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MSc Sustainable Entrepreneurship

Sustainable Entrepreneurship Project

An Investigation of Groningen's municipality's strategy to reduce its food waste through circular solutions.

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Abstract

Food waste represents a significant sustainability challenge, with around one-thirds of food produced for human consumption never being eaten, thus heavily contributing to greenhouse gas emissions. This study examines how the municipality of Groningen can accelerate its transition to a zero-waste food system by 2030 using a Theory of Change (ToC) framework. It uses a qualitative case study methodology, conducting eight interviews with stakeholders from the public sector, civil society and sustainable entrepreneurship, complemented by a literature review. The results indicate that the current approach in Groningen is fragmented, lacks comprehensive data and relies mainly on downstream solutions such as composting rather than prevention strategies. The main challenges are the absence of adapted measurement systems, inadequate infrastructure, and a lack of collaboration between stakeholders. The study shows that effective reduction of urban food waste requires integrated approaches combining behavioural change, cross-sector collaboration and the development of systemic infrastructures. This thesis recommends three measures to the municipality of Groningen: a transparent data monitoring system with public dashboards, the redirection of financial incentives from composting to upstream reduction solutions, and the designation of a circular food facilitator to coordinate multi-stakeholder collaboration. These interventions can reduce waste, while also promoting food democracy, and providing a replicable model for European municipalities aiming to achieve zero waste targets.

Keywords: Food Waste Management, Municipal Waste, Circular Food Chains, Theory of Change, Food Actors

Introduction

Food waste is one of the most persistent failures of today's global food systems. Around one third of the food produced for human consumption is not consumed, representing approximately 1.3 billion tonnes of waste generated each year throughout the supply chain (FAO, 2013; Närvänen et al., 2020). Food waste is not just about throwing food away. It involves wasting all the resources, land, energy and water that were needed to produce it. It also leads to unnecessary greenhouse gas emissions, with food waste accounting for approximately 8-10% of global emissions (IPCC, 2019; HLPE, 2014). In high-income countries, most of this waste occurs at the end of the food chain, mainly in supermarkets and households (FAO, 2013). Despite all that has been written on the subject recently, academic research on food waste still lacks consistency and clear theoretical direction (Närvänen et al., 2020).

One reason why food waste has attracted so much attention is its potential to make food systems more sustainable. Target 12.3 of the Sustainable Development Goals (SDGs), for example, focuses specifically on reducing food waste at the retail and consumer levels (HLPE, 2014). The food waste hierarchy encourages action in a specific order: first by preventing waste, then by redistributing food surpluses, and finally by converting them into compost or energy (Närvänen et al., 2020). In practice, the opposite is usually observed. In the Netherlands, around 25% of separately collected household food waste is first converted into biogas and around 75% is composted, while barely 2% of edible surplus from retail and catering reaches food banks (Rijkswaterstaat, 2024; ABN AMRO, 2016). Strategies to combat food waste therefore continue to focus on downstream actions such as recycling or donation, while preventive measures, although a priority in the food waste hierarchy, remain underdeveloped and underutilised (Gollnhofer et al., 2020).

What makes food waste so difficult to address is that, since it is embedded in the production chain, it is often placed in a linear model, whereas it has multiple levels, perspectives and is highly context-dependent (Lake et al., 2020). Researchers often refer to it as a “wicked problem” because it resists simple definitions and involves conflicting interests, responsibilities and values (Närvänen et al., 2020). It is not enough to encourage consumers to waste less or invest in better packaging. These strategies are useful, but they do not address the root causes, which are embedded in the very functioning of the food system (Sonnino et al., 2020; Moraes et al., 2020).

On a social level, the issue is further complicated by the paradox of widespread food insecurity, which affects more than 780 million people worldwide, despite the large quantities of edible food being thrown away (UNEP, 2024). Increasingly, researchers are calling for integrated approaches that can work at all levels and across all sectors, involving the people, institutions and infrastructure that shape food waste in different places (Mattila et al., 2020).

The Netherlands is often considered one of the most progressive countries in terms of sustainability. National policy aims to halve resource use by 2030 and become a fully circular economy by 2050 (OECD, 2020). As part of this broader agenda, the government has committed to halving its food waste by 2030, compared to 2015, in line with SDG goal 12.3. However, progress remains uneven across cities and regions. Many local governments lack the tools, data, or capacity to link national goals to actions on the ground (Sonnino et al., 2020; HLPE, 2014). There is growing recognition that local responses must be tailored to local conditions, while fitting into broader sustainability frameworks (Mattila et al., 2020).

Groningen is one of the Dutch cities taking up this challenge, with the goal of becoming zero waste by 2030. The city has implemented several measures, such as improving organic waste sorting and launching public campaigns. The municipality is working with six entrepreneurs in the hospitality sector to rethink their menus and practices in order to reduce food waste and encourage other businesses to do the same (Gemeente Groningen, 2024). However, food waste remains a major problem for the municipality and there is a lack of data on the exact situation in Groningen (OECD, 2020). Infrastructure for food services, such as selective collection for restaurants and cafés, is limited and there is no clear strategy linking the various actors in the food system. Nevertheless, Groningen also has great potential. It is surrounded by agricultural land and agricultural stakeholders, is strongly community-oriented and supports innovation in circularity (Sonnino et al., 2020; Circle Economy, 2020). To exploit these opportunities, it is important to implement specific support programmes and policies, addressing specific and strategic areas for action (Fattibene, 2020).

The objective of this research is to determine how the municipality of Groningen can accelerate its transition to a circular and waste-free food system by 2030, using the Theory of Change (ToC) approach. Rather than starting with solutions, ToC begins with the final impact desired by an organisation and works backwards to identify the conditions, actors and actions needed to achieve it (Anderson, 2004). It makes the assumptions underlying a specific issue visible, links short-term actions to long-term goals and enables systematic thinking about change.

To achieve this, three objectives guide this research: (i) to map the current regional landscape in terms of food waste; (ii) to identify the components of the ToC that have enabled other municipalities to reduce food waste; and (iii) to formulate recommendations specific to the context of the municipality of Groningen.

Consequently, this thesis addresses the following sub-research questions:

- RQ1: What are the current practices for preventing and managing food waste in the Groningen region?
- RQ2: What are the key elements of food chains that reduce waste in urban areas that recur regularly in examples of good practice, according to the ToC framework?
- RQ3: What recommendations based on the ToC can support Groningen's zero waste ambition?

This thesis begins by reviewing the relevant literature in the field of sustainable food waste practices and the theoretical framework used to support the analysis. It then describes the chosen research methodology and the data collection and analysis process. It then presents the research results, accompanied by a discussion of their implications. Finally, the conclusion addresses the practical implications of this project and makes suggestions for future research.

Theory

Literature review

The fight against food waste is increasingly recognised as a major challenge in the field of environmental protection. Moraes et al. (2020) demonstrate that the existing literature on food waste tends to focus more on the causes of waste than on reduction practices, suggesting that this field is still in its infancy. However, Närvänen et al. (2020) point out that the relevant management perspective has shifted from single waste management to a whole food supply chain management approach.

Food waste management (FWM) is increasingly seen as a complex and systemic challenge, reflecting its embeddedness in every stage of the food supply chain and in the dynamics of different stakeholders (Närvänen et al., 2020). The literature emphasises that food waste is not an isolated problem, but a “wicked problem” that requires holistic, multi-stakeholder strategies rather than isolated interventions (Sonnino, 2023). At the retail level, food waste is marked by operational inefficiencies, aesthetic standards and supply chain misalignments, with retailers playing a key role in guiding upstream production and downstream consumer behaviour,

making these two actors intrinsically linked (Moraes et al., 2020). Households are another important factor in food waste, and reducing this flow is often addressed through public information campaigns (Geffen et al., 2020). The literature shows that once informed about behaviours and associated with social marketing principles, community programmes can reduce waste in the long term (Kim et al., 2019). Despite the proliferation of initiatives, food waste policy continues to be characterised by fragmented governance and a lack of coordination between actors and levels (Sonnino, 2023). Mapping studies indicate a rapid expansion of research on food waste management since 2010, but they also reveal thematic fragmentation, with limited integration between disciplines and sectors (Ouyang et al., 2021). Cities are highlighted as potential laboratories for transformation, but their efforts are often hampered by rigid national policy frameworks and a lack of detailed data necessary for localised action (Sonnino, 2023).

Understanding consumer behaviour is essential to tackling food waste at its main source in high-income countries: households (Stancu et al., 2016). According to Stancu et al. (2016), "food waste behaviour (...) is embedded in the household food supply process," which includes routines related to shopping, cooking, and managing leftovers. These routines, along with perceived competence in food-related tasks, significantly influence waste outcomes. The Theory of Planned Behaviour (TPB) provides a solid framework for explaining these dynamics (Stancu et al., 2016). Key concepts, attitudes, perceived behavioural control and subjective norms influence both intention and actual behaviour in relation to food waste (Coskun & Yetkin Ozbük, 2020). In restaurants, perceived behavioural control and intention to reduce waste were found to be negative predictors of food waste behaviour, while attitudes towards food waste and price awareness positively influenced intentions to reduce waste (Coskun & Yetkin Ozbük, 2020). Roodhuyzen et al. (2017) emphasise that food waste is not the result of isolated decisions, but of "complex relationships between activities, attitudes and values", and advocate a systemic approach. This complexity is also illustrated by findings that consumers rarely associate food waste with environmental damage, viewing it primarily as "a waste of money" (Stancu et al., 2016). Moreover, interventions must move beyond awareness campaigns. Strategies oriented towards routine and habits, such as supporting meal planning and enhancing leftover reuse skills, can result in substantial reductions in avoidable food waste (Stancu et al., 2016). Effective programmes are those that recognise the routine, socially embedded and context-dependent nature of consumer eating behaviours (Roodhuyzen et al., 2017).

The Netherlands generates approximately 2,350 kilo tons of food waste per year, an average of 134 kg per person (Soethoudt & Vollebregt, 2023). Despite modest improvements, with a 7% reduction compared to 2021, household waste remains the main contributor, accounting for more than a third of national food losses (Soethoudt & Vollebregt, 2023). However, data remains fragmented, often relying on inconsistent definitions and sectoral estimates, which limits comparability and policy harmonisation (Soethoudt & Vollebregt, 2023). While the national government has set ambitious targets, including halving food waste by 2030, monitoring and interventions at the subnational level vary considerably. Groningen, for example, has committed to becoming a zero-waste city by 2030 (OECD, 2020). According to the municipality's Groningen Circular 2023-2026 implementation programme, being waste-free means “producing as little waste as possible” and “optimally reusing all waste produced” (Gemeente Groningen, 2023). The municipality has prioritised public procurement, knowledge sharing and waste management systems, but it does not have clear measures or specific baseline data for food waste streams (OECD, 2020). The Circular Economy report on Groningen demonstrates the potential for valorising biomass from food systems and promoting urban-industrial symbiosis, but highlights a lack of policy coherence and accurate data on waste management (Circle Economy, 2023). This highlights a significant gap, given that Groningen verbally aligns itself with national targets but still lacks the measurable, localised strategies needed to achieve its zero waste ambition (OECD, 2020; Circle Economy, 2023).

Effective strategies to combat urban food waste increasingly emphasise integrated and circular approaches that offer related environmental, social and economic benefits. A notable model is the system-wide assessment carried out in Bristol, which demonstrates that “reducing food waste in the consumption sectors and redistribution in the supply sectors offer the greatest benefits for the environment, society and the economy” (Parsa et al., 2024). These interventions, while they may reduce demand in certain economic sectors, have been identified as “high-yield, low-risk options” with clear gains on all three fronts (Parsa et al., 2024). In Brazil, Belo Horizonte exemplifies government-led models, where food policy is part of a broader social justice programme (Rocha & Lessa, 2009). Over 15 years, the city has developed a system “marked by its commitment to social justice and equitable access to food,” integrating urban agriculture, food subsidies, and education through its Municipal Secretariat for Food Policy and Supply (Rocha & Lessa, 2009). However, empirical data on the persistence and long-term effects of good practices remain limited. Cerciello et al. (2019) found that urban food waste behaviours

exhibit temporal persistence and “spatial spillovers” for both good and bad practices, suggesting that behavioural change can be slow and highly localised. These examples highlight the need for sustained political commitment, localised data and adaptive governance to effectively implement large-scale solutions to urban food waste.

Despite the increasing number of research studies on food waste, there remains a significant gap between quantitative measurements and the underlying social, institutional, and systemic causes of waste in urban contexts. As Ouyang et al. (2021) note, research on food waste often lacks basic knowledge about composting, has limitations in terms of recovery processes, and needs more refined assessment and management tools, especially ones that are adapted to different contexts and stages of the food supply chain. Roodhuyzen et al. (2017) emphasize that understanding food waste must go beyond correlations: “it is necessary to understand the background of these correlations, including the intermediate steps, the role of conditional factors, and the possible existence of correlated but non-causal factors.” This reveals a major blind spot, namely how local social norms, institutional fragmentation, and infrastructural constraints influence the consequences of food waste, especially in diverse urban areas. Furthermore, as Bagherzadeh et al. (2014) argue, both public and private sector measures are hampered by insufficient data and an inadequate causal understanding of food waste. This is particularly true at the municipal level, where cities lack uniform metrics and frameworks to translate national goals into locally anchored policies. The literature therefore lacks an integrated, localized understanding of why food waste persists and how urban systems can adapt to combat it structurally.

Theoretical framework

This research is guided by the ToC, a planning approach that explains how and why a particular change is expected. ToC starts by identifying a long-term goal, in this case a waste-free Groningen by 2030, and works backwards to understand what needs to happen to achieve that goal. As described by ActKnowledge (2004), it is “a comprehensive description and illustration of how and why a desired change is expected in a specific context.” By using the ToC, this study can identify the steps, actions, and actors necessary for the municipality of Groningen to change its current strategies to achieve its desired goal. This is particularly relevant for food waste, which is influenced by many different parts of the food system and affects many different people and organizations.

A key concept that supports this approach is food democracy. This concept focuses on who is involved in decisions about food and how fair those decisions are. Behringer and Feindt (2024) describe food democracy as open discussions in communities and as essential for protecting people's right to decide for themselves what they eat. Both perspectives are helpful when it comes to food waste, as they involve more voices, especially local ones, in the search for and implementation of solutions. When people who produce, buy, cook, and throw away food are involved in decisions, the chances of real and lasting change increase.

It is also important to understand the food system as a whole and not just as a chain of separated steps. A food chain suggests a simple line from farmer to consumer. However, a food system encompasses everything and everyone involved in growing, processing, transporting, selling, consuming, and disposing of food. Sonnino (2023) explains that this way of thinking, known as systems thinking, helps us to recognize the connections between environmental concerns, social needs, and public regulations. This is crucial for combating food waste, which is not only the result of poor decisions at the end of the process, but often a sign of deeper problems in the structure and management of the system.

Finally, a major challenge in reducing food waste is finding a common definition of its extent and characteristics. The UNEP (2024) defines food waste as “the decrease in the quantity or quality of food resulting from decisions and actions by retailers, food service providers, and consumers.” But not all countries or organizations use the same definition. Some include only food that could have been eaten, while others also count parts like bones or peels. The difference between food waste and food loss can also cause confusion. Närvänen et al. (2020) highlight that agreeing on what food waste means is difficult, but essential if people and institutions have to work together on shared goals. The ToC helps address this by making sure that all definitions and assumptions are clear from the start.

Methodology

Research methodology

This study uses a qualitative case study design to examine how the municipality of Groningen can improve its food waste management practices in order to achieve its goal of becoming waste-free by 2030. The case study approach is particularly well suited to investigating complex phenomena in real-world contexts where the boundaries between the challenge and its context are not clearly discernible (Creswell, 2009). Given the complexity of food waste and municipal

administration, a qualitative research method is best suited to capture the dynamic interactions and stakeholder insights relevant to this study.

The study draws on two key data sources: semi-structured interviews and a systematic literature review. These methods complement each other, as interviews provide context-specific experiential data from relevant stakeholders, while the literature review provides a conceptual basis for the study. The theoretical framework of this research follows the structure of the ToC, which serves as both an analytical and organisational lens (Anderson, 2004). The ToC method maps the causal pathways through which a series of interventions, based on defined assumptions, prerequisites and contextual factors, are expected to lead to long-term outcomes. This makes it a particularly suitable approach for understanding complex, systemic interventions such as food waste management in city administration (Anderson, 2004). Finally, the qualitative evidence underscores Creswell's thesis that stringency in qualitative research results from methodological coherence, a systematic coding method for determining the themes that make up the results section, and constant comparison, which increases the reliability of these results (Creswell, 2009).

Data collection

Literature review

The literature review included both academic and grey literature, including peer-reviewed journal articles, municipal reports and white papers from institutions such as the OECD, FAO, UNEP and the Dutch Nutrition Centre. The sources were retrieved from Google Scholar and the University of Groningen library system and filtered to focus on publications that appeared after 2010 and dealt with circular food systems, causes and management of food waste in urban areas, and municipal zero-waste strategies. Grey literature was also crucial for understanding local policy frameworks, pilot projects and non-academic initiatives by interest groups. These sources also helped to validate the findings from the interviews and provided an empirical context for the ToC modelling.

Selection of documents and relevance criteria

The sources included in the overview were selected based on relevance, credibility and publication date. Academic sources were preferred when dealing with theories, strategies and long-term impacts, while reports from institutions and NGOs provided detailed descriptions of

ongoing initiatives and practices. Together, they form the basis for a cross-validated evidence base.

Interviews

Participants were selected using purposive sampling to ensure representation across three key stakeholder categories: from the public sector, including municipal waste management officials, from civil society including NGO representatives and community activists, and sustainable food entrepreneurs (Creswell, 2009). Selection criteria were direct involvement in food waste initiatives, decision-making authority within their organization, and operational presence in the Groningen region. This corresponds to the standard of qualitative saturation for studies with small samples in social research (Creswell, 2009). Participants were recruited via email and LinkedIn with first a short invitation with a description of the research, followed by a detailed project description and a consent form (Appendix A). The interview questions (Appendix B) were organised based on the ToC framework and thus follow the chain of inputs, assumptions, activities, outputs and outcomes. They focused on four categories: current practices and gaps in food waste management, cross-sector collaboration, systemic barriers and assumptions, and future opportunities and long-term visions. All interviews were conducted between March and May 2025 in either English or French, with the latter being translated by the researcher to ensure consistency and avoid misinterpretation.

Data analysis

All interview transcripts were analysed using Atlas.ti, applying a deductive-inductive coding strategy. Deductive codes were defined in advance based on the main components of the ToC framework: final intended impact, intermediate outcomes, short-term outcomes, activities and interventions, key assumptions and inputs. Inductive codes emerged during the review of the transcripts and were organised.

Supporting quotes were collected and categorised in a matrix (see Appendix C) to ensure transparency and traceability for each claim. The interview data was then compared with the results of the literature review. This method is consistent with the “results chain” logic used in the impact analysis by Ebrahim & Rangan (2014), whereby each insight gained from the data contributes to an outcome within the ToC structure and ultimately feeds into the final strategic

recommendations. The components of the ToC are used as themes to organise the data in the matrix, and this structure is also transferred to the results section.

Ethical considerations

This research strictly adhered to the ethical standards of the University of Groningen and Campus Fryslân. Ethical approval was obtained prior to data collection, and all participants were given a formal consent form. This form contained detailed information about the scope, purpose and processing of the data, as well as the voluntary nature of participation, in order to ensure transparency and participant autonomy (Creswell, 2009).

The interviews were recorded and transcribed with the consent of the participants. All data were anonymised during transcription and identifying features were replaced with pseudonyms. The data were stored on password-protected university servers and will be permanently deleted after the thesis has been submitted.

In accordance with Creswell's (2009) recommendations, ethical considerations also extended to interview dynamics and power asymmetries, especially when working with stakeholders from different institutional levels. The interviews were designed to be non-intrusive and included flexible questions so that participants could avoid topics they did not want to discuss. In addition, attention was paid to the integrity of the translation: as recommended by Crewell (2009), the French interview was translated directly by the bilingual researcher to avoid semantic distortions.

Results and Discussion

This section presents the results from a cross-analysis of data retrieved from the interviews conducted amongst experts on sustainable food systems supported by the literature review of relevant articles and reports. It outlines the main outcomes of the analysis, and presents a comprehensive explanation on how the municipality of Groningen can improve its food waste management practices to reach its goal of being waste-free by 2030. It does so by breaking down the results according to the sub-research question of this paper, namely identifying the current relevant landscape in the region of Groningen, exposing best practice examples of successful urban food waste reduction programs drawing upon the ToC framework and transposing the latter to the case of Groningen to present actionable recommendations to its municipality.

Recurring obstacles in developing sustainable food systems in urban areas are also analyzed, to better support the chosen interventions and activities necessary to reach the desired final impact.

Main Research Outcomes

According to the data collected across interviews, transitioning to more sustainable food systems in urban areas requires an integrated approach, strong collaboration within the region and a behavioural change amongst consumers.

Firstly, food waste is a highly complex challenge, due to the numerous stakeholders it involves and the social, environmental and economic plan. All the interviewees pointed out the importance of considering the integrality of the food system's realm when designing strategies for food waste reduction, and that it is important to not "think about just the circular food system alone (...) rather the wider circular city."

Secondly, such an integrated approach demands a strong collaboration across governmental bodies, between the private and local sector and amongst local stakeholders who have a direct role in developing sustainable food solutions (Lipinski et al., 2013). According to a researcher on urban circular food waste systems, a "multi-governance" including as many actors as possible results in more efficient and "intelligent" solutions specific to each city. This collaboration can create a "multistakeholder dialogue (...) that critically discusses the use and need for standards, rules, quality specifications and habits" (Moraes et al., 2020). Participants similarly argued that governmental institutions have the power to adopt policies to facilitate sustainable food systems on the national and local scale, while private organizations detain the necessary infrastructure and strong influence on the market, and local actors have knowledge on the region's specificities and direct impact on the local food production to develop short food chains.

Lastly, behavioral change is key to transforming food systems as unanimously agreed with by the participants. Participants repeatedly mention the importance of behavior to reduce food waste. Observed successful initiatives have come with raising awareness on one's own waste and consumption's impact, the extent of their responsibility in generating waste, and the different forms that food waste can take. According to Coskun et al., "behavioral control has the highest impact on the intention to reduce food waste and food waste behavior." (2020). This is supported in the study conducted by Stancu et al., on determinants of food waste behavior. The authors demonstrate that "food-related routines are the main drivers of food waste in addition to

perceived behavioural control" (2015). Similarly, a research by Roodhuyzen et al, concludes that food planning, shopping, storing, preparation and consumption practices had an important impact on the amount of generated waste (2017).

RQ1. The Food Waste Management Landscape in the Groningen Region

The integrated approach required to analyze food systems and management practices obliges research on urban areas to also consider the latter's surroundings. This can lead to more complete and extensive results. Thus, when analyzing opportunities for the municipality of Groningen to decrease its food waste, this paper looks at the stakeholders from the whole region of Groningen.

According to the municipality's representative interviewed, the city of Groningen has just launched a new program to reduce waste, as part of its goal to be waste free by 2030. This program is for now mostly relying on raising awareness amongst residents, though "we don't know how big the problem is in Groningen" due to a lack of local data. The current strategy emphasizes prevention through communication, offering tips such as planning meals, organizing pantries, and using measurement tools. As described by the participant, public campaigns at local markets distribute items like fridge tape to help residents track leftovers. Complementing this municipal effort, the Free Café operates as a grassroots, volunteer-run initiative that turns discarded food into communal meals twice a week. As Ulug and Trell describe, it is "a restaurant where food is offered for free" and serves as a space to rethink food systems beyond monetary transactions (2019). This community economy challenges norms and raises awareness about food waste, while experimenting with autonomous and resilient models. Further upstream in the food chain, Voedselbank Groningen (Food Bank Groningen) plays a crucial role by collecting unsold food from supermarkets and producers to support low-income households. The city also participates in the EU-funded Food Trails initiative, integrating food sustainability into urban planning, and signaling broader alignment with European policy goals.

Participants point out that effective circular food strategies require close urban-rural collaboration, since "municipalities alone can't influence production systems." The National Programme Groningen (NPG), a partnership investing €1.15 billion in sustainability projects, supports this systemic transition. Urban areas must enhance symbiosis with surrounding agricultural zones to manage organic waste and food system impacts more holistically. Together, these actors form an evolving ecosystem for food waste prevention. While Groningen's approach is still in early stages, the integration of top-down policy, bottom-up civic action, and regional

partnerships signals promising potential for a more circular and sustainable food system (Circle Economy, 2023; OECD, 2020).

Obstacles to reducing food waste in urban areas

Measuring food waste

Difficulty in obtaining accurate, comparable data on what, where and how much food is wasted comes back as an important barrier across interviews. “To know how big the problem is you have to analyse the waste (...) but it’s very complicated and we have to think if we want to do that” points out Groningen Municipality's representative adding that “we don’t have the data”. Cities find difficulties in knowing how much, where or why food is wasted because data are dispersed, or non-existing in the case of Groningen, and materiality can differ across sectors (UNEP, 2024). Additionally, as participants mentioned, edible and inedible parts are difficult to split which results in inaccurate measurements.

Finance Food Waste Reduction

Up-front capital for redistribution logistics or separate collection is identified as a major barrier by participants, both for public and private organizations. An expert from Circle Economy describes circular food systems as “very expensive compared to doing it the linear way, unless the structure of incentives changes from a financial and regulatory point of view.” Other participants mention the need for a certainty on the financial benefits for stakeholders to adopt innovative solutions.

Lack of awareness

Urban households are disconnected to food production processes and thus are “less aware of what (...) choices they would need to make to support a circular system.” Consequently, consumers tend to underestimate the food they discard. As a representent from Orbisk mentioned, “people think they already do a good job (...) they sometimes don't believe how much they waste”. Groningen Municipality’s representative also notices that “At the moment sustainability is not the driving force: people want tasty products (...) the mass doesn't really care.”

Lack of infrastructures

Overall, participants find that the lack of structures to support technologies and efficient practices is inhibiting transition to circular food models. An expert from Circle Economy states that “Infrastructure for managing waste and making sure you valorise it in the best possible way” is missing. Additionally, UNEP stresses that cities still lack composting or biogas transformation capacity, making landfill the default disposal for organic waste (UNEP, 2024). Even simple home-composting or separate-collection systems require adapted transportation networks, which many municipalities still have to fund (UNEP, 2024).

Social Standards on Food

Expectations of abundance and perfect-looking foods also drive over-production and waste. Four participants pointed out how habits of abundance in quantity and choice of foods are heavily undermining food waste prevention in addition to norms regarding the products themselves: “we love the image of abundance and we don't want to be told how to restrict ourselves.”. At the Horeca level, this is mainly visible through the diversity and availability of the menu “we are offering like 10 to 15 things to our customers and they have to be able to choose from everything”. They also observed that what counts as edible also vary culturally, complicating efforts to valorise by-products or change recipes that currently consider ingredients as “inedible”.

Food Norms and Regulations

Participants mention that food norms normalise discarding edible food at every stage; “Some side-streams could be considered novel food, but legislation makes it very difficult to bring them back into food.” Criterias like the cooling-chain or indicated shelf life results in waste. A food innovator observed that “Most food-waste happens at the consumer; shelf-life labels have a high margin and people just follow them.” These legal, operational and informational conventions collectively block urban food-waste reduction.

Lack of collaboration

Collaboration amongst stakeholders is essential to reducing food waste in the long term, and exists, but remains insufficient, slow and difficult to achieve. A manager in food innovation notes that “Collaboration is hard and very slow for everyone on every end”. Another actor of the circular food sector argues that “the private parties have an expertise that the public ones don't

have and then, even though the public parties could change things on the citizen level, the fact that they don't have access to this expertise makes it hard for them to change it." Bagherzadeh et al., (2020) similarly point out the "lack of coordination between different actors in the supply chain", resulting from a lack of collaboration between them. This makes the transition to circular food models difficult to achieve and even more to scale-up.

RQ2: Key Food Chains Elements to Reduce Waste in Urban Areas, Following the ToC Framework

As pointed out by the participants, in order to reduce food waste, cities have to tackle the entirety of the food chain and not only aim to recycle produced waste. Following the ToC framework, the data from the interviews, and best-practice examples extracted from reports, this section exposes the necessary context for prosperous sustainable food systems in urban areas. The overview of the ToC for a municipality with a zero-waste goal is presented in Table 1 below.

Inputs

Reducing food waste requires knowledge sharing, appropriate infrastructure, financial resources, and systemic thinking. Cities view communication as the "best way" to engage residents, via tips on "wise pantry organisation" or "grocery lists", while businesses use monitoring dashboards to help "chefs and F-and-B managers" identify kitchen inefficiencies. Tools such as "at-home compost machines," "measurement cups," and "tape for leftovers" empower consumers, while kitchens adopt "a camera with a scale" to track waste. However, processing infrastructure remains a bottleneck: "side-streams spoil very fast," needing "on-site or close by" solutions. This calls for "a systematic way of working" that integrates all food-system stages and connects urban and rural areas. Yet, funding is essential as "quite a capital investment is needed", with feasibility often determined by a "positive ROI", argue participants. Support includes "subsidies," "development fundings," and "tax cuts,".

Assumptions

The most fundamental assumption according to participants is that consumer behavior represents the largest source of food waste, driven by deeply ingrained purchasing, storing, and eating routines. As one interviewee noted, "Households are responsible for the most volume... there's this disconnect between the money you're spending at the store and the concept of food

that you throw out." This behavioral pattern is reinforced by cultural norms where "it's normal for them to throw it away; it's very difficult to learn them that there are other ways." The interviews reveal that consumers are often driven by impulses beyond rational decision-making: "We try to raise consumer awareness to tell them that they waste too much... But we don't take into account why people buy too many products... it's that they're driven to buy."

A second key assumption is that food waste persists due to an uneven distribution of accountability among consumers, businesses, and governments. The interviews suggest that businesses have normalized waste as an operational cost: "A lot of businesses have just accepted that that is the cost of doing business... they're not incentivized to help the consumer make the most of that food; actually they will make more money if the consumer doesn't eat it and has to go back to the store and buy more." Meanwhile, consumers often lack awareness of their own waste patterns, with interviewees noting that "lots of people think they don't have food-waste... they don't realize that by throwing food away... you're having food-waste."

The final assumption underlying food waste is that only comprehensive, cross-sector collaboration can address the problem effectively. As articulated in the interviews, "the whole point (of sustainable food systems) is to articulate several challenges and not to favour one over the other." This system's perspective recognizes that "a municipality is influential in how food is consumed and waste managed, but production is outside the city, so the two have to work together."

These assumptions form the foundation for understanding that food waste is not merely a technical problem but a complex behavioral and systemic challenge requiring coordinated intervention across multiple levels and actors.

Activities and Interventions

Municipalities implement campaigns, workshops, and training (e.g., with “hotel schools”) on waste reduction and cooking with leftovers. Supporting “cooperatives” and “peri-urban agriculture” fosters redistribution and supply-chain resilience. Cities promote sustainable entrepreneurship through “tax breaks,” “discounts,” and “biorefinery support,” sometimes via dedicated agencies bridging public-private strategies. Connecting local actors is key: mapping “allies and opponents,” facilitating “groups of chefs,” and encouraging public-private dialogue, despite “hard and very slow” coordination. Infrastructure remains critical, with municipalities

offering “below-market space” for local shops or investing in “biogas from organic waste”. Regulatory issues also challenge reuse of by-products such as “novel food”.

Outputs (Short-Term Impacts)

Short-term results include growing sustainable businesses such as restaurants with waste-reduction “labels”, and increased public-private collaboration: “just a few businesses to sign on” can create a catalyzing movement. Monitoring tools help reduce edible food waste “by up to 30 % after a year”. Public engagement grows as people reconnect with food cycles through school-farm links or “community gardens” that turn waste into compost.

Outcomes (Long-Term Impacts)

In the long run, circular systems build local resilience, protecting agricultural land and reducing climate risk, while lowering food costs. Improved diets result from access to “healthy” and “microplastic-free” produce. Food democracy emerges as citizens co-create policies via “food committees,” shifting the narrative from aid to empowerment. Finally, reduced waste lowers municipal emissions, “embodied carbon would definitely decrease”, and reused ingredients offer a “more competitive footprint,” supporting the overarching goal of zero waste.

Ultimately, these efforts contribute to achieving the intended impact of Zero waste. This goal, articulated by some municipalities, means that “all the waste you have is separated so we can recycle it”, rather than having no waste at all. This collective movement towards separation and valorisation, alongside prevention, represents the long-term vision for sustainable urban food systems.

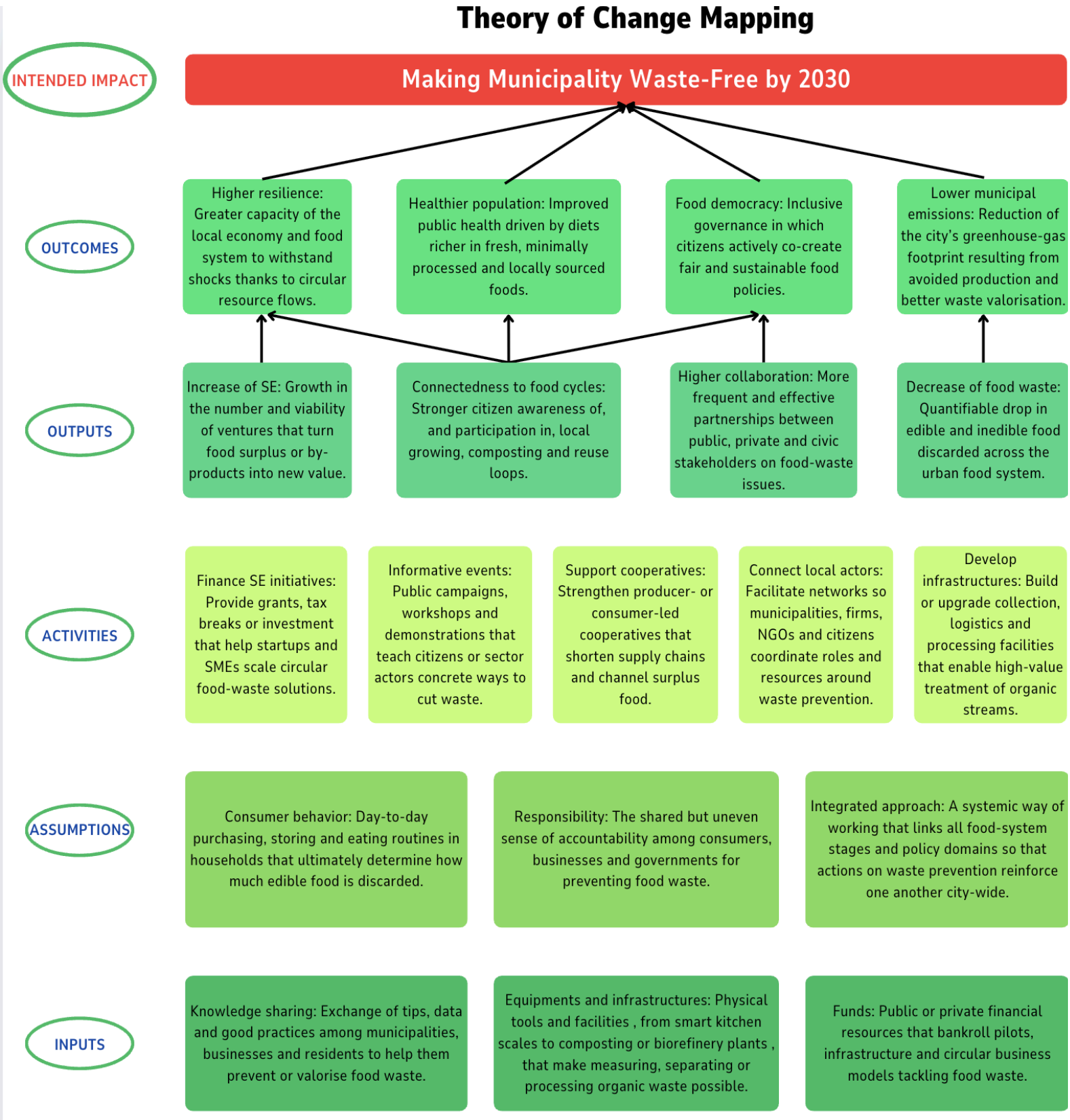

Table 1: Theory of Change for a waste-free municipality.

RQ3: Recommendations to the municipality of Groningen, based on the ToC framework

This section details the recommended contributions and activities for the municipality of Groningen to achieve its zero waste target by 2030, based on the ToC method.

Inputs

As mentioned by participants, the municipality plays a key role in supporting the exchange of expertise on sustainable food practices within the local stakeholder landscape. A governance platform that appoints a "circular food facilitator" responsible for "mobilising stakeholders" and aligning value chains, as recommended by the Circle Economy (2023) framework, would facilitate behavioural change and regional collaboration. Locally sourced organic food would become more accessible and consumers would avoid the temptation of overconsumption in supermarkets.

Data on food waste in Groningen is very inadequate, which hinders the implementation of food waste reduction strategies. A data dashboard, in collaboration with the University of Groningen (RUG) and Hanzehogeschool, would help monitor and measure the impact of food waste in the city. It would also improve the effectiveness of the municipality's communication campaign by publicly sharing specific data with citizens and showing them their actual waste footprint, rather than underestimating it. The municipality should give relevant stakeholders access to public spaces. One participant gave the example of a municipality that successfully organises regular markets with only regional producers.

A specific budget line is essential to achieve the desired impact. The 2024 city council has already allocated €250,000 to the food and protein transition (municipality of Groningen, 2024). Specific budgets should be set for each stage of the food chain to ensure waste prevention at all levels. Participants also recommend tax breaks for businesses or initiatives that directly tackle food waste in the Groningen region, which is particularly relevant when resources are limited. These measures can be used to financially support sustainable local entrepreneurship, cooperatives and organic farming, as well as events and information programmes for consumers and staff in the hotel and catering sector on the benefits of waste reduction and how to achieve it.

Activities and Interventions

The municipality of Groningen should develop integrated facilities for high value-added processing of organic waste streams, moving beyond traditional waste management towards circular resource recovery. As one stakeholder exemplified, “the city rents commercial premises at below market rates on condition that the shops sell local products.” This approach should be extended to strategic investments in “biogas production from the separate collection of organic waste” in recycling facilities, and to active support for biorefinery activities, as according to a circular economy expert, “the municipality of Groningen has an interest in developing biorefinery activities and biomass recovery”.

The municipality must also put in place frameworks that are conducive to innovation, as “the city can provide space and tax breaks to enable these projects to develop”, while strengthening partnerships with organisations such as Voedselbank Groningen to ensure that food surpluses reach people in need before other recovery options are considered. This requires the establishment of collaborative networks that recognise that “it is really the municipality that supports this network” by facilitating “groups of chefs who discuss lessons learned together... share their experiences instead of everyone reinventing the wheel” through initiatives such as the Groningen hospitality sector sustainability working groups.

Given that “the municipality has influence over how food is consumed and waste is managed, but production takes place outside the city, so the two must work together”, the municipality should strengthen its partnerships with surrounding agricultural cooperatives, thereby creating “the beginnings of a network between public and private sector actors” that links urban food waste reduction to rural production efficiency. Educational initiatives should take advantage of Groningen's student population through targeted programmes at institutions such as the Stenden Hotel School and NHL Stenden, offering “presentations and lectures at hotel schools” where students would learn monitoring techniques. Awareness-raising activities among the general public in public markets such as the Grote Markt, as mentioned by the municipal official, could also increase awareness and shift practices. Local restaurants should be encouraged to participate in storytelling initiatives where they share a “good story and a tasting of products that would otherwise have been thrown away.” This could be coordinated with Walnut, a company that helps restaurants reduce food waste through behavioural change.

Throughout these activities, the municipality should set up systems to monitor progress in the various areas of intervention, in partnership with the University of Groningen's sustainability

research programmes, to ensure that the activities contribute measurably to the 2030 food waste reduction targets, while creating scalable models that other municipalities can replicate.

Discussion

This research explored how the municipality of Groningen can advance food waste reduction in line with its “zero waste” target for 2030, using a theoretical framework based on backward mapping and causal logic, the ToC. The results highlight that reducing food waste should not be seen as an isolated issue, but rather as an integral part of a broader transformation towards circular and sustainable food systems. This section discusses the theoretical implications of the present study, highlights its limitations, and examines the advantages and disadvantages of a transdisciplinary approach.

Theoretical contributions

This thesis contributes to current debates on food waste and circular economy research by demonstrating the value of localised ToC modelling. This research advances the theory of change methodology by demonstrating its applicability to multi-stakeholder urban sustainability challenges, where traditional linear planning approaches often fail. Specifically, this study provides three methodological insights: incorporating behavioural hypotheses into the theory of change framework improves its predictive capacity for food system interventions, the backward mapping approach proves particularly effective in translating ambitious municipal goals into feasible pathways, and visual hypothesis mapping reveals hidden dependencies between stakeholder actions that traditional policy analysis might overlook. As argued by Närvänen et al. (2020), food waste is a complex problem rooted in inefficiencies in the food supply chain. By applying ToC, this research highlights the assumptions and interventions needed to translate broad sustainability goals into a context-appropriate action plan. In this way, the study extends the systemic approaches advocated by Sonnino (2023) and Mattila et al. (2020), offering a framework that is both structured and flexible enough to adapt to regional specificities, while formulating recommendations specific to the city of Groningen.

In addition, the research emphasises the geographical characteristic of connections in food systems. Although the study focused on the city of Groningen, it reveals that the dynamics of food waste are inextricably linked to the surrounding agricultural region, in this case the province of Groningen. This reflects Sonnino's (2023) call for multi-level thinking in food

governance and supports the concept of urban-rural symbiosis, which remains under-explored in circular economy policy. In addition, the study highlights food democracy, both as a theoretical perspective and as a practical challenge for governance. The participation of citizens, entrepreneurs and institutions in food waste governance strengthens legitimacy and is in line with Behringer and Feindt's (2024) vision of a more inclusive and fairer food system.

The study also draws on behavioural theories such as the TPB (Coskun & Yetkin Ozbük, 2020; Stancu et al., 2016), reinforcing the idea that dietary habits can play an important role in waste production. This behavioural knowledge, when combined with structural conditions such as data availability and logistical infrastructure, helps to integrate the micro and macro levels of the food system transition.

Limitations

While the results provide valuable insights, they are limited by several factors. The case study design, although appropriate for the exploratory nature of the research, limits the generalisability of the findings. The political and regional context and stakeholders specific to Groningen mean that the recommendations cannot be easily transferred to other municipalities without adaptation.

Another limitation of this research is the availability of data. The lack of consistent and disaggregated data on food waste in Groningen was a recurring challenge in both interviews and literature. As highlighted by UNEP (2024), data fragmentation is an obstacle to effective municipal action. This limited the accuracy of the mapping of results and made it difficult to establish baselines for measuring future impacts.

The lack of integration between municipal, regional and private data systems was particularly striking and echoes concerns raised by Bagherzadeh et al. 's work (2014). Finally, while the ToC is useful for structuring interventions and tracing assumptions, it has its limitations in dynamic and non-linear systems such as food governance. System feedback, unintended consequences and political landscapes are not easy to model within the ToC framework. Future studies could therefore combine the ToC with scenario modelling or system dynamics to better capture their complexity over time.

Reflection on transdisciplinarity

This research was conducted in a transdisciplinary framework combining academic methods and practical, policy-relevant knowledge, examining the social, environmental and economic impacts

of food waste reduction. Interviews were central to this approach, providing direct information from municipal officials, NGOs and food entrepreneurs. This not only complemented the documentary analysis, but also ensured that the recommendations proposed were based on real situations. As Creswell (2009) points out, qualitative research benefits from diverse perspectives, particularly when addressing challenges rooted in society.

However, this framework also introduced tensions. Different actors had divergent views on what constituted "waste" or on the interventions to be prioritised. For example, some stakeholders emphasised household awareness-raising, while others prioritised systemic changes in supply or redistribution.

To navigate between these competing perspectives, the researcher had to be flexible and transparent about their methodological choices. Despite these challenges, the transdisciplinary approach strengthened the practical relevance of the study. It allowed the research to go beyond academic criticism and produce recommendations that could be immediately used by the municipality.

Furthermore, it made room for other knowledge systems, particularly those of actors on the ground such as the Free Café, whose practices challenge dominant discourses on waste, value and responsibility. As Rocha & Lessa (2009) observed in the case of Belo Horizonte, integrating food waste reduction policy into a broader social justice programme strengthens both its scope and resilience.

Conclusion

This study analyses the possibilities for Groningen to achieve its zero waste target by 2030 through circular food management, thereby enabling the establishment of a prosperous and resilient system. Starting from the final target set for 2030 and based on a theoretical framework for change, and then substantiating each step with interviews with various stakeholders and comparative data from other cities, this study demonstrates that food waste prevention and redistribution are the most effective options for achieving simultaneous positive environmental, social and economic effects (Parsa et al., 2024). However, as the interviews show, Groningen views food waste primarily as a disposal problem, following the global trend of favouring end-of-pipe solutions in "complex" policy areas where causes, responsibilities and impacts are disaggregated (Närvänen et al., 2020). This study implies that progress will stagnate unless the

municipality reframes food waste as a systemic governance challenge that begins long before leftovers reach the bin.

Four lessons emerge from the data analysed. First, cities that implement transparent measurement systems create the feedback loops necessary for adaptive learning; without a common standard for tracking waste from plates, buffets and preparation, municipal targets become rhetoric (Eriksson et al., 2019). Second, prevention and redistribution outperform recycling across all pillars of the triple bottom line, even when modelling modest reductions in retailer turnover, as the avoided production and logistics costs far outweigh the savings from disposal (Parsa et al., 2024). Third, lasting change depends on cross-sector platforms that align city councils, peri-urban farmers, value chain intermediaries and civil initiatives, an idea long enshrined in the Milan Urban Food Policy Pact but still underutilised at the local level (MUFPP, 2015).

In concrete terms, Groningen should therefore include three complementary measures in its next policy cycle. It should institutionalise a common data monitoring system that requires the hospitality sector and waste management operators to report weekly on the tonnages processed, because, as one participant mentioned, “what gets measured gets managed”, especially when data is fed back to citizens via public dashboards. It should redirect financial incentives for composting towards upstream reduction technologies, such as smart scales and dynamic pricing apps, given their proven effect of reducing waste by 30-50% in comparable European kitchens (Parsa et al., 2024). A dedicated circular food facilitator is also needed to link municipal public procurement, food bank logistics and peri-urban supply contracts into a coherent programme, reflecting the governance logic endorsed by the Pact (MUFPP, 2015). These measures would not only reduce waste volumes but also strengthen food democracy by opening up rule-making to producers, entrepreneurs and cooperatives that are already experimenting with innovative alternative models.

This study presents some limitations. It lacks general statistical data to deepen the qualitative analysis, and the absence of specific reference data for Groningen has limited the accuracy of the scenarios. Furthermore, while the ToC map highlights linear dependencies, it cannot fully capture the dynamics specific to the context of urban food systems. Nevertheless, the study provides a solid starting point for policy development, as each recommended lever is triangulated by at least two independent sources, thus meeting Creswell's methodological reliability requirement (Creswell, 2009).

Future work should therefore build on this foundation in three directions. Longitudinal studies could track changes in household habits once real-time feedback becomes commonplace, filling the current gap between short-term campaigns and the lasting behavioural changes found in systematic reviews (Ouyang et al., 2021). Finally, mixed-methods modelling should quantify the effects of supply chain shortening on employment, carbon emissions and income, an issue that is only touched upon in this study but is crucial for gaining private sector buy-in.

In conclusion, the path to a zero-waste Groningen by 2030 lies in recognising food waste as an intersectional governance issue, prioritising prevention over repair, and establishing robust monitoring and data collection using inclusive platforms. If the municipality implements these changes, it will not only manage its waste more effectively, but also redefine food as a circular public good and, in doing so, provide a replicable model for European cities that are still hesitating between aspiration and action.

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Appendix

Appendix A: Inform and Consent Form

I. **INFORMATION SHEET:** An Investigation of Groningen's Municipality's Strategy to Reduce Food Waste Through Circular Solutions.

Dear Participant,

Thank you for your interest in participating in this study. The research aims to investigate how the municipality of Groningen manages food waste through prevention, redistribution, and recycling efforts. We will explore existing policies and initiatives to identify what works well and where there is room for improvement, with a focus on collaboration among local government, businesses, and community organizations.

In total, we aim to include approximately 8-10 participants in this research. Participants will include municipality officials, representatives from local businesses and nonprofit organizations, and community members engaged in food waste reduction efforts. You have been selected to participate because you are either directly involved in food waste management or have relevant knowledge and experience that can contribute valuable insights to our study.

This research is not funded by any commercial sponsors; it is carried out as part of a university-based project within the University of Groningen.

WHAT DOES PARTICIPATION INVOLVE?

If you agree to take part, you will be asked to participate in an interview (either online or in person) of approximately 45 minutes. We will discuss your experiences, opinions, and insights on food waste reduction, redistribution, or recycling.

Participation is entirely voluntary, and you can withdraw at any point or choose not to answer specific questions without providing any reason.

DO YOU HAVE TO PARTICIPATE?

You are free to decide whether you wish to participate or not. If at any point during the study you change your mind, you may withdraw without consequence or explanation. You also have the right to refuse to answer any question during the interview.

ARE THERE ANY RISKS IN PARTICIPATING?

The study **poses minimal risk**, as primarily participants will be discussing professional experiences in designing and implementing circular strategies.

ARE THERE ANY BENEFITS IN PARTICIPATING?

There are no direct financial or personal benefits for participating. However, your contributions will inform research that may guide improvements to the City of Groningen's food waste management strategies. This research may help future policy-making and community initiatives by identifying effective practices and areas needing further support.

HOW WILL INFORMATION YOU PROVIDE BE RECORDED, STORED AND PROTECTED?

- **Recording & Transcripts**: With your permission, interviews will be audio-recorded to capture the full conversation accurately. To transcribe the interview, the platform Otter.ai will be used for this purpose, which complies with the EU-U.S. DPF regulations.
- **Confidentiality & Anonymization**: Any identifying information (e.g., your name, specific job title) will be removed or disguised in transcripts and publications unless you explicitly agree to be identified.
- **Data Storage**: All data, including audio recordings and transcripts, will be stored on the University of Groningen's secure server and will be accessible only to the research team (me and the supervisor). Data will be retained for five years in accordance with GDPR regulations. After this period, the data will be destroyed or archived in anonymized form.

WHAT WILL HAPPEN TO THE RESULTS OF THE STUDY?

The results of this study will be used in a research dissertation for a master's thesis, and may be published in academic journals or presented at conferences. Summaries of findings may also be shared with relevant stakeholders within the municipality of Groningen to inform future policy and community engagement.

ETHICAL APPROVAL

This study has obtained ethical approval from the Campus Fryslân Ethics Committee of the University of Groningen. The researchers commit to following the university's ethical guidelines throughout the duration of the study.

INFORMED CONSENT FORM

By signing the informed consent form, you acknowledge that you have read and understood this information sheet. Signing also indicates your voluntary agreement to participate. You retain the right to withdraw or refuse to answer any question without penalty, at any time.

WHO SHOULD YOU CONTACT FOR FURTHER INFORMATION?

Name of Lead Researcher: Luísa Soares de Albergaria
Email of main Researcher:
L.Soares.de.Albergaria.Frotier.de.la.Coste.Messeliere@student.rug.nl

II. INFORMED CONSENT FORM

Title study: An Investigation of Groningen's Municipality's Strategy to Reduce Food Waste Through Circular Solutions.

Name participant:

Assessment

- I have read the information sheet and was able to ask any additional question to the researcher.
- I understand I may ask questions about the study at any time.
- I understand I have the right to withdraw from the study within two weeks after this
- I understand that at any time I can refuse to answer any question without any consequences.
- I understand that I will not benefit directly from participating in this research.

Confidentiality and Data Use

- I understand that none of my individual information will be disclosed to anyone outside the study team and my name will not be published.
- I understand that the information provided will be used only for this research and publications directly related to this research project.
- I understand that data (consent forms, recordings, interview transcripts) will be retained on the Y-drive of the University of Groningen server for 5 years, in correspondence with the university GDPR legislation.

Future involvement

- I wish to receive a copy of the scientific output of the project. Yes ( ) no ( )
- I consent to be re-contacted for participating in future studies. Yes ( ) no ( )

Having read and understood all the above, I agree to participate in the research study: yes / no

Date

Signature

To be filled in by the researcher

- I declare that I have thoroughly informed the research participant about the research study and answered any remaining questions to the best of my knowledge.
- I agree that this person participates in the research study.

Date

Signature

Appendix B: Interview Guide

Topic: An Investigation of Groningen's Municipality's Strategy to Reduce Food Waste Through Circular Solutions.

1. **Introduction and Context**
   - 1.1. Could you briefly describe your role and how it relates to food waste management (in Groningen)?
   - 1.2. How would you define the main problem related to food waste in this city/your organization?

2. **ToC Inputs and Assumptions**
   - 2.1. Are there any assumptions you or your organization hold about why food waste occurs or how it should be addressed?
   - 2.2. How do different stakeholders (municipality, businesses, community groups) typically coordinate or collaborate in these kinds of projects?

3. **Activities and Interventions**
   - 3.1. What specific initiatives or programs are currently in place to reduce or manage food waste?
   - 3.2. Could you describe the main strategies used in these initiatives (e.g., educational campaigns, policy regulations, redistribution efforts)? *Focus on one depending on the actor*
   - 3.3. How do you select or prioritize which interventions to implement?

3.4. What do you consider key factors for success in these programs?
3.5. What barriers might prevent these long-term changes from happening, and how could they be addressed?

4. Outcomes and Short-Term Changes

4.1. What short-term changes do you expect from these interventions (e.g., reduced disposal costs, improved community awareness)?

4.1.1. Have you observed any tangible short-term results so far (e.g., reduction in waste volume, increased food donation)?

4.2. Which indicators or measurements do you use to gauge success in the short term?

5. Long-Term Outcomes and Impact

5.1. In an ideal scenario, how do you envision the long-term impact of better food waste management in Groningen? *Only for Groningen experts*

5.2. What broader societal or environmental benefits do you see resulting from more effective food waste strategies?

6. Reflection and Future Steps

6.1. Is there anything else you would like to add or emphasize about food waste management in Groningen/other cities?

Appendix C: Interview Coding Matrix

Theme: Elements of the ToC	Code	Definition	Citation
Inputs	*Knowledge sharing*	Exchange of tips, data and good practices among municipalities, businesses and residents to help them prevent or valorise food waste.	""On our website (…) we give our (Groningen) residents several advices like organise your pantry wisely" "I have a lot of contact with different municipalities which are also busy with food-waste (...) all of them say communication is the best way." "We combine all the data in our dashboard … that allows chefs and F-and-B managers … to see what their inefficiencies in the kitchen are." "I have a lots of contact with different municipalities which are uh also busy with the food waste (...) all of them say that communication is the best way to.", "(We) try to bring people together whether that is through learning opportunities or networking opportunities." "That peer-to-peer so the chefs could really rely to each other and give each other tips without feeling hesitant"
	Equipments and infrastructures	Physical tools and facilities , from smart kitchen scales to composting or biorefinery plants , that make measuring, separating or processing organic waste possible.	"Counter-top at-home compost machines (…) a dehydrator that looks like a trash can (…) consumers are actually buying less and reducing their waste.", "Measurement-cup so you can measure pasta or rice (…) tape you put in your fridge and all the leftovers you put where the tape is." "We put a camera with a scale in the kitchen (…) we actually track everything that you throw away in the bin.", "We have a patented technology in-house (…) our business-model is to license our technology on-site or close by the other party, because some side-streams spoil very fast so you should do the processing as soon as possible." "He made an investment into having it to have the buffet um with cooled elements so he could put it in and it was still fresh and the chain wasn't broken."
	Funds	Public or private financial resources that bankroll pilots, infrastructure and circular business models tackling food waste.	"You give yourself a budget for a few years. Often it's on the basis of an externally funded project to experiment with (…) lots and lots of new ways", "…some development fundings from the national government (…) to transition the economy.", "There is quite a capital investment needed (…) we write subsidy proposals and of course we talk to investors."
Assumptions	*Consumer behavior*	Day-to-day purchasing, storing and eating routines in households that ultimately determine how much edible food is discarded.	"We try to raise consumer awareness to tell them that they waste too much (...) But we don't take into account why people buy too many products (...) it's that they're driven to buy.", "Households are responsible for the most volume (...) there's this disconnect between the money you're spending at the store and the concept of food that you throw out.", "The most difficult is how people are used to act (...) it's normal for them to throw it away; it's very difficult to learn them that there are other ways.", "It's all about behavioural change in the end, the monitor just gives you the insights; people have to act on them.", "Over-consumption is also food waste (...) even though you don't see it in the waste streams.", "They say they want to do it but they are not doing it. So they have they have the cognitive dissonance."
	Responsibility	The shared but uneven sense of accountability among consumers, businesses and governments for preventing food waste.	"Too Good To Go contributes, like the supermarket, to trying to get rid of its over-production (...) in the end it's the consumer who will have to destroy the product.", "A lot of businesses have just accepted that that is the cost of doing business (...) they're not incentivized to help the consumer make the most of that food; actually they will make more money if the consumer doesn't eat it and has to go back to the store and buy more.", "Lots of people think they don't have food-waste (...) they don't realise that by throwing food away … you're having food-waste.", "They think the other kitchens are super-inefficient and they're fine, but without tracking they just don't see their own waste.", "Urban consumers are less aware of what food choices they need to make to support a circular system.", "What I understand is that most food-waste happens at the consumer.", "If you want to tell others what to do, then show yourself that you're doing it."
	Integrated approach	A systemic way of working that links all food-system stages and policy domains so that actions on waste prevention reinforce one another city-wide.	"It's difficult to think about just the circular food system alone (…) rather the wider circular city", "There's not just one single challenge (…) because it's a problem that takes place across sectors and at all levels." "If you tackle prevention you will also have less waste of course.", "It needs to be a strong rural- and urban-symbiosis (…) you cannot just improve it by focusing on either one of these two." "So it's not only where's the waste in your kitchen, but where do you source your products from? And is there in your chain and do you have influence on your chain", "the whole point (of sustainable food systems) is to articulate several challenges and not to favour one over the other.", "You see a pattern and back it up with pictures to talk about it with the employees; it's insights and staff engagement together.",

Activities and Interventions	*Finance sustainable entrepreneurship (SE) initiatives*	Provide grants, tax breaks or investment that help startups and SMEs scale circular food-waste solutions.	“The city can provide spaces, can provide tax cuts (...) that can allow these projects (SE) to flourish.”, “Sometimes municipalities say, ‘Everyone will get €2 000 discount'; that’s something we can work with.”, “It’s heavily subsidised by the government (...) an organisation literally there to make the connections between government strategies and companies.”, “They (Groningen Municipality) have an interest in working with more biorefinery activities and high-valorisation of biomass and bio-waste.”
	Informative events	Public campaigns, workshops and demonstrations that teach citizens or sector actors concrete ways to cut waste.	“These local meetings bring together all the players from French local authorities committed to transforming their food systems.”, “We were standing at the Fish-market (...) giving information to people about food-waste.”, “We give introductions and lectures at hotel schools (...) the students use our monitor in their trial kitchens.”, "We also worked on that with them on storytelling. So if you go to a restaurant, you don't want to be bothered with food waste. But you can be bored with a nice story and a nice tasting of um products that otherwise would have been thrown away"
	Support cooperatives	Strengthen producer- or consumer-led cooperatives that shorten supply chains and channel surplus food.	“There are some cooperatives (...) really enforcing peri-urban agricultural areas.”, “It was people super-close to the agricultural cooperatives and the industrial companies; already the beginning of a network happening between public- and private-sector actors.”
	Connect local actors	Facilitate networks so municipalities, firms, NGOs and citizens coordinate roles and resources around waste prevention.	"We need a map of the players ; understand who are the allies and who are the opponents (...) who can be the leader and who can be the driving force.”, “What’s interesting is to facilitate groups of chefs that talk together about the learnings (...) share experiences instead of everyone inventing the wheel on their own.”, "The city governments (should) collaborate more with like the region or per urban municipalities where then they're much more close to the producers and the agriculture activities", "A municipality is influential in how food is consumed and waste managed, but production is outside the city, so the two have to work together.”, "The municipality is really the the the one that is um supporting this network."
	Develop infrastructures	Build or upgrade collection, logistics and processing facilities that enable high-value treatment of organic streams.	“(The city) rents commercial space at below-market prices on condition that shops are selling local products: so it’s a form of subsidy for more favourable forms of food supply.”, “In Prague there’s a good example with biogas production out of organic waste separated collection.”, “We separate the okara into protein and fibre fractions, remove the off-flavours, and we have done a larger pilot at an outsourced manufacturing party.”
Outputs (short term impacts)	*Increase of SE*	Growth in the number and viability of ventures that turn food surplus or by-products into new value.	"labels for restaurants that undertake to respect a certain number of rules (...) recycling waste, organic waste in particular, (...) provided it's organised so that it can be returned to the areas where it's grown", “…more business-model opportunities at the local level on how to … treat any potential food waste.”, “Short term you’d see the creation of a lot of new initiatives that need to supply these services – it creates jobs and alternative sources of revenue.”, "it (food chain) needs to be a strong rural and urban symbiosis basically"
	Connectedness to food cycles	Stronger citizen awareness of, and participation in, local growing, composting and reuse loops.	"can put city-dwellers who no longer understand anything about agriculture back in touch with a world of agricultural production when it’s nearby.”, “Barcelona (...) has a lot of peri-urban agricultural areas, which creates some interesting synergies with the city.”, “Schools could source from a local farm and then bring kids to the farm so they learn ‘this is where your food comes from’", “Community gardens can be a solution where you collect food waste and turn it into compost in a decentralised way across a city.”, "Know where the produce come from and with that connection and transparency and shorten that relation and and and also invest in that relation. they they value the produce and the people will make the produce better and that's in itself um causes less waste" "You know the farmer you maybe go there you see how much love and attention and he puts into the growth of the produce and then you bring it to the plate there is art in there"
	Higher collaboration	More frequent and effective partnerships between public, private and civic stakeholders on food-waste issues.	“There’s definitely a dialogue between the private and the public sector and the willingness to collaborate.”, “If you can get even just a few businesses to sign on (...) smaller organizations tend to look at them as leaders and it feels like a movement that’s begun.”, "There is this bond between the the entrepreneurs and the municipality supports" "People that can make the bridge between the entrepreneurs and the municipality"

	Decrease of food waste	Quantifiable drop in edible and inedible food discarded across the urban food system.	"“They (West Coast states) were able to reduce their waste (...) by 20 or 25 percent over four years.”, “They (horeca) save up to 30 % of their edible food waste after a year, and that builds up towards 50 % after two years.”
Outcomes (long term impacts)	*Higher resilience*	Greater capacity of the local economy and food system to withstand shocks thanks to circular resource flows.	"Protecting agricultural land in or around the city (...) makes the city more resilient to climate change.”, “I think it (circular food systems) would definitely make the economy more resilient.”, "you spend less money of course if you uh um buy less", “They would be in an extremely favourable position to implement all of these [cascading] steps, leveraging the port, the manufacturing hub and the agricultural region.”, "The farmer change on that because he likes his job again because he has diversity and he has security because the chef already says that he will buy all the produce" "The normal farmers they don't even know the price or the price isn't in their hands and they they don't even know if they can sell their products."
	Healthier population	Improved public health driven by diets richer in fresh, minimally processed and locally sourced foods.	"Shops that are subject to product-quality rules give neighbourhoods access to fruit and vegetable produce that is both healthy for nutrition and healthy from the point of view of the absence of microplastics.”, “less animal protein-based [diets] (...) would (...) improve human health.” (J)
	Food democracy	Inclusive governance in which citizens actively co-create fair and sustainable food policies.	“We are moving from a vision that was the fight against food insecurity to a vision that is called food democracy (...) food democracy involves everyone, including people who have never had the chance to speak out.”
	Lower municipal emissions	Reduction of the city’s greenhouse-gas footprint resulting from avoided production and better waste valorisation.	“The embodied carbon would definitely decrease.”, “When you start cutting down the volumes of waste you move up to higher-value bio-based applications; that’s where the environmental gain really is.”, “When you compare our ingredients to the ones they replace, the footprint becomes more interesting even though we add processing.”
Intented Impact	*Zero waste*	Limited public understanding of the scale, causes and impacts of food waste.	“We (Groningen Municipality) have one aim: in 2030 no waste (...) to be waste-free doesn't mean you don't have waste at all, it means all the waste you have is separated so we can recycle it.”
Obstacles	*Measuring food waste*	Difficulty in obtaining accurate, comparable data on what, where and how much food is wasted.	“We don't know how big the problem is (...) to know how big the problem is you have to have different tests with the waste (...) we don't have data.”, “To know how big the problem is you have to analyse the waste (...) there is a company that can do it, but it’s very complicated and we have to think if we want to do that also.”
	Finance	Insufficient capital or unattractive cost-benefit perceptions that hold back investment in prevention measures.	“There is quite a capital investment needed (...) they need to be very convinced the ingredients will actually sell.”, “If the solution is too expensive they just won't do it (…) everyone wants to be sustainable but they want a positive ROI.”, “Whatever you do, it’s very expensive compared to doing it the linear way, unless the structure of incentives changes from a financial and regulatory point of view.”, "All the attention goes to we have to survive, we have to make money... there's a lot of survival mode going on." "It's hard to do green if you're in the red uh numbers."
	Lack of awareness	Limited public understanding of the scale, causes and impacts of food waste.	"Urban consumers being less aware of what it would take really, like what what food choices they they would need to make to support a circular system", “People think they already do a good job (...) they sometimes don't believe how much they waste; commitment and time are the big challenges.”, “At the moment sustainability is not the driving force: people want tasty products (...) the mass doesn't really care." "People not valuing food as it should." "People don't realize how much money also they're wasting by wasting food."
	Lack of infrastructures	Absence of suitable collection and processing facilities for organic streams within reach of generators.	“Infrastructure for managing waste and making sure you valorise it in the best possible way”, “Some side-streams spoil very fast so you should do the processing as soon as possible (...) not easy if the plant is far away.”.

	Social standards on food	Cultural expectation for plentiful, perfect food that drives over-production and discard of edible items.	“In the US we love the image of abundance and we don't want to be told how to restrict ourselves.”, “It’s very difficult to teach them (...) it’s normal for them to throw it away.”, "we are offering like 10 to 15 things to our customers and they have to be able to choose from everything until the end of the menu. If you can change that perception of what is luxury in hospitality (...) that's a huge step forward as well.", "I think it's not in our culture to value food as we actually should.", "We live in abundance and we don't um we don't experience the scarcity while there is a lot of scarcity of course around the world it's just divided uneven"
	Food norms and refulations	Regulatory or cultural rules about what is “acceptable” to eat that restrict reuse of by-products or surplus.	“Some side-streams could be considered novel food (...) legislation makes it very difficult to bring them back into food.”, "there's food wasted because the the cooling chain for example is broken", “Most food-waste happens at the consumer (...) shelf-life labels have a high margin and people just follow them.”.
	Lack of collaboration	Fragmented responsibilities and weak coordination among supply-chain actors and authorities.	“Collaboration is hard and very slow for everyone on every end”, “Regulation should change the structure of incentives; otherwise it stays more expensive than the linear way.”, ""they don't always talk to the right actors (...) there's a lack of coordination", "the private parties have an expertise that the public ones don't have and then even though the public parties could change things on the citizen level the fact that they don't have have access to this expertise makes it hard for them to change it."