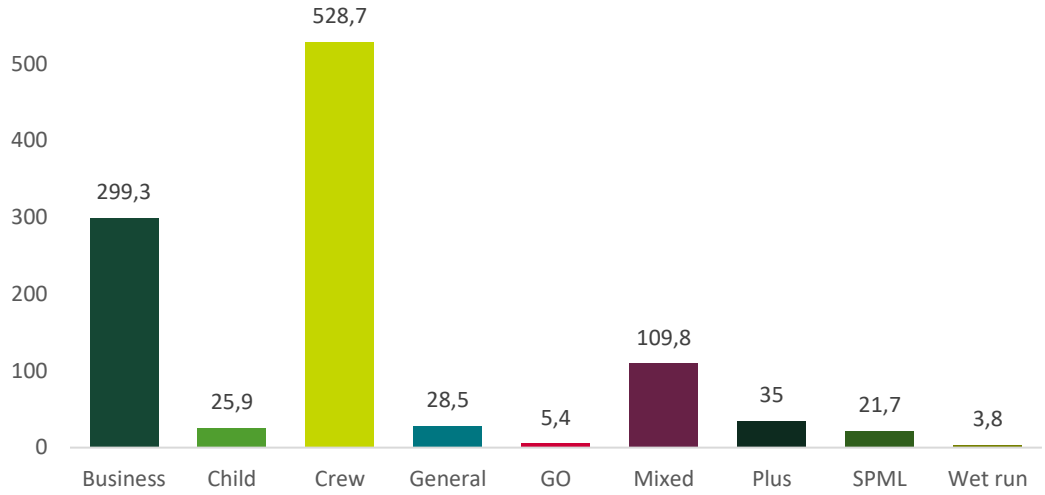

Figure 8. Display edible food waste (kg) based on the meal/service type

3.2 Qualitative analysis: Interview analysis

The interviews data was collected from eight employees across production department (five), including the supply (two) and quality team (one). Four broad themes were predetermined for the analysis, including company challenges and barriers, current practices and waste process, attitudes and motivation and external influence as shown in figure 4.

3.2.1 Theme1: Challenges and barriers

The theme, "challenges and barriers" presents the difficulties associated with food waste in the production kitchen as described by the participant. The challenges were homogenous between the general workers across the different departments, with a few exceptions. The same goes for the managers, with little variance with the quality team participant. Most challenges described were related to internal production process barriers, the nature and

demand of the work, Kitchen management complications and strict company food regulations (see figure 4).

The analysis identified three primary sub-themes within the overarching theme of "Challenges and Barriers", which were: Internal production barriers and work nature, difficulty in managing the cooking process and strict company food regulations. Each reflecting specific production and organisational difficulties that contribute to food waste in the in-flight catering context.

4.2.1.1 Sub-theme 1: Internal production barriers and work nature

Participants described multiple constraints in the Internal production barriers and work nature that directly resulted in surplus meals being discarded. Many of the participants noted that production planning and forecasting were particularly problematic. For example, one participant observed

> *"The greater the difference between forecast and reality, the more waste we make as well, especially of sensitive items. So, these three essentially will have more waste. Also, the volume of that order and matching the forecast and the volume. So, the more volume you have of those sensitive items, the more waste you have."*

Likewise, another participant indicated that food bank's requirement to augment prepared meals in response to unexpected increases in food demand and to prevent food shortages frequently resulted in surplus. The Participant further explained:

> *"It's more like I cooked food, we didn't use everything for the flights, so now I have food remaining and this food will expire. And once it's expired then it becomes waste."*

In addition, high workload and constant time pressure of daily operations collectively complicate the process's barriers. One staff member commented:

> *"You cannot afford to miss meals last minute and to produce meals last minutes because all of this process of cooking, plus chilling and plating follow specific timeline, yeah."*

Others emphasised that demand surges and peak travel periods force them to prepare for worst-case scenarios. For instance, another respondent said:

> *"We work under constant deadlines. And or lack of time. Sometimes you have any rush and OK, I will do it. And you forgot. OK. It's only this, this, this."*

Many noted that these internal process barriers and unpredictability left little opportunity to adjust production downward without risking shortages. In other words, the inherent variability and tight schedules of the work itself consistently led to higher volumes of food waste in day-to-day operations.

4.2.1.2 Sub-theme 2: Difficulty in managing cooking process

The sub-theme involves broader management and communication issues within the kitchen that led to waste. Participants frequently mentioned the difference between what was produced after cooking and what the system calculated. For example, one participant reported:

"If the fridge and plating suddenly have too much left or too short of some items, so the yield gap is not correct. There is some yield gap implemented in the system, but it's not accurate 100% because it being done rushed by a very short time by the head chefs and head design."

Others highlighted communication and coordination problems between teams. A participant claimed:

"Participant 3: No, I think communication is not good.
Interviewer: Between production and supply.
Participant 3: Yes, yes, yes, yes."

As a result, poor communication between different teams often led to waste, a participant reported:

"Many times, it shows they pushed over to the thawing room. What happens with this over if they can't consume, we can't send it to flight, and they can't eat it, for example 100 extra pieces? What should we do with this hundred? We eat OK 20 or 30. It's already in food. The rest will be wasted."

These kitchen management complications repeatedly led to good food being discarded due to poor communication between different teams, resulting operational gaps and inefficiencies.

4.2.1.3 Sub-theme 3: Strict Company Food Regulations

Participant identified Challenges and Barries concerns the strict policies and regulations governing airline catering food production, as a key driver of waste. Some of the participant explained that rigorous safety and quality rules which sometime is stricter than both the international standard regulation and local food safety regulations often forbid any reuse of food that is still safe to eat. As one participant stated:

"If the aviation rule is here, the company has a little bit above the standards for itself, their client has something, but the company has something over, so that's why the rules are bit more rigid"

Another participant stated:

"By policy, you need to consume in 24 hours after thawing and consuming after 24 hours plating is company non-negotiable rules. We can't bend the rules for safety reasons."

Others noted that health and hygiene guidelines mandate quick disposal of perishables. For example, one staff member said:

"Food which we prepare for crew is only three days. Expiry date is cooking +2 days. So, this is only three days, or we cannot use it for another day. Yes, that's why we have."

In addition, some participants also pointed to issues such as shelf-life variability of raw food and its cooked/opened form, for example, a participant commented:

"Yeah, there are two different types of shelf life. There is a shelf life after cooking. So, I cooked something. This thing has two days of expiry date. So, of shelf life. And then there is the products, the raw material that I use, I open them and then I give them a certain shelf life following the company rules"

These company regulations, while ensuring passenger safety, were repeatedly mentioned as directly contributing to the volume of food waste in the catering operation.

3.2.2 Theme 2: Current Production Kitchen Practices and Waste Process

The analysis of the thematic results around the theme “Current Production Kitchen Practices and Waste Process revealed important insights into the organisation’s handling of food waste. Two sub-themes (Current production waste composition and Production Kitchen waste reduction practices and interventions, see figure 4) were used to analyse the participants’ responses:

4.2.2.1 Sub-theme 1: Current Production Waste Composition

Participants consistently identified the main types of food most often wasted within the production kitchens. Several respondents pointed out that vegetables and salads were particularly prone to wastage. One speaker observed:

"A salad? Almost salad. Vegetables are wasted the more. Yeah,"

While another noted similarly:

"If I think directly that which thing is most… it's salads that are wasted more."

Cooked food was also highlighted as a significant contributor to the waste stream, with another participant stating plainly:

"The food that we waste the most is the cooked food."

Despite some efforts at documentation, it was acknowledged that not all food waste is fully recorded. As one speaker explained:

"They don't register 100%. If they register, we register, but we don't register either 100%."

These findings suggest that while there is awareness about which food categories dominate waste generation, the precise quantities are likely underestimated due to gaps in recording practices.

4.2.2.2 Sub-theme 2: Production Kitchen waste reduction practices and interventions

Many of the interviewers discussed several initiatives implemented to minimise food waste across production operations. Repurposing surplus food for staff meals was one notable strategy. As one participant shared:

"We wrote a proposal for staff canteen… we had one person saving food for canteen and then we decided to cook the same crew meal food for staff to repurpose the leftover."

Another key measure involved modifying recipes or preparation methods to extend the shelf life of meals. Following these modifications, products were sent to laboratories for testing before formally extending their shelf life, as one participant explained:

"After the modification to extend shelf life of some food, they sent it to the lab test for confirmation. Then they extended shelf life."

These initiatives show that despite the different constraints and busy schedules, proactive steps are taken within the kitchens to recover or extend the use of food where operationally possible. Additionally, one of the participants described how the implementation of Just in time and FIFO (First In First Out) practices has been essential in food waste generation in the production. The participant reported that

> *"We ask daily, now for the kitchen order they need to cook tomorrow. So, what supply team need to push tomorrow we can push."*

Another participant described that:

> *"We have a system… we check expiry dates, and we put what we received today at the back so that older products are used first."*

These measures ensure stock rotation and narrowing the procurement window to only what is immediately necessary; the kitchens aim to reduce surplus stock and its associated risk of spoilage.

3.2.3 Theme 3: Staff Attitude and Motivation

The theme explores the internal factors influencing how employees engage with food waste practices in the production kitchen. It encompasses three interconnected sub-themes: staff perception of food waste (FW), staff operational discipline and practical know-how, and staff motivation and trust (see figure 4). Together, these sub-themes offer insight into how personal values, work habits, interpersonal dynamics, and technical skills contribute to food waste generation.

4.2.3.1 Sub-theme 1: Staff Perception of Food Waste

Staff members consistently acknowledged that food waste is an important issue within the kitchen environment. During one interview, when asked directly whether waste was a significant concern, a participant simply affirmed,

> *"Yeah, of course."*

reflecting a widespread awareness among employees about the severity of the problem. Similarly, another participant expressed a personal dislike for food waste, stating:

> *"I don't like the waste of food."*

These perceptions indicate that at an individual level, employees are conscious of the presence and undesirable nature of food waste within their daily operations. This shared attitude serves as a foundational awareness that may shape other behaviours and practices across the workplace.

4.2.3.2 Sub-theme 2: Staff operational discipline and practical know-how

Work discipline, particularly regarding adherence to operational protocols like stock rotation and inventory management like FIFO (First in, First out), FEFO (First Expired, First Out) emerged as

a second critical sub-theme. Despite the general acknowledgement of waste as an issue, interview data suggested inconsistencies in everyday practices. One respondent explained,

"People will just take any ones and yeah, yeah, the one that is about to expire. We'll talk every morning. We'll talk about it all up before. Take care of FIFO, yes."

However, another participant highlighted the lapses, recounting:

"They don't check the FEFO, and that's it. I saw that one million times"

practice often neglected in busy periods. Furthermore, another respondent emphasised the importance of strict rules, suggesting:

"I think the stricter the rules are, the better"

While most of the participants have differing perceptions about operational discipline, staff competency was explored based on who possesses both operational understanding and practical know-how. One interviewee asserted:

"You must have good people. You must have people who know how to do jobs."

However, challenges persisted despite the knowledge based as another participant commented:

"The general worker, they know the job, but sometimes they don't want to do that"

Suggesting a gap between capability and consistent application. Team leadership competence was also seen as crucial, with one participant explaining that team leaders must

"Know everything about your department"

Ensuring that team members can be properly supported when needed. Skill deficits occasionally hampered operations, as described by a staff member who recounted an incident:

"She came to me for vegetable, and I told (asked) her how much quantity she needs. She said she doesn't know that it's my problem to find out."

Such examples demonstrate that task competence and proactive engagement are vital to preventing waste. Pointing to the need for more staff discipline and practical knowledge of the operational activities to minimise waste. Together, these insights reveal that while knowledge of correct practices exists, actual work habits sometimes fall short of ideal standards, leading to avoidable waste.

4.2.3.2 Sub-theme 3: Staff motivation and trust

A positive work atmosphere was acknowledged by some; for example, a participant enthusiastically noted:

"Yes, yes, we are really positive. I like this stuff, and I like people who work with me."

Nevertheless, a contrasting perspective also emerged, as another participant reflected:

"Motivation. Motivation. Maybe they don't like to work,"

Hinting at possible disengagement among certain team members. Trust and communication were also identified as fragile in some areas. For instance, a participant noted difficulties in direct communication, stating:

"If I go to them, they are super rude"

implying tension and strained interactions within teams. Training and encouragement appeared as partial solutions; as one participant mentioned, it was important to guide staff to refer to the correct data sheets and product images to maintain accuracy in food preparation. Staff attitudes toward expressing opinions also varied: though the majority of the participants believe that they are given the opportunity to talk and new ideas are entertained, one of the participants shared that:

"Now when we have some ideas. They ask us, and sometimes we just have to tell them that I'm thinking about that thing, but they told us if we have something in our mind, just tell us"

While another participant lamented:

"They make decision and who am I to give opinions"

Indicating that at least some managers encouraged open communication to strengthen internal relationships.

3.2.4 Theme 4: Perceived external Influence

The analysis of the theme "External Influence" using the three distinct sub-themes (i.e. Aviation catering standard, client's airlines standard and specifications and Influence from other airline industry actors) reflects the broader external factors that shaped food waste generation in the airline catering production environment. These external pressures, while outside the direct control of production staff, were frequently cited by participants as major contributors to operational inefficiencies and unavoidable wastage.

4.2.4.2 Sub-theme 1: Aviation Catering Standards

The first sub-theme concerns the strict aviation catering standards imposed by regulatory bodies and industry practices. Participants consistently highlighted that aviation regulations dictate stringent timelines for the preparation and use of meals, particularly around food safety and shelf life. One participant clearly explained:

"For example, one rule that is very aviation rules is when you plate something you have to eat it in 24 hours before departure. I mean 24 hours. You cannot plate and put it for two days."

This rule means that any meal plated more than 24 hours before a flight must be discarded if not used, even if it remains microbiologically safe. These non-negotiable timelines, rooted in aviation industry policies, significantly limit flexibility in production scheduling and make it difficult to repurpose meals, directly leading to increased quantities of food waste whenever operational changes occur.

4.2.4.2 Sub-theme 2: Client airlines' standard and specifications

While aviation industry standards influence, specific airlines also tend to have their rules and requirements which exert influence on their catering company, particularly their late order adjustments, complex menu demands and changing requirements. Interviews revealed that airlines often finalised or amended their catering orders at very short notice. One participant explained:

"30 minutes before departure for yes, yes, and for long haul 45."

Another participant emphasised the unpredictability created by the airline:

"They put in the figures in the very end. Sometimes they put in ahead for one week, but it's too much. And suddenly when we need to plate it in the same day is different figures."

These last-minute changes meant that production teams were often forced to discard food items already prepared based on earlier forecasts.

One participant described the situation as:

"Sometime order is already on the way to the fly so and they want to change. We give it to them and so what do we do with this first order? We discard."

Although reusing cancelled flight meals was sometimes technically possible, it remained limited. As one participant noted:

"Yes, it's possible, but... food prepared also have expiry date, and we are packing crew meal one day before the flight, so it's difficult to reuse all the time."

Additionally, the high variability and complexity of airline menus compounded the challenges. In response to a question about the impact of menu complexity, one staff member confirmed:

"Yeah, this is exactly what I told you. That's yes."

Overall, the influence of client airlines, through unpredictable ordering behaviour and diverse menu requirements, was repeatedly mentioned as a dominant external driver of food waste.

4.2.4.3 Sub-theme 3: Influence from other Airline Industry Actors

The third sub-theme involves the influence of broader supply chain actors, such as suppliers of ingredients and products. Participants described instances where ingredient quality issues led to waste even before production began. The participant described the process, saying:

"Not good quality. Yes. Yes, we do claim. We do claim send to them and they reply to us, OK. Send to us or send back or throw away and we can pay for it."

However, this system had limitations: the ability to return goods was often contingent on whether items had already been unpacked. If packaging had been opened, products might not have be returned and had to be discarded. This meant that operational waste sometimes arose not only from internal practices but also from failures upstream in the supply chain. Even when claims could be made and compensation received, the physical waste of resources for food items still occurred.

4. Discussion

The analysis of the composition and drivers of food waste has revealed the food items that are disposed of in relatively large quantities. By quantifying the generated food waste, it provides a benchmark tool against which reduction efforts can be implemented and measured. By creating a food waste inventory, this data can serve as a solid foundation for targeted food waste reduction plans and efforts. Minimising food waste can help businesses improve food security, increase natural resource use efficiency, reduce environmental consequences and achieve economic benefits (e.g., lower purchase and disposal costs).

4.1 Composition of Food Waste in the Catering Kitchen

The waste audit revealed that over the 21-day study, according to Table 1, partner airline kitchens produced about 1 205.2 kg of solid waste for 56 601 meals (approx. 8.4% of production weight). Notably, 88% of this waste (≈1 058 kg) was edible food, and only 12% (≈147 kg) was inedible. This high edible fraction is broadly consistent with prior catering research, which finds that production leftovers (spoilage and unused meals) dominate waste in airline catering.

However, the overall food waste rate in this study (~8%) is lower than the 12.71% reported by Thamagasorn and Pharino (2019) in a similar case study of an airline catering production. Comparable waste levels have also been observed in other institutional foodservice settings: 15–18% in Sweden (Engström and Carlsson-Kanyama, 2004; Malefors et al., 2019), 21–24% in Finland (Silvennoinen et al., 2012), although, Betz et al. (2015) reported lower rates 7–10% in Swiss food service operations. In my study the lower percentage likely reflects that only food waste from the production department (i.e., cold, hot kitchen and slicing room) was recorded, excluding food waste from food banks and Uplift managed by the transport team, storage waste from the supply team and inflight food waste from the client's airline. It may also indicate relatively efficient practices at this site. Nevertheless, even this 8% production kitchen(s) represents a substantial mass of food with environmental and economic impact (Campbell et al., 2017; Springmann et al., 2018).

Drilling into the sources of waste, my study found the hot kitchen and slicing stations were the primary "hotspots". The hot kitchen generated about 672 kg of waste (95% edible) and the slicing line about 492 kg (77% edible), with trolley waste accounting for 76% of the total edible waste, preparation waste 21% and portioning waste 3%. This spatial pattern contradicts earlier studies: Thamagasorn and Pharino (2019) found that the meal portioning process (which in my study was in the cold kitchen) yielded the highest edible waste in airline catering, although a study by Sonnino and McWilliam (2011) reported similar findings in a hospital setting where trolley waste (food that was prepared but not served) was the highest. Contrastingly, Lévesque et al. (2022) study on hotel

food waste reported that preparation waste constituted a major proportion of the generated food waste. These variations could be due to the operational differences between different (sometimes the same) sectors within the foodservice industry and the study context. For example, Thamagasorn and Pharino (2019) study classified meal portioning as a subunit within the production kitchen, whereas in my study, meal portioning is part of the cold kitchen processes, and leftovers from the process are the responsibility of the hot kitchen, as most of the food waste recorded in the hot kitchen was leftover that remained in the fridge after the portioning/packing process. In other words, as expected in airline catering, most waste arose before service when meals are prepared and cooked. This underscores that interventions should target these areas. My finding that the slicing and hot kitchen lines are waste-intensive confirms literature emphasising that complex menu preparation amplifies waste. It also represents a new contribution by quantifying exactly how much each section contributes within an airline catering kitchen in Sweden.

4.2 Waste Composition by Food Type

According to my report, vegetable (salads, peelings, and produce) was the largest component of edible waste (32.2% of edible waste). Cooked grains and main dishes accounted for 21.6%, and sauces/condiments 11.9%, with smaller shares for mixed preparations, poultry, dairy, seafood and bakery. These proportions echo general findings in previous airline catering studies: for instance, studies by Ross (2014) and Thamagasorn and Pharino (2019) both reported that nearly half of flight-catering waste (more than 40%) was vegetable waste. The somewhat lower share in my audit may reflect the difference in the food classification, as cooked food and grains in the study contain a significant share of food that would originally be classified as vegetables, for example, salads, cooked root vegetables, etc.

However, this isn't limited to the airline sectors; Betz et al. (2015) study reported that starch accompaniment and vegetables constitute a major part of the total recorded food waste; likewise, Eriksson et al. (2017) case study in Swedish public catering showed consistent findings, reporting carbohydrate-rich components and vegetables as the highest amounts of serving waste. This suggests a strong need to curb waste at the trimming and cooking stages (e.g., careful vegetable usage, recipe optimisation). Indeed, the literature advises redesigning menus (eliminating persistently wasted items) (Sustainable Restaurant Association, 2010) and training staff in waste avoidance (e.g., judicious trimming) to address such waste streams (Betz et al., 2015).

Looking by service category, crew meals accounted for fully half of edible waste (529 kg, 50.0%), and business-class meals 28.3% (299 kg). Other categories (child meals, special meals, PLUS class, etc.) contributed much smaller amounts. The predominance of crew and business waste likely reflects the company operations: volume of production and variety of the food for both services, which include both hot and cold meals; particularly, high-end business-class menus (often multi-

course) are prone to leftovers, a point noted in the study by Ross (2014) on in-flight service (multiple meals increase uneaten food). These breakdown highlights exactly where the bulk of production waste originates. This finding extends prior general estimates by quantifying waste per service type. It implies that targeting these services processes (for example, adjusting crew forecasting or portion sizes where feasible) could yield significant reductions.

4.3 Drivers of Food Waste

The qualitative interviews illuminated multiple interlocking drivers that explain why waste accumulates. Chief among these were planning and forecasting issues. Production staff repeatedly pointed to discrepancies between forecasts and actual orders: *"the greater the difference between forecast and reality…we make more waste as well, especially [in] sensitive items."* These findings are consistent with previous studies (Ross, 2014; Megodawickrama and P.L., 2018). In practice, the kitchen often had to prepare for a "worst-case" scenario (peak demand or sporadic flight changes) to avoid shortfalls. As one participant noted, "no opportunity to adjust production downward without risking shortages," implying constant variation in tight deadlines and last-minute rushes is left. These accounts mirror insights from the literature: airline caterers typically buffer against schedule uncertainties by overproducing (ICAO, 2014), and fixed portion protocols make such surplus inevitable (Law, 2011; Rajaratnam and Sunmola, 2021). Additionally, studies from other foodservice sectors share similar concerns; for example, in 2011, Sonnino and McWilliam's study evidently shows that forecasting figures are often exaggerated, resulting in the preparation of food exceeding the anticipated number of patients who will consume, with Ofei et al. (2015) reporting similar findings in their explorative studies within large-scale foodservice institutions, reiterating the complexity of the forecasting and its significance in reducing food waste across all foodservice sectors. In short, planning errors and high demand variability directly translate to excess waste, as others have documented (Megodawickrama, 2018; Thamagasorn and Pharino, 2019).

Operational and communication breakdowns were another set of causes. Staff described gaps between the production yield and the system's planning figures and poor coordination between kitchen stations. For example, incomplete information or rushed shifts meant that excess stock built up in one area *"If fridge and plating suddenly have too much left … yield gap … not accurate"*. Miscommunication often left perfectly good food unused: "*one participant recounted 100 extra meal trays being thawed in anticipation, of which only 20–30 were used, and "the rest will be wasted"*. These anecdotes show how even routine process inefficiencies, mismatched data, and handoff errors between teams can cascade into waste. Indeed, Gładysz et al. (2020) suggest standardised processes and waste-reduction targets in kitchens to close such gaps. My findings thus reinforce the importance of smoothing handoffs (e.g., between cooking and portioning) and improving real-time communication to prevent needless discard.

Perhaps most striking were the constraints imposed by food-safety regulations and company policies. Every interviewee emphasised that strict hygiene rules drive waste. Participants noted that their company's standards often exceed general requirements: once food items that will be prepared have exceeded company-defined holding times (for example, more than 24 hours post-thaw), they must be dumped, no exceptions. All hot meals have only a 3-day shelf life (cook day + 2), while cold meals have a 2-day shelf life, so any leftovers beyond that window are automatically waste. In effect, policy forbids any reuse of still-edible food. These internal rules mirror points raised by Law (2011) about aviation's "zero-risk" stance: unopened meal trays or surplus portions cannot be donated or kept, unlike in other sectors. This regulatory rigidity was cited as a key waste driver. The upshot is a systemic inflation of waste that the interviews confirmed is beyond the kitchen's control. These drivers, the structural obligation to overproduce and dispose, are well-aligned with the literature's emphasis on aviation-specific constraints (ICAO, 2014; Rajaratnam and Sunmola, 2021).

A final contributor involves staff attitudes and practices. Though all participants recognised waste as a problem (*"I don't like wasted food,"* one said), interviewees revealed that on-the-ground behaviour sometimes fell short of this awareness, reinforcing the possibility of social desirability bias. (Grimm, P., 2010). Participants described inconsistent adherence to basic protocols like FIFO inventory rotation. Some acknowledged that, under pressure, expired products were occasionally overlooked (*"they don't check the FEFO… I've seen that a million times"*). Skill and knowledge gaps also emerged, as sometimes some of the workers had to be reminded of how to calculate needed quantities. Thus, while staff generally understood the importance of waste reduction, in the hectic kitchen environment it did not always translate into disciplined action. This disconnect between awareness and habit is a known issue in foodservice: Betz et al. (2015) note that training and workplace culture are critical to actual waste outcomes. Although my study did not quantify these human factors, the interviews suggest that strengthening staff engagement (through training or feedback) could support any technical changes.

4.4 Recommendations

Findings in my study underscore that food waste in airline catering is a dynamic, system wide challenge requiring coordinated interventions across forecasting, operations, and workplace culture. The following recommendations draw directly from the study's quantitative and qualitative insights and offer a roadmap for both immediate and sustained waste reduction.

4.4.1 Optimisation and managing the forecasting system

Forecasting discrepancies and excessive menu variation were identified as key waste drivers. the combined findings suggest focusing on better forecasting (as recommended by Megodawickrama,

2018). To address this, a 10-day rolling review of the existing production quantity model (which is dependent on the forecast) should be implemented, with more emphasis placed on the crew and business meals and using the current wastage reporting to investigate trends and make plausible predictions based on the previous season. The wastage report will be an important accountability tool for identifying meal types with overproduction and over-assembly to cross-reference each wastage spike with menu specifications or data-entry logs for root cause analysis, which can be traced back to identify the cause (for example, an error in the menu or yield gap miscalculation). For wastage reporting to be successful, all departments and both management and floor staff will need to be on board and involved.

4.4.2 Embed food waste stewardship in Staff Culture

A strong commitment to food waste management throughout departments and staffing levels will be important for changing staff attitudes and behaviours. Food waste management will need to be an ongoing priority for all staff. Involving floor staff in identifying and solving food waste issues would help increase staff buy-in and promote a sense of responsibility and pride in their role in the company. Practical ways to achieve this would be to:

1. Organise biannual staff training/workshops on food waste prevention techniques, portion control and food preparation skills (for chefs).
2. Establish effective onboarding process for new staff and temporary staff.
3. Include food waste on the agenda of regular meetings and ensuring a platform for crowdsourcing practical ideas.
4. Emphasise teamwork and joint responsibility between departments by sharing issues and solutions between management to assist each other in reducing food waste.

It is an essential component of a company's social responsibility to create a positive work environment. This could be achieved by maximising staff involvement in food waste management Another staff behaviour that needs to be addressed is non-compliance with the FIFO/FEFO rule. Some barriers to following the rule identified by staff included lack of time and lack of knowledge (particularly during rushing hours). In addition to further staff training, it is recommended the company establish a nudge practice which can subtly influence the behavioural pattern of the staff and a monitoring system related to fridge organisation for cooked menu items to evaluate the staff adherence to the rule. For example, to keep track of food arrangements.

4.4.3 Evaluation and refine existing interventions

Although the company has implemented several context-specific waste reduction measures, it currently lacks a systematic mechanism to assess whether these interventions genuinely decrease waste or merely redirect it. For instance, during data collection the organisation implemented an on-site staff canteen that repurposes surplus crew meals. While this reuse strategy appears effective, it also raises a critical question: by not accounting for canteen leftovers in the company official

waste record, might the initiative simply shift the waste burden rather than eliminate it? Thereby, creating a pseudo-impact and enabling the systemic and operational issues resulting in food waste. To close this evaluation gap, I recommend establishing clear key performance indicators such as the ratio of surplus meals channelled to the canteen versus the proportion consumed there and tracking canteen plate waste alongside kitchen waste. This dual-metric approach will reveal the net impact of the canteen reuse program, ensure that repurposed food genuinely reduces overall waste rather than obscuring it, and more importantly, it aligns with the EU's emphasis on monitoring and evaluating food waste prevention interventions to ensure their effectiveness.

4.4.4 Strategies to utilise excess food

Strategies are required to manage over-ordered and over-produced food. One way to achieve this would be to create more standardisation between customer menus in addition to the existing interventions, for example, the adoption of continuous lean improvement (Gładysz et al., 2020), especially for crew meals, which make up most meals produced. More standardisation between menus would give more opportunities for overproduced or overordered food to be utilised, decreasing the amount of food wasted, as suggested by Vizzoto et al. (2021). This could be done through the crew meal catalogue, a concept that isn’t new in the airline industry. The meal catalogue would need to be well marketed to customers' airlines, and a competitive price offered to help gain customer buy-in. This idea would create more overlap between customer menus and will make production more efficient by reducing the production volume, though it might be difficult to implement as there are differences in the standard of the meals for different airline classes, similar to the model formulated to optimise meals size and types by Teoh and Inderjit Singh (2018). If implemented, it would be easier to streamline production processes, for example, by producing similar meal components that belong to different menus at the same time. It is anticipated the food cost savings made by employing strategies to decrease food waste will balance some of the difference in offering lower-cost meals.

4.5 Limitations

While this study provides novel and practical insights into the nature and drivers of food waste in airline catering production kitchens, several limitations should be acknowledged. First, a potential social desirability bias, as staff may have given responses they thought were expected or acceptable, rather than fully honest reflections, especially regarding adherence to food waste protocols or attitudes toward waste. Second, this research scope does not quantify the usage and the waste of the oils and condiments in the production process due to practical reasons and even though the scope of data collection was confined to production kitchen waste, it does not include storage losses managed by the supply team, food bank waste (internal cold storage before dispatch), or uplift waste (physical transport and loading of meals onto aircraft) handled by the transport team. This exclusion may lead to an underestimation of total food waste across the full catering chain.

Third, single-site case study: Findings may not be generalisable to other airline catering contexts, and there is possible potential observer bias, as the researcher collected waste and conducted interviews alone; this could affect what was captured or how participants responded. Fourth, the study focused primarily on internal kitchen operations and staff perspectives, without incorporating the views and roles of key external stakeholders such as airlines, suppliers, and regulatory bodies. Their inclusion could offer a more systemic understanding of food waste dynamics and potential cross-actor solutions. Lastly, data were collected during the low travel season in March, which may not fully capture the cycle variations which often span for 3 months and more specific is the operational complexity characteristic of peak summer months. Future research should aim for a multi-stakeholder approach across different cycle periods to build a more comprehensive and scalable framework for waste reduction in the airline catering sector.

4.6 Conclusions

In conclusion, the evidence from this case study offers actionable lessons. It shows that significant waste originates in routine production processes, and that multiple points of intervention are possible. This study is among the first to quantify waste by airline service type, showing that crew and business-class meals account for nearly 80% of edible waste. These segments should be priority targets for forecasting improvements and portion size adjustments. For the partner company (and similar airlines), the combined findings suggest adoption of better forecasting model, continuous lean improvement and exploring policy flexibility (to allow safe reuse or donation). More broadly, these results have implications for the goal of reducing food waste in aviation. By identifying the volumes and causes of waste, we lay the groundwork for targeted reduction strategies in a sector that plays a growing role in global foodservice. Such efforts are critical for advancing sustainability commitments and SDG 12.3 (halving food waste by 2030). In short, this study confirms that addressing waste in airline catering requires attention at every level of the production cycle from raw ingredients to human behaviour as echoed by the integrated frameworks of food waste research (Papargyropoulou et al., 2016). The findings suggest that coordinated changes at multiple levels may be necessary to achieve substantial reductions in airline catering waste.

While the findings align with past literature, they also introduce novel perspectives that enhance our understanding. I found that about one-fifth of food service output may ultimately become waste, though here the figure was somewhat lower due to the study scope. Corroborating Thamagasorn and Pharino's (2019), my study emphasis on production-line losses (particularly vegetable waste), and the study echo law and Rajaratnam's (2011; 2021) identification of regulation and planning as drivers. At the same time, this study contributes new context-specific insights. To my knowledge, it is the first published quantification of kitchen waste in Swedish airline catering, filling a gap noted by You et al. (2020) and others. I also uncovered internal factors (communication gaps, staff practices) and practical workarounds (staff reuse, shelf-life extensions)

that have not been previously described in the aviation food waste literature. In so doing, my study provide a holistic picture that tightly links the data to the study aims.

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Popular science summary

Airline companies use a lot of resources to keep planes flying and passengers comfortable especially when it comes to preparing meals for flights. But many people don't realise just how much food gets wasted before it even reaches the plane. This research looked into how much food is wasted in the kitchen of an airline catering company in Sweden and why it happens. Although the airline industry serves billions of passengers every year, very few studies have explored the problem of food waste behind the scenes.

To better understand the issue, I studied a real catering kitchen that prepares meals for flights. We weighed all the food thrown away in the kitchen over a set period and also talked to the staff working there. This helped us figure out what kinds of food are wasted most, and what parts of the process cause the most waste. I found that vegetables were the most commonly wasted food, making up about 32% of the total. Also, most of the food wasted came from crew and business class meals about 78% of it. The hot kitchen was the area where most waste happened, especially during cooking. We also saw that food left on trolleys made up 69% of waste, while food from preparation and portioning made up 28% and 3%, respectively.

From this, we learnt that the waste problem isn't just about cooking too much it also has to do with planning, menus, and how staff work together. That's why we suggest improving the way meals are forecasted, making menus more standard, and giving staff better training. Instead of only focusing on recycling or turning waste into energy, we believe it's better to stop waste from happening in the first place. This research gives useful advice to airline companies that want to manage food better and protect the environment.

Appendix 1- Waste audit data form

Time	Food name	Food class	Location	Loss reason	Weight (g)	% of the total

Appendix 2- Information letter for the interview session

Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

INFORMATION LETTER

2025-02-05

Tahir Alasinrin Babatunde
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Dear Madame/Sir,

You are invited to participate in a research master's project conducted at your company branch in Sweden regarding in-flight catering food waste management. Participation is voluntary and you may withdraw at any time by contacting the undersigned. You may choose not to take part in the project without any consequences or disadvantage.

The overall aim of this project is to assess and quantify food waste in an in-flight service provider company, investigating how much waste is generated, why the waste is being generated and developing recommendations for what can be done to prevent, and reduce the waste significantly.

The interview is expected to take approximately 30-60 minutes and will be conducted by Tahir Alasinrin, a master's student at Swedish University of Agricultural Sciences and currently a project intern at in the company. The interview will be conducted in an interview room at your workplace, during working hours.

If you agree to participate in the interview, you will be asked to discuss your perceptions, attitudes and practices regarding food waste during the production of inflight meals. The interview sessions will be audio recorded to allow the student to remember and accurately transcribe what was said during the session. Neither the audio recordings, nor the transcripts, will be shared with anyone outside the current research project and will be deleted after the project.

Any food waste issue you raise will be treated in confidence and investigated. After the interview, personal data will be removed and replaced with a pseudonym to protect your identity. Any indirect personal information, such as your job tittle will only be used to assist in explaining the study result as aggregate values (e.g. total number of kitchen assistants included).

The results of the project may be published in which case they will be available in the homepage of Swedish University of Agricultural Sciences page. Every attempt will be made to preserve your anonymity. You are most welcome to request a summary of the study results.

In case of any questions, you are welcome to contact the undersigned, or their supervisors, please see the contact details to the left.

Yours sincerely,
Tahir Alasinrin

Appendix 3- Consent form for the interview session

Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

Consent form

I have read the information in the information letter concerning the study on the food waste management project.

I understand that my participation is voluntary and that I can withdraw my consent at any time before the publication of the thesis report.

I hereby give my consent for my interview responses on food waste management at the company's office in Sweden in-flight catering to be used in the analysis and published anonymously.

……
Participant's signature

……
Participant's name

……
Date and place

Appendix 4- Questionaire for the interview splited into different categories

Introduction

Hello, good morning. My name is Tahir, an intern and I am a master's student at the Swedish University of Agricultural Sciences, studying Sustainable Food Systems.

Before we begin, please read the information sheet. If you have any questions, feel free to ask. Once you are comfortable and ready to take part in this interview, please sign the consent form.

This interview is part of my master's project thesis on food waste in airline catering production kitchens. My goal is to understand how much food waste occur, where and why they happen, the drivers influencing this waste, and how we can develop interventions to reduce it.

We will spend about 30 minutes to 1 hour on this interview. Feel free to express your thoughts, ideas, and observations. There are no right or wrong answers, and your responses will help me understand the current situation better.

General Questions for All Staff

1. **Perceptions of Food Waste**
    - What are your thoughts when you see food being wasted in the kitchen? (e.g. How do you feel about food being wasted?)
    - Do you think food waste is a significant issue in the kitchens (and other production department)? Why or why not?
2. **Understanding the Waste Process**
    - Describe the kinds of food that are most commonly wasted?
    - At which stages of production do you think the most food waste occurs? Why?
    - Are there specific rules or guidelines for deciding when food should be thrown away? If so, who makes these decisions?
3. **Current Practices**
    - Has anything been done to reduce food waste in the kitchen or in your department? What happened. Did it help?
    - Currently, have you noticed any practices that help reduce food waste in the kitchen/department?
    - Are there any actions or habits that you think contribute to more food waste?
    - For example, do you see leftover being reused creatively in other menus?

4. **Challenges and Barriers**
    - What do you think makes it difficult to reduce food waste in this kitchen/your department?
    - Are there any particular challenges? (like time, resources, or communication)
5. **Motivations and Benefits**
    - What do you think would be the benefits of reducing food waste for the kitchen or company?
    - How might reducing food waste impact the staff workload? or costs or environment?
6. **Ideas for Improvement**
    - What ideas do you have for reducing food waste in this kitchen/your department?
    - Are there any systems, tools, or policies that you think could help?
    - Are there any systems, tools, or policies that leads to food waste? Why?
    - Is there anything you would like to add?

Additional Questions for Management Staff

1. **Existing Waste Management Systems**
    - Has this kitchen/department ever conducted a waste audit? If so, what were the results?
    - Is any information currently collected about food waste, like weighing bins or tracking waste types? How is this information recorded? How is it used?
2. **Potential Interventions**
    - Would it be feasible to implement a system to track all food waste daily/weekly/monthly/yearly? Why or why not?
    - Who do you think could/should be responsible for monitoring and managing food waste in this kitchen/department?
    - Do you see a potential benefit of a regular follow up of food waste? How?
3. **External Influences**
    - Are there any departments influencing how much is wasted in your department? And why?

    - Are there any external pressures causing food waste? (such as from airlines or suppliers)
    - How do these pressures affect your decisions? and how does it influence the company focus on sustainability?
4. **Company Policy**
    - What is the company's policy on handling food waste?
    - Is there room for negotiation or for changes in this policy? How?
5. **Levels of Concern**
    - How concerned is the company about food waste? Is it seen as more of a financial, environmental, or social issue?
    - At what level (e.g., company-wide or specific departments) do you think waste reduction efforts would be most effective?
6. **Final Thoughts**
    - Do you have any other thoughts, concerns, or suggestions about food waste in this kitchen/department that you'd like to share?

Closing

Thank you for your time and for sharing your insights today. Your input is valuable and will help me better understand food waste challenges and opportunities for improvement. If you have any further thoughts or questions later, feel free to reach out.

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☒ YES, I, Tahir Alasinrin Babatunde, have read and agree to the agreement for publication and the personal data processing that takes place in connection with this.

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