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From Street Market to Superstore: Retail Modernization and Food Waste in South Korea

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Retail Modernization and Food Waste in South Korea

By

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Committee in charge:

Professor Jennifer Wolch, Chair
Professor Jason Corburn
Professor Dara O'Rourke

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Abstract

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Food waste is an increasingly pressing issue with adverse environmental, social, and economic impacts related to climate change, water use, land use change, and food security. A better understanding of this phenomenon is required to better shape policies for its reduction and improved management. One trend especially relevant to food waste that remains under-examined is retail modernization, which occurs in concert with urbanization and involves the food retail sector's transition from traditional and family-owned retailers to corporate-owned retailers, who operate a range of store formats, including hypermarkets, supermarkets, and convenience stores.

In this dissertation, I explore and compare the potential for corporate and traditional retailers to exert influence both "downstream" and "upstream" in South Korea's food supply chain, with varying consequences for food waste. Downstream, I investigate and compare the influence of corporate and traditional food retail formats on South Korean households' grocery shopping and food-related practices. In particular, I focus on how factors such as grocery shopping trip characteristics like shopping frequency, travel time, and mode choice, in addition to related influences like marketing tactics, product mix, and packaging sizes, affect households' tendencies to buy too much food, contributing to household food waste. Turning upstream, I then compare the production and distribution networks that serve corporate and traditional retailers, which are differentiated mainly by corporate retailers' greater vertical integration, access to cold-chain technology, and improved logistics. While these factors may reduce food waste during distribution and retailing, corporate retailers may also employ more stringent quality standards, which may exacerbate food waste by increasing the discards of potentially edible food that does not meet these standards.

I developed a mixed-methods research design to assess the above-described effects of retail modernization on food waste. Employing a theoretical framework that primarily draws from practice theory, I collected data on household food waste using a household survey (N=460), food waste diary (N=102), and semi-structured interviews (N=13), which I analyzed using a combination of multivariate regression and bivariate analyses. I evaluated the causes and extent of fresh fruit and vegetable (FFV) food waste from the postharvest to retail stages of the food supply chain using a case study approach built on data from informant interviews and secondary

research. In this case study, I trace and compare traditional and corporate retailers' supply chains for FFV in order to identify the main causes of food waste. Using interview data and existing data on transactions South Korean FFV distribution channels, I also develop a rudimentary model that estimates and compares the quantity of food waste in the South Korean FFV distribution system attributable to traditional and corporate retailers.

My findings connected retail modernization to food waste in several ways, while also raising questions for further research. At the household level, there was evidence to suggest from analysis of my survey data that avoidable food waste per person tended to decrease as households' grocery shopping trips increased in frequency from once a week to every day. The survey data also showed that longer travel times were associated with more avoidable food waste per person. Both longer travel times and less-frequent grocery shopping trips tended to be more closely associated with corporate retail formats, in particular hypermarkets. Analysis of diary data also implicated corporate retailers in contributing to household food waste due to the greater presence of sell-by dates on their food products. At the retail stage, limited access to cold chain and demand forecasting technology meant that traditional retailers discarded more FFV food waste than corporate retailers due to their vulnerability to adverse weather conditions and poorer-than-expected sales. During post-harvest processing, corporate retailers' food waste was not substantially differentiated from traditional retailers' because FFV processing and grading is undertaken at facilities common to corporate and traditional retailers' supply chains.

Although my findings indicated that while retail modernization may reduce food waste in the pre-consumer stages of the food supply chain, there was also evidence to indicate that this advantage may be being eroded by its simultaneous contribution to increased household food waste. Policy implications include the need to ensure the continued presence of small-format food retailers while supporting the modernization of their food procurement systems and infrastructure. This should be accompanied by efforts to regulate packaging and marketing promotions as well as continued consumer initiatives that help households buy the right amounts and manage their food more efficiently. Future research should examine more closely the potential interrelationships between food retailing, households' grocery shopping trip characteristics, and households' food management practices. It may also be valuable to formally investigate the role that actor diversity in agricultural production and distribution systems helps mitigate pre-consumer food waste by providing more sales channels for lower-quality produce.

A limitation to the research is the reliance of the household survey on self-reported household food waste data, although this was mitigated to an extent by asking households' to quantify their food waste using South Korea's volume-based food waste pricing system as a frame of reference. The research is also limited by its potential lack of applicability and replicability in other geographic or cultural contexts, which stems from the context-specific nature of food production, distribution, and consumption.

To Choot, Mama, Baba, and Ah Mui

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Chapter 1– Introduction

1.1 Food waste—a multidimensional problem

Informally speaking, the starting point for this dissertation was an observation I made while walking around Seoul several years ago concerning the sheer number and density of shops there, particularly food retailers. Being already pre-occupied at the time with the question of how urban planning influences consumer behavior, this made me wonder whether such a high density of shops enables excessive consumption—and by extension, waste—by affording consumers more physical access, opportunities, and temptations to buy more stuff. This led me down a path of study that brought me to the concept of supermarketization, or retail modernization, the process by which retail sectors transition from being comprised primarily of traditional markets and small, family-owned businesses to becoming dominated by corporate-owned retailers. Recognizing that this process was still underway in South Korea, I decided that retail modernization could be the link between consumer behavior and urban planning that I was looking for. In this manner, it has become the springboard for this dissertation.

During the time I have spent conceiving, researching, and writing this dissertation, food waste has become a hot topic, attracting increasing attention both in the media and academic research. The scale of the problem is compelling. Estimates suggest that between one-third (Gustavsson, Cederberg, Sonesson, Van Otterdijk, & Meybeck, 2011) and half of global food production (Smil, 2001, cited in Lundqvist, de Fraiture, & Molden, 2008). This means that in absolute terms, at least 1.3 billion tonnes of edible food is discarded annually (Gustavsson et al., 2011). The economic cost of food waste is similarly severe. In developed nations, households and retailers are the main sources of food waste—the byproduct of economic prosperity and consumerist lifestyles. In 2009, food waste in the US alone totaled 55 million tonnes and was valued at $200 billion, of which $124 billion was consumer food waste. This was equivalent to losses of $1,600 per year for a four-person family (Venkat, 2012). In the UK, households discarded food worth around $16 billion in 2015 (Quested & Parry, 2017). In developing nations, food waste is primarily generated during post-harvest processing and distribution as a result of inadequate infrastructure and technology (Institute of Mechanical Engineers, 2013). The size of the global food waste problem will only keep growing as urbanization proceeds in developing countries and their middle classes swell. Adhikari, Barrington, and Martinez (2009) project that urban food waste production will have grown by 44 percent between 2005 and 2025. Such growth will exert significant pressure on extant urban waste management systems, many of which already struggle to manage municipal solid waste.

The scale and expected growth of global food waste is concerning due to its multiple adverse impacts, which are environmental, economic and social in nature. The sheer loss of economic value incurred by food waste takes place throughout the food supply chain, i.e. the production, processing, manufacturing, distribution, retail, consumption, and disposal of food. From producers and distributors to retailers, food service providers and households, food waste is an unrecoverable cost that reduces their income. Reducing food waste could therefore help generate substantial savings and improve profits, with knock-on effects as a result of the ensuring savings in production inputs that would occur as a result. Additional financial costs are also incurred by the management of food waste. The total life-cycle costs of managing US food waste in 2009

with municipal collection and landfilling would have been approximately $10 billion dollars;[1] alternatives such as composting or incineration would have cost even more.

The social dimension to food waste includes its moral aspects and its implications for food security. Most of us have likely been subject to parental admonishments to "eat up" because of all the starving children in Africa, to which the cheekier among us might have sarcastically volunteered to send them our leftovers. Implicit here is the notion that food is something that we should be grateful for. Gjerris and Gaiani (2013) suggest that we feel discomfited more by discarding food than other everyday items not just because the money or resources that went into producing the food could have been used more gainfully, but also because society retains a collective memory of times when food was not so bountiful. The moral discomfort experienced when discarding food is also related to the eco-centric perspective that food waste is "disrespectful to the processes and places that brought forth the food in the first place" (Gjerris & Gaiani, 2013, p. 17). The dinner table scene however, also hints at the multi-faceted nature of food waste's connection to food insecurity, which is a matter of supply, distribution, and access. For subsistence farmers in developing countries, preventing food waste directly affects their food supply and significantly impacts their wellbeing, while improving farmers' ability to get food to market in developing countries would also greatly shore up food security by improving overall food supply. For many urban households, food insecurity is an economic issue rooted in poverty and high food prices. Reducing food waste would therefore also mitigate food insecurity by reducing supply chain inefficiencies and as a result, food prices (Gustavsson et al., 2011).

The environmental argument against food waste is grounded in direct and indirect impacts on the environment. The direct environmental impacts of food waste primarily result from its deposition in landfills, where it undergoes anaerobic decomposition, producing methane, a potent greenhouse gas. However, this contribution is dwarfed by food waste's indirect climate change impacts from the embodied emissions associated with the production, distribution, and retailing of wasted food. A recent study conservatively estimated food waste to be responsible for 113 million tonnes CO_2 eq. annually, or 2 percent of net US greenhouse gas emissions in 2009, of which 10 percent was direct emissions from disposal and nearly 70 percent from the production and processing of the wasted food (Venkat, 2012).

Beyond climate change, food waste's environmental impacts encompass the wastage of other resources used in agricultural production. The volume of crop irrigation water used to grow the food we discard is estimated at 1,350 km^3 globally and 120 km^3 in the US (Lundqvist, de Fraiture, & Molden, 2008). This water is mostly taken from lakes, rivers, and aquifers, and their depletion negatively impacts downstream ecosystems and communities (Lundqvist et al., 2008). Climate change will exacerbate water scarcity due to its effects on rainfall patterns and temperatures, which will adversely affect crop yields and water availability (Elliott et al., 2014). Additionally, industrial agriculture continues to be dependent on chemical fertilizers to supply crops with nitrogen and phosphorus (Cordell, Drangert, & White, 2009; Smil, 2002). Their application has increased by approximately 7 and 3.5 times, respectively, as food production doubled over the past 35 years and is expected to treble during the next doubling of global food production (Tilman, 1999). When introduced into the environment, excess nitrogen and

[1] Based on management costs from 1998 of $13.65 per 100 kg (Diggelman & Ham, 2003), expressed in 2009 dollar values using US consumer price index data, and total food waste estimates of 55 million tonnes (Venkat, 2012)

phosphorus disrupt ecosystem function. For instance, they contribute to eutrophication in marine and aquatic ecosystems, with consequences that include biodiversity loss and altered food chains (Tilman, 1999). Lastly, the land use impacts are significant, even on top of farmland already being used to produce waste food. If current trends continue, landfilling requirements for food waste will grow to around 400,000 hectares in 2025, an area capable of growing enough wheat to fulfill the carbohydrate requirements of around 2 million people (Adhikari et al., 2009). Reducing food waste at source will be critical for averting these impacts.

1.2 An issue for planners?

It is clear that the issue of food waste needs to be engaged on multiple disciplinary fronts, yet urban planners have only just begun to arrive for battle. This absence is part of the lack of attention they have paid to the broader food system, defined as the food supply chain plus its connected institutions and activities, relative to more traditional focus areas such as economic development, public health, social justice housing, land use, transportation, and environmental issues including energy, water, and waste (Morgan, 2009). Though this has changed significantly over the last fifteen years, planners' inattentiveness to the food system has been attributed to a number of factors, as identified by Pothukuchi and Kaufman (2000) in their survey of 22 city planning agencies in the US. Included among these were the following: 1) food is not closely connected enough to the built environment to be a planning issue; 2) food is a rural, not urban issue; 3) food is the domain of the private sector; 4) little or non-existent government funding for food system planning; 5) the food system does not experience market failure unlike other planning domains; 6) confusion over who to collaborate with on food system issues; and 7) lack of expertise and acceptance concerning the role of planners in food systems.

Yet one does not have to grasp for reasons to justify a greater emphasis on food system planning. Pothukuchi and Kaufman (2000) illustrate by singling out two themes from Myers' (1997) report for the Association of Collegiate Schools of Planning on planning's disciplinary identity; these include improving the ability of human settlements to meet the needs of people and focusing on addressing the interconnections between separate dimensions (physical, social, economic), sectors (transportation, housing, economic development), and actors (private, public) of urban communities. The relevance of food systems to either of these goals cannot be understated. The latter stages of the food supply chain not only create urban jobs and economic value, but as a significant portion of urban households' budgets, food affordability and access are connected to the provision and pricing of other necessities such as housing (Pothukuchi & Kaufman, 2000).

This ties food system planning into public health and nutrition as well; planners need to address urban food insecurity and hunger stem by improving physical and economic access to fresh and healthy foods (Corburn, 2007). Such issues of access are symptomatic of the unwillingness of private food retailers to locate in poor neighborhoods as well as excessively car-oriented land-use planning; these factors contribute to spatial inequities in food access, i.e. the creation of "food deserts" that severely constrict the choice of food available to their residents (Walker, Keane, & Burke, 2010). A further connection between land use, transportation, and the food system, is the ability of grocery retail development to stimulate and shape traffic flows; a new supermarket on city's outskirts, for instance, could contribute to larger numbers of cars on the road (Boarnet, Crane, Chatman, & Manvill, 2004). Lastly, excessive pesticide and chemical

fertilizer use would potentially contribute to surface and groundwater pollution in urban areas situated in the same watershed (Pothukuchi & Kaufman, 2000).

There are also very good reasons why food waste should be a focus of planners as well, which should be apparent from the foregoing discussion. The most immediate reason pertains to waste management—for cities relying on landfilling as their primary means of disposal, food waste and packaging increase the amount of land area required for waste management (Pothukuchi & Kaufman, 2000). Where municipal garbage is primarily incinerated, the extra moisture content introduced by food waste necessitates additional energy inputs, increasing the carbon footprint of these cities. In developing nations, inadequate waste collection and the use of open landfills means that food waste directly impacts public health by clogging drains and attracting disease-carrying vermin (Konteh, 2009). Needless to say, waste management systems cost money and are an important aspect of municipal governments' service provision responsibilities; waste reduction could thus reduce financial burdens on local government budgets. Urban food security is also relevant—as has already been mentioned, food waste represents a cost in the food supply chain that suppliers and retailers factor into their pricing, and reducing food waste could improve food affordability. Additionally, excess food on farms or from retailers that is still safe for consumption often cannot be redistributed to vulnerable populations because organizations such as food banks lack resources or are unable to coordinate with potential donors to collect food in time—planners could play an important role in addressing these problems.

At a more conceptual level, the notion of urban metabolism and life-cycle thinking highlight how cities are responsible for resource consumption and environmental degradation far beyond their borders as a result of their constant need for resource inputs and generation of waste (Barles, 2010). This implies that sustainability planners must account for the indirect as well as direct impacts of resource consumption and waste generation, or else sustainability planning will not be sufficient in the face of the complex environmental, social, and economic challenges that accompany global anthropogenic change (Grimm et al., 2008; Steffen et al., 2015). Although food waste has received nominal attention from planners in the past as a problem requiring technical solutions and planning, end-of-pipe solutions are no longer enough. As food waste's direct impacts are dwarfed by its indirect impacts, waste reduction, and not just its improved management, is a critical issue for sustainability planners that demands greater intervention in the behavior of the actors creating and reproducing the unsustainable patterns of food waste.

It is easy at this juncture to blame rich-world consumers, whose acclimatization to an age of abundance has ostensibly produced a callous attitude towards food and other resources. However, planners interested in reducing food waste would be remiss not to draw parallels with transportation planning—we can hardly blame people for driving if they do not have any other alternatives. It would be too controversial to follow this by suggesting that consumers in the modern food retail system have no choice but to throw away more and more food, but the comparison nevertheless underscores the need to examine limitations to individual agency by introducing a focus on the broader systems at play. Examining the "system" at multiple scales opens up new perspectives on the causes of food waste. By looking at the full length of the value chain, Gille (2012), for instance, argues that food waste is an outcome of institutions and actors' efforts to manage economic, technological, and political risk—economic risk where farmers deliberately grow excess food in order to fulfill contracts and hedge against natural disasters,

technological risk where product standards relegate out-grades of misshapen fruit and vegetables to the bin, and political risk where overproduction-inducing subsidies stay in place due to the strength of the agricultural lobby. Gille (2012) also argues that analyses of food waste should transcend scale by recognizing that the causes of food waste within a particular stage in the FSC may lie in another, pointing to how household food waste is often attributable to packaging size or labelling, factors well beyond a household's control.

It is precisely such perspectives that make retail modernization a compelling theoretical starting point for this dissertation. Retail modernization appears to be complicit in the production of food waste along multiple stages in the FSC. From contract farming through the development of standards to their employment of marketing strategies that affect the packaging sizes and promotions consumers face, corporate retailers exert significant influence upstream and downstream on their suppliers and customers, respectively. Returning to one of Myers' (1997) six anchor points of the planner's identity, the focus on cross-sectoral interconnections raises the question of whether corporate retailers are associated with particular patterns of land use, and how they impact households' grocery shopping trips and waste-generating tendencies. Furthermore, the competitive success of corporate retailers, which hinges in part on their ability to strategically locate stores, may have structural implications for food production, manufacturing, and distribution networks, with ensuing ramifications for food waste.

1.3 The dissertation ahead

In this dissertation, I set out to investigate the relationships between retail modernization and food waste. Given the transition from traditional to corporate retailing that retail modernization implies, my approach involved identifying key differences between traditional and corporate food retailers and assessing the extent to which these differences can be connected to variations in the quantity and nature of food waste being generated in households and the pre-consumer stages of the food supply chain. Specifically, I attempt to answer the following research questions:

RQ1. What effect does shopping for groceries at different kinds of food retailers have on the quantities of avoidable food waste discarded by households in industrialized nations? How are these differences related to the effects of food retail modernization on food-related practices?

RQ2. How has retail modernization affected the quantity and nature of pre-consumer food waste for corporate and traditional retailers in industrialized nations?

For household food waste, my research is guided by hypotheses about the influence of corporate retailers on households' grocery shopping practices, and in particular, their tendency to buy too much food. I hypothesize that this tendency is driven by the association of corporate retailers with shopping experiences and grocery trip characteristics that are conducive to overpurchasing. Such shopping experiences may include greater exposure to sophisticated marketing tactics and increased package sizes. Additionally, land use patterns associated with large corporate retail formats may induce less frequent, car-reliant, and longer grocery shopping trips in which consumers buy larger quantities per trip. Over-purchasing that results from such factors increases

the chance that food spoils or is thrown away for another reason before it can be consumed. The hypothesized effects of retail modernization on pre-consumer food waste stem from two main factors. First, corporate retailers' greater access to improved logistics and technology reduce spoilage occurring in supply chains and in stores, helping to reduce food waste. Second, although their increased buying power and establishment of direct procurement systems potentially reduces food waste by shortening supply chains, the application of private quality standards may exacerbate food waste by prompting more discards of out-graded, yet edible produce

To test my hypotheses, I employed a mixed-methods research design that relies on a survey, diary, and interviews to collect data on household behaviors and food waste, as well as a case study of pre-consumer food waste in the fresh fruit and vegetables (FFV) distribution system that relies on informant interviews and secondary data. The survey (N=460), diary (N=102), and interviews (N=13) formed the three points of a triangulatory approach that aimed to understand the drivers of household food waste, with a specific focus on comparing households that shopped at corporate and traditional retail formats across a range of relevant variables. The quantitative data collected were analyzed with a combination of different multivariate regression techniques, bivariate testing, and the novel approach of odds ratio analysis. Qualitative interview data and secondary data provided additional perspectives that helped interpret the results of quantitative analysis. My case study of pre-consumer food waste compared the causes and extent of food waste in retailing and supply operations for corporate and traditional retailers. It was restricted to FFV in order to control its scope; this focus was theorized to provide the greatest contrast between traditional and corporate retailers due to the fragile and perishable nature of this food group. Interviews with key informants along the supply chain provided data on the various reasons for food wastes, while the estimates they provided of the percentage wasted in each stage, combined with secondary data, enabled the creation of a model that estimated total FFV food waste in the South Korean distribution system.

I chose to undertake this research in Seoul, South Korea for two main reasons. I have touched upon the first already, which pertains to the high level of access to diverse forms of food retailing in Seoul. After opening its retail sector to foreign investment in the mid 1990's, South Korea has experienced rapid retail modernization. This permitted the entrance of foreign retail chains, who introduced the hypermarket format, variously known as big-box retailers or superstores. Where the South Korean retail sector was previously dominated by family-owned stores and traditional markets (Cho, Chun, & Lee, 2013), the "one-stop-shop" hypermarket format shook up the retail sector by offering convenient access to groceries and a host of other goods and services in a comfortable and clean environment (Coe & Lee, 2006). Corporate retailers have followed up their success with the hypermarket format by first opening smaller supermarkets, dubbed "super-supermarkets" or SSMs, and then expanding into the convenience store segment. This has come at the expense of family-owned stores and traditional markets, whose share of the food retail sector was 27% in 2014, with corporate retail formats taking the rest (Euromonitor, 2016). These trends have helped create the highly diverse retail environment that makes Seoul an ideal site for research into the effects of retail modernization on food waste.

The second reason pertains to South Korea's history of waste management policy. Up till the mid-1990's, landfilling was the primary means of waste disposal, but the growing shortage of land for urban development around Seoul prompted environmental policymakers to embark on a

path of waste reduction and diversion (Kim & Kim, 2012). Most significantly, this has taken the form of laws mandating the segregation of waste into general waste, recyclables, and food waste, as well as volume-based pricing systems, first for general waste, and more recently for food waste. Coupled with extensive educational campaigns, this has contributed to strong public awareness about food waste, as well as familiarity with segregating food waste on a daily basis. I anticipated that this would aid data collection in two ways. In the survey, households were asked to estimate their food waste using the volume-based pricing system as a frame of reference, which was theorized to mitigate recall bias that normally leads households to underestimate their food waste (WRAP, 2013). For the diary study, this familiarity with having to segregate their food waste daily was thought to increase households' receptivity to participating.

My dissertation is organized in the following manner. In Chapter 2, I present the theoretical argument for studying food waste from the perspective of retail modernization. This involves reviewing the literature on retail modernization and food waste, in addition to the construction of my conceptual framework. For the analysis of household food waste, this is grounded in social practice theory, which is a sociological perspective on behavior that grew out of the work of theorists such as Bourdieu (1986) and Giddens (Giddens, 1984) and was more extensively developed by Schatzki (1996) and Reckwitz (2002). By focusing on social practices, or a recognizable, "routinized type of behavior" (Reckwitz, 2002, p. 249) that is broadly understood by society as being comprised of specific "doings and sayings" (Schatzki, 1996, p. 89), practice theory privileges neither structure nor agency. As such, it filled the need for a theoretical approach to household food waste that was able to adequately account for contextual influences on behavior without entirely discounting the role of individual agency. In particular, I employ practice theory's concept of infrastructures, or systems of provision (Southerton, Warde, & Hand, 2005) as a theoretical lens through which to understand the interactions of the food retailing system with households' food-related practices. In addition, I complement practice theory with elements from behavioral economics, which helps to link irrational consumer behavior, such as buying too much, to external influences on the subconscious, such as a store's environment. For a framework that helps conceptualize the influences of retail modernization on pre-consumer food waste, I draw upon the literature on transnational retailing and supermarketization, which have extensively examined the role of corporate retailers in shaping agricultural production, distribution networks, and procurement practices. I end the chapter by reiterating my research questions and outlining my hypotheses.

Chapter 3 details my research design and methodology. It begins by justifying how my choices in research design are most suited to answering my research questions, before moving on to a description of my data collection and sampling procedures. These include a household survey, waste diary study, household interviews, informant interviews, and the use of other data sources. I then describe the processes of data analyses, before wrapping up a chapter with a treatment of my research design and methodology's contributions and limitations. Chapter 4 then discusses the empirical context for my dissertation research, providing more detail on South Korea's waste management policies before reporting on the country's history and status of retail modernization. It then sketches the ways in which retail modernization combined with other trends, such as the demographic shift towards smaller households, to simultaneously influence and be influenced by food-related practices. I conclude Chapter 4 with a discussion of what these trends and interactions might mean for food waste.

Chapters 5, 6, and 7 delve into the data collected by the household survey and waste diary. Chapter 5 introduces the findings from the survey. After providing a demographic snapshot of the survey sample, it explores trends among survey participants regarding their attitudes, food-related practices, and grocery trip characteristics, including where they shop, how they get there, how far they travel, and how often they go. It uses bivariate analyses to assess the linkages of such variables to different types of retailers, as well as to measures of household food waste, before presenting and discussing the results of two multivariate regression models that predict quantities of total food waste and avoidable food waste and their implications for policy. Chapter 6 focuses solely on the diary data, beginning with a snapshot of diary participants and comparing them to the wider survey sample. Using bivariate and odds ratio analyses, the chapter analyzes how differences in the distribution of households' food waste across different categories of food waste are correlated with where the food was originally purchased. After discussing the findings, I conclude with implications for policy. In Chapter 7, I continue analyzing the diary data, choosing six measures of food waste to analyze using bivariate analyses and multivariate regression models constructed with independent variables collected from the diary participants' survey responses. After presenting and discussing the results, I conclude the chapter with implications for policy.

Collectively, chapters 5 and 6 provide evidence that links increased household food waste to specific facets of retail modernization, such as longer and less frequent trips to the grocery store, the presence of date labelling, and larger packaging sizes. The bivariate analyses in Chapter 7 mostly supported these linkages. Although findings from multivariate regression modelling were more mixed in their support for these linkages, they also provided other connections between increased household food waste to corporate retail formats, such as the importance that customers placed on store atmosphere and customer service.

Chapter 8 presents a case study of pre-consumer food waste in South Korea, focusing on traditional and corporate food supply chains for FFV, from post-harvest processing, packaging, and distribution (PPD) stage, through wholesale, to retailing. The chapter describes each stage's key actors, processes, and main causes of food waste, drawing on informant interviews and secondary data. I then describe the construction and output from a rudimentary model that combines interview data and secondary data to estimate and compare the total quantities of FFV food waste through the distribution and retail stages that is attributable to traditional and corporate retailers. The model finds that although traditional retailers are associated with approximately twice as much FFV food waste as corporate retailers in absolute terms, the efficiency of their supply chain is not much lower. In the ensuing discussion of my findings from the interviews and model, I explore the key differences between traditional and corporate retail supply chains and the implications of continued retail modernization for food waste, before ending with a discussion of implications for policy.

In Chapter 9, I conclude my dissertation with a synthesis of my findings, present my main conclusions, and reflect upon the broader academic contributions of my research. I provide some thoughts on directions for future research, as well as make some final recommendations for policymaking in the areas of sustainability planning and waste management policy.

Chapter 2 – Retail modernization, food waste, and their interconnections

2.1 Introduction

In this chapter, I make the case that investigating food waste from the perspective of retail modernization provides insights into the causes and nature of food waste that contributes to a more holistic understanding of the issue, potentially providing knowledge that could inform the development of more effective initiatives for reducing food waste and mitigating its multiple detriments. I propose that, as retail modernization progresses, food retailers are increasingly positioned to exert influence both "upstream" and "downstream"—that is, on their suppliers and their customers, respectively, with ramifications for pre-consumer and post-consumer food waste.

I begin this chapter with a discussion of retail modernization, including its history, defining features, and its connections to the built environment and urban planning. In order to illustrate the relevance of retail modernization to food waste, I then review two additional bodies of literature. First, to develop a fuller picture of how retail modernization might influence "downstream" household waste behaviors, I review theories of human behavior that go beyond individual decision-making and recognize the embeddedness of behavior in different norms and contexts. Among these contexts is the urban retail environment. I then review the current body of knowledge concerning household food waste, before devising a conceptual framework that attempts to integrate food retail modernization's effects into theoretical understandings of household food waste. Second, I turn my attention "upstream" by presenting the state of knowledge concerning pre-consumer food waste, which I define as food waste generated during post-harvest processing, distribution, and retail. I then connect this knowledge with the concept of food retail modernization, taking particular note of the ways in which the rise of corporate retailers influences food production and distribution, as well as the relationships which underpin these processes. In the final section of this chapter, I set forth my research questions and hypotheses, which set the stage for the next chapter's discussion of research design and methodology.

2.2 Food retail modernization

2.2.1 History and status

The modern supermarket has a long history in Western Europe and North America, having originated in the US and been adopted in the UK in the periods prior to and following the Second World War (Shaw, Curth, and Alexander 2004). Their immediate precursor was the chain grocery store format, which took over from specialized food retailers in the early 1900s thanks to their incorporation of manufacturing, warehousing, and distribution in support of the retail business. Additionally, standardized store formats and products, modern accounting and management principles, and the phase-out of store credit and delivery with cash-and-carry systems all contributed to greater cost efficiencies (Ellickson 2011). Enabled by lower costs, chain grocery stores sold products at lower prices than specialized retailers and rapidly grew in popularity and market share as a result.

From 1930-50, the emergence of the car and refrigeration technology meant that grocery stores no longer had to be sited close to consumers and could thus take advantage of lower rents on the outskirts of town (Ellickson 2011). Additionally, price competition and low profit margins meant that grocery retailers relied on large sales volumes, prompting the development of stores ten times larger than earlier self-service retailers (Shaw, Curth, and Alexander 2004). Stores opened in this manner were the first supermarkets, and sold a large variety of products, including nationally branded goods made popular by radio advertising (Ellickson 2011). Due to the competitive power of the supermarket format, most chain grocers began transforming their stores into supermarkets. By 1958, supermarkets accounted for 68% of all food sales in the US, and by the 1960s, the supermarket format has also been established in the UK following much discussion over the economic benefits of large-scale, self-service formats (Shaw, Curth, and Alexander 2004).

Benefiting from economies of scale, supermarkets grew rapidly in size and coverage until the 1970s, when market saturation and economic recession forced supermarket chains to experiment with new formats to maintain profit growth. This include the arrival of club-format supermarkets, in which consumers pay monthly or annual membership fees to benefit from low product pricing (Costco is a notable example). Format diversification in this era also saw the arrival of retailers that targeted more niche customer segements, such as Whole Foods and Trader Joe's (Ellickson 2011). Grocery retail formats also continued to evolve with changes in information technology. Notably, universal product codes (UPCs) and the scanning register enabled supermarkets to further expand their product variety, which necessitated increasingly large stores. Better management of inventory and logistics continued to reward scale in chain and store size. The largest of these stores with the most diverse product offerings became the hypermarkets—most notable among these is Wal-Mart, which began selling groceries together with discount merchandise in 1988 (Ellickson 2011).

Wal-Mart's arrival on the grocery scene had significant impacts on industry structure. In the fifty years following its first store opening, the number of single-store retailers in the US halved, while large chains (100+ stores) more than tripled their number of outlets (Basker 2007). These competitive pressures not only sparked significant consolidation in the grocery retail sector (Ellickson 2011), but also led to increased competitor imitation (Basker 2007), growing the popularity of the hypermarket format. Trends of vertical integration, larger store areas, and market consolidation have also taken place in Europe, albeit at different rates and extents in different countries (Dobson, Waterson, and Davies 2003; Poole, Clarke, and Clarke 2002).

Despite the rapid rise to popularity of the hypermarket format, supermarkets in the West continue to hold a share of the market. Faced with competitive pressures from hypermarkets, more traditional supermarket retailers have altered their value proposition by emphasizing the quality of their goods, in particular what were historically less profitable "perimeter goods"—produce and other perishables—thereby distancing themselves from more discount-oriented hypermarkets (Guptill and Wilkins 2002). This shift in focus was partially in response to growing consumer attention to consuming fresh food and potentially explains the continued success of more supermarkets such as Whole Foods (Guptill and Wilkins 2002). Recently, Wal-Mart has started experimenting with smaller stores in the US, allowing them to site their stores in denser urban areas, and putting them into more direct competition with smaller modern grocery

retailer formats such as convenience stores and druggists such as Walgreens and CVS (Wood 2013). This suggests that the dynamics of retail modernization have taken a new turn.

The story of supermarketization and the emergence of hypermarkets is similar in developing and newly-industrialized countries, albeit taking place much more briskly over five to ten years compared to the eighty or so it took in the US (Reardon et al. 2003). This trend has been attributed to demand side factors such as growing incomes, urbanization, and growing female labor force participation, and two supply side factors. The effects of the first supply side factor, improvements in technology for logistics and inventory management, have already been discussed, and contributed by bringing down procurement costs (Reardon, Berdegué, and Timmer 2005). The second concerns foreign direct investment. By the late 1990s, Western corporate food retailers were not only subject to increasing competition and market saturation at home (Reardon et al. 2003), but also to increasingly tight regulation (Coe and Wrigley 2007), whereas many developing nations' governments were opening up their retail markets and actively attracting foreign direct investment. Low interest rates at the time afforded growth-minded Western retailers such as Carrefour, Tesco, and Wal-Mart the capital they needed to spur new growth by expanding into these foreign markets (Coe and Wrigley 2007).

Reardon et al. (2005) divide the subsequent surge of retail FDI investment flows into three waves; the first was into Latin America and East Asia (excluding China), the second into Southeast Asia, Central America, and Mexico, and the third into China and the remaining Latin American and Southeast Asian countries (such as Nicaragua, Peru, and Vietnam). The influx of retail FDI into developing countries has helped rapidly modernize these countries' grocery retail sectors (Coe and Wrigley 2007). Though high market fragmentation and the predominance of traditional grocery retailers presented foreign investors with little competition, these markets now often feature a handful of home-grown "second-mover" players that compete with foreign corporate retailers (Coe and Wrigley 2007).

It is unclear whether the end result of retail modernization will mirror the near-total dominance of supermarkets and hypermarkets in the West, especially in East and Southeast Asia, as the outcome of competition between corporate and traditional retail formats (i.e. traditional markets and small shops) is uncertain. Reardon and Hopkins (2006) suggest that this competition takes place on three fronts: price, convenience, and quality, and research remains divided with regards to the anticipated outcome of this competition. On the one hand, modern grocery retail has achieved significant market shares of 50-60% and 30-50% in first and second wave countries, respectively (Reardon et al. 2003). Additionally, studies in Thailand (Gorton, Sauer, and Supatpongkul 2011) and Taiwan (Trappey and Lai 1997) suggest that traditional grocery retailers are not competitive enough and expect modern retailers' market shares to continue growing, supporting others' predictions about the eventual dominance of modern grocery formats (Reardon and Hopkins 2006). However, studies in Malaysia (Mohd Roslin and Melewar 2008), mainland China (Bai, Wahl, and McCluskey 2008; Zhang and Pan 2013), and Hong Kong (Goldman, Krider, and Ramaswami 1999) suggest otherwise, noting that traditional retailers hold competitive advantages in price and perceived freshness, the latter of which is heavily rooted in cultural food preferences. This suggests that the future grocery retail landscape in developing countries will likely be more varied than in the West (Humphrey 2007).

2.2.2 Regulation and other institutional impacts

Beyond its impacts on traditional retailers, the modernization of grocery retail has a number of other consequences. In the US, research has identified multiple negative impacts associated with hypermarket expansion. When non-unionized hypermarket employers like Wal-Mart outcompete unionized local grocers and supermarkets, average local wages and benefits decline significantly. Due to their large physical footprints, they are often located on urban fringes, contributing to urban sprawl and decentralizing economic activity when outcompeting more centrally located retailers. Additionally, their non-central location may result in longer grocery trips, increasing total vehicle miles travelled, and possibly contributing to congestion. Lastly, hypermarkets are associated with undesirable aesthetics, both due to their mismatch with older and quainter urban characteristics and their tendency to cause retail vacancies by putting local stores out of business (M. Boarnet et al. 2004; M. G. Boarnet et al. 2005).

Together with the pressure they exert on traditional retailers, the various perceived negative impacts of modernized grocery retailers have either attracted regulation or led locals to lobby for it. When enacted, such regulation affects the competitive balance between corporate and traditional retail. Common forms of municipal-level regulation targeted at hypermarkets include introducing lot size and retail space licensing requirements, zoning regulations, use of parking and aesthetic design standards, limited opening hours, building codes, and regulatory obstacles such as mandatory impact assessments prior to store construction (Curtin 2004; Mutebi 2007; Reardon and Hopkins 2006; Salkin 2004). Higher-level regulation has limited modern retailer power through competition law and pricing regulations, while other policies have sought to improve the competitiveness of traditional retailers (Reardon and Hopkins 2006). In contexts where foreign players are relevant, regulation can also limit their operations through measures such as restricting foreign property ownership, requiring local partnerships, and restricting FDI flows (Mutebi 2007).

Outside of formal regulatory channels, the institutional and economic context are also relevant to retail modernization. For example, Zhang and Pan (2013) link real estate privatization and rising property prices to the decline of traditional markets in Shanghai, citing their comparatively low return on investment for property developers. Though the municipal government stipulated the construction of traditional markets in local zoning plans, developers have mostly circumvented or ignored these regulations. This leads Zhang and Pan to suggest that the continued success of traditional markets in Hong Kong and Singapore is contingent on their governments' construction and occasional operation of traditional markets, which keeps stall rental rates, and thus retail prices, low. The competitiveness of traditional wet markets may thus be dependent on governmental recognition of their potential to play public service roles in the form of providing affordable fresh food. This could further motivate local governments to introduce policies that support traditional retailers in the face of grocery modernization.

Depending on competitive outcomes, different regulations, and social, cultural, economic, and political contexts, grocery retail modernization will have differing influences on the urban fabric and the spatial nature of retail development, with different implications for consumption and waste behavior.

2.2.3 Relationship to household division of labor and time scarcity

As a key part of meal provisioning and eating, grocery shopping is central to everyday household life. In urban environments where the majority of food is imported from rural areas, households rely upon the food supply chain, ending in grocery stores, for sustenance. The centrality of grocery stores to household life has allowed their evolution over time to also alter the ways that households shop for groceries and prepare meals. As we shall see, the physical and organizational centralization of grocery retailers into large store spaces and organizations, paired with the increasing time-scarcity faced by households where women have also entered the labor force, has led to a similar restructuring of everyday life. Where household shopping routines were once frequent and purchases were made on an as-needed basis, they are now less frequent and involve purchasing larger quantities in advance.

One perspective from which the relationship between the grocery store and the household can be observed is that of time-scarcity, or the feeling that one does not have enough time to accomplish one's everyday goals. Research has identified several causes of increased perceptions of time-scarcity. One is the growing tendency for women to be employed while also raising children, signifying a shift from traditional gender divisions of labor in which the man is traditionally the provider and the woman the homemaker (Jabs and Devine 2006). Women are increasingly faced with the phenomenon of the "second shift," which describes how their workday does not end after leaving the workplace, but continues at home with household tasks such as childcare, laundry, cleaning, and meal preparation. Whereas housewives previously tackled these tasks over the course of the day, working women have had to compress the same tasks into their evenings. Though men increasingly contribute to household tasks, thereby creating some convergence in the division of labor, women still spend disproportionately more time on household tasks (Johnson and Johnson 2008).

The increasing time scarcity experienced by working women has increased their opportunity cost of time, prompting several different responses. Some women may simply devote less time to household tasks such as meal preparation and instead substitute their own labor for purchased services like pre-prepared meals or domestic help (Bryant 1988). Those that persist with preparing meals at home may rely on time-shifting strategies like cooking big batches of food (Heslop et al. 2006). Similarly, Reardon et al (2003) highlight how increasingly time-strapped women sought out greater shopping convenience at supermarkets, which alleviated previously difficult, time-consuming, and labor-intensive processes of shopping (Deutsch 2010). Interestingly, some authors even suggest that suburbanization and the development of big-box retail in the US has helped to preserve the second shift by ensuring that it remains convenient for women to go shopping (Johnson and Johnson 2008). The relationship between the trends in women's labor force participation and grocery retail modernization illustrates how the need for convenience represents an important linkage between patterns of urban development and the performance of everyday life.

2.2.4 Impact on agricultural production and distribution

The entry of corporate retailers into developing world markets has had significant impacts on agricultural production systems, especially those dominated by smallholder farmers. Reardon et al (2009) argue that a main avenue of impact has been the modernization of procurement systems, which corporate retailers have used to address food safety and quality concerns, cut out

middlemen costs, and minimize financial risk (Reardon et al. 2003). Procurement system modernization has three features: the introduction of private standards, the transition from spot market procurement to vertical integration, and the implementation of centralized procurement systems (Reardon et al. 2009).

Private standards refer to the systems corporate retailers use to improve assurance over product quality and safety, either to fill in for non-existent public food safety and quality standards or to supplement existing ones. This is especially important because these retailers often seek to differentiate themselves on the basis of product quality. In addition to specifying product safety and quality and the relevant safeguards taken, retailers' private standards can govern the conditions of production (e.g. environmental and labor), as well as the terms and conditions of the transaction (e.g. timing, volume, packaging, price) (Reardon 2006). For smallholder farmers, meeting such standards may require significant investments in farming techniques and post-harvest equipment and processing; their ability to make these investments often determines whether they can participate in new markets for their products. In cases where farmers cannot satisfy retailers' demand for food produced under private standards, retailers may help farmers achieve minimum standards by providing credit, production inputs, equipment, and technical assistance (Reardon et al. 2009). In this way, retailers' employment of private standards can contribute to agricultural technology transfer and improvements in farm technology in developing markets.

The assistance that corporate retailers offer producers creates a path towards greater vertical integration. In return for assistance, producers often make contracts with retailers, thereby enabling retailers to achieve cost-savings by bypassing the wholesale market (Reardon and Berdegué 2002). In situations where dealing with a large number of small suppliers would create high transaction costs, retailers might deal instead with specialized wholesalers, or procurement agents, who identify, contract with, and enforce standards with suppliers on behalf of retailers (Reardon et al. 2009).

A centralized procurement model features in investment in centralized distribution centers, which occurs after a retailer has opened up a sufficiently large number of stores and would therefore benefit from economies-of-scale. This reduces coordination costs by centralizing procurement decisions and the receipt and redistribution of inventory from individual stores to distribution centers that serve multiple stores in its coverage area (Reardon et al. 2003). Requiring suppliers to conform to particular best practices governing the pre-processing and delivery of products also helps improve distribution efficiency (Reardon et al. 2003).

2.2.5 A typology of food retail

While the market share and individual characteristics of different kinds of grocery retail vary from country to country, the typology of food retail in industrialized nations is largely consistent. Common store formats include convenience stores, supermarkets, hypermarkets, independent grocers, and traditional markets. Definitional parameters such as floor space, sales percentages, and number of stores are drawn from a (2005) Pacific Economic Cooperation Council (PECC) report on food retail.

Convenience stores

Convenience stores are characterized by extended opening hours and small floor areas. They usually offer a wide range of food and non-food products. The former are primarily restricted to packaged food, though some may sell also sell a limited quantity of fresh produce, and many sell hot and cold pre-prepared foods.

Supermarkets

Supermarkets are large stores that primarily sell a very large range of food products. They may or may not be chain stores, and can be owned by entities including international companies, cooperative societies, and local business owners. Though the definition varies depending on country, supermarkets generally have selling areas between 400 and 2,500 square meters, with foodstuffs comprising at least 70% of sales. Corporately-owned, large supermarkets tend to feature marketing displays and promotions. An increasing number of supermarkets offer online shopping and delivery services.

Hypermarkets

Hypermarkets are characterized by their large floor areas and large variety of product offerings. As with supermarkets, their defining floor area varies according to context, but it generally exceeds 2,500 square meters. Their product offerings always include food products, though these are sold in varying quantities and varieties. Non-food product categories offered may include apparel, electronics, consumer durables, and health and beauty products; these take up at least 35% of store selling space. Hypermarkets are almost always part of national or international chains and are usually either located on city outskirts or as shopping center anchors due to their large space requirements. A subset of hypermarkets may have a discount focus or warehouse-style format which prominently feature low pricing and bulk discounts, to an even greater extent. As with supermarkets, and increasing number of hypermarkets offer online shopping and delivery services.

Independent grocers

Independent grocers describe stores usually smaller than supermarkets, with food products accounting for at least 50% of all sales. These are generally family owned and operated and limited to less than ten outlets. Small, single-store independent grocers are sometimes referred to as mom-and-pop or family-owned shops. Certain smaller supermarkets may also fall into this category if independently owned.

Traditional markets

Traditional markets are collections of stalls, usually open-air, specializing primarily in categories of fresh and unprocessed foods.

2.3 Theories of consumer behavior

Explanations of human behavior most commonly propose that behavior originates with individuals' rational decision making and that social processes are the aggregate of all individual actors' actions. However, these models have their limitations; critiques of these models of individual behavior originate in their inability to satisfactorily account for factors external to the individual—contextual, environmental, and systemic factors. Alternate models for human behavior have emerged which stress how "behavior" is socially constructed, and practice theory

is foremost among these in recent times. Another critique of individualistic behavioral models originate from the standpoint that decision-making is often irrational. Supported by psychology, behavioral economics seeks to account for bounded rationality in humans to explain human behavior. In this section, I will first summarize individualistic models of human behavior before discussing their potential shortcomings and moving on to a discussion of other behavioral theories that can address these shortcomings.

2.3.1 Individualistic models of human behavior

A small number of oft-cited and related theories centered on the individual as a decision-making unit include Ajzen's Theory of Planned Behavior (TPB) (1991), the Needs-Opportunities-Abilities (NOA) model (Gatersleben & Vlek, 1998), and Triandis's Theory of Interpersonal Behavior (Triandis, 1977). These theories are generally founded on the basis that behavior is the result of individual rational decision-making. All three situate the origin of behavior in individuals' intentions, which can be influenced by factors internal as well as external to the individual. Broadly speaking, the models divide internal factors into a few categories: attitudes towards the behavior, the individual's actual and perceived ability to perform the behavior, and how the behavior makes the individual feel (affect). External factors influencing behavior include social factors (e.g. norms, roles, and perceived self-identity) and facilitating conditions, which refer to the availability and accessibility of goods, services, information, and other material required to perform a behavior. It is important to note that external and internal factors can interact. In particular, prior knowledge of facilitating conditions is likely to affect individuals' intentions.

Not mentioned above is the role of past behaviors and habit in determining future behavior, which presents one difference among these models. The NOA model does not explicitly account for these. Triandis' model (1977) suggests that repeated past behaviors constitute habits, which co-determine behavior with intention. Habit thus permits individual behavior to emerge without conscious thought, thereby "short-circuiting" the decision-making process outlined above (Chatterton, 2011). However, Ajzen suggests that the effects of past behavior and habit on future behavior are distinct. He argues that past behavior influences future behavior through its influence on attitudes, exposure to social norms, and reinforcement of individuals' own perceived abilities. Ajzen's TPB does not explicitly account for how habit might produce behavior, but subsequent empirical research using Ajzen's TPB suggests that force of habit may mediate the effects of intentions and perceived behavioral control in determining behavior in a similar fashion as suggested by Triandis' model (Conner & Armitage, 1998).

Although such models have been successful at predicting human behavior for the most part, one critique relates to how they account for factors external to the individual and the possibility that human behaviors are as much constructed as they stem from the individual. In particular, individualistic models view influences on human behavior external to the individual as causal variables. These are either straightforward barriers to behavior or modify an individual's belief in their ability to carry out a behavior. In this sense, context becomes a "catch-all" variable (Shove, 2010, p. 1275) that is used to refer to any factor external to the individual in the prediction of human behavior. Put another way, using context in this sense lumps together external factors as diverse as physical infrastructure, culture, social norms, lifestyles, policy, technology, and institutions. Without saying anything about the way these things might interact or the differences

in how they might act as "barriers"' to individual behavior, such a conceptualization renders individualistic models of human behavior mushy and imprecise (Shove, 2010). Another important critique stems from how these models assume individuals are capable of consistently weighing various criteria in their decision making and making the most rational choice. However, recent research has shown that irrational and spontaneous behavior can emerge in response to particular contextual variables (Thaler & Sunstein, 2008).

Individualistic models of human behavior, while well-developed, thus remain inadequate for confronting systemic factors that constrain, construct, and condition human behavior. Practice theory and behavioral economics provide alternate models for understanding human behavior that address the above critiques. The next section will describe these alternatives and their implications for behavioral change strategy.

2.3.2 Practice theory

Practice theory is a recent development in sociological theory that has been applied to an increasing extent to studying social practices and in particular, sustainable behavior. Much social theory has revolved around the structure-actor dualism, which pits individually-oriented explanations for behavior against those that elevate the social whole over its individual parts (Røpke 2009). Practice theory emerges as a theoretical vantage point that privileges neither by adopting social practices as the ontological unit of analysis. Theodore Schatzki and Andreas Reckwitz are commonly credited for the contemporary development of practice theory, though they often cite Giddens, Bourdieu, Lyotard, Wittgenstein and Charles Taylor as their intellectual predecessors (Warde 2005). In particular, Schatzki and Reckwitz, and later Elizabeth Shove, expanded practice theory from the purely social-theoretical to the material realm by including material artefacts, infrastructures, and products in its conceptualization (Røpke 2009). Practice theory has since been used as the basis for extensive empirical investigations into sustainable behavior, including studies of showering (Hand, Shove, and Southerton 2005), energy use (Gram-Hanssen 2010; Shove 2004), transportation (Shove and Walker 2010; Watson 2012) and food waste (Evans 2012b; Evans 2012a; Ganglbauer, Fitzpatrick, and Comber 2013).

Practice theory enables an explanation of behavior by placing social practices at the center of analysis. It theorizes human activity as being composed of clusters of elements, each of which are coordinated and interdependent enough to be distinguishable from others, enabling their conception as entities. When these entities are reproduced enough across space and time through routinization and reproduction, they become practices. Reckwitz (2002, in Røpke 2009) described a practice's constituent activities as elements, while Shove and Pantzar (2005) recommended the categorization of all elements into three broad categories that describe different aspects of a practice's constituent elements: material, meaning, and competence. All practices can be broken down into different combinations of elements from these three categories. Material elements refer to physical objects required to perform the practice, elements of meaning are those which imbue practices with purpose, and competence elements refer to the necessary skills and knowledge required to carry out a particular practice. A common example used to illustrate these points is Shove's analysis of the practice of showering (Shove and Walker 2010; Shove 2003), which identifies bathrooms and their constituent objects and technologies as the material elements of showering; perceptions of freshness, well-being, and health as its meaning,

and understandings of propriety and procedure as its elements of competence, or background knowledge.

It is important to note that practices inherently have both a temporal and spatial dimension. Understanding how this is so and why it is important calls for an exposition of Pred's time-geographic work which linked Giddens'theory of structuration and Hägerstrand's original time-geography, and which Røpke (2009) highlights as particularly complementary to practice theory. Pred's work (1981) is in essence predicated on two key ideas about the constraints of time and space on individual behavior. Firstly, and as has been stated already, individuals are physically indivisible and can only be in one place at one time. Secondly, individuals must not only perform practices in a particular place and time, but these practices also take time. Thirdly, moving through space from one point to another takes time. When taken in concert, these three points highlight the fact that over the course of their lifetime, individuals traverse unique paths through time and space. Such time-space paths do not only apply to humans, but can be applied to other living things and inanimate objects.

As a result, Pred calls the moments in which individuals enter into and exit from interactions with each other and other material entities the "coupling" and "decoupling" of hitherto separate time-space paths—moments in which their time-space paths join up and then go their separate ways again. Individuals' tendency to perform certain behaviors (whether shaped by social norms, attitudes, etc.) is thus formed entirely by a series of historical coupling and decoupling of their time-space path with others. In turn, their future paths are shaped by their actions in the present. In this way, "*the ordinary individual is not only created by society*, or socialized, *but creates herself*, purposively or habitually adding action elements to her path by internally reflecting upon or in other ways drawing upon what she has been externally exposed to, *thereby contributing* (usually unknowingly) *to social reproduction and the perpetuation or transformation of society's structural relationships*" (Pred 1981, 12; italics in original). In layman's terms, an individual's behavior is shaped by past experiences and exposure to society, but performing that behavior also shapes themselves and society in a way that depends on precisely those past experiences and exposure. The similarities between time-geography and practice theory in the ways in which individual behavior is reproduced are clear. Also clear are the ways in which both can potentially account for the influence of external factors on individual behavior without ruling out individual agency.

The value of introducing Pred's time-geographic perspective here stems from time being a uniformly-finite resource, which means that practices must compete for an individual's attention and time (Røpke 2009). Through their meanings, materials, and competencies, practices also exert certain requirements on individuals, such as requiring an individual to interact with others or make use of particular physical objects. This means that individuals often must take time-space paths that are coupled with those of others. Broadly, this highlights the interconnectedness of practices and individuals (Pred 1981) Interconnectedness exists within the set of practices performed by a single individual, because performance of one reduce the time available for the performance of another. Interconnectedness also exists between individuals and physical entities through the coupling and decoupling of their time-space paths. Such interconnectedness reveals a complex system of behaviors and relationships that interact to produce individual behavior; altering any part of the system therefore leads to changes in individual behavior.

Coordinating practices can be tricky considering they take up time, a finite resource. Performing one practice leaves less time for others. Therefore, accounting for time management is vital to understanding individual behavior. This is particularly relevant in modern society as the notion of time-scarcity, or the perception of not having enough time, grows with income (Hamermesh and Lee 2007). People develop particular expectations and understandings regarding the when, how long, and sequence of particular practices, leading to the normalization of practices' temporal characteristics. For example, a three-course "dinner" is often understood to begin with an appetizer and to finish with dessert (Shove 2009). Practices may require "synchronization and coordination" with other practices or individuals by requiring one to be in certain places at specific times—family holidays, for example (Southerton 2006, 443). Temporality and practices shape each other simultaneously; practices influence temporality through particular requirements (for example, dinner parties are understood to be evening events) and temporality influences practices through the existence of "collective and personal rhythms" (for example, the daily cycle of work commutes) (Southerton 2012, 344).

The temporality of practices in modern society has been altered by convenience, which has allowed people to compress and re-order time to fit their needs (Warde, Shove, and Southerton 1998). For example, freezers and microwaves provide shortcuts to meal preparation by saving labor and cutting cooking time (Shove and Southerton 2000). However, greater convenience has led to increasingly fragmented individual schedules; whereas they were previously governed by collective temporal markers like the day of the week, increased convenience has enabled individuals to be more independent from "formalised, collectively shared, temporal structures" as they can now shift or double-up certain practices (Shove 2003, 412). This increased complexity paradoxically creates an even greater need for convenience so that individuals can maintain coordination of not only their own practices, but those that involve others too. Shove (2003) identifies growing reliance on convenience as a potential problem if it creates convergence towards, and lock-in of, undesirably resource-intensive norms of daily life.

Within practice theory, the concept of systems of provision constitutes an important material element to practices (Shove and Walker 2010) and provides a vantage point on the evolution of practices over time as well as insights into how individuals coordinate practices in daily life. Originally introduced to emphasize a technological-historical perspective on consumption patterns (Fine and Leopold 2002), systems of provision most readily refer to infrastructure such as power and gas, sewage, and transportation systems, but have also been conceptualized as the physical and institutional infrastructures that enable access to goods and services, providing the structure within which people carry out practices in daily life. In the food context, SOPs include the food production and distribution system, namely, food production, harvest, storage, distribution, and retail. Systems of provision also exist at smaller scales. For instance, most household kitchens contain a stove, refrigerator, and miscellaneous items such as toasters, microwaves, among others, forming an "infrastructure of the home" (Shove and Walker 2010, 473). These are all dependent upon larger systems like the power and gas network and are also delivered by their own systems of provision (for example, manufacturing, retail), revealing the nested and multi-scalar nature of SOPs. In addition to social norms and individuals resources (as represented by social, cultural, and economic capital), systems of provision represent very real constraints to behavior that limit the ways in which consumers understand and perform everyday

practices (Southerton, Warde, and Hand 2005). In this manner, systems of provision mediate the relationships between consumers and their practices, and as I discuss later in this chapter, a large part of this relates to their ability to facilitate or obstruct the coordination of everyday practices through the provision of convenience.

In summary, practice theory provides a perspective on behavior that prioritizes the examination of practices themselves, which implies that efforts to improve the sustainability of behavior requires changing the ways practices are performed. This requires an understanding of how practices emerge and evolve over time in response to influences from the individuals who reproduce and mold practices through performance, in addition to influences from multiple contextual factors. The deployment of practice theory in my dissertation is centered on understanding how systems of provision, as shaped by ongoing retail modernization, alter individuals' performance of food-related practices, with varying consequences for household food waste.

2.3.3 Behavioral economics and theories of bounded rationality

The previous sections have highlighted the limitations of individualistic models of behavior with three main points. First, analyzing the disposal of household food waste as an isolated action is of limited utility as it is the emergent outcome of multiple spatially and temporally distributed behaviors (practices). Second, the social and temporal contingencies associated with daily life affect the extent to which households can perform practices that control the amount of food waste they generate. Third, their performance of these practices is strongly affected by systems of provision, as represented by food retailers. As such, the importance of contextual variables for household food waste is clear. This section will further contribute to this case by illustrating how contextual factors, including, but not limited to, food retailers' in-store environments, influence human behavior in ways that are independent of rational decision-making processes, by drawing upon theories from behavioral economics and psychology. It then illustrates how these theories have been applied in research and policy.

Recent research has suggested that the human brain has two distinct systems that are responsible for decision-making processes: the automatic and the reflective, corresponding to intuition and reason, or system 1 and system 2 in psychological terminology (Kahneman 2003; Thaler and Sunstein 2008). The reflective process is what models of decision-making developed by Ajzen and others (see section 2.3.1) sometimes do well at explaining because aspects of human behavior are indeed rational and reflect the outcome of an individual's conscious consideration of their available options (Dolan et al. 2012). This process is conceptualized as not only being self-conscious, but deliberate, requiring effort, and generally rule-governed (Kahneman 2003). Where Ajzen's and similar models fall short is in accounting for the automatic process, or intuition. Automatic processes take place in a different part of the brain and are rapid, instinctive, effortless, and governed by habit. As a result, they are usually beyond individual control and are difficult to change (Kahneman 2003). The difference in these two processes' effects on human perception has been characterized as forming judgments versus impressions, respectively, where judgments are explicit and intentional, while impressions are involuntary (Kahneman 2003).

Delineating human thought processes into these separate systems allows behavioral economists to characterize human behavior as having only partial, or bounded, rationality. Models of

bounded rationality help address some of the limitations of the individualistic models previously described. In particular, they help account for the influence of habit and other unconscious influences on behavior that are not described by simple examination of attitudes, intentions, and perceived behavioral control. Behavioral economics depends on these models and concerns the development of strategies for behavioral modification, most popularly known as "nudges," as popularized by Thaler and Sunstein (2008).

Describing the automatic and reflective processes as entirely distinct is overly simplistic because in reality, the two processes interact to cause behavioral change. Vlaev and Dolan (2009, 8) term this the "reflective-automatic model," which posits that cognitive cues, incentives, and contextual cues comprise three ways in which behavior change can be stimulated. Cognitive and contextual cues predominantly affect the reflective and automatic processes, respectively, while incentives can influence both (Vlaev and Dolan 2009). Research has also found that individuals use heuristics to simplify complex sensory information and make judgments accordingly, though with inherent systematic biases (Kahneman 2003). Three main heuristics are anchoring, availability, and representativeness, and all relate to the tendency for individual perception to be linked to prior perceptions and experience—i.e. what is familiar to them. Kahneman (2003) refers to this tendency as "attribute substitution," moments in which individuals assess an object not according to the attribute that truly describes the object, but according to a related attribute that comes more readily to mind, or that which is more *accessible*. In all three heuristics, individuals' judgments are thus influenced by what is more accessible, or familiar to them.

The first heuristic, anchoring, refers to how people subconsciously make use of reference points known to them (i.e. anchors) when asked to think about something they are unfamiliar with—commonly an estimate of some unknown quantity—before adjusting from that reference point to make a judgment about that quantity. Anchors produce systematic biases because individuals tend to under-adjust from their initial anchor when making judgments (Thaler and Sunstein 2008). The second heuristic is availability, in which individuals' reference points are things which are familiar to them, either through personal experience or other forms of repeated exposure. Therefore, judgments over the likelihood of different outcomes depends on familiarity with the range of outcomes. Thaler and Sunstein (2008) cite decisions over precautionary behavior as illustrative of this effect—purchases of earthquake or flood insurance are not dependent on the actual risk of either natural disaster, but upon how vivid individuals' memories of such events are. Availability is closely related to the interrelated concepts of accessibility and salience. The former describes how easily mental content comes to mind, whereas salience affects accessibility by making certain things more memorable than others, often through distinctive physical attributes (Kahneman 2003). Beyond affecting recall, salience can also direct the focus of individuals' attentions. The third heuristic is representativeness and describes how, when asked to judge how likely something belongs to a particular category, individuals tend to fall back on similarity as a measure of that likelihood instead of rationally assessing the probability of belonging (Kahneman 2003). This heuristic often leads people to see patterns in what are actually random occurrences, due to a mental mismatch between their preconceptions of randomness and what it actually looks like (Thaler and Sunstein 2008).

In addition to the existence of these three main heuristics for human judgment, research has also revealed other ways in which the brain's automatic processes influences reflective processes to

produce irrational judgment and behavior. Thaler and Sunstein (2008) identify overconfidence and optimism, loss aversion and a preference for the status quo, and framing as other influences on behavior that tend to derail or otherwise modify reflective processes. Overconfidence and optimism refer to the tendency for humans to be unrealistically optimistic, leading them to take unnecessary risks. Loss aversion refers to how individuals are usually reluctant to give up what they already have. Status quo bias is partially the result of loss aversion, and means that individuals prefer to stick with current circumstances. Finally, framing can influence the automatic system through the way that problems or questions are stated, meaning that individuals can respond to the same stimuli differently if they are presented in different ways (Thaler and Sunstein 2008).

Finally, Thaler and Sunstein (2008) identify two other ways in which humans behave irrationally. The first is the effect of temptation on self-control, which occurs when external stimuli appeal strongly to the automatic part of the brain while the reflective part of the brain is required to resist. Often, succumbing to temptation involves the brain's automatic processes taking over. Thaler and Sunstein (2008) suggest that individuals are more likely to succumb when in a "hot" state than if in a "cold" state, e.g. being less able to resist the aromas of unhealthy foods when hungry. Self-control can also be undermined in situations where individuals' latent preference for the status quo takes over. Loss of self-control leads to individuals often find making mindless choices. A prime example of this is the tendency to overeat. Another way humans behave irrationally relates to understandings or perceptions of social norms; people are more likely to behave in a manner that conforms to those around them, both consciously and subconsciously (Thaler and Sunstein 2008).

That contextual factors can have a strong effect on automatic behaviors underscores the inadequacies of individualistic models of behavior to adequately address external influences on behavior, namely contextual factors that vary with an individual's surroundings. The above aspects of bounded rationality have illustrated how the brain's automatic system often undoes the best-laid plans when faced with certain contextual stimuli (Thaler and Sunstein 2008). As noted earlier, the occurrence of household food waste is strongly tied to households' ability to plan their meals and purchase and use their perishable ingredients accordingly. Theories about bounded rationality draw our attention to how these plans can be easily undone by contextual factors, such as those presented to households during their grocery trips.

2.4 Household food waste

I have developed my conceptual framework using the theories described above, their relevance for consumption and waste studies, and a review of empirical household food waste research (see Figure 2.1). The dependent variable (per capita household food waste) is shown in black, endogenous (or mediating) variables are shown in white, and exogenous (or independent) variables are shown in grey. Arrows indicate the directionality of influence that one variable has on another. Plus and minus signs indicate whether one variable increases or decreases the other and assumes an increase in the origin variable. For example, increased time scarcity reduces the performance of good shopping and planning practices. This increases excess purchases, which increases average food inventory, which reduces the spoilage and discard rate, finally leading to an increase in per capita household food waste.

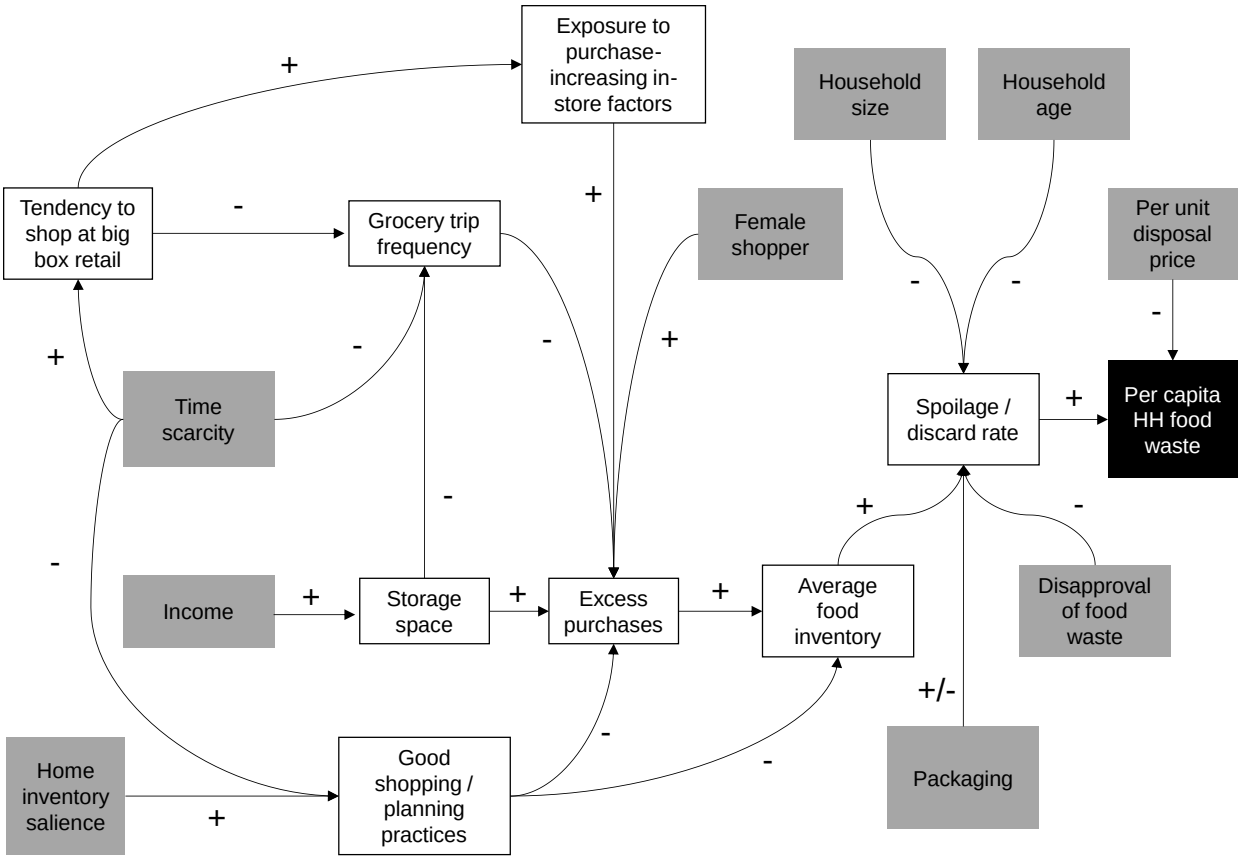

Figure 2.1 Conceptual framework

The conceptual framework reflects the complexity of household food waste issues, as will be discussed in the following sections. There are a wide variety of factors which influence how much food waste a household discards. These range from more traditional variables associated with the individual, such as socioeconomic and attitudinal factors, to variables emerging from more recent studies. These include behavioral variables such as households' tendencies to carry out favorable meal planning and shopping practices, and how these tendencies are affected by the extent to which households experience time scarcity. Other variables also include contextual and environmental influences on behavior, such as exposure to in-store factors that might increase excess purchases, such as promotions.

2.4.1 The nature of household food waste

Definitional differences in household food waste studies increase as the level of distinction among different kinds of food waste increase. An overview of the literature suggests that kitchen waste is clearly differentiated from other forms of organic waste (i.e. garden waste) in general (Lebersorger and Schneider 2011). Within kitchen waste, most studies also make the distinction between avoidable food waste and non-avoidable food waste, although differences remain over what each comprises. Langley et al (2010) define avoidable food waste as anything not discarded during food preparation (e.g. vegetable peelings), while others consider avoidable food waste as anything inedible (OECD 2013). This distinction reveals the subjective nature of food waste—that which is deemed inedible and discarded by households may not be discarded in others (Lebersorger and Schneider 2011). As such, a third, often-used category is potentially avoidable

food waste, into which contextually-defined food waste is categorized (e.g bread crust, organs, etc.).

2.4.2 Socioeconomic variables

Socioeconomic variables have traditionally been the primary focus of household waste studies; variables often cited as important predictors of waste generation include income, age, household size and composition, education, urbanization, and population density (Beigl, Lebersorger, and Salhofer 2008). Not all of these apply to food waste, however. Studies focused specifically on explaining household food waste generation suggest that age, household size and composition, and gender are the most relevant.

Income's exclusion from this list is notable, though likely the result of most food waste studies having been conducted in industrialized nations. Although the differential in post-consumer food waste between developed and developing nations is clear (Parfitt, Barthel, and Macnaughton 2010), research performed in industrialized countries has not found that income significantly increases food waste (Koivupuro et al. 2012; Stefan et al. 2013; Wenlock et al. 1980; Williams et al. 2012; WRAP 2008), which suggests that it may no longer have an effect once it exceeds a certain threshold. This makes sense intuitively—as a daily necessity that individuals can only physically consume in limited quantities, the overall quantity of food purchased is likely to taper off once incomes have reached that threshold. Since this caps the total amount of food that can actually be discarded (extreme displays of wealth not withstanding), the amount of food waste then becomes a function of factors related to whether that food becomes waste or not.

Despite the findings of previous studies, income can nevertheless be theorized to play a role. Beyond simply increasing the quantities of food purchased, higher income means that food purchases become a smaller proportion of total income, which may increase the willingness of households to waste food. Income may also play a small role by determining the amount of storage space available to households; higher incomes may correlate with home size, which permits larger kitchens, larger cupboards, pantries, and more and larger refrigerators. This permits households to store on average larger quantities of food, thereby increasing the risk of spoilage. Due to upper limits on refrigerators and other food storage space, this effect may also disappear once income has reached a certain threshold.

Household size and composition have been found to be important factors. As would be expected, larger household size contributes to larger absolute quantities of food waste (Koivupuro et al. 2012; Wenlock et al. 1980; Williams et al. 2012) simply due to there being greater quantities of food present at home; this is particularly pronounced for households with children (Hamilton, Denniss, and Baker 2005; WRAP 2008), which is likely to be because children have the potential to be more picky about eating certain foods and leftovers. However on a per capita basis, single-person households have been found to generate the greatest quantity of food waste (Koivupuro et al. 2012; WRAP 2008). This is thought to be due to be associated with the challenge of using up perishable ingredients in time (Quested et al. 2011).

Gender has also been found to be an important factor. Koivupuro et al (2012) found that female single-person households wasted those most food per capita. They also found that households

where women were primarily responsible for provisioning generated more food waste per capita than those where men were solely responsible or shared responsibility with women.

The effect of age on food waste is unclear. Koivupuro et al (2012) report no effect of age on per capita food waste, but their approach only looked at the age of the eldest member of the household. By investigating the age of the grocery shopper, WRAP (2008) found that households with younger shoppers tended to waste the most food. However, the same study found that on a per capita basis, households with shoppers aged 55-64 wasted the most food.

2.4.3 Attitudinal variables

Attitudinal variables related to the environment, food prices, and packaging are theorized to have an influence on food waste and have been the subject of several studies. For instance, households who believed that purchasing larger packages of food contributed to food waste were found to generate greater quantities of food waste (Koivupuro et al. 2012). Households with greater consciousness of food prices were found to waste less food (Koivupuro et al. 2012; Williams et al. 2012). Unsurprisingly, food waste has also been found to be higher among households that have more relaxed attitudes towards wasting food in general, as well as among households with less environmental education (Williams et al. 2012).

However, Ajzen's Theory of Planned Behavior muddies the picture concerning the influence of attitudes on food waste. Attitudes towards food waste (whether moral, financial, or environmental) would be manifested in individual intentions not to waste food, together with perceived ability to actually do so. These have been the subject of a few studies investigating the role of attitudes on food waste. Stefan et al (2013) found that although moral attitudes and lack of concern about food waste could predict the extent to which individuals intended not to waste food, the intention not to waste food itself did not significantly reduce household food waste. Interestingly, households which were aware of their potential ability to reduce food waste have been found to generate more food waste than those who did not believe they were able to (Koivupuro et al. 2012).

Theories of bounded rationality suggest that attitudes towards food waste are influenced by social norms. Norms may determine the boundaries between avoidable, partially avoidable, and unavoidable food waste. Social norms over what is edible and inedible are important for determining what gets eaten and what gets thrown away. Additionally, social norms over how long it is safe for households to store their food could lead to cooked and uncooked food being discarded while it is still safe to eat.

2.4.4 Meal planning and shopping routines

Practice theory has proven useful for understanding consumption and other behaviors in a different light (Brand 2010; Shove 2010; Southerton 2012; Warde 2005). Firstly, the recognition that a practice usually has some sort of material element that springs from processes of natural resource extraction, manufacturing, and distribution before its "final use and destruction" during consumption highlights the resource appropriative nature of different activities, while providing a definition of consumption distinct from market transactions (Røpke 2009, 2495). Acknowledging the material element of practices also helps us recognize that all practices inevitably involve consumption (Warde 2005). This is evident when we consider that

consumption never takes place for its own sake; it is always embedded in a more general purpose. Consequently, "consumption is not itself a practice but is, rather, a moment in almost every practice" (Warde 2005, 137).

Specifically, consumption represents the point at which material elements enter into the service of the practice—an input into the system of behaviors we have termed a practice. It then follows naturally that practices can also have moments which require the output of these material elements once they have served their purpose. Evans says as much in the specific context of food waste; he argues that "the passage of 'food' into 'waste' occurs as a consequence of households enacting ordinary domestic practices and negotiating the contingencies of everyday life" and that "disposal (and wasting) is a necessary moment in the competent enactment of domestic practice" (Evans 2012b, 53). Whether or not disposal constitutes an absolutely necessary moment in the enactment of a practice or not remains unclear, but what is certain is that when disposal *does* take place, it happens as part of a broader practice that at some point also involved a moment of consumption. In this way, the generation of waste can be inextricably tied to the nature and circumstances of consumption, and both consumption and waste generation consequently will be impacted following any change to the materials, meanings, and competences associated with any given practice. Household food waste thus becomes inextricable from the domestic practices of household provisioning and meal preparation.

The utility of practice theory in studies of household waste then is in its capacity to highlight the complexity of waste behaviors. The act of disposal is theorized as an outcome of the interaction among a broader set of behaviors that are dispersed over differentiated time and space (Ganglbauer, Fitzpatrick, and Comber 2013). As a result, the disposal of food waste specifically cannot be analyzed in and of itself as a behavior resulting from a single decision, but as the emergent outcome of a system of behaviors that take place within the broader practice of household provisioning and meal preparation. Whether food becomes waste or not is not determined at the point at which it is discarded, but in fact as early as the moment it is purchased (Ganglbauer, Fitzpatrick, and Comber 2013).

With the exception of one study (Koivupuro et al. 2012), shopping and planning routines have been found to be important factors in determining household food waste (Quested et al. 2011; Stefan et al. 2013; Williams et al. 2012; WRAP 2008). Specific behaviors associated with these variables include: use of a shopping list, checking inventory, planning meals in advance, avoiding large packaging or buying too much food, avoiding impulse purchases, storing food properly, using up leftovers, and understanding use-by and expiry dates.

2.4.5 Time-scarcity and everyday life's contingencies

While the research described in the previous section suggests that the performance of these behaviors affects the quantities of household food waste generated, households are not always able to carry out these behaviors. Qualitative research into household food waste has explored how and why this may be the case. Much of this research has focused on how the contingencies of daily life disrupt the ability of individuals to carry out the above behaviors. For instance, Evans' (2012b) highlights how, despite his subjects' anxiety concerning food wastage, they routinely provided more food than they could consume as a result of complex interactions between their own intentions and attitudes and their need to negotiate the contingencies of daily

life. Such contingencies encompass social relations, norms, domestic technologies, food's own material properties, tastes, time, and systems of provision (Evans 2012b). These contingencies affect the meanings, materials, and competencies that make up the practices of household provisioning and meal preparation, thereby affecting the material outcome of these practices—food waste. As an example of how social relations affect food waste, Evans describes how a mother's grocery shopping involves buying more than is needed so as to balance her own desire to feed her family new and healthy foods and her husband and children's tendencies to balk at such offerings. In order to preserve the practice of eating as a family, she normally gives up on cooking the healthier options, thereby condemning those ingredients to the bin (Evans 2012b).

Time-use, particularly as it relates to perceptions of convenience, is a particularly salient factor that also has implications for household waste. Godbey, Lifeset, and Robinson (1998) highlighted how growing time scarcity, the result of an increasing pace of life and a growing number of dual-earner households, has the potential to increase household waste by pushing households to purchase more convenience products, which may be more heavily packaged or disposable in their own right. Their analysis does not extend to food beyond the discussion of single-serving convenience foods.

However, the importance of time-use can be seen in another example from ethnographic research, which combines time-geographic notions with those of practice theory to explain household food waste by showing how time scarcity impacts the time-space paths that people take and the practices they are able to fit in along the way. Ganglbauer et al (2013) explain how busy individuals often do not have time to make lists. They also show how time scarcity is responsible for "opportunistic" shopping behavior in which individuals make use of an opportune moment for unplanned grocery shopping, but do so without being able to check what they have at home first. Increased perceptions of time-scarcity and the related desire for convenience can also contribute to the tendency for households to stock up on food in order to insulate them from unexpected events that might prevent them from doing their regular grocery shopping (Graham-Rowe, Jessop, and Sparks 2014). Here, the indivisible nature of the individual as they travel their path in time-space is visible as a factor that affects how and whether they carry out behaviors relevant to household provisioning and meal preparation.

Such research on the demands of social relations and time-scarcity illustrate how practices compete with each other for an individual's time-space resources in a society where perceptions of time-scarcity are increasingly prevalent (Hamermesh and Lee 2007; Southerton 2003). In short, the social and temporal organization of daily life has important implications for the generation of household food waste and consequently for policy making for reducing household food waste.

2.4.6 In-store, home, and other environmental variables

Practice theory also draws attention to the effect of the built environment on behavior by highlighting the importance of systems of provision, i.e. the physical sites of consumption, their supporting infrastructures, and the pattern of behaviors they elicit. More concretely, where consumers purchase their groceries and how they get there may be linked to behaviors that can reduce food waste such as bulk buying, meal planning, inventory management (Quested et al. 2011).

Here, theories of bounded rationality prove complementary in understanding how different in-store environments and contextual variables influence behavior. Theories of bounded rationality illustrate how contextual variables affect behavior, but few studies have utilized these theories to study food waste. Two studies have indicated that shrinking plate size and putting up signs to encourage buffet customers to visit the buffet multiple times reduces food waste (Freedman and Brochado 2010; Kallbekken and Sælen 2013), but none have examined household food waste specifically. There is however, a significant body of literature straddling the fields of marketing and public health that engages with contextual stimuli and irrational behavior. This literature is most concerned with a) the different types and calories of food consumed, with an eye on trends in obesity and other diet-related conditions and b) predicting consumers' purchasing behavior in service of improving marketing and increasing retail sales. Although logic suggests household food waste is the difference between a households' purchases and actual food consumption, existing studies have only tangentially touched upon issues of spoilage in this regard. The likely relationships among food purchases, quantities consumed, and household food waste indicate that it valuable to briefly sample these literatures.

Wansink (2004) divides environmental influences on the amounts of food consumed into the eating environment and the food environment. Both take effect by either impairing consumers' ability to accurately monitor their intake or by altering consumption-related norms. The eating environment includes atmospherics, the effort of obtaining food, the presence of social interactions, and distractions. The food environment includes the food's salience, structure, portion or package size, whether it is stockpiled, and how it is served (Wansink 2004). Both refer to multiple contexts, including the home, restaurants, and food retail locations like supermarkets.

When considering the effect of the eating and food environment of food retail locations on quantities consumed, it is safe to assume that increased intake is first preceded by increased purchases; this is an unstated assumption of much of the public health literature, but one that provides a useful linkage with household food waste. In the context of this paper, the food and eating environments can have two effects on household food waste. Firstly, environmental factors associated with households' grocery shopping routines can influence household food waste by altering the quantities of food they purchase in relation to their actual needs. Secondly, environmental factors at home can influence household food waste by influencing whether perishables are eaten or ultimately discarded (independently of purchases).

Environmental factors affect food intake (and hence purchases) through access, salience, and convenience. Cohen and Babey's (2012) review of contextual factors' influence on purchasing behavior identifies a large number of factors in the grocery store context. Purchases can be influenced by strategic placement of different products, which alters consumers' paths through the store and increases their exposure to different products. In particular, placement of much-needed items at the back of the store increases the length of consumers' paths, while placement of products at the end of aisles and at eye-level increases their salience. Salience of different products can also be affected by variation in the colors, materials, shapes, and graphics used in packaging.

Sales promotions also increase purchases by raising the salience of different products; these might include bulk and percentage discounts (Hawkes 2009). It has also been found that offering products in larger quantities, even at the same unit cost, increases sales. As consumers tend to determine their purchase quantities by making adjustments from an anchor, such promotions persuade consumers to purchase more by offering highly salient anchors that suggest larger-than-normal purchase quantities (Wansink, Kent, and Hoch 1998). Atmospheric influences are also strongly linked to the grocery store context and include background music and smells; the latter are influential in particular with cooking demonstrations and other forms of product sampling (Cohen and Babey 2012).

Another way in which home and grocery environments affect purchases is through inventory estimation. More accurate household estimates of inventory, either before or during shopping, will affect household food waste by reducing the amount of excess food purchased. Research suggests that when consumers have the chance to check inventory levels before shopping, anchoring and salience affect the accuracy of their estimates (Chandon and Wansink 2006). In general, consumers anchor their estimate on their average inventory level, unless there is a more salient reference point, such as the form of the packaging. If food is stored in highly visible places or is used frequently, its salience also increases, improving the accuracy of consumers' estimates.

When unable to check beforehand, consumers anchored their estimates of household inventory on recollection of average inventory estimates unless provided with an external reference point, such as information about the other households' average inventories for different products. Households averse to running out of food at home were found to over-purchase and increase food spoilage if they underestimated home inventory levels. These findings suggest that in-store efforts to raise inventory salience (the authors cite the "Got Milk" campaign as an example) could improve the accuracy of home inventory estimates and reduce spoilage. Chandon and Wansink's (2006) findings also suggest that displaying information about the average household's inventory levels for different products can be used to alter purchase quantities as well; this is a clear illustration of using anchoring and social norms together as nudges to alter grocery shopping behavior.

In addition to explaining how in-store factors possibly lead to over-purchasing and greater household food waste, bounded rationality also show how household food waste may also influenced by behavior that takes place after food has been brought home from the grocery store. Although large purchase volumes and greater stockpiling increases average inventory levels, increasing spoilage risk, the effect of salience and convenience on rates of consumption at home is important. For example, stockpiling has been found to influence rates of consumption (Chandon and Wansink 2002). Salience is again the primary mechanism by which this takes place since increased stockpiles are more visible and also fresher in consumers' memories. Food requiring little preparation is also consumed more often when stockpiled. Storing perishables such that they are more salient or making them easier to prepare and eat could help reduce household food waste by ensuring that they are consumed before spoilage occurs (Wansink, Brasel, and Amjad 2000).

2.4.7 Packaging

A final factor to consider when considering household food waste is packaging. Although often vilified, it is not often recognized that the environmental impacts of packaging waste may in fact be less than that of food waste. Additionally, packaging has a key role to play in preventing food waste—when well designed, packaging can extend the shelf-life of food. On the other hand, packaging that is either too large or poorly designed can contribute to household food waste. Finally, labelling on packaging related to sell-by and use-by dates is also an important factor to consider given concerns and norms over food safety (Watson and Meah 2012; Williams et al. 2012)

The influence of packaging on food waste is the primary focus of the study by Williams et al (2012), who estimated that 20-25% of food waste in the households they studied could be related to packaging being either too large or too difficult to empty. They suggest that this percentage could easily be larger if other issues related to packaging, e.g. re-sealability or inadequate packaging are taken into account.

2.4.8 Per-unit waste pricing

Under the "polluter pays" principle, household waste can be reduced by charging households for waste disposal. Although charging a flat fee for municipal waste collection is common, less common is the practice of charging households on a per-unit basis for waste collection for source-reduction of waste. Households are charged for waste collection according to the quantity that they discard, measured either in terms of volume or weight. A number of studies in Europe (Dijkgraaf and Gradus 2004; Linderhof et al. 2001), North America (Fullerton and Kinnaman 1994), and South Korea (Hong 1999; G.-S. Kim, Young-Jae Chang, and Kelleher 2008) have identified that such systems are effective in reducing the quantities of waste discarded. These studies also note an increase in the quantities of recyclables collected, suggesting that per-unit waste pricing schemes need to be accompanied by adequate recycling infrastructure. Additionally, these studies note the possibility that illegal dumping of waste is also increased when unit pricing schemes are introduced.

2.4.9 Linking grocery retail development to food waste

In some ways, listing potential explanatory factors in this fashion is overly reductionist due to their potentially co-constitutive nature. For example, it is possible that behavioral factors emerge out of the interaction between socioeconomic factors and environmental factors. It is also possible that behavioral factors and environmental factors are dependent on socioeconomic factors. However, listing the variables in this way brings into play the mechanisms by which food becomes waste, thereby building usefully on the findings of qualitative research on food waste that highlight the need to account for the complexity of behaviors that contribute to household food waste (Evans 2012b; Evans 2012a; Graham-Rowe, Jessop, and Sparks 2014; Watson and Meah 2012).

The complexity of these behaviors and the only recent shift in focus to this aspect of household food waste suggests that there is a fertile field of research ahead. In particular, the potential of an allied practice, time-geographic, and behavioral economic theoretical framework has not been fully exploited. Although the socio-temporal aspects of food waste have received substantial

attention so far, considerations of time, social relations, and behavior in everyday life would also not be complete without consideration of space. This is critical for two reasons. Not only can individuals not physically be in two places at once, but we should also not forget that individual behavior has to be physically sited. As such, not only the social context is relevant, but a consideration of the spatial and geographic context would also shed new light on individual behavior (Ellegård 1999). I thus argue that a consideration of the physical sites of food consumption and waste generation, as well as the broader built environment, is imperative in order to unravelling the complexities of household food waste.

Consequently, the landscape of retail development in relation to transportation infrastructure is potentially implicated in terms of having influences on household food waste. We have already seen this with the example of "opportunistic" shopping behavior (Graham-Rowe, Jessop, and Sparks 2014), which would almost certainly have been influenced by the relative locations of home, work, and grocery retail. The effect of grocery retail as a system of provision on food waste has also been mentioned in relation to individuals living alone who are unable to purchase perishables in quantities appropriate for single-member households (Evans 2012b).

This draws attention to how physical accessibility to grocery retail from home or work has a strong effect on the time-space paths of individuals by either aggravating or alleviating the effects of time-scarcity. Two interrelated factors which are of interest for further research thus present themselves: trip frequency and grocery retail format. Different retail formats have been associated with different trip frequencies—households tend to visit supermarkets less frequently than neighborhood grocery stores, and in turn, lower trip frequencies are linked with greater quantities of food purchased per trip (Sonesson et al. 2005). This relationship should not be surprising when considering that larger stores such as supermarkets and superstores tend to be located on the outskirts of town where land is cheaper and parcels are larger, and neighborhood grocery stores are often located closer to residential areas. When we take this relationship in concert with research showing that households buying more per trip also generate more avoidable food waste (Williams et al. 2012), the question of whether there is a linkage between retail format and household food waste begs itself and the case for designing walkable neighborhoods takes on a new environmental dimension beyond that of transportation and emissions.

It is also possible that the built environment more broadly acts as a systemic constraint on individual behavior by altering the ways and ease with which they negotiate their time-space paths, thereby affecting their ability to carry out practices that may or may not require coupling with other individuals and material objects. For example, greater accessibility to shops and jobs has been found to increase the tendency for men to accompany women while grocery shopping and also to take sole responsibility for groceries (Schwanen, Ettema, and Timmermans 2007). This finding could be particularly salient for food waste given the earlier example of how a mother's meal planning and grocery purchasing would be disrupted by her husband and children's insistence on particular foods (Evans 2012b).

Other research shows how other everyday practices such as the need to take care of children interact with factors such as housing affordability and transportation interaction to create specific demands on the ways in which families navigate their time-space effectively (Jarvis 2005).

Given that household provisioning and meal preparation are also time consuming and exert similar demands on individuals' use of time and mobility needs, urban planning and issues of accessibility may also have ramifications for food waste. Finally, processes like supermarketization and the growing value placed by households on amenities that make the practices of meal preparation and eating at home more convenient have been suggested to have reduced the amount of time Western households spend on these practices (Warde et al. 2007).

Differences in the characteristics of food retail also provide reasons to believe that grocery retail formats have implications for household food waste, especially in relation to the recent growth in popularity of hypermarket chains around the world (Cho, Chun, and Lee 2013; S.-H. Kim and Chen-Yu 2005; Basker, Klimek, and Hoang Van 2012; Bai, Wahl, and McCluskey 2008). By offering convenient one-stop-shop generalized shopping locations where individuals can load up on significant supplies of not only groceries but of other general merchandise too, hypermarkets permit individuals to alleviate time-scarcity, freeing up temporal resources for other practices.

This shift in the retail landscape does not only alter the systems of provision associated with the practices of household provisioning and meal preparation, but also represents shifts in their other materials and meanings. The altered materiality of practices is evident in the differences in products sold in superstores—qualities, quantities, packaging, and pricing are all different from other retail formats, especially more traditional options like neighborhood grocers and wet markets. Such variation in products is also associated with variation in marketing and other environmental factors. This can be linked, through the behavioral economic literature surveyed above, to behaviors such as succumbing to bulk discounts, making impulse purchases, and over-purchasing. The different experience of shopping at different kinds of food retail also alters the meanings of household provisioning. For example, purchasing groceries at hypermarkets is imbued with new meanings of leisure and a sense of consumer citizenship in a global marketplace, particularly outside the Western world (Coe and Wrigley 2007; Jin and Kim 2003).

2.5 Measuring household food waste

The main challenge to household food waste research is the measurement of household food waste for use as the dependent variable in quantitative analysis. Households tend to underestimate the quantity of food waste they generate (Quested et al. 2011), meaning that self-reported measures of food waste may be unreliable, leaving measurement as the alternative. However, the tendency for food waste to decompose means that the measurement of food waste often needs to take place relatively soon following discard if it is not to become unnecessarily unpleasant. Researchers may not always be available to perform these tasks, in which case they must rely on households to do so. Yet households cannot always be relied upon to report food waste quantities accurately. This creates a trade-off between the high costs of visiting households regularly to measure waste and increasing households' burden of participating in food waste measurement studies. This section reviews the various methodologies used in prior household waste research and discusses their advantages and disadvantages. These include direct waste analysis and individual household sampling, which can take the form of researcher-led collction and measurement, diaries, and surveys.

2.5.1 Direct waste analysis

The composition and size of the municipal waste stream can be estimated using direct waste analysis (DWA). DWA involves using probability sampling of municipal waste streams to characterize the size and composition of the municipal waste stream. However, the aggregated nature of the municipal waste streams makes it difficult to gather detailed data on the composition of the waste stream. Nonetheless, DWA can be a reliable method of characterizing municipal waste streams given a large enough sample size. However, the work involved can be highly unpleasant, take long hours, and is subject to numerous health and safety regulations. It is therefore often very expensive and municipal authorities can wait ten years or more in between DWAs (Chung 2008). Furthermore, waste management companies often collect waste from a large number of households across large areas, making it impossible for researchers to gather information on the size of the waste stream at the household level. Linking households' socioeconomic and consumption data to their particular waste streams is also impossible, which makes analyses of the drivers of household waste particularly difficult. In general, direct waste analysis requires the cooperation and support of municipal authorities and waste management companies.

2.5.2 Individual household sampling

The alternative is to sample individual households and collect waste data directly in addition to other data on the drivers of household waste generation. Researchers have several options in this regard: sort and weigh waste themselves, have households sort, weigh, and record information about their waste, or ask households to recall or estimate quantities and composition of waste generated.

<u>Researcher-led collection and measurement</u>

Having the researcher collect, sort, and measure household waste is arguably the most objective and accurate option as it avoids subjectivities associated with definitions of waste and measurement methods. It also reduces participant burden, eliminates recall bias, and potentially reduces the observer effect (Langley et al. 2010). This methodology has been applied extensively in both developed and developing countries for measuring entire household solid waste streams. However, there are fewer examples of studies focused specifically on food waste that have used this methodology—ongoing research by the UK government-funded Waste and Resources Action Programme (WRAP) is one example study where this methodology has been deployed successfully (WRAP 2008; WRAP 2013).

In ideal situations, the researcher would collect, sort, and measure participant households' waste every day, but this is difficult in practice due to the intrusive nature of the research. It is also time and labor-intensive and can be expensive as a result. Additionally, if not collected every day, food waste in particular could break down and degrade, altering its mass and making it difficult to identify particular components. Seasonal variation in weather also presents a problem by affecting decomposition rates over time (Langley et al. 2010). Similarly, using this methodology during hot and humid times of the year is likely to be unpopular for households and researchers alike due to the odors and pest problems associated with accumulating food waste.

<u>Household waste diaries</u>

The diary method relies on households to sort and weigh their own waste over a specified period of time. As the participants ideally record information on their disposals at the point of disposal, the diary method allows researchers to collect detailed information about each disposal, such as the type of waste disposed of and the reason for disposal (Koivupuro et al. 2012). Information on related behavior such as household characteristics, practices, and attitudes can also be collected using accompanying surveys. Another strength of the diary method is that it enables capture of data on food waste that is disposed of separately from the municipal waste stream, i.e. down the sink or in home compost systems (WRAP 2009).

At a minimum, household waste diary studies performed to date asked households to record the quantity of food waste disposed and the reason for disposal, while providing households with the necessary equipment for measurement (e.g. electronic weighing scale). Most diaries also asked households to indicate the life-cycle stage of food disposed, which refers to whether the food waste is originating from storage, during meal preparation, or after meal preparation. Information about food waste from storage has also been divided into food that is entirely or partially unused (Langley et al. 2010).

Other aspects of the diary methodology varied with the objectives of the studies. For example, Langley et al (2010) were most concerned with household waste composition in their study of 13 British households; this was an extreme example of a highly detailed and demanding diary. They asked participant households to classify their food waste over a week into eleven categories. They also asked households to record the waste disposal route and the life-cycle stage of the food disposed, giving participants seven and five categories to choose from, respectively. Finally, they asked participants about packaging type, origin, weight, percent consumed, price, and use-by/best-by dates on the food disposed. Sonesson et al (2005) were interested in understanding habits related to shopping, food management, and transportation. They performed a study in Sweden that combined a waste diary with a larger-scale questionnaire for 35 households. In addition to the basic information mentioned above, Sonesson et al also requested households to record information on how the food had been stored and how long it had been in storage. The authors also collected data on food preparation habits, asking households to record the number of portions of each type of food they prepared each week, which they used as a baseline for calculating the proportion of food wasted. Williams et al (2012), in a study of 61 households in Sweden, attempted to account for packaging-related reasons for food waste by offering households the option of choosing packaging-related reasons when indicating the reason for disposal.

The studies described above have been for relatively small samples ranging from just 13 to 61. There have been four waste diary studies with larger samples, ranging from 284 to 950 households. Large sample diary studies are methodologically similar to those just described, but are logistically more challenging and harder to administer. Sampling is often carried out remotely and face-to-face interaction with participating households is near impossible.

Of the four large-sample diary studies, only one is associated with academic research: Koivupuro's diary study (also the basis of Katajajuuri et al. 2014) was conducted over a period of two weeks in the autumn in Finland. Participants were equipped with electronic weighing scales and given detailed instructions on how to weigh their food waste. They were asked to

record information concerning their disposals of food waste that included the weight, type of food, and reason for disposal. The authors provided multiple categories of food types with corresponding boxes that participants simply had to tick in order to record the type of food disposed. As an incentive for completing the study and to reduce participation bias, respondents were paid €30 (~US$40) and allowed to keep the €20 (~US$28) kitchen scale.

The other three larger-scale studies were part of a broader food waste research program conducted by WRAP that combined use of all three waste quantification methodologies discussed here. The first was a week-long study (Exodus Market Research 2007; reported in WRAP 2008) of 284 households which asked participants to record the type of waste, the approximate account (including colloquial measures like "a cupful" where standard units did not apply) and the method and reason for disposal. The second diary study (WRAP 2009) was aimed specifically at quantifying food waste that was disposed of via household sewage systems. Participants were provided with equipment for measuring waste volumes and asked to record the volume, source, and reason of disposal. 319 out of 334 households returned completed diaries and were given an incentive payment (amount unspecified) for their efforts in addition to being allowed to keep the measuring instruments. The third study updated the results of the prior two.

Most of the diary studies reviewed also augmented the diary with questionnaires about related variables such as demographics, reasons for food waste (if not covered in the diary entries themselves), travel behavior (Sonesson et al. 2005), food shopping and management habits (Koivupuro et al. 2012; Sonesson et al. 2005; Williams et al. 2012), and attitudes towards food waste, packaging etc. (Koivupuro et al. 2012; Williams et al. 2012). Such surveys can be conducted either pre- or post-diary; in some cases both have been employed to measure any increased effects of food waste awareness brought about by the diary (WRAP 2009).

As shown, diary studies are particularly useful when detailed data on the quantity and composition of food waste are required, and especially so when information on the circumstances under which food was discarded is of interest. However, the burden on participants in diary studies is considerable, especially if they are required to not only weigh their waste but also record supplemental information. Additionally, the unappetizing nature of food waste may also dampen enthusiasm. Consequently, participant motivation to complete the diary has been noted to flag over the course of the study, though this was for the one rather extreme example described above (Langley et al. 2010). Additionally, food waste diaries are a constant and obvious reminder to participants that they are being observed, and the observer effect is a potential source of bias as participants may alter their behavior in ways they deem more favorable (e.g. actively reducing their food waste) (Langley et al. 2010; WRAP 2009). Participants may also forget, or choose not to record disposals, and the researcher has no good means of verifying the accuracy of the recorded data (WRAP 2009).

There are several options for reducing these biases. Firstly, the duration of the diary study should be limited so as to reduce household burden. With respect to the detail requested of the participating household in the diary, researchers should also weigh their need for data against the increased burden that asking for increased detail represents. The effect of these issues can be reduced by giving participants a thorough briefing, ensuring that written instructions are easy to understand, and by using a well-designed recording system. Providing telephone support to

participants also ensures that their questions or concerns can be answered (WRAP 2009). Contacting households regularly throughout the week has been used as a method of checking in on and reminding households (WRAP 2009). As reflected in the studies reviewed above, offering incentives for completion of the diary is also vital to maintaining household interest in the diary and helps reduce participant bias. Nonetheless, quantities of food waste estimated using the diary method are likely to be underestimates.

A separate issue for consideration is the study duration and which day of the week to start the study. At a minimum, the diary study should be one week long in order to capture variations between weekdays and weekends. Although a two-week long study could potentially reduce observer effects by allowing households to "settle" back into regular patterns of behavior, this is probably also the longest study duration possible without increasing drop-out rates or reducing participant motivation—none of the diary studies reviewed above lasted longer than two weeks; most only were for one week. Starting week-long diaries in midweek is also suggested as one way of ensuring that important weekend data is captured before households start to lose motivation.

Standalone household surveys

Collecting data on household waste via surveys is the least burdensome method for both researcher and participant. Surveys can be used to gather data on quantities of waste generated, as well as the reasons for waste generation. However, they are the least accurate method.

Quantifying household waste through surveys involves asking survey participants to estimate the quantity of waste they generate, either on average or over a specific, recent time period. In order to aid recall and attempt to standardize units, researchers can present participants with visual aids, such as actual, or pictures of containers or bags of a certain size (OECD 2013). Researchers studying food waste in particular also have the option to ask respondents what proportion of food purchased they throw away. In some studies, this is used as the primary method of quantifying food waste (OECD 2013; Stefan et al. 2013). As a relative measure, this avoids problems of quantification associated with the tendency for households not to think of their food or food waste in terms of specific units of mass or volume. However, using this relative measure for food waste does not capture absolute quantities of data, which could potentially be important when the researcher wishes to know the magnitude of individual household waste streams. Although unlikely, it is possible that this methodology will fail to capture large flows of household food waste that are a relatively small proportion of household food purchases.

A primary difficulty with the survey method involves the reliability of self-reported answers during surveys. As consumers do not often think about the waste they generate in formal, quantified terms, their responses to questions about the quantities of waste they generate are subject to an amount of recall bias. Chung (2008) investigated the extent and direction of this bias for plastic bag waste in Hong Kong by comparing the results of a large-scale consumer survey with those of a DWA previously undertaken by the Hong Kong Ministry of Environment. Chung found that self-reported quantities of plastic bag waste were systematically underestimated at one-fifth the quantity indicated by the DWA. However, this was a worst-case estimate, and the author highlights plausible factors which would reduce this gap. Additionally, by incorporating multiple tests for internal consistency in their survey, Chung was able to show

that the results were internally consistent and therefore still valuable in analyses of waste generation.

2.6 Pre-consumer food waste

Food supply chains (FSCs) can generally be divided into the following stages: production, postharvest handling and storage, processing, distribution, and consumption (Gustavsson et al. 2011). Food that is discarded after harvest, but before the latter stages of the FSC, i.e. distribution and consumption, is most often referred to as "food losses" or "spoilage," while "food waste" refers to food discarded in distribution and consumption (Parfitt, Barthel, and Macnaughton 2010). For ease of reference, "food waste" will be used to refer to both food losses and food waste, in keeping with the approach taken by Parfitt et al (2010). Additionally, I will use "pre-consumption food waste" to refer to the discard of any food intended for human consumption in the stages up to, but excluding, consumption. The remainder of this section is organized using the pre-consumption stages of the FSC; the issues relating to food waste for each stage will be discussed in each subsection that follows.

2.6.1 Production

Food waste generated during production occurs either prior to harvest, i.e. when it is being grown, or during the process of harvest itself. Reasons pertaining to the former include threats to crops such as disease and pests. During harvest, waste can occur if crops are damaged and rendered unfit for consumption due to poor harvesting technique or damage from mechanical equipment (Gustavsson et al. 2011). Weather may also role in leading to crop damage, e.g. in instances where unusually high moisture levels from rain lead to problems like mold (Hodges, Buzby, and Bennett 2011).

Where crops are primarily harvested by hand, weather or pest-damage and spoilage have a greater chance to occur if there is insufficient labor available to harvest everything in time (Institute of Mechanical Engineers 2013). Additionally, compensation systems for harvest laborers may over-incentive speed. As a result, laborers may rush their work, handling produce too roughly or not bothering to harvest fruit that take too much effort to reach (Bloom 2010). If mechanized harvesting techniques are introduced, but the rate of harvest exceeds the rate at which crops can be properly transported away to market or stored, then the risk of crop damage may also increase (Institute of Mechanical Engineers 2013). Food waste can also occur prior to harvest in "walk-by" situations. These refer to occasions when market prices are so low that farmers would lose money by paying for crops to be harvested. In such instances, entire crops are left unharvested and are usually turned back into the soil (Bloom 2010).

In general, the options for reducing food waste generated at this stage include improving technology and practices to prevent damage to crops from pests and diseases. Improvements in harvest technology and farmer education can also help minimize damage to crops during the harvest process. However, preventing food waste from walk-bys is difficult because the root causes are often random in nature—bumper harvests may create oversupply in markets and collapse prices, or food safety scares could dampen consumer demand. When farmers opt not to harvest crops, they may alert food banks or other charities to the fact and allow them to come

and harvest some of the crops (Bloom 2010). However, the waste averted this way has mostly been constrained by the limited manpower available to these groups (Bloom 2010).

2.6.2 Postharvest handling, storage, and transportation

The postharvest handling and storage stage encompasses the period after food has been harvested up till the point where it is ready for distribution, either to consumers or to commercial buyers. This stage includes sorting, packaging, storage, and transportation. Wastage in postharvest handling occurs primarily due to physical damage from rough handling, spillage, or transportation, as well as spoilage. As with the case for the production stage, this can be curtailed through mechanization. Mechanization not only reduces the risk of human mishandling, but improves the timeliness with which different processes are completed, minimizing exposure to suboptimal conditions. For example, in cases where farmers need to sun-dry their crops before storage, inclement weather may contribute to food waste by obstructing the drying process and preventing farmers from storing their crops (Hodges, Buzby, and Bennett 2011). This can be prevented through the use of drying equipment.

In the case of storage and transportation, inadequate infrastructure and technology is a common cause of damage to food that leads to its discard. This includes the inability to properly control temperature, humidity, and ventilation while also keeping out pests and disease (Institute of Mechanical Engineers 2013). Besides increasing the risk of spoilage, poor storage and transportation conditions may also reduce confidence in food safety, potentially leading to increased discard of food that is deemed unsafe for consumption (Gustavsson et al. 2011). In addition, controlling environmental concentrations of carbon dioxide, oxygen, and ethylene is important for preventing premature ripening and deterioration of fruits and vegetables (Jedermann et al. 2014). The logistics of storage and transportation are also important due to the challenges of transporting perishable produce across long distances, even with access to environmental control technology (Nunes et al. 2014).

Sorting is another reason for food waste in the food supply chain, especially where it involves grading of produce according to quality standards. Both government and private sector actors have introduced standards not only in order to guarantee food safety and traceability, but also as a means of quality assurance and product differentiation (Henson and Reardon 2005). A subset of such standards govern the appearance of produce, including its size, shape, and color. Produce leaving farms is subject to sorting and grading according to these standards, and the discard of large quantities of otherwise edible produce that do not conform to these standards has been well-documented as a pervasive cause of food waste (Stuart 2009). Food retailers sometimes argue that they have no choice but to reject cosmetically-flawed produce because of consumer expectations about what their fruit and vegetables should look like (Royte 2016).

Recent efforts to address the problem of out-graded produce, particularly in Europe and the US, suggest that consumer expectations are not entirely to blame. These include initiatives to improve the sales of “ugly” fruits and vegetables, such as dedicated sections in supermarkets and home delivery services for out-graded produce (Godoy 2014; Medina 2015; Russell 2016). The relative success of such efforts suggest that if consumers are not inherently picky about the appearance of their produce, then their expectations and preferences are at least malleable and responsive to marketing and consumer education campaigns. It is therefore probable that food

retailers have played a role in shaping consumer expectations by only selling perfectly shaped and colored produce.

Although finding markets for out-graded produce helps reduce food waste, some view such solutions as merely treating the symptoms of a broader problem that is rooted in inequality and power imbalances between retailers and farmers. Gilles (2012) argues that with their buying power and the assistance of quality standards, food retailers have transferred the risks of out-grades and demand fluctuations to farmers. We can see this from reports of how supermarkets reject produce deliveries, citing failed quality standards when the real reason is poor sales (Goldenberg 2016; Royte 2016). As a result, systemic solutions, such as relaxing produce standards, may be more important for addressing the problem of out-graded produce than the creation of new markets (Royte 2016).

2.6.3 Retail

Food waste during distribution and retail is mainly driven by supply-demand imbalances and poor in-store management practices. In the case of the former, food waste occurs due to the challenge of demand forecasting; besides the influence of external factors (e.g. weather, seasonality) on sales, stores also face added uncertainty if they employ promotions to drive store traffic and revenues (Mena, Adenso-Diaz, and Yurt 2011). Poor information sharing between stores and suppliers can create discrepancies between forecasts and orders, leading to excess ordering and waste (Mena, Adenso-Diaz, and Yurt 2011).

An aspect of store management that may contribute to food waste is the nature of a retailer's performance monitoring and measurement. Sourcing strategy and procurement decisions that do not adequately account for the cost of food waste can lead to trade-offs among different cost measures that contribute to greater food waste in stores (Rijpkema, Rossi, and Van der Vorst 2014). This can be exacerbated if systems are not in place to measure food waste in the first place. An example of this is the practice of maintaining high stock levels to ensure customer demand is met (Mena, Adenso-Diaz, and Yurt 2011). A focus on waste as something to be "managed," rather than "prevented" for cost-saving purposes, is another aspect of store management that can contribute to food waste (WRAP 2010). Additionally, improper handling of store inventory, either by employees or customers (Mena et al. 2014), as well as suboptimal shelving and rotation of certain products (Mena, Adenso-Diaz, and Yurt 2011) can contribute to food waste. Lastly, the mismanagement of cold chain facilities, their absence, or other forms of improper food storage will contribute to food waste as well (Mena, Adenso-Diaz, and Yurt 2011).

Together, imperfect demand forecasting and retail management practices result in surplus food at retailers that does not get sold before it passes its sell-by date, nears its expiry date, or loses its freshness and therefore, desirability to customers. The consequence is that food retailers dispose of large quantities of edible food each day. Food retailers have, for the most part, not donated this food to charity because they believe that their sales will suffer if it becomes known that their food is available for free (Stuart 2009). The extent of food discarded each day in Western supermarkets is such that activists such as Freegans[2] and others purport to be able to live solely

[2] Freegans are members of an anti-consumerist movement that aims to reduce waste in society by maximizing the use and of discarded food and other goods.

off food discarded by retailers. In response, many retailers have actively tried to discourage people from taking food from their rubbish dumpsters; such efforts included making police reports and tainting food with bleach or paint (Stuart 2009). In recognition of the scale of the problem, some European governments have required by law that large food retailers to donate unsold food or removed legal barriers to food donation (Vogt 2016).

2.6.4 Pre-consumer food waste and food retail modernization

Two main themes emerge from the above discussion of pre-consumer food waste: technology and management and power imbalances in food supply chains. Retail modernization has the potential to drive change with respect to both. As discussed in section 2.2.4, retail modernization in developing countries has been connected to increased access to technology for small farmers as well as increased investment in modern infrastructure for FFV distribution (Reardon et al. 2009). Consequently, one might expect that, as retail modernization progresses, pre-consumer food waste will decrease due to factors such as mechanization and farmers' increased ability to grow crops that are more resistant to disease, pests, and adverse weather conditions. Improvements in logistics, such as those brought about by investments in distribution centers, cold-chains, and packaging technology, could reduce the time produce spends in transit and improve storage and transportation conditions.

However, gains in technology brought about by retail modernization are accompanied by greater vertical integration between retailers and producers and the increased concentration of market power among large retailers. As shown already, power imbalances in food supply chains are to an extent responsible for pre-consumer food waste when retailers abuse this power by rejecting produce shipments, forcing suppliers to buyback unsold produce (Bloom 2010). Although such behavior qualifies producers to file complaints with governmental regulatory boards, few do so for fear of upsetting relationships with and losing business from retailers. Similarly, even though most farmers grow crops in surplus to hedge against natural risks, disproportionate buyer power, in conjunction with the use of contract farming, may exacerbate such behavior because of the potential penalties to growers for not being able to deliver on a contract (Stuart 2009). Lastly, the private standards that corporate retailers may employ often form the basis for the grading and discard of ugly but edible produce, while conveniently giving corporate retailers the grounds to reject shipments from growers.

The above effects illustrate how retail modernization can help mitigate or exacerbate the occurrence of pre-consumer food waste, but the net outcome is unclear.

2.7 Research questions and hypotheses

Through the literature reviewed above, I have illustrated the importance of retail modernization as a perspective from which to approach the question of food waste, be it household or pre-consumer food waste. It is clear that the former, while undoubtedly influenced by basic factors such as age and household size, cannot be separated from other moments in the broader practice of household provisioning and meal preparation. In particular, practice theory's contribution that the occurrence of food waste may be preordained in advance of its actual disposal necessitates greater focus on the circumstances associated with the purchase and management of groceries,

and the physical sites of these behaviors. These connections lead to the following research question concerning household food waste:

RQ1. What effect does shopping for groceries at different kinds of food retailers have on the quantities of avoidable food waste discarded by households in industrialized nations? How are these differences related to the effects of food retail modernization on food-related practices?

I have also described how food retail modernization contributes to changes in agricultural supply chains and distribution networks by paving the way for increased investments infrastructure, logistics, and farming techniques, as well as the introduction of direct supplier relationships and private standards. These considerations produce the following research question:

RQ2. How has retail modernization affected the quantity and nature of pre-consumer food waste for corporate and traditional retailers in industrialized nations?

Amid the complex web of factors contributing to household food waste descrbed in this chapter so far, the hypotheses that I present in response to RQ1 primarily center on over-purchasing in households, which is one important driver of avoidable food waste. The logics by which this may take place are threefold and flow from the attributes of households' grocery shopping practices that are related to whether households buy groceries from traditional or corporate retailers.

The first of these logics concerns differences in the consumers' in-store experiences. In relation to this, I hypothesize that when shopping at corporate retailers, households are more exposed to three drivers of over-purchasing: 1) discounts and promotions, such as buy-one, get-one-free offers; 2) tactics designed to exploit human psychology and induce impulse purchases, such as store layouts, shelving arrangements, and environmental factors, such as music and aromas; and 3) a wide range of amenities and goods on offer at corporate retail formats, specifically hypermarkets, which promote them as one-stop-shop destinations not only for pure grocery shopping, but also as leisure experiences that may put consumers in a more free-spending frame of mind than if they were singularly focused on grocery shopping.

The second logic pertains to the characteristics of products sold. Here, I hypothesize that at corporate retailers, 1) households may not always be able to buy food in the quantities they need due to fixed packaging sizes and 2) households may buy more food at corporate retailers that is labelled with sell-by dates or the like, potentially creating premature discards due to confusion over whether food is safe to eat or not.

The third logic stems from the effect of land use patterns on grocery shopping trip characteristics. My hypotheses here are that by offering more parking and being further away from households on average, corporate retailers' hypermarket formats may produce 1) more grocery shopping trips by car, which removes the physical burden of transporting their purchases home and makes it easier for households to buy more; 2) less frequent grocery shopping trips with more purchases per trip, which increases the challenge of buying the right amounts; and 3) longer travel times to the grocery store, which increase the pressure on households to buy enough food in order to avoid the inconvenience of having to return.

In response to RQ2, the hypotheses I aim to test concern the potentially opposing effects on pre-consumer food waste of corporate retailers' superor access to technology and their propensity to establish direct supplier relationships and apply private quality standards.

In particular, corporate retailers' investment in cold-chain infrastructure, more accurate demand forecasting systems, more efficient logistics, and potential to help farmers improve farming techniques should reduce pre-consumer food waste by 1) reducing the amount of time food spends in transit; 2) ensuring that food is transported and stored under optimal conditions for maximizing shelf-life; 3) limiting the amount of unsold food discarded from stores; and 4) reducing the proportion of harvested crops that cannot be marketed due to causes such as disease, pests, or inclement weather.

On the other hand, corporate retailers' use of direct supplier relationships, greater buying power, and imposition of stringent grading practices could lead to increased rejection of produce from suppliers if the produce does not meet quality standards; if alternative markets cannot be found for such produce, this would exacerbate pre-consumer food waste.

In attempting to address these questions and test my hypotheses, I employ a research design with two parts. The first addresses household food waste and includes the use of surveys, waste diaries, and interviews. The second employs a case study approach, informed by informant interviews and the analysis of secondary data. In the next chapter, I outline my research design and methodology before going on to introduce my chosen site for research in Chapter 4.

Chapter 3 – Research design and methodology

3.1 Introduction

My dissertation is, at its core, motivated by the question of how retail modernization might be tied to patterns of food waste generation. To answer this question, I crafted a research design that on a macro-level takes for its foundation South Korea as a locus of retail modernization, and seeks to understand how retail modernization has influenced food waste in the South Korean context. Based on the two research questions I posed in the previous chapter, I divided my research design into two halves that respectively address pre-consumer and post-consumer food waste and draw upon a combination of quantitative and qualitative methodologies and analytical techniques. This chapter provides a guide to my overall research design and describes these methods and processes of data analysis. Using my research questions as a starting point, the chapter begins by describing and justifying the various components of my research design. I then move on to discuss the process through which I collected my data before providing details about how the data were analyzed. The conclusion then offers some reflection on the novel aspects of my research design as well as its limitations.

3.2 Research design

My two research questions, as formulated at the end of last chapter, were as follows:

RQ1. What effect does shopping for groceries at different kinds of food retailers have on the quantities of avoidable food waste discarded by households in industrialized nations? How are these differences related to the effects of food retail modernization on food-related practices?

RQ2. How has retail modernization affected the quantity and nature of pre-consumer food waste for corporate and traditional retailers in industrialized nations?

Consequently, my research design is divided into two parts—one for each research question (Figure 3.1). The first part describes, investigates, and attempts to quantify aspects of the relationship between retail modernization and household food waste, utilizing a triangulatory approach relying on a survey, diary study, interviews, and secondary data. The second part addresses the question of how retail modernization has affected pre-consumer food waste, relying on informant interviews and a rudimentary model of waste generation to compare food waste across the supply chains for modern and traditional retailers.

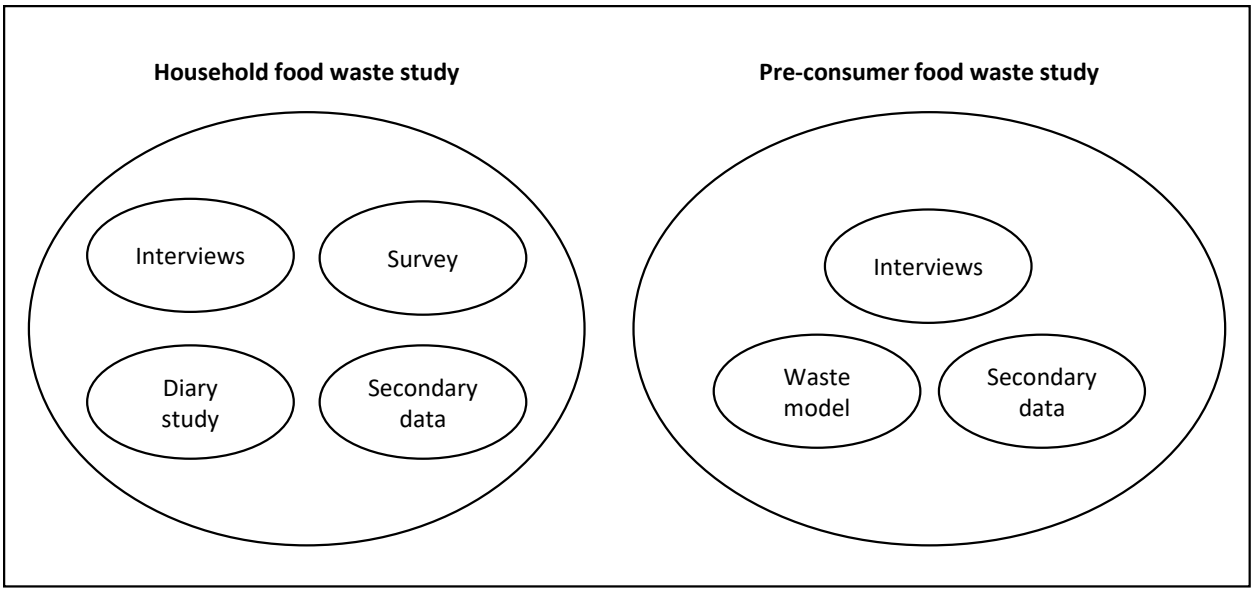

Figure 3.1 Research design schematic

3.2.1 Household food waste study

The first part of RQ1 seeks to understand whether shopping at certain kinds of food retailers is correlated with different quantities of avoidable food waste—the dependent variable. I hypothesized that shopping at corporate food retailers predisposes a household to throw away more food than if they shopped at traditional retailers, and that this difference is mainly attributable to over-purchasing, which is affected by factors such as the store environment, marketing, packaging, shopping frequency, and trip characteristics. To test this hypothesis, it was necessary to measure household food waste and test its correlations with the hypothesized predictor variables, as well as to collect data on, and control for, the effect of any other influences. This points to the need for quantitative research and in particular, inferential statistics. Experimental designs, whether true or quasi in nature, were not suitable for the study's focus on households and their daily lives since it was not possible nor ethical to form experimental treatment and control groups by forcing households to only shop at certain food retailers. As such, it was necessary to choose an observational research design. Longitudinal research was considered, but ruled out because the time scale over which households' food waste-influencing behaviors might change, if at all, would not have been possible to cover within the time available to conduct this study.

A cross-sectional study design with case-controls was thus chosen. With this approach, households could be divided into groups according to the main variables of interest, which represented different aspects of the theorized relationships between households' preferred food retail types and the quantities of food waste they generate, as well as the control variables. Assessing these relationships required obtaining a sample of households that represented the full extents of the control variables and variables of interest. As this would not have been practical or possible with direct observation of household behavior, a survey was chosen to collect the required data.

Another important consideration in the research design was selecting the methodology that would be used to measure household food waste. The methods available for measuring household food waste have various advantages and disadvantages, as was illustrated in the last chapter. Researchers aiming to quantify household waste of any kind need to make trade-offs between accuracy, sample size, and study costs—direct analysis of household waste streams may be most accurate, but is expensive and time-consuming to conduct on a large scale, whereas asking households to quantify their waste via a survey is cheaper and can reach a larger number of households, while being less accurate than direct waste analysis. Asking households to complete waste diaries might be considered a feasible middle-ground between the two. Based on these considerations, it was decided that a combination of survey-based recall and waste diaries would yield the best data for this study's scope and available resources.

Despite the drawbacks associated with survey-based recall, it was selected because of its potential to achieve a larger sample, which was necessary for statistical analyses, which I aimed to employ in order to isolate the effects of retail type on household food waste. Additionally, it was theorized that the recall bias ordinarily associated with surveys could be significantly reduced by taking advantage of South Korea's volume-based pricing system for food waste when asking households about their food waste, which the next section will describe in more detail. A waste diary was chosen to supplement the survey data by obtaining a second measure of food waste, albeit from a smaller sample. The diary afforded a means of directly collecting detailed data on food waste in near real-time, provided that participants were diligent about recording their food waste in a timely and accurate fashion. Additionally, the diaries would allow the application of a second set of case controls to the research design—whereas the discussion so far has assumed a comparison of food waste across households, the diary data would also permit comparisons of food waste across different types of food retail.

RQ1 also poses the question of *how* differences in food retail type, as driven by retail modernization, contribute to food waste—in other words, it asks about the mechanisms by which obtaining food from modern instead of traditional sources alters the chance that it is ultimately discarded. As laid out in the previous chapter, the premise of this study is that these mechanisms are driven primarily by over-purchasing, which is theorized to be a function of grocery trip frequency, travel time, and mode choice, and other characteristics of grocery shopping trips, in addition to a household's characteristics and behavioral patterns. The survey and diary instruments begin to address this question by collecting information not just on food waste quantities, but on households' reasons for throwing food away and the aforementioned characteristics of their grocery shopping trips. Statistical analyses of these data yield correlations, which if statistically significant, provide evidence for the in-tandem variation of such factors.

There is however, less evidence to explain how and why these correlations exist. For this reason, I also included a qualitative component to this study that relies on interviews and secondary data analysis. Evans (2014), among others, has shown the value of participant-observation for tracing and explaining how food makes its way from the stores to household bins, and he uses the method effectively to achieve his goal of simultaneously critiquing existing theories about food waste and producing his own sociological account of this phenomenon. My research does not share this objective. Instead, it uses the survey and diary data to identify particular relationships between food waste and retail type before attempting to interpret these relationships by situating

them in the specific context of everyday household life and retail modernization in South Korea. Achieving this requires first understanding how retail modernization has entered the everyday lives of consumers and then connecting the ways in which it has done so to the food-related practices that contribute to food waste. Participant-observation would certainly be a valid means for approaching this goal, but I propose that with my narrow focus on retail modernization's relationship to food practices, in-depth household interviews, and analyses of how retail modernization has played out in the consumer realm, can sufficiently address this part of RQ1.

Altogether, the survey, diary study, and interviews, supplemented with secondary data analysis, uncover multiple perspectives on the relationships between retail modernization and household food waste.

3.2.2 Pre-consumer food waste study

RQ2 moves away from households and up the food supply chain to address the connections between food waste and retail modernization at a different scale. It implies the need to assess pre-consumer food waste quantities and connect any patterns identified to changes wrought by retail modernization. The hypothesis proposed here was that technological and logistical improvements associated with retail modernization have reduced the quantity of pre-consumer food waste, but these gains have been undermined by increased food waste from stricter grading processes and other consequences of corporate retailers' growth in buying power. The most direct means of testing these hypotheses would have been to quantify growth in pre-consumer food waste being discarded as a result of out-grading and compare it to reductions in food waste from improvements in technology and logistics over the same time period. However, this comparison depends on the availability of intertemporal data on food waste discarded, ideally, from the same sources. As such data are unavailable or inaccessible, then another approach would be to compare pre-consumer food waste between traditional and corporate retailers. This would produce an insight into hypothesized tradeoff, as these retailers' respective food waste generation patterns ought to be differentiated by 1) the extent to which they benefit from improvements in technology and logistics and 2) the stringency of their grading processes.

Addressing RQ2 thus entails a focus on the quantities of pre-consumer food waste. This might have been approached with a survey in a similar fashion to RQ1 in order to measure food waste and offer analytical insight into its cause. However, doing so would have been much less practical than for households due to the difficulty of accessing the requisite actors in South Korea's food distribution and retail system and obtaining enough quantitative data on food waste. Since pre-consumer waste directly translates to economic losses for these actors while also posing reputational risk for larger firms, they may be sensitive to disclosing such information. Furthermore, collecting data on control variables requires these actors to disclose other sensitive information about their operations and finances. Ultimately, the survey method was incapable in this situation of capturing the full context in which pre-consumer food waste occurs.

For reasons similar to the household study, a longitudinal study would not have been practical nor possible. Instead, it was necessary to employ a cross-sectional design with case controls in the form of interviews with key informants in South Korea's food distribution system. As retail modernization marks the transition between traditional and modern forms of food retail, it was most logical to pick and interview cases from each of these categories to ensure that collectively,

the information provided would cover the contemporary extent of the South Korean retail modernization process. In practice, these interviews confirmed existing knowledge about the effects of retail modernization while also providing additional nuances to retail modernization in the South Korean context. Crucially, the interviews also provided insights into the extent and causes of pre-consumer food waste. Secondary data collected from existing studies, South Korean news, and statistical databases helped fill in data gaps and construct the framework on which the case study's lines of inquiry were built.

Lastly, it was necessary to limit the scope of the pre-consumer case study. The stages of production, distribution, and retail vary across different foods, and understanding the relationships between food waste and retail modernization would have been a highly complex project without limiting the type of food under study. As such, fresh fruits and vegetables (FFV) were selected to be the focus of pre-consumer food waste study due to their inherently fragile and perishable nature. Additionally, a very high percentage of FFV consumed in South Korea is produced domestically (Park and Kim 2013), which meant easier access to actors throughout its distribution chain.

3.3 Data collection and sampling

The data collection process for the household-based part of this study consisted of a survey, a food waste diary study, interviews, and sourcing secondary data. This portion of my dissertation qualifies as human subjects research under US federal regulations (45 CFR §46.102, 2009), as it involves personal interactions with and collection of data, including privately identifiable information, from living individuals. As such, prior to beginning the household data collection processes outlined above, I completed Collaborative Institutional Training Initiative (CITI) training on human subjects research and prepared a protocol outlining the steps and procedures undertaken to protect human subjects. The protocol (ID 2014-07-6512) was first submitted to the Institutional Review Board of the University of California, Berkeley on 8 August, 2014 and approved on 7 October, 2014. An amendment to the protocol was submitted on 26 April, 2015 and approved on 20 May, 2015. In contrast, the part of my dissertation focused on pre-consumer food waste did not qualify as human subjects research as it was centered on economic and market processes. This portion relied on interviews and secondary data analysis. The following sub-sections provide an overview of each methodology used during the data collection process.

3.3.1 Household survey

A survey was used to collect data on household characteristics, attitudes, and behaviors pertaining to grocery shopping, food management, and food waste. The survey also collected information on the amount of food waste households discarded and served as a recruitment device for the diary study (see section 3.3.1). Survey questions were formulated based on my theoretical framework and survey instruments employed in prior studies of household food waste. The survey questions were written in English and then translated into Korean; these translations were then checked for cultural relevance and accuracy by a native Korean speaker. In order to test the survey questions, a pilot study was conducted in October, 2014 that consisted of two parts: a street-intercept survey and an online survey. For the street-intercept survey, participants were approached outside corporate retailers and in traditional markets and asked to complete the pilot survey on an electronic tablet. The online survey was posted on several internet community

forums. In both cases, survey completion was incentivized with a shopping voucher worth 5,000 South Korean won[3] that was paid electronically following survey completion. The pilot study results were analyzed and the questions revised accordingly before finalizing the survey instrument. In addition, the pilot study helped establish the poor viability of using street-intercepts for survey sampling in the South Korean context owing to very low response rates. These were attributed to several factors, including the generally harried nature of grocery shoppers and a high level of suspicion to being approached on the street by a male stranger.

The target population under study was Seoul households, as represented by the household member primarily responsible for food provisioning. Independent probabilistic sampling was not possible due to lack of access to a relevant sampling frame. Because the pilot study had determined that on-street and online convenience sampling were not cost-effective and would most likely produce a sample biased towards a highly specific demographic, the decision was made to engage a research firm with access to a panel of respondents. AIP Global ("AIP") was selected primarily for its proprietary participant panel in South Korea, the demographic reach of its panel, and its ability to also recruit for and carry out the diary study. AIP's recruitment process involves inviting randomly selected panel members by email to participate in the survey. Under my instruction, AIP invited only panel members who met three criteria: they identified themselves as the primary grocery shopper in their household, were aged 18 and over, and lived in Seoul. Prospective participants were given a general description of the survey's subject matter and the expected time required. They could then opt-in to take the survey by clicking on a link in the invitation email, which directed them to survey instrument, which I programmed online using the Qualtrics survey platform.[4] Before being allowed to proceed to the survey questions, participants were presented with the study participation agreement and required to give their informed consent to participate in the survey. In addition to giving informed consent, participants also had to re-verify their age, city of residence, and their status as the person primarily in charge of their household's food provisioning. Participants who did not meet any of these criteria were immediately ejected from the survey.

Two methods were used to control the quality of the survey responses. Firstly, participants who completed the survey in less than one-third of the median time taken by the sample were removed as "speedsters." Secondly, three trap questions, which directed participants to select a particular answer, were deployed to identify participants who were answering questions randomly. Participants who failed two out of three of these questions were ejected immediately from the survey. As per AIP's policies, participants who were eliminated as speedsters or by failing the trap questions were offered only partial compensation. As a means of mitigating self-selection bias, participants were offered a survey completion incentive equivalent to 5,000 South Korean won to encourage those less interested in the survey topic to participate. The incentive was issued in the form of AIP's "e-points," which AIP's panel members can redeem for vouchers.

The survey was also administered to a small number of participants who were recruited without AIP's assistance to hedge against lower-than-expected completion rates for the diary study. These participants were recruited by circulating a link to the survey among the graduate student community at Seoul National University and on the forum pages of an online community. With

[3] Approximately $4.38 at the time of the pilot study
[4] Accessible at http://www.qualtrics.com

the exception of the informed consent documents, which were altered to remove mention of AIP, materials used to recruit these participants and the survey administered were identical to those presented to AIP panel members.

The target sample size for the survey was 500. This was determined based on power analysis calculations that took into account anticipated effect size, the number of variables, the level of statistical significance, and the statistical power desired (Cohen 1992). These calculations were performed assuming that F-tests and t-tests would be used to test for the statistical significance of ordinary least squares regression results. Additionally, quotas were applied such that survey respondents were evenly distributed according to their household size, age, and gender.

The survey was conducted by AIP over 1-9 June, 2015, during which AIP invited a total of 3,805 panel members to participate. Overall, 34% of invitees expressed a desire to participate in the survey, and the overall completion rate (valid responses divided by invitees) was 13%. This completion rate was reduced by the removal of 7% of invitees that were screened out by either failing to agree with the participation agreement or by being ineligible, in addition to a further 9% who were screened because the quota for their age, gender, and household size had already been filled. A detailed breakdown of the survey invitees' different fates is provided below (Table 3.1).

Table 3.1 Breakdown of AIP survey invitees by status

Status	Number	% of total invited
Received invitation email	3,805	100%
Clicked on email link	1,287	34%
Responded to participation agreement	1,259	33%
Declined to participate or was ineligible	248	6.5%
Stopped due to full quota	349	9.2%
Failed trap questions or were speedsters	111	2.9%
Did not finish within 72 hours	48	1.3%
Submitted valid response	503	13%

In addition to the above, there were a total of 22 valid survey responses associated with the diary participants I recruited independently from AIP, which brought the total number of valid survey responses to 535.

The final survey instrument is presented in Appendix A. The variables measured in the survey were selected based on my theoretical framework and were organized into the following categories: household characteristics, attitudes, diet and food consumption patterns, behavior governing grocery shopping and meal preparation, grocery shopping trip characteristics, food waste management at home, and the volume-based pricing system. The exact variables in each of these categories are summarized in

Table 3.2.

Table 3.2 Summary of independent variables

Category of independent variable	Characteristics / constructs measured
Household characteristics	Respondent age Respondent gender Respondent education Respondent occupational status Respondent financial independence Household monthly income Household size Presence of / no. of children in household
Food waste-related attitudes	Attitudes towards food waste pertaining to: - Environmental impact - Social norms - Money - Morality Attitudes towards food safety
Diet and food consumption patterns	No. of meals eaten at home per week No. of household members present each meal Relative consumption frequency of different food groups Percentage of stored food in different food groups Frequency of buying take-out food Frequency of entertaining guests at home Frequency of packing food for / receiving food from family Refrigerator volume and percentage full Grows own food to eat
Food-related competencies	Confidence in cooking tasty food Tendency to try cooking new foods Tendency to think about what to cook Means of storing different food groups Tendency to prioritize leftover / perishing ingredients Tendency to have / reasons for leftovers
Grocery shopping behavior	Tendency to perform known waste-reducing behaviors: Strategies used for buying the right amount Tendency to buy too much Reasons for buying too much Average amount spent on food per trip to each retailer visited Availability of somewhere nearby to buy food urgently
Shopping trip characteristics	Type of retailer visited Frequency of buying different foods from each retailer visited Mode choice for each retailer visited Travel time from home to each retailer visited Reasons for shopping at each retailer visited Tendency to use delivery services
Food waste management at home	Preparation state of food discarded Reasons for discarding food Alternate channels for disposing food waste
Volume-based pricing system	Type of system used to pay for food waste disposal Per-liter fee paid for food waste disposal Food waste disposal and collection frequency

As indicated earlier, data on the dependent variable were collected by leveraging South Korea's volume-based food waste pricing system. This allowed survey respondents to more accurately gauge the quantities of food waste they discarded this way. First, respondents were asked which of the four available payment systems they used to pay for food waste disposal. Depending on their answer, respondents were then shown a customized follow-up question. Respondents who indicated using the volume-rate plastic bag or sticker/chip systems were asked to recollect the number and volume of bags or stickers they used to dispose of food waste. In order to improve the accuracy of responses, the question also emphasized that participants should base their estimates as much as possible on the number of full plastic bags or containers of food waste discarded.

Respondents who indicated paying for and discarding their food waste using the radio-frequency identification (RFID) system were asked to report the fees they paid per month or per week for food waste disposal. They were reminded that this amount was usually available on the monthly utility bill sent by their apartment complex's management office. Based on the fees they paid, it was possible to calculate the amount of food waste discarded using the per kilogram disposal price for their district, which was available online.

The last set of respondents were those who, unlike the others, paid a fixed fee to their apartment complex in exchange for food waste disposal services. As a result, it was not possible to ask these respondents to use a well-known reference point to estimate their food waste. Nevertheless, to maintain consistency in how the question was asked, these households were asked to estimate the volume of the plastic bags they used to dispose of food waste and the number they used. In all cases, participants were asked to indicate the average quantity they discarded, using the last three months as their reference point, on a per month or per week basis. This option was provided to avoid confusion for households with less food waste, who may make their discards less often than once a week.

3.3.2 Diary study

The diary study was developed by adapting the research procedures and diary instrument used by the Waste & Resources Action Programme (WRAP) in their study of household food waste in the United Kingdom (2013). The WRAP study was selected as a suitable model as it was a large-sample diary study that had the goal of accurately quantifying the amount and value of food waste in the UK. The biggest change made to WRAP's diary instrument involved asking participants to indicate where food discarded was originally obtained instead of asking how they disposed of food waste. As with the survey, the diary was first written in English before being translated into Korean and checked for accuracy and cultural relevance by a native Korean speaker. In addition to providing pages for participants to make entries about their food waste, the diary booklet also included an introductory section that briefed the participant about the goals of the study and provided instructions for properly completing the diary. The diary instrument was piloted together with the survey in October, 2014, and feedback about the diary study was collected from participants that were also interviewed (see section 3.3.3). Revisions were then made to the diary instrument based on the feedback collected as well as the experience of coding and analyzing the pilot diary data. The final diary instrument is presented in Appendix B.

Recruitment for the diary study took place via the survey, and involved a double opt-in process to ensure participants were fully committed to the study. This involved providing participants at the end of the survey with information about the purpose of the study, as well as details of the anticipated daily time commitment, the planned study dates, and the 40,000 South Korean won[5] financial incentive. Participants were then given the option to sign up for the study. Those who signed up then received a separate email from AIP with a link to a page that displayed the study participation agreement and asked them to give their informed consent to participate. Only after giving their informed consent were participants allowed to enter their contact information, which officially completed the sign-up process.

As mentioned earlier, I also recruited a small group of diary participants independently from AIP via surveys distributed online and among the graduate student community at Seoul National University. The procedures followed for these participants were exactly the same as those detailed above, except I conducted all logistical operations instead of AIP. All incentives were paid to participants following the receipt of their completed diaries.

Diary study kits, which included a physical copy of the diary, a measuring cup, and a prepaid return envelope, were mailed by AIP to all diary participants on 15 June, 2015. One week was allowed for participants to receive their diaries in the mail. Over 22-24 June, diary participants then received a phone call to confirm that they had received the diary study kit, walk them through the instructions, and allow them to ask any clarifying questions. The phone calls were carried out by a professional caller hired by AIP whom I had fully briefed in a face-to-face meeting. The caller was instructed to only brief the person in the household who had completed the survey, i.e. the person responsible for food provisioning at home. All participants then completed the diary study between Thursday, 25 June and Wednesday, 1 July. As participants are more likely to be home and hence discard more food waste on weekends, it was important to pick diary study dates such that the weekend fell during the middle of the diary study period. This gave participants a few days to "warm up" to the process of recording their food waste, while also avoiding participation fatigue towards the end of the study period. Participants were also given a follow-up phone call by same AIP-hired caller during the middle of the diary study period to check in on their progress and help resolve outstanding issues. In addition, participants were provided a "helpline" phone number in the diary booklet that they were encouraged to call if they had any questions.

Diary study participants were required to record any organic waste disposed of during the study period in the diary booklet provided. For each item of food waste entered in the diary, they had to record what was discarded, the quantity discarded, where the discarded food was originally purchased/obtained, and the reason for discard. The diary spread each day's entries across four pages; one each for breakfast, lunch, and dinner, and a fourth for any other times during the day when food was thrown away. If there was no food waste to record, participants were asked to indicate the reason, which included not being home or not throwing any food. Participants were also asked to make note of any food-related spending each day and given space on each page to make notes about any special circumstances that affected their entries, such as having guests over for dinner. It was stressed in the written instructions and during the pre-diary briefing phone call that participants should not leave any pages completely blank. Participants were also

[5] Approximately US$36 at the time of the study

encouraged to always provide a unit for the quantity of food they discarded—mass or volume units wherever possible, but to reduce participant burden, the instructions also suggested that participants could use more subjective measures where direct measurement was not possible, e.g. "peel from one apple," or "half a bowl of rice." Other instructions included directions to record any and all organic waste disposed during the diary period and best practices for filling out the diary. After the conclusion of the study period, participants were given until 5 July, 2015 to mail their completed diaries back using the prepaid envelope provided.

The original target sample size for the diary study was 50, which was established on the basis that the diary data would mainly be analyzed using descriptive statistics and that any multivariate analysis would be primarily exploratory. The decision to recruit two sets of participants stemmed from the need to hedge against a lower-than-expected diary completion rate and keep costs within the allocated budget. Although the WRAP diary study (2013) experienced an 80% completion rate with a 50-pound[6] financial incentive, South Korean AIP representatives advised that the completion rate in South Korea would likely be closer to 25%, even with the 40,000 won incentive on offer. Based on scenario analysis that took into account different completion rates and project costs, it was eventually decided to assume a 50% completion rate and recruit 100 diary participants via AIP, but to also make allowances for a lower completion rate by recruiting an additional 20-30 participants independently.

In the end, 233 survey respondents expressed and confirmed their interest in participating in the diary study via the double opt-in process. Of these, 207 were AIP panel members (41% of valid completes), from whom 100 individuals were randomly selected into the diary sample. The remaining 26 were recruited independently from AIP, all of whom were included in the diary sample. Summing across both sets of participants, a total of 126 diaries were mailed and 102 were completed to a satisfactory standard, representing a completion rate of 81%. The completion rate was not substantially different between AIP-recruited participants (82%) and independently-recruited participants (77%).

3.3.3 Household interviews

Interviewees were recruited by asking diary study participants to also indicate their openness to being interviewed. Without additional fees, AIP was unwilling to grant interview access to the diary participants they helped to recruit, and so interviewees were only recruited from amongst the diary participants that I recruited independently. Participation in the interview was incentivized by offering a shopping voucher with value equivalent to 20,000 South Korean won.[7] Interviewees were randomly selected from among the diary participants who opted to be interviewed.

The interviews were conducted with the person who was primarily in charge of filling out the diary and were conducted in a location of the participant's choice in order to ensure that they were in a comfortable setting. Prior to the start of the interview, interviewees were guided through the participation agreement and asked to verbally and explicitly indicate their consent to

[6] Approximately US$81 at the time of the WRAP study. Although this is larger than the incentive I offered for my diary study, pilot testing of the diary suggested that this incentive was sufficiently attractive to generate interest in participating.

[7] Approximately US$18 at the time of the study

participate in the interview. The interviewees were also asked for permission to record the interview; none declined. The interview itself was semi-structured and based on a list of pre-prepared questions that asked participants about their household and details of their daily lives pertinent to meal provisioning and food waste. A semi-structured format was chosen because it would favor a more exploratory approach to the conversation in which participants could be asked to elaborate specific details where necessary. Interviewees were also asked about their experiences participating in the diary study and at the end of the interview, were given the opportunity to ask questions about the study or any related areas of interest. In total, 13 interviews were conducted in this manner. The interview questions are provided in Appendix C.

3.3.4 Informant interviews

The selection of interviews to inform the pre-consumer food waste study was based on theoretical and convenience sampling. Theoretical sampling was performed following a review and mapping of South Korea's FFV distribution system, which helped identify its main channels and players. It was possible to then identify the best actors to interview. The sampling process was, in a way, also convenience sampling because interviews could only be conducted with contacts who responded positively to requests for interviews.

Ultimately, interviews concerning pre-consumer food waste were divided into two groups: those conducted with traditional retailers and those conducted with other actors in the South Korean food distribution system. Interviews with traditional retailers were mostly conducted with the assistance of Dr. Kim Woohyoung, a researcher at the South Korean government's Small Enterprise and Market Service (SEMAS), who also served as a key informant about the status of South Korea's traditional market sector. His assistance was critical for overcoming the difficulties I faced when communicating with traditional market sellers, which resulted from their use of unfamiliar Korean dialect or their aversion to answering questions posed by outsiders. As SEMAS is an agency tasked with supporting and protecting the livelihoods of traditional market sellers, Dr. Kim's presence and introduction as a SEMAS researcher was critical to success of these interviews.

Interviews with traditional market sellers were conducted on 30 March, 2015 at Songhwa Market and on 30 May, 2015 at Shinyoung Market, which are located in Seoul's Gangseo and Yangcheon districts, respectively. These two markets were chosen by Dr. Kim on the basis of his having a relationship with the president of each market's seller association, who was able to introduce us to individual vendors where necessary. Both markets were housed in well-maintained, purpose built structures that appeared to have benefited from several upgrades, including a small car park, café, and community learning center. As such, it is likely that both markets have received more investment than is average for traditional markets in Seoul. However, other than possibly improved customer traffic, the stalls in these markets were mostly representative of the wider traditional market sector with respect to their day-to-day operations.

Upon arrival at the market, stalls selling fruit or vegetables were identified for interviewing. Interviews were only conducted with the owner of these stalls in order to ensure the collection of accurate information about day-to-day operations. Interview questions were asked by Dr. Kim from a pre-prepared list I had shared and briefed him about prior to the interviews. If stall owners were busy or not available, the stall was visited again later during the visit. A total of five fruit

stalls and four vegetable stalls were interviewed this way. Dr. Kim shared his field notes with me after each round of interviews, which I crosschecked with my own for accuracy. Where numbers or facts differed, I deferred to Dr. Kim's notes on account of his native language proficiency. In addition to interviews with traditional market sellers, I also conducted interviews independently with two small family-run grocery stores in Seoul's Gwanak district. The interview questions employed were identical to those used during interviews with Dr. Kim's assistance.

The other group of interviews were arranged via email contact with interviewees, who included a range actors across South Korea's distribution network for FFV, e.g. agricultural cooperatives, wholesale food distributors, and food banks, and academic experts. These interviews were structured according to a list of pre-prepared questions. The exception was Homeplus, whom I only had indirect access to through Dr. Jung Hyejin, a researcher at Seoul National University who had previously led a sustainable consumption study in cooperation with Homeplus. I worked with Dr. Jung to develop a list of questions organized by topic in Korean. This list was sent via email to his contact person at Homeplus and distributed by email to the relevant departments, whose answers were compiled and returned to me by email. Follow-up interviews were then conducted with the relevant Homeplus employees to clarify their responses where required. All interviews, with Homeplus or otherwise, were recorded with permission for later reference and were not incentivized in any way.

The interview questions used for traditional market interviews and Homeplus are presented in Appendix D.

3.3.5 Other data sources

I also supplemented the data collected via the methods described above with data collected from general observation and secondary sources. General observation focused on visiting multiple kinds of food retailers and taking notes on the readily visible aspects of retailers' day-to-day operations. Secondary sources provided additional information to household food waste and pre-consumer food waste. For the former, data from the South Korean census (KOSIS 2015b), Korean Time Use Survey (KOSIS 2015e), and Korean Family Survey (KOSIS 2015c) were downloaded from the South Korean government's official statistics database and used to provide contextual information about food retail modernization and food-related aspects of South Korean consumers' lifestyles. The main sources of secondary data for the case study of pre-consumer food waste included the Korean Agriculture and Fisheries Survey (KOSIS 2015a), statistical yearbooks published by the Ministry of Agricultural and Rural Affairs (MAFRA 2014; MAFRA 2013; MAFRA 2012; MAFRA 2012; MAFRA 2011; MAFRA 2010), Korean academic journal articles, and South Korean news archives.

3.4 Data analysis

3.4.1 Survey data

The survey data were compiled and organized using Microsoft Excel and SPSS in preparation for statistical analysis. This involved labelling, transforming, and recoding variables, e.g. creating dummy variables to represent categorical data and recoding responses to Likert-scale variables such that the direction of their anticipated effects on the dependent variable were consistent with

each other. The dependent variables were created by standardizing participants' estimates of food waste on a per-week basis. As participants could also report food waste in grams or liters depending on the payment system used for volume-based waste pricing, estimates in mass units were converted to liters using average density data for municipal food waste (KOSIS 2015d). Additionally, the reported volumes of food waste were multiplied by participants' estimate of the edible percentage of their food waste stream to produce a measure of their avoidable food waste. The total food waste and avoidable food waste variables were then normalized for household size to produce per-person measures of food waste that were employed as the dependent variables for this portion of the study. The last step in preparing the data for analysis involved removing outliers, which were defined as data points that fell more than 1.5 times the interquartile range above the 75^{th} percentile or below the 25^{th} percentile. After removing outliers and excluding participants who did not answer the question about their food waste quantities, the total sample size was 460.

Statistical analysis of the dependent variables took two main forms: bivariate analyses and multivariate regression analyses. Even with the removal of outliers, the dependent variables had very extreme positive skew and were not normally distributed. As a result, non-parametric methods were chosen when conducting both bivariate and multivariate analyses. When conducting bivariate analyses, Kruskal-Wallis H-tests were used to compare differences in the dependent variables across categorical independent variables, while Jonckheere-Terpstra tests were used to test for relationships between the dependent variables and ordinal independent variables. Lastly, Spearman rank correlation was used to test for relationships between the dependent variables and other continuous variables. For multiple regression, the extreme positive skew in the data created heteroscedasticity regardless of how the dependent variables were transformed, invalidating the use of ordinary least squares regression. As such, the decision was made to instead model the data using a generalized linear model with a gamma distribution and log link function, which is more appropriate for modelling positive-skewed data (McCullagh and Nelder 1989).

The significant departure from normality observed in the dependent variables also meant that the power analysis calculations originally used to inform the target sample size were less applicable due to the assumptions for F-tests and t-tests about normally-distributed sample means. However, statistical research suggests that apriori sample size calculations assuming normality may overestimate the required sample size when the populations are in fact non-normal, including those that fit the gamma, binomial, and negative binomial distributions (Cundill and Alexander 2015). As such, it was probable that the final sample size for the survey data still provided sufficient statistical power for the purposes of this study, where "sufficient" is defined as 0.80 (Cohen 1992).

3.4.2 Diary data

In total, 102 Seoul households completed the diary study in a satisfactory manner. This was determined based on whether the participant followed instructions to always include units when recording food waste quantities and made sure to indicate occasions when no food was discarded and why, thereby leaving no blank pages. Each household's diary entries were transcribed in English and Korean into a spreadsheet for analysis. The food waste quantities that participants recorded were converted into grams where participants had provided descriptive units (e.g. peel

from one banana). These unit conversions were made based on internet research about the typical mass and/or compositional data for these foods. Food waste recorded in volumetric units was converted into unit mass using densities that depended on whether the food waste described was closer to solid or liquid form. A list of the assumptions used is provided in Appendix E. Based on the participants' descriptions, diary entries were organized and coded according to the categories shown in Table 3.3. These codes are based on an initial set of codes that were reevaluated and refined during the coding process.

Table 3.3 Food waste categories

Avoidability	Preparation state	Reason for discard
Avoidable	Prepared	Preference
Potentially avoidable	Unprepared	Spoilage
Unavoidable	Previously prepared	Old
		Date
		Leftover
		Inedible
		Other

The avoidability of food waste was determined based on whether it was considered currently or previously edible. If not, it was considered unavoidable (e.g. peach seeds or crab shells). Items eaten only by some South Korean households were classified as potentially avoidable (e.g. potato peel). A household with a high percentage of avoidable food waste has more potential to reduce its food waste than one with a low percentage.

Preparation state describes whether food was thrown away before being cooked, served, or prepared for consumption in any way. The most common benchmark used to determine the preparation state of an item was whether it was discarded straight from storage or after it was prepared, cooked, or served. For instance, expired food items were considered to be "unprepared." On the other hand, leftover rice discarded after a meal was considered "prepared" food waste, as was a banana peel thrown away after eating. Items that were discarded from storage but had previously been cooked and/or served were coded as "previously prepared" (e.g. week-old leftover curry). Coding items according to their preparation state helped to assess the extent to which a household is able to make use of food before it spoils or is otherwise deemed unfit for consumption. High proportions of unprepared food waste in a household may be an indication of chronic over-purchasing behavior.

Each item of food waste was assigned a reason for discard based on the explanation provided by the participant household.

Table 3.4 below provides further information on how these reasons were assigned.

Table 3.4 Description of reasons for discard

Reason	Description
Preference	Food discarded due to personal preference and/or habit, such as not liking the taste, food that an individual does not eat, food not eaten due to health reasons, small amounts of food habitually left behind
Spoilage	Food discarded because it was moldy or was declared by participants to smell and/or taste strange
Old	Food discarded because the participant deemed it to have been in the fridge for too long or otherwise unfit for consumption (e.g. stale biscuits)
Date	Food discarded because the participant observed that it wa past its sell-by date, regardless of whether it had gone bad or not
Leftover	Food discarded because the participant served too much food, stated there was too much food, or that they could not finish everything
Inedible	Food discarded because it was deemed inedible by the participant
Other	Food discarded for miscellaneous reasons, e.g. remnants in containers, residues from sink strainers, or food accidentally spilled or burned

Lastly, where the food discarded was originally obtained was recorded as one of the following: supermarket (including department store supermarkets), hypermarket, family market (including other independent retailers), convenience store, traditional market, take-out/delivery, internet shopping, and "other." Entries where participants failed to indicate the source of food were recorded under a ninth category, "unaccounted," which was excluded from analysis.

Two supplemental categories were also created: "modern" retailers, which included supermarkets, hypermarkets, and internet shopping, as well as "traditional" retailers, which included family markets and traditional markets. These categories were used in the analyses to facilitate direct comparisons between modern and traditional forms of grocery retail and thereby inform the hypotheses of this dissertation. Convenience stores, take-out/delivery, and "Other" sources were excluded from these two supplemental categories as they are not conventional sources of groceries and fulfill a comparatively smaller proportion of consumers' grocery shopping needs.

Ideally, analysis of the diary data would have provided evidence that food discards as a percentage of purchases varies systematically according to where it was obtained. However, this would have required households to also record all their food purchases and their quantities during the study period, which would have created an unfeasibly high level of participant burden. Instead, this part of the diary data analysis relied on comparing average compositions of food waste, e.g. the percentage of food waste that was unprepared, across different retail types. The hypotheses proposed that retail choice influences household food waste by increasing the likelihood of over-purchasing and consequently, the chance that food is discarded because it has spoiled, is old, or is past its sell-by date. With this in mind, analysis of the diary data primarily focused on avoidable food waste and unprepared food waste that was discarded for the reasons of "spoilage," "old," and "date."

Two statistical techniques were used for this analysis. Due to the non-normal nature of the data, conventional statistical testing, such as t-tests, were not valid. Therefore, Wilcoxon signed-ranked tests were used. To mitigate potential bias from relying solely on mass data, count data were also analyzed. Count data treated each diary entry as an occurrence of food waste and then

categorized and counted the number of these occurrences according to the coding schemes described above. Because mass percentage comparisons undertaken using households as the unit of analysis suffered from a low number of cases for certain comparisons, the analysis of count data treated each food waste occurrence as independent of households in order to maximize the number of cases available for comparison. Based on these count data, odds ratio analyses were applied to compare the odds (i.e. likelihood) that food waste from different sources was discarded in a particular state of avoidability or preparedness and for different reasons.

3.4.3 Combined survey and diary data

The data on food waste obtained from the diary study were much more detailed than recall-based measures of food waste collected during the survey. As such, analyzing food waste data from the diary in conjunction with data about participants' characteristics, attitudes, and behaviors from the survey was anticipated to yield further insights into the reasons for household food waste. Specifically, the aim was to test whether food waste discarded as a result of over-purchasing was affected by parameters governing households' grocery shopping trips, such as visit frequency, travel time, and mode choice. Bearing these goals in mind, six measures of food waste from the diary data were chosen for analysis in conjunction with independent variables obtained from the survey (see

Table 3.2). Three different regression techniques were used in order to appropriately model these different measures of food waste, and these are listed in Table 3.5.

Table 3.5 Summary of dependent variables and regression techniques

Dependent variable	Regression technique
Avoidable mass of food waste per person	Generalized linear model: - Gamma distribution - Log link function
Percent avoidable FW	Generalized linear model: - Binomial distribution - Logit link function
No. of avoidable food waste discards	Negative binomial regression
Unprepared mass of food waste per person	Generalized linear model: - Gamma distribution - Log link function
Percent unprepared food waste by mass	Generalized linear model: - Binomial distribution - Logit link function
No. of unprepared food waste discards	Negative binomial regression

As with the survey data analysis, the statistical power achieved when analyzing the combined survey and diary study data was deemed sufficient. This was established based on the outputs of previously performed power analysis and findings from prior research indicating that apriori sample size calculations tend to overestimate the required sample size when assuming normality for population data that are in fact distributed according to other distributions (Cundill and Alexander 2015). This is true for the gamma, binomial, and negative binomial distributions, all of which were used in generalized linear models to analyze the survey and diary data.

3.4.4 Interview data

Analyses of qualitative data were performed for the household food waste case study as well as the pre-consumer case study. In both cases, the analyses conducted were informal, i.e. without the use of systematic coding or thematic analysis. Instead, interview content was examined with the specific aim of collecting anecdotal evidence that would be illustrative of the possible linkages between household food waste and grocery shopping trips' and food retailers' characteristics. Anecdotal evidence garnered from the interviews also helped to guide quantitative data analysis and aided the interpretation of its results. Evidence identified in this manner was loosely organized into a combination of categories derived from my theoretical framework and identified when conducting and analyzing the interviews (Table 3.6). Organizing the data into these categories helped gauge the extent to which the interviews supported the objectives of the interviews and provided evidence for the hypotheses being tested.

Table 3.6 Categories of anecdotal evidence

Identified during:	
Theoretical framework development • Mode choice • Travel time • Shopping frequency • Packaging (type and size) • Marketing • Retailer-consumer relationship • Leisureliness	Interview data collection and analysis • Family provision • Healthy diet (infant/adult) • Organic food • Thrift

The qualitative data collected in support of the pre-consumer food waste case study were relied upon to document the differences in the characteristics of modern and traditional retailers' supply chains, operations, and food waste generation. As these data were collected during interviews that did not necessarily make specific reference to retail modernization or other actors in the food distribution system, synthesis and interpretation were required in order to situate the data more neatly within the context of retail modernization. Doing so permitted me to assess and speculate on the ramifications of my findings.

3.4.5 Secondary data

Secondary data analysis was performed using Microsoft Excel on two separate occasions. The first involved the analysis of aggregated data from the Korean Time Use Surveys conducted in 1999, 2004, 2009, and 2014 (KOSIS 2015e). The main objective of this analysis was to identify any discernible trends in the frequency of South Korean households' grocery shopping trips and was made possible by the existence of data on the percentage of households who indicated shopping for "household-related purposes" over the full course of a day, at the resolution of 10-minute intervals and differentiated according to weekdays, Saturdays, and Sundays. Additionally, it was possible to further divide the data according to the respondents' gender and marital status. The analysis consisted of plotting these percentages against the times of the day, overlaying the resulting graphs for 1999, 2004, and 2009 data, and comparing the patterns observed across the day of the week, marital status, and gender. The results of this analysis are presented as part of Chapter 4.

The second analysis of secondary data was conducted with the aim of estimating the quantitative difference in pre-consumer food waste between traditional and modern retailers, so as to supplement the qualitative data obtained via interviews. To achieve this comparison, outflows of food waste from the main stages in the FFV distribution network were estimated using an analytical framework based on material flow analysis (MFA)—the "systematic assessment of the flows and stocks of materials within a system defined in space and time" (Brunner and Rechberger 2004, 3). In the context of this analysis, the "system" in question is the South Korean distribution system for FFV. System boundaries were assumed to be "farm gate to retail," which spans the processes beginning immediately after harvest up till the point that consumers buy the FFV from retailers.

Utilizing pre-existing data from 2010 on FFV transactions in South Korea's various distribution channels (Park and Kim 2013) and percent estimates of waste generation at each stage in the

system collected from interviews, it was possible to calculate the outflows of FFV waste from each stage for modern and traditional retailers. The details of the analysis are best discussed following my presentation of qualitative findings regarding pre-consumer food waste in Chapter 8, so I have reserved a more detailed discussion for then. After assessing the model outputs, sensitivity analyses were then conducted to assess the extent to which model findings would be affected by changes to the assumptions made.

3.5 Conclusion

With its use of a mix of quantitative and qualitative data collected from a survey, diary study, interviews, and secondary sources, my research design employs a mixed-methods approach that offers several methodological contributions to food waste research. The first relates to the tactic of asking participants to estimate their food waste using the volume-based food waste pricing system as their frame of reference, which helps to reduce recall bias. This chapter and the last have already illustrated the methodological challenge in quantifying household waste associated with balancing intrusiveness, participant burden, and study costs against bias and errors from self-reporting. There is still no easy remedy to this problem, but the tactic I employed in my survey may significantly reduce recall bias by asking participants to base their estimates on experiences and objects that they are already highly familiar with. This familiarity stems not just from the physical experience of separating food waste for disposal, but also from the salient albeit small financial costs involved. The applicability of this tactic may be limited to contexts in which similar systems for food waste disposal exist, but the concept of referencing physical objects or experiences could still be relevant for future survey-based studies of household waste.

The next contribution of my research design lies in the conceptualization of food waste discards as outcomes of interest with probabilities that vary based on independent variables—for instance, where the food was originally obtained. This permitted odds ratio analysis of my diary data, which compared the probabilities that food were discarded in different states of avoidability or preparation across their respective sources. As a result, it was possible to assess the relationship between retail type and food waste without having to know the actual quantities of food originally purchased by households, thereby overcoming a limitation to the diary data. Odds ratio analysis also provided a means of analysis that was insulated from possible measurement errors and biases in households' diary entries. In this way, analysis of count data helped to compensate for problems associated with mass data, thereby enabling triangulation when analyzing and interpreting the data. Future studies may benefit from analyzing count data in addition to more traditional measures of food waste, particularly if it is sufficient for their objectives to evaluate or predict the probability of food waste occurring rather than the quantity of food waste discarded.

Despite the considerations that have gone into the research design and methodology described above, there remain several limitations to this study. Most of these will be addressed in each of the empirical chapters that follow, but here I aim to discuss a broader issue: the generalizability, or external validity, of my findings. It is important to recognize that generalizability exists at multiple levels. Research can be generalized empirically, theoretically, or both, and while quantitative studies do well with the former, qualitative research designs, including case studies, are better-suited for the generalization and falsification of theory, which include the building, extending, and testing of theory (Tsang 2014).

Let us first examine the household-focused portion of my research from this perspective. Tsang (2014, 377) asserts that "the central objective of empirical generalization is to establish whether there is some sort of empirical regularity in the population concerned." Successfully achieving this objective requires drawing a random sample from the population. Using Tsang's language, the objective of my survey was indeed to establish the existence of particular empirical regularities in Seoul households' food waste patterns. However, the generalizability of my findings will have been limited by the ultimately non-random nature of my sampling methodology. Although recruitment for the survey was random in the sense that AIP sent out invitation emails randomly, the recruitment of its proprietary panel is not random. Additionally, since survey participation was optional, invitees' decisions to participate were highly unlikely to be random, and among those who decided to participate, there could also have been non-random patterns in whether they were prevented from doing so due to a filled quota. These factors reduce my sample's representativeness of the population under study and therefore limit the generalizability of my findings. The diary study faces the same limitations as the survey, but to a greater extent because of the smaller sample involved and the fact that diary participants were recruited from within the survey sample.

It is also important to address the survey and diary studies' findings in the direct context of RQ1, which specified a focus on households in industrialized nations. Although South Korea meets the criterion of being an industrialized nation, this research has shown that, due to the close connections among food waste, food consumption, and social, economic, and cultural contexts, studies of household food waste have a certain level of site-specificity. Consequently, while it remains likely that most drivers of household food waste are shared internationally, their relative importance in different geographic contexts will be different. As such, the findings from my household survey and diary studies may be limited in their applicability to other industrialized countries.

The remaining, more qualitative, sections of this dissertation draw upon a relatively small number of interviews, supplemented by secondary data analysis, to examine the mechanisms behind food waste in households and supply chains. Here, empirical generalizability is very limited by the small sample of interviews in each case. Instead, I propose that my case studies contribute to theoretical generalization and falsification in two ways. The first presents itself in Chapter 4, wherein I describe retail modernization in South Korea and, informed by household interviews, connect it to household food waste by way of social practice theory's concept of systems of provision. Chapter 4, together with the more quantitatively-oriented Chapters 5, 6, and 7, explores and tests the relationships between systems of provision and social practices, thereby contributing to the extension and generalization of social practice theory.

The next route my dissertation offers to theoretical generalization is through its objective of connecting food retail modernization to changing patterns of pre-consumer food waste, which I cover in Chapter 8. This connection is not new, especially if one has reviewed the literature that regularly casts pre-consumer food waste as a problem mostly endemic to the developing world. However, this literature tends to hazily point to urban, economic, and technological development as having shifted the occurrence of food waste down the food supply chain from the pre-consumer to post-consumer stages. To borrow Tsang's (2014) terminology again, this is a

regularity that has been observed empirically across time and space, which might lead one to say that empirical generalization about the relationship between food waste and development has already taken place. But the studies that have contributed to this generalization tend to say much less about the underlying mechanisms, or the "ways of acting of things" (Bhaskar 2013, 13). In developing a case study that connects retail modernization to the widely observed shift in the sites and causes of food waste along the food supply chain, I hope to make a modest contribution to theory building in the areas of food waste and retail modernization alike.

Chapter 4 – Research context: South Korea

4.1 Introduction

As intimated in the introductory chapter to this dissertation, the original observation that sparked the ideas for my research happened in Seoul, South Korea. As such, its selection as the site for my research should come as no surprise. Formally speaking, the reasons for this choice are twofold. The first is South Korea's track record of implementing progressive waste management policies. Borne of the limited land it can spare for landfilling, these policies have culminated in the implementation of mandatory waste separation laws, a slew of waste reduction initiatives, and volume-based pricing systems for general waste and food waste. The extensive educational campaigns the government has run to smooth over the introduction of such laws and policies has increased South Korean society's general consciousness about food waste, which I hoped would benefit my data collection (see section 3.3.1 in Chapter 3). Additionally, the volume-based pricing system is not without its flaws, and it seemed valuable to perform research that might highlight other approaches to addressing food waste in South Korea.

The second reason pertains to South Korea's diverse food retail environment, which signified the ongoing nature of retail modernization and highlighted the opportunity to better connect this macro trend to the issue of food waste. This chapter describes these twin justifications for my site selection in more detail, providing the empirical context for this dissertation's remaining chapters. Following a brief background on urban development in Seoul, I provide a brief history and snapshot of waste management policy in South Korea. I then trace the process of retail modernization in South Korea, from its beginnings to its future outlook. Lastly, I draw upon secondary data sources and interviews with thirteen households to illustrate context-specific connections between retail modernization, other macro trends, and changing food practices not discussed in Chapter 2.

4.2 Background

South Korea, also known as the Republic of Korea, is located in northeast Asia and makes up the southern half of the Korean peninsula. The country has experienced rapid economic growth over the latter half of the twentieth century and has gone from third-world to first in a very short period of time, a phenomenon often referred to as "the miracle on the Han River." As such, living standards have skyrocketed and South Korea now holds the distinction of being the only country that has gone from being a recipient to a donor of foreign aid (U. S. Embassy, 2013). Rising disposable incomes have however been accompanied by the adoption of Western consumerist lifestyles, which has seen consumption grow rapidly as a portion of incomes over time (Nelson, 2006). This has been enabled by globalization and trade liberalization. The visible proliferation of the mainly *chaebol* (conglomerate)-controlled domestic retail chains alongside the influx of Western staples like Starbucks and McDonald's is testament to the growth of the South Korean consumer market.

Seoul is the largest city in South Korea and is the nation's economic, political, and cultural capital. It is home to about 10 million people (approximately 20% of South Korea's 50 million) and covers an area of approximately 600 km^2 (233 sq. miles). Seoul's urban density is among the

highest in the world at over 16,000 people per km^2. The city is governed overall by the Seoul Metropolitan government, which is responsible for long-term master planning. Each of the city's 25 administrative wards (*gu*) is administered by its own local government, which is responsible for implementing the policies established in master planning and has jurisdiction over municipal functions, including waste management. Each ward is further divided into neighborhoods, or (*dong*), which is the smallest administrative division to have its own government office and staff. There are a total of 434 *dong* in Seoul.

South Korea's rapid industrialization and urbanization over the latter half of the 20^{th} century has been focused in Seoul and its surrounding areas, resulting in rapid population growth and outward expansion. A capital city with a 600-year history, Seoul retains a monocentric structure, with its center in the area north of the Han River. Development has transformed the historically residential center of Seoul into its central business district, pushing housing further out and expanding the city's boundary. This also saw the emergence of two other commercial centers in the city, the Gangnam and Youngdeungpo areas, giving rise to Seoul's present polycentric form (M. Jun & Ha, 2002). Continued economic development has also led to extensive outward growth and suburbanization beyond Seoul's historical footprint. In the 1980s, development began spilling into neighboring Incheon city and Gyeonggi province. In order to relieve housing pressures, the central government announced in 1989 the construction of five new towns on Seoul's periphery. Driven by outmigration from Seoul throughout the 1980s, decentralization and growth in these new towns and Seoul's other satellite areas resulted in the agglomeration of the city of Seoul itself, Incheon to its west, and parts of neighboring Gyeonggi province. This conurbation is referred to as Seoul Metropolitan Area (SMA), and has a population of 25 million.

Though scholars often describe these development patterns as urban sprawl, sprawl in the South Korean context does not imply the spread of low-density, single-family housing, as has been the case in the West. Rather, suburbanization has involved continued high-density development, and sprawl is used to refer to poorly planned residential development that free-rides on existing public infrastructure such as highways (Jaeseong Cho, 2005). Bedroom communities, however, remain a characteristic of South Korean sprawl—housing decentralization has outpaced job decentralization, leading to an overall increase in commute times from suburban areas to Seoul (Richardson & Bae, 2011). Commuters make use of several highways, extensive bus services, and subway lines to access central Seoul. Commute distances have also been exacerbated by the controversial, restricted development green belt surrounding Seoul (M.-J. Jun & Hur, 2001; M.-J. Jun, Kim, Kwon, & Jeong, 2013). However, while the jobs-housing balance in the SMA remains a problem, research indicates that self-sufficiency in Seoul's satellite towns has improved for non-work trips (C.-M. Lee & Ahn, 2005).

Future growth plans in the SMA are oriented around continued decentralization in the SMA itself with improved spatial balance as a goal, as outlined in the 3^{rd} Arrangement Plan for the Capital Region (Oh, 2009). The 2020 Master Plan for Seoul highlights redevelopment of key areas in downtown Seoul in order to reintroduce housing into the CBD, as well as several new town projects in other parts of Seoul.

4.3 Waste management in South Korea

Prior to the 1990s, municipal waste in South Korea was entirely disposed of in landfills. However, by the 1990s, the advent of mass consumption, land scarcity, NIMBY-ism,[8] and local opposition to alternatives such as incineration combined to create a situation demanding urgent action by the South Korean government. In 1992, the municipal solid waste stream had reached 75,000 tons per day. On a per capita basis, this was equivalent to 1.8 kg per day, more than the United States' 1.5 kg and nearly double that of other industrialized nations such as Japan (1.0 kg) and the United Kingdom (0.9 kg) at the time (K.-Y. Kim & Kim, 2012). The government responded to these problems with a paradigm shift in which waste reduction, rather than treatment, became the primary policy focus. Under this new paradigm, a slew of policies were introduced to divert waste from the municipal waste stream. In 1991, segregated collection of recyclables and general waste became mandatory by law. Between 1993 and 1994, the government also introduced a deposit-refund system for recyclables, the volume-based waste pricing system, and acts to reduce packaging and the use of disposal goods (K.-Y. Kim & Kim, 2012).

Of these policies, volume-based waste pricing (VBWP) is the most notable because South Korea became the first country to implement such a system on a nationwide scale and in such a short period of time (Hong, 1999a). The VBWP system is administered by local governments and requires prepayment for waste disposal via the sale of officially issued plastic bags. Households and small commercial establishments are legally required to dispose of waste using these bags, which are available in different sizes and priced accordingly. Prices determined by local governments and therefore may vary throughout the country. The VBWP has been highly successful at reducing the quantity of material entering the municipal solid waste stream. In the first full year following its implementation, total household solid waste declined by 25% and collection of source-separated recyclables increased by 27% (K.-Y. Kim & Kim, 2012). Municipal solid waste per capita in 2010, at 0.96 kg per day, was approximately half its 1992 level, and total municipal solid waste has largely stabilized over the past 10 years at approximately 50,000 tons per day (Ministry of Environment, 2014a).

Food waste in South Korea has also presented a significant challenge to waste management. In 1992, total food waste per capita stood at 0.52 kg per day. As with municipal solid waste, this was nearly double the comparable figures for Japan (0.37 kg) and the United Kingdom (0.26 kg) (K.-Y. Kim & Kim, 2012). Food waste generation has declined over the past two decades; in 2011, total food waste per capita was 0.32 kg per day in South Korea (Ministry of Environment, 2011). This decline is attributable to a set of new policies that helped manage food waste at its source. Public campaigns, such as one that urged restaurant goers to reduce their table waste, were introduced, as well as mandatory reduction quotas for restaurants. Beginning in 1997, commercial sources of food waste were required to segregate food waste from other types of rubbish. This law was expanded to cover small businesses and households in 2005, when the government also introduced a ban on food waste in landfills. While these policies have largely halted growth in food waste, there have not been any significant decreases in food waste generation since the introduction of the ban on food waste in landfills in 2005 (Figure 4.1).

[8] "NIMBY" stands for "not in my backyard" and refers to the tendency for people to support the development of projects with negative environmental consequences provided they are not located in their vicinity.

Recent official estimates indicate that the majority of food waste (57%) is generated during distribution and cooking. The remainder is divided up among leftovers (30%), food discarded from storage (9%), and rejected food (4%) (Ministry of Environment, 2014b). This suggests that just under half of all food waste in South Korea can be classified as avoidable. Approximately 54% of food waste is generated by households; this figure rises to 67% in the Seoul Metropolitan Area (Ministry of Environment, 2011).

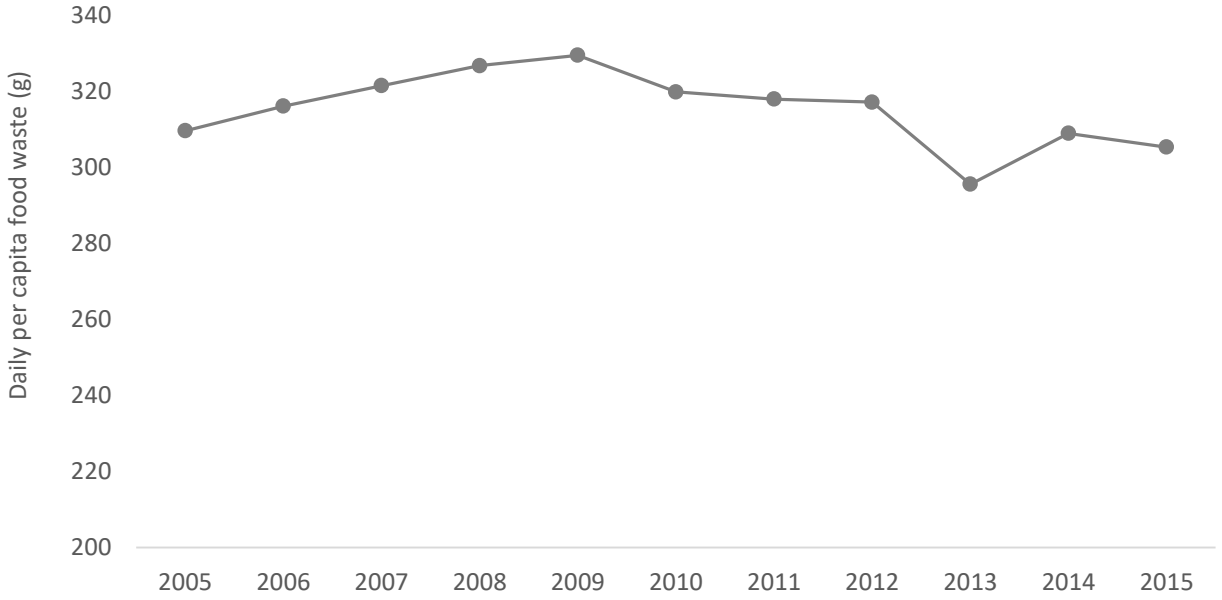

Figure 4.1 Trend in daily food waste per capita in Seoul, 2004-2011 (Seoul Metropolitan Government, 2014)

Following the success of the VBWP system for the general municipal waste stream, the Ministry of Environment began planning the implementation of a VBWP system in 2010 to further reduce food waste at its source. By the start of 2013, 126 of 144 local governments in South Korea had already implemented VBWP for food waste (Ministry of Environment, 2014b). In addition to using volume-rate plastic bags, the VBWP system for food waste makes use of RFID for payment and a sticker system in which residents pay for authorized stickers that qualify their food waste for collection. Local authorities are given autonomy to choose among the three systems. Early results suggest that the RFID system has been successful, with reported reductions in food waste from pilot testing of 54% over two years (Ministry of Environment, 2014b), although data after 2013 do not reflect this.

Despite the historical and anticipated success of the VBWP system for general waste and food waste, respectively, it is not without its limitations. First, enforcing compulsory waste segregation is tricky, and it is unclear how much any decreases in food waste are attributable to reductions in moisture content or illegal dumping, which was reported to have increased following the introduction of VBWP for general waste (Hong, 1999b). Households can also become desensitized to volume-pricing over time without sustained price increases, which are politically unpopular. As waste pricing is determined by local governments, officials seeking

reelection are unlikely to want to raise prices after the initial introduction of the VBWP for food waste in order not to upset their electorate (K.S. Park,[9] personal communication).

Given the potential limitations of the VBWP system, it is worthwhile to continue investigating alternative strategies for waste reduction. The long history of waste reduction policies in South Korea presents a progressive policy environment which may have nearly exhausted the potential of such initiatives. However, as the bulk of this waste policy has been built around individual models of behavioral change (Shove, 2010), research that investigates potential for waste reduction through systemic alterations will be particularly valuable. In particular, it will be worthwhile to understand how system-level influences like systems of provision (SOPs) may be linked to food waste in order to identify further policy options for managing food waste (Evans, 2014). One such SOP is the food retail system, which influences the ways in which households go about purchasing their food and preparing their meals.

4.4 Retail modernization in South Korea

In Europe and North America, supermarkets and hypermarkets[10] are often taken for granted as the default source of groceries. Elsewhere however, the rise of supermarkets and other forms of corporate retail over more traditional food retail has been compressed into a shorter period of time (Reardon, Timmer, Barrett, & Berdegué, 2003), accentuating its effects and creating a more diverse food retail landscape. Known as "retail modernization" or "supermarketization," this process is associated with economic development and the adoption of Western consumerist lifestyles.

South Korea is one country where this has taken place—prior to retail sector liberalization between 1989 and 1996, there were no supermarket chains, and food retailers were mainly comprised of family-run stores and traditional market sellers (Cho, Chun, & Lee, 2013). Liberalization was a government-led initiative to improve productivity and efficiency in the retail and distribution industries (Suh & Howard, 2009); it allowed the entrance of foreign retailers like Carrefour, Wal-Mart, and Tesco, which introduced the novel hypermarket format (Jin & Kim, 2003). Hypermarkets offer not only groceries, but a wide array of products including electronics, clothing, household goods, and appliances, making them convenient "one-stop-shop" locations. Over the last twenty years, the convenience hypermarkets offered has proved growingly welcome to South Korean consumers as urbanization, rising disposable incomes, and female labor force participation in South Korea increased their sensations of time-scarcity and their opportunity cost of time (Hamermesh & Lee, 2007). This has contributed to the growth in popularity of hypermarkets and enabled their rapid expansion (Figure 4.2).

[9] Director, Ministry of Environment, Republic of Korea

[10] Also known as superstores, supercenters, or large discount retailers, hypermarkets combine the sale of groceries with a wide variety of other goods, including electronics, appliances, clothing, and sports goods in stores with large floor areas. Korean law defines hypermarkets as stores having floor areas larger than 3,300 square meters.

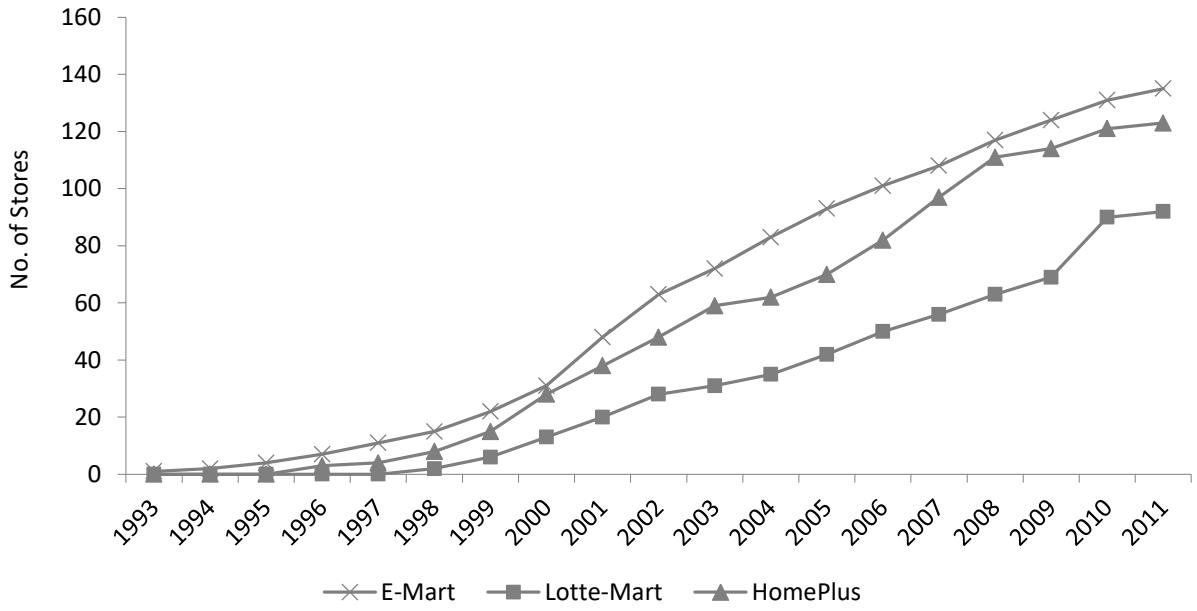

Figure 4.2 Hypermarket growth (includes stores acquired from other chains), 1993-2011 (Adapted from Cho et al., 2013)

The three largest discount store retailers (by number of stores) in South Korea are E-Mart, Lotte Mart, and Homeplus, each of which has rapidly established a significant nationwide presence. However, all the foreign retailers who entered South Korea in the 1990s have since withdrawn, mostly reflecting their failure to accommodate South Korean consumer preferences. Their low-pricing strategies and spartan warehouse-style stores repelled brand-loyal and quality-conscious locals (R. B. Kim, 2008), who prefer attractive product displays, lively sales promotion, and customer service (Gandolfi & Strach, 2009).[11] Korean cuisine is vegetable-heavy, contributing to a cultural preference for freshness that underlines a tendency to shop frequently and buy in small quantities. Western retailers failed to account for this preference (Coe & Lee, 2006) and compounded this mistake by locating in areas not easily accessible by foot (R. B. Kim, 2008). The case of Homeplus throws these particularities further into relief. Originally owned by Tesco,[12] Homeplus successfully localized by placing fresh food displays near store entrances, developing private brands, and cultivating local supplier relationships (Coe & Lee, 2006). Homeplus also pushed the boundaries of one-stop-shopping by providing other amenities, including food courts, art galleries, wine bars, and health clubs (Coe & Lee, 2013). In short, the hypermarket format has taken on a distinctly local flavor in South Korea.

Whereas the expansion of hypermarkets in the West has been linked with undesirable, low-density urban sprawl, this has not been the case in South Korea. Here, hypermarkets are not warehouse-style, single floor, large-footprint developments surrounded by outdoor parking, a format reported to be unfavorable with South Korean shoppers (Ramstad, 2006). Instead, they are often opened as part of larger urban shopping complexes with many other shops and

[11] Costco, with thirteen stores in Korea, is a notable exception to this rule, and its Seoul location was Costco's highest-grossing outlet in 2014 (Fairchild, 2014)

[12] Tesco sold Homeplus to a private investor consortium in September 2015, but this has been attributed more to Tesco's financial difficulties than the poor performance of Homeplus.

amenities, serving as anchor tenants. Parking is generally provided in the form of underground or multi-story car parks. This mode of development is likely to be conditioned by the high-density nature of urban development in Seoul, as well as the need to cater to Korean preferences. Locational characteristics of South Korean hypermarkets are different as well. For example, E-Mart is known to locate its stores in highly residential areas (J. O. Kim & Jin, 2001). Although some research suggests that hypermarket accessibility is dependent on car ownership (Choung & Noh, 2000), the high-density nature of urban development and need to cater to South Korean shopper preferences nevertheless precludes the assumption that the impacts of hypermarket entry into the urban retail environment has had identical impacts on the urban fabric as in the US.

South Korea's retail modernization has also involved chain supermarkets and convenience stores. Following their successes with the hypermarket format, the local "big three" of Emart, Homeplus, and Lotte Mart began opening supermarkets in the mid-2000s. Dubbed "SSMs" (super-supermarkets), these are sized[13] between hypermarkets and family-run stores. SSMs sell food and household products, employing a strategy that balances product selection, prices, promotions, and customer service (Moon, 2010). The number of SSMs in South Korea grew from 273 in 2005 to 699 in 2009. Finally, chain convenience stores are the latest trend in the South Korean grocery retail sector, and are distinguished by their small size[14] and extended opening hours. Although previously selling sundries and ready-to-eat food, convenience stores now increasingly stock fresh foods like eggs, vegetables, and fruit. As with South Korea's hypermarkets and supermarkets, convenience stores are predominantly owned or franchised by corporate retailers.

Although research in other parts of the world remains divided over the full extent of the impact of hypermarkets and retail modernization on traditional retailers, the picture may be clearer in South Korea. Studies investigating competition among hypermarkets, SSMs, and traditional markets have found that modern grocery retail formats have had negative impacts on traditional markets (W. Kim & Hallsworth, 2013; Sudong Lee & Kim, 2013). In 2014, hypermarkets, supermarkets, and convenience stores accounted for 73% of grocery retail revenues, and traditional market sellers and family-run stores (collectively "traditional retailers") held the remainder (Euromonitor, 2016).

Traditional retailers' shrinking market share and the ensuing backlash against corporate retailers (Choe, 2012) has prompted government regulation of corporate retailers, along with investments to upgrade traditional market facilities. For example, hypermarkets and SSMs in Seoul must close on two days every month and may not operate between midnight and 8 am (traditional markets tend to close around 8 pm while family-run stores sometimes close as late as midnight). Hypermarkets and SSMs have also been barred from opening within one kilometer of traditional market areas (Distribution Development Industry Act, 2012; Song, 2012). The South Korean government's Small and Medium Business Administration has heavily funded renovation and upgrading of traditional market facilities to improve their attractiveness to consumers (Sudong Lee & Kim, 2013). Although these regulations have helped sales at traditional markets (W. Kim & Hallsworth, 2015), some family-run stores have been converting their shops into franchised convenience stores in order to survive (Cho et al., 2013). Corporate retailers have also begun moving into the less-regulated convenience store segment, prompting accusations of opening

[13] Defined according to Korean law as having floor area between 330 and 3,300 square meters.
[14] Defined according to Korean law as having floor area less than 330 square meters.

"mini-SSMs" in the guise of convenience shops in order to bypass regulations (S. Kim, 2013). Internet grocery retailing is also expected to become increasingly important (Euromonitor, 2013), with many large retailers offering mobile and internet shopping options with rapid delivery times. Though the eventual outcome of food retail competition in South Korea's urban areas remains uncertain, the impact of corporate retailers has been significant.

The impact of corporate retailers on the South Korean grocery retail market will have had a similarly important impact on the behavior of South Korean shoppers. Practice theory permits us to conceptualize the shift in the food retail landscape as bringing about changes in the practice of household provisioning and meal preparation. Of the three elements of practice—meaning, materials, and competence (Shove & Pantzar, 2005)—there are clear changes to the meaning and materials of household provisioning and meal preparation. Purchasing groceries is no longer understood simply as an act of household provisioning, but is now imbued with meanings of leisure and a sense of significance in a global marketplace. For example, research has found that South Korean consumers shop at hypermarkets not only to buy goods, but also as an experiential, leisure activity (Jin & Kim, 2003) that encompasses grocery shopping.

The new retail format also represents a change to a physical system of provision: hypermarkets are physically worlds apart from traditional markets and neighborhood supermarkets. This change is accompanied by the way in which complementary infrastructures fit into individual practices of provisioning. The altered materiality of practices is also evident in the differences in products sold in hypermarkets—qualities, quantities, packaging, and pricing are all different from traditional markets. Finally, the one-stop-shop nature of shopping at hypermarkets also alters the time dimension of these practices—time spent grocery shopping becomes less homogeneously distributed and increasingly clumped together in larger and less frequent occurrences.

One other, less-explored avenue by which grocery retail modernization in South Korea impacts consumer practices is through online grocery shopping and delivery services. Online shopping is popular in South Korea, in which online sales comprise a larger percentage (5%) than they do in the US (2.7%) of total retail sales, despite lagging the US in internet usage (Jin, Park, & Kim, 2010). Despite the popularity of internet shopping due to its speed, ease, and variety of goods available, it is unclear whether this trend will take off for groceries, due to concerns over freshness, being at home to receive deliveries, and the inability to pick and choose items like fresh produce (Geuens, Brengman, & S'Jegers, 2003). However, corporate retailers in South Korea have begun investing more in their online storefronts (Euromonitor, 2013), and HomePlus famously implemented virtual stores which allowed commuters to order groceries while waiting at bus and subway stations ("Tesco builds virtual shops for Korean commuters," 2011).

It is also important to note that delivery service is not limited to online purchases. South Korean shoppers generally expect free delivery of groceries purchased while in-store, and that small-scale grocery retailers have widely provided this service (Min, 2004). As such, hypermarkets and supermarkets provide this service for free as well. This has several potential ramifications for per trip purchase deliveries and trip modes. In contexts where this option is not available, consumers are limited in the quantities they can purchases by how much they are willing to carry home. As grocery shopping trips have declined in frequency and increased in per trip quantities as retail

modernization has proceeded, grocery shopping has increasingly required a car, being the most convenient way to transport groceries. However, with free deliveries for in-store purchases, consumers no longer have to carry their purchases home, making it easier for them to take public transport. On the other hand, it is much easier for consumers to purchase food in excess amounts, with possible consequences for household food waste.

By describing recent changes in the South Korean grocery retail sector, I have sketched the distinctive nature of the SOPs that undergird South Korean households' food-related practices. The question that follows is what this ongoing, South Korean flavor of retail modernization has meant for food-related practices among Seoul's households, and what this entails for food waste. It is also relevant to ask how SOPs are responding to or shaping food-related practices, and how everyday life might simultaneously shape and be shaped by SOPs. In the next section, I will use Korean Time Use Survey (KTUS) data to assess trends in the temporal and demographic dimensions of food-related practices, link these changes to South Korea's retail modernization, and finally discuss the implications for food waste.

4.5 Changing food practices

In order to understand changes in food-related practices over time, I examined KTUS data between 1999 and 2014. First, I attempted to assess the possibility that South Korean shoppers are increasingly shopping less often (for example, once a week versus two to three times a week) and buying more per trip. This could be reflected in a shift over time in the percentage of people shopping for groceries on weekdays to the percentage shopping on weekends and for longer durations. Figure 4.3 shows the increase in the *percentage of people shopping on weekends over most times of the day.*

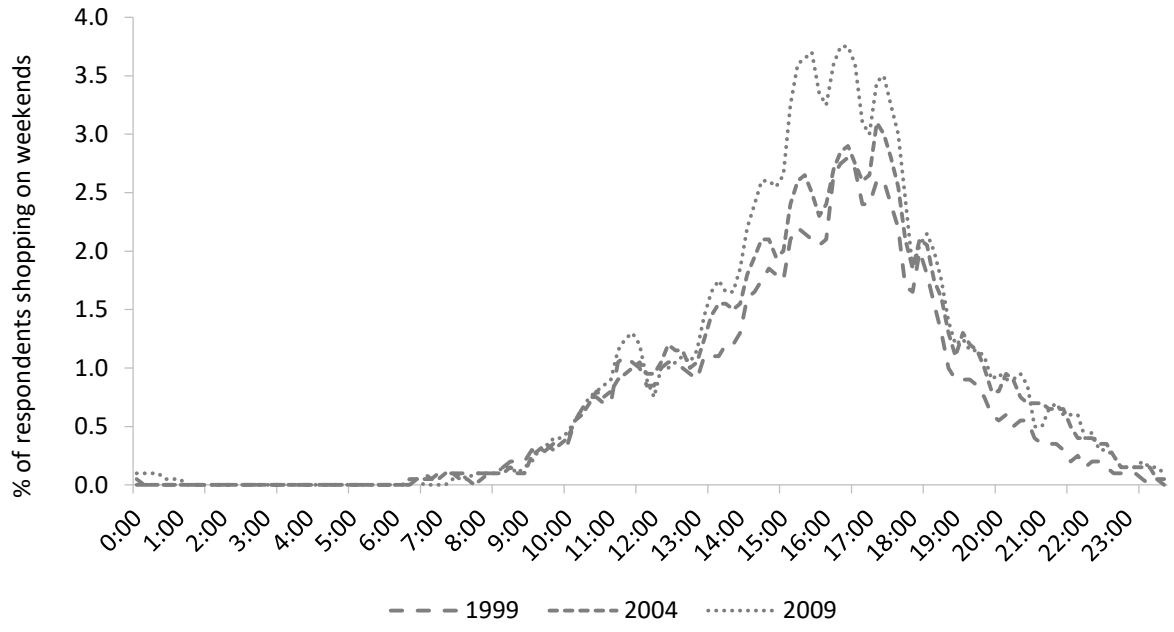

Figure 4.3 Percentage of respondents (aged 10+) who reported spending time shopping for household-related purposes at different times on weekends (Korea Time Use Survey 1999, 2004, 2009)

However, an increased tendency towards once-a-week weekend shopping trips would be accompanied by a decreased percentage of people shopping on weekdays, which is not supported by the data (*Figure 4.4*). Conversely, this percentage has increased marginally over the period shown. This suggests that South Korean consumers are still shopping several times during the week while adding weekend trips, or that any trend towards once-a-week weekend shopping among some has been confounded by an increasing tendency among others to shop on weekdays.

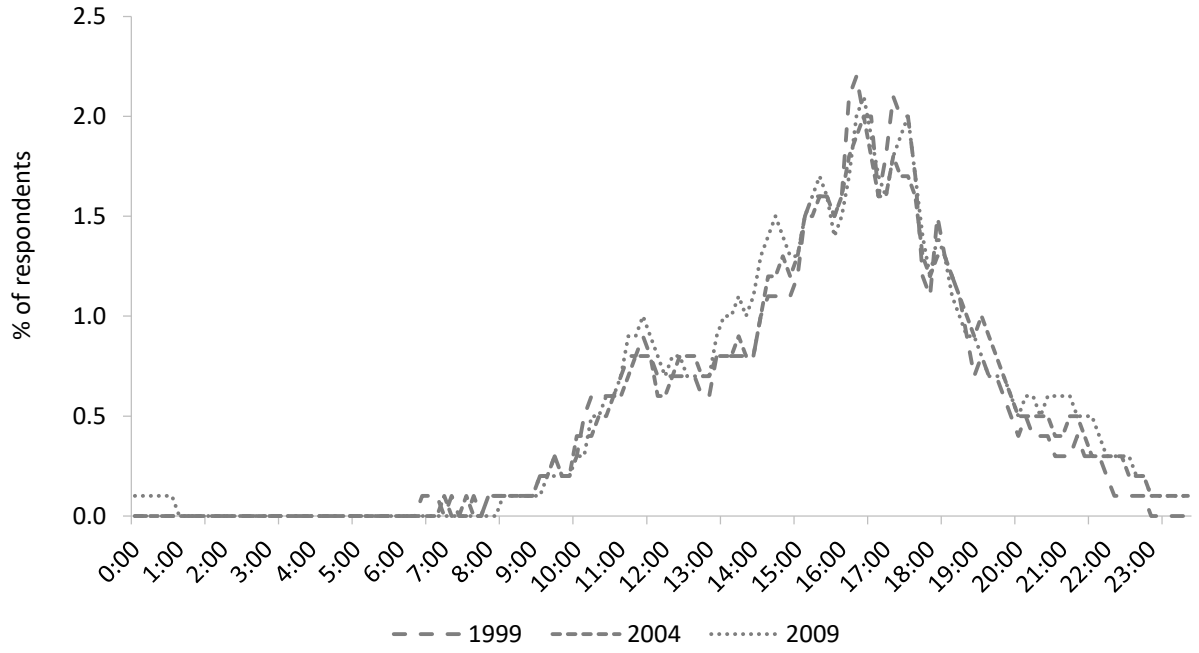

Figure 4.4 Percentage of respondents (aged 10+) who reported spending time shopping for household-related purposes on weekdays (Korea Time Use Survey 1999, 2004, 2009)

Examining disaggregated data provides further insights.

Figure 4.5 compares weekday shopping patterns for unmarried and married shoppers, revealing minor changes in the percentage of married people shopping during the week and an increase in the percentage of unmarried people shopping on weekdays. This suggests that married shoppers are not giving up on weekday shopping trips, while unmarried shoppers are increasingly going to stores on weekdays.

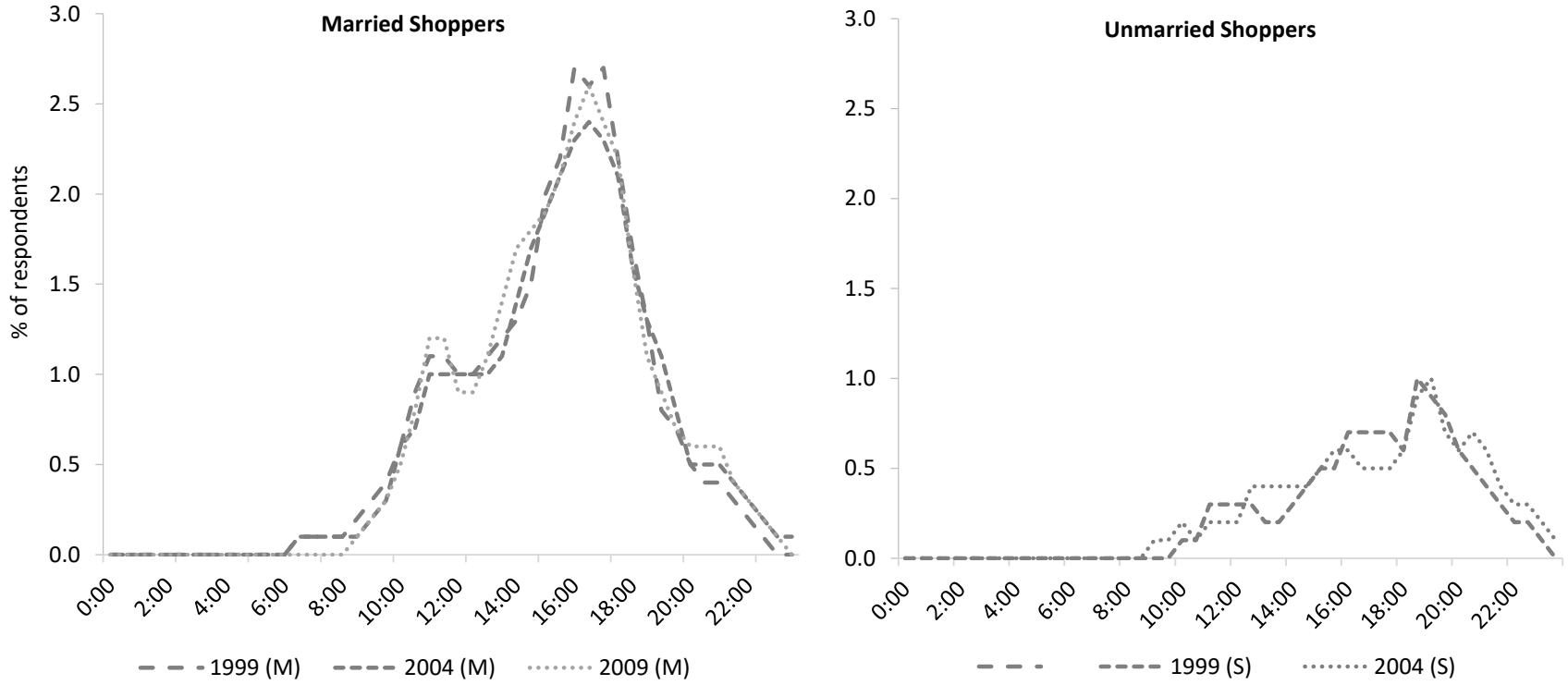

Figure 4.5 Percentage of married (M) and single (S) respondents (aged 20+) who spent time shopping for household-related purposes on weekdays (KTUS 1999, 2004, 2009

The increase in shopping taking place after 8pm is noteworthy, as it reflects how South Koreans are increasingly utilizing the modern retailers' longer opening hours. Unlike traditional markets, which rarely stay open past 8 or 9 pm, hypermarkets and SSMs usually stay open until midnight, and convenience stores are open twenty-four hours. These extended hours are crucial in light of how South Koreans work some of the longest hours in the (Sangheon Lee, McCann, & Messenger, 2007) and face ever longer commutes (Jun, Kim, Kwon, & Jeong, 2013). Office culture also often demands that workers socialize over drinks in the evenings, even during the week, meaning workers may not have time to buy groceries until late after work. Modern grocery retailers' extended hours ease the temporal restrictions on when consumers do their grocery shopping, making it easier for them to fit the practice of grocery shopping into their everyday schedules. Extended opening hours may also have unanticipated effects on shopping practices. Two fifty-something housewives I interviewed, Mi-young and Young-sook,[15] described how they not only shopped several times during the week, but also at multiple venues for the ingredients deemed best at each location. However, they also enjoyed shopping in the evenings after dinner. This was not due to any time constraints, but because the evening clearance discounts offered by retailers offered the thrill of bargain-hunting. These observations and the above data suggest how the temporal characteristics of SOPs can shape food-related practices in expected and unexpected ways.

Besides extending their opening hours, modern grocery retailers have also adapted to South Korean workers' long working hours and busy lifestyles in other ways. In particular, Homeplus drew international attention by experimenting with virtual grocery stores, which involved pasting displays of shelved grocery items in Seoul's subway stations and bus stops. This allowed commuters the chance to purchase needed items with their mobile phones while waiting for their bus or train. Items purchased this way before 1 pm would be delivered the same evening ("Tesco opens world's first virtual store," 2011). In a sense, this innovation is an outgrowth of the broader culture of home delivery that pervades the South Korean grocery sector. Given a minimum amount spent, free home delivery is widely available from physical store locations, not only from hypermarket and SSM chains, but also from family-run grocery stores. This allows South Korean consumers to walk to the grocery store while freeing them from having to carry their groceries home. Such delivery services and innovations such as Homeplus' virtual stores, together with extensive online shopping options and high overall walkability mean that South Korean consumers benefit from unprecedented convenience and access when it comes to grocery shopping.

Concurrent with the rise in percentages of unmarried shoppers on weekdays, the percentages of married and unmarried people shopping on weekends have increased (Figure 4.6). Interestingly the percentage of married men shopping on weekends grew from 12% in 1999 to 21% in 2014. Since weekday shopping trips have not declined, this increase suggests that the additional weekend shopping trips may represent opportunities for leisure and/or family bonding rather than reflect any transition towards once-a-week grocery shopping. With the efforts made by hypermarket chains such as Homeplus to increase the array of services and products offered in their stores, traditional retailers struggle to compete with hypermarkets in terms of providing an integrated venue for family leisure. As early as 2003, 46% of South Korean hypermarket

[15] I have used pseudonyms to preserve anonymity for all interviewees.

shoppers were found to have been motivated by leisure or socialization (Jin & Kim, 2003), and the data in Figure 4.6 may reflect this.

Interestingly, there has also been an increase in the overall proportion of unmarried people who indicated shopping for groceries at all (

Figure 4.5 and 4.6). This may be related to growth in the number of single-person households, which has increased from 9% to 25% of the population between 1990 and 2010 as a result of urbanization, later marriage, low fertility, and rising divorce rates (Y. Kim, 2014). There has also been growth in the percentages of unmarried men and women who spent time preparing food at home from 15% and 29% in 1999 to 22% and 32% in 2009, respectively. These trends have been attributed to the recent popularity of cooking shows (Gallup Korea, 2015). Single-person households are an attractive customer group for retailers, and as such these trends are likely to drive adaptive changes in modern retailers' operations and promotional campaigns.

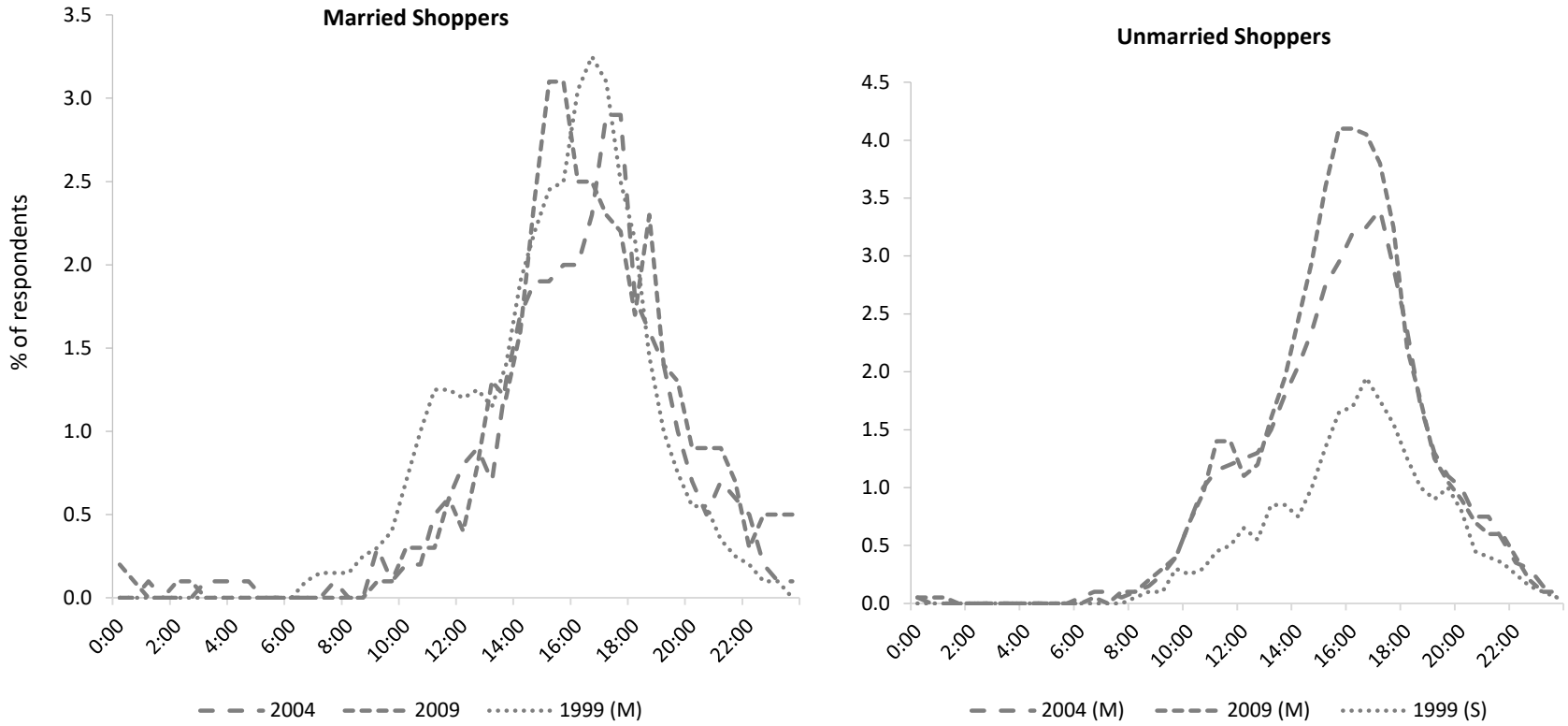

Figure 4.6 Percentage of married (M) and single (S) respondents (aged 20+) who spent time shopping for household-related purposes at different times on weekends (Korea Time Use Survey 1999, 2004, 2009)

Shrinking South Korean households and the growing tendency among unmarried consumers to cook at home increases the tendency for packaging sizes to exceed consumers' needs. When consumers are forced to buy food in greater quantities than needed, the result is often the spoilage of partially used ingredients—one way Western supermarkets are blamed for food waste (Graham-Rowe, Jessop, & Sparks, 2014). In the South Korean case, however, these trends have been noted by modern retailers, who have expanded their offerings of ready-to-eat convenience foods and food packaged into small portions, particularly spoilage-prone fruits and vegetables (B. Kim, 2013). As such, it is common to see half an onion sealed in a vacuum pack for sale in convenience stores, SSMs, and hypermarkets alike. This response not only reflects how SOPs are mutable and responsive to broader change, but also illustrates the connections between small and large-scale SOPs. Selling food in smaller portions addresses not only the smaller quantities consumed by single-person households, but also the smaller scale of these households' kitchen infrastructure—smaller refrigerators and cupboards provide limited storage space, while cramped kitchens with small surfaces often make elaborate food preparation more trouble than it is worth.

The 2014 KTUS data also revealed the extreme gender division of labor in South Korean households. Just 20% and 15% unmarried and married men, respectively, reported spending any time preparing food. In contrast, whereas 27% of unmarried women reported spending any time preparing food, the equivalent figure for married women was 88%. The gap was no smaller amongst dual-income couples, among whom the figures were 88% for wives and 13% for husbands. Motherhood further increased the extent to which married women prepared food at home regardless of employment status—a prior study based on 1999-2009 KTUS data found maternal employment actually increased the probability that working mothers spent time on food preparation, albeit for shorter durations than non-working mothers (Chang & Lee, 2012).

These data reflect several characteristics of South Korean domestic life that contribute to time stress experienced by Korean women. Korean men have traditionally not helped out with household chores as they were historically forbidden from entering the kitchen (Y.-O. Lee, 2005). South Korean women thus face heavy expectations to cook for their families (Bak, 2014), regardless of employment status. The time-stress these expectations create is potentially exacerbated by the characteristics of the Korean diet. Unlike other Asian countries that experienced rapid economic development, South Korea's dietary transition towards increased fat and carbohydrate intake has been very slow; instead, vegetable consumption has remained high, reflecting an adherence to the traditionally low-fat and vegetable-heavy Korean diet (H.-S. Lee, Duffey, & Popkin, 2012).

This has been attributed to South Koreans' conservative food attitudes, government policies, and government-initiated movements that promoted traditional Korean cuisine in order to address dietary health concerns and ensure continued support for local vegetable production. These efforts involved cooking training for housewives, nutritional education, and mass media campaigns (M.-J. Lee, Popkin, & Kim, 2002). However, preparing vegetables is highly time and labor-intensive due to the need for extensive trimming and peeling by hand. Korean cuisine is also notable for its wide array of side dishes, or *banchan*, which vary from region to region and are traditionally meant to harmoniously complement each other when served (Oum, 2005). The

wide range of ingredients and knowledge required make Korean cooking a time-intensive endeavor.

The nature of Korean cooking and the expectations faced by Korean women illustrate how food-related practices "outcompete" other practices for places in their daily schedules. Prior research suggests that in terms of food choices, people respond to increased time scarcity in several ways, including eating faster, limiting mealtimes, and using time-saving substitutes (Jabs & Devine, 2006). The latter might include eating out, ordering in, or buying convenience foods. The 2010 Korean Family Survey (KFS) of 2,063 households found that 65% and 62% of couples with children and married couples, respectively, cooked homemade meals at least once a day. Twenty eight percent of KFS respondents identified cooking duration as the biggest challenge to cooking at home, but only 11% of respondents listed not having enough time as the main reason for eating out (KOSIS, 2015a). These data suggest that South Korean households are persisting with home-cooked meals. However, working wives spent twenty-one fewer minutes on average than housewives on food preparation (KOSIS, 2015b), which suggests they are taking advantage of time-saving devices or preparing simpler meals when cooking at home.

Among the time saving opportunities are the new forms of food provided by modern retailers: hypermarkets and SSMs increasingly sell fruits and vegetables in pre-washed, pre-trimmed, pre-peeled, or pre-sliced packages. Although the concept is not new to Western supermarkets, a glance at the "convenience vegetables" for sale reveals the extent to which South Korea's modern grocery retailers have taken this concept (Figure 4.7). For example, beyond pre-washed salad mixes, one can find pre-diced sweet potato and pumpkins, pre-shredded and pre-seasoned spring onions, and a pre-diced vegetable mix specifically for use in Korean omelets. In the fresh meat and seafood sections, one may purchase trays of ingredients in the right proportions for use in stews. Fresh ready-to-eat foods on sale are also not lacking in variety, and there is a dizzying variety of pickled and fermented vegetables. Rather than being protected behind glass counters, these are heaped on large open trays, emulating the displays of traditional markets.

Figure 4.7 "Convenience vegetables" and prepackaged salads on sale at Homeplus

Besides modern retailers, relatives form another SOP that provides significant convenience to single-person households and married South Korean women. It is common, for mothers and mothers-in-law especially, to continue cooking and giving food to married children who live separately, often because they are too busy to prepare food for themselves. According to Bak (2014), this act helps Korean mothers maintain a sense of connection to their children. This is not only gratifying, but may also serve as a source of power. Bak (2014, 26) provides a case in point with her analysis of *kimchi* and social relations:

> *For younger married couples, when both side's mothers are willing to provide kimchi, things can become competitive between the two mothers. One male college professor confessed that he and his wife always have too much kimchi in the refrigerator. To solve this problem, they give the excess kimchi to friends. They simply could not tell either of the mothers to stop giving them kimchi.*

Many of my interviewees told similar stories, although the motherly menus expanded well beyond *kimchi*. Most live alone in Seoul and receive food every few months, either via delivery services or a visit. The standard care package for Seo-yoon, a working professional who lives on her own, includes pre-prepared *banchan* and fresh ingredients like onions, sweet potatoes, potatoes, spring onions, cucumbers, and zucchinis. Ji-min, a university student, normally receives a month's supply of *banchan* in addition to frozen meat. Such examples reveal the key role that families play in supporting or substituting food practices among South Korean households; as household sizes continue to shrink, these alternate systems of provision are only likely to grow in importance.

As covered in Chapter 2, prior research has suggested that supermarkets and refrigeration led to a convergence in grocery shopping patterns towards high-volume, once-a-week trips (Watson, 2012), and that this may lead to increased food waste due to the challenges of storing large quantities of perishable food (Williams, Wikström, Otterbring, Löfgren, & Gustafsson, 2012). Examining KTUS data in conjunction with my interview and observational data suggests that even if true in the West, this may be an oversimplification of South Korean consumer lifestyles. Albeit a small and non-representative sample, none of my thirteen interviewees had adopted such a pattern, nor did any indicate only ever patronizing a single retailer.

It instead appears that South Korean consumers may utilize a range of different retailers when shopping for different foods, and at varying frequencies. This illustrates the significance of the diverse South Korean food retail landscape. Furthermore, the role of related SOPs, such as the transportation system, is highlighted not only with the example of Homeplus' virtual grocery stores, but also when considering how almost all my interviewees walked or used public transportation and shopped close to home or on their way home from work. In this way, South Korean consumers' cultural tendency to shop frequently (Coe & Lee, 2006) is supported by urban development patterns that feature high physical accessibility to food. However, without being able compare quantitative food waste data across different shopping patterns within the same sociocultural context, it remains to be seen whether higher-frequency shopping patterns are associated with less food waste.

Although South Korea's retail modernization may not have sparked convergence in shopping patterns, the emergence of hypermarkets in particular has encouraged people to use grocery shopping as an opportunity for leisure. Here, the implications for food waste lie in the possibility that spending more time in a store with leisure as the primary mindset could increase the risk that consumers buy more than needed. In particular, consumers who are grocery shopping for pleasure may have less concrete purchasing goals before entering the store, which may promote impulse purchases (Bell, Corsten, & Knox, 2011). Furthermore, food shopping contexts such as store layout, shelf arrangements, music, lighting, and smells can subconsciously encourage excessive buying (Cohen & Babey, 2012). Finally, the potential increase in evening bargain-hunting trips as described by my interviewees may be linked to increased household food waste if the shorter shelf life of food purchased on discount is not taken into account when planning meals at home.

At first glance, the convenience offered by retailers who appeal to single-person households by selling small-portion vegetables has the potential to help reduce food waste by ensuring that people can buy ingredients in the quantities needed, as well as aiding portioning with pre-measured amounts. However, by replacing naturally protective outer layers with plastic vacuum packaging, as is done for commonly pre-trimmed vegetables like garlic, onions, potatoes, among others, it is possible that the shelf life of these vegetables is reduced, especially if the packaging is subsequently opened but the ingredients are not used all at once. Even if packaged fresh ingredients are equally effective at inhibiting spoilage, the presence of packaging and sell-by dates could create concerns about food safety, leading to their premature disposal if not used in time. It is interesting to note that most of my interviewees who lived alone[16] said they preferred

[16] All of these interviewees were women; it is possible that the primary market for convenience and small-portion vegetables is men living alone.

not to buy small-portion convenience vegetables due to higher prices and a perceived lack of freshness. Further research is required to understand which consumer segments are buying such products and how they are being used in food practices, but their potential lack of popularity and use of sell-by dates suggests that when unsold they may also contribute to increased food waste in stores. The environmental impacts from the manufacture and disposal of additional packaging also need to be considered, upstream from consumers.

My interviews also revealed how South Korean households supplemented their food provisioning practices via alternate SOPs by receiving food from parents. The potential for increased food waste is clear with Bak's (2014) reference to excess *kimchi*. Although Bak's interviewees mentioned giving away the excess, many of my interviewees ended up throwing away some of this food provided by their mothers. Reasons cited included growing tired of repeatedly eating the same thing, not liking their mothers' cooking, insufficient storage space, not having enough time to eat at home, or that there was just too much food to eat. Ji-ae, a bank teller in her thirties, ultimately asked her mother to stop giving her food because she had just resumed work after giving birth, and neither she nor her husband had enough time to eat everything. Although Ji-ae was able to prevent potentially large amounts of food waste through communication with her mother, this aspect of South Korean society illustrates how social relations are embedded in a household's food-related SOPs, making it difficult for recipient households to control the quantity and timing of these inflows of food. In households where working mothers continue to shop for groceries, this dynamic complicates their coordination of daily food practices in terms of how much to buy and what to cook, with substantial implications for food waste.

As with the case of refrigeration, the trends in food retail SOPs and parental SOPs alike provide additional convenience while also generating the potential to increase household food waste. Modern retailers have already played a significant role in enabling South Korean consumers to maintain their performance of shopping and home-cooking practices via the provision of convenience; they will likely find similar ways to tap into the recent popularity of home-cooking. The end result is likely to be increased physical and temporal access to food among a wider variety of consumers, and an increase in the extent to which food practices are imbued, or even dominated by, meanings of leisure. This could promote greater ambitiousness around home cooking while also increasing the tendency to treat food as a commodity input into leisure cooking.

Just as Evans (2012) conceptualizes food waste as an often inevitable outcome of competent domestic practice, it is important to consider whether food waste will also become an inevitable outcome of competent food practices that incorporate elements of leisure. Ji-ae provided a possible portent when describing how she would buy ingredients to garnish her dishes for aesthetic reasons, but ended up discarding the remainders because she had no use for them. Among consumers who are relatively new to the kitchen, increased convenience in accessing food and the knowledge of how to prepare it may need to be balanced by increased competence and regularity in managing and preparing food in order to avoid increased food waste.

4.6 Conclusion

In this chapter, I have described how, through retail modernization, SOPs in South Korea are linked to changes in the nature of food practices. This may take place through the provision of convenience, either via temporal access to food or by providing shortcuts in food preparation. I have linked trends in food-related practices to changing household structure, a wave of popularity in home cooking, the potential for modern retailers to support these trends, and the increased meanings of leisure associated with food practices. While increased household food waste is not a foregone conclusion, it may come about if consumers buy food as part of a trend without engaging with a separate set of food management competencies to avoid food waste.

More broadly, the case of food retail modernization in South Korea shows how SOPs evolve over time in response to the social, economic, cultural, and institutional contexts of food-related practices, while simultaneously holding the power to structure food-related practices in both expected and unexpected ways. Unlike how particular norms have emerged for other practices such as bathing and indoor temperature control (Shove, 2003), the interaction between SOPs and food practices may create more complicated outcomes in terms of how individuals coordinate their daily lives around household provisioning and sustenance. These outcomes are also inextricable from the deeply cultural and symbolic nature of food and food consumption practices. In turn, these dynamics have the potential to both alleviate and exacerbate the generation of household food waste, echoing prior work that has highlighted the complexities of household food waste (Quested et al. 2013).

From a methodological standpoint, this chapter, informed by qualitative and secondary data, does not substantively contribute to debates over which variables increase or decrease food waste. Instead, it attempts to situate the phenomenon of household food waste within my empirical context of South Korea's modernizing food retail sector. In doing so, it sets the stage for the following three chapters and provides the angle from which I perform and interpret the results of my analyses of household food waste data.

Chapter 5 – Analysis of household survey data

5.1 Introduction

This chapter explores the drivers of food waste volumes that households reported when taking the survey. Variables used in the regression models presented in this chapter were selected and tested based on the theoretical framework presented in Chapter 2. I begin the chapter by describing the two dependent variables used in the regression—total food waste and avoidable food waste, before providing an overview of the sample's characteristics with regard to the independent variables used in the regressions. Along the way, I describe each variable's bivariate effect on the dependent variables with Spearman rank correlations, Kruskal Wallis H-tests, and Jonckheere-Terpstra tests, which best suited the non-normally distributed data. I then present the results of two multivariate regressions that use total food waste and avoidable food waste as the dependent variables, respectively. In performing these analyses, I first developed regression models that tested drivers of food waste already identified by prior research. I then built on those models by introducing previously untested variables, namely those representing the influences of store type, grocery trip parameters, and waste management policy. Improvements in model fit demonstrated the importance of including these variables. I then proceed with a discussion that synthesizes model results before concluding the chapter with implications for policy.

5.2 The dependent variables

Total food waste was measured by asking households to first indicate the volume-based food waste pricing system they use. They were then asked to recall the quantity of food waste discarded on average each week during the last three months. This question was customized for the food waste pricing system they used. For example, if a participant indicated using volume-rate plastic bags, they were asked to indicate how many filled bags they threw away last week or month and the volume of the bag used. The figure reported by each household was normalized according to the number of people in the household to generate a per person figure. Volumes reported on a monthly basis were also divided by four to produce a per week quantity. Finally, a measure of avoidable food waste per person per week was produced by multiplying each household's reported total food waste by the percentage of avoidable food waste they estimated. Respondents (N=36) who indicated using the RFID machine system were excluded from the analysis because the ongoing introduction of the RFID machines in many parts of Seoul at the time was hypothesized to potentially create instability in behavior that could influence analysis of survey responses.

It is important to note that guidance offered by each of the 25 administrative ward governments in Seoul on what households should include for disposal as "food waste" is quite inconsistent and as such, households tend to be confused about what should be included and what should not. Guidelines commonly instruct not to include bones and usually to include offal, but the status of peel and shells from various fruits, vegetables, and nuts is less clear. A common rule of thumb Seoul residents use to determine what to include is that it can be eaten by animals, but this does not always reflect official guidelines. As such, there are definitional challenges associated with the dependent variable in this study. "Total food waste" may not include items like bones, but often includes inedible portions from fruits and vegetables such as peel, seeds and trimmings. It

is anticipated that the main difference between "total food waste" and "avoidable food waste" lies in the absence of inedible fruit and vegetable portions from the latter. Although avoidable food waste is the primary focus of this study, its analysis in parallel with total food waste provided clues to explain why some variables may or may not have statistically significant effects when analyzed using multivariate regression. After removing outliers, a total of 460 respondents provided estimates of their household food waste volume per week. A summary of these data are presented in Table 5.1 below.

Table 5.1 Dependent variable summary

	Volume per week (L)	Volume per week per person (L)	Percentage edible	Edible volume per week per person (L)
Mean	14.0	5.7	35.8%	2.4
Median	5.0	2.0	30.0%	0.5
Standard deviation	30.0	11.8	29.4%	8.3
Range	500.0	100.0	100.0%	90.0
Minimum	0.0	0.0	0.0%	0.0
Maximum	500.0	100.0	100.0%	90.0

5.3 Survey sample characteristics

Females were overrepresented in the sample when compared to Seoul data (Figure 5.1). This was most likely because of the criterion that the survey respondent had to be the person primarily in charge of grocery shopping and meals in the household, which is a role traditionally played by females in South Korean society. Although males are underrepresented in the sample, the actual gender distribution of the household shopper population is likely to be biased towards females. Consequently, the distribution encountered in the sample is unlikely to significantly bias the findings of this survey.

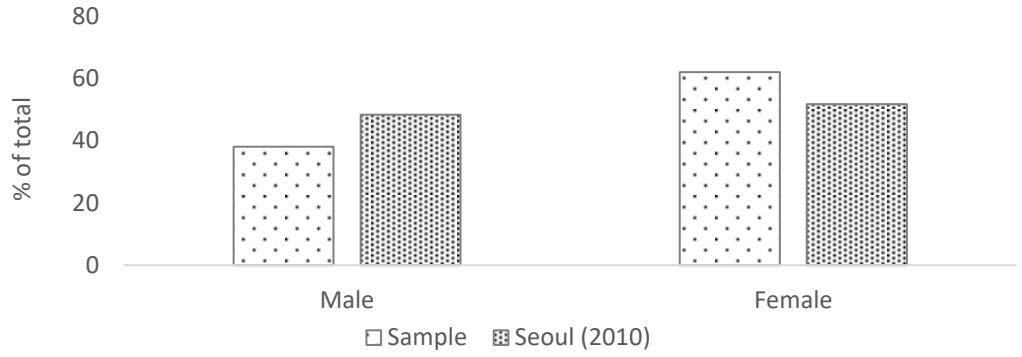

Figure 5.1 Sample distribution by gender

A Kruskal Wallis H-test showed that gender had a significant effect for total food waste, but not for avoidable food waste (Table 5.2).

Table 5.2 Kruskal Wallis H-test results for effect of gender on food waste volume

	Total food waste per person	Avoidable food waste per person
Mean rank:		
Male	218.806	196.779
Female	177.935	191.483
Chi-square	12.245	0.205
df	1	1
p-value	0.000	0.650

Figure 5.2 below compares the age distribution of the sample with the age distribution in Seoul. As the survey was online-only, the population aged 60+ was severely underrepresented, and the 51-60 age group was very slightly underrepresented. These shortfalls were made up for by mild overrepresentation in the youngest three age groups.

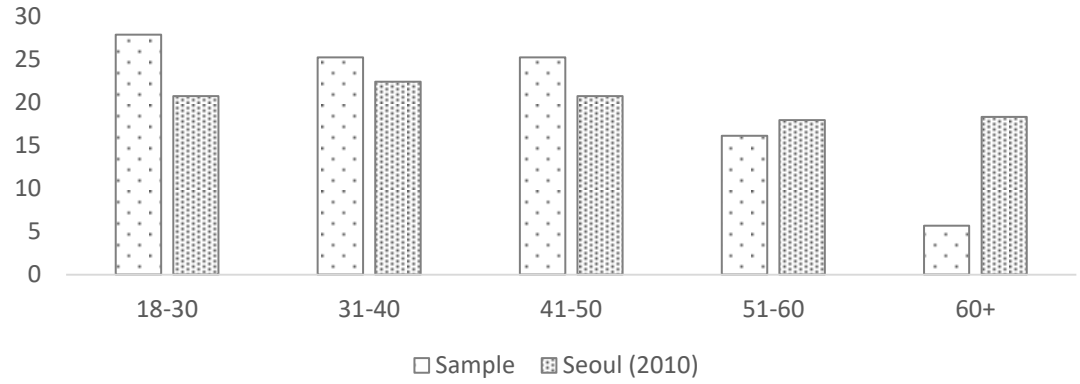

Figure 5.2 Sample distribution by age

A Kruskal Wallis H-test (Table 5.3) showed that older respondents were significantly linked with more total food waste, but there was no connection between age and avoidable food waste.

Table 5.3 Jonckheere-Terpstra test results for effect of age on food waste volume

	Total food waste per person	Avoidable food waste per person
Mean rank:		
18-30	177.875	190.575
31-40	180.346	198.938
41-50	194.200	190.326
51-60	205.730	186.836
60+	274.962	210.231
Observed J-T Statistic	32711.000	28806.500
Mean J-T Statistic	28689.500	28689.500
Std. Deviation of J-T Statistic	1228.317	1229.147
Std. J-T Statistic	3.274	.095
Asymp. Sig. (2-tailed)	.001	.924

The distributions of respondents by income group and education level are shown below in Figure 5.3. 31% of respondents made more than 5,000,000 won per month and 85% of respondents had bachelor's degrees or higher.

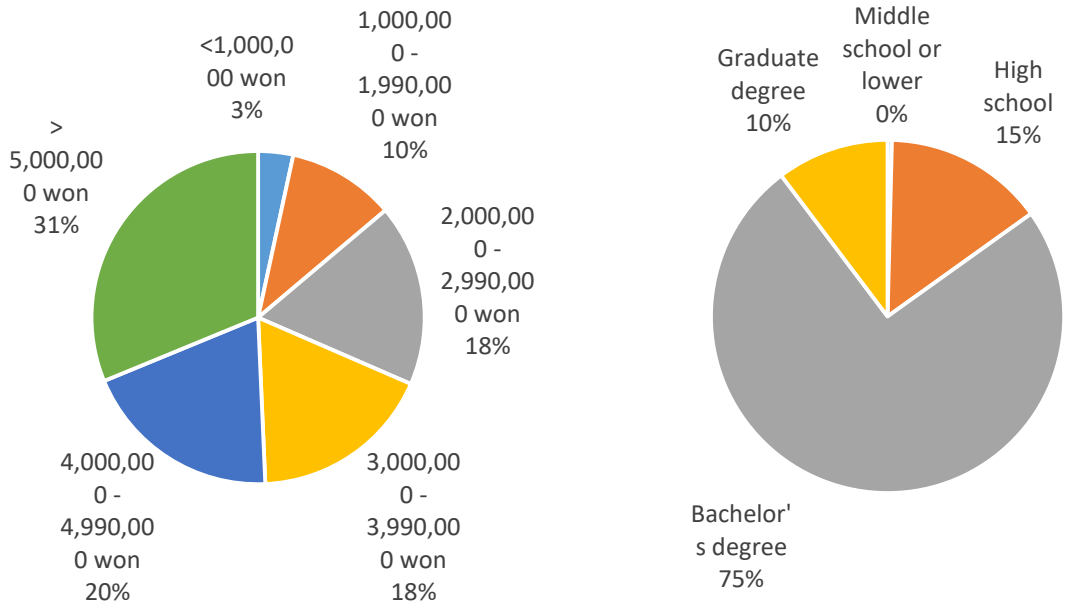

Figure 5.3 Sample distribution by income and education

Income did not have any significant influence on either measure of food waste (Table 5.4).

Table 5.4 Jonckheere-Terpstra test results for effect of income on food waste volume

	Total food waste per person	Avoidable food waste per person
Mean rank:		
< 1,000,000 won	173.455	213.500
1,000,000 - 1,999,999 won	174.191	178.515
2,000,000 - 2,999,999 won	195.815	199.024
3,000,000 - 3,999,999 won	188.058	185.732
4,000,000 - 4,999,999 won	190.244	183.023
> 5,000,000 won	195.610	195.568
Observed J-T Statistic	29212.500	28482.500
Mean J-T Statistic	28299.500	28299.500
Std. Deviation of J-T Statistic	1202.045	1202.854
Std. J-T Statistic	.760	.152
p-value	.448	.879

Similarly, education was not found to have an influence on either measure of food waste (Table 5.5).

Table 5.5 Jonckheere-Terpstra test results for effect of education on food waste volume

	Total food waste per person	Avoidable food waste per person
Mean rank:		
Middle school or lower	134.500	275.000
High school	191.714	184.420
Bachelor's degree	193.017	193.542
Graduate degree	196.218	199.205
Observed J-T Statistic	15246.500	15564.500
Mean J-T Statistic	15011.500	15011.500
Std. Deviation of J-T Statistic	953.057	953.696
Std. J-T Statistic	.247	.580
Asymp. Sig. (2-tailed)	.805	.562

Respondents were also asked to indicate their job status. 54% worked full-time, while the remaining 46% were divided among being housewives, students, self-employed, part-time workers, and other (
Figure 5.4).

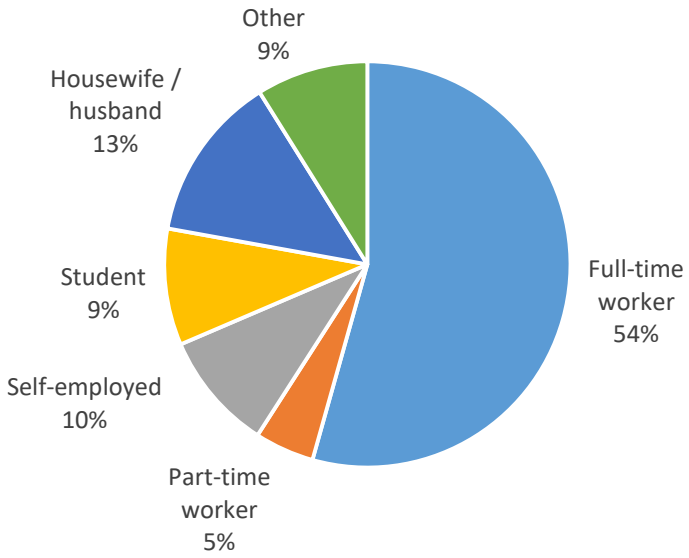

Figure 5.4 Sample distribution by employment status

Employment status was found to have a significant effect on total food waste, but not for avoidable food waste, according to a Kruskal-Wallis H-test (Table 5.6). Interestingly, participants who identified as self-employed generated more total food waste than those in other employment categories. However, multivariate regression did not reflect this result, suggesting that the effect is likely correlated with other factors.

Table 5.6 Kruskal Wallis H-test results for effect of employment status on food waste volume

	Total food waste per person	Avoidable food waste per person
Mean rank:		
Full-time	193.636	186.174
Part-time	202.952	222.357
Self-employed	257.361	237.528
Student	162.903	208.468
Housewife / husband	183.490	180.833
Retired	128.400	126.500
Unemployed (seeking job)	176.158	190.237
Other (please specify)	161.808	187.846
Chi-square	17.943	10.997
df	7	7
p-value	0.012	0.139

Figure 5.5 below shows the distribution of survey respondents by household size in comparison with the equivalent data for Seoul in 2010. One, two, and three-person households were underrepresented, while four and five or more person households were overrepresented in the survey sample.

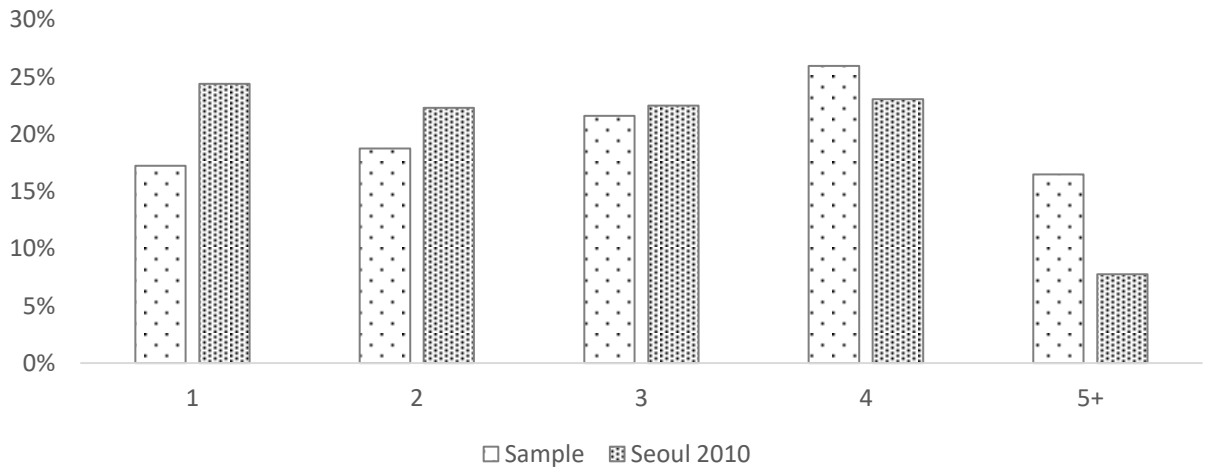

Figure 5.5 Sample distribution by household size

Household size data for Seoul were used to weight the survey data in order to be more representative of the Seoul population. The calculated sample weights for each household size are presented in

Table 5.7.

Table 5.7 Sample weights based on household size

Household Size	Sample		Seoul 2010	Weight
	Frequency	Percentage		
1	91	17.2%	24.4%	1.415
2	99	18.8%	22.3%	1.189
3	114	21.6%	22.5%	1.042
4	137	25.9%	23.1%	0.888
5+	87	16.5%	7.8%	0.471

5.4 Attitudinal factors

On average, respondents tended to agree with statements that portrayed food waste in a negative manner, though this was strongest for "Wasting food is morally unacceptable," "Wasting food is bad for the environment," and "Wasting food is a waste of money" (Figure 5.6, recoded for directionality). That respondents tended to agree that food waste is bad for the environment is likely linked to the relatively long history of food waste reduction policy in South Korea, which has included extensive educational campaigns.

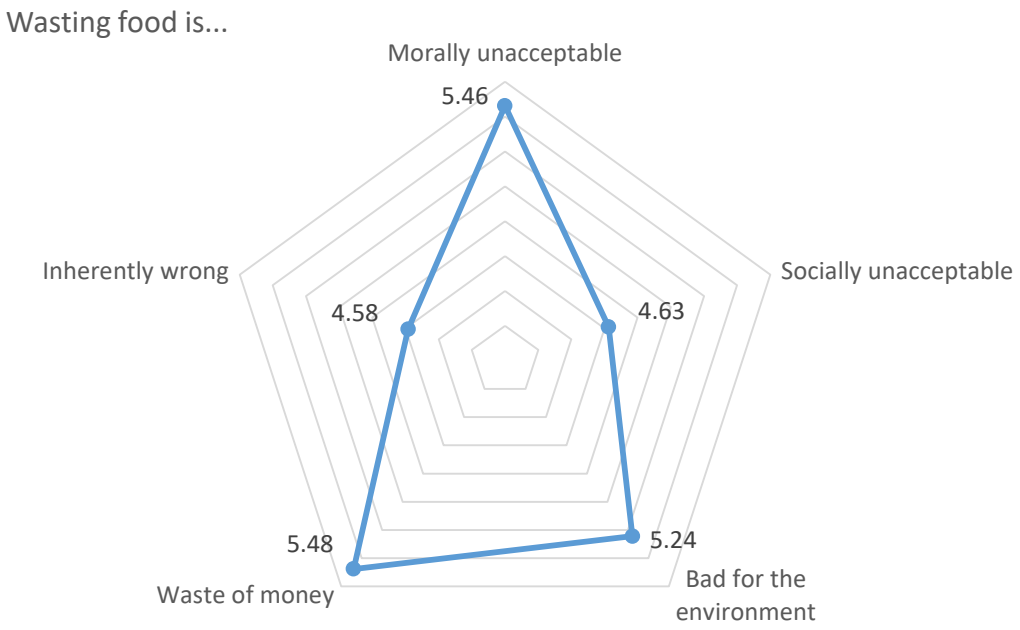

Figure 5.6 Mean response for attitudinal questions (1=completely disagree, 7=completely agree)

It was interesting to note that, in comparison with the other three attitudinal statements, respondents on average did not agree as strongly with "Wasting food is socially unacceptable" and "Wasting food is inherently wrong." Spearman correlations among the five attitudes and two measures of food waste are shown in Table 5.8 below. None of the attitudinal variables are significantly correlated with total food waste per person, but all of them are negatively correlated with avoidable food waste per person. The environmental attitude had the strongest correlation.

Table 5.8 Spearman correlations among attitudinal and food waste variables

	Morally unacceptable	Socially unacceptable	Inherently wrong	Bad for the environment	Waste of money	Food waste per person	Avoidable food waste per person
Morally unacceptable	1.000						
Socially unacceptable	.553**	1.000					
Inherently wrong	.539**	.539**	1.000				
Bad for the environment	.421**	.168**	.273**	1.000			
Waste of money	.378**	.171**	.316**	.571**	1.000		
Food waste per person	-.053	.022	-.021	-.074	-.062	1.000	
Avoidable food waste per person	-.188**	-.119*	-.153**	-.221**	-.155**	.662**	1.000

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Attitudes in respondents' households towards food freshness and safety were also assessed by asking how many of their family members (none, some, or all) would eat leftover or expired food that does not look, smell, or taste spoiled at various points in time. Figure 5.7 illustrates the percentage distribution of the responses for each category of leftover or expired food. There appears to be some aversion overall even to eating leftover food that looks, smells, and tastes fine after a few days and food on its sell-by date. Less than half of the respondents indicated that all of their household members would be willing to eat leftover food after a few days and food on its sell-by date.

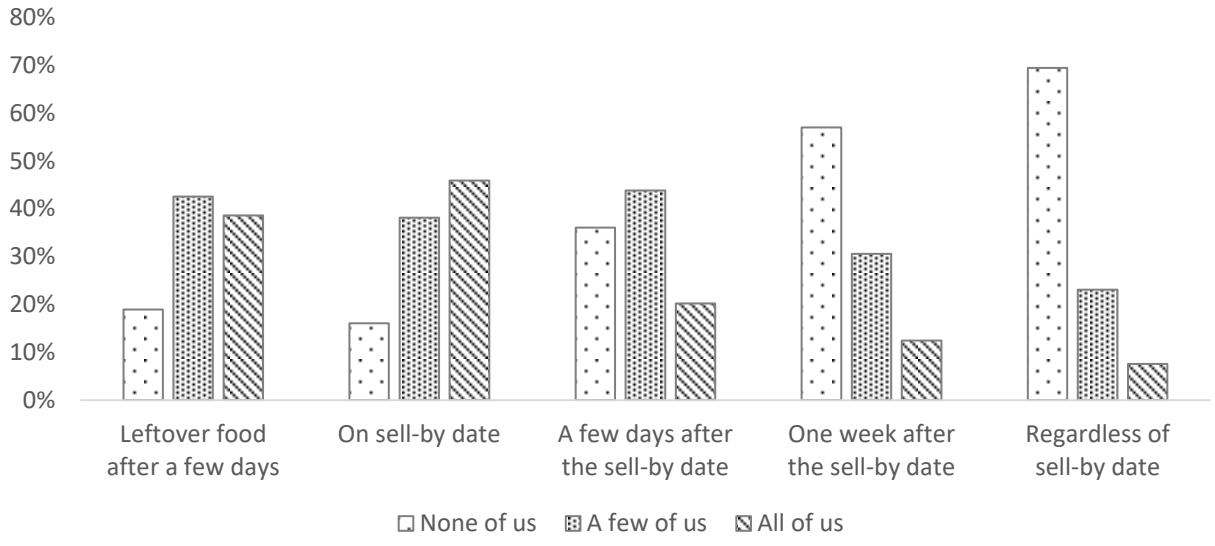

Figure 5.7 Median response for attitudinal questions

Kruskal-Wallis H-tests were conducted to assess the effect of this group of variables on food waste; the results are shown in Table 5.9. There were only statistically significant differences across responses for "leftover after a few days" and "on sell-by date;" the more household members were willing to eat food in these categories, the less food waste was generated.

Interestingly, the remaining three variables did not have any significant correlation with food waste volumes. This likely suggests that food is rarely allowed to sit in the fridge until more than a few days past its sell-by date; it is either consumed or thrown out beforehand. Hence, little or no difference is made to household food waste volumes even if household members are willing to consume food well after its sell-by date.

Table 5.9 Kruskal Wallis H-test results for effect of food safety attitudes on food waste volume

	Leftover after a few days	On sell-by date	A few days after sell-by date	One week after sell-by date	Regardless of sell-by date
Total food waste per person					
Mean rank:					
None	222.18	229.51	202.82	191.88	194.74
A few of us	203.41	198.11	192.24	196.47	188.87
All of us	168.55	177.06	179.62	193.61	196.26
Chi-square	13.603	10.577	2.205	0.130	0.204
df	2	2	2	2	2
p-value	0.001	0.005	0.332	0.937	0.903
Avoidable food waste per person					
Mean rank:					
None	210.37	209.72	198.96	198.82	195.50
A few of us	214.23	210.78	199.49	194.67	194.94
All of us	162.42	173.47	170.78	166.25	170.62
Chi-square	18.915	10.557	4.060	3.380	1.322
df	2	2	2	2	2
p-value	0.000	0.005	0.131	0.185	0.516

5.5 Behavioral factors

Participants were asked to indicate the extent to which they performed six habits related to food management; the mean response for each habit, recoded for directionality, is shown in Figure 5.8 below. The responses suggest that on average, the most frequently performed habit on average was to avoid buying perishables in large amounts, and that planning meals was performed least frequently.

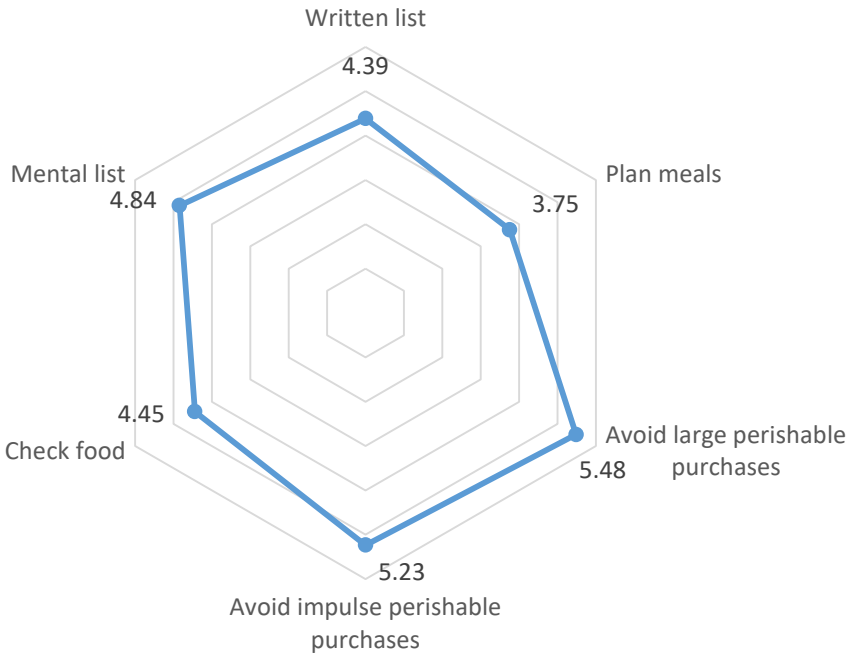

Figure 5.8 Mean response for food management habits (1=never, 7=always)

Spearman correlations for the six habits and food waste are shown below in Table 5.10. It was clear that several of the habits were correlated with each other. For example, the correlation coefficients among written lists, checking food, and planning meals were all just under 0.400, and avoiding large perishable purchases was strongly correlated with avoiding impulse perishable purchases, with a correlation coefficient of 0.716.

Although there were multiple statistically significant correlations between habits and measures of food waste, the correlations were not strong, and in some cases, counterintuitive. For example, written lists and planning meals were statistically significant but positively correlated with both measures of food waste. This result is explored further in the regression analysis and discussion section.

Table 5.10 Spearman correlations for behavioral factors and food waste

	Written list	Mental list	Check food	Plan meals	Avoid large perishable purchases	Avoid impulse perishable purchases	Total food waste	Avoidable food waste
Written list	1.000							
Mental list	.015	1.000						
Check food	.376**	.220**	1.000					
Plan meals	.393**	.086	.387**	1.000				
Avoid large perishable purchases	-.038	.107*	.031	-.216**	1.000			
Avoid impulse perishable purchases	.005	.084	.065	-.121*	.716**	1.000		
Total food waste	.109*	-.019	.044	.179**	-.164**	-.045	1.000	
Avoidable food waste	.105*	-.105*	-.023	.123*	-.193**	-.112*	.662**	1.000

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

5.6 Retail format and shopping frequency

Hypermarkets were the leading choice of retail format for households, with 423 households (80%) indicating that they visited hypermarkets to buy food within the last three months (**Error! Reference source not found.**). This was followed by supermarkets (309, 59%) and traditional markets (259, 49%). Interestingly, internet shopping proved to be a more popular choice of retail format than more traditional formats like family stores, convenience stores, and department stores.

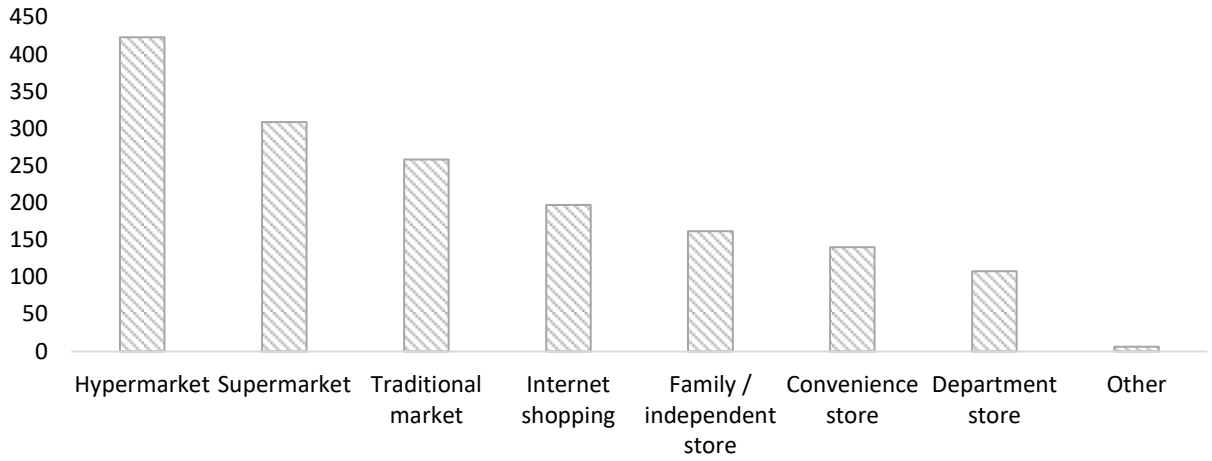

Figure 5.9 Number of households visiting each retail format

Most participants preferred to do their grocery shopping at more than one retail format (Figure 5.10). Only 74 households (14%) indicated shopping at just one kind of food retailer. Shopping at two or three separate formats appeared to be the sweet spot, with a total of 276 (53%) households indicating that they did so. The number of households that shopped at four or more destinations totaled 175 (33%).

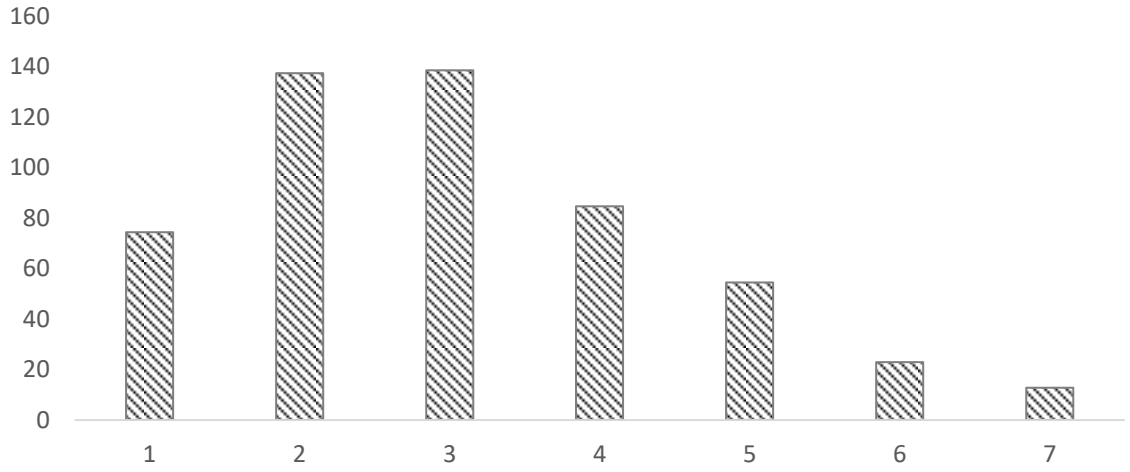

Figure 5.10 Sample distribution by number of formats visited

Although data on shopping frequencies for multiple food groups were collected, I focused primarily on fresh fruits and vegetables (FFV) in this analysis as it is the most perishable food group and as such, food waste is likely to be the most sensitive to variation in FFV shopping frequency. Additionally, FFV shopping frequency was well correlated with shopping frequency for other perishable food groups, i.e. meat; seafood; and dairy, eggs and soy (Table 5.11), which further justifies its selection for analysis.

Table 5.11 Spearman correlations among shopping frequencies for different food groups

	FFV	Meat	Seafood	Dairy, eggs, and soy	Rice, cereals, bread	Pre-cooked	Non-perishable
FFV	1						
Meat	.606**	1					
Seafood	.569**	.719**	1				
Dairy, eggs, and soy	.614**	.504**	.534**	1			
Rice, cereals, bread	.357**	.415**	.393**	.417**	1		
Pre-cooked	.335**	.451**	.526**	.372**	.542**	1	
Non-perishable	.181**	.378**	.422**	.330**	.433**	.568**	1

** denotes statistical significance at the 0.01 level (2-tailed)

Respondents reported FFV shopping frequency for each of the food retail types they visited. In order to have a single measure of shopping frequency for each respondent, I looked at the highest frequency of FFV shopping that each respondent reported (Figure 5.11). This was based on the assumption that the highest frequency is the most reflective of respondents' shopping routines.

36% of respondents who reported buying FFV did so once a week and another 27% indicated buying FFV 2-3 times a month.

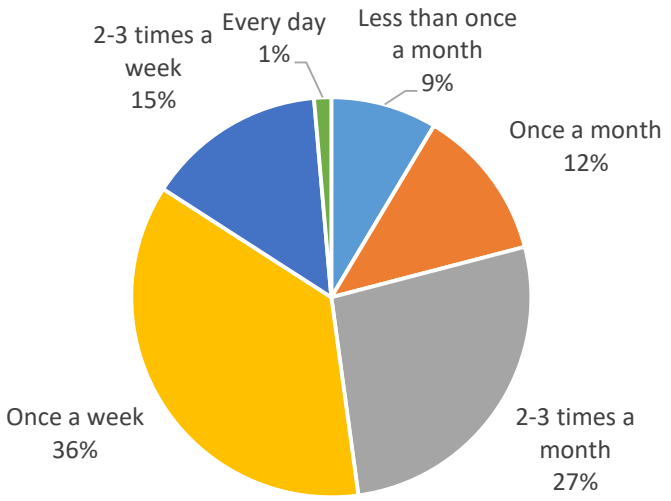

Figure 5.11 Sample distribution by highest FFV shopping frequency indicated, regardless of retail format

How FFV shopping frequency varied according to retail type is shown below in Figure 5.12. Convenience stores and internet are excluded from the graph as the majority of respondents reported not ever buying FFV at these venues.

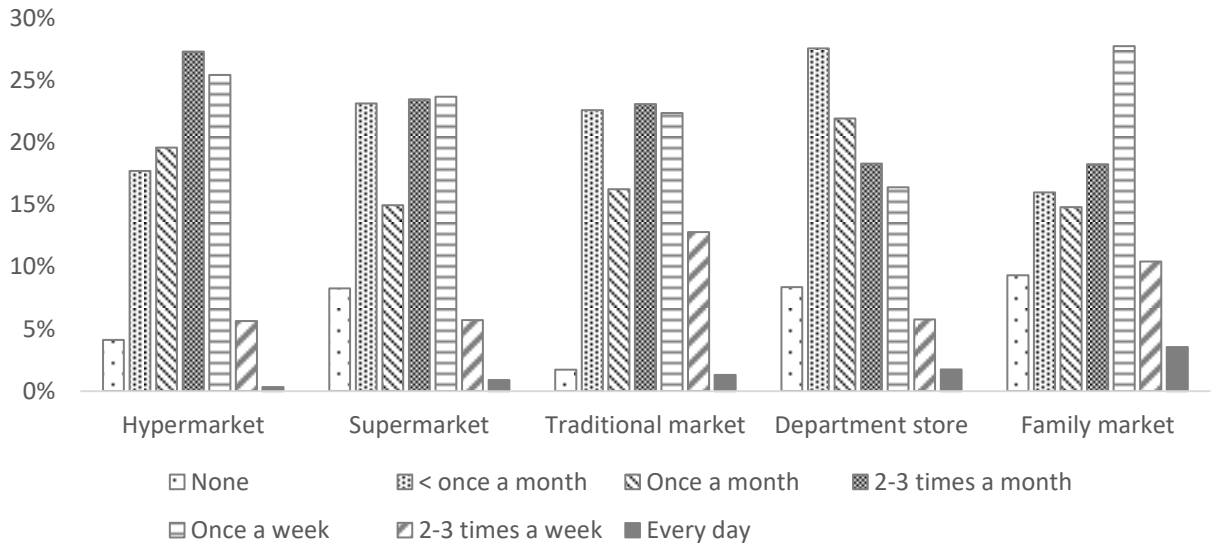

Figure 5.12 Sample distribution by FFV shopping frequency and retail format

There were some notable differences in FFV shopping frequency across the different retail formats. For hypermarkets, supermarkets, and traditional markets, a majority of shoppers bought FFV either 2-3 times a month or once a week. In contrast, the majority of department store shoppers bought FFV less than once a month (28%), whereas for family market shoppers, the most popular frequency was by far once a week (28%).

Although shoppers buying FFV daily or 2-3 times a week were in the minority across all retail formats, it appeared that traditional market shoppers and family market shoppers were more predisposed to buying FFV at these frequencies than shoppers at other venues. 13% and 10% of shoppers at traditional markets and family markets, respectively, shopped 2-3 times a week, compared to 6% each for hypermarkets, supermarkets, and department stores.

It was also notable that there were sizeable percentages of shoppers who bought FFV less than once a month at traditional markets and supermarkets (23% for both). Given that only 9% of all shoppers most frequently purchased FFV less than once a month, these figures likely reflect how supermarkets and traditional markets also played roles as destinations for supplemental, or "top-up," FFV buying trips. Top-up trips were possibly also the underlying reason for department stores being most frequently visited less than once per month. On the other hand, considering that department stores tend to sell gourmet, specialized, and more expensive foodstuffs, it is possible that department stores were visited primarily when shoppers wanted to "treat" themselves to special items or to buy rarely used foods.

In order to separate "top-up" trips from regular shopping trips, survey participants were classified into groups according to the retail type they most frequently visited. This was done for each household by averaging shopping frequencies across food groups for each retail type they visited—I called this the "average frequency score." For each household, the retail type with the highest "average frequency score" was thus deemed that household's most frequently visited retail type. The distribution of households according to their most frequently visited retail type is shown in Figure 5.13 below. 41% visited hypermarkets, 22% visited supermarkets, and 12% visited traditional markets at the highest frequency. A further 9% of households were "tied," i.e. they visited two or more formats equally frequently.

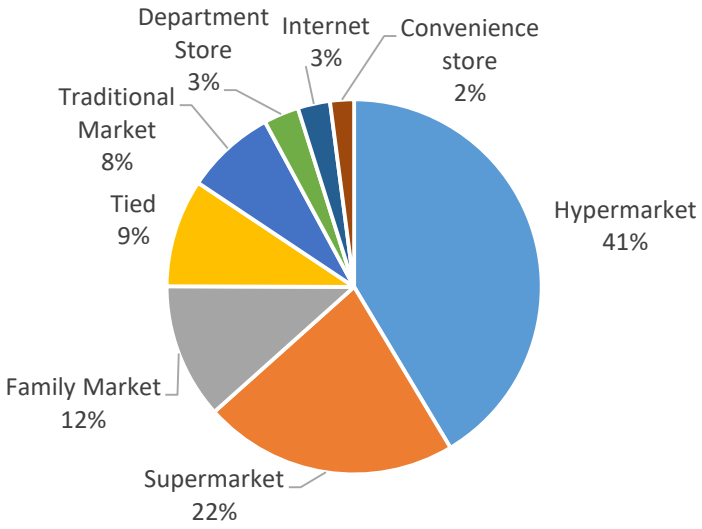

Figure 5.13 Sample distribution by most frequently visited retail format

This result indicates the relative popularity of different retail formats, but does not reveal anything about what respondents' shopping frequencies were, or whether retail types can be

differentiated according to average shopping frequency or not. In order to address this question, a Kruskal Wallis H-test was conducted to see if households' FFV highest buying frequency was correlated with their most frequently visited retail type (Table 5.12).

Table 5.12 Kruskal Wallis H-test results for effect of retail type on highest FFV buying frequency

Highest FFV buying frequency	
Mean rank:	
Traditional Market	295.172
Department Store	265.192
Family Market	249.920
Convenience store	217.250
Supermarket	208.849
Internet	203.545
Hypermarket	201.586
Tied	193.131
Chi-square	24.636
df	7
p-value	0.001

Post-hoc analysis conducted using a Mann-Whitney test for one-to-one comparisons of each group confirmed the mean ranks presented in Table 5.12. Most importantly, those visiting hypermarkets most frequently were found to shop for FFV at lower frequencies than those who most frequently visited supermarkets, family markets, and traditional markets. Conversely, those visiting traditional markets most frequently shopped for FFV at higher frequencies than those who visited supermarkets and hypermarkets the most, as well as those who visited two or more formats equally frequently. Finally, a Kruskal Wallis H-test was performed to assess the bivariate relationship between FFV shopping frequency and food waste (Table 5.13). The results indicate that different shopping frequencies are significantly associated with different levels of both total and avoidable food waste per person.

Table 5.13 Kruskal Wallis H-test results for effect of highest FFV buying frequency on food waste

	Total food waste per person	**Avoidable food waste per person**
Mean rank:		
Less than once a month	130.518	119.393
Once a month	185.489	180.489
2-3 times a month	180.216	189.304
Once a week	207.414	209.579
2-3 times a week	203.667	194.694
Every day	184.000	131.000
Chi-square	13.550	17.714
df	5	5
p-value	0.019	0.003

The results presented in this section collectively suggested that different retail types have varying influences on household food waste via their tendency to be associated with different shopping frequencies.

5.7 Spending

Respondents estimated the average amount of money spent on food each time they visited different retail formats; the median quantity per trip spent by households, normalized for household size, for each retail format is shown below in Figure 5.14. Per-trip spending is used here as a proxy for the physical quantity of food purchased per trip. Although it is an imperfect measure of per trip purchase volumes due to pricing differences across different products and retail formats, asking about spending was also the simplest means of accounting for per trip purchase volumes.

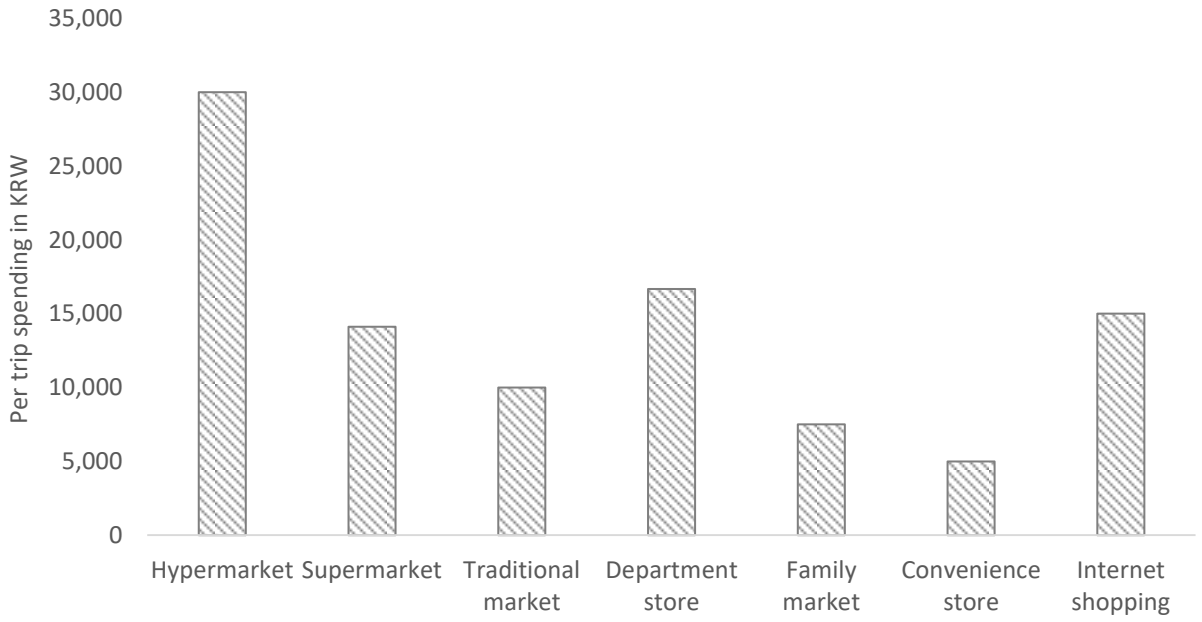

Figure 5.14 Median amount spent on groceries per trip by retail format

In general, the relationship between spending and retail type appears to match the hypothesis that retail type is linked to per-trip spending and per-trip purchase volumes. In particular, per-trip spending is highest at hypermarkets, which households are expected to visit less frequently and buy a lot of items at once, and lowest at convenience stores, traditional markets, and family markets, where households are more likely to visit more frequently but buy items in smaller volumes.

However, department stores and internet shopping are slightly different and do not fit well into this relationship. With the former, it is possible that high per-trip spending reflects larger per-trip purchase volumes, but it is also probable that the pricier nature of goods at these venues contribute more to the higher per-trip spending than larger purchase volumes. Internet shopping is an oddity in the sense that "visit" frequency and purchase volumes are not constrained by trip-

related variables. However, the large selection of products available would suggest that on average, customers are more likely to make larger rather than smaller purchases. It is also plausible that customers only buy a limited range of food items online; this would potentially limit the amount spent per purchase.

In Chapter 2, it was suggested that shopping frequency could be an important factor in determining food waste because it may affect the quantity of food purchased per trip, which in turn affects average inventory size and the likelihood of generating food waste from spoilage. To assess this possibility, plots of FFV shopping frequency versus average amounts spent per trip per household member were generated for the three most frequently visited shopping formats—hypermarkets, supermarkets, and traditional markets, shown in Figure 5.15, Figure 5.16, and Figure 5.17, respectively. For the most part, there is evidence from the data to support this hypothesis. This is clearest from Figure 5.15, in which there appears to be a peak in the region of 3-5, which corresponds to shopping frequencies of once a month, 2-3 times a month, and once a week. It is likely that shoppers who fall to the left of this peak are shoppers who do not shop regularly at hypermarkets, and therefore spend less per trip as their shopping frequency decreases. Those who fall to the right of the peak are regular shoppers at hypermarkets; there is a clear decrease in per trip spending as their shopping frequency increases.

This trend is less obvious for supermarkets and traditional markets, but it is mostly clear that those who shop daily or 2-3 times a week spend less per trip than those towards the middle of the graph. To take into account the shape of these graphs, a quadratic transformation was applied to the FFV shopping frequency variable for the multiple regression, which will be discussed later.

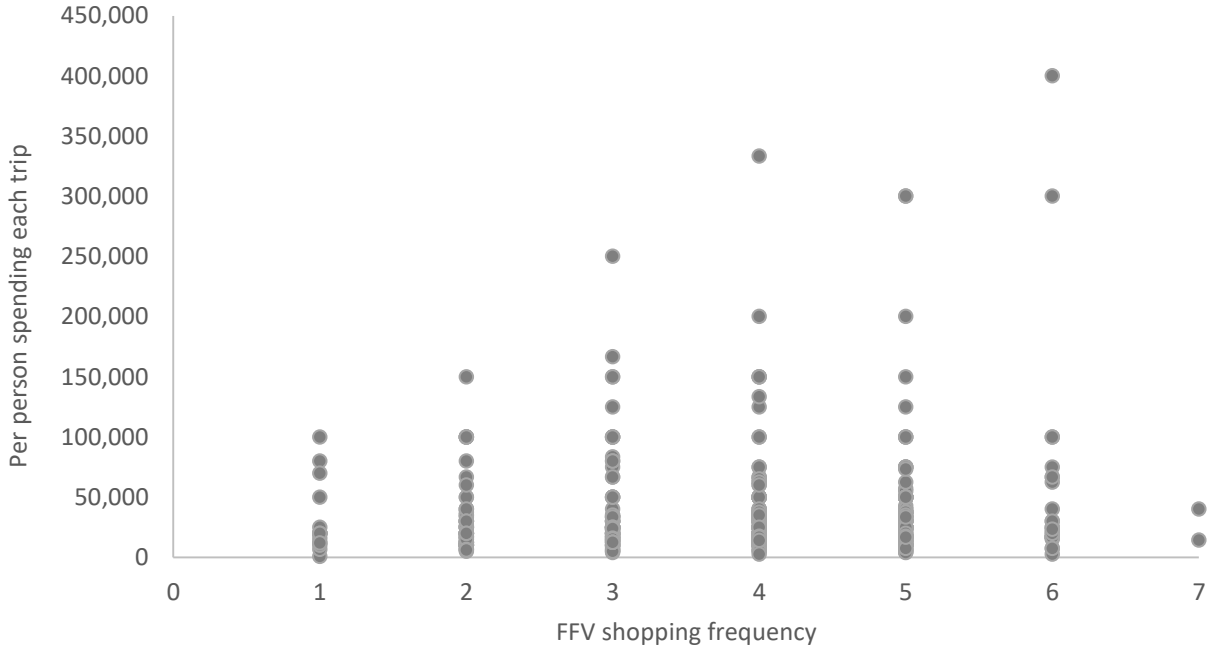

Figure 5.15 Per trip spending vs. FFV shopping frequency (1=less than once a month, 7=every day) for hypermarkets

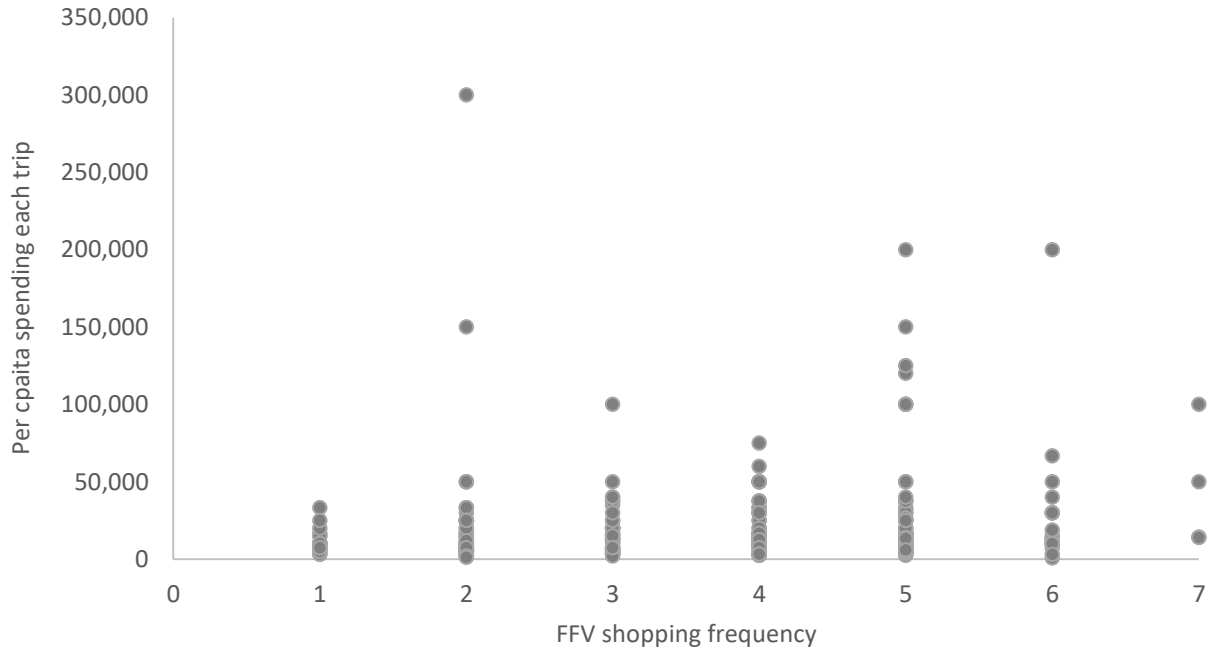

Figure 5.16 Per trip spending vs. FFV shopping frequency (1=less than once a month, 7=every day) for supermarkets

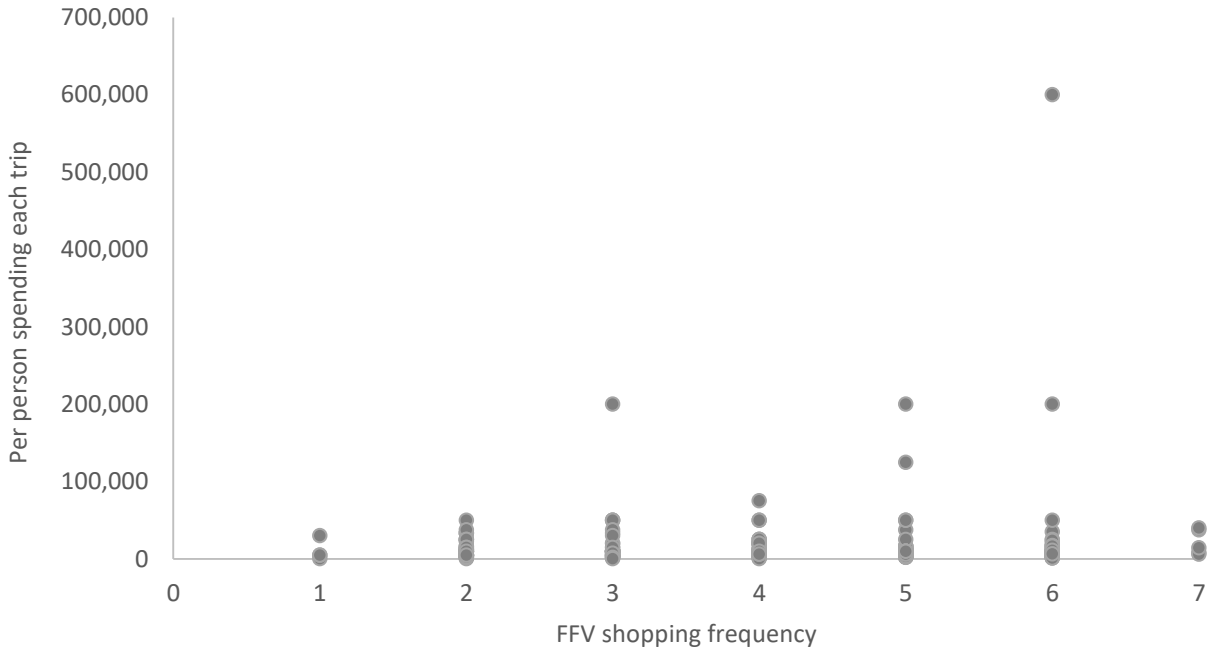

Figure 5.17 Per trip spending vs. FFV shopping frequency (1=less than once a month, 7=every day) for traditional markets

5.8 Mode choice

Mode choice could also be linked to retail format (Figure 5.18). Walking was the predominant form of transport to all formats except hypermarkets and department stores, which were most frequently visited by car. This outcome most likely reflects the greater parking availability at these retail formats and the tendency for higher income households to visit these formats.

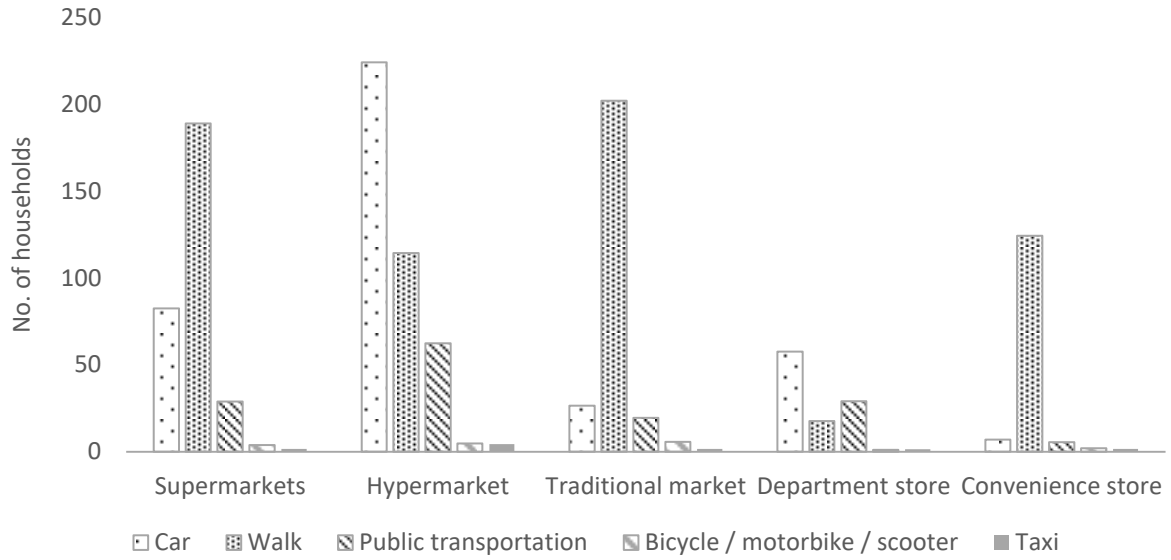

Figure 5.18 Sample distribution by mode choice across retail formats

Interestingly, department stores had the largest proportion of shoppers (27%) arriving by public transportation. This was next highest for hypermarket shoppers at 15%. One possible explanation for this could be that department stores and hypermarkets are large-format stores often built near transportation hubs, featuring a large number of bus lines and usually, a subway station. Conversely, the smaller retail formats tend to be very accessible on foot by virtue of being located closer to, or inside, residential areas, as is reflected in Figure 5.18.

Mode choice alone did not have any significant effect on the amount of food waste generated, whether total or edible, across the three most popular shopping destinations (Table 5.14). It was however worth noting that the p-value for hypermarket mode choice came close to statistical significance for total food waste per person, with drivers generating the most and pedestrian shoppers, the least. This result is reflected in the regression results with more statistical significance and will be discussed later.

Table 5.14 Kruskal Wallis H-test results for effect of mode choice on food waste volume

	Hypermarket	Supermarket	Traditional market
Total food waste per person			
Mean rank:			
Public transport	144.214	112.955	86.029
Car	167.928	131.015	119.690
Walk	135.371	108.162	96.724
Bicycle / motorbike / scooter	141.250	99.833	68.875
Taxi	136.750	-	156.500
Chi-square	8.643	5.476	1.790
df	4	3	4
p-value	0.071	0.140	0.774
Avoidable food waste per person			
Mean rank:			
Public transport	151.429	115.318	108.706
Car	164.445	129.500	108.857
Walk	138.076	108.482	95.470
Bicycle / motorbike / scooter	134.625	100.500	90.000
Taxi	161.625	-	104.500
Chi-square	5.298	4.609	1.790
df	4	3	4
p-value	0.258	0.203	0.774

5.9 Travel time

Respondents were also asked to indicate their one-way travel time from their homes to each of the physical retail types they visited, regardless of mode choice (Figure 5.19). These also appeared to be linked to retail format; convenience stores and family/independent stores were mostly located within 10 minutes from home. Supermarkets and traditional markets were located mostly within 15 minutes, while hypermarkets and department stores were mostly located within 30 minutes from respondents' homes.

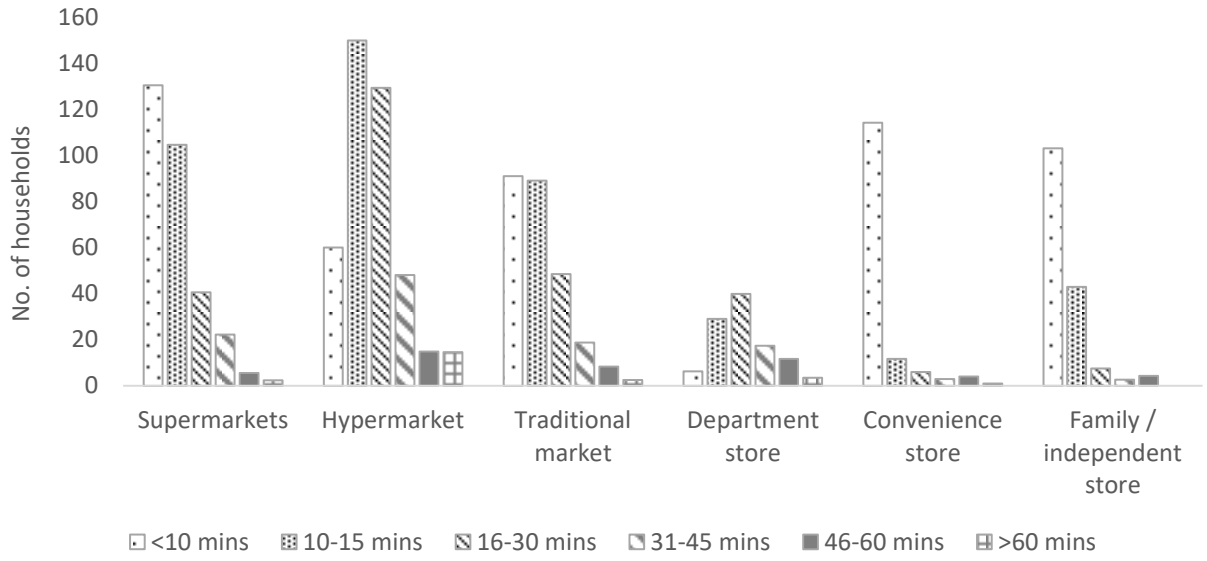

Figure 5.19 Sample distribution by one-way travel time across retail formats

To get a better sense of respondents' overall proximity to physical food retailers, the minimum travel time of respondents across all the food retailers they visited was assessed (Figure 5.20). Approximately 63% of respondents visited food retailers that were within 10 minutes away. It is worth noting that even when excluding ubiquitous convenience stores from the assessment, 54% still visited food retailers within 10 minutes and a further 22% only had to travel 10-15 minutes to get to their preferred food retailer.

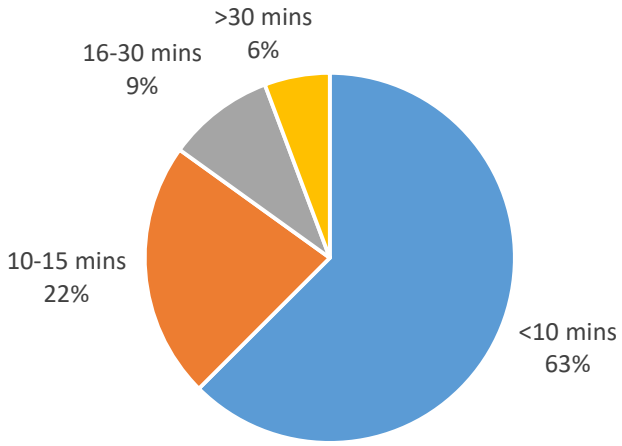

Figure 5.20 Sample distribution by minimum travel time, regardless of retail format visited

Minimum travel time was positively and significantly correlated with total food waste per person, and came close to statistical significance for avoidable food waste per person (Table 5.15). In multiple regression, minimum travel time maintains its significant and positive influence on both measures of food waste; this will be further discussed later.

Table 5.15 Jonckheere-Terpstra test results for effect of minimum travel time on food waste

	Total food waste per person	Avoidable food waste per person
Mean rank:		
<10 mins	184.05	185.11
10-15 mins	198.61	207.26
16-30 mins	226.06	181.29
>30 mins	222.05	244.32
Observed J-T Statistic	22244.000	21794.500
Mean J-T Statistic	19770.000	19770.000
Std. Deviation of J-T Statistic	1074.365	1075.065
Std. J-T Statistic	2.303	1.883
p-value	.021	.060

5.10 Waste management policy

Approximately 64% of respondents indicated that they used volume-rate plastic bags to pay for their food waste disposal. 8% said they paid using an RFID system, and 3% said they used a sticker/chip system. Out of the remaining 25%, 17% indicated they paid a fixed fee to their apartment complex, 6% said they were not subject to volume-pricing for food waste, and 2% said they did not know. The Kruskal-Wallis H-test conducted to examine differences food waste across these groups of participants found no significant difference found for either total food waste or avoidable food waste. However, the pricing system has a statistically significant influence in regression modelling, as will be discussed later.

Survey participants paid a range of prices for food waste disposal, which varied from 18 won to 80 won per liter. The per-liter disposal price had a weak and negative correlation with avoidable food waste per person (Table 5.16).

Table 5.16 Spearman correlations between per-liter food waste disposal price and food waste

	Price	Total food waste per person	Avoidable food waste per person
Price	1.000		
Total food waste per person	-.020	1.000	
Avoidable food waste per person	-.123*	.662**	1.000

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

5.11 Regression analysis of food waste volume per person

With weekly volume of food waste per person as the dependent variable, various regression models were developed in order to assess the improvement in model fit with the addition of different categories of independent variables. This resulted in six models (A-F), beginning with the inclusion only of demographic variables and progressing with the introduction of variables associated with habits, meal and dietary patterns, attitudes, shopping patterns, and waste management policy. An overview of the coefficients and goodness-of-fit measures is presented in Table 5.17 below, and the correlation matrix for all variables in the model is presented in Table 5.18.

The regression results confirmed the influence of demographic variables on the volume of food waste generated per person. In particular, older respondents were associated with higher levels of food waste, whereas being female and larger household size were linked to less food waste per person. Of the six food management habits, only meal planning and avoiding large perishable purchases were included in the model due to minor multicollinearity. In addition to including the Likert scale response variables for meal planning, a dummy variable was also introduced to assess the possibility of a non-linear relationship between meal planning and food waste. This dummy variable represented respondents who indicated that they planned meals all the time, and was found to have a statistically significant and negative coefficient in model B. In contrast, the meal planning variable had a statistically significant but positive coefficient. Avoiding large perishable purchases had a negative and statistically significant coefficient. However, the significance of meal planning disappeared in Model C, and that of avoiding large perishable purchases disappeared in Model D.

In Model C, attitudinal variables were introduced, which included the extent to which respondents agreed that wasting food is immoral and their attitudes towards food safety, as represented by their households' willingness to eat leftover food after a few days in the fridge. Both were found to have a significant negative influence on the quantity of food waste generated.

In Model D, variables representing households' consumption patterns and diets were introduced. Weekday meals was not found to be significant, although it later became significant in Model E with a positive coefficient. Weekend meals were found to be significantly associated with reduced food waste, and fresh fruit consumption was found to be significantly linked to more food waste. Lastly, participants who indicated they were not confident in their ability to cook tasty meals were significantly associated with higher quantities of food waste, although this was no longer significant with the introduction of variables related to waste management in Model F.

Variables related to grocery shopping patterns and characteristics were introduced in Model E. Participants that drove to at least one retail location were significantly associated with higher food waste volumes, as were longer travel times to their shopping destinations. The frequency at which participants bought FFV on its own did not have any significant effect, but the coefficient for its square term was found to be significant and negative, suggesting that food waste increases and then decreases as FFV shopping frequency increases.

Model F saw the introduction of two variables related to South Korea's volume-based food waste pricing system. The price of food waste disposal per liter was not found to be significant, while

participants who lived in apartment complexes where they paid a flat fee for food waste disposal were significantly associated with lower volumes of household food waste.

Overall, there were substantial improvements in model fit from A through F, as shown by the large decrease in the AIC value from 1748.042 in Model A to 1652.284 in Model F. Based on Akaike weight and evidence ratio calculations, Model F is estimated to be 6.2×10^{20} times more likely than Model A.

Table 5.17 Summary of regression results for total food waste volume per person

	A	B	C	D	E	F
(Intercept)	1.930	1.680	1.882	1.410	2.048	2.078
Respondent is Female	-.489***	-.366*	-.282*	-.357**	-.338**	-.343**
Age	.184***	.217***	.252***	.273***	.178***	.181***
Household size	-.195***	-.182***	-.207***	-.283***	-.311***	-.292***
Avoids large perishable purchases		-.109*	-.048	-.057	-.013	-.010
Plans meals (1 through 6)		.171***	.169***	.080	.080	.077
Plans meals everyday (dummy)		-1.044**	-.746*	-.284	-.237	-.268
Attitude: wasting food is immoral			-.186***	-.175***	-.161***	-.167***
Attitude towards leftover food			-.304***	-.270***	-.311***	-.307***
Number of weekday meals cooked				.030	.036*	.037*
Number of weekend meals cooked				-.130**	-.141**	-.141**
Relative tendency to eat fresh fruit				.262***	.212***	.232***
Not confident in ability to cook tasty meals				.079*	.080*	.071
FFV purchase frequency					.073	.075
FFV purchase frequency (square term)					-.096**	-.087*
Travel time					.164*	.183*
Drives to at least one retail destination (dummy)					.253	.272*
Respondent pays flat fee for food waste (dummy)						-.317*
Food waste disposal price						-.003
Akaike Information Criterion (AIC)	1748.041	1728.032	1706.510	1666.071	1653.326	1652.284
Δ AIC (vs. model A)	0	-20.009	-41.531	-81.970	-94.7146	-95.7573
Likelihood ratio chi-square	38.414***	64.423***	89.945***	138.385***	159.129***	164.172***
No. of observations	343	343	343	343	343	343

*, **, and *** denote significance at the 5%, 1%, and 0.1% levels, respectively

Table 5.18 Spearman correlations for all independent variables

	Female	Age group	HH size	Plans Meals	Plans meals always	Av large perish. purchases	Wkday meals	Wkend meals	Eat fruits	Not conf	Morally unacc.	Eat left-overs	FFV purch freq	FFV purch freq (sq)	Trav time	Drives	Apt flat fee	FW price
Female	1.000																	
Age group	-.115*	1.000																
HH size	-.034	.103*	1.000															
Plans Meals	-.056	.061	.108*	1.000														
Plans meals always	.017	.027	-.045	.321**	1.000													
Av large perishable purchases	.061	.071	-.147**	-.216**	.157**	1.000												
Wkday meals	.308**	.166**	.099*	.197**	.047	-.059	1.000											
Wkend meals	.261**	.143**	.043	.072	.019	-.030	.545**	1.000										
Eat fruits	.052	.086	.232**	.196**	-.007	-.136**	.083	.031	1.000									
Not conf	-.071	.027	-.045	-.078	-.044	-.034	-.117*	-.105*	-.049	1.000								
Morally unaccept.	.019	.294**	-.084	-.025	.103*	.274**	-.005	.070	.017	-.026	1.000							
Eat leftovers	.067	.004	-.101*	-.095*	.121*	.288**	.039	-.025	-.046	-.032	.047	1.000						
FFV purch freq	.015	.177**	.190**	.177**	.038	-.167**	.148**	.101*	.339**	-.081	-.058	-.004	1.000					
FFV purch freq (sq)	-.044	-.021	-.043	-.082	.040	.081	.012	-.047	-.067	-.018	-.007	-.012	.125**	1.000				
Trav time	-.015	.123**	-.017	.024	.012	-.211**	.091	.052	.002	.038	-.044	-.062	-.010	.056	1.000			
Drives	-.082	.192**	.322**	.095*	-.061	-.065	.006	-.007	.232**	-.062	.009	-.052	.147**	-.101*	.062	1.000		
Apt flat fee	.031	.109*	.136**	.013	-.025	-.018	.060	-.007	.138**	.000	-.004	.111*	.066	.001	.002	.069	1.000	
FW price	-.006	.062	.040	.026	-.018	.026	.023	.033	.095*	-.037	.016	-.060	.074	-.021	.000	.091	-.106*	1.000

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

5.12 Regression analysis of avoidable food waste volume

The models developed for total food waste were used as the basis for developing a regression model for avoidable food waste. Results from these regressions are presented in Table 5.19. In general, there were many variables from the previous model that were also significant in the model for avoidable food waste. For demographic variables however, age was not a significant factor from the outset. Additionally, being female was found to be significant in Model A, but this disappeared in Model D. Household size remained consistently significant throughout, with larger households generating less avoidable food waste per person.

Food management habits, including meal planning and avoiding large perishable purchases, were found to be significant in Model B. Meal planning was positively associated with larger amounts of avoidable food waste except in the case of respondents who indicated they always planned meals. However, the significance of the latter variable disappeared in Model C. Avoiding large perishable purchases was significantly associated with lower amounts of avoidable food waste, but this effect disappeared in Model C.

In Model C, attitudes towards food waste and food safety were found to be significant– respondents who agreed that wasting food is not moral generated less avoidable food waste and respondents whose households were more willing to eat leftover food after a few days were associated with less avoidable food waste.

In Model D, the number of meals cooked, either on weekdays or weekends, were not found to be significant. On the other hand, a household's tendency to eat fruits, as well as the extent to which respondents lacked confidence in their ability to cook tasty meals, were significantly correlated with larger amounts of food waste.

The coefficient for FFV purchasing frequency was found to be significant in Model E, although this was for its square term, which suggests that avoidable food waste increases and then decreases as FFV purchasing frequency increases. Travel time was not statistically significant in Model E, although it developed significance in Model F, where greater travel times were linked with more avoidable food waste. Car use was not found to be statistically significant.

In Model F, higher food waste disposal prices were statistically significant and inversely correlated with avoidable food waste. Additionally, respondents who lived in apartment complexes where they paid only a flat fee for food waste disposal were significantly associated with lower amounts of food waste.

As variables were added in Models A through F, model fit improved substantially as measured by the decrease in the AIC value from 795.976 to 703.774. Model F is estimated to be 1.05×10^{20} times more likely than Model A, based on Akaike weight and evidence ratio calculations.

Table 5.19 Summary of regression results for avoidable food waste volume

	A	B	C	D	E	F
(Intercept)	1.459	1.208	1.867	1.275	1.613	1.750
Respondent is female	-.638***	-.453*	-.155	-.302	-.225	-.173
Age	.028	.068	.154*	.141	.023	-.036
Household size	-.235***	-.203**	-.245***	-.294***	-.297***	-.226**
Avoids large perishable purchases		-.147*	-.045	-0.054	-.022	.015
Plans meals (1 through 6)		.185***	.206***	.152**	.129*	.140**
Plans meals always (dummy)			.977*	-.686	-.463	-.719
Attitude: wasting food is immoral			-.324***	-.262***	-.254***	-.230***
Attitude towards leftover food			-.474***	-.375**	-.421***	-.481***
Number of weekday meals cooked				.040	.047	.033
Number of weekend meals cooked				-.037	-.087	-.041
Relative tendency to eat fruits				.195***	.150*	.164**
Not confident in ability to cook tasty meals				.159**	.151**	.137**
FFV purchase frequency					.096	.140
FFV purchase frequency (square term)					-.158**	-.144**
Travel time					.183	.284**
Drives to at least one retail destination (dummy)					.213	.262
Apartment flat fee for food waste (dummy)						-.431*
Food waste disposal price						-.016***
Akaike Information Criterion (AIC)	795.976	780.023	748.745	732.550	721.275	703.774
Δ AIC (vs. model A)	0	-15.9528	-47.2305	-63.4253	-74.7008	-92.202
Likelihood ratio chi-square	25.349***	45.302***	82.579***	106.774***	126.050***	147.551***
No. of observations	343	343	343	343	343	343

*, **, and *** denote significance at the 5%, 1%, and 0.1% levels, respectively

5.13 Discussion

In general, the regression results both confirmed and contrasted with theory and prior research findings. The positive influence of age on total food waste was surprising, given that intuition suggests that older individuals may be more reluctant to waste food given their memories of food shortage due to war or poverty, or that they have more experience with managing food in ways that are less wasteful. It was expected that this would be the case in South Korea as well, especially given the relative recentness of the Korean War and the nation's recent industrialization. The result could be explained by how older individuals may purchase food in forms which require more preparation, e.g. vegetables that require a lot of trimming or peeling. This is corroborated by the fact that age had no effect on avoidable food waste, a finding that reflects prior research (Koivupuro et al., 2012; WRAP, 2008).

Male respondents were associated with more food waste but not with more avoidable food waste, suggesting that they generate lower quantities of unavoidable food waste. This may reflect the fact that traditionally, Korean men have never played large roles in the kitchen and therefore may opt to prepare simpler meals or use pre-trimmed ingredients than women, thereby generating smaller quantities of unavoidable food waste such as peel and other forms of trimmings.

That larger household sizes reduced total and avoidable food waste per person was consistent with findings from prior research (Koivupuro et al., 2012; WRAP, 2008) and is intuitive. More people in the household means that there is overall a greater probability that leftovers will be eaten and that it also becomes easier to purchase food in appropriate amounts.

Habits were represented by household tendencies to avoid large perishable purchases and to plan their meals. The former was not significant in Model F for total food waste or for avoidable food waste. Though significant when first introduced in Model B, it lost its significance once household attitudes towards leftovers were included. This could be suggestive of how a greater willingness to eat up leftover food could compensate for a household's tendency to buy food in larger quantities. For example, if a household tends to buy large quantities of perishables but then uses them all when cooking to produce large quantities of leftovers, very little food waste will be generated as long as there are people at home who do not mind finishing those leftovers.

The behavior of the meal planning variable was harder to explain due to the positive sign on its coefficient. In the total food waste model, meal planning (for Likert scale responses 1-6) lost its significance after the tendency to eat fresh fruit was introduced. This is likely linked to how these two variables are significantly and positively correlated (0.196), a link supported by prior evidence connecting more frequent meal planning and other organizational food-related behaviors to higher intakes of fruits and vegetables (Crawford, Ball, Mishra, Salmon, & Timperio, 2007; Gholami, Lange, Luszczynska, Knoll, & Schwarzer, 2013). This could help explain why meal planning has a positive coefficient in the regression model.

However, meal planning remained significant and positively correlated with avoidable food waste even in the final model for responses ranging from 1-6 (but not 7—"always") on the Likert scale. This was interpreted to mean that increased efforts to plan meals led to more food waste, unless the participant always (i.e. consistently) planned their meals. One possible reason for this counterintuitive result may be that a high level of consistency is required in order for planning

meals to be effective in reducing food waste. For example, if a household only plans meals sporadically, it may purchase foodstuffs for a number of meals but subsequently fail to account for the need to finish any leftover cooked food or partially used ingredients. In addition, if a household decides to begin planning meals, it may end up buying specific ingredients for multiple different dishes, potentially leaving it with partially-used ingredients that it fails to manage or does not know how to use up, leading to more food waste in the process.

The findings about meal planning and shopping habits discussed above are of particular interest as prior research has had conflicting findings over the importance of these behaviors for reducing food waste, with Koivupuro et al (2012) finding them irrelevant and Stefan et al (2013) and Williams et al (2012) identifying them as predictors of food waste. It is possible that these differences are due to variation in the wording of survey questions, as well as how the dependent variable was measured. For example, while Koivupuro etal (2012) and Williams et al (2012) relied on waste diaries to measure their dependent variable, Stefan et al (2013) did not measure actual quantities of food waste, but instead used the proportion of food thrown away as their dependent variable. Additionally, the definition of "meal planning and shopping routines" varied. For example, Williams et al (2012) only discuss planning ability implicitly, based on data they collected about shopping frequency and environmental education. Furthermore, the connection between meal planning and dietary composition is illustrative of such behaviors' complexity; isolating their effects on food waste in survey research may be more difficult than anticipated.

The more participants agreed with the statement, "wasting food is immoral," the less total and avoidable food waste they generated; this was the only attitude toward food waste for which this was true, as tested using multiple regression. Although intuitive, this finding is interesting in light of the attitude-behavior gap discussed in Chapter 2 and raises questions over the extent to which this gap is applicable across cultures and types of behavior. The attitude of household members towards food safety, as represented by their willingness to eat leftovers, was also associated with smaller quantities of total and avoidable food waste. This was intuitive, as this would help reduce the quantity of leftover food that spoils or is thrown out immediately after a meal.

The number of weekday and weekend meals cooked were included in order to assess the total physical inflow of food into each household since households that did not cook at home at all are unlikely to generate any food waste. As expected, a larger number of meals cooked on weekdays was significantly linked to larger amounts of total food waste, but the coefficient on this variable only became significant after the introduction of variables controlling per-trip purchase volumes (see discussion below). This change in significance could be considered intuitive as the number of meals cooked would be connected to how frequently households shop for groceries.

Conversely, more meals cooked on weekends reduced total food waste, although it is not clear why this should be the case. One potential explanation is that cooking on weekends gives families the chance to use up ingredients and consume leftovers created during the week. However, if this were true, the number of meals cooked on weekends would also reduce avoidable food waste, but it does not. Instead, neither weekday meals nor weekend meals have any significant effect on avoidable food waste. Overall, this result is counterintuitive and not easily explained.

The relative tendency of a household to eat fresh fruit was positively and significantly correlated with larger amounts of total and avoidable food waste. It is likely there are two effects at play here. Firstly, higher consumption of fruits also likely means that there is a larger output of inedible fruit parts such as seeds, peel, husks, etc. Secondly, higher consumption of fruits also means that a household is buying larger quantities of fruit, which can spoil easily in relation to other food groups. Nonetheless, it is strange that consumption of fresh leafy vegetables, which are in general more perishable than fruit, was not correlated with larger amounts of food waste. One possible explanation is the statistically significant correlation between fresh vegetable consumption and fruit consumption (Spearman rank correlation: 0.418, $p<0.01$), which could have masked any effect of the former on avoidable food waste.

Participants who indicated not being confident in their ability to cook tasty food tended to discard larger amounts of avoidable food waste than other participants. This result is highly intuitive; not only are households more likely to throw away leftover food that they did not enjoy eating, but it is also possible to imagine occasions on which meals are abandoned entirely due to taste, leading to more food waste in the process. That this variable was not significant in the final model for total food waste suggests that cooking confidence may not be linked with the generation of unavoidable food waste portions, and that discarded leftover food may not be a significant enough proportion of total food waste for cooking confidence to show up as a statistically significant driving variable.

Next, the maximum frequency at which households bought FFV across any retail format was found to be significant when included in the form of a square term for both total and avoidable food waste. That the coefficient on the square term as negative indicates that the relationship takes the shape of an inverse parabola; i.e. as FFV buying frequency increases, food waste volume first increases and then decreases. Based on plots of the data, the apex of the curve likely occurs somewhere around 2-3 times a month and once a week. The upward and downward portions of the curve may be explained by two different dynamics. On the upward sloping part of the curve, households are likely increasing their FFV buying frequency while also increasing the total volume bought per month, i.e. overall household FFV consumption is increasing. This explains why food waste also increases at these FFV buying frequencies: with larger volumes of FFV, spoilage propensity increases, as does the output of inedible portions such as trimmings and peel. On the downward part of the curve however, it is likely that total FFV purchases per month are largely stable but as purchase frequency increases, per-trip purchase volumes decrease. This could lead to lower food waste as the overall manageability of home FFV inventory is improved, leading to less spoilage.

Travel time proved to be a significant positive influence on both total and avoidable food waste. This is most likely linked to purchase sizes; the further participants have to travel further to a grocery retail location, the less frequently they are able to visit and therefore they need to make larger purchases in order to make up for their lower visit frequency. Additionally, these participants who have to travel further have a higher opportunity cost of not buying enough food or forgetting to buy something—this also increases the tendency to make larger purchases. As discussed previously, larger purchases may then increase the difficulty of managing perishable ingredients, increasing the risk of spoilage.

The third factor hypothesized to have an influence on per trip purchase volume was car use—this was modelled as a dummy variable that indicated whether participants drove or not to at least one of their food shopping destinations. It was anticipated that car use would enable consumers to transport more groceries more easily than consumers walking or taking public transport, suggesting larger purchase volumes and consequently, more food waste, for the reasons indicated above. Oddly, this dummy variable was found to be significant and positive for total food waste, but not for avoidable food waste, which suggests that the dynamics linking purchase volume and food waste is not as straightforward as previously thought.

One possible explanation is that whereas longer travel times and lower buying frequencies may physically necessitate larger purchase volumes, this may not be true for car usage. In other words, although participants may drive to the grocery store and purchase larger amounts as a result, other factors (e.g. travel time and buying frequency) could be more important in terms of determining whether over-purchasing takes place or not. Consumers may not always be taking full advantage of their car's capacity to transport groceries, and even when they do, the tendency to over-purchase may be tempered by the knowledge that they can easily come back again if needed. Consequently, the linkage between car use and total food waste is being driven by a larger throughput of foodstuffs through the household, generating larger quantities of inedible waste, but not necessarily avoidable food waste.

It is important to highlight the deliberate exclusion of per trip spending amounts from the regression model. Per trip spending amounts are important in theory as a proxy (albeit an imperfect one) for the physical quantity of groceries bought each trip. However, through regression models conducted for per trip spending at each of hypermarkets, supermarkets, and traditional markets, it was clear that per trip spending could be predicted using a combination of the variables already present in the regression model being discussed here, in particular those pertaining to visit frequency, travel time, and car use.

The last variables for discussion pertain to the waste management system. The first is a dummy variable indicating that the respondent was using a food waste disposal system in which they paid a flat monthly fee to their apartment complex—i.e. they were not directly exposed to a pay-as-you-throw system for food waste. In theory, this should be associated with higher amounts of food waste as these households are not being made to pay directly for their food waste. However, this variable was found to be significantly associated with lower amounts of total and avoidable food waste.

The explanation most likely lies in the fact that the measurement of this study's dependent variable was dependent on households' exposure to a volume-based pricing system. However, participants using the apartment flat fee system are not required to purchase official plastic bags nor prepay for the food waste they throw away and may not be as conscious of the volume of food waste they generate as other households. Given that people tend to underestimate the quantity of waste they throw away (Chung, 2008), it is likely that households using the apartment flat fee system systematically reported lower quantities of food waste than other households.

Finally, the per liter price paid for food waste disposal was found to have a significant and negative effect on avoidable food waste, but not for total food waste. This most likely reflects how households cannot do much to reduce the inedible fraction of food waste they generate. However, that the food waste disposal price was negatively correlated with lower quantities of avoidable food waste suggests that the volume-based waste pricing system is effective in reducing avoidable food waste volumes, underscoring the relevance of the polluter-pays principle in food waste reduction policy.

5.14 Policy implications

The findings presented in this chapter hold a number of policy implications. It is clear that policy goals for reducing household food waste should include encouraging households to shop more frequently while buying less each trip, discouraging the use of cars, and reducing travel time to stores. Although these three factors are all likely to be influenced by the physical accessibility of food retail to households, reducing the distance consumers have to travel only has a limited amount of potential to help achieve these goals.

The main reason for this is that food retailers in Seoul, regardless of format, already tend to be highly accessible; 63% of respondents only have to travel less than 10 minutes and 92% of respondents said they live near a store they can walk to and buy food from if needed urgently. People's decisions to drive and how frequently they shop are likely to be functions of factors other than physical accessibility. Research that explores such factors is required to understand why consumers make these choices. Possible factors to explore include time scarcity and convenience, which are likely to be significant drivers of low frequency, high volume shopping trips.

Despite the above, policies that target car users can be implemented. Hypermarkets and department stores offer ample parking space and parking redemption with a minimum purchase, which encourages shoppers to drive. In the short term, introducing regulation to remove such systems, charge nominal parking fees, and reduce parking availability, while politically unpopular, may help to discourage unnecessary car use.

The finding connecting the perception of food waste as immoral with less food waste is intriguing given questions previously raised over the effectiveness of moralizing as a strategy for promoting waste-reducing behaviors (Gjerris & Gaiani, 2013). Although this is not evidence that South Korean consumers will respond well to guilt-inducing campaigns, it does suggest they may have a certain level of responsiveness to more general tactics for reducing food waste. In addition to potentially reflecting cultural norms, it may also reflect the lasting effects of extensive public education campaigns that have accompanied the introduction of mandatory waste segregation and volume-based pricing policies in South Korea.

It is difficult to develop policy implications from the finding that increased fruit consumption contributes to more avoidable food waste without further research into the reasons for this. However, assuming that the relationship is linked to the increased perishability of fruit, developing highly visible labels or sticker systems that warn consumers about fruit perishability

could help reduce food waste from fruit. Existing efforts to improve the visibility of foods in the refrigerator, particularly the fruit and vegetable drawers, may also be effective.

Other findings suggest the continued importance of consumer education about different food practices. For instance, it is likely that initiatives to help people portion food properly will help reduce food waste in cases where families are averse to eating leftovers. Additionally, encouraging the consumption of leftovers could also help reduce food waste. Personal biases against food that is several days old due to aesthetics or perceptions linking freshness and quality are hard to overcome. Yet it may be possible to reduce discards from leftovers by introducing concrete guidelines over how long cooked food can be safely stored in the fridge, or by encouraging families to freeze leftovers they do not feel like eating.

Finally, the findings suggest that volume-based food waste pricing is an effective policy for reducing food waste. That per-liter disposal prices were significant for avoidable food waste but not total food waste reinforces this conclusion, suggesting that households in areas with higher disposal prices make greater efforts to reduce the volume of avoidable food waste they discard. Although survey participants were asked whether they dispose of food waste via channels other than the food waste collection system, this factor proved insignificant in the regression analysis. Nevertheless, it is important not to rule out the possibility that higher disposal prices are linked to increased illegal disposal of food waste due to possible social desirability bias in the survey response. Further research is also required into the extent to which decreased food waste is attributable to deliberately reduced moisture content rather than actual behavioral change. Lastly, the findings did not indicate whether any one volume-based pricing system was more effective than others in reducing food waste. This would be an interesting topic for follow-up research.

5.15 Conclusion

This chapter has presented and discussed findings from a household survey that garnered estimates of weekly household food waste generation and collected data on independent variables that were theorized to have an influence on household food waste. The aim was to test the hypothesis that shopping destination has an effect on the quantity of household food waste generated at home and to more broadly investigate the drivers of household food waste.

Independent variables represented demographics, attitudes, behaviors, consumption patterns and diets, grocery shopping patterns, and waste management policy. Two dependent variables were used: total food waste and avoidable food waste. Although this study is primarily concerned with avoidable food waste, analyzing total food waste in comparison with avoidable food waste provided an additional insight into different variables' effects on food waste.

Data collected via the household survey were primarily analyzed using multivariate regression; several regression models were created for both dependent variables. These models were differentiated by the successive introduction of different categories of independent variables in order to assess changes in independent variable coefficients and their statistical significance. Most findings were intuitive, both in terms of the sign on the coefficient and statistical significance.

From regression analyses, it was not possible to identify any distinct effect of shopping destination on food waste when looking only at whether a participant visited particular food retail types or not. However, survey data also indicated how different retail types are differentiated by visit frequency, mode choice, travel time, and purchase size. Taking these factors into account, it can be argued that food retail choice has an effect on household food waste, and that this effect is most clearly linked to factors connecting land use, transportation, and shopping frequency. Due to the complexity of variables underlying household food waste generation, it was not possible to assess from the analysis presented in this chapter whether characteristics inherent to different retail types, such as store environment, marketing, and product characteristics were associated with over-purchasing or not.

Otherwise, the primary limitation to the survey was its reliance on participant recall to measure the dependent variable. Although framing the question about food waste quantities using the volume-based pricing system was theorized to reduce this bias, it cannot nonetheless cannot be ruled out. Additionally, relying on the volume-based pricing system as the frame of reference may have introduced definitional issues with respect to what participants report as "food waste," as was touched upon in the introduction to this chapter. Another limitation is the representativeness of the sample. Despite having been reweighted to better match the distribution of household sizes in Seoul's population, the sample was still non-random in nature. If participants opted to take the survey because they had a latent interest in food waste or related issues, then self-selection bias may be present. Social desirability bias may also have played a factor; even though the survey questions were carefully worded, participants may regardless have felt pressured to represent their behaviors and attitudes positively. This may have limited the internal validity of some questions, particularly those designed to measure participants' food waste quantities and their attitudes towards food waste.

Chapter 6 – Analysis of household diary data

6.1 Introduction

This is the first of two chapters that analyze data on household food waste that was collected using a household kitchen waste diary. The aim of these chapters is twofold: to understand patterns in the composition and nature of food waste with respect to where food is being obtained and to supplement survey data first explored in Chapter 5 in order to probe the complexities of household food waste generation and identify any underlying relationships to food retail modernization. This chapter addresses the first of these objectives and is organized as follows. First, I provide a brief reminder of the different coding categories used when recording and coding the diary data and reiterate the logic that drives the line of analysis followed in this chapter, particularly in relation to the hypotheses being tested in this dissertation. I then present a brief profile of the households that participated in the diary study, before moving onto the bulk of the chapter, which presents the results of the analyses undertaken.

6.2 Methodological review

A total of 102 households completed and returned the diaries, and the items of food waste they recorded were coded according to several categories (Table 6.1). For the definitions of these categories, please refer to section 3.4.2 in Chapter 3. As the hypotheses being tested in this dissertation concern discards attributable to over-purchasing, the following analyses will be centered primarily on avoidable food waste that is unprepared. Three main reasons for discard will also be examined due to their association with over-purchasing; these are "spoilage," "old," and "date"—collectively, "SOD."

Table 6.1 Food waste categories

Avoidability	Preparation state	Reason for discard
Avoidable	Prepared	Preference
Potentially avoidable	Unprepared	Spoilage
Unavoidable	Previously prepared	Old
		Date
		Leftover
		Inedible
		Other

6.3 Profile of participant households

The 102 participant households represented a subsample of survey participants from chapter X, recruited using convenience sampling. Their distribution by age group is shown in Figure 6.1. Although quotas were not used for diary participant recruitment, age groups were represented fairly evenly. Those aged 31-40 were the majority at 29%. With the recruitment having been online only, it was surprising that participants in the 60+ age group were represented at all; together with participants aged 51-60, they made up 27% of the sample.

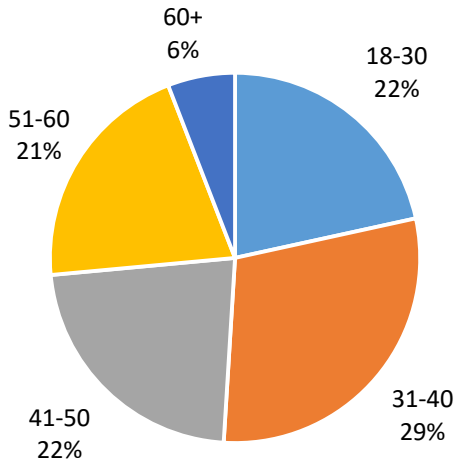

Figure 6.1 Distribution of diary participants by age

Diary participants were less evenly distributed than survey respondents with respect to household size (Figure 6.2). Households with four members were the majority with 33%, followed by 3-person households and 2-person households with 30% and 21% respectively.

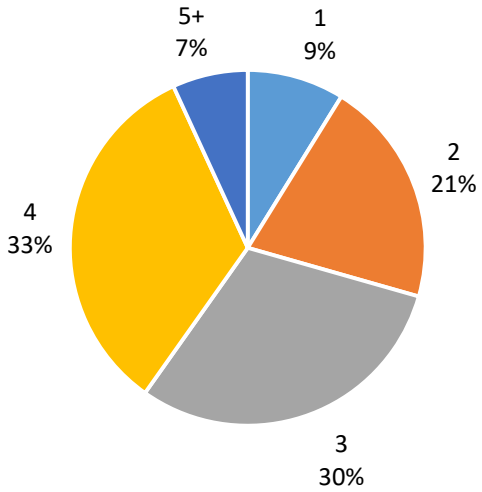

Figure 6.2 Distribution of diary participants by household size

Male participants were underrepresented in the diary sample at 32% (Figure 6.3). As with the survey, this was expected due to the cultural tendency in Korea for men not to help with household chores, including meal provisioning.

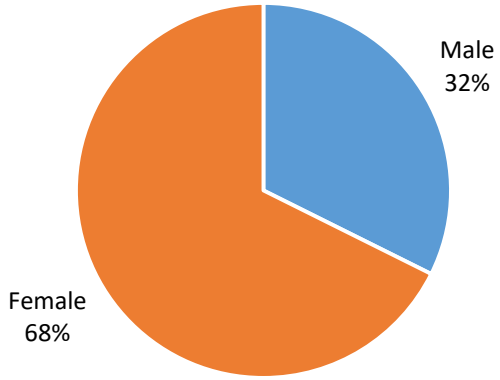

Figure 6.3 Distribution of diary participants by gender

Diary participants appeared to be slightly more educated overall than survey participants, with 15% holding graduate degrees, as opposed to 10% for the survey (Figure 6.4).

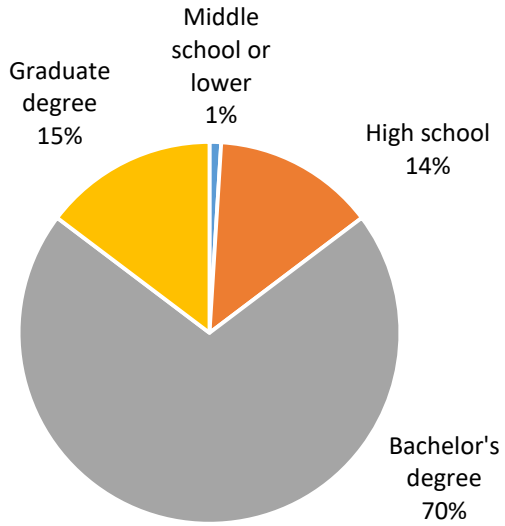

Figure 6.4 Distribution of diary participants by education level

Household incomes were also higher on average than the broader survey sample (Figure 6.5).

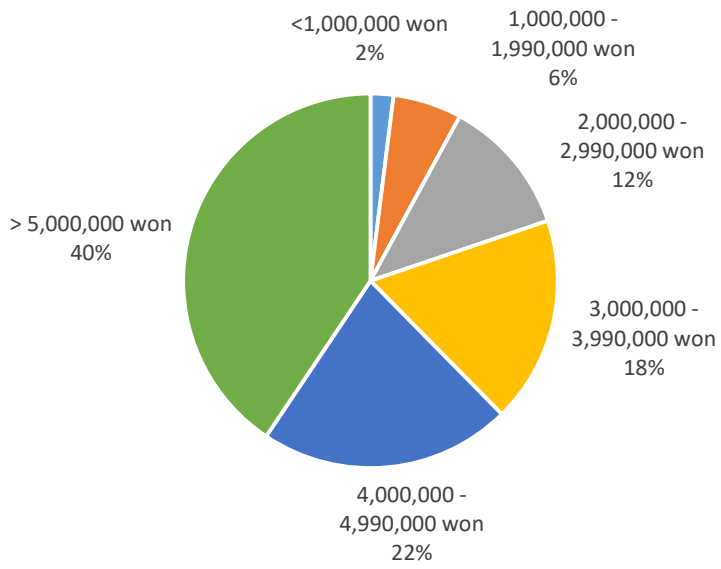

Figure 6.5 Distribution of diary participants by monthly household income

The analysis of survey data suggested that the primary demographic drivers of household food waste are age, gender, and household size. On this basis, the demographic profile of diary participants is unlikely to be statistically representative of either the survey sample or of the population as a whole.

6.4 Summary of diary data

In total, the 102 participant households recorded 4,617 entries, corresponding to 500 kg of food waste. This translates into an average of 4.9 kg of food waste per household over one week, or 700 g of food waste per day.

The composition of an average household's food waste by avoidability and by preparation state are shown in Figure 6.6 and Figure 6.7 respectively. By mass, just over half (53%) of household food waste was avoidable, with a further 6% being potentially avoidable. As for preparation state by mass, 75% was prepared, 18% was not prepared, and 7% was previously prepared.

Not shown in the figures are the equivalent breakdowns of household food waste based on count data. According to this data, 50% of food waste occurrences were avoidable, 7% potentially avoidable, and 43% unavoidable. These figures are nearly identical to the percentages derived from calculating the composition by mass. It thus appears that, the average mass of each item of avoidable food waste is quite similar to the average mass of each item of unavoidable food waste.

On the other hand, count data for preparation state indicate that 85% of food waste occurrences were prepared, 5% previously prepared, and 10% unprepared. The discrepancy between these data and the composition by mass data indicates that unprepared food waste occurs relatively

infrequently, but that the average mass of an unprepared food item is likely to be larger than that of a prepared food item.

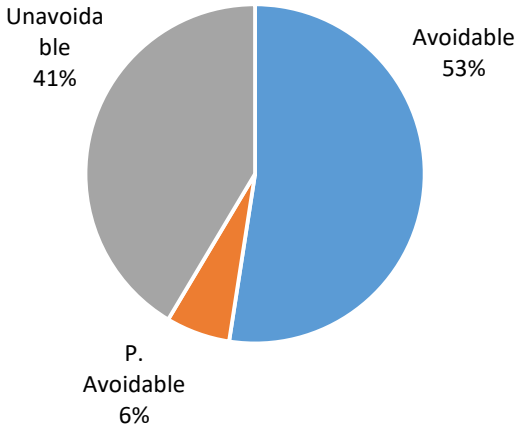

Figure 6.6 Average composition by avoidability

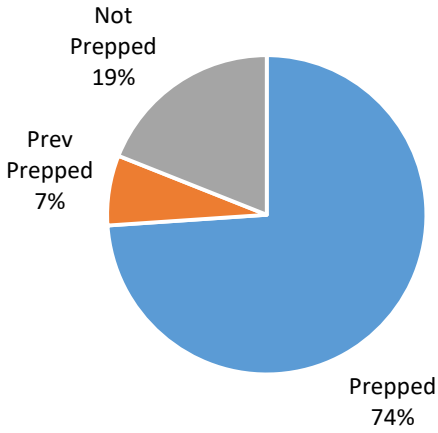

Figure 6.7 Average composition by preparation state

Further statistics are shown in Table 6.2 below. As indicated by the high standard deviations for all the data presented, there was a lot of variability in the composition of the households' food waste with respect to avoidability and preparation state.

Table 6.2 Summary statistics

	Food waste (g)		Avoidability (%)			Preparation State (%)		
	Total	per person	Avoid.	P. Avoid.	Unavoid.	Prep.	Prev. Prep.	Not Prep.
Mean	4,897	2,435	52.4	6.1	41.4	73.9	7.1	19.0
Median	3,910	1,068	55.4	2.4	39.9	77.3	2.6	13.6
Std Dev	3,369	3,767	24.8	10.3	22.5	19.3	10.0	17.4
Maximum	19,256	18,931	100.0	58.4	97.3	100.0	49.4	68.5
Minimum	739	108	0.0	0.0	0.0	12.4	0.0	0.0

Table 6.3 summarizes composition by mass data on where households' originally obtained the food they discarded. For the average household, the bulk of food waste (31%) came from hypermarkets. Family markets and traditional markets followed with 17% and 16%, respectively. Interestingly, the next most common source of food being discarded was the "Other" category (13%), which mostly referred to food obtained from parents and other relatives.

Table 6.3 Average food waste composition by mass according to original food source

Units: %	Spmkt	Hypmkt	Fam	Conv	TrMkt	TkOut	Internet	Other	Unacc
Mean	8.0	31.2	17.1	1.0	15.7	6.5	4.1	13.4	3.1
Median	0.0	23.2	10.3	0.0	5.0	2.9	0.0	6.9	0.0
Std Dev	16.7	28.3	20.3	3.8	20.8	8.3	11.8	18.2	6.7
Maximum	96.2	95.9	74.3	34.2	79.9	36.2	90.8	73.9	44.7
Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 6.8 shows how the average household's food waste was broken down, by mass, according to reason for discard. Other than unavoidable food waste, personal preference was the greatest contributor to food waste at 20%, followed by spoilage at 14%, and leftover at 10%.

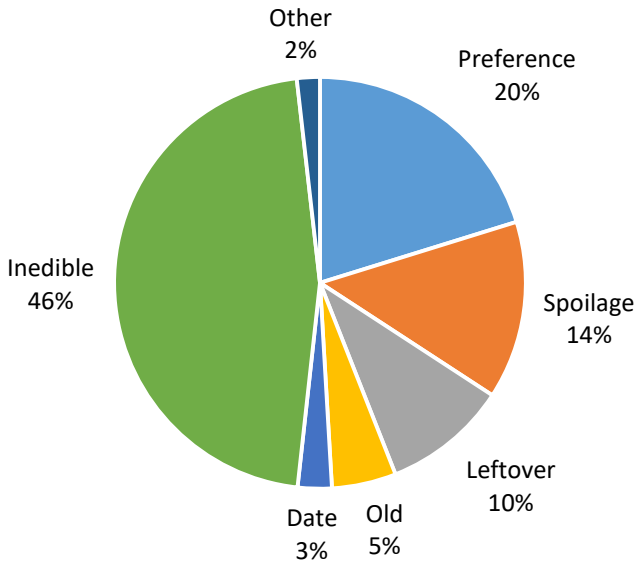

Figure 6.8 Average composition by reason for discard

6.5 Analysis of food waste by avoidability

Averaged across all participant households, 52% of food waste was avoidable and 41% was unavoidable. However, this split was very different for different sources of the food waste. The average percentages food waste for each source that were avoidable and unavoidable are shown in Figure 6.9. For more conventional sources of groceries, (i.e. supermarkets, hypermarkets, family markets, and traditional markets), the discrepancy between avoidable and unavoidable food waste is not as large as for supplemental sources of food (i.e. convenience stores, internet shopping, take-out/delivery, and "Other").

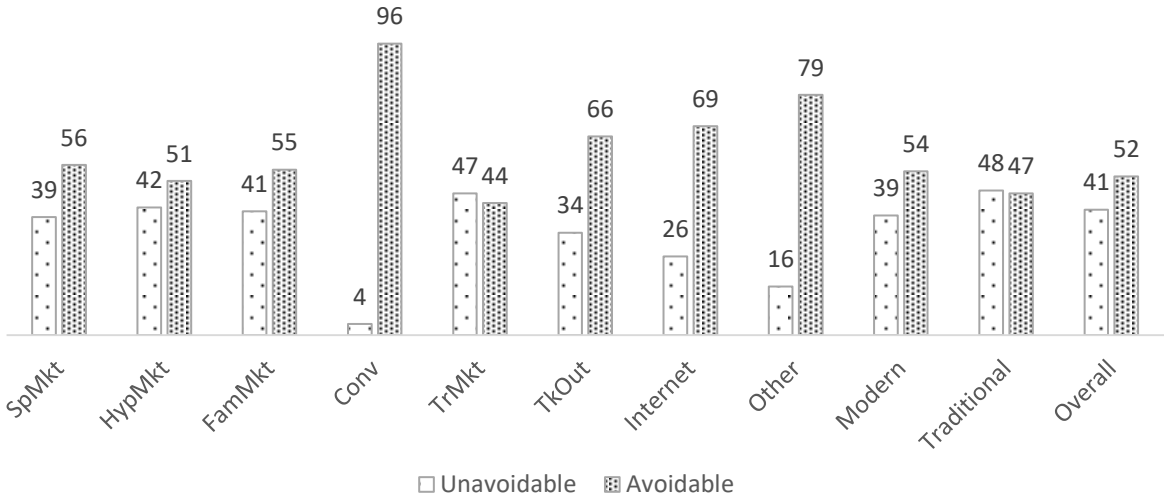

Figure 6.9 Food waste avoidability by source (average percentage)

Wilcoxon signed-rank testing was used to test for statistical significance and directly compare the proportions of avoidable and unavoidable food waste between traditional markets and the other sources of food. The results of these comparisons are presented below in Table 6.4, where statistically significant outcomes are recorded as "less" or "greater." Here, we see that the percentage of avoidable food waste was lower for traditional markets than all other sources, but that the percentage of unavoidable food waste was no different from supermarkets, hypermarkets, or family markets.

Table 6.4 Wilcoxon signed-rank test results for avoidability by mass

	% of food waste that was:	
Traditional markets had _____ percentages compared to:	**Avoidable**	**Unavoidable**
Supermarkets	No difference	No difference
Hypermarkets	Less	No difference
Family markets	Less	No difference
Convenience stores	Less	Greater
Take-out/Delivery	Less	No difference
Internet	Less	Greater
Other	Less	Greater
All excl. traditional markets	Less	No difference
Modern retailers	Less	Greater
Traditional retailers compared to:		
Modern retailers	Less	Greater

* "Greater" or "Less" indicate comparisons that were statistically significant at the 5% level

In order to further analyze the connection between avoidability and retail type, count data were used to calculate odds ratios for avoidable and unavoidable food waste for each source of food (Table 6.5).

Table 6.5 Odds ratio analysis for food waste avoidability by retail type

	Avoidable FW		Unavoidable FW	
	Odds Ratio	Confidence Interval (95%)	Odds Ratio	Confidence Interval (95%)
Supermarkets	0.83	0.700–1.02	1.27*	1.03–1.57
Hypermarkets	0.90	0.79–1.01	1.10	0.97–1.25
Family markets	0.87	0.76–1.01	1.20*	1.04–1.39
Convenience stores	34.99*	4.79–255.59	0.04	0.01–0.29
Traditional markets	0.61	0.51–0.72	1.43*	1.21–1.68
Take-out/Delivery	3.17*	2.34–4.30	0.42	0.31–1.69
Internet	0.88	0.65–1.20	1.24	0.91–1.69
Other	1.81*	1.51–2.17	0.49	0.40–0.59
Modern	1.15*	1.01–1.31	0.90	0.79–1.02
Traditional	0.87*	0.76–0.99	1.11	0.98–1.27

* Indicates statistical significance at the 5% level

Reflecting the data in Figure 6.9, the odds ratios for avoidable food waste were greater than parity and significant at the 5% level for convenience stores, take-out/delivery, and other sources of food waste. For unavoidable food waste, odds ratios were greater than parity and significant at the 5% level for supermarkets, family markets, and traditional markets.

As a group, modern retailers were more likely to be connected with avoidable food waste, with a statistically significant odds ratio of 1.152. Traditional retailers were significantly linked with lower odds of generating avoidable food waste (odds ratio 0.868).

6.5.1 Analysis of food waste by avoidability—FFV only

In order to control for the possible influence of food characteristics on avoidability, FFV food waste was analyzed separately. Figure 6.10 shows the average percentage of FFV food waste that was unavoidable or avoidable for each source of food. Unlike Figure 6.9, where most sources had more avoidable than unavoidable food waste, FFV food waste tends to mostly be unavoidable. Notable exceptions were take-out/delivery food and "Other" sources, which had high percentages of avoidable FFV food waste.

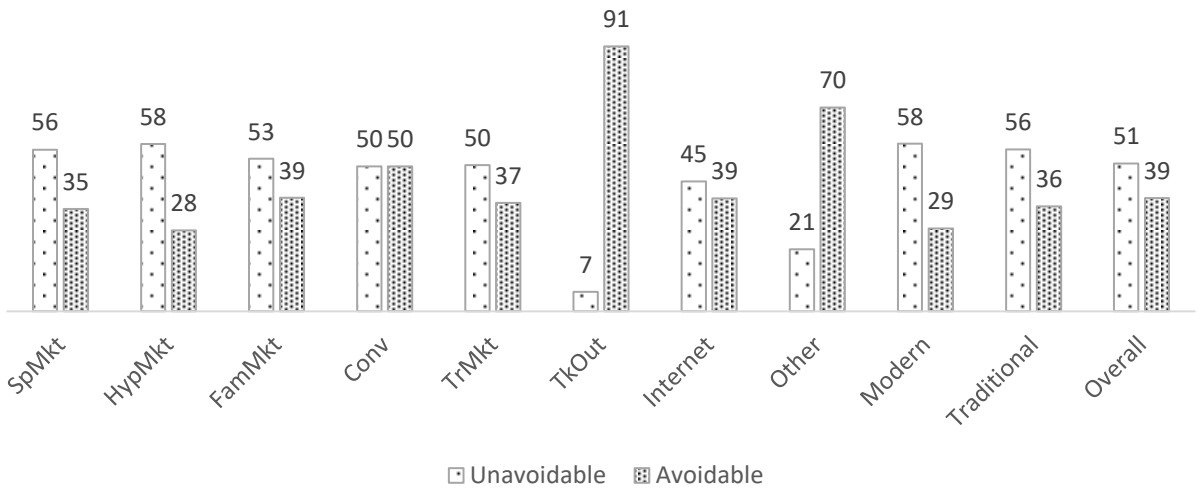

Figure 6.10 Average percent composition by mass of FFV food waste according to avoidability

Wilcoxon signed-rank tests found few statistically significant differences across food sources for avoidability and unavoidability of FFV food waste (Table 6.6). As might be anticipated from Figure 6.10, traditional markets were linked with lower percentages of avoidable food waste than convenience stores (N = 25, Z = -3.582, $p = 0.000$) and "Other" sources (N = 37, Z = -2.920, $p = 0.004$).

Table 6.6 Wilcoxon signed-rank test results for avoidability of FFV food waste

	% of FFV food waste that was:	
Traditional markets had _____ percentages compared to:	**Avoidable**	**Unavoidable**
Supermarkets	No difference	No difference
Hypermarkets	No difference	No difference
Family markets	No difference	No difference
Convenience stores	na	na
Take-out/Delivery	Less	Greater
Internet	No difference	No difference
Other	Less	Greater
All excl. traditional markets	No difference	No difference
Modern retailers	No difference	No difference
Traditional retailers compared to:		
Modern retailers	No difference	No difference

* "Greater" or "Less" indicate comparisons that were statistically significant at the 5% level

The results of odds ratio analysis used to compare the avoidability of FFV food waste across food sources are shown in Table 6.7. The data do not reveal any significant difference in the odds of FFV food waste being avoidable or unavoidable if comparing modern and traditional retail formats directly.

Table 6.7 Odds ratio analysis for avoidability of FFV food waste only

	Avoidable FW - FFV		Unavoidable FW - FFV	
	Odds Ratio	Confidence Interval (95%)	Odds Ratio	Confidence Interval (95%)
Supermarkets	0.74	0.53 – 1.02	1.54*	1.14 – 2.07
Hypermarkets	0.77*	0.63 – 0.93	1.10	0.92 – 1.31
Family markets	0.87	0.70 – 1.07	1.17	0.96 – 1.43
Convenience stores	2.02	0.13 – 32.35	0.86	0.05 – 13.71
Traditional markets	0.75*	0.56 – 0.94	1.30*	1.06 – 1.61
Take-out/Delivery	9.82*	4.93 – 19.56	0.14*	0.07 – 0.29
Internet	0.57*	0.34 – 0.96	1.68*	1.07 – 2.66
Other	2.49*	1.95 – 3.18	0.41*	0.32 – 0.52
Modern	0.94	0.77 – 1.14	1.00	0.84 – 1.19
Traditional	1.07	0.88 – 1.30	1.00	0.84 – 1.20

* Indicates statistical significance at the 5% level

However, there are significant differences between the individual retail types. Looking firstly at unavoidable FFV food waste, we see that FFV food waste from supermarkets, traditional markets, and internet shopping was more likely to be unavoidable, a statistically significant finding. This validates the possibility that FFV bought at traditional markets and supermarkets requires more trimming on average, but does not support the same notion for family markets. However, it was unexpected that internet shopping was also significantly associated with greater odds of there being unavoidable FFV food waste.

Retail types that were significantly associated with lower odds of generating unavoidable FFV food waste were take-out/delivery and "Other" sources. These results support the intuition about food obtained from these sources—as has been noted already, food from take-out/delivery requires zero preparation by nature and is almost entirely edible, and food from "Other" sources (mainly parents and relatives) is also more likely to be ready-to-eat than not.

For avoidable FFV food waste, take-out/delivery and "Other" sources had significantly higher odds ratios, a result which matches the earlier finding that these sources were associated with higher odds of avoidable food waste overall. It was interesting here that hypermarkets, traditional markets, and internet shopping had odds ratios for avoidable FFV food waste that were statistically significant and less than parity, yet this was not the case for family markets and supermarkets.

6.5.2 Reasons for avoidable food waste

When divided according to reason for discard by mass, avoidable food waste was, on average, generated mainly due to personal preference (38%, Figure 6.11). Next most common was "spoilage" at 26% and "leftover" at 19%. Analyzing avoidability by frequency data (Figure 6.12) paints a slightly different picture; although preference is still the predominant reason for discard, "leftover" is a more frequent occurrence than "spoilage." This indicates that the each item discarded due to spoilage is likely to weigh more on average than one discarded as a leftover.

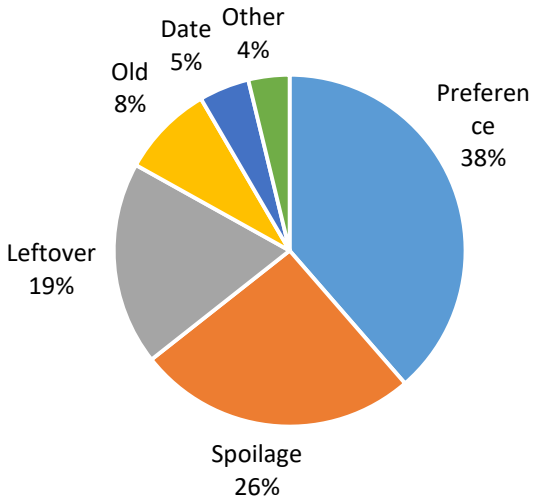

Figure 6.11 Avoidable food waste composition by mass according to reason for discard

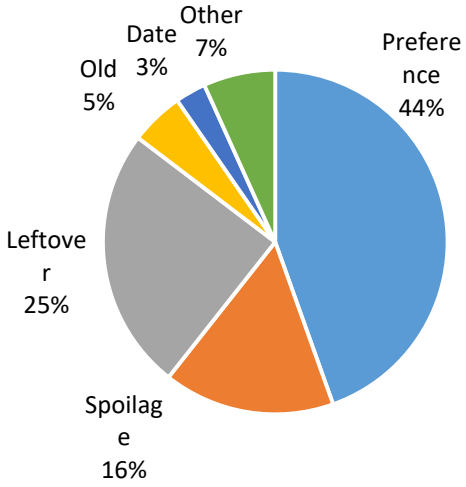

Figure 6.12 Avoidable food waste composition by frequency according to reason for discard

6.6 Analysis of food waste by preparation state

We have already seen that by mass, 74% of household food waste was prepared, 9% was previously prepared, and 17% was unprepared. To examine the relationship between preparation state and retail type, the average composition of household food waste that was prepared, unprepared, and previously prepared was calculated for each retail type (Figure 6.13). Avoidable food waste for each of the food sources shown in Figure 6.13 was mostly prepared. Unprepared food waste formed the next largest portion and previously prepared food was the smallest proportion for all retail types except for take-out/delivery.

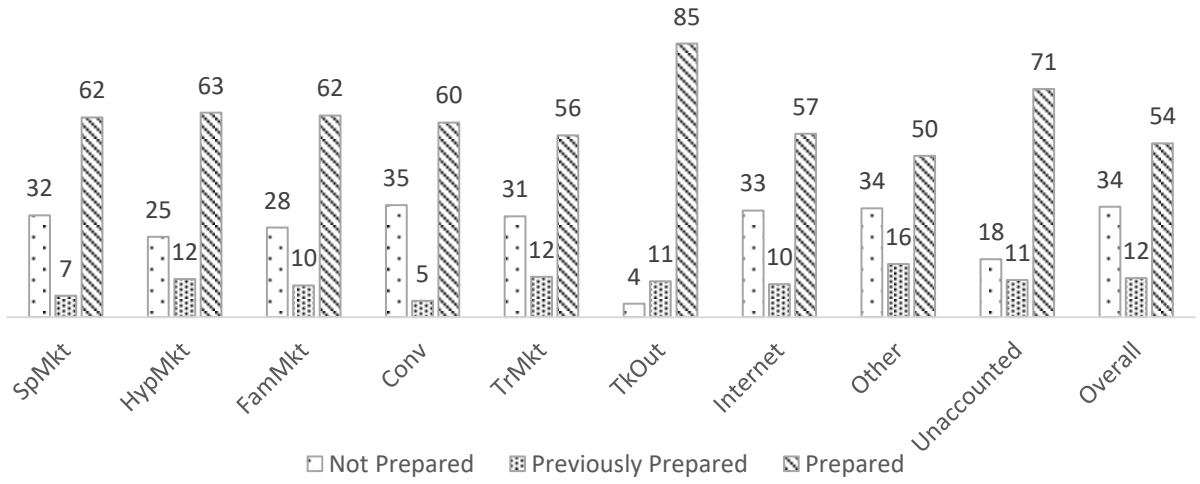

Figure 6.13 Food waste preparation state by source (average percentage by mass)

When comparing the percentage of avoidable food waste that was unprepared between traditional markets and other sources of food, Wilcoxon signed-rank tests (Table 6.8) did not yield any statistically significant differences, except with take-out/delivery food (N = 36, Z = -

3.363, $p = 0.001$). There was also no statistically significant difference when comparing modern with traditional forms of retail. It is however worth pointing out that one comparison came close to statistical significance; it suggested that supermarkets had a higher percentage of unprepared avoidable food waste than traditional markets (N = 25, Z = -1.810, $p = 0.070$).

Table 6.8 Wilcoxon signed-rank test results for preparation state of avoidable food waste

	% of avoidable food waste that was:
Traditional markets had _____ percentages compared to:	**Unprepared**
Supermarkets	No difference
Hypermarkets	No difference
Family markets	No difference
Convenience stores	No difference
Take-out/Delivery	Less
Internet	No difference
Other	No difference
All excl. traditional markets	No difference
Modern retailers	No difference
Traditional retailers compared to:	
Modern retailers	No difference

* "Greater" or "Less" indicate statistically significant comparisons at the 5% level

The results of odds ratios analysis that compared the prevalence of food waste in different preparation states across food sources are presented in Table 6.9. For the purposes of this analysis, prepared food waste was grouped together with previously prepared food waste.

Table 6.9 Odds ratio analysis for food waste according to preparation state and source

	Previously Prepared + Prepared FW		**Unprepared FW**	
	Odds Ratio	**Confidence Interval (95%)**	**Odds Ratio**	**Confidence Interval (95%)**
Supermarkets	0.85	0.58–1.24	1.18	0.81–1.72
Hypermarkets	1.16	0.93–1.45	0.86	0.69–1.08
Family markets	1.00	0.77–1.30	1.00	0.77–1.30
Convenience stores	0.58	0.28–1.21	1.73	0.82–3.62
Traditional markets	0.93	0.67–1.28	1.08	0.78–1.49
Take-out/Delivery	10.83*	4.00–29.36	0.09*	0.03–0.25
Internet	0.51*	0.31–0.83	1.97*	1.21–3.19
Other	0.67*	0.51–0.87	1.50*	1.15–1.95
Modern	1.01	0.79–1.29	0.99	0.78–1.26
Traditional	0.99	0.78–1.26	1.01	0.79–1.29

* Indicates statistical significance at the 5% level

It was notable that the only food sources with statistically significant odds ratios, for either unprepared or prepared food waste, were take-out/delivery, internet, and "Other" sources. Of these, take-out/delivery had a statistically significant odds ratio of nearly 11 for prepared avoidable food waste. In contrast, internet shopping and "Other" sources were more strongly associated with unprepared avoidable food waste.

6.6.1 Analysis of preparation state in conjunction with reason for discard

Looking at the preparation state of avoidable food waste provides a preliminary indicator of how much food waste households discarded due to reasons related to over-purchasing. Going by percentage mass data, 34% of avoidable household food waste on average was not prepared (Figure 6.14). However, when using count data, this percentage was only 20% (Figure 6.15), indicating that the discard of unprepared food waste is a relatively infrequent occurrence, but when it does happen, a relatively large quantity is discarded.

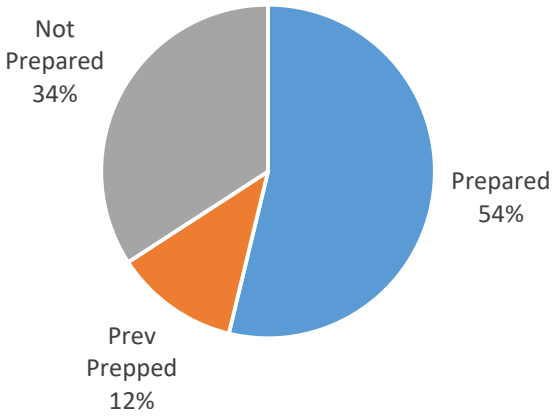

Figure 6.14 Average composition by mass of avoidable food waste according to preparation state

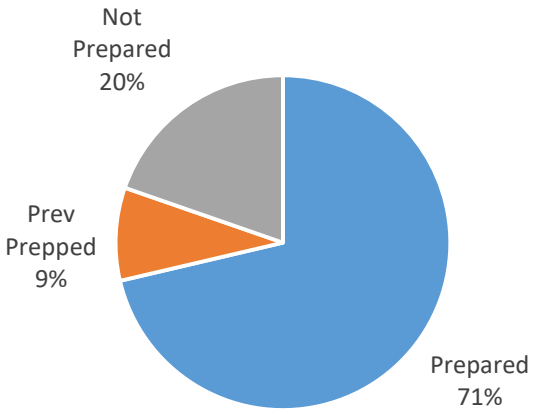

Figure 6.15 Average composition by frequency of avoidable food waste according to preparation state

Preparation state was strongly connected to avoidability and the reason for discard. For instance, most prepared food waste (62% by mass, Figure 6.18) was also unavoidable; this is because trimmings and other inedible portions are considered to have been prepared when thrown away. The remainder of prepared food waste was either thrown away due to portion size ("leftover," 15%) or personal preference (23%).

In contrast, unprepared food waste was entirely avoidable (Figure 6.16). 58% by mass of unprepared food waste was thrown away due to spoilage, and a further 13% and 15% because of the sell-by date and the food being old, respectively. That only 11% of unprepared food waste was thrown away due to personal preference reflects the reluctance of households to throw away food that is still fit for consumption. This reflects the tendency uncovered in prior research for households to procrastinate eating something until it goes bad and there is no choice but to throw it away (Evans, 2012).

Because previously prepared food waste (Figure 6.17) primarily consisted of leftovers that had been stored in the fridge for some time, it was natural that 44% and 35% were thrown away because of spoilage and because it was old, respectively.

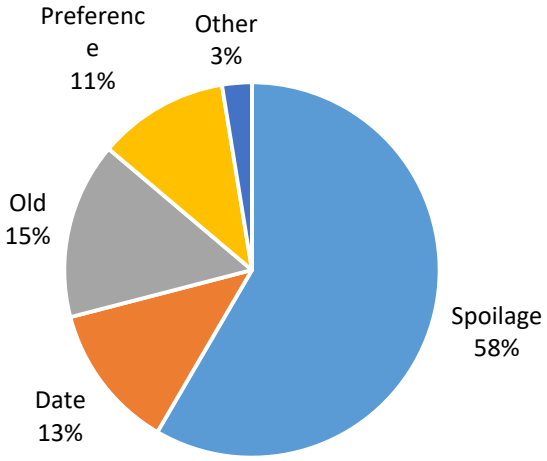

Figure 6.16 Average composition of unprepared food waste by reason for discard

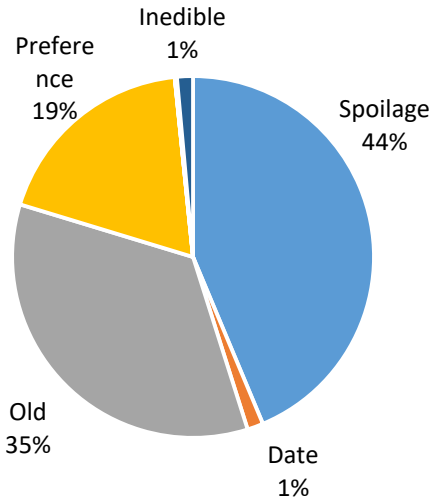

Figure 6.17 Average composition of previously prepared food waste by reason for discard

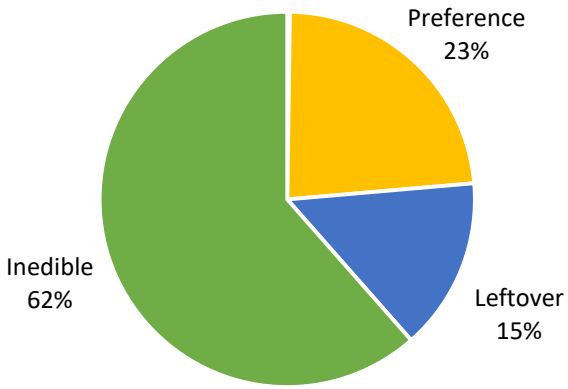

Figure 6.18 Average composition of prepared food waste by reason for discard

The hypotheses presented in Chapter 2 suggested that retail type influences food waste by increasing the risk of over-purchasing, thereby increasing the probability that the food is discarded before it can be used. This might be because of spoilage, the sell-by date, or the age of the food ("old"). Bearing this in mind, the mean percentages of avoidable unprepared food waste discarded for these three reasons (collectively, "SOD") are presented in Figure 6.19.

In general, spoilage dominated as the reason for discard across most sources of food. This percentage was highest for traditional markets at 72% and non-existent for take-out/delivery food. Food waste discarded because of "old" was most prevalent for take-out/delivery food and

smallest for family markets (8%). Lastly, convenience stores had the greatest percentage discarded due to the sell-by date (71%), while this figure was lowest for take-out/delivery food (0%).

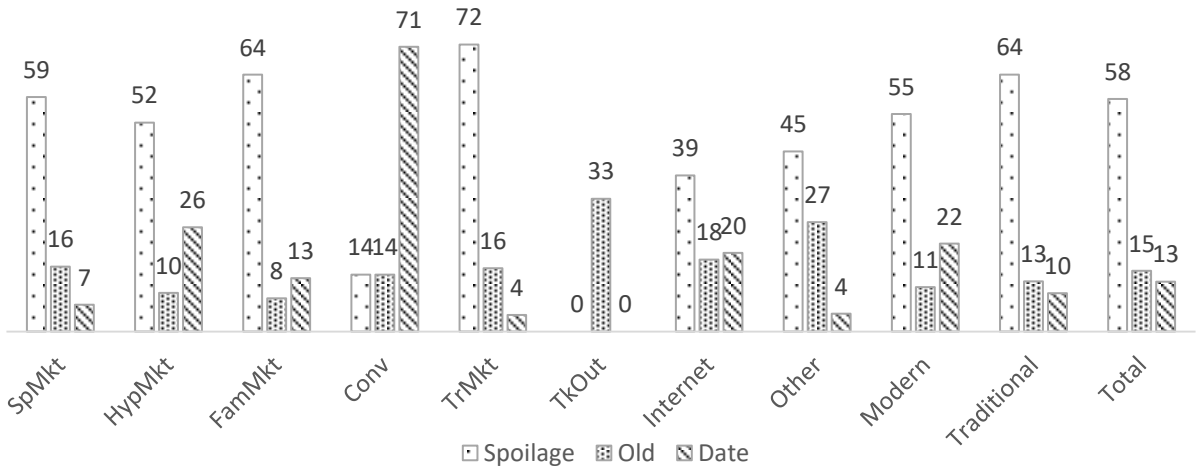

Figure 6.19 Average percentage by mass of avoidable unprepared food waste discarded due to SOD

Wilcoxon signed-ranked tests were performed to test for statistically significant differences in the percentages of avoidable unprepared food waste that was discarded due to SOD across retail types (Table 6.10). Turning first to spoilage, traditional markets had higher percentages discarded due to spoilage than internet shopping (N = 4, Z = -2.000, p = 0-.046) and "Other" sources (N = 8, Z = -2.060, p = 0.039). When compared to all other sources combined, traditional markets also had a greater percentage of avoidable unprepared food waste discarded due to spoilage (N = 27, Z = -2.011, p = 0.044).

Table 6.10 Wilcoxon signed-rank test results for avoidable unprepared food waste discarded due to SOD

	% of avoidable unprepared food waste that was discarded due to:			
Traditional markets had _____ percentages compared to:	**Spoilage**	**Old**	**Date**	**SOD**
Supermarkets	-	-	-	-
Hypermarkets	-	Greater	Less	Greater
Family markets	-	-	-	-
Convenience stores	-	-	-	-
Take-out/Delivery	na	-	-	-
Internet	Greater	-	-	-
Other	Greater	-	-	-
All excl. traditional markets	Greater	-	Less	-
Modern retailers	-	-	-	-
Traditional retailers compared to:				
Modern retailers	-	-	-	-

* "Greater" or "Less" indicate statistically significant comparisons at the 5% level

Two other comparisons came close to statistical significance; they suggested that hypermarkets (N = 13, Z = -1.787, p = 0.074) and family markets (N = 12, Z = -1.826, p = 0.068) also had greater percentages discarded due to spoilage that than traditional markets. There was no statistically significant difference found when comparing traditional and modern retailers. There was just one statistically significant result when comparing the percentages of avoidable unprepared food waste discarded due to "old;" this was higher for traditional markets than for hypermarkets (N = 13, Z = -2.023, p = 0.043). There were no results that approached statistical significance.[17]

Comparing the percentages of avoidable unprepared food waste due to "date" yielded two statistically significant results: traditional markets had lower percentages than hypermarkets (N = 13, Z =-2.060, p = 0.039) and all other sources combined (N = 27, Z = -2.100, p = 0.036). Additionally, the comparison between traditional markets and family markets was close to statistical significance, with family markets having a higher percentage (N = 12, Z = -1.841, p = 0.066).

When comparing SOD percentages, traditional markets had a statistically significant greater percentage than hypermarkets (N = 13, Z = -2.103, p = 0.035). Approaching statistical significance was the comparison between traditional markets and all other sources, with traditional markets having the lower percentage (N = 27, Z = -1.807, p = 0.071).

Moving on, the results of the odds ratio analysis for avoidable unprepared food waste discarded due to each of the SOD reasons are presented in Table 6.11.

Table 6.11 Odds ratio analysis for avoidable and unprepared food waste by reason for discard and source

	Avoidable + Unprepared FW discarded due to:					
	Spoilage		Old		Date	
	Odds Ratio	Conf. Interval (95%)	Odds Ratio	Conf. Interval (95%)	Odds Ratio	Conf. Interval (95%)
Supermarkets	1.11	0.56–2.19	1.32	0.55–3.14	0.80	0.30–2.14
Hypermarkets	0.73	0.48–1.10	0.50*	0.26–0.95	2.55*	1.51–4.30
Family markets	1.60	0.98–2.61	0.44*	0.19–0.99	0.83	0.42–1.63
Convenience stores	0.09*	0.01–0.71	0.61	0.08–4.86	23.48*	4.87–113.19
Traditional markets	2.34*	1.25–4.40	1.15	0.53–2.47	0.18*	0.04–0.76
Take-out/Delivery	0.00	na	5.65	0.78–40.80	0.00	na
Internet	0.64	0.29–1.45	1.41	0.51–3.90	1.33	0.48–3.67
Other	0.93	0.58–1.48	2.40*	1.36–4.25	0.20*	0.07–0.57
Modern	0.50*	0.32–0.78	1.12	0.57–2.19	2.58*	1.35–4.93
Traditional	2.02*	1.29–3.17	0.89	0.46–1.74	0.39*	0.20–0.74

* Indicates statistical significance at the 5% level

[17] Defined as having p-values greater than 5% but less than 10%.

Of the odds ratios calculated for spoilage, those for convenience stores and traditional markets stood out as statistically significant. With the former, avoidable unprepared food waste was significantly less likely to be thrown out because of spoilage, whereas the reverse was true for traditional markets. The odds ratios for spoilage that directly compared modern and traditional retailers were both statistically significant, with modern retailers having low odds and traditional retailers having high odds.

Next, avoidable unprepared food waste from family markets was found to be significantly less likely to be thrown away due to being old, but so was that from hypermarkets. The odds ratio for "Other" sources was also statistically significant—avoidable unprepared food waste was more than twice as likely to occur due to it being old than that from other retail types. There was no statistically significant difference in odds ratios for "old" when directly comparing modern and traditional retailers.

Turning to the odds ratios calculated for the "date" reason for discard, hypermarkets and convenience stores stood out as having statistically significant high odds of discard due to the sell-by date. The corresponding odds ratios for traditional markets and "Other" sources were also significant and much smaller than parity. This pattern of findings is repeated when directly comparing modern and traditional retailers; avoidable unprepared food waste from the former was 2.6 times more likely to be discarded due to the date, whereas for traditional sources the equivalent number was 0.39.

Lastly, comparisons of the odds of discard due to SOD in aggregate are presented in Table 6.12. Interestingly, statistical significance of the individual odds ratios for "spoilage," "old," and "date" (Table 6.11) were not reflected in this set of results.

Table 6.12 Odds ratio analysis for avoidable unprepared food waste discarded due to SOD

	Avoidable unprepared FW discarded due to spoilage, old, and date (SOD)	
	Odds Ratio	**Conf. Interval (95%)**
Supermarkets	1.40	0.48 – 4.11
Hypermarkets	0.84	0.47 – 1.48
Family markets	1.01	0.51 – 2.00
Convenience stores	na	na
Traditional markets	2.19	0.76 – 6.30
Take-out/Delivery	0.16	0.02 – 1.17
Internet	0.86	0.29 – 2.60
Other	0.77	0.41 – 1.46
Modern	0.75	0.39 – 1.44
Traditional	1.33	0.69 – 2.56

* Indicates statistical significance at the 5% level

6.6.2 Analysis of diary data by preparation state and reason for discard—FFV only

In order to control for possible correlations between food type, preparation state, and reasons for discard, the analyses in section 6.6.1 were repeated, but for FFV food waste only. First, to check for differences across food sources in the proportion of avoidable unprepared food waste that was FFV, a Wilcoxon signed-rank test was conducted. It found that this percentage was statistically significantly less for modern retailers than for traditional retailers (N = 41, Z = -2.015, p = 0.044). Though not quite statistically significant, the same relationship was found between hypermarkets and traditional markets (N = 13, Z = -1.890, p = 0.059) and between other sources and traditional markets (N = 8, Z = -1.826, p = 0.068).

Figure 6.20 summarizes the average extent to which SOD accounted for discards of avoidable unprepared FFV food waste for different retail types. Spoilage was the main reason for discard across all retail types shown, but was highest for family markets at 87% and lowest for internet shopping at 48%. "Old" was most prevalent for internet shopping at 27%. Discards due to the sell-by date were mostly negligible and ranged between 1-2%.

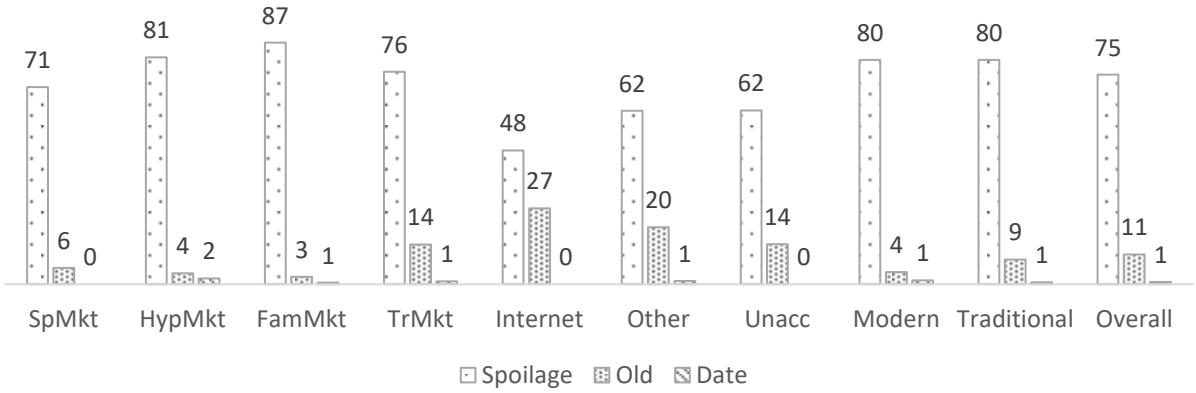

Figure 6.20 Average percentage by mass of avoidable unprepared FFV food waste discarded due to SOD

However, Wilcoxon signed-rank tests were unable to turn up any statistically significant differences between traditional markets or traditional retailers and other sources of food when comparing mass percentages across each of "spoilage," "old," "date," and SOD.

Odds ratio analysis was also applied to compare the relative prevalence of different causes of avoidable unprepared FFV food waste; the results are shown in Table 6.13.

Table 6.13 Odds ratio analysis for avoidable unprepared FFV food waste by reason for discard and source

	Avoidable + Unprepared FFV food waste discarded due to:					
	Spoilage		Old		Date	
	Odds Ratio	Conf. Interval (95%)	Odds Ratio	Conf. Interval (95%)	Odds Ratio	Conf. Interval (95%)
FFV Overall	8.06*	5.24 – 12.40	0.39*	0.23 – 0.67	0.06*	0.03 – 0.13
Supermarkets	1.22	0.43 – 3.44	0.38	0.05 – 2.95	0.00	na
Hypermarkets	1.39	0.69 – 2.77	0.23	0.05 – 1.01	2.26	0.49 – 10.40
Family markets	2.29	0.97 – 5.41	0.15	0.02 – 1.15	0.67	0.08 – 5.70
Convenience stores	na	na	na	na	na	na
Traditional markets	1.00	0.46 – 2.19	1.76	0.65 – 4.71	0.86	0.10 – 7.37
Take-out/Delivery	na	na	na	na	0.00	na
Internet	0.77	0.19 – 3.07	2.34	0.47 – 11.67	0.00	na
Other	0.42*	0.23 – 0.78	3.75*	1.61 – 8.73	1.18	0.22 – 6.24
Modern	0.84	0.41 – 1.73	0.64	0.20 – 2.11	1.40	0.23 – 8.60
Traditional	1.19	0.58 – 2.43	1.55	0.48 – 5.09	0.71	0.12 – 4.37

* Indicates statistical significance at the 5% level

Firstly, it is clear from looking at the odds ratios for FFV overall (i.e. total of FFV food waste from all sources) that avoidable unprepared FFV food waste indeed has a much higher likelihood of being discarded due to spoilage than other food types. Conversely, the odds that it was discarded because it was old or because of the sell-by date were lower than other food types. This suggests that spoilage rates for food waste overall are strongly driven by the presence of FFV in household food inventories. Otherwise, it was apparent that, except for "Other," no one retail type was more associated than the rest with the discard of FFV due to spoilage, "old," or "date.

The final piece of analysis in this section was to perform the odds ratio analysis on data combining "spoilage," "old," and "date"-based discards of avoidable unprepared food waste, the results of which are presented in Table 6.14 below.

Table 6.14 Odds ratio analysis for avoidable unprepared FFV food waste discarded due to SOD

	Avoidable unprepared FFV FW discarded due to spoilage, old, and date (SOD)	
	Odds Ratio	**Conf. Interval (95%)**
FFV Overall	1.49	0.87 – 2.56
Supermarkets	0.62	0.20 – 1.97
Hypermarkets	0.93	0.39 – 2.20
Family markets	1.26	0.46 – 3.49
Convenience stores	na	na
Traditional markets	1.84	0.53 – 6.38
Take-out/Delivery	na	na
Internet	1.25	0.15 – 10.22
Other	0.77	0.33 – 1.78
Modern	0.63	0.25 – 1.60
Traditional	1.59	0.62 – 4.03

* Indicates statistical significance at the 5% level

Given the lack of statistical significance found in Table 6.13, it was unsurprising that none of the retail types had statistically significant odds ratios when looking at aggregate SOD data. It was however noteworthy that the odds ratio for FFV overall was also not statistically significant. As has previously been noted, this may be the result of aggregating "spoilage," "old," and "date," thereby averaging out their individually extreme odds ratios (Table 6.13).

6.7 Discussion

Overall, the results provide statistical evidence that the composition of, and reasons for, food waste are different depending on where the food was originally obtained. Beginning with avoidability, there was evidence that traditional markets were associated with lower proportions of avoidable food waste than other sources of food, and also with higher proportions of unavoidable food waste. On its own, this may suggest that food from traditional markets is wasted to a lesser extent than food from other sources.

However, examining the avoidability of food waste is limited by its tendency to also reflect the extent to which food (particularly FFV) is pre-processed, which varies according to retail type. For instance, the convenience vegetables highlighted in Chapter 4 are not sold in traditional markets. As such, the results about avoidability are more likely to reflect the greater need to trim and/or peel food obtained from traditional markets. This is most obvious from the very high odds ratio for avoidable food waste from convenience stores, which almost exclusively sell food that is ready to eat. Similarly, the odds ratio on avoidable food waste was very high for "Other,"

which primarily consists of food received from parents and other relatives that is also mostly pre-prepared and thus ready-to-eat.

It was also plausible that the discrepancies observed in the percentages of unavoidable food waste across different sources reflect variation in purchase basket compositions from one retail type to another. If households buy more FFV from traditional markets, unavoidable food waste may appear to be more closely linked with traditional markets because FFV usually requires more peeling and/or trimming than other food types. Nonetheless, in order to exclude the influence of purchase basket composition, avoidability percentages were also compared for FFV food waste data only. In theory, any differences in unavoidable food waste that are attributable to purchase basket composition should disappear when looking only at FFV.

However, this was not the case. Although there was no discernible difference between modern and traditional retailers, traditional markets retained statistically significant odds ratios of both having more unavoidable food waste and less avoidable food waste when looking at FFV only. It was also interesting that the odds ratios of unavoidable food waste for supermarkets and internet shopping were also statistically significant and greater than parity. This suggests that FFV bought at these retail types may also be less processed than that bought at hypermarkets. Overall, it seems likely that the difference in avoidability of food waste is indeed attributable not to purchase basket composition, but to either greater "wastefulness" or variation in FFV packaging and pre-trimming across retail types.

To distinguish between the effects of wastefulness and FFV characteristics on food waste, the remainder of the analyses focused on avoidable food waste only and delved into comparisons across preparation state and reasons for discard. Of particular interest was the extent to which food waste associated with each format was unprepared, as this is theorized to be the primary indicator that households are unable to use up food before it spoils or is no longer optimal for consumption.

Wilcoxon signed-rank testing of mass percentages (Table 6.8) only served to highlight that take-out/delivery avoidable food waste tended to have a much lower percentage that was unprepared than traditional markets. This was expected since take-out/delivery food is, by definition, almost never "unprepared," because it is normally being served shortly after purchase or delivery. No other results from these tests were statistically significant.

Odds ratio analysis (Table 6.9) confirmed the finding about take-out/delivery food. It also showed that the odds of unprepared food waste was significantly higher for "Other" sources of food and internet shopping. The finding about "Other" sources is unsurprising, given how interviewees in Chapter 4 described discarding food that they received from their parents and other relatives, often untouched. The result for internet shopping suggests that food purchased online may be particularly prone to being "wasted" in the sense that it is being thrown away before households have a chance to make use of it. This could reflect a tendency for households to buy in bulk when shopping online, or the difficulty of deciding how much to buy without being able to see and handle the food in question. The ease of adding items to virtual shopping baskets and clicking to check out may also make online shopping a more thoughtless endeavor than visiting brick-and-mortar stores, increasing the risk of making unneeded or misjudged

purchases. Strangely however, internet shopping does not emerge as a significant source of food waste when looking at reasons for discard associated with over-purchasing, as will be discussed shortly.

Based on the foregoing analyses, only internet shopping appears to be linked with a higher risk of generating unprepared food waste. In contrast to the hypotheses presented, the analyses failed to identify any differences in the proportions and odds of unprepared food waste associated with traditional markets and other conventional grocery destination such as supermarkets, hypermarkets, and family markets.

However, it remains a possibility that unprepared food from these sources is discarded for different reasons. Wilcoxon signed-rank tests and odds ratio analyses were thus performed to examine the difference in the proportions and odds of avoidable unprepared food waste discarded due to "spoilage," "old," and "date." These tests mostly failed to provide evidence that supports the hypotheses. If anything, both traditional markets and traditional retailers were associated with higher percentages and odds of spoilage for avoidable unprepared food waste than other retailers. This was true when comparing mass percentages for traditional markets to all other sources (Table 6.10). It was also the case when looking at odds ratios for traditional markets and when comparing odds for traditional retailers with modern retailers (Table 6.11). This lattermost finding was interesting, especially because convenience stores (which had a very low odds ratio for spoilage) have already been excluded from the definition of modern retailers for the purposes of this analysis.

Households may also discard excess food before it is obviously spoiled, especially if they are skittish about food safety, and therefore sensitive to freshness and sell-by dates. Examining avoidable unprepared food waste discarded due to "old" and "date" helps assess this tendency. Here, the analyses provided evidence that both refuted and supported the hypotheses. Traditional markets were linked with higher mass percentages for "old" than hypermarkets (Table 6.10), while unexpectedly, both family markets and hypermarkets had low and statistically significant odds ratios for "old" (Table 6.11).

Elsewhere, it was notable that the odds ratio for "old" was high and statistically significant for "Other" sources of food. It was interesting that this should be the case for "old," but not for "spoilage," in light of the findings in Chapter 4 about the contribution of familial systems of provision to household food waste. This suggests that households tend to throw away food from "Other" sources without waiting for it to spoil. It may also reflect the fact that much of the food obtained from relatives is pre-cooked and hence might not spoil as easily as fresh ingredients. This is especially true for *kimchi* and other fermented side dishes, which are foods commonly received from family members.

The only results that supported my hypotheses came from comparing the mass percentages (Table 6.10) and odd ratios (Table 6.11) of avoidable unprepared food waste discarded due to the sell-by date. Doing so yielded a clear delineation between modern and traditional retailers, as well as between hypermarkets and traditional markets. Considering that sell-by dates are only issued for processed food and where packaging is present, this finding is intuitive and most likely reflects how a greater proportion of purchase baskets at hypermarkets and other modern retailers

are products with sell-by dates. This tendency was also reflected by the very high odds ratio (23.48) for convenience stores.

The foregoing discussion and comparison of reasons for discard across different sources of food clearly illustrated how food sources are strongly connected with different reasons for discard, albeit in a way that does not provide much evidence for the hypotheses. Rather, they reflect how food obtained from different sources has different characteristics (presence of sell-by date, freshness, packaging, etc.), and that these characteristics produce different reasons for discard. Traditional retailers appeared to be more closely associated with spoilage, while modern retailers were more closely linked to date-based discards; this sets up an interesting "trade-off" in food waste between modern and traditional retailers.

Assessing the extent to which spoilage-based discards at traditional markets balances date-based discards at hypermarkets required comparing data for avoidable unprepared food waste due to SOD across retailers. Whereas mass percentage comparisons (Table 6.10) showed that traditional markets were associated with more SOD food waste than any of the other sources of food, odds ratio analysis (Table 6.12) was unable to find any statistically significant differences. This was also true of less conventional sources of food such as take-out/delivery, convenience stores, and "Other." It may therefore be the case that, when buying from hypermarkets, any "savings" on food waste from reduced spoilage are lost due to date-induced discards.

However, it may also be that the reduced odds of spoilage associated with modern retailers are directly due to the presence of the sell-by date. In other words, the existence of the sell-by date simply results in food that might have gone bad anyway being thrown away earlier. If this is so, then the apparent connection between modern retailers and less spoilage-based food waste may be illusory. Another possibility is that, as a group, hypermarket shoppers are simply more sensitive to sell-by dates than traditional markets

As with the analyses of avoidable food waste however, the possibility that the above findings are due to differences in purchase basket composition across different retail types cannot be ruled out. As a result, Wilcoxon signed-rank tests and odds ratio analyses were repeated to compare only avoidable unprepared FFV food waste discarded due to "spoilage," "old," or "date." The sole statistically significant result here was for "Other," which had low and high odds ratios for "spoilage" and "old," respectively (Table 6.13). Together, these results highlight the likelihood that FFV obtained from "Other" sources will be thrown away due to it being too old for a household's preferences, as opposed to it having gone bad. As proposed previously, this could reflect how food, even FFV, received from family may be already precooked or fermented, increasing its shelf life. The lack of statistical significance elsewhere for the FFV-oriented comparisons fails to provide evidence that FFV discard rates due to "spoilage," "old," or "date" are different depending on where it is bought. This finding in particular is surprising, given observations in Chapter 8 suggesting that FFV at traditional retailers may have shorter remaining shelf-lives than that bought at modern retailers due to lengthier supply chains and reduced access to cold-chain infrastructure.

It was also interesting that there was no apparent difference in FFV discard rates between retail types, yet FFV proved to be a greater percentage of avoidable unprepared food waste for

traditional retailers than for modern retailers. This could indicate that, on average, traditional retailers are preferred over modern retailers as places to buy FFV. Recall also that avoidable unprepared food waste due to spoilage was found to be more prevalent for traditional retailers. Since this result was not repeated when examining FFV on its own, it must be non-FFV food groups that had higher rates of spoilage for traditional markets. Supplemental statistical testing of non-FFV food waste (not presented) confirms that this was the case for spoilage. Traditional retailers also had a lower proportion of discards caused by the sell-by date for non-FFV food groups than modern retailers.

That differences in spoilage rates between traditional and modern retailers should exist for non-FFV good groups, but not for FFV, is an intriguing result that is not easily explained. It may simply be the case that households are in general very aware of the increased spoilage risk associated with FFV, and therefore tend to be mindful of the quantities they purchase, regardless of where they are shopping. It may also be possible that FFV is not subject to the same kind of discounting and/or promotions which have been theorized to drive household food waste. In this way, households may be more adept at controlling inflows of FFV than anticipated. Another possible factor is that of differences in pricing. Whereas it was previously proposed that hypermarkets offer value for money via bulk discounts and other promotions, food sold there may still be more expensive than that sold in traditional markets. Consequently, households shopping at traditional markets may be just as, if not more, tempted by good deals than elsewhere, engendering more over-purchasing and thus, spoilage. Ultimately however, further investigation is required to shed more light on these results.

These possibilities could help make further sense of the findings in Table 6.13, where “Other” was the only source of FFV that was differentiated from others for discards due to “old” and “date.” “Other” sources are unique in the sense that, in comparison to obtaining food from food retailers, households have much less control over when they receive food from their parents and other relatives, as well as what food they receive. It is this lack of control that differentiates “Other” from other retailers with respect to SOD-based discards of FFV.

6.8 Policy implications

The analyses in this chapter have brought up several areas for consideration with respect to implications for policy. First and foremost, sell-by dates were undoubtedly responsible for the discard of a large proportion of food obtained at modern retailers, and in particular, hypermarkets. This is particularly concerning because under South Korean law, sell-by dates are not an indication of when food is best before, or when food can be safely consumed by, but is the date before which retailers are legally permitted to display and sell the food product. Nonetheless, it is evident from the analyses that participant households tend to misconstrue the sell-by date as the expiration date. Consequently, it is important to implement policies that improve consumer understanding of these dates. It may also be prudent for the government to revisit and revise the existing food labelling system.

Next, it was apparent that familial systems of provision contribute to the problem of food waste. The most obvious means of addressing this issue may be educational campaigns that discourage parents from being overly zealous in the provisioning they undertake on their children’s behalf.

However, such initiatives will be challenging to implement and may not be very effective due to the cultural embeddedness of this behavior. Furthermore, it is important to recognize that this problem may be exacerbated by shrinking household sizes and the growing number of single-generation households. Additionally, small living spaces in urban South Korea may limit the availability of storage space in household kitchens, especially for single-person households. This could contribute to the discard of food from "Other" sources if limited storage space prevents food from being stored under the right conditions. Subsidies that encourage couples to live near their parents may help address this problem. Doing so allows younger households to have meals at their parents' homes, which may relieve the sense of duty that parents feel to provide their children with extra food.

Looking at the bigger picture, there are also takeaways to be had from looking at the composition of household food waste more broadly. Although the focus of this chapter has been on the extent to which retail type influences SOD-based discards, it is also important to note that on average, the SOD reasons account for just under half of avoidable household food waste by mass. In contrast, 38% of avoidable food waste by mass was discarded due to personal preference, and another 19% as leftovers after a meal. These figures increase to 44% and 25%, respectively, if looking at count data (Figure 6.12). Furthermore, 54% of avoidable food waste by mass was already prepared, whereas discards accounted for by SOD are primarily unprepared.

Consequently, it is also important to address reasons for discard associated with avoidable prepared food waste, such as leftovers (i.e. imperfect portioning) and personal preferences. When recording the diary entries, it quickly became apparent that a large number of households chose to discard leftovers immediately after meals instead of storing them to eat later on. Further research is required to understand why this is the case, and comparisons across cultures would help establish whether the aversion towards storing leftover food is culture-specific or not. Continued consumer education about portioning and food safety would also be useful for reducing the production of leftover, and where they cannot be avoided, to encourage the consumption of leftover food.

6.9 Conclusion

The analyses in this chapter have been limited because it has not focused on explicating the drivers of household food waste in a way that Chapter 5 did using the household survey results. Rather, it has analyzed the composition of household food waste from multiple angles and tested its associations with where the food was originally obtained. This was achieved by coding and organizing diary entries in four main ways: avoidability, preparation state, reason for discard, and the original source of the food. Wilcoxon signed-rank testing and odds ratio analysis were used to compare the mass percentages and odds ratios, respectively, of different food waste categories across food sources. In particular, the aim was to test the hypothesis that certain food sources facilitate increased food waste by promoting over-purchasing and thereby increasing the risk of spoilage or the food otherwise turning a suboptimal state for consumption. For this reason, the analysis focused most on examining not only avoidable food waste, but also avoidable unprepared food waste that was discarded due to three reasons: "spoilage," "old," and "date."

For the most part, there was evidence for a linkage between the source of food and the composition of food waste, although for the most part it was contrary to what was hypothesized. Instead of promoting lower rates of spoilage, traditional markets were found to be associated with greater odds of food waste being discarded due to spoilage, as well as greater odds of food being discarded due to this reason. Another finding that confounded expectations was that there appeared to be no difference across food sources in the odds or mass percentages of FFV discarded due to spoilage. Rather, the discrepancy in spoilage rates between traditional markets and other sources was most likely attributable to non-FFV food groups.

The relationships uncovered between food source and food waste were not limited to spoilage-based discards. Whereas traditional markets were worse than other retailers for food waste in this regard, hypermarkets were found to be strongly connected with higher percentages and odds of discard due to sell-by dates. Additionally, the odds of food waste being avoidable and unprepared were found to be higher for internet shopping, although this finding did not extend to analyses that looked specifically at SOD.

Finally, "Other" sources of food, primarily consisting of food received from parents and other relatives, were found to be a more important source of food than anticipated before starting this research (13% of all food waste). This was significant because along with internet shopping, "Other" sources were also linked with higher odds of food waste being avoidable and unprepared. Further investigation found that food from "Other" sources was strongly associated with higher odds of discard due to "old," reflecting and providing evidence for the problems associated with familial systems of provision highlighted in Chapter 4.
Policy recommendations from this chapter's findings primarily sought to address the prevalence of sell-by dates as a likely cause of excess food waste and the revelation that familial systems of provision may also be a more important driver of food waste than previously imagined. Lastly, the picture of household food waste composition presented by the diary data also suggest that in addition to address over-purchasing behavior, is just as important that food waste policy addresses consumer preferences and understandings about food safety and leftovers.

There are several important limitations to the diary methodology and analyses presented in this chapter. The first is the reliability and accuracy of self-reported diary entries. It is possible that participants' measurement or estimates of food waste were not as accurate as they could be, which is especially true for participants who did not have access to a weighing scale and had to report their food waste in other units. Social desirability bias and the observer effect are also important to consider. To portray their behavior in a more positive light, households could deliberately under-report their food waste or alter their behavior to reduce food waste. As such, the diary entries may not be fully representative of their actual behavior. The analysis of count data in addition to mass data helped to provide a perspective on the data that was less susceptible to measurement inaccuracies and under-reporting, at the expense of some information loss. Finally, the analyses did not take into consideration the potentially confounding influences of demographic and behavioral factors. The following chapter addresses this by analyzing the diary data in conjunction with my survey data.

Chapter 7 – Joint analysis of household survey and diary data

7.1 Introduction

So far in this dissertation, I have analyzed household food waste generation using data gathered from the household survey, which were entirely reliant on the respondents' ability to accurately recall their behaviors and estimate how much food waste they had discarded on average during the last three months. Then, in the previous chapter, I took an in-depth look at the diary entries that participant households provided during a week-long diary study, comparing the masses and tendencies associated with discards of food that originated at different kinds of food retail. In this chapter, I hope to tie the two prior chapters together by returning to an analysis of households' survey responses, only this time with the diary-collected food waste data serving as my dependent variables.

As was on display in the previous chapter, the food waste data from the diary were very detailed, and there were numerous ways to "slice" and categorize the data for analysis. I have only carried over a subset of the different categories of food waste created in the previous chapter. My choice of which categories of food waste to use in this chapter was informed primarily by the need to test the hypotheses underlying my general supposition that retail format primarily affects household food waste by influencing over-purchasing. Avoidable food waste requires inclusion in order to remain in dialogue with the existing food waste literature, but I will also examine unprepared food waste, which directly represents the effects of over-purchasing by being defined as unused or partially used food that has been discarded straight out of the refrigerator (or other storage space).

The first section in this chapter elaborates on my choice of dependent variables, their variants, and their respective characteristics. I then proceed to assess the extent to which this set of dependent variables are correlated with independent variables, recorded by my survey, that cover categories including household demographics, attitudes, food-related behaviors, and grocery shopping trip characteristics. Next, I present the results of multivariate regression modelling conducted for each of the dependent variables and discuss the results in tandem with each other, with the aim of presenting a triangulated picture of how different variables are interrelated and influential (or not) with respect to the dependent variables. I then offer a brief discussion of policy implications before concluding the chapter.

7.2 Dependent variables

The analyses that fill the remainder of this chapter focus on a small number of dependent variables that help investigate the hypothesis that retail format can influence households' shopping behavior and food waste. The dependent variables fall into two main categories, where the second is a subset of the first: avoidable food waste and unprepared-avoidable food waste, normalized for household size and denoted in grams, as measured over the seven-day diary study period. In order to balance the shortcomings of these mass-based measures, I will also employ as dependent variables two other measures of avoidable food waste and avoidable-unprepared food waste: percentage-based and count-based data.

There are several advantages to analyzing percentage data and count data in addition to mass data. First, one of the challenges with the diary data was that participants' entries for the quantities they discarded were likely to have varying degrees of accuracy and reliability, even if recorded in grams from the outset. Since these variations were likely to be systematic for each participant, calculating avoidable and avoidable-unprepared food waste as percentages of broader categories helped to control for them. On the other hand, percentage data only indirectly accounts for the absolute quantities of food waste discarded. Although this represents information loss, it also save degrees of freedom in the regression analyses as it can help control for variables that increase the absolute quantity of food being purchased and discarded by households, most notably household size and participants' tendency to cook and eat at home.

Employing count data goes one step further than percentage data by measuring only the number of times that households discarded food waste, thereby eliminating the effects of any inaccuracies associated with the measurement of food waste. Again, information loss is an issue, as is the possibility that the count-based measure may more heavily reflect food discards that naturally occur more often, such as leftovers from meals. Since the diary entries were coded according to food types, count data also reflects the variety of food discards, in addition to their frequency. Altogether, the distinct characteristics of count data will provide a slightly different perspective on waste-related behaviors.

Finally, although it will not be included in my regression analyses, I will also include total food waste per person as an additional information point and "foil" to the other measures employed. Table 7.1 summarizes the dependent variables used in this chapter:

Table 7.1 Summary of dependent variables

Dependent variable	Definition	Characteristics
Total FW per person	Total mass of food waste divided by household size	- Reflects mass of all food waste discarded, controlling for household size - Meaningfulness limited by its inclusion of avoidable and unavoidable food waste - Susceptible to participants' measurement error and imprecision introduced by conversion from non-mass to mass units
Avoidable FW per person	Mass of avoidable food waste divided by household size	- Reflects mass of avoidable food waste discarded, controlling for household size - Most intuitive measure of household food waste - Susceptible to participants' measurement error and imprecision introduced by conversion from non-mass to mass units
Percent avoidable FW	Mass of avoidable food waste divided by mass of total food waste	- Reflects household's tendency to discard avoidable food waste in relation to unavoidable food waste - Also affected by the discard of unavoidable food waste as a result - Reduces imprecision introduced by measurement error and conversion from non-mass to mass units

# of avoidable discards	No. of food items discarded by households that were classified as avoidable	- Unaffected by imprecision introduced by measurement error and conversion from non-mass to mass units - Reflects variety in addition to quantity - Does not control for scale effects from household size - Potentially biased towards discards that naturally occur more frequently, such as table leftovers
Unprepared FW per person	Mass of avoidable-unprepared food waste divided by household size	- Reflects mass of avoidable-unprepared food waste discarded, controlling for household size - Most intuitive measure of household food waste - Susceptible to participants' measurement error and imprecision introduced by conversion from non-mass to mass units
Percent unprepared FW	Mass of avoidable unprepared food waste divided by mass of avoidable food waste	- Reflects tendency to discard avoidable unprepared food waste - Also affected by the discard of avoidable prepared and previously prepared food waste - Reduces imprecision introduced by measurement error and conversion from non-mass to mass units
# of unprepared FW	No. of food items discarded that were classified as avoidable and unprepared	- Unaffected by imprecision introduced by measurement error and conversion from non-mass to mass units - Reflects variety in addition to quantity - Does not control for scale effects from household size - Potentially biased towards discards that naturally occur more frequently, such as table leftovers

The correlation coefficients between the different measures of food waste are shown below in Table 7.2. Most are statistically significant, and the range extends from 0.046 to 0.787, indicating that the dependent variables are measuring similar, but not exactly the same aspects of household food waste.

Table 7.2 Spearman rank correlation coefficients among dependent variables

	Total FW per person	Avoidable FW per person	Percent Avoidable FW	# of Avoidable FW	Unprep FW per person	Percent Unprep FW	# of Unprep FW
Total FW per person	1.000						
Avoidable FW per person	.774**	1.000					
Percent Avoidable FW	.110	.650**	1.000				
# of Avoidable FW	.540**	.642**	.416**	1.000			
Unprep FW per person	.473**	.653**	.466**	.437**	1.000		
Percent Unprep FW	.054	.177	.174	.046	.775**	1.000	
# of Unprep FW	.353**	.502**	.408**	.617**	.787**	.592**	1.000

* and ** denote significance at the 5% and 1% levels, respectively

In addition to the categories identified above, I will refer to other, more narrow categories of food waste if doing so adds additional color to the analyses. For example, looking at variables that drive prepared food waste can help explain why other variables might be correlated with unprepared food waste.

7.3 Demographic characteristics

First, the effect of gender on the dependent variables was tested using a Kruskal-Wallis H Test (Table 7.3). This found that total food waste per person was higher for females than males. There was also a nearly statistical significant difference in the count of avoidable discards, with females throwing away a higher number than males.

Table 7.3 Kruskal-Wallis H test results for effect of gender on food waste

	Total FW per person	Avoidable FW per person	Percent Avoidable FW	# of avoidable discards	Unprep FW per person	Percent Unprep FW	# of unprep discards
Mean rank:							
Male	43.09	46.53	52.64	43.79	49.36	51.00	52.68
Female	55.52	53.88	50.96	55.19	52.52	51.74	50.93
Chi-square	3.940	1.376	.072	3.318	.255	.325	.079
df	1	1	1	1	1	1	1
p-value	.047	.241	.789	.069	.569	.905	.779

Kruskal-Wallis H Testing found a significant relationship only between age and avoidable food waste per person (Table 7.4). Post-hoc testing confirmed that this relationship was owed to avoidable food waste per person being higher for the 31-40 age group than the 41-50 age group, but did not identify any other differences between the age groups. Additionally, Jonckheere-Terpstra Tests provided statistically significant evidence for monotonic and decreasing

relationships between age and avoidable food waste per person [T_{JT} = 1600.00, z =-2.404, p =0.016] and the avoidable percentage of food waste [T_{JT} = 1616.00, z =-2.309, p =0.021].

Table 7.4 Kruskal-Wallis H Test results for effect of age on food waste

	Total FW per person	Avoidable FW per person	Percent Avoidable FW	# of avoidable discards	Unprep FW per person	Percent Unprep FW	# of unprep discards
Mean rank:							
18-30	51.91	55.57	57.18	49.07	50.98	59.02	48.11
31-40	59.33	63.87	60.77	57.00	56.23	54.07	55.20
41-50	44.54	43.76	42.61	52.24	45.00	47.61	49.43
51-60	45.31	38.95	43.24	47.79	50.17	47.07	53.76
60+	59.17	48.33	47.33	43.08	59.33	41.50	45.42
Chi-square	4.700	11.075	7.587	49.07	2.353	5.098	48.11
df	4	4	4	4	4	4	4
p-value	.319	.026	.108	.732	.277	.508	.868

Moving on, there were statistically significant relationships between income and the counts of avoidable discards and unprepared discards, which was unsurprising as these measures do not control for the effects of household size, and larger households in the diary sample also had higher incomes (Table 7.5). The relationship between unprepared food waste per person and income came close to being statistically significant, with higher-earning families throwing away a larger amount.

Table 7.5 Jonckheere-Terpstra Test results for effect of income on food waste

	Total FW per person	Avoidable FW per person	Percent Avoidable FW	# of avoidable discards	Unprep FW per person	Percent Unprep FW	# of unprep discards
Mean rank:							
< 1 million won	22.00	6.50	5.50	4.50	18.50	31.50	12.50
1-1.9 million won	44.33	43.92	54.17	28.58	29.17	24.33	25.67
2-2.9 million won	63.88	57.83	48.58	47.50	62.25	60.33	51.04
3-3.9 million won	56.83	53.64	50.11	50.33	44.47	48.83	46.67
4-4.9 million won	43.52	44.09	47.68	52.34	45.57	44.73	49.00
≥5,000,000 won	51.07	54.76	55.63	57.15	58.27	56.35	59.55
Observed J-T Statistic	1820.000	2015.000	2108.000	2286.500	2193.000	2100.500	2339.000
Mean J-T Statistic	1882.000	1882.000	1882.000	1882.000	1882.000	1852.000	1882.000
Std. Deviation of J-T Statistic	162.808	162.806	162.809	162.709	162.627	160.502	161.725
Std. J-T Statistic	-.381	.817	1.388	2.486	1.912	1.548	2.826
p-value	.703	.414	.165	.013	.056	.122	.005

The unprepared percentage of avoidable food waste had a statistically significant correlation with educational attainment (Table 7.6). This difference was attributable to those only holding bachelor's degrees having a lower unprepared food waste percentage than those who had high school education at most. There was no evidence of a monotonic relationship between educational attainment and any of the dependent variables.

Table 7.6 Kruskal-Wallis H Test results for effect of education on food waste

	Total FW per person	Avoidable FW per person	Percent Avoidable FW	# of avoidable FW	Unprep FW per person	Percent Unprep FW	# of unprep FW
Mean rank:							
High school & lower	52.53	48.87	47.40	48.93	63.20	68.73	52.17
Bachelor's degree	49.98	52.69	55.22	52.15	48.30	45.10	50.10
Graduate degree	57.77	48.43	37.73	50.93	55.17	61.20	57.57
Chi-square	.881	.396	4.674	.154	3.426	10.206	.810
df	2	2	2	2	2	2	2
p-value	.644	.820	.097	.926	.180	.006	.667

Household size only had a significant influence on two measures of food waste: the number of avoidable discards and the number of unprepared-avoidable discards (Table 7.7). As with income, this was not a surprising result since larger households naturally generated larger quantities of food waste than smaller ones.

Table 7.7 Jonckheere-Terpstra Test results for effect of household size on food waste

	Total FW per person	Avoidable FW per person	Percent Avoidable FW	# of avoidable discards	Unprep FW per person	Percent Unprep FW	# of unprep discards
Mean rank:							
1	56.00	66.11	65.89	24.39	50.56	49.83	25.78
2	58.74	56.67	52.00	41.88	54.29	41.33	46.93
3	51.11	48.18	44.58	55.23	51.34	51.98	55.31
4	44.21	47.65	55.35	58.47	49.88	56.99	55.56
5+	61.14	50.64	43.43	64.86	52.93	55.36	61.71
Observed J-T Statistic	1738.000	1677.000	1840.000	2502.000	1877.000	1935.500	2326.500
Mean J-T Statistic	1929.000	1929.000	1929.000	1929.000	1929.000	1893.500	1929.000
Std. Deviation of J-T Statistic	166.111	166.110	166.112	166.009	165.932	163.616	165.002
Std. J-T Statistic	-1.150	-1.517	-.536	3.452	-.313	.257	2.409
p-value	.250	.129	.592	.001	.754	.797	.016

Employment status was also tested against the dependent variables, but there were no significant relationships identified.

7.4 Attitudinal factors

There were very few statistically significant relationships uncovered between the dependent variables and attitudes towards food waste, as measured by degrees of agreement with statements as to food waste being morally acceptable, bad for the environment, socially unacceptable, a waste of money, and inherently wrong. There were very slight positive relationships between participants' unprepared percentage of food waste and their agreement that food waste is morally unacceptable [T_{JT} = 1741.50, z =-2.019, p =0.043] and that food waste is socially unacceptable [T_{JT} = 1793.50, z =-1.997, p =0.046]. However, spearman rank correlation coefficients for each

of the above relationships were not statistically significant and close to zero (<0.1), which suggests that they were all very weak.

On the other hand, attitudes towards food safety had various significant effects on food waste (Table 7.8). First, the extent to which households were willing to eat leftover food in the fridge after a few days was negatively correlated with the numbers of avoidable discards and unprepared discards, an intuitive result. However, less intuitive was the result that households with more members willing to eat food regardless of sell-by date were associated with higher absolute quantities and unprepared percentages of food waste. This finding was mirrored with respect to eating food a few days after its sell-by date; greater willingness to do so was connected with higher per person quantities of total food waste, avoidable food waste, and unprepared-avoidable food waste.

Table 7.8 Jonckheere-Terpstra Test results for effect of food safety attitudes on food waste

	Total FW per person	Avoidable FW per person	Percent Avoidable FW	# of Avoidable FW	Unprepared FW per person	Percent Unprep FW	# of Unprep FW
Eat leftover food in fridge after a few days							
Mean rank:							
None of us	51.14	47.79	45.50	58.21	46.46	44.14	52.79
Some of us	50.89	53.47	55.87	60.68	56.13	57.95	59.99
All of us	52.06	51.04	49.86	42.64	49.39	47.78	44.69
Observed J-T Statistic	1593.000	1577.000	1536.000	1138.000	1508.000	1449.000	1270.000
Mean J-T Statistic	1566.000	1566.000	1566.000	1566.000	1566.000	1534.000	1566.000
Std. Deviation of J-T Statistic	157.054	157.053	157.055	156.963	156.889	154.559	156.028
Std. J-T Statistic	.172	.070	-.191	-2.727	-.370	-.550	-1.897
p-value	.864	.944	.849	.006	.712	.582	.058
Eat food regardless of sell-by date:							
Mean rank:							
None of us	50.92	52.85	51.63	52.21	47.91	45.80	48.91
Some of us	43.96	42.63	49.74	50.19	51.41	58.77	55.22
All of us	73.36	65.41	55.09	50.59	72.64	62.91	57.41
Observed J-T Statistic	1483.000	1345.000	1372.000	1319.500	1654.500	1666.000	1537.500
Mean J-T Statistic	1364.500	1364.500	1364.500	1364.500	1364.500	1327.000	1364.500
Std. Deviation of J-T Statistic	147.782	147.782	147.783	147.697	147.627	144.935	146.820
Std. J-T Statistic	.802	-.132	.051	-.305	1.964	2.339	1.178
p-value	.423	.895	.960	.761	.049	.019	.239
Eat food a few days after sell-by date:							
Mean rank:							
None of us	44.95	42.80	42.47	49.75	42.42	47.56	46.36
Some of us	49.49	52.52	57.07	54.78	54.73	53.27	55.82
All of us	63.50	60.80	53.04	47.84	57.30	51.40	50.30
Observed J-T Statistic	2058.500	2064.500	1926.000	1660.000	2026.000	1748.500	1797.500
Mean J-T Statistic	1682.500	1682.500	1682.500	1682.500	1682.500	1654.000	1682.500
Std. Deviation of J-T Statistic	160.881	160.880	160.882	160.786	160.710	158.592	159.824
Std. J-T Statistic	2.337	2.374	1.514	-.140	2.137	0.596	.720
p-value	.019	.018	.130	.889	.033	.551	.472

7.5 Behavioral factors

7.5.1 Shopping and meal planning

Out of the six behaviors related to shopping and meal planning, three exhibited statistically significant relationships with the dependent variables in Jonchkheere-Terpstra tests. Avoiding large purchases of perishable foods was negatively correlated with the percent of avoidable food waste that was unprepared [T_{JT} = 1621.00, z =-2.041, p =0.041], which was consistent with its hypothesized effect. Oddly however, checking food before shopping was positively correlated with the number of unprepared items discarded [T_{JT} = 2457.00, z =1.995, p =0.046]. The result for planning meals was also unexpected; testing indicated that it was correlated with all three measures of unprepared food waste (Table 7.9). This finding reflected the finding about meal planning from analysis of the survey data and will be discussed later as it persisted in the regression results.

Table 7.9 Jonckheere-Terpstra Test results for effect of meal planning on food waste

	Total FW per person	Avoidable FW per person	Percent Avoidable FW	# of Avoidable FW	Unprep FW per person	Percent Unprep FW	# of Unprep FW
Plans meals for next few days or week (1=never, 7=all the time)							
Mean rank:							
1	60.29	59.17	51.58	47.33	44.21	34.91	41.67
2	42.20	24.10	33.60	30.00	35.60	42.40	41.50
3	49.24	51.05	51.43	47.79	49.36	48.81	45.45
4	50.02	47.96	45.13	52.10	49.46	47.08	46.96
5	56.37	56.37	53.57	60.75	57.28	58.60	64.50
6	44.88	54.69	67.50	48.00	61.44	64.38	52.13
7	17.00	35.50	78.00	37.25	55.50	63.50	56.00
Observed J-T Statistic	1979.500	2157.000	2337.000	2311.500	2394.000	2479.500	2472.000
Mean J-T Statistic	2062.500	2062.500	2062.500	2062.500	2062.500	2017.500	2062.500
Std. Deviation of J-T Statistic	168.417	168.416	168.418	168.311	168.234	165.748	167.283
Std. J-T Statistic	-.493	.561	1.630	1.479	1.970	2.787	2.448
p-value	.622	.575	.103	.139	.049	.005	.014

7.5.2 Other variables related to meal planning

Other food-related behaviors expected to influence food waste included the extent to which participants thought about what to cook, tried to cook new foods, were confident they could cook tasty meals, found cooking a chore, or bought take-out food to eat at home. Of these, the extent to which participants thought about what to cook was correlated with five of the dependent variables (Table 7.10). This result was intuitive and also significant in the regression results.

Table 7.10 Jonckheere-Terpstra Test results for effect of thinking about what to cook on food waste

	Total FW per person	Avoidable FW per person	Percent Avoidable FW	# of Avoidable FW	Unprep FW per person	Percent Unprep FW	# of Unprep FW
Spends time thinking about / researching what to cook (1=never, 7=all the time)							
Mean rank:							
1	9.00	22.00	67.00	46.50	33.00	37.00	68.50
2	48.50	35.00	30.50	36.00	40.50	39.50	34.00
3	59.94	43.84	36.94	54.53	44.88	46.38	50.91
4	34.64	40.39	47.72	39.33	31.89	37.12	34.78
5	54.02	55.87	54.32	54.21	57.60	55.97	56.66
6	54.61	59.70	60.46	56.64	61.48	59.57	58.77
7	66.00	64.75	59.25	53.88	64.75	45.00	51.50
Observed J-T Statistic	2216.500	2496.500	2476.000	2235.000	2537.000	2323.500	2338.000
Mean J-T Statistic	2011.500	2011.500	2011.500	2011.500	2011.500	1969.500	2011.500
Std. Deviation of J-T Statistic	167.619	167.618	167.620	167.515	167.438	164.984	166.495
Std. J-T Statistic	1.223	2.893	2.771	1.334	3.138	2.146	1.961
p-value	.221	.004	.006	.182	.002	.032	.050

The extent to which participants bought and ate take-out food at home was also positively correlated with several measures of food waste, including total food waste per person, avoidable food waste per person, and unprepared food waste per person. The positive correlations with avoidable food waste and total food waste, but not percent avoidable food waste, suggest that ordering take-out food contributes to food waste by increasing leftovers and also unavoidable food waste, such as bones from ordering fried chicken, a common take-out meal. Its correlation with unprepared food waste was unexpected, though potentially explainable if buying take-out food contributes to spoilage by distracting households from eating food in their fridge.

Table 7.11 Jonckheere-Terpstra Test results for effect of buying take-out food to eat at home on food waste

	Total FW per person	Avoidable FW per person	Percent Avoidable FW	# of Avoidable FW	Unprep FW per person	Percent Unprep FW	# of Unprep FW
Spends time thinking about / researching what to cook (1=never, 7=all the time)							
Mean rank:							
Never	71.50	23.25	7.50	17.75	11.50	14.00	25.00
< once a month	42.36	43.55	57.18	55.91	52.36	53.36	60.36
Once a month	42.04	39.57	43.07	44.89	40.32	39.29	41.39
2-3 times a month	49.80	50.30	49.47	51.27	48.88	51.57	50.50
Once a week	60.63	66.47	63.89	63.76	63.26	54.26	62.34
2-3 times a week	58.62	57.50	51.15	42.92	60.42	60.69	46.42
Every day	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Observed J-T Statistic	2250.500	2390.500	2160.000	2041.500	2329.500	2187.500	2041.000
Mean J-T Statistic	1926.000	1926.000	1926.000	1926.000	1926.000	1896.500	1926.000
Std. Deviation of J-T Statistic	165.000	164.999	165.002	164.898	164.822	162.717	163.896
Std. J-T Statistic	1.967	2.815	1.418	.700	2.448	1.788	.702
p-value	.049	.005	.156	.484	.014	.074	.483

Lastly, participants who agreed more that "cooking is a chore and I only do it because it is necessary" were correlated with less avoidable food waste per person [T_{JT} = 1642.50, z =-1.939, p =0.052] and a lower percent avoidable food waste [T_{JT} = 1647.00, z =-1.912, p =0.056], although these relationships just missed statistical significance.

7.5.3 Diet

The only dietary variable found to be a significant influence on food waste was meat consumption, which was positively correlated with all three measures of unprepared food waste (Table 7.12). A closer look at the data suggests that meat consumption was specifically correlated with the percentage of avoidable unprepared food waste that was discarded due to its sell-by date [Jonckheere-Terpstra Test, T_{JT} = 1808.000, z =1.944, p =0.052].

Table 7.12 Jonckheere-Terpstra Test results for effect of meat consumption frequency on food waste

	Total FW per person	Avoidable FW per person	Percent Avoidable FW	# of Avoidable FW	Unprep FW per person	Percent Unprep FW	# of Unprep FW
Frequency of meat consumption (1=never, 7=all the time)							
Mean rank:							
1	37.75	49.50	58.25	38.38	10.75	9.00	9.63
2	52.60	35.40	40.90	34.20	44.50	50.90	42.25
3	46.81	44.36	44.52	48.40	43.62	45.43	45.43
4	60.04	62.41	57.07	62.22	57.44	53.58	59.78
5	45.60	48.92	52.31	51.56	52.79	53.77	51.04
6	56.18	58.04	55.36	51.46	66.11	61.50	64.07
7	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Observed J-T Statistic	2129.000	2307.000	2251.000	2261.500	2558.000	2401.500	2508.000
Mean J-T Statistic	2061.500	2061.500	2061.500	2061.500	2061.500	2024.000	2061.500
Std. Deviation of J-T Statistic	168.592	168.591	168.593	168.486	168.409	166.072	167.457
Std. J-T Statistic	.400	1.456	1.124	1.187	2.948	2.273	2.666
p-value	.689	.145	.261	.235	.003	.023	.008

7.5.4 Familial systems of provision and social interactions

The influence of familial systems of provision and other food-related social interactions were tested as well—these variables included the frequency with which participants received food from, packed food for, gave food to others, or entertained guests for meals at home. Of these, the most striking was receiving food from relatives, which was positively correlated with all but two measures of food waste tested (Table 7.13). These results are unsurprising in light of my findings about familial systems of provision, described in Chapter X. Receiving food from relatives also turned out to be a fairly consistent predictor of food waste in regression analysis, as will be illustrated later in this chapter.

Table 7.13 Jonckheere-Terpstra Test results for effect of receiving food from relatives on food waste

	Total FW per person	Avoidable FW per person	Percent Avoidable FW	# of Avoidable FW	Unprep FW per person	Percent Unprep FW	# of Unprep FW
Frequency receives food from relatives							
Mean rank:							
Never	47.37	42.69	41.87	38.97	45.15	48.61	39.44
< once a month	52.74	55.17	56.39	57.24	49.38	48.73	52.71
Once a month	43.64	45.76	49.81	54.10	48.86	50.60	52.50
2-3 times a month	58.08	59.96	57.83	54.83	70.83	64.25	67.13
Once a week	89.83	97.67	87.67	66.83	79.17	59.67	79.50
2-3 times a week	85.00	88.00	65.00	98.50	76.00	48.00	86.50
Every day	76.00	47.50	26.00	63.00	34.50	26.00	58.00
Observed J-T Statistic	2183.000	2293.500	2267.000	2345.000	2324.000	2072.000	2470.000
Mean J-T Statistic	1939.500	1939.500	1939.500	1939.500	1939.500	1899.000	1939.500
Std. Deviation of J-T Statistic	166.340	166.339	166.341	166.238	166.161	163.717	165.230
Std. J-T Statistic	1.464	2.128	1.969	2.439	2.314	1.057	3.211
p-value	.143	.033	.049	.015	.021	.291	.001

The other variable related to social interaction that showed statistical significance and positive correlations when tested against multiple measures of food waste was participants' stated tendency to have guests over for meals (Table 7.14). The expectation that one is overgenerous to guests in South Korean society suggests that having guests over might be most immediately connected with plate leftovers. However, the data did not quite support this, as the count of avoidable food waste discards was statistically significant, but neither mass nor percent-based measures of avoidable food waste were significant. Instead, and oddly, entertaining guests was positively correlated with the mass of unprepared food waste and the number of unprepared discards. This was unexpected, but could make sense if households always buy new ingredients when entertaining guests and as a result, delay the consumption of existing ingredients in the fridge, leading to their eventual discard.

Table 7.14 Jonckheere-Terpstra Test results for effect of entertaining guests on food waste

	Total FW per person	Avoidable FW per person	Percent Avoidable FW	# of Avoidable FW	Unprep FW per person	Percent Unprep FW	# of Unprep FW
Frequency of entertaining guests at home							
Mean rank:							
Never	47.02	44.60	44.79	40.93	42.55	45.18	39.02
< once a month	52.72	50.97	48.30	50.30	49.90	48.80	49.93
Once a month	57.18	60.93	62.70	64.40	63.10	53.85	63.83
2-3 times a month	53.54	55.04	54.43	58.54	54.79	56.71	60.00
Once a week	52.67	50.25	47.17	51.67	47.50	52.67	54.75
2-3 times a week	68.00	72.00	58.00	80.50	87.00	75.00	91.50
Every day	15.50	34.00	74.00	29.50	60.50	80.00	43.50
Observed J-T Statistic	2096.000	2227.500	2293.000	2376.000	2340.000	2264.000	2476.000
Mean J-T Statistic	2006.500	2006.500	2006.500	2006.500	2006.500	1970.000	2006.500
Std. Deviation of J-T Statistic	167.570	167.569	167.572	167.466	167.389	165.065	166.447
Std. J-T Statistic	.534	1.319	1.710	2.206	1.992	1.781	2.821
p-value	.593	.187	.087	.027	.046	.075	.005

7.6 Retail format and shopping frequency

As was the case with the survey sample, hypermarkets proved to be the most popular shopping destination among diary participants, with 86 of them (84%) indicating that they had visited a hypermarket to buy food within the last three months. Ranked according to this measure, the popularity of each retail format was not different from the survey sample except for department stores and convenience stores, whose positions were reversed (Figure 7.1).

Figure 7.1 Sample distribution by shopping destinations visited (no. of households that visited each format)

In the survey sample, there was a visually observable relationship between maximum FFV shopping frequency and where respondents most frequently bought FFV—the modal FFV shopping frequency was lower for hypermarkets than for supermarkets and traditional markets, both of which had nearly even numbers of households buying FFV 2-3 times a month and once a week. For the diary sample however (Figure 7.2), the number of participants purchasing FFV at supermarkets and traditional markets most commonly did so 2-3 times a month (i.e. slightly less frequently than the survey sample). The modal purchasing frequency at department stores was also different—less than once a month for the survey sample but once a month for the diary sample. On the other hand, the most common FFV purchase frequency for family/independent stores was the same for both the survey and the diary at once a week.

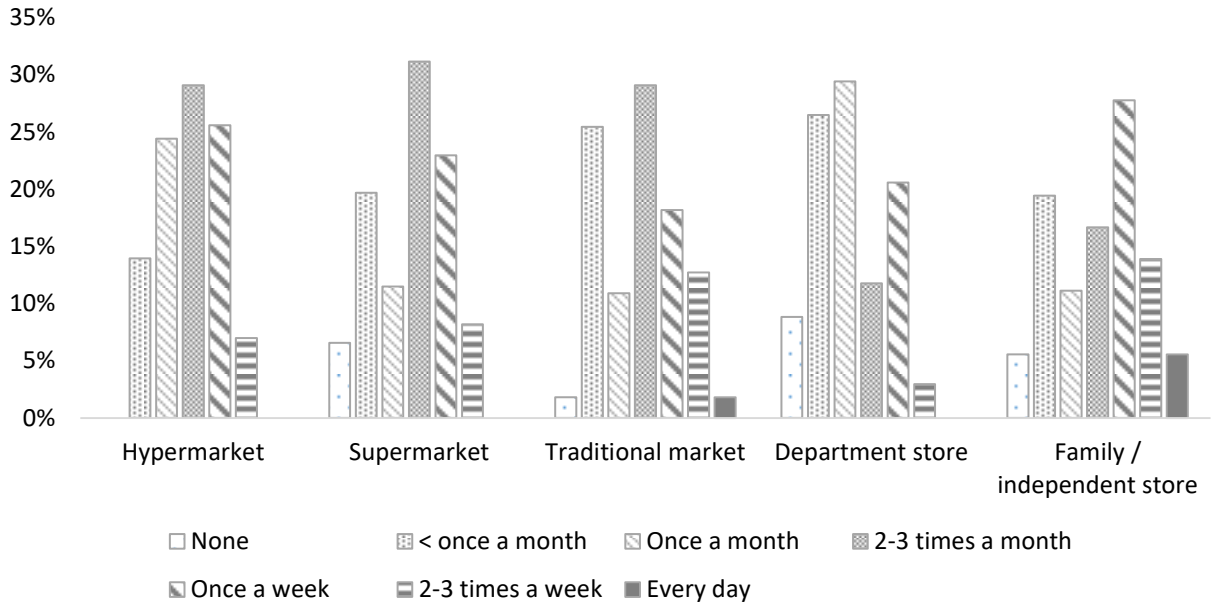

Figure 7.2 Sample distribution by FFV shopping frequency and retail format

The most popular destination for the diary participants, as measured by the format each participant visited most frequently regardless of what they bought, was the hypermarket (Figure 7.3). This was followed by supermarkets, family markets, and department stores.

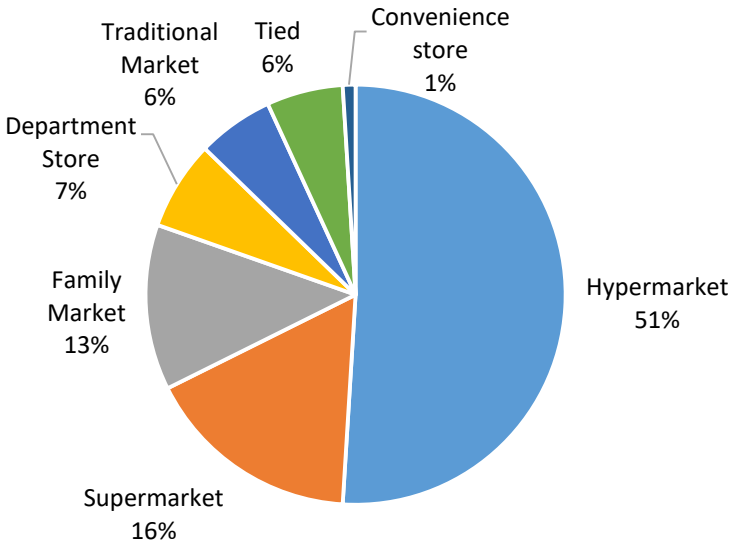

Figure 7.3 Sample distribution by most frequently visited retail format

As with the survey sample, a Kruskal-Wallis H Test confirmed a statistically significant relationship between households' most frequently visited retail format and their highest FFV shopping frequency (Table 7.15). Post-hoc testing found that the statistical significance originated from differences in shopping frequency between 1) hypermarkets and family markets and 2) hypermarkets and traditional markets. In both cases, maximum FFV purchasing frequency was lower for households who most frequently visited hypermarkets. Additionally, when households were organized into groups according to whether their most frequently visited retail format was "modern" (supermarkets, hypermarkets, or department stores) or "traditional" (traditional markets or family stores), and these groups tested against shopping frequencies for different food groups, FFV purchasing frequency was lower for the "modern" group than for the "traditional group" [Kruskal-Wallis H Test, $\chi^2(df=1)=10.980, p=0.001$].

Table 7.15 Kruskal-Wallis H test results for effect of retail type on highest FFV buying frequency

Highest FFV buying frequency	
Mean rank:	
Supermarket	51.88
Family Market	68.12
Department Store	54.57
Hypermarket	43.45
Convenience store	63.00
Traditional Market	73.33
Tied	56.83
Chi-square	12.805
df	6.000
p-value	.046

There were few statistically significant relationships found between diary participants' FFV shopping frequencies and the dependent variables. Only the percent avoidable food waste had a

statistically significant relationship with FFV shopping frequency [Kruskal-Wallis H Test, χ^2(df=5)=12.037,p=0.034]. Post-hoc testing found that shoppers who bought FFV once a week had lower percentages of avoidable food waste than those who did so 2-3 times a month or once a month. Also, a Jonckheere-Terpstra Test found a negative correlation between FFV shopping frequency and percent avoidable food waste [T_{JT} = 1438.00, z =-2.700, p =0.007]. These results are notable as they contrast with the squared, up-and-down relationship between FFV shopping frequency and food waste found in the survey data. However, if we examine the data more closely by looking at the percentage of avoidable and unprepared food waste discarded due to spoilage, oldness, or date ("SOD"), there is some evidence for an up and down relationship between food waste and FFV shopping frequency. A Mann-Whitney Test found that the SOD percentage was significantly higher for those shopping once a week than for those shopping 2-3 times a week. The test also came close to statistical significance (<10%) when finding that the SOD percentage was higher for once-a-week FFV shoppers than those who shopped 2-3 times a month and once a month.

In the diary data, FFV shopping frequency was not the only variable related to shopping frequency that had statistical significance when tested against the dependent variables. Seafood shopping frequency across all formats was very strongly linked with food waste, as it was significantly correlated with five out of the seven dependent variables (Table 7.16). There was no evidence for a squared relationship, as indicated both by the mean ranks as well as from visual inspection of scatterplots (not presented). As with FFV shopping frequency, there were statistically significant differences in seafood shopping frequency between households when grouped according to where they most frequently bought seafood [Kruskal-Wallis H Test, χ^2(df=5)=16.224,p=0.006]. Specifically, seafood purchasing frequency was significantly higher at family markets than at hypermarkets and supermarkets. Additionally households that purchased seafood equally frequently at more than one format tended to do so less often than those who bought seafood most frequently at family markets and department stores.

Table 7.16 Jonckheere-Terpstra Test results for effect of seafood shopping frequency on food waste

	Total FW per person	Avoidable FW per person	Percent Avoidable FW	# of Avoidable FW	Unprep FW per person	Percent Unprep FW	# of Unprep FW
Maximum frequency of seafood shopping across all formats							
Mean rank:							
< once a month	32.34	31.38	40.25	32.94	38.59	48.97	41.16
Once a month	50.64	50.02	51.39	46.32	42.32	38.67	36.96
2-3 times a month	46.33	44.75	42.42	47.29	50.77	54.33	52.27
Once a week	57.33	59.67	55.50	63.28	50.69	39.78	58.06
2-3 times a week	60.50	64.50	58.88	57.94	77.63	75.50	69.81
Every day	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Observed J-T Statistic	2164.000	2224.500	1988.000	2255.500	2227.000	1973.500	2296.000
Mean J-T Statistic	1778.000	1778.000	1778.000	1778.000	1778.000	1744.000	1778.000
Std. Deviation of J-T Statistic	153.245	153.244	153.246	153.144	153.089	150.844	152.265
Std. J-T Statistic	2.519	2.914	1.370	3.118	2.933	1.521	3.402
p-value	.012	.004	.171	.002	.003	.128	.001

The above results continue to provide evidence that retail format is indirectly connected to food waste via households' tendencies to shop at different retail formats with varying frequencies. However, it was not possible to establish this relationship by directly testing the correlations between the dependent variables and where households most frequently did their grocery shopping. Only after comparing households using the "modern" and "traditional" groupings introduced earlier did several notable findings emerge. In the first instance, the modern and traditional groupings were compared irrespective of food type purchased. Kruskal-Wallis H Tests found that the "modern" group generated more avoidable food waste per person and a greater number of avoidable discards, but that the "traditional" group had a higher percent unprepared food waste (Table 7.17). When comparing the two groups for FFV buying only, a Kruskal-Wallis H Test found that households in the "modern" group generated a greater amount of avoidable food waste per person than the "traditional" group [χ^2(df=1)=3.852,p=0.050].

Table 7.17 Kruskal-Wallis H Test results for effect of most frequented retail format on food waste

	Total FW per person	Avoidable FW per person	Percent Avoidable FW	# of Avoidable FW	Unprep FW per person	Percent Unprep FW	# of Unprep FW
Type of retail format visited most frequently to buy any kind of food							
Mean rank:							
Modern	51.49	53.06	52.43	52.92	49.49	45.56	50.58
Traditional	43.98	39.63	41.38	40.02	49.52	58.90	46.52
Chi-square	1.333	4.260	2.883	3.939	.000	4.172	.394
df	1	1	1	1	1	1	1
p-value	.248	.039	.090	.047	.997	.041	.530

The other set of variables that were analyzed in connection with retail format were the factors that households took into account when deciding where to do their grocery shopping. These included product quality, selection, shopping atmosphere and experience, customer service, opening hours, location, ease of parking, and "other." These data were collected for each of the retail formats that households said they visited, which necessitated aggregating and averaging these data to see which factors households found most important overall. To do this, scores for each factor were calculated according to how often a household indicated that it was important to their decision-making. The average scores for each factor are shown in Figure 7.4. They can be interpreted on a scale of 0 to 1, where a factor with a score of 1 was indicated as important for every retail format visited by a household. On average, the top three most important factors that households took into consideration were location, quality, and opening hours.

Figure 7.4 Average importance of factors influencing households' shopping destination choice

Spearman correlation coefficients between these scores and the dependent variables are shown in Table 7.18. The importance of customer service was the most strongly associated with food waste, as its correlation coefficient was statistically significant for all three measures of unprepared food waste. The only other factor that was significant was parking ease, which was positively correlated with the number of avoidable food waste discards.

Table 7.18 Spearman rank correlation coefficients for factors influencing shopping destination choice and food waste

	Total FW per person	Avoidable FW per person	Percent Avoidable FW	# of Avoidable FW	Unprep FW per person	Percent Unprep FW	# of Unprep FW
Selection	.083	.131	.048	.064	.037	.007	.099
Quality	.067	.118	.116	.029	.120	.075	.110
Atmosphere	-.100	.008	.043	-.117	.061	.118	.046
Customer service	.078	.105	.051	.089	.283**	.244*	.251*
Opening hours	.059	.058	.074	.025	.042	-.069	.009
Location	-.087	-.039	.028	.071	-.170	-.177	-.094
Parking ease	.028	-.021	-.086	.218*	-.089	-.130	.061
Other	.127	.035	-.004	-.049	.054	.040	.037

* and ** denote significance at the 5% and 1% levels, respectively

7.7 Spending

The relationship between per-trip spending and retail format exhibited in the diary sample reflected the survey sample—median spending per-person, per-trip was by far the highest for hypermarkets than for other formats. However, unlike for the survey sample, visual inspection of scatterplots (not presented) that plotted the seven dependent variables from the diary against

spending amounts reported in the survey failed to provide evidence that per-trip spending increases and then decreases as shopping frequency progresses from less than once a month to every day.

When correlating median per-person, per-trip spending for each retail format with the different measures of food waste, there was only statistical significance for two formats. Department store spending was positively correlated with total food waste per person [Spearman's Rho=0.357, p=0.045] and avoidable food waste per person [Spearman's Rho=0.362, p=0.042], and internet spending was negatively correlated with the number of avoidable food waste discards [Spearman's Rho=-0.325, p=0.041].

The other measure of spending tested was the total amount that households spent during the diary period, normalized for household size as well as the number of occasions the participant reported spending money on food. These data were correlated only with measures of avoidable food waste (Table 7.19).

Table 7.19 Spearman's rank correlation coefficients for diary period spending and food waste

Diary period food spending:	Total FW per person	Avoidable FW per person	Percent Avoidable FW	# of Avoidable FW	Unprep FW per person	Percent Unprep FW	# of Unprep FW
Per person	.462**	.377**	.386**	.027	.140	-.052	.116
Per person per occasion	.293**	.238*	.172	-.002	.043	-.083	.005

* and ** denote significance at the 5% and 1% levels, respectively

7.8 Mode choice

As with the survey data, car was the most popular mode choice when households shopped at hypermarkets and department stores, and households most frequently walked to supermarkets, family stores, traditional markets, and convenience stores. Comparisons of the dependent variables across mode choices for each format revealed just two statistically significant relationships: households who walked to department store supermarkets threw away more unprepared food waste per person and had a higher percent unprepared avoidable food waste. However, there were only three households in this group, and further examination of their diary entries revealed that each threw away unusually heavy foodstuffs, such as one-third of a watermelon and a big daikon radish. While it might not be impossible for these discards to be linked in some way to these households' preference for walking to department store supermarkets, this seems unlikely and as such it is important to consider the possibility that this finding was spurious.

There were differences in food waste generation when comparing households that drove to at least one shopping destination with those that did not. The former group had a larger number of avoidable discards [Kruskal-Wallis H Test, χ^2(df=1)=10.672,p=0.001] and a larger number of avoidable unprepared discards [Kruskal-Wallis H Test, χ^2(df=1)=4.304,p=0.038].

7.9 Travel time

The relationship between travel time and retail format among diary participants was similar to the survey data in that hypermarkets and department stores tended to require longer travel times than supermarkets, family stores, traditional markets, and convenience stores. In terms of the minimum travel time they faced, participants were distributed similarly to the survey data, with 62% traveling less than 10 minutes and 25% traveling 10-15 minutes to their closest grocery shopping destination.

There were no significant results when testing for differences in the seven dependent variables across minimum travel time. However, several significant results were obtained when using a more specific dependent variable—the percentage of avoidable unprepared food waste discarded due to SOD (Table 7.20). Not only did the tests reveal that this percentage increased with longer travel times across all formats, but that this relationship was also significant specifically for travel times to hypermarkets and supermarkets, and nearly significant for department stores.

Table 7.20 Jonckheere-Terpstra Test results for effect of travel time on the percentage of avoidable unprepared food waste discarded due to SOD

	Min. travel time (all formats)	Travel time to hypermarket	Travel time to supermarket	Travel time to department store
Mean rank:				
<10 mins	38.49	34.38	21.88	11.67
10-15 mins	53.90	33.36	29.67	12.83
16-30 mins	60.20	37.18	31.50	11.70
>30 mins	65.50	48.29	35.71	19.67
Observed J-T Statistic	1430.000	1192.000	613.000	181.000
Mean J-T Statistic	1042.000	1000.500	468.500	139.500
Std. Deviation of J-T Statistic	110.016	96.059	55.906	22.792
Std. J-T Statistic	3.527	1.994	2.585	1.821
p-value	.000	.046	.010	.069

7.10 Waste management policy

Approximately 49% of diary participants indicated that they used volume-rate plastic bags to pay for their food waste disposal. 14% said they paid using an RFID system, and 3% said they used a sticker/chip system. Out of the remaining 34%, 26% indicated they paid a fixed fee to their apartment complex, 6% said they were not subject to volume-pricing for food waste, and 2% said they did not know. Compared to the survey sample, a larger proportion of diary participants paid using RFID and paid a fixed-fee to their apartment complex, while a smaller proportion paid using volume-rate plastic bags. The payment system utilized by participants was not correlated with any of the dependent variables if all systems were compared together. When comparing households who paid using RFID against all other households, the number of avoidable-unprepared discards was lower for the former group [Kruskal-Wallis H Test, $\chi^2(df=1)=4.615, p=0.032$].

The range of prices paid by participants for food waste disposal was the same as for the survey sample—18 won to 80 won per liter. These prices were also not found to have any correlation with any of the dependent variables. However, the percentage of avoidable unprepared food waste discarded due to the sell-by date was found to be negatively correlated with the disposal price, albeit very weakly [Spearman's Rho=-0.214, p=0.043].

7.11 Regression analysis results

Several forms of multivariate regression were used to analyze the dependent variables in order to best fit their different frequency distributions and properties. As with the analysis of the survey data, gamma regression with a log link function was used to analyze mass data due to its extreme positive skew and boundedness at zero. Percentage data were analyzed using a generalized linear model that used the binomial distribution with a logit link function and robust errors, as recommended by Papke and Woolridge (1996). Count data were analyzed using negative binomial regression, which was favored over Poisson regression because over-dispersion made the variance much greater than the mean. Independent variables representing categories such as household characteristics, attitudes towards food waste and food safety, diet, behaviors and habits related to grocery shopping and food management, grocery trip frequency and mode choice, and the volume-based pricing system, were tested for significance in the process of developing the models.

Due to the relatively small sample size (N=102), the number of independent variables used in each of the models was limited as much as possible to avoid overfitting, which can create artificial gains in model fit and statistical significance. Insignificant variables were removed to minimize the unnecessary consumption of degrees of freedom. Although goodness-of-fit measures and tests are reported for each regression, I also report a pseudo adjusted-R^2, which is the calculated correlation coefficient between the predicted values and observed values for each model, adjusted according to the number of observations and independent variables in each models. This provides an indication of goodness-of-fit that can be more easily compared across the six models. Finally, for ease of reference, the models for measures of avoidable food waste have been numbered A1, A2, and A3, and the models for measures of unprepared food waste have been numbered U1, U2, and U3.

7.11.1 Avoidable food waste per person (A1)

The model for avoidable household food waste per person is shown below (Table 7.21). First, a dummy variable was included to control for participants that made note of cleaning their fridge during the diary period. Participants who did this invariably found food to discard, an influence that was reflected by the positive and statistically significant coefficient for this variable.

Out of the demographic variables tested, education and age were found to be statistically significant. Specifically, graduate degree holders generated less avoidable food waste per person than those who only had high school qualifications or lower. Larger households generated less avoidable food waste per person. Age was included as it had a low, but not statistically significant p-value, a result likely attributable to the correlation between age and household size in this sample—participants who were older tended to come from larger households and also threw away less avoidable food waste per person.

Among behavioral variables, participants' meal planning and shopping habits were represented in the model through their tendency to think about what to cook, strategies for buying the correct amount of food, and their food spending during the diary period. Diary participants that spent more time thinking about what to cook generated more avoidable food waste per person. Unsurprisingly, participants whose shopping strategies including buying only loosely-sold ingredients were correlated with less food waste, though oddly, those who avoided shopping on an empty stomach threw away more avoidable food waste per person. Higher per person spending during the diary period was also correlated with more avoidable food waste per person. Lastly, the frequency with which participants had no leftovers had a negative influence on the dependent variables, while participants who received food from relatives more often tended to generate more avoidable food waste per person.

Table 7.21 Regression results summary for avoidable food waste per person

	Coeff.	Std. Err.	Z	P > z	95% Confidence Interval	
Cleaned fridge during diary period (dummy)	0.299	0.135	2.220	0.026	0.035	0.563
Household size	-0.144	0.054	-2.700	0.007	-0.249	-0.039
Age	-0.109	0.066	-1.660	0.097	-0.238	0.020
Undergraduate degree holder (dummy)	-0.266	0.211	-1.260	0.209	-0.680	0.149
Graduate degree holder (dummy)	-0.544	0.251	-2.170	0.030	-1.036	-0.052
Thinks about what to cook (tendency)	0.202	0.050	4.020	0.000	0.103	0.300
Per person food spending over diary period	0.009	0.002	3.780	0.000	0.004	0.013
Buys items sold loose (dummy)	-0.372	0.159	-2.330	0.020	-0.685	-0.060
Shops only when not hungry (dummy)	0.297	0.140	2.120	0.034	0.022	0.572
No leftovers after meal (tendency)	-0.181	0.046	-3.930	0.000	-0.271	-0.090
Receive food from family (tendency)	0.169	0.057	2.970	0.003	0.058	0.281
(Intercept)	6.695	0.603	11.100	0.000	5.513	7.877
Deviance	68.101					
Log pseudolikelihood	-768.407					
Pseudo Adjusted-R^2	0.614					
No. of observations	101					

7.11.2 Percentage of total food waste that was avoidable (A2)

Table 7.22 shows the regression results for the percent of total food waste that was avoidable. The control variable indicating whether the participant cleaned the fridge during the diary period was insignificant. Significant demographic variables included age, household size, income, and education. As age and household size increased, the avoidable percentage of food waste decreased. Graduate degree holders, but not undergraduate degree holders, had a lower

percentage than those who did not study beyond high school. Households with higher incomes were positively correlated with higher avoidable food waste percentages.

With regards to behavior, households that more frequently had no leftovers had lower percentages of avoidable food waste, whereas those who indicated planning meals more often had higher percentages of avoidable food waste. Higher purchase frequencies for seafood were significantly associated with higher percentages of avoidable food waste, and the opposite was true for FFV.

Table 7.22 Summary of regression results for percentage of food waste that was avoidable

	Coeff.	Std. Err.	Z	P > z	95% Confidence Interval	
Cleaned fridge during diary period (dummy)	-0.006	0.188	-0.030	0.975	-0.375	0.363
Age	-0.243	0.078	-3.110	0.002	-0.396	-0.090
Household size	-0.168	0.081	-2.080	0.037	-0.327	-0.010
Undergraduate degree holder (dummy)	-0.077	0.238	-0.320	0.746	-0.543	0.389
Graduate degree holder (dummy)	-0.502	0.294	-1.700	0.088	-1.078	0.075
Income	0.197	0.078	2.510	0.012	0.043	0.350
No leftovers after meal (tendency)	-0.277	0.076	-3.650	0.000	-0.425	-0.128
Thinks about what to cook (tendency)	0.234	0.069	3.410	0.001	0.099	0.368
Plans meals (tendency)	0.170	0.067	2.530	0.011	0.038	0.301
FFV purchase frequency	-0.472	0.103	-4.570	0.000	-0.675	-0.270
Seafood purchase frequency	0.266	0.096	2.760	0.006	0.077	0.455
(Intercept)	-1.038	0.687	-1.510	0.131	-2.385	0.308
Deviance	16.201					
Log pseudolikelihood	-42.834					
Pseudo Adjusted-R^2	0.694					
No. of observations	95					

7.11.3 Number of discards that were avoidable food waste (A3)

Regression results from using count data for avoidable food waste as the dependent variable are shown in Table 7.25. As before, the "cleaned fridge" variable was included as a control, although in this instance it was not statistically significant. Age, household size, and gender were statistically significant; older participants recorded fewer instances of avoidable food waste while larger households recorded more. Female participants also tended to discard more items that were avoidable. Average per-person spending during the diary period, log-transfromed, was correlated with higher counts of avoidable food waste.

The only variable related to food management at home that was statistically significant was the tendency to prioritize using up leftover ingredients. As expected, the more participants did this, the fewer items of avoidable food waste they discarded. However, its significance was dependent

on the inclusion of the variable representing a household's tendency not to have any leftovers. This tendency was only statistically significant at the 10% level but was included due to its appearance in the foregoing two models. As in the previous model, seafood purchasing frequency and FFV purchasing frequency were both statistically significant, although correlated with the dependent variable in opposite directions. More frequent seafood purchasing was associated with a higher avoidable food waste count, whereas the opposite was true for FFV purchasing frequency.

The final pair of variables in the model were related to participant households' shopping trips. Participant households that drove to at least one of their grocery shopping destinations were associated with a higher count of avoidable food waste discards, while those that placed a higher priority on shopping atmosphere tended to throw away fewer items of avoidable food waste.

Table 7.23 Regression results summary for no. of items that were avoidable food waste

	Coeff.	Std. Err.	Z	P > z	95% Confidence Interval	
Cleaned fridge during diary period (dummy)	0.136	0.118	1.150	0.249	-0.095	0.367
Age	-0.148	0.047	-3.160	0.002	-0.240	-0.056
Female (dummy)	0.351	0.114	3.080	0.002	0.127	0.575
Household size	0.175	0.053	3.280	0.001	0.071	0.280
Per person food spending over diary period (log term)	0.231	0.072	3.200	0.001	0.089	0.372
Tendency to prioritize using up ingredients	-0.095	0.046	-2.060	0.039	-0.186	-0.005
Tendency to have no leftovers after meal	-0.073	0.044	-1.670	0.095	-0.159	0.013
Seafood purchasing frequency	0.178	0.054	3.290	0.001	0.072	0.285
FFV purchasing frequency	-0.114	0.057	-2.010	0.045	-0.225	-0.003
Drives to at least one destination (dummy)	0.327	0.118	2.760	0.006	0.095	0.559
Shopping atmosphere importance	-0.626	0.196	-3.190	0.001	-1.011	-0.242
(Intercept)	0.401	0.861	0.470	0.641	-1.286	2.088
Likelihood ratio chi-square	60.13***					
Log-likelihood	-327.115					
Pseudo Adjusted-R^2	0.747					
No. of observations	88					

*, **, and *** denote significance at the 5%, 1%, and 0.1% levels, respectively

7.11.4 Avoidable unprepared food waste per person (U1)

The model for avoidable unprepared food waste per person is presented below in Table 7.24. Participants who cleaned their fridge during the diary period generated more unprepared food

waste per person than those who did not. Demographic factors that proved statistically significant included education and household size. Education was represented through a dummy variable indicating whether the respondent went to university or not; non-university graduates were associated with more food waste. Larger household sizes were associated with lower amounts of unprepared food waste.

A range of behavioral factors were found to be statistically significant. The first was the extent to which the participant thought about what to cook—as this increased, the dependent variable increased as well. The tendency for households to receive food from relatives was also positively correlated with the dependent variable. Diet was found to be important, with participants who ate more meat being correlated with higher amounts of unprepared food waste per person. Oddly, increased consumption of seafood was correlated with less unprepared food waste per person. The sole grocery shopping habit that was significant was the tendency to plan meals, which was positively correlated with unprepared food waste per person. Lastly, participants that bought items sold loosely as a method for buying the right amount were associated with lower quantities of unprepared food waste per person. Lastly, the more importance a participant ascribed to customer service when deciding where to buy groceries, the more unprepared food waste per person their household generated.

Table 7.24 Summary of regression results for unprepared food waste per person

	Coeff.	Std. Err.	Z	P > z	95% Confidence Interval	
Cleaned fridge in diary period (dummy)	0.794	0.194	4.090	0.000	0.414	1.174
Non-university graduate (dummy)	1.170	0.252	4.640	0.000	0.675	1.665
Household size	-0.219	0.103	-2.130	0.033	-0.421	-0.018
Thinks about what to cook (tendency)	0.330	0.062	5.290	0.000	0.208	0.453
Receives food from family (tendency)	0.409	0.087	4.720	0.000	0.239	0.578
Tendency to have no leftovers after meal	-0.188	0.065	-2.870	0.004	-0.316	-0.060
Eats meat (tendency)	0.337	0.082	4.120	0.000	0.177	0.497
Eats seafood (tendency)	-0.169	0.077	-2.190	0.029	-0.320	-0.017
Plans meals (tendency)	0.159	0.070	2.280	0.022	0.023	0.296
Buys items sold loose (dummy)	-0.662	0.219	-3.030	0.002	-1.090	-0.234
Customer service importance	1.036	0.357	2.910	0.004	0.337	1.735
(Intercept)	2.460	0.771	3.190	0.001	0.949	3.970
Deviance	340.446					
Log-pseudolikelihood	-638.597					
Pseudo Adjusted-R^2	0.530					
No. of observations	101					

7.11.5 Percentage of avoidable food waste that was unprepared (U2)

The model predicting the unprepared percentage of avoidable food waste is presented below in Table 7.25. As with several of the prior models, the dummy variable controlling for whether the participant cleaned the fridge during the diary period was statistically significant and positively correlated with the dependent variable. The sole significant demographic variable was educational attainment. Participants who did not study beyond high school were positively correlated with higher unprepared percentages.

Two behavioral factors stood out as being positively correlated with the dependent variable. They were the tendency to plan meals and the extent to which the participants think about what to cook. The coefficient for the latter factor was not quite statistically significant with its a p-value of 0.064, but was kept in the model due to its presence in prior regression models and its closeness to statistical significance. Attitudes towards food safety were found to be important as well, though not in an intuitive way; households where more members were willing to eat food regardless of its sell-by date were positively correlated with higher percentages of unavoidable food waste.

Lastly, those who factored opening hours and parking availability more into their decision-making had lower percentages of unprepared food waste, while those who valued customer service more were associated with higher percentages of unprepared food waste.

Table 7.25 Summary of regression results for the percentage of avoidable food waste that was unprepared

	Coeff.	Std. Err.	Z	P > z	95% Confidence Interval	
Cleaned fridge in diary period (dummy)	0.481	0.194	2.480	0.013	0.102	0.861
Non-university graduate (dummy)	0.771	0.244	3.150	0.002	0.292	1.250
Plans meals (tendency)	0.218	0.082	2.640	0.008	0.056	0.379
Thinks about what to cook (tendency)	0.142	0.077	1.850	0.064	-0.008	0.293
Attitude towards eating food past its sell-by date	0.336	0.141	2.390	0.017	0.060	0.611
Opening hours importance	-1.238	0.337	-3.670	0.000	-1.900	-0.577
Customer service importance	0.974	0.331	2.950	0.003	0.326	1.622
Parking availability importance	-1.141	0.575	-1.980	0.047	-2.268	-0.014
(Intercept)	-2.609	0.593	-4.400	0.000	-3.771	-1.446
Deviance	22.942					
Log-pseudolikelihood	-43.539					
Pseudo Adjusted-R^2	0.560					
No. of observations	100					

7.11.6 Number of discards of avoidable-unprepared food waste (U3)

The final model predicted the number of discards that were avoidable and unprepared (Table 7.26). Whether participants cleaned their fridge or not was statistically significant and associated with more discards of avoidable-unprepared food waste. No demographic variables were statistically significant in this model.

Food management and meal habits were well-represented. Firstly, the number of meals eaten at home during the diary period was positively correlated with the dependent variable, as were the tendencies for participants to receive food from their relatives and think about what to cook. As would be expected, the extent to which participant households did not have leftovers after meals was negatively correlated with their discards of avoidable unprepared food waste. Diet-wise, households that indicated eating meat more frequently were positively correlated with the dependent variable.

Grocery shopping habits that showed statistical significance included the tendency to plan meals and two strategies for determining the right amounts to buy: participants that shopped only when they were not hungry were correlated with more discards of avoidable and unprepared food waste, as were those who chose to buy more when uncertain about the needed quantity. Finally, the importance that participants ascribed to the food product selection was positively correlated with the dependent variable.

Table 7.26 Regression results summary for no. of discards that were avoidable and unprepared food waste

	Coeff.	Std. Err.	Z	P > z	95% Confidence Interval	
Cleaned fridge during diary period (dummy)	0.303	0.146	2.070	0.039	0.303	0.146
No. of meals at home during diary period	0.073	0.020	3.710	0.000	0.073	0.020
Receives food from relatives (tendency)	0.188	0.050	3.730	0.000	0.188	0.050
Thinks about what to cook (tendency)	0.161	0.052	3.110	0.002	0.161	0.052
No leftovers after meals (tendency)	-0.178	0.049	-3.620	0.000	-0.178	0.049
Eats meat (tendency)	0.134	0.052	2.560	0.010	0.134	0.052
Plans meals (tendency)	0.134	0.046	2.920	0.004	0.134	0.046
Shops only when not hungry (dummy)	0.368	0.173	2.120	0.034	0.368	0.173
Buys more if unsure (dummy)	0.289	0.138	2.090	0.037	0.289	0.138
Food selection importance	0.426	0.209	2.040	0.041	0.426	0.209
(Intercept)	-1.606	0.538	-2.990	0.003	-1.606	0.538
Likelihood ratio chi-square	67.68***					
Log-likelihood	-224.989					
Pseudo Adjusted-R^2	0.711					
No. of observations	101					

*, **, and *** denote significance at the 5%, 1%, and 0.1% levels, respectively

7.12 Overview and discussion of regression models

. The results from the six regression models yielded intuitive results that provided mixed evidence for the hypotheses being tested. In this section, I will discuss the regression results by comparing and contrasting the significance, or lack thereof, of independent variables in the various models created. The discussion will be organized by the categories of independent variables, which include diary period behavior, household demographics, shopping habits, meal habits, grocery trip-related factors, and destination-related factors. For each category, I have provided a table that lists the variables included in each model, their levels of statistical significance, and the signs on their coefficients.

7.12.1 Diary period behavior

"Cleaned fridge" indicated whether participants cleaned out their fridge during the diary period or not and was the only variable deliberately included in every model as a necessary control variable. (Table 7.27). It proved to be statistically significant for models U1, U2, and U3, which was unsurprising and intuitive given that these models predicted discards of unused or partially-used food straight out of the fridge. Its significance in A1 was also expected since food discarded from the fridge also included previously prepared foods, which fall into the "avoidable" category as well. It was more surprising that fridge cleaning was not statistically significant in A2 or A3. However, considering that A2 also measures a household's ratio of avoidable to unavoidable food waste, it is conceivable that just cleaning the fridge would have no significant effect. For A3, one possible explanation lies in the fact that, unlike their mass, the incremental number of discards just from cleaning the fridge could be very small, which could obscure their effect if the overall number of avoidable food waste discard is much larger.

That per-person food spending during the diary period was significant for only models A1 and A3 (Table 7.27) can be interpreted by looking also at its positive correlation with the per person mass of food waste that originated as a result of take-out or delivery meals eaten at home [Spearman's Rho=0.328, p=0.001]. Such meals tended to mainly generate food waste due to leftovers, which are avoidable, but do not affect unprepared food waste. Its lack of significance in A2 is also explainable due to the fact that take-out meals contribute to unavoidable food waste as well as avoidable food waste.

Table 7.27 Model comparison—diary period behavior

	Dependent variable					
	A1	**A2**	**A3**	**U1**	**U2**	**U3**
Independent variable category	**Avoidable FW per person**	**Percent avoidable FW**	**# of avoidable discards**	**Unprepared FW per person**	**Percent unprepared FW**	**# of unprepared discards**
Diary period behavior	Cleaned fridge* (+)	Cleaned fridge (-)	Cleaned fridge (+)	Cleaned fridge*** (+)	Cleaned fridge** (+)	Cleaned fridge* (+)
	Per person food spend*** (+)		Per person food spend (log)** (+)			
						# of meals at home*** (+)

*, **, and *** denote significance at the 5%, 1%, and 0.1% levels, respectively

It was odd that the number of meals eaten during the diary period was positively correlated with the number of discards of unprepared avoidable food waste (U3). This was counterintuitive because eating more regularly at home was theorized to reduce discards of unprepared food by increasing the chances that households have to use up perishing ingredients. Although a Kruskal-Wallis H Test showed a statistically significant and positive correlation between "meals in" and "cleaned fridge" [$\chi^2(df=1)=6.083, p=0.014$], examining variance-inflation factors indicated that collinearity was not a problem. Given that "meals in" was not significant in U1 or U2, it seems likely that it is attributable to the properties of the dependent variable, i.e. its use of count data. The number of items discarded not only reflects the quantity of food waste discarded, but also the variety. In households that tend to eat more meals at home, family members may not like to eat the same dishes all the time, necessitating the storage of a greater variety of ingredients. This could potentially explain the positive correlation between number of meals eaten and the number of unprepared food waste discards.

7.12.2 Household demographics

Among demographic variables, household size was statistically significant in all models except for U2 and U3 (Table 7.28). In A1, A2, and U1, it had a negative coefficient. This was expected since larger households are generally more suited to consuming food in portions sold by food retailers, and having more people in the household increases the likelihood that food will be consumed in time. Its absence from U2 was also expected, since not only unprepared food, but prepared and previously prepared food, would have a higher chance of being eaten in larger households. In A3 however, larger household sizes contributed to a larger count of avoidable food waste discards. This relationship may reflect how the count-based dependent variable also measures food waste variety, a factor that could be positively correlated with household size. If included instead of the "meals in" variable, household size would also have been statistically significant and positively correlated with the count of avoidable unprepared food waste items (U3), mirroring the effect observed in A3. However, it was ultimately excluded as "meals in" provided a better model fit.

Table 7.28 Model comparison—household demographics

	Model and dependent variable					
	A1	**A2**	**A3**	**U1**	**U2**	**U3**
Independent variable category	**Avoidable FW per person**	**Percent avoidable FW**	**# of avoidable discards**	**Unprepared FW per person**	**Percent unprepared FW**	**# of unprepared discards**
Demographics	HH Size** (-)	HH Size* (-)	HH Size** (+)	HH Size* (-)		
	Age† (-)	Age** (-)	Age** (-)			
			Female** (+)			
				High school*** (+)	High school** (+)	
	Undergrad (-)	Undergrad (-)				
	Grad school* (-)	Grad school† (-)				
		Income** (+)				

†, *, **, and *** denote significance at the 10%, 5%, 1%, and 0.1% levels, respectively

Age was interesting because it did not register in any of the models predicting unprepared food waste, but was statistically significant or close to statistically significant in A1, A2, and A3. In all three cases, it was negatively correlated with the dependent variable. This indicates that households with an older diary participant were less wasteful when it came to managing leftovers, but were no better at preventing the discard of unused or partially used ingredients than their younger counterparts.

The effects of education on both sets of dependent variables were generally consistent with each other in that higher educational attainment was negatively correlated with the food waste in A1, A2, U1, and U2. Although one plausible reason for this is a possible correlation between educational attainment and attitudes towards food waste (e.g. awareness of its detrimental environmental impacts), there were no statistically significant relationships between any attitudes towards food waste and education in the diary sample. Nor was education a predictor of whether households performed any waste-reducing shopping habits other than checking foods, which was actually lower for more educated households. There was also consistency from the fact that education was not statistically significant in A3 and U3—the models with count-based dependent variables. This suggests that the less well-educated households discard a similar number of items, but in greater quantities than those with higher educational attainment. Further investigation is required to explain these observations.

Income was only significant in A2, where it correlated positively with the percentage of food waste that was avoidable. Higher incomes are most likely connected to lower quantities of unavoidable food waste, since income did not affect the mass or count of avoidable food waste. This could indicate that higher-earning households may buy more food that is pre-trimmed in order to save time when cooking or may shop at retail formats where pre-trimmed food is more commonly sold.

7.12.3 Shopping habits

Very few variables pertaining to shopping habits turned out to be significant (Table 7.29). Meal planning was present most consistently, proving to be statistically significant in A2, U1, U2, and U3. Since meal planning would most directly affect the quantity and consumption of ingredients in the fridge, its presence in the models for the lattermost three models was expected. In all cases however, the effect was counterintuitive, as the more households planned their meals, the more food they discarded. This result mostly agrees with the regression analysis of my survey data, which uncovered the same relationship except for those who planned meals all the time—these survey participants reported less food waste than the others. As a result, I had previously suggested that meal-planning might require commitment and consistency in order to be effective. However, the diary data did not support this theory.

Table 7.29 Model comparison—shopping habits

	Model and dependent variable					
	A1	**A2**	**A3**	**U1**	**U2**	**U3**
Independent variable category	**Avoidable FW per person**	**Percent avoidable FW**	**# of avoidable discards**	**Unprepared FW per person**	**Percent unprepared FW**	**# of unprepared discards**
Shopping habits		Plans meals* (+)		Plans meals* (+)	Plans meals** (+)	Plans meals** (+)
	Buys items sold loose* (-)			Buys items sold loose** (-)		
						Buys more if unsure* (+)
	Shops when not hungry* (+)					Shops when not hungry* (+)

*, **, and *** denote significance at the 5%, 1%, and 0.1% levels, respectively

While the small diary sample should not be ruled out as the reason for this discrepancy, it is also important to consider that meal planning on its own represents a household's intention to cook and eat at home, which is a proxy for the total amount of food stored in its fridge. A fuller fridge is harder to manage due to both the larger number of perishable ingredients and their reduced visibility, which would explain the positive correlation between meal planning and specifically, unprepared food waste. Also, as with the case of the "meals in" variable, households that plan and eat more meals at home may inherently store a larger range of ingredients for variety's sake, thereby making it harder to manage their perishables, leading to unprepared food waste as a result. This is supported by the fact that, in addition to mass and percentage, meal planning contributed to a greater count of unprepared food waste (model U3). It was also interesting that meal planning was a significant driver of the percentage measure of avoidable food waste, but not its mass or count. This suggests that meal planning may be linked with a lower fraction of unavoidable food waste in a household's waste stream, but it is not readily apparently how this might be the case.

Besides meal planning, three other statistically significant shopping habits included buying items sold loose ("sold loose"), buying more when unsure about how much to buy ("buy more"), and shopping only when not hungry ("not hungry"). Participants who indicated buying items sold loose (N=22) were correlated with lower masses of food waste (A1 and U1), but not their percentage or count variants. The lack of correlation with count data is logical since buying items loose would mainly reduce the quantities wasted from over-purchasing and not the variety of discards. It is also possible to explain its lack of significance in A2 since it would not necessarily affect a household's ratio of avoidable to unavoidable food waste.

While unexpected, the absence of "sold loose" from U2 may reflect how it not only affects unprepared food waste, but the other components of avoidable food waste as well, i.e. prepared and previously prepared food waste, which mainly comprise leftover food. This is supported by its statistical significance in A1 and could be possible if participants who buy loosely sold items are well-practiced at judging not only how much to buy, but also how much to prepare. This would improve meal portioning and help avoid excessive leftovers. This could also be possible if, by having smaller quantities of ingredients in the fridge, they feel less pressured to use them, again avoiding large meal portions and reducing leftovers as a result. The data partially

supported this idea—diary participants who bought items sold loose also threw away less prepared food waste per person [Jonckheere-Terpstra Test, T_{JT} = 566.50, z =-2.551, p =0.011], although they were no different in terms of their stated propensity to generate leftovers after cooking at home.

Though its positive coefficient in U3 was expected and self-explanatory as a direct indicator of over-purchasing, it was unclear why "buys more" (when unsure) was not statistically significant in U1 or U2. One explanation lies in the fact that U3 was also the only model which did not control for household size. In this vein, further examination of the data found that the "buys more" behavior had a nearly significant and positive correlation with avoidable food waste and unprepared food waste, but not with their per person variants—this suggests that household size is at play as an intermediary. There was no statistically significant difference in household size between those in the "buys more" group than those who were not, but there was some weak evidence for this within the survey sample, where larger households were more strongly associated with "buys more" than smaller households [Kruskal-Wallis H Test, χ^2(df=1)=2.969,p=0.085]. This relationship is plausible since the scale benefits of larger households mean that buying more may present less risk of creating discards than for smaller households.

It was surprising that the tactic of shopping only when not hungry (N=14) was positively correlated with food waste in models A1 and U3. This variable's inclusion was prompted by intuition that suggests going shopping on an empty stomach can lead to over-purchasing by prompting more impulse buying. However, further examination of the public health literature to explain the result seen in this analysis revealed that obesity mediates the effect of hunger on over-purchasing; obese individuals may spend more than average on groceries right after a meal (Nisbett & Kanouse, 1969). Though technically possible, it seems unlikely that all fourteen diary participants that reported using this tactic were also obese. An alternative explanation is that only shopping when not hungry may be connected to the practice of making grocery shopping a leisure activity by going "bargain-hunting" in evenings after dinner, which may contribute to increased food waste (as highlighted in Chapter 4).

7.12.4 Meal habits

Compared to shopping habits, findings regarding meal-related habits were a lot more consistent across the six models. In particular, the extent to which participants indicated thinking or researching what to cook ("think cook") was positively correlated and statistically significant or nearly statistically significant in all models except A3. It is plausible that thinking more about what to cook may prompt greater experimentation with new recipes or ingredients, which may contribute to food waste if the results are not tasty or if the household is not good at using up unfamiliar and partially-used ingredients. These effects could be exacerbated if participants shopped at venues which sold food in portions too large for their households. The above explanation might lead one to expect that "think cook" would also increase the variety of food waste discarded, and hence should be significant in A3. However, while "think cook" might increase the variety of ingredients in the fridge, it may not increase the variety of food served each meal and thus would not necessarily affect the variety of leftovers discard after each meal either. Considering that leftovers are categorized as prepared food waste, which comprises, on

average, 80% of a household's avoidable food waste count, it is conceivable that the effect of "think cook" on this measure of food waste is not statistically significant.

Table 7.30 Model comparison—meal habits

	Dependent variable					
	A1	**A2**	**A3**	**U1**	**U2**	**U3**
Independent variable category	**Avoidable FW per person**	**Percent avoidable FW**	**# of avoidable discards**	**Unprepared FW per person**	**Percent unprepared FW**	**# of unprepared discards**
Meal habits	Thinks about what to cook*** (+)	Thinks about what to cook** (+)		Thinks about what to cook*** (+)	Thinks about what to cook† (+)	Thinks about what to cook** (+)
	Frequency no leftovers*** (-)	Frequency no leftovers*** (-)	Frequency no leftovers† (-)	Frequency no leftovers** (-)		Frequency no leftovers*** (-)
			Prioritize leftover ingredients* (-)			
	Freq. receive food** (+)			Freq. receive food*** (+)		Freq. receive food*** (+)
				Tendency to eat meat*** (+)		Tendency to eat meat** (+)
				Tendency to eat seafood* (-)		
					Eats regardless of sell-by date* (+)	

†, *, **, and *** denote significance at the 10%, 5%, 1%, and 0.1% levels, respectively

The other variable consistently significant across the six regression models was participants' tendency not to have leftovers after meals ("none left"), which was negatively correlated with food waste in all models except U2. The negative coefficients seen for measures of avoidable food waste is highly intuitive and needs no explanation, but is not as natural for unprepared food waste, which by definition excludes leftovers. This result could reflect the positive correlation observed in the diary data between "none left" and the frequency with which participants prioritize using up perishable ingredients in the fridge [Jonckheere-Terpstra Test, $T_{JT} = 2490.00$, $z = 2.966$, $p = 0.003$]. A common factor connecting these behaviors would be negative attitudes towards food waste.

However, there were no observable correlations between participants' stated attitudes and "none left" or their tendency to prioritize using up perishable ingredients. Another potential explanation is one that has already been brought up earlier—it is possible that regardless of attitudes, householders who are better at meal portioning and avoiding leftovers are also more competent at buying food in the right amounts, which would reduce their discards of unprepared food waste. Lastly, the absence of "none left" from U2 could be explained by considering that the percentage of avoidable food waste that is unprepared is also affected by prepared and previously-prepared food waste, categories which include leftovers. Therefore, any effect "none left" may have on the

percentage of avoidable food waste that is unprepared could be obscured by a similar effect on prepared and previously-prepared food waste.

The frequency with which households received food from relatives ("receive food") was also quite consistent across models by having positive coefficients in A1, U1, and U3. This provides statistical evidence for the notion that "familial systems of provision" contribute to food waste, as discussed in Chapter 4. It was surprising that this effect was not visible in A2, because "receive food" was positively correlated with the percentage of food waste that was avoidable (see Table 7.13). Its absence from A3 was also unexpected but more easily explained, as its effect could be diluted in households where there are a large number of discards of other kinds of avoidable food waste. That "receiving food" was not significant in U2 was less surprising, since food received from relatives could easily count as being prepared or pre-prepared when discarded, depending on whether and when the participant managed to eat some of it or not.

The tendency to eat meat was positively correlated and statistically significant only for measures of unprepared food waste (U1 and U3), indicating that meat consumption is linked with the discard of food for reasons pertaining over-purchasing, i.e. spoilage, age, or expiration dates. This meshes with my previous finding that meat consumption is correlated with the percentage of avoidable unprepared food waste discarded due to the sell-by date (section 7.5.2). Also, Jonckheere-Terpstra testing found that a household's stated level of meat consumption was positively correlated with how often they said threw food away because of the sell-by date [T_{JT} = 2417.00, z=2.138, p =0.033] and concerns about food safety [T_{JT} = 2571.00, z =3.078, p =0.002]. Together, these findings suggest that in U1 and U3, meat consumption may be acting as a proxy for concerns about food safety, which seems reasonable considering the potentially serious health consequences of consuming spoiled meat. This would also explain why only measures of unprepared food waste were affected, as well as the its absence from U2—if a household is discarding unprepared food due to concerns about food safety, it is quite likely that they will discard prepared food and previously prepared food as well for the same reasons.

Oddly enough, U2 was also the only model where a variable that was explicitly intended to measure food safety attitudes was significant. This variable was the extent to which a household eats food regardless of its sell-by date, which had a positive coefficient. Given the discussion in the previous paragraph, this measure should be acknowledged as imperfect due to potential variability across food types, which could explain why it is not present in any of the other models. Its positive coefficient was unexpected because in theory, a greater willingness to eat food regardless of its sell-by date should mean fewer discards of food past its sell-by date. However, an alternate interpretation is that households who are more indifferent towards sell-by dates might also pay less attention to the status of food in their refrigerator, increasing the risk that food not only passes its sell-by date, but deteriorates to the point of being moldy, thereby demanding its discard.

7.12.5 Grocery trip-related factors

The only trip-related variables that were significant in any of the models were related to shopping frequency and mode choice, and these were present in A2 and A3 and not at all with the models for measures of unprepared food waste. This was unexpected since shopping frequency was hypothesized to affect over-purchasing, which would influence only unprepared

food waste. Since higher seafood shopping frequencies were correlated with a higher percentage, but not mass, of avoidable food waste per person, the higher percentage must result from a lower mass of unavoidable food waste per person. Additionally, higher seafood shopping frequencies were correlated with a higher count of avoidable food waste, but uncorrelated with avoidable food waste per person. This indicates that more frequent seafood shopping is linked with a greater variety of avoidable food waste discards, but in order to the mass to be unaffected, each discard must be smaller on average. Finally, we also know that shopping frequencies do not affect unprepared food waste due to their absence from U1, U2, and U3, which means that an increase in the count of avoidable food waste items only applies to previously prepared and prepared food waste.

Altogether, participants who purchased seafood at more frequent intervals tended to throw away more leftovers after meals and out of the fridge may have put together meals incorporating a wider range of ingredients, and threw away less unavoidable food waste in the process. Although FFV was also significant in A2 and A3, its coefficient was negative in both, indicating that it had the opposite effect on food waste than seafood shopping frequency. As such, more frequent FFV shopping is correlated with fewer discards of leftovers after meals and out of the fridge, meals with a smaller variety of ingredients, and greater quantities of unavoidable food waste. Further qualitative research is required to confirm and explain these tendencies.

Table 7.31 Model comparison--grocery trip-related variables

	Dependent variable					
	A1	**A2**	**A3**	**U1**	**U2**	**U3**
Independent variable category	**Avoidable FW per person**	**Percent avoidable FW**	**# of avoidable discards**	**Unprepared FW per person**	**Percent unprepared FW**	**# of unprepared discards**
Trip-related		Seafood purchase freq** (+)	Seafood purchase freq*** (+)			
		FFV purchase freq*** (-)	FFV purchase freq* (-)			
			Drives to at least one destination** (+)			

*, **, and *** denote significance at the 5%, 1%, and 0.1% levels, respectively

The fact that car use, as represented by whether households drove to at least one of their grocery destinations, was not correlated with any of the measures of unprepared food waste fails to support the hypothesis that car use contributes to food waste by enabling over-purchasing. On the other hand, the fact that it has a statistically significant and positive influence on the count of avoidable food waste items suggests that car use may be related to food waste in terms of the variety of foods it makes available to households. Since modern retail formats tend to offer a wider variety of products than traditional ones, this result may indicate that car use is correlated with the retail destination favored by households, which in turn might influence the range of foods they purchase.

7.12.6 Destination choice

Variables pertaining to destination choice were mainly significant in models that predicted unprepared food waste. The positive coefficient on the value households placed on selection ("selection") when deciding where to shop and the number of unprepared food waste discards was quite intuitive. In light of its absence from U1 and U2, it likely represents how these households may buy a wider range of ingredients, thus contributing to a higher count of unprepared food waste discards. Also, positive correlations between the value that households placed on customer service and the dependent variables in U1 and U2 were also intuitive since we can reasonably assume that the pleasant experience of good customer service can contribute to higher spending and potential over-purchasing.

Table 7.32 Model comparison--factors influencing households' choice of shopping destination

	Dependent variable					
	A1	**A2**	**A3**	**U1**	**U2**	**U3**
Independent variable category	**Avoidable FW per person**	**Percent avoidable FW**	**# of avoidable discards**	**Unprepared FW per person**	**Percent unprepared FW**	**# of unprepared discards**
Destination choice factors				Customer service importance** (+)	Customer service importance** (+)	
					Parking importance* (-)	
					Opening hours importance*** (-)	
			Atmosphere importance** (-)			
						Selection importance* (+)

*, **, and *** denote significance at the 5%, 1%, and 0.1% levels, respectively

The importance of easy parking and opening hours were only present in U2, where they were both negatively correlated with the percent of avoidable food waste that was unprepared. The negative coefficient on parking ease was unexpected since prior analyses suggested that car users might generate more food waste. One way this result could be interpreted intuitively would be to treat parking ease as a measure of trip opportunity cost—the easier it is to find parking, the less likely a household is to buy too much to avoid having to come back for a forgotten ingredient. However, this was not supported by the broader survey data, which instead showed a positive correlation between parking ease and stated over-purchasing tendencies for hypermarket and supermarket shoppers.

Using a similar logic, the concept of trip opportunity cost might also be used to explain the effect of opening hours. However, the fact that both of these factors were associated with a lower percentage, but not mass, of avoidable unprepared food waste suggests that, in addition to reducing unprepared food waste, they may also be linked with higher amounts of previously prepared and prepared food waste. This suggests an effect on household dynamics involving the occurrence, storage, and consumption of leftovers, but it is hard to see how parking importance

and opening hours are relevant in this regard. Further qualitative research is required to confirm and understand these observations.

Interestingly, the only variable governing households' choice of shopping destination in the models for avoidable food waste was shopping atmosphere, which was negatively associated with the number of avoidable food waste discards. Again, this effect was counterintuitive in light of prior research about the effect of shopping environment on purchasing behavior, which was supported by positive correlations in the survey data between the importance of atmosphere and the frequency of over-purchasing for most retail formats. On the other hand, the fact that this variable was only significant in A3 suggests that households who valued atmosphere did not necessarily discard less avoidable food waste, but a smaller variety. As before, further investigation is required to understand why this might be the case.

7.13 Policy and research implications

It was difficult to develop policy implications with confidence from this chapter's findings due to the exploratory nature of the analysis and the difficulty of interpreting certain results. However, much can be said from the absence of certain variables from the regression models. First among these were variables representing South Korea's volume-based waste pricing system. The food waste disposal price was significantly, but very weakly correlated with the amount of unprepared food waste discarded due to sell-by dates (section 7.10). This may be evidence that households only know how to respond to volume-pricing by paying more attention to sell-by dates, or procrastinating the disposal of food that is past its sell-by date. However, food waste disposal prices were not significant at all in the regression analyses. As such, policymakers may be unwise to rely solely on the volume-based pricing system to reduce household food waste.

Instead, it will be important to assess the extent to which households are aware of and practiced in a range of waste-prevention strategies and to accompany volume-based waste pricing with consumer education programs and campaigns to help households reduce food waste. Worryingly though, there was not only a lack of evidence that many commonly-touted waste-prevention strategies (e.g. writing lists, checking the refrigerator, etc.) are effective, but also evidence to suggest that some may actually generate more food waste. As a result, it is recommended that South Korean policymakers not only increase the amount of consumer messaging around household food waste, but also improve its content and nuance.

In this regard, it would be remiss not to discuss the findings concerning meal planning, particularly since they were supported by both survey and diary data. Much popular English-language advice found online recommends meal planning as an effective strategy for reducing food waste at home, but such advice is also often accompanied by recommendations that meal planning be undertaken in conjunction with other practices, such as taking into account leftover ingredients and leaving some meals unplanned—essentially suggesting that households remain adaptable and flexible. In light of this, it seems likely that the majority of households in the survey and diary samples may be carrying out meal planning without also taking care to perform the necessary accompanying practices, rendering it a counterproductive means of reducing food waste. As such, it may be necessary to review and revise consumer messaging in South Korea regarding meal planning to ensure that household deploy the tactic more effectively. Further

research could also investigate interaction effects between meal planning and related practices, e.g. participants' abilities to prioritize and make use of leftover ingredients or the extent to which they receive food from their parents.

Another piece of consumer advice that may require additional nuance is the recommendation that households avoid grocery shopping on an empty stomach, pending research that confirms that this tactic may be associated with more, rather than less, food waste. In particular, it would be important to investigate whether its effectiveness depends on consumers' mindsets and motivations, since this strategy may be especially attractive to consumers who enjoy after-dinner grocery shopping as a form of leisure, an activity potentially associated with more food waste. In the diary sample, this tactic tended to be employed more by higher income households, which suggests that its effectiveness may vary across socio-economic status as well.

Additionally, consumer education to improve consumers' competencies in food management should focus on minimizing the occurrence of leftovers, especially if households are not good at keeping track of and finishing leftovers stored in the fridge. This could be achieved by offering guidance on how to determine portion sizes. Another much-needed focus for consumer education is the issue of parents' overenthusiasm when providing food to their adult children, which in the South Korean context, appears to be a common source of food waste. It will be beneficial to start public campaigns that raise awareness about this cause of food waste and help start conversations between parents and children that would otherwise be difficult to have due to the potentially emotional nature of the issue.

At the level of food retail development, planning, and policy, the results in this chapter continue to hint at the existence of relationships between the characteristics of food retailers and household food waste generation. For instance, my interviews with Homeplus revealed that their packaging of FFV is designed with four-person households in mind; that consumers who bought items sold loosely were associated with less food waste confirms that packaged portions may still be too large for the average consumer. Consequently, it is clear that retailers should be encouraged, or even required, to sell items loosely in order to help consumers more easily buy the quantities they require.

As with the survey data, it was possible to connect food waste to specific retail formats via shopping frequency, though not in the manner hypothesized. In short, although higher frequency FFV shopping tends to take place at traditional retail formats and is associated with less avoidable waste, there was no evidence from the diary data that this stemmed from less over-purchasing. This was because unprepared food waste was not the measure of food waste that was correlated with FFV shopping frequency. Furthermore, the finding that avoidable food waste increases with seafood shopping frequency also runs contrary to the hypotheses being tested. Therefore, further research into how shopping frequencies for different kinds of foods are connected to food waste is required before solid policy recommendations can be made.

That being said, the fact the bivariate testing found that buying FFV most frequently at modern retail formats is associated with greater discards of food waste nonetheless supports policymaking that protects traditional retailers and encourages households to continue visiting their neighborhood grocer or traditional market to buy FFV. However, the size of any such effect

is unclear, and such policymaking efforts may be unrealistic, especially if prevailing economic and consumer trends mean that traditional retailers are set to continue losing market share. If this is the case, further research and policymaking should instead identify the attributes of traditional retailers that are most closely associated with less food waste and focus on encouraging and regulating corporate retail stores to take on these attributes.

It was also possible to connect food waste to retail formats via the reasons that households chose to shop at particular types of retail, though further research may be required to fully understand these connections. For example, higher amounts of unprepared food waste were correlated with households who placed more value on customer service, a prioritization that was strongest amongst those who visited department store supermarkets. Despite it being possible to intuitively connect better customer service to over-purchasing and food waste, this relationship may result more from the specific characteristics of customers who prefer good customer service, rather than something inherent to good customer service itself or the department store supermarket environment.

In the survey chapter, it was suggested that making grocery stores more accessible on foot and otherwise discouraging consumers from driving could help reduce food waste while dovetailing with efforts to reduce vehicular emissions. Analysis of the diary data provided only weak evidence to support this recommendation and some evidence to contradict it. For instance, in light of the finding that connected parking ease with less unprepared food waste, the recommendation from Chapter 5 to limit parking availability could be counterproductive if households do not have better options for getting to grocery stores. Consequently, further research into the relationship between mode choice, travel time, over-purchasing, and food waste is recommended. Because the analysis in this chapter was not specific to any one retail format, it would be valuable to conduct further analyses that compare how this relationship may vary across different kinds of food retail. Ultimately, policies governing food retail development may need to be more integrated with transportation and waste management planning and policy than previously realized.

Overall, this chapter's analyses were likely hampered by the diary's sample size, which was relatively small relative to the sheer number of variables being explored and tested. It is quite possible that many of the relationships described above are attributable to idiosyncrasies of the households who participated in the diary. It is also possible that the smaller sample size may have prevented statistically significant effects in survey data regression from being statistically significant here. Confirmatory research in the form of larger-sample quantitative analyses or more focused studies that attempt to unpick the puzzling relationships uncovered in this chapter would be valuable for extending the body of knowledge on how the characteristics of the food retail sector interact with and influence food-related behaviors in the home.

Additionally, this chapter's findings may lack validity beyond urban South Korea—not only due to the small sample size, but also because of the highly context-specific nature of food-related behavior, which has been illustrated elsewhere in this dissertation. Despite this, there are likely to be enough commonalities in household behavior and food retail environments across geographic and cultural boundaries to justify the adaptation of this study elsewhere.

7.14 Conclusion

This chapter's goal was to connect households' survey responses with their waste diaries by using their diary data as the dependent variable in both bivariate and multivariate statistical analyses. This built on the previous chapter, which introduced the different measures of food waste created from coding and analyzing the diary data on its own. Six measures of food waste were carried over for analysis in this chapter, and these included mass per person, percentage, and count data for two categories of food waste: avoidable food waste and unprepared food waste. Multiple measures of food waste were employed in order to compensate for their individual limitations, and side-by-side analyses of these measures for the categories of avoidable food waste and unprepared food waste helped to test the hypothesis that retail format influences household food waste via the incidence over-purchasing. Independent variables employed in this chapter's analyses covered the effects of household demographics, attitudes, meal and shopping-related behavior, diets and consumption patterns, grocery shopping trip characteristics, and waste management policy.

Overall, the analyses provided mixed evidence to support the hypotheses, while also confirming findings from prior research (e.g. the negative influence of household size) and my analysis of the survey data—most notably the positive correlation of meal planning with food waste. Another notable finding from the analyses highlighted the clear contribution of familial systems of provision to household food waste. As with the survey data, there was evidence that higher purchasing frequencies were correlated with particular retail types and also helped reduce household food waste. However, this was only true for FFV and not for seafood purchasing, which was instead positively correlated with purchase frequency. Lastly, it was possible to connect mode choice and travel time to food waste using bivariate testing, but these effects mostly disappeared in the regression analyses.

Due to the mixed bag of results concerning the relationships between retail format and food waste, concrete policy recommendations were mostly limited to reviewing and improving the content of food waste-related consumer education in South Korea. As these analyses rely on the same data as Chapters 5 and 6, the same limitations apply here.

Chapter 8 – Food waste in distribution networks for fresh fruit and vegetables

8.1 Introduction

The majority of South Korean fresh fruit and vegetable (FFV) production is domestic—of approximately 16.3 million tonnes of FFV supplied in 2011, 13.8 million tonnes (85%) were produced domestically (UN FAO, 2011), and 2.6 million tonnes (16%) were imported. Exports were minimal at 183,000 tonnes (1%). In 2014, 38% of South Korean farmers engaged in growing FFV, a percentage which grew steadily as the nation industrialized and its households started consuming more FFV. Consequently, FFV, as well as meat and dairy products, has become more profitable for farmers than grains and cereals (OECD, 2008). Similar to the rest of South Korean agriculture, the bulk of FFV production takes place on small, family-owned farms. In 2014, 69% of FFV-producing farms were smaller than one hectare and 98% were smaller than three hectares (KOSIS, 2015). Their small size is attributed to government regulation of the sale, transfer, and ownership of arable land. Farms were not permitted to be larger than three hectares until 1993, when the maximum size was raised to ten hectares—a restriction that was only removed entirely in 2002 (OECD, 2008). The farming population has also aged rapidly in tandem with South Korea's economic development and urbanization. In 2014, the head of nearly 70% of FFV farming households was more than 60 years old (KOSIS, 2015).

South Korean farmers have been supported extensively since 1961 by the National Agricultural Cooperative Federation (NACF), which has provided an increasingly comprehensive range of financial and enterprise services to its members. These services include banking, insurance, brokerage, product distribution, marketing, and retail. In particular, the NACF has invested in joint distribution facilities such as collection points, warehouses, and processing facilities, thereby increasing the scale of processing, distribution, and marketing activities (J.-H. Choi, 2006). This has not only helped modernize supply chain conditions in South Korea, but has also helped farmers maintain their bargaining power against corporate retailers (KREI, 2008). Though managed at the national level, the NACF is organized into regional cooperatives and commodity-focused cooperatives, and nearly all South Korean farmers are members of either (J.-H. Choi, 2006).

The postharvest distribution system for FFV in South Korea is complicated and diverse, with produce passing through multiple stages and transactions before reaching consumers. After harvest, farmers bring FFV for sorting, grading, and packaging, usually at facilities owned and/or operated by farmers' associations or local branches of the NACF. I will refer to these organizations collectively as "grower organizations." These grower organizations set aside a proportion of some produce types for storage and transport the remainder to wholesale markets. Produce also arrives at wholesale markets via collector organizations, who buy produce directly from farmers to sell. Buyers of FFV at wholesale markets include traditional retailers (including traditional market sellers and family-run shops), commercial end users (e.g. restaurants and food manufacturers), and middlemen. Grower organizations and collector organizations may also ship FFV directly to distribution centers operated by corporate retailers, who then redistribute the produce among their network of hypermarkets, supermarkets, and convenience stores in accordance with their inventory management systems.

The main players in the South Korean distribution system for FFV thus include grower organizations, collector organizations, wholesalers, traditional retailers, and corporate retailers. There is also a set of less significant players, which includes NACF-operated retail stores, farmers' markets, specialist organic retailers, and small online retailers. This chapter will not focus on these retailers because they account for small proportion (16%) of consumer demand. In contrast, traditional and corporate retailers, together, account for the remaining 84% (Park & Kim, 2013).

After a brief discussion of data sources, this chapter comprises two main sections. The first discusses the major stages of the South Korean distribution system, including: 1) post-harvest processing, packaging, and distribution, 2) wholesale, 3) traditional retail and 4) corporate retail. For each of these stages, I describe the movement and management of FFV and discuss the primary causes of waste. In the second half of the chapter, I present the results of a rudimentary model that estimates and compares the quantity pre-consumer food waste associated with corporate retailers and traditional retailers. I then present a broader assessment of food waste in South Korea's FFV distribution system and potential opportunities for mitigation, before concluding with a discussion of policy implications.

The information and data presented in this chapter were drawn from a variety of primary and secondary sources. Primary sources included 22 interviews with researchers, NGOs, cooperative members, traditional retailers, and corporate retailers.

8.2 Post-harvest processing, packaging, and distribution

There are two distinct dynamics in the South Korean FFV distribution system; one for vegetables primarily planted in fields (e.g. napa cabbage, onions, daikon, carrots) and one for orchard and greenhouse-grown produce (e.g. tomatoes, capsicum, apples, pears). The former is known as *batttegi* (밭떼기) in Korean and is a distinctive characteristic of vegetable farming in South Korea. *Batttegi* is characterized by the practice of speculative buying by a class of middlemen known as collector organizations. Due to the farmers' high average age and small average farm size, farmers who plant field-based vegetable crops do not have ready access to labor and often are not able to harvest their crops efficiently. As such, farmers in the *batttegi* system often only take responsibility for sowing seeds. After the seeds have sprouted, collector organizations visit farms to inspect the immature plants. Based on the crop condition and their assessment of current and future market conditions, the collector organizations make offers to farmers to buy their crop. If the farmer accepts, the two parties make a contract specifying the purchase price and quantity. At harvest time, the collector organization sends a team of laborers to harvest the crop, who also perform postharvest processing before packing the crops for distribution.

Postharvest processing first takes place on farms, directly after harvest. For *batttegi* vegetables, this includes the cleaning and removal of non-edible parts, such as outer leaves and roots. With napa cabbage, for example, the roots are left in the ground and the outer leaves are stripped before the cabbages leave the farm. There is also a minimal amount of sorting that takes place, in which produce that the farmer or harvester deems unworthy of sale is separated. In the case of orchard and greenhouse-grown produce, farmers normally remain responsible for their crop from

planting through harvest, after which they transport their crop to agricultural processing centers (APCs) that are normally owned and operated by farmer associations or cooperatives. In general, farmers must be members of an association or the cooperative in order to benefit from the sorting, packing, and shipping services offered by these facilities.

Together with rice processing centers and livestock processing centers, APCs were developed as part of the South Korean government's efforts to modernize the agricultural sector in the 1990s with investments in postharvest technology and infrastructure. Since 1993, close to 400 APCs have been constructed throughout the country, which provide centralized sorting, packing, and storage services. The majority of domestically-grown fruits are processed through APCs due to the need for machine-performed grading. On the other hand, vegetables are often sorted and graded by hand and as such are not always processed through APCs. FFV are graded on several criteria—evenness, color, shape, sugar content, size, and weight—which determine classification into three grades: premium, excellent, and fair. After sorting, produce in these categories are packaged for shipping and dispatched to wholesale markets or directly to retailers. Produce not falling into these grades are classed as out-grades and are normally bought by food processors and manufacturers, sold at local markets and other channels, or thrown away.

In addition to discards of out-graded FFV, food waste also occurs when farmers opt not to harvest their crops and instead leave them in fields to rot. This most often happens when crop yields are unusually high and sending the entire harvest to market would collapse prices, or when consumer demand is unexpectedly poor. In such cases, it is more profitable for farmers to only harvest and sell a portion of their crop and abandon the remainder. When this happens, the NACF may make available funds for compensation, which farmers can apply for. Most recent available data indicate that in 2009, unharvested FFV amounted to 64,000 tonnes, or 0.5% of total FFV production, and that there was none in 2010 (Park & Kim, 2013).

8.2.1 Case Study: Hwaaksan Tomato Farmers Association, Gangwon Province

The APC visited is owned by the Hwaaksan Tomato Farmers Association and was constructed in 2006. Its annual revenue in 2014 was approximately 8 billion won, of which tomatoes comprised 5 billion won. The corresponding tonnage of tomatoes shipped was 800 tonnes. The association is notable as the sole producer and distributor in South Korea of domestically-grown Campari tomatoes, which comprise around 25% of its tomatoes; the remainder are generic large tomatoes. Other crops handled by the facility include cucumbers and *chwinamul* (취나물), a leafy vegetable. The facility's operations are managed by staff from the local branch of the NACF, which has been in operation since 1972. Farmers pay a 2% commission to the local branch of NACF and another 1.7% to its regional branch, and a one-time fee of 3 million won for association membership, which guarantees them better crop prices and access to subsidized inputs.

The facility accepts all tomatoes, regardless of condition, that are delivered by its member farmers on a daily basis. The tomatoes are sorted first by machine according to weight and color. However, as the machine is unable to distinguish between edible, inedible (e.g. due to disease or rot), and deformed tomatoes, a second round of grading is performed by hand on-site to separate out the latter two. Approximately 70% of the total amount of tomatoes collected meets minimum grading requirements and is packaged for distribution. Shipments leave the Hwaaksan facility

every day by midnight in order to arrive at wholesale markets or corporate retailers' distribution centers on time. 40% of its generic tomatoes and all of its Campari tomatoes are shipped to directly to corporate retailers like E-Mart, which require that all tomatoes be delivered directly to distribution centers in refrigerated trucks at 10-15 degrees Celsius. The association only began using refrigerated trucks after it started selling to E-Mart approximately five years ago. As is still the case for wholesale market-bound shipments, tomatoes were transported in open-air trucks. The NACF representative who helps manage the facility felt that refrigeration was not actually necessary, and in fact may be detrimental due to the swings in humidity that such refrigeration may subject tomatoes to. Regardless of whether it was accurate or not, this claim was interesting to note as it illustrates technical knowledge over storage and transport conditions for FFV may exist between different parties.

Corporate retail buyers do not impose any grading standards beyond those prescribed government-issued manuals, but only buy tomatoes of the highest grade and only in sizes up to medium due to consumer preference. Tomatoes are inspected on arrival at distribution centers; if the shipment fails the inspection, the buyer may reject the shipment and return the tomatoes to the association, although this was noted as being an extremely rare occurrence. Deliveries to the wholesale markets in Seoul, about two hours away from the Hwaaksan facility, are still made using open air trucks. In contrast to corporate retailers, wholesalers prefer larger, firmer tomatoes for their greater durability and longer shelf life. Prices that farmers receive at wholesale are determined by auction. These prices form the basis for the prices corporate retail buyers offer the association. In particular, E-Mart adjusts its prices on a weekly basis and places orders electronically every day with the regional branch of NACF.

Grading is the primary source of discards at the Hwaaksan facility. Out of the 30% that are out-graded, 20% are still edible and are sold via alternate channels (mainly local markets). Inedible tomatoes comprise the remaining 10%. These are left in fields as fertilizer. In extremely rare cases, produce delivered to hypermarkets fails inspection and is returned; these tomatoes have to be discarded as by then, their shelf-lives are almost at an end. Lastly, large amounts of tomatoes can be discarded in unusually productive years in order to avoid price collapses due to oversupply, although this is reported to be an extremely rare occurrence, having only occurred once during the farm association's history, in 2007.

When asked how food waste at the facility might be reduced, the local NACF branch representative suggested encouraging farmers to be more selective about the quality of the tomatoes they bring to be sold. As the facility accepts all tomatoes regardless of quality, farmers bring all their tomatoes to the facility in hopes of selling them, increasing the number of rejected tomatoes at the Hwaaksan facility. Although this would certainly reduce the generation of waste at the facility itself, such a measure would only move the occurrence of tomato discards away from the facility and to the farms. Otherwise, the representative felt that the only other way to reduce wasted tomatoes would be through improved technology and know-how among tomato farmers to reduce the occurrence of disease, rot, and similar factors that make their tomatoes inedible.

8.3 Wholesale and second-stage distribution

As of 2014, there are a total of 48 wholesale markets nationwide. Of these, 33 are funded and operated by the central government in partnership with local governments (MAFRA, 2014). Twelve are operated by the NACF with governmental approval, and the remaining three are privately operated (KREI, 2008). The government-funded wholesale markets were established as part of the South Korean government's modernization of the agricultural distribution industry. Since their introduction, wholesale markets have played a central role in FFV distribution in South Korea, primarily by ensuring that even small-scale farmers have a reliable venue to systematically sell and receive fair prices for their produce (KREI, 2008).

The majority of FFV production in South Korea passes through wholesale markets; Park and Kim (2013) estimated that in 2010, 51% by mass of the total FFV food supply was sold through wholesale markets and 3% sold through NACF-operated wholesale markets. Approximately 84% by tonnage of listed FFV wholesale transactions are sold via auction, and the remainder are sold via fixed price settlements (MAFRA, 2014). The primary buyers at wholesale markets include traditional retailers, commercial end-users, corporate retailers, as well as intermediary wholesalers, who buy and resell to the first two groups.

In general, FFV arrives at wholesale markets in the early hours of the morning for sorting and repackaging. Historically, FFV was also trimmed upon arrival to remove withered leaves and otherwise unsaleable portions. However, much of this activity was moved to farms and APCs in order to reduce the amount of organic waste generated at wholesale markets; this move has also made it easier to convert trimmings into fertilizer and redistribute it to farmers. However, trimming still takes place at wholesale markets and remains a contributor to waste generation. Napa cabbage is a commonly trimmed crop; it is transported in open trucks, exposing them to heat and sunlight and causing the outermost leaves to wither in the summer. These must be stripped and disposed of before they are sold. Waste generated this way can also be exacerbated when cabbage are piled on top of each other for display during auction, which leads to deteriorated outer leaves that need to be stripped away.

Spoilage and discard of FFV also regularly occurs due to inadequate cold-storage facilities. Although refrigerated space is available for rent, not all wholesalers choose to incur the additional expense of doing so. Even so, there is often not enough refrigerated space available to meet demand. As such, the incidence of hot weather contributes significantly to food waste generation at wholesale markets. There is also a reported overall shortage of processing and packaging facilities (KREI, 2008); if this creates queues for processing FFV, then spoilage due to suboptimal storage and holding conditions may be exacerbated. Lastly, reports indicate that mechanization rates remain relatively low at wholesale markets (KREI, 2008), suggesting that manual handling errors may also be a contributor to food waste at wholesale market facilities.

It was not possible to directly obtain estimates of FFV waste percentages from wholesale market operators. However, Ministry of Agriculture, Food and Rural Affairs (MAFRA) statistical yearbooks on wholesale market activity include data on FFV waste generation and transaction volumes for the 33 publicly owned and operated wholesale markets. Averaged over five years between 2010 and 2014, the tonnage of FFV waste generated was approximately 2% of the total transaction volume (MAFRA, 2010, 2011, 2012, 2013, 2014). Based on statistical yearbook

records and interviews with experts at the Korea Rural Economic Institute (KREI), food waste generated at wholesale markets is either processed into compost or animal feed, incinerated, or landfilled. That wholesale market food waste is sometimes landfilled is surprising given South Korea's ban on food waste in landfills, which reflects the difficulty of fully enforcing this ban, even at government-owned and operated facilities. Some unsold produce from wholesale markets is also donated to food banks.

8.4 Traditional retailers

Traditional retailers can be divided into two major groups, traditional market sellers and family-owned stores. The focus of this section is on the former group due to the fact that traditional markets fulfill a larger proportion of final demand for FFV than family-owned stores. This section therefore largely draws upon interviews with FFV sellers in two of Seoul's traditional markets: Songhwa Market, Gangseo district and Shinyoung Market, Yangcheon district. These markets are fairly typical of traditional markets in Seoul with respect to their size and composition. Interviews were also conducted with two family-owned grocery stores in Gwanak district, which helped ascertain that the challenges faced by these retailers with respect to food waste are similar to those faced by traditional market sellers.

FFV sellers in traditional markets tend to exclusively sell fruits or vegetables. In general, they plan their buying and selling on a day-to-day basis. Each morning, FFV sellers visit wholesale markets to purchase their day's inventory, which they transport using their own truck. All the sellers interviewed made their purchasing decisions with the intention of clearing their inventory each day. Their decision is based on a combination of factors, including their existing stock, the previous day's sales, the weather, day of the week, and the season. The sellers did not have access to any point-of-sale systems to keep track of revenues or inventory. Consequently, the amount of unsold produce remaining each day depends on a seller's ability to accurately gauge daily demand and on unexpected influences such as adverse weather conditions and poor patronage. As FFV naturally loses freshness and consequently, customer appeal, over time, the occurrence of unsold produce is a major factor in determining the rate of food waste generation for FFV sellers in traditional markets.

In general, as with households, food waste discarded by traditional market sellers can be classified as avoidable or unavoidable food waste. Unavoidable food waste comprises almost all of the food waste discarded by vegetable sellers, who often need to trim and repackage their produce for resale. In contrast, avoidable food waste refers to produce that was fit-for-sale but has been discarded because it is no longer so. In some cases, the line between avoidable and unavoidable food waste is blurred. For instance, vegetable vendors may gradually trim away the withered leaves of produce such as cabbage and lettuce as their condition deteriorates in order to ensure they still look appealing to consumers (Figure 8.1).

Figure 8.1 Discarded napa cabbage leaves and other trimmings at a roadside market, Sillim-dong, Seoul

Most sellers indicated that they threw away very little avoidable food waste. Data collected from traditional market sellers about their food waste are displayed below in Table 8.1. Revenue data were collected as an indicator of each seller's operating scale. However, all data are rough estimates made by the sellers interviewed and should only be considered indicative.

Table 8.1 Summary of data obtained from traditional market sellers

		Daily:			
Stall	**Selling**	**Revenue (won)**	**FW (kg)**	**FW (L)**	**% Sold**
Songhwa market					
1	Fruits	1,500,000	<1	-	~100
2	Vegetables	1,000,000	5	-	80
3	Fruits	1,500,000	3-5	-	>95
4	Fruits	4,000,000	3	-	-
5	Vegetables	1,500,000	5	-	-
Shinyoung market					
1	Fruits	1,500,000	5	10	30-40
2	Fruits	weekdays: 1,500,000 weekends: 2,800,000	10	-	80
3	Vegetables	600,000	-	20	~100
4	Vegetables	500,000	-	50	70

Table 8.1 indicates that most sellers interviewed were able to sell upwards of 70-80% of their inventory every day. The remaining 20-30% consists of rotten and damaged produce, customer

samples, and unsold produce that is still fit-for-sale. Given the already rough nature of the estimates, it would not have been meaningful to ask for a further breakdown of food waste according to the above three categories. However, customer samples are minimal, and it is unlikely that sellers would simply discard fit-for-sale produce since it represents a direct economic loss. It is thus reasonable to assume that avoidable food waste at traditional markets is mostly rotten or damaged.

Sellers identified the weather as the primary cause that rendered produce unfit for sale. Fruit sellers said that their food waste peaked in the summer and autumn due to heat-induced rot, with one (Stall 4, Songhwa market) claiming that his food waste doubles in the months of June, July, and August. Spoilage also tended to occur during the winter if vegetables froze. One vegetable seller said that onions and garlic tended to spoil the most in the winter and spring due to the length of time elapsed since harvest. Weather also affected food waste generation by reducing foot-traffic through traditional markets; sellers noted specifically that heavy rain strongly influenced how much produce remained unsold each day.

Sellers also indicated that the quality of the produce purchased at wholesale had an influence on food waste, either by reducing shelf life or by reducing customer demand. Several sellers noted that they occasionally received rotten fruit from wholesalers, which they suggested could have been because the fruit remained at wholesale for too long. One seller noted being able to minimize the chances of this happening by paying closer attention to the grower, whose name is marked on each box of produce sold at wholesale. Although sellers could not provide more precise estimates, in most cases it did not seem that they had a lot of leftover fit-for-sale produce at the end of each day. Those that did (e.g. Stall 1, Shinyoung market) had access to refrigeration and had the option of storing unsold produce in the refrigerator overnight.

The sellers interviewed described various methods to minimize the amount of food waste generated. Almost all said that it was most important to buy the right amount each day in order to avoid having unsold produce. The next most mentioned method was to use discounting tactics to clear their inventory. These tactics took several forms; some vendors chose to sell at a discount towards closing time in a last effort to clear their day's inventory, while others might lower prices gradually over a few days. Another discounting tactic described was to offer damaged, but still edible, produce at lower prices (Figure 8.2), which is bought by customers to make jam or juice. Beyond discounting, another tactic for reducing food waste involved covering produce with wet newspapers or cardboard in the summer to preserve humidity and freshness and shade produce from the sun. Some sellers also had enterprising means of cutting their losses—one vegetable seller said that they would often cook or pickle unsold vegetables and sell them as pre-cooked side dishes rather than risk them go bad the next day. Eating unsold produce at home was another option, as demonstrated by the proprietor who showed me the stew she was making with unsold tomatoes in the back of her grocery store.

Figure 8.2 Damaged fruit on sale at Shinyoung market, Seoul

The traditional market sellers interviewed reported different means of disposing of their food waste. Several noted that they paid a fixed fee each month to a waste collection company which picks up food waste every day; this sometimes involved buying a bin used specifically for food waste. Others indicated that they purchased volume-rate food waste disposal bags for their food waste, while others still indicated that they simply disposed of their food waste via the general waste stream. According to South Korean law, traditional market sellers are classed as small businesses and thus are required to dispose of their food waste using the volume-based waste pricing system. The range of disposal methods employed across just nine market sellers thus suggests that there is room for interpretation of this law or that enforcement is inadequate.

8.5 Corporate retailers

Corporate retailers operate four main types of retail stores, including hypermarkets, super-super markets (SSMs), convenience stores, and department store supermarkets.[18] They are owned by a small number of South Korean conglomerates, each of which operates its own store network. Individual store networks may consist of different numbers of hypermarkets, SSMs, convenience stores, and department store supermarkets, but common to all is their organization around distribution centers that receive inventory from suppliers and supply individual stores. As the main players in driving retail modernization, corporate retailers are characterized by extensive cold-chain infrastructure, sophisticated inventory management systems, and the tendency to purchase inventory via direct procurement (Reardon & Timmer, 2005). Of the four sub-categories of corporate retailers, hypermarkets, SSMs, and department stores are the most important with respect to FFV sales; convenience stores devote a very small amount of shelf-

[18] Please refer to Chapter 4 for a more detailed description of corporate retailers

space to FFV. This part of the chapter focuses on understanding the main reasons for food waste associated directly with corporate retailers, i.e. that which occurs in their distribution centers and stores, using the case of Homeplus, one of the top three retailers in South Korea.

8.5.1 Case Study: Homeplus

Homeplus was chosen for this case study by default; I was able to gain access to Homeplus via a contact at Seoul National University who had previously cooperated with them on consumer research. Efforts to establish contact with Emart and Lotte, the two other leading grocery retailers, were unsuccessful. As a result, the discussion of corporate retailers is based almost entirely upon information shared by Homeplus. While the discussion would have benefited from comparing differences in business practices across more than one corporate retailer, these differences are unlikely to change the thesis of this chapter. Due to the huge variety of FFV that Homeplus sells, some questions were impossible to answer without referring to specific products. Where this was the case, tomatoes and onions were used as examples due their high loss rates, as reported by UN FAO food balance data (2011). Tomatoes and onions are also well-differentiated with respect to their harvest frequency, relative durability, and supply channels; though they will not be representative of the entire range of FFV in the following discussion, tomatoes and onions are nonetheless different enough to provide different angles on FFV food waste.

Questions were first conveyed to Homeplus via email for distribution to the relevant departments to answer. After Homeplus' compiled responses were received, two in-person interviews were performed to follow-up, clarify, and seek greater detail where needed. One of these was at Homeplus' distribution center in Anseong City, about one hour's drive south of Seoul. In general, Homeplus was unwilling to share specific data, presumably for competitive and reputational reasons. The following discussion is thus informed mostly by the ranges and estimates their representatives were willing to provide.

Homeplus was originally established as a joint venture between Samsung and Tesco in 1999, eventually becoming solely owned in 2011 when Tesco bought out the remainder of Samsung's share in the venture. Since entering the market, Homeplus has experienced rapid growth and is widely regarded as the sole foreign-owned retailer to successfully establish a foothold in the South Korean grocery retail market (Coe & Lee, 2006). In 2015 however, Tesco sold Homeplus to a private investor consortium due to financial struggles throughout the company (Armstrong, 2015). As of 2015, Homeplus was the second largest grocery retailer in South Korea by revenue ((Euromonitor, 2016), with a market share of approximately 11%. It operates a total of 884 physical stores throughout South Korea; of these, 141 are hypermarkets, 371 are SSMs, and 372 are convenience stores. These stores are served by ten Hompelus distribution centers.

Homeplus' distribution centers receive and redistribute 56% of all the food products it sells, with the remainder being delivered directly from its suppliers to its stores. However, nearly all FFV is routed through its distribution centers. The distribution center in Anseong City is designated as a "fresh distribution center," meaning that it is primarily dedicated to handling FFV, other fresh foods (i.e. meat, dairy, and seafood), and frozen foods. As such, the entire center is temperature controlled; there are three zones at maintained at 10, 1 and -21 degrees centigrade where different food products are handled. The Anseong distribution center supplies 89 stores in the northern region of the country and operates 24 hours a day, 7 days a week, sending out two

“waves” of deliveries each day. FFV comprises 54% by volume of the first wave, which leaves the distribution center by 6 a.m. at the latest. Deliveries from suppliers of FFV take place between 3 p.m. and 11 p.m.; upon arrival, the delivery vehicle’s temperature is inspected for compliance before handlers unload the delivered produce. Quality control staff then sample the shipment and perform quality inspections to ensure compliance with Homeplus standards. If upwards of 7-8% of the boxes in the shipment fails an initial inspection, another 7% are inspected; if a total of 15-20% of boxes fail, Homeplus rejects the entire shipment and returns it to the supplier. Distribution center managers estimated that this takes place for less than 0.5% of shipments. Shipments that pass quality control are then moved to picking grids, where pickers compile shipments for delivery to individual Homeplus stores based on their orders. Another temperature check is performed for each pallet before it is loaded onto trucks leaving the distribution center.

Spoilage of FFV does not occur at Homeplus’ distribution centers because produce arrives, is handled, and departs in less than a day under strict temperature controls. As such, the only direct cause of food waste is mishandling—when boxes break or when produce spills and is damaged for other reasons. Homeplus’ target is to restrict the rate of these occurrences to 0.04%; as such it can be considered a nearly negligible source of food waste in its value chain. Otherwise, waste is generated indirectly when deliveries fail quality control—in such cases they are returned to suppliers and likely discarded, as was discussed in section 8.2.1.

Unit-picking was identified as an important contributor to reducing food waste in stores; it involves assembling store orders in individual units, as opposed to larger units such as boxes or cases. This means that store orders can be assembled with greater granularity, making it easier to meet store demand. This way, there is a lower probability that stores receive larger orders than requested, in turn lowering the quantity of unsold inventory. However, unit-picking is currently only employed for 3.7% of inventory passing through Anseong distribution center. This is because it is not suitable for all kinds of produce. Because unit-picking involves increased physical handling of produce, it is not used for leafy vegetables as this would lead to increased product deterioration and loss of freshness. Additionally, unit-picking is best employed for products with low sales volumes.

Besides unit-picking, it was also noted that stores are able reduce waste by redistributing inventory among themselves. A centralized system enables store managers to check inventory levels in Homeplus’ store network and place requests for inventory to be sent over from other stores if need be. This system works primarily for low turnover, long shelf-life foods and is rarely employed for vegetables due to their short shelf lives, relatively small order volumes, and susceptibility to damage from the increased handling that unit-picking would entail.

Buyers at Homeplus generally place orders for tomatoes and onions 1-2 weeks in advance. The order volume each week is determined according to a procurement plan that is determined at the end of each year for the coming year. Based on data from the previous year, planners are able to create a baseline estimate of the quantities needed each week. These data include the previous year’s sales, as well as the number and length of promotions that Homeplus ran in the past year.

It was notable that, over the last five years, Homeplus has sourced the entirety of its tomatoes and onions directly from suppliers. On average, 60% of its tomatoes and onions come from collector organizations (e.g. via *batttegi* and other middlemen) and 40% from cooperatives similar to Hwaaksan Tomato. Although Homeplus maintains a list of cooperatives they prefer to procure from, the percentages procured from cooperatives change each year. In situations where farmers' crops are too small for cooperatives to fulfill Homeplus' orders, Homeplus fills this deficit by purchasing from collector organizations instead. It was noted that Homeplus has been attempting to increase the extent to which it purchases FFV directly from cooperatives.

Pricing for onions and tomatoes is determined differently due to the differences in harvesting patterns for each crop. Onions are harvested once a year only and are held in storage by cooperatives and other distributors. Although Homeplus pre-determines its order quantities each year, pricing paid to suppliers is determined weekly. A reference price is adjusted to account for the continuous degradation of quality that takes place in stored onions, which can be as much as 20 percent by mass over one year. The result is that as the time after harvest lengthens, Homeplus receives an increasing number of onions that are rotten or on the brink of being unsaleable. On the other hand, tomatoes are continuously grown throughout the year and as such prices are negotiated with suppliers on a weekly basis based on Homeplus' demand estimates.

Homeplus enforces standards for its FFV produce in three areas: 1) product specifications, 2) packaging, storage, and transportation conditions, and 3) packaging specifications. For product quality, Homeplus makes use of nationally issued standards that classify produce based on size and grade. In addition to only procuring the highest grade produce, Homeplus chooses to procure produce in specific sizes based on its knowledge of customer preferences. For instance, Homeplus only buys medium-sized onions because large and small-sized onions do not sell well. Only produce that meets Homeplus' specification arrives at its' distribution centers. Hence, grading does not need to take place again, although Homeplus inspects shipments to ensure that suppliers are meeting their specifications. Homeplus also requires that its suppliers package and transport the produce to its distribution centers under refrigeration, after which the produce must stay refrigerated until it is displayed in stores. Lastly, Homeplus requires that its suppliers package produce using specific designs and in particular quantities. The design specifications are required because normally 90% of FFV at Homeplus is sold under its private branding. The quantities packaged are specified according to the needs of the average South Korean four-person household, which Homeplus has determined to be its primary customer segment. Another factor affecting the quantities packaged is the seasonality of produce. For example, packaged quantities for tomatoes can range from 4-5kg during their peak season to 750g during the off-season.

Suppliers perform all the packaging of produce for sale in Homeplus' stores prior to its arrival at its distribution centers, and as such no further repackaging is needed. Although South Korean law does not require fresh foods to be labeled with sell-by dates, Homeplus independently labels its private brand produce with "display until" dates. These dates are invisible to consumers, but are used by Homeplus as a means of monitoring and guaranteeing freshness. Although this varies by produce type, the display-until date is generally 1-3 days after the arrival of the produce in-store.

Homeplus estimated that 5-7% of the FFV it procures remains unsold and that unsold produce constitutes the main cause of food waste in Homeplus' stores. This occurs due to poor sales, errors in ordering and demand estimation, and spoilage. In situations where promotions cannot help to clear its inventory, Homeplus sells the produce at wholesale markets. Produce sold in this way accounts for 3-5% of FFV inventory. Otherwise, the primary means by which Homeplus mitigates these losses is through discounting and other promotions that help sell excess produce. Homeplus discards any produce that remains after this is; discards makes up the remaining 2% of procured FFV that is unsold. Homeplus also indicated that some waste occurs during transportation due to physical damage and contamination, but that this is a negligible amount.

In the case of onions, selling excess inventory through the wholesale market often results in monetary losses due to the low price received there. As such, Homeplus may use unsellable but otherwise edible onions to make and sell onion juice, although they are unable to use up all of the unsold onions this way. This option is available for onions due to the relatively small number of onion juice makers. In the case of tomatoes, however, there are a large and established number of players who buy unsellable but edible tomatoes to make ketchup and other tomato-based foods. Consequently, cooperatives and other tomato suppliers have already learned to separate out tomatoes during their sorting processes and sell them directly to food manufacturers, leaving little for Homeplus to do in this regard. Homeplus noted that even if it processed the unsold 5-7% of its tomatoes into other foods, the additional revenue and profit would not be worthwhile.

The representative interviewed indicated that Homplus does not currently donate any excess food to food banks or other charities. [19] One reason for not doing so alluded to the general absence of a "donation culture" and a lack of vitality among food banks. Cost was another reason; it appeared that for Homeplus, the cost of donation (i.e. transportation and handling) is similar or greater than the cost of food waste disposal. Lastly, concerns over potential liabilities relating to food safety were also mentioned as a barrier to donations of unsold FFV.

8.6 Model estimation and comparison of pre-consumer food waste

In this section, I use the estimated percentages of food waste generation that were collected from interviews and secondary sources as the bases for a preliminary comparison of food waste in supply chains for corporate and traditional retailers.

8.6.1 System boundaries

System boundaries for the analysis were assumed to be "farm gate to retail." In other words, the first stage included is processing, packing, and distribution by grower organizations and the last stage is retail, either at corporate retail stores or traditional retailers. The analysis thus excludes any waste generated on farms and in consumer households. Figure 8.3 is a simplified representation of FFV flows within the system boundaries.

[19] Subsequent newspaper research I performed has indicated that this is untrue.

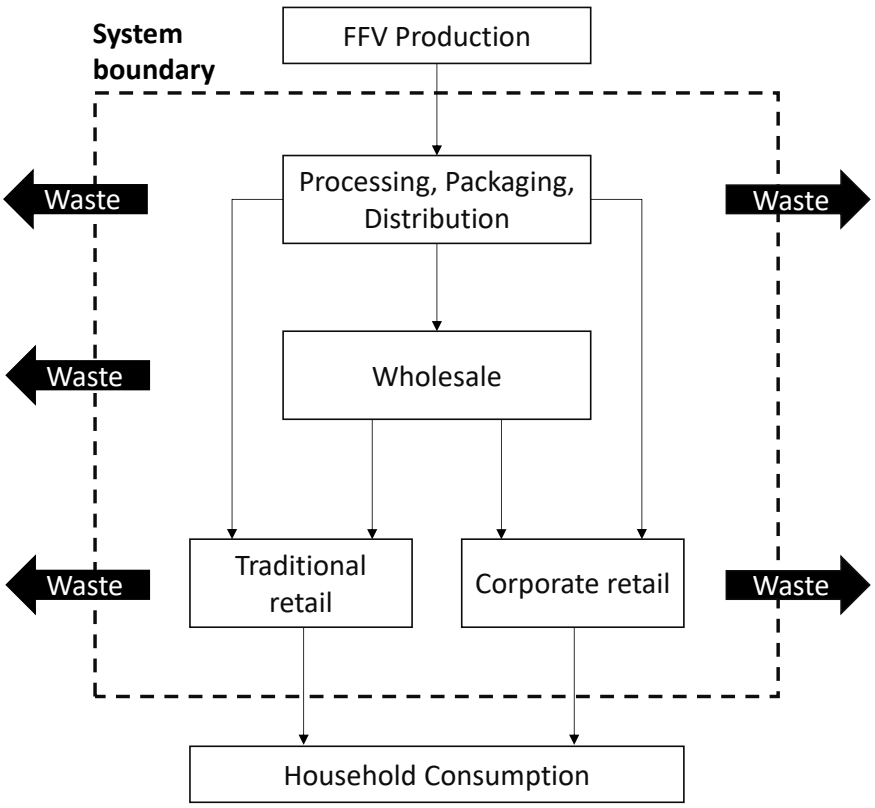

Figure 8.3 Simplified South Korean FFV distribution system

As indicated by the arrows labeled "waste" in Figure 8.3 and the data in Table 8.2, the analysis focuses on waste generated during three stages: 1) processing, packaging, and distribution (PPD), 2) wholesale, and 3) retail. The organization of the system into these three stages reflects several simplifications made to the, in reality, much more diverse South Korean distribution system and were necessary to facilitate the application of the available FFV waste percent data to FFV transaction data.

First, PPD was taken to encompass the activities undertaken by cooperatives, farmer associations, and collector organizations (as described in section 8.2). Consequently, harvest waste is excluded from this analysis. Second, wholesale includes not only activities at public wholesale markets, but also wholesale transactions undertaken by cooperatives and secondary wholesalers (as described in section 8.3). Traditional retailers include not only traditional markets, but also family-owned stores. Overall, these simplifications are based on the assumption that levels of infrastructure and technology are similar across each of the categories. For example, similar to traditional market sellers, family-owned FFV retailers purchase their FFV inventory every day from wholesalers and have low access to POS systems for keeping track of sales and estimating future demand.

Even though FFV waste is known to occur from storage, this has not been included in the analysis for simplicity. Because only certain kinds of FFV are stored (e.g. onions, garlic, potatoes) after harvest, accounting for storage would require not only crop-specific production data, but also data on the percent stored and loss rates for each crop. Given that storage is performed by grower organizations during the PPD process and storage loss rates are not a

function of who ultimately sells the produce, I have assumed that storage losses are similar for traditional and corporate retail.

Lastly, a number of minor players in consumer food retail have been excluded from this analysis due to their small size. These cooperative-run grocery stores, purely internet-based FFV retailers, farmers' markets, and organic-only FFV retailers. Collectively, FFV tonnage sold through these outlets accounted for just 7% of final demand, compared to the 38% that corporate and traditional retailers accounted for together. Also, because this dissertation focuses on consumer food retail, commercial demand for FFV has been excluded as well.

8.6.2 Data and methodology

Park and Kim's (2013) estimates of FFV distribution channel volumes in 2010 were used as the basis for this analysis. Their research was based on production volumes, sales, and unit price data gathered from sources that included government statistics, industry yearbooks, and existing research. In addition to the size of different distribution channels, the authors also provided an estimate of total supply chain losses, which amounted to approximately 1 million tonnes, or 8.5% of total FFV supply. However, this was calculated by subtracting final consumption from total supply; as such there were no estimates of food waste for each stage in the supply chain.

To recap, percent estimates and the nature of FFV food waste generation at each stage in the supply chain are summarized below in Table 8.2. These percentages were used to estimate the volume of FFV waste generated at each stage shown in Figure 8.3. It should be noted that during interviews, traditional market sellers were asked about the percentage of their inventory they could not sell each day; their answers ranged from 0% to 70%. However, as several had access to refrigeration to store unsold produce overnight, it was not possible to obtain an estimate of the percentage discarded. Consequently, a conservative estimate of 5% was used for traditional retailers. Additionally, because wholesale market data appeared to have errors for individual markets that overstated the amount of waste generated, a conservative estimate of 1.5% was used even though the average waste percentage from 2010 to 2014 was 2%. Lastly, although Homeplus' distribution centers provided an indicative percentage for food waste at distribution centers, it was so small (<0.5%) as to be considered negligible given the overall low precision of the model.

Table 8.2 Summary of FFV waste percent data

Stage	% Waste	Main cause of food waste	Data source
Production, packaging, and distribution	10% (w_p)	Outgrading of FFV deemed unsaleable	Interviews
Wholesale	1.5% (w_w)	Spoilage due to: − suboptimal storage conditions − suboptimal transport conditions	Agricultural Product Wholesale Market Statistical Yearbooks (2014)
Corporate retail	2% (w_c)	Spoilage due to: − poor sales	Interviews
Traditional retail	5% (w_t)	Spoilage due to: − suboptimal storage conditions − poor sales	Interviews

It is possible to estimate the quantity of pre-consumer food waste at each stage by subtracting Park and Kim's (2013) estimated sales volumes from estimated procured volumes for each stage in the distribution system. However, for some stages, estimated procurement volumes were smaller than sales volumes, which is physically impossible. Because the authors' raw data were unavailable, it was not possible to assess if this was due to error or if there was additional data that was not published. To get around this problem, it was necessary to work backwards from retail sales volumes (i.e. final consumption) to calculate the quantity of FFV originally procured during each stage of distribution. This required assuming that the difference between the quantity procured and the quantity sold is solely attributable to waste. Waste generated at each stage is then assumed to be the difference between quantity procured and quantity sold.

The process for estimating the quantity of pre-consumer food waste associated with traditional retailers is illustrated with reference to (
Figure 8.4) below, where:

A = traditional retailers' sales volume in tonnes
B + C = quantity procured by traditional retailers
D = quantity procured by wholesalers for eventual sale to traditional retailers
E = quantity supplied by producers to PPD for eventual sale to traditional retailers

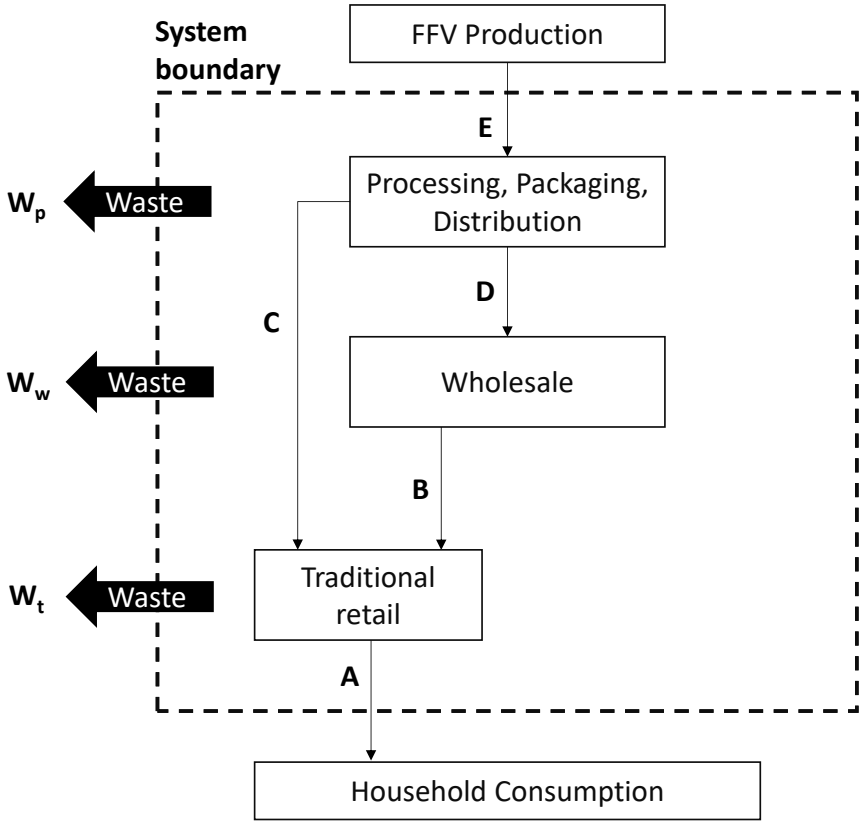

Figure 8.4 FFV supply chain for traditional retail

Given the above relationships and knowing w_t, w_w, and w_p, the percentages of procured FFV that become waste during traditional retail, wholesale, and PPD, respectively (Table 8.2), it was possible to calculate preceding transaction volumes:

$$\mathbf{B + C = A / (1-}w_t\mathbf{)}$$
$$\mathbf{D = B / (1-}w_w\mathbf{)}$$
$$\mathbf{E = (C + D) / (1-}w_p\mathbf{)}$$

Where procurement was split between different sources (e.g. traditional markets procuring from PPD and wholesale), the actual percentage breakdown from Park and Kim's study (2013) was applied to determine the tonnage procured from each source. Waste generated at each stage is then estimated by finding the difference between quantities sold and quantities procured:

$$\mathbf{W_t = (B + C) – A}$$
$$\mathbf{W_w = D – B}$$
$$\mathbf{W_p = E – (C + D)}$$

In this way, the quantity of FFV food waste generated along the entire supply chain for traditional retailers was calculated. The equivalent steps were repeated for corporate retailers and the difference in FFV food waste between corporate and traditional retailers was calculated. Sensitivity analyses were then conducted to evaluate the extent to which model results vary in response to changes in the underlying assumptions.

8.6.3 Model results

Key outputs from the model are presented in Table 8.3. Food waste estimates are shown for traditional and corporate retail and for each, divided according to distribution stage. Estimates of FFV food waste summed across both retail types are also shown in the last two columns.

Table 8.3 Estimated FFV food waste in South Korean distribution channels, 2010

	Traditional retail		Corporate retail		Traditional + Corporate retail	
	'000 tonnes	*% of total*	'000 tonnes	*% of total*	'000 tonnes	*% of total*
Processing, Packaging, Distribution	285	*65%*	177	*80%*	462	*70%*
Direct PPD	81	*6%*	85	*38%*	166	*25%*
Indirect PPD	204	*46%*	92	*42%*	296	*45%*
Wholesale	28	*6%*	12	*6%*	40	*6%*
Retail	127	*29%*	32	*14%*	158	*24%*
Total FFV food waste	**439**	***100%***	**221**	***100%***	**660**	***100%***
Total associated FFV production	2,849		1,771		4,620	
Waste as % of FFV production	*15%*		*12%*		*14%*	

Given the waste percentage assumptions used for each distribution stage (Table 8.2), it is perhaps no surprise that the majority of waste generated in either retail type is in the PPD stage. Direct

PPD food waste refers to waste generated by grower organizations before shipping directly to retailers, whereas indirect PPD food waste refers to waste generated by grower organizations before being sold to retailers via wholesale markets. Traditional retailers have a much higher percentage of indirect PPD food waste than corporate retailers because of their tendency to procure FFV from wholesale markets. On the other hand, corporate retail has a higher percentage of waste occurring in the PPD stage due to the higher percentage of FFV procured directly from grower organizations. Due to the lack of storage infrastructure at traditional markets, it was expected that traditional retail has a higher percentage of food waste generated at the retail stage than for corporate retail, which was reflected in the model results. Looking at FFV food waste fr traditional and corporate retailers together, 70% occurs during PPD, 24% at retail, and 6% at wholesale, again reflecting the high percentage of FFV that gets discarded during PPD.

The overall efficiency of each retailing type can be assessed by calculating FFV waste as a percentage of associated FFV production, defined as the quantity of FFV that needs to arrive at PPD in order to fulfill consumer demand at each retail type. The difference in efficiency between traditional and corporate retail—15% versus 12%, respectively—is attributable to the difference in retail stage food waste and the difference in how much each retail type procures from wholesale as opposed to directly from grower organizations.

Food waste ratios are useful for making comparisons across categories of food waste. The overall ratio of traditional to corporate food waste is 1.99, indicating that FFV waste associated with traditional retailers is double that of corporate retailers. Comparing supply chain (PPD + wholesale) waste only, the ratio is 1.65; this likely reflects increased wastage at wholesale incurred by traditional retailers. For retail stage food waste, the ratio is 4.01, which is high considering that the ratio of waste percentages at retail for each is 2.5 (5% vs. 2%). This reflects the large quantity of FFV being sold, and hence also wasted, at traditional retailers.

It is also worth examining and comparing the ratios of supply chain food waste to retail food waste for traditional and corporate retailing. Overall, the ratio is 3.17, indicating that the bulk of FFV food waste is discarded in the supply chain rather than at retail. The ratio is more extreme for corporate retailers at 5.99, reflecting the relatively low loss rates at the retail stage. Because of higher retail stage wastage, the ratio is 2.46 for traditional retailers.

8.6.4 Sensitivity analyses

Sensitivity tests were performed to evaluate the sensitivity of different model outcomes to changes in the underlying assumptions. Beyond helping to assess the conclusions drawn from the model, sensitivity testing also helps assess how waste reduction in different stages of the South Korean FFV distribution network affects the distribution of food waste. For all outcomes except the traditional-corporate food waste ratio, sensitivity was measured in terms of the percentage change in the outcome following a one percentage point change in the waste percentage assumption being tested.

First, the sensitivity of total food waste (i.e. traditional plus corporate food waste) to changes in the four main waste percentage assumptions was tested (Figure 8.5). Here, sensitivity is measured in terms of the percentage change in total food waste following a one percentage point

change in the waste percentage assumption being manipulated. Two observations stand out, though one was more anticipated than the other. Since PPD has the largest percentage of waste generated, we would expect that reducing PPD waste has the largest proportional effects on food waste—a one percentage point reduction leads to an 8% decrease in total food waste. However, it was less expected that wholesale food waste could have a large effect given the already small percentage losses incurred in this stage—decreasing the waste percentage at wholesale by one percentage point produces a 5% decrease in total food waste. This is due to the large volume of FFV that passes through wholesale markets. However, given that the percentage wasted at wholesale is already low (1.5%), the potential scale of further reduction is limited.

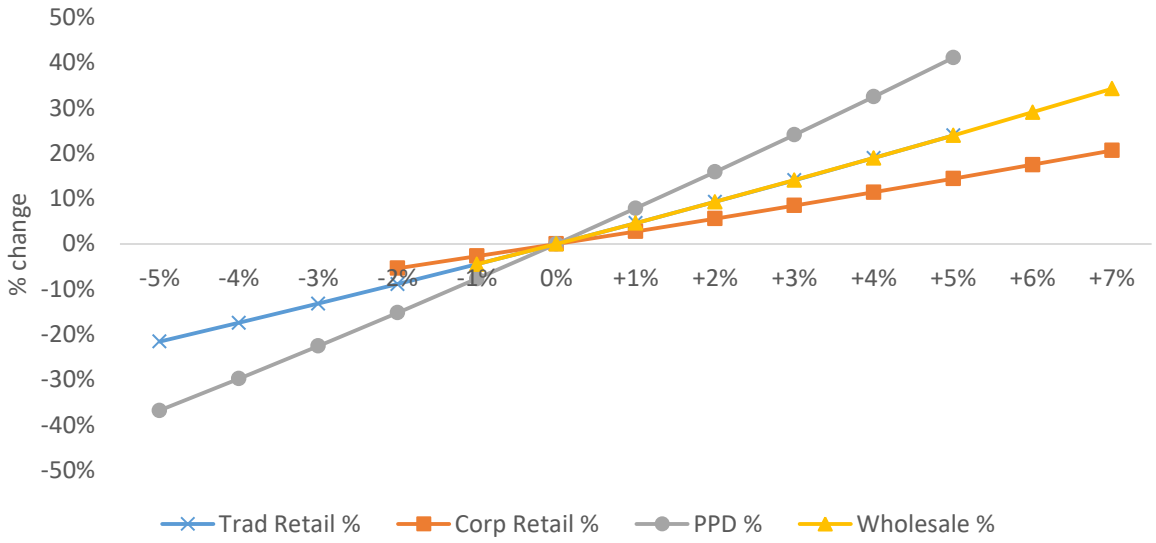

Figure 8.5 Sensitivity of total food waste to waste percentage changes

In Figure 8.6 we can see how the traditional-corporate food waste ratio responds to changes in the four main waste percentage assumptions. Lowering the waste percentage for the PPD stage increases the traditional-corporate food waste ratio because a lower percentage of food waste occurs during PPD for traditional retailers. Altering the assumption for wholesale waste has a very minimal effect. Reducing the waste percentage for the retail stage of traditional retail by 5 percentage points (from 5% to 0%) alters the ratio from 1.99 to 1.34. Despite this, traditional retailers still generate more food waste than corporate retailers. The ratio does not drop below 1 even by increasing the waste percentage for the retail stage of corporate retail from 2% to 5%.

This is an important result as it illustrates that traditional food waste cannot be greater than corporate food waste even if the waste percentages used grossly overestimate or underestimate the actual percentages of FFV wasted in traditional and corporate retail stages, respectively, holding all other factors constant. In fact, the percentage of FFV wasted in the corporate retail stage would have to be 13% before the ratio reaches 1. Barring the possibility of inaccurate reporting, this is an unlikely prospect in light of the fact that Homeplus reported unsold FFV produce before discards as being 5-7% of inventory.

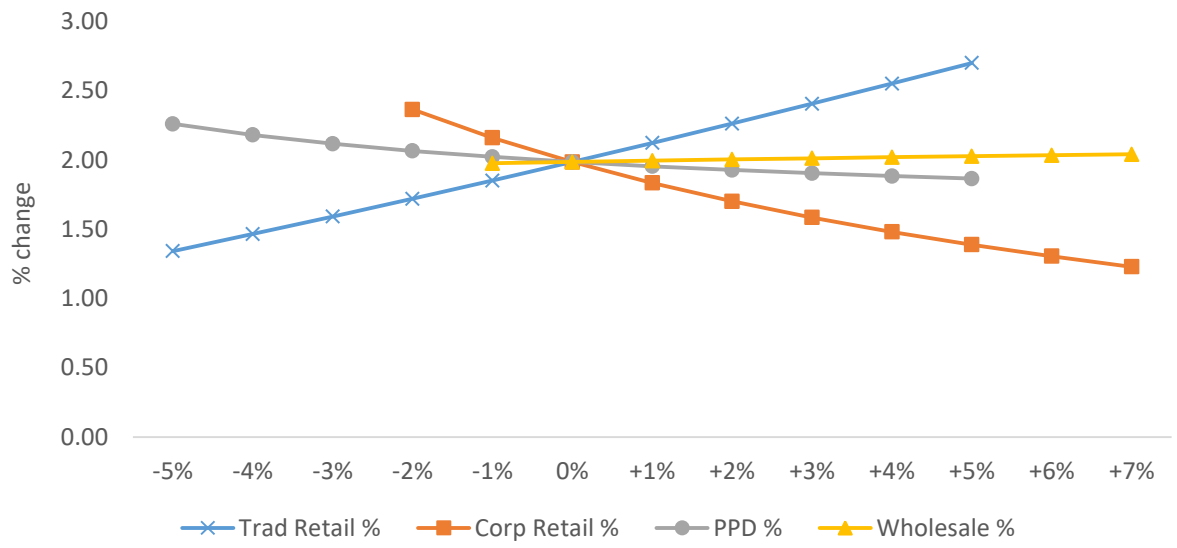

Figure 8.6 Sensitivity of traditional-corporate food waste ratio to waste percentage changes

Turning to Figure 8.7, we see that reducing retail stage food waste for traditional retailers has the largest effect on the ratio of supply chain to retail stage food waste due to the high percentage of retail stage food waste associated with traditional retailers. We can also see that a 1 percentage point reduction for both PPD food waste and wholesale food waste decreases the supply chain-retail food waste ratio. This is slightly more pronounced for PPD due to the bulk of pre-consumer food waste occurring in the PPD stage.

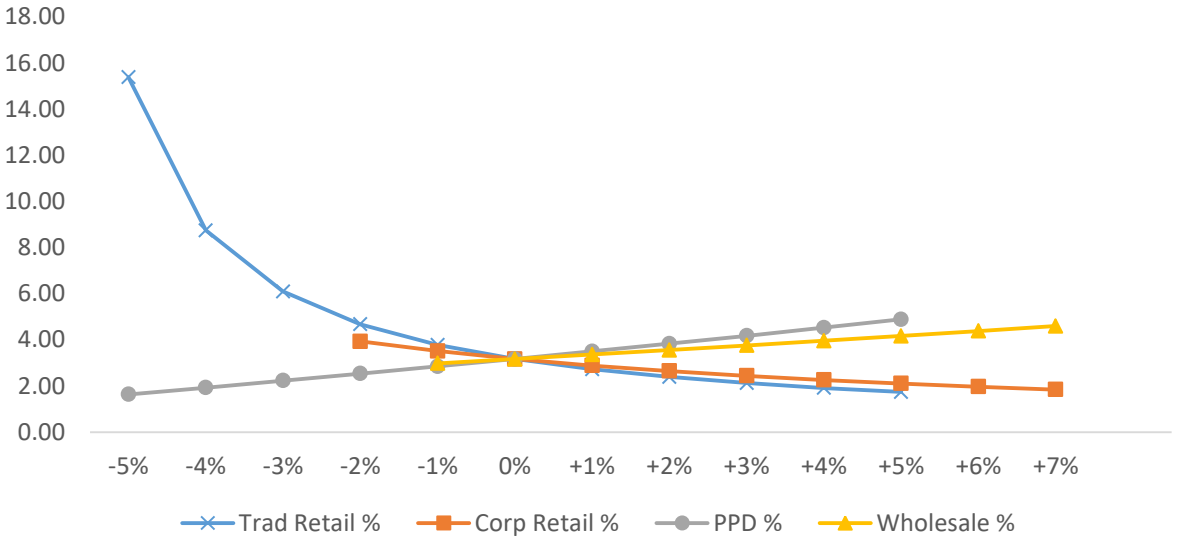

Figure 8.7 Sensitivity of supply chain-retail food waste ratio to waste percentage changes

In addition to examining how changes to waste percentage assumptions affect total food waste and the ratios described above, it is also worth noting how these outputs respond to changes in corporate retailers' market share and traditional retailers' procurement patterns. In Figure 8.8 for instance, it is evident that as corporate retailers' market share continues to grow, there will be a

gradual increase in the proportion of food waste generated in the supply chain. Additionally, traditional retail food waste will decrease due to a reduction in FFV volumes sold through these channels. This translates to an overall decrease of 0.3% in total pre-consumer food waste for every percentage point increase in corporate retailers' market share. These findings assume that any market share gained by corporate retailers is taken directly from traditional retailers.

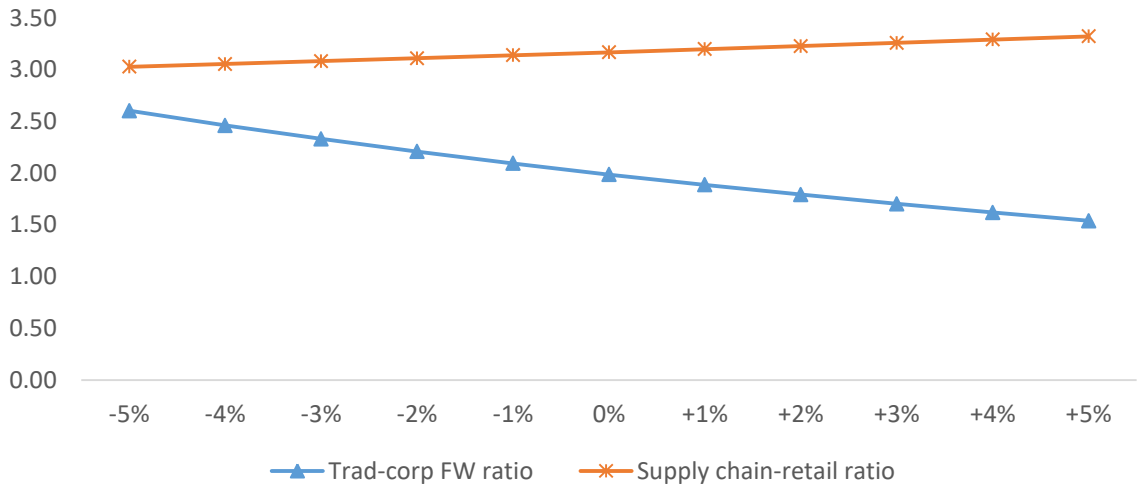

Figure 8.8 Sensitivity of food waste ratios to changes in corporate retail market share

Figure 8.9 shows how food waste for traditional and corporate retailers responds to changes in their respective procurement patterns—the percentages they procure directly from grower organizations instead of via wholesale. Increasing this percentage reduces food waste for both, although to a greater percentage for corporate retailers. Nonetheless, the change is very small; a 2 percentage point increase in direct procurement for traditional retailers reduces their food waste by just under 0.2%.

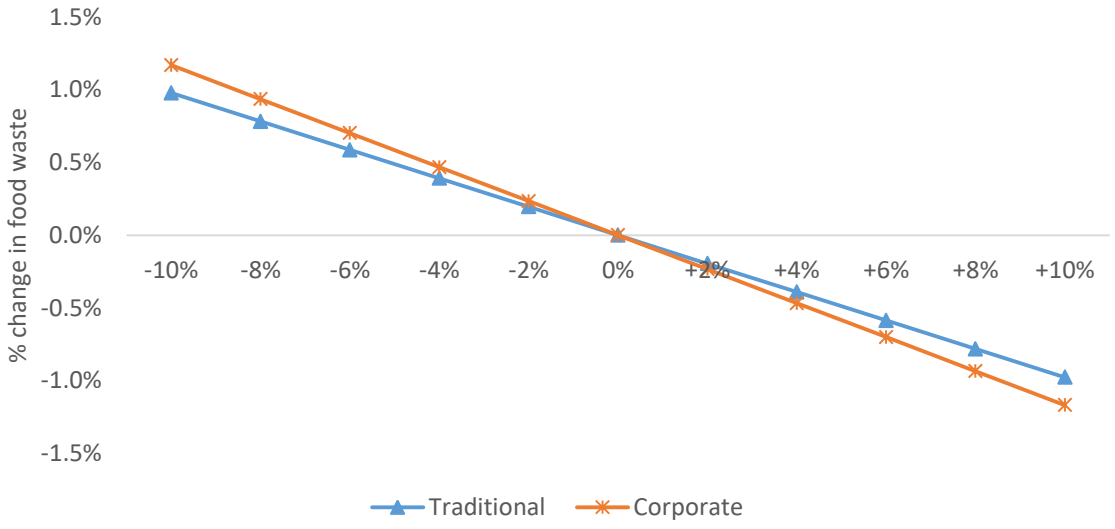

Figure 8.9 Sensitivity of food waste ratios to changes in the percentage of FFV procured directly

8.6.5 Extending the model

The model results so far indicated that supply chain FFV food waste for corporate retailers is lower than that for traditional retailers. However, this finding only addresses part of the research questions posed in Chapter 2 about the difference between traditional and corporate retail across the entire South Korean food system. In other words, it does not address the possibility that FFV bought at corporate retailers is more likely to be wasted than FFV bought at traditional retailers. At this point, it therefore remains unclear how system-wide (i.e. supply chain + household) food waste associated with corporate retailers is different from system-wide food waste associated with traditional retailers.

In order to assess this difference, the model was extended to estimate household food waste using previous estimates of the percentage of household food purchases that is ultimately thrown away (Buzby, Wells, & Hyman, 2014; WRAP, 2013). This percentage was first assumed to be the same for FFV bought at corporate and traditional retail. I then calculated the percentage point difference between the two that is required for system-wide FFV food waste (i.e. pre-consumer and household food waste) to be the equal for traditional and corporate retail—i.e. the theoretical "breakeven point" where greater supply chain efficiency for corporate retail is outweighed by hypothesized increased wastefulness amongst its customers. This breakeven point is then discussed in the context of findings about household food waste from the foregoing chapters.

Based on the methodology described above, the model estimated that corporate retail customers must discard 38% of their FFV purchases and traditional retail customers must discard 16% of their FFV purchases before corporate food waste breaks even with traditional food waste. In other words, households must discard FFV bought from corporate retailers must be discarded twice as often as FFV bought from traditional retailers, before the "savings" in pre-consumer food waste attributable to corporate retailers are eclipsed by their hypothesized tendency to enable or encourage greater wastefulness at the household level. In light of results from analyses of household food waste discussed in the previous three chapters, it seems unlikely that any discrepancy in wastefulness attributed to customers of traditional and corporate retailers is as large as 16 percentage points.

8.7 Discussion

Overall, it was apparent that traditional and corporate retailers share one main reason for FFV food waste—the spoilage of produce left unsold in stores due to over-procurement or unexpectedly poor customer demand. However, there is a large difference between the means of traditional and corporate retailers to, firstly, minimize the occurrence of unsold produce, and secondly, mitigate the generation of food waste caused by such occurrences. With the former, unsold produce that goes bad equates to losses, and as such, it is in the interest of retailers to only procure what they think they can sell.

Thanks to its POS and demand forecasting systems, Homeplus appears to be able to forecast weekly demand with an error of 5-7% (the average percentage of produce remaining unsold); this is likely to be similar for Homeplus' competitors, although benchmarking this figure, both domestically and internationally, in future research will be important. As individual stores are responsible for placing orders with the distribution center, it is less certain how this percentage

varies within Homeplus' network of stores. Unit-picking and the ability of stores to request and deliver excess inventory to other stores enables store managers to more accurately match supply with demand, which may help reduce demand forecasting errors at the individual store level. Such systems are less applicable to FFV due to its short shelf-life and fragility and, as such, accurate demand forecasting is crucial for minimizing waste in this product segment. The discard rate of 2% that Homeplus reported was low when compared to estimates that place retail food losses for FFV at around 10% in the United States (Buzby et al., 2014), but closer to research in the UK that estimated retail stage waste for various types of FFV as ranging from 0.5% to 5% (Mena, Terry, Williams, & Ellram, 2014). These data points are not directly comparable due to methodological differences, but they may suggest that South Korean corporate retailers are better at mitigating food waste than their Western counterparts. Further investigation is required to understand if and how these difference is related to Homeplus' ability to manage inventory and minimize food waste and South Korea's policy environment.

In contrast to corporate retailers, traditional retailers are left to estimate demand using intuition and experience. Even if traditional retailers can minimize unsold produce by perfectly anticipating each day's sales, they remain completely vulnerable to circumstances beyond their control—the weather for instance, as well as any factors that might hurt demand. This vulnerability stems primarily from an overall lack of access to refrigeration. This is less of a problem among family-run stores, but many traditional market sellers do not own, or have access to, refrigerators. The ability to store FFV in refrigerators during the day or overnight is an important factor in maintaining the freshness of FFV, and consequently, minimizing a stall owner's losses from rot and spoilage. Access to refrigeration enables stall owners to be more aggressive when buying their inventory each morning because they have the option of storing unsold produce overnight. In turn, this influences discounting tactics—those whose FFV might not be saleable tomorrow might slash prices more drastically today than those who can minimize overnight loss in freshness with refrigeration. In this way, traditional retailers' vulnerability to external conditions not only contributes to retail stage food waste, but may also translate into foregone income.

Just as unsold produce is a common driver of food waste for traditional and corporate retailers, discounting is a tactic used by both to minimize its quantity—both reported selling older and damaged produce at reduced prices. This was the case for all of the traditional retailers interviewed. In contrast, there were indications that corporate retailers may be more limited in their ability to discount produce because of the need to protect their brand and image; this may be especially true for high-end department store supermarkets. For other types of corporate retailers, stores that are run under franchising agreements may have more autonomy over the decision to introduce discounts than stores operated directly by corporate headquarters (B.R. Kim, personal communication). As a result, the management structures employed by corporate retailers may also affect the extent to which produce remains unsold.

Repurposing old produce was also a method that was common to traditional and corporate retailers, although to varying extents. Of the traditional retailers interviewed, only a few mentioned that they either processed unsold produce for resale or brought it home to eat. Labor and time constraints are a likely factor which prevents more traditional retailers from doing the former. Corporate retailers can process certain types of unsold produce into other products.

Whether they can do so depends on the type of produce, namely the extent to which other uses already exist and the potential to create and market new derivative products. Homeplus' tactic of making and selling onion juice from unsold onions illustrates this aptly (see section 8.5.1). However, because onion juice is growing in popularity as a health food, sustained consumer demand may attract more onion juice manufacturers into the market. This could potentially erode Homeplus' profits from making and selling onion juice, making it no longer worthwhile for them to do so, as is currently the case for tomato-based products. It is therefore unclear whether Homeplus and other corporate retailers can continue to reliably mitigate food waste this way. Further investigation of how other unsold produce is or is not repurposed in the context of broader market trends would thus be very pertinent to understanding the potential for additional waste generation or mitigation at corporate retailers.

Besides repurposing its produce, Homeplus also reported selling some of its produce via wholesale markets in situations where discounting alone is not enough to avoid losses from spoilage. Unlike repurposing, this option is only available to corporate retailers; their shorter, climate-controlled supply chains give store managers more time to observe that sales are slow and decide to send the produce to wholesale. The large procurement scale at which corporate retailers operate also makes it possible to sell excess produce at wholesale this way.

Overall, corporate retailers have more options than traditional retailers for reducing unsold produce and preventing unsold produce from turning into food waste. However, unlike traditional retailers, corporate retailers employ certain practices that may actively maintain a minimum amount of unsold produce. First, even if they can accurately forecast demand, corporate retailers are most likely to maintain inventories at some level of excess in order to avoid running out of stock, which represents lost revenue and adversely affect consumer purchasing behavior (Campo, Gijsbrechts, & Nisol, 2003). Although these retailers would be unlikely to admit it explicitly, a certain amount of waste is considered, as an indication that shelves are fully stocked, to be a necessary cost of doing business (Gunders, 2012). Corporate retailers may also maintain strict freshness standards that result in fresh FFV being removed from display earlier than may be required. For example, Homeplus labels all its produce with "display-until" dates. Therefore, while it would be important to explore the potential for reducing unsold produce by improving the accuracy of demand-forecasting systems, it also remains to be seen whether doing so will actually reduce the occurrence of unsold produce.

As with traditional retailers, inadequate refrigeration and the lack of cold chain facilities are key contributors to food waste at this stage although to a lesser extent due to the shorter period of time produce spends in wholesale. In absolute terms, there is less wholesale stage wastage for corporate retailers because a larger percentage of their FFV bypasses wholesalers as a result of their direct procurement systems. This also helps reduce retail stage food waste due to the better condition in which produce arrives at stores. In contrast, the majority of FFV sold by traditional retailers is procured via wholesale markets, thereby making wholesale market waste more prevalent in their supply chains.

Grading was identified as the major contributor to waste during PPD, although unlike wholesale, food waste in PPD is equally prevalent for traditional and corporate retailers. Produce are graded regardless of whether they are destined for wholesale markets or for corporate retailers'

distribution centers. Grading is performed according to official standards that are maintained by the South Korean government's National Agricultural Products Quality Management Service (NAQS), and which pre-date the rise of South Korea's corporate retailers. Corporate retailers rely on these standards for some produce (as was seen in section 8.2.1) and enforce their own standards for others. Such private standards are potentially problematic as distribution centers can reject an entire shipment if a certain percentage does not pass quality inspections. Homeplus reported that 0.5% of its shipments are rejected, which suggests that this is an infrequent occurrence.

Homeplus attributes its low rejection rate to successful supplier outreach programs, which share information about consumer preferences and help ensure that growers and other suppliers understand what is required of them and are able to grow FFV according to Homeplus' specifications. As such, the low rejection rate experienced at distribution centers may just reflect growers being more selective over what they decide to ship, which may mean increased rejection of produce during PPD. Nonetheless, mass discards of unsuitable yet edible FFV are rare because produce that does not meet corporate retailers' standards but still exceeds minimum national quality standards can be sold at wholesale markets. There are also alternate sales channels for out-grades—the Hwaaksan Farmers Association is able to sell two-thirds of all its out-graded tomatoes at local markets, and the remaining one-third are only discarded because they have been deemed inedible due to disease or rot. Consequently, it is difficult to conclude that the rise of corporate retailing has contributed to increased discards of out-graded produce, at least thus far.

In the long term, the continued viability of these alternate sales channels depends on the sustained vitality of traditional markets and the wholesale markets they depend upon. The volume of FFV passing through wholesale markets is in decline. According to Korea Agricultural Marketing Information Service (KAMIS) data, the percentage of domestic FFV supply sold through wholesale markets has declined from 74% in 2010 to 58% in 2014 (KAMIS, 2010, 2014). This has coincided with continued growth in direct procurement by corporate retailers. Over the same period, the proportion of FFV large retailers procured directly from grower organizations increased from 31% to 52% (KAMIS, 2010, 2014). This upward trend in direct procurement might be less worrisome if traditional retailers were not also losing market share to corporate retailers (see Chapter X). The demise of traditional retailers could mean the loss of a large outlet for lower-quality FFV that is not procured by corporate retailers. Corporate retailers may also find it harder to dump unsold produce via wholesale markets due to a lack of buyers. Under such circumstances, food waste, in the form of discarded out-grades and unsold produce, would grow substantially. In order to avoid this, one or a combination of several things must happen: South Korean corporate retailers must be willing to relax procurement standards, growers must significantly increase the percentage of their crops that meets corporate retailers' standards, or additional markets for out-graded produce must be found.

Even if traditional retailers and other sales channels for lower-quality produce do not disappear entirely, questions should be raised about whether short-term consumer demand for FFV is strong enough to support the additional supply introduced when corporate retailers dump unsold FFV at wholesale markets. If not, this may contribute to price collapses, prompting farmers to abandon some of their crops to prop up prices. In such circumstances, food waste "savings"

corporate retailers achieve by dumping unsold produce at wholesale are potentially cancelled out by food waste generated on farms as a result of the impact on prices. Further research is required to investigate the possibility of this occurring.

Another structural trend that may play a role in the future is the continued aging of the farm population and its effects on farm size in South Korea. This may affect food waste from PPD via the ensuing effects on mechanization and APC utilization. Up till now the small scale of farming has limited the economic returns on investing in machinery (K.-H. Choi & Kang, 2005), and therefore also the potential for mechanization. Having recognized the negative impacts that small farm scale has on economic competitiveness and the long-term vitality of South Korean agriculture, the South Korean government has attempted to promote farm consolidation and large-scale commercial farming ever since it started easing restrictions on farm size, culminating in their abolishment in 2002 (OECD, 2008). Additionally, the government has attempted to encourage younger people to take up farming by offering training programs and subsidizing loans to enable younger farmers to buy land and capital equipment (Im & Jeong, 2014). The gradual replacement of older farmers with fewer younger farmers would result in higher land-labor ratios and a farming population that may be more willing to adopt newer agricultural techniques.

Both of these factors might prompt greater mechanization, as would a government decision to lift the current prohibition on leasing farmland. Overall, with increased use of machinery, on-farm and post-harvest losses can be expected to fall (Hodges, Buzby, & Bennett, 2011). However, at current technology levels, mechanization rates may not rise for all crops. Although there are machines under development that can potentially harvest fruit orchards, many fruits and vegetables mostly still need to be harvested by hand, a labor-intensive process. If land-labor ratios fall and farmers have difficulties securing enough labor during harvest time, there may be increased instances in which fruits are not harvested in time, as has been the case in the US (Bloom, 2010).

The trend of farm consolidation and expansion also raises questions over APC utilization rates. To remind, APCs were established by the South Korean government to help small farmers benefit from otherwise inaccessible economies of scale by providing joint sorting, packaging, and marketing services. The government's goal was to have 50% of domestic FFV production be processed through APCs by 2017, but as of 2012, the percentage was just 18% (Yi & Goh, 2015). Research on APC utilization rates suggests that they are driven by farmers' desires for better prices and insufficient labor (Yi & Goh, 2015). APC utilization is also negatively correlated with growth in contract farming (K.-H. Choi & Kang, 2005), presumably because both compete in terms of the benefits they offer: better prices and access to markets. Furthermore, contract farming is associated with increased vertical integration and retail modernization (Reardon, Barrett, Berdegué, & Swinnen, 2009). If farm consolidation and mechanization are accompanied by further vertical integration as retail modernization proceeds in South Korea, farmers may increasingly lose their incentive to utilize APCs to sort, package, and distribute their produce. As farms commercialize and grow in scale, it also becomes more viable for corporate retailers to buy directly from farmers instead of having to access farmers through grower organizations. As a result, the percentage of FFV production processed through APCs is likely to fall.

How this potential drop in APC utilization then affects PPD food waste depends on the grading and sorting standards employed outside of APCs. Till now, retailers such as Homeplus have relied on publicly issued quality standards used by APCs. However, treating directly with growers makes it easier for corporate retailers to introduce their own grading standards. If these are more stringent than those previously relied upon, the consequence may be increased out-grading of edible produce. If this happens in conjunction with the potential reduction in alternative sales channels for out-graded produce discussed earlier, this could lead to an increase in the overall quantity of food waste generated during PPD.

Farm consolidation, mechanization, and continued vertical integration may also hold broader ramifications for the South Korean food system. I have already touched upon the consequences of growing direct procurement for the vitality of wholesale markets and traditional retailers. Even if government support turns traditional markets into cultural attractions, their decline would nevertheless see the loss of cultural value in terms of the livelihoods, lifestyles, and shopping practices associated with them. Similarly, whatever traditional farming techniques that do remain risk being lost as well. Additionally, if orchard harvesting eventually becomes a fully mechanized process, it has been proposed that this may create demand among farmers for genetic varieties that are more robust to the increased physical impacts that this harvesting technique might entail (Bloom, 2010). If true, and depending on younger South Korean farmers' receptiveness to foreign varieties or genetic modifications of Korean fruit, this would also contribute to a loss in cultural value.

The flip side to farm consolidation is the growth of organic farming and ecotourism in South Korea. In addition to encouraging farm scale-up, the South Korean government has also promoted organic farming as a means of bolstering small farmers' livelihoods and reducing environmental impacts from heavy chemical fertilizer use (Choo & Jamal, 2009). This trend has been accompanied by growing South Korean consumer consciousness about food safety and health, prompting rapid growth in both the market for organic produce and the acreage devoted to growing it (Choo & Jamal, 2009). The government has also promoted ecotourism on such farms in order to raise off-farm incomes among the rural population. Though the organic produce market is at risk of co-optation by corporate retailers, there remains an opportunity for traditional retailers to specialize in selling organic produce. In light of these trends, further research into spoilage rates for organic versus conventional produce would be important. Additionally, it is possible that growing rural ecotourism and any increase in popularity of buying organic and/or local produce could prompt reconnections between urban consumers and their food, with potential effects on food waste; further research to assess these possibilities would also be valuable.

This chapter has focused less on two other sources of food waste: storage and waste from overproduction. Storage was not included in the model due to difficulties obtaining data on storage rates for different crops and FFV loss rates from storage. Additionally, because storage is performed primarily by grower organizations, similar loss rates will likely apply to corporate retailers and traditional retailers, which would not substantially influence the result of the comparisons of their food waste performed earlier. Even if corporate retailers are more stringent about the conditions under which their produce is stored, this would not change the directionality of the outcomes reported above.

Waste from overproduction and walk-bys is also difficult to account for due to a lack of official data, but the implications for the research question at hand are less clear. Further research in this regard is required, especially into the causes and extent of overproduction. A quick, non-systematic search of a South Korean news database revealed instances of overproduction leading to waste in each of the years from 2014-16 for paprika (1,000 tonnes) (Lim, 2016), napa cabbage (150,000 tonnes) (Kim, 2014), onions (1,151 tonnes) (Chang, 2014), and tangerines (40,000 tonnes) (Ko, 2015). In the case of tangerines and napa cabbage, peculiar weather conditions contributed to oversupply, and in the case of paprika and onions, currency fluctuation-driven declines in exports and poor consumer demand were cited as the main causes.

Anecdotally then, recent instances of waste from overproduction do not appear to be directly connected to direct procurement systems or other aspects of corporate retailers' operations. It is nonetheless important to note that farmers are eligible to receive compensation for not harvesting their crops in certain circumstances, which amounts to an indirect subsidy for overproduction. Additionally, the fact that farmers can be penalized for not fulfilling supply contracts with corporate retailers incentivizes overproduction, although experts suggest that excess FFV produced for this reason does not contribute to waste from overproduction as it can be sold on the wholesale market (B.R. Kim, personal communication). This claim requires further investigation. Finally, the reach and impact of production subsidies for FFV should also be investigated given their potential for driving systemic overproduction.

8.8 Policy implications

At present, South Korea's volume-based pricing system for food waste only applies to households and small businesses. As such, corporate retailers are subject to different food waste disposal laws than traditional retailers. Although they are subject to additional reporting regulations concerning their management of food waste, they are not required to pay per-unit disposal fees, and are also subject to. Instead, they negotiate contracts with waste management firms who transport and process their food waste for them. The reasons for this differentiation in policy should be investigated and the extension of the volume-rate pricing system to apply to corporate retailers should be evaluated as a potential method of pressuring them to more actively cut down on food waste.

As small businesses, traditional retailers are required to dispose of food waste in a similar manner to households—through the use of volume-rate plastic bags, sticker-chip systems, or RFID machines. However, the application and enforcement of this requirement for traditional markets in particular is not uniform, in light of the differing accounts given by traditional market sellers about how they disposed of their food waste. Consequently, it would be important for policymakers to assess the extent to which the volume-based pricing system and ban on food waste in the general waste stream is being enforced. Although standardization of food waste disposal for traditional markets especially may not be the strongest policy lever for reducing food waste, doing so would at least increase diversion of traditional market food waste from landfills or incinerators. Given the additional financial burden that volume-rate disposal presents for traditional market sellers and their declining economic fortunes, it may also be beneficial to evaluate the appropriateness of the volume-rate disposal system. The tendency for traditional

market sellers to be clustered in traditional markets means that it may be worth considering the viability of allowing market sellers to collectively sign fixed-fee, bulk disposal contracts with waste management firms.

Policies for improving aspects of the South Korean distribution system also have a key role to play in reducing food waste. This chapter's findings indicate that lack of refrigeration is a key driver of spoilage in traditional markets. Consequently, subsidies or incentives for the purchase of refrigerators, both for storage and display, at traditional markets may help reduce food waste. Improving cold-chain systems and facilities for wholesale markets would have similar effects, while possibly helping to reduce food waste at traditional markets by ensuring that produce has a longer remaining shelf life when it arrives at retail. Investments in refrigeration could also enable market sellers to more aggressively procure inventory each day, reducing the opportunity cost of stock-outs on days when business is good, as well as improve average product quality.

On the other hand, refrigeration may contribute to increased food waste at traditional markets if stall owners become too aggressive with procurement and end up with increased quantities of unsold produce. As such, it would also be important to accompany refrigeration-improvement policies with training programs to help stall owners adapt their inventory management practices to the presence of refrigerators. Other drawbacks to the above recommendations include the larger electricity bills that market sellers would face—one seller interviewed indicated that he did not invest in a refrigerator due to the additional expenses involved. Consequently, it may be also beneficial to invest in more common refrigerated space that sellers who do not want refrigerators can rent during exceptionally hot weather. Lastly, studies that weigh the life-cycle impacts from food waste against additional electricity consumption from additional refrigerators will be important to understand the potential tradeoffs involved.

Beyond reducing food waste directly, investments in refrigeration may have the added benefit of improving business at traditional markets and contributing to their sustained vitality. This is another goal that policymakers should keep in view due to the importance of traditional markets for the sale of produce that would not otherwise be procured by corporate retailers. Ensuring their continued viability may be important for preventing future increases in discards of out-grades and lower-quality produce. This is however a challenging goal; despite continued government efforts to support the traditional retail sector (see Chapter 4), traditional markets have lost significant market share to corporate retailers, a trend that is expected to continue as corporate retailers expand via convenience stores and internet retailing (Euromonitor, 2016). It is unclear whether government efforts have exhausted their potential or not, but if they fail to prevent the anticipated decline of traditional retailers, it will then be important for policymakers to ensure the continued existence of sales channels for produce rejected by corporate retailers. This could include promoting direct replacements to traditional markets, such as direct sales farmers' markets, or passing legislation that restricts corporate retailers' selectivity of domestically-produced FFV. These measures may be less crucial if producers start growing more of the crops and cultivars that corporate retailers prefer, since this would improve allocative efficiency in the market. Nonetheless, if retail modernization proceeds and South Korean consumer preferences continue to evolve in accordance with Western precedents, out-grades are likely to grow in significance as a source of food waste.

Corporate retailers can potentially reduce the occurrence of unsold produce in their stores by improving their demand forecasting and logistics systems. Specifically, the potential efficacy of unit-picking as a means of reducing unsold produce could be explored further by looking into whether it can be applied to a greater range of FFV types. It was however most glaring that Homeplus did not mention donations as an option for mitigating food waste from Homeplus' stores. Nonetheless, there is significant potential for Homeplus to increase food donations—in 2014, it donated 54 million won of food, whereas Emart's donations totaled 535 million won (Heo, 2015). As discussed in section 8.5.1, barriers to increasing donations include the cost of transporting food to food banks and concerns over legal and reputational risks pertaining to food safety. The first is addressed by the fact that South Korea's main food banks are able to directly pick up food from stores with their own trucks. However, the second barrier is harder to overcome. Even though donors and food banks are protected by the law from civil and criminal law suits and food banks have access to insurance policies that cover such liabilities, reputational damage from being linked to food poisoning remains difficult to overcome. As such, following France and Italy's lead in passing laws that, respectively, require corporate retailers to donate unsold food or remove barriers to food donation (Vogt, 2016) would likely be the most effective step towards reducing in-store food waste.

Lastly, it would be remiss not to mention the finding from sensitivity analysis suggesting that reducing FFV discards during PPD creates a larger percentage decrease in total food waste than any other stage. It was noted that out-graded but still edible produce can be sold via alternative distribution channels, but further research on the nature and scale of these channels would be valuable. If it is true that barely any edible produce is discarded during PPD, then the potential for reducing waste during PPD may be limited by farmers' ability to minimize the occurrence of inedible produce, i.e. by limiting disease and other causes of spoilage. Consequently, continued technical support, either by corporate retailers or the government, should be provided to help continually improve farming techniques.

As suggested in relation to the policy implications highlighted above, future research should focus on what rapid, continued change in South Korea's agricultural production and distribution sector will mean for food waste. It is apparent that commercialization and consolidation in South Korea's farm sector is overdue, and therefore it is necessary to understand how growth in average farm size might affect food waste through changes in production patterns and supplier relationships. Similarly, it will be important to understand the role of diversity in South Korea's distribution system in establishing and maintaining markets for produce of all grades.

8.9 Conclusion

In this chapter, I have presented a high-level overview of the South Korean distribution system for FFV and identified the key issues relating to and driving the occurrence of food waste from post-harvest processing, packaging, and distribution, through wholesale, to the retail stage. While doing so, I have differentiated the pathways—traditional and corporate—by which domestically produced FFV reach consumers and illustrated their differences and commonalities in the generation of food waste. These findings are unsurprising in a sense because they reflect what we already know about pre-consumer food waste—that it is, when compared to post-consumer food waste, less relevant in industrialized nations due to investments in technologies such as cold-

chain systems and efficient logistics systems (Gustavsson, Cederberg, Sonesson, Van Otterdijk, & Meybeck, 2011; Institute of Mechanical Engineers, 2013). However, despite South Korea's status as an industrialized nation, there remain differences between traditional and corporate retailers in the efficiency of their respective supply chains, their ability to physically control losses from spoilage, and the options they have available for preventing losses from unsold produce.

I have attempted to quantify these differences with a model that uses existing transaction data to perform an order-of-magnitude comparison of FFV food waste directly and indirectly associated with traditional and corporate retailers. The model suggests that in 2010, pre-consumer FFV food waste associated with traditional retailers is approximately twice the magnitude of that associated with corporate retailers. This difference is not only attributable to their qualitative differences described above, but also the large quantity of FFV that is still sold through traditional retailers. Traditional retailers still perform more poorly than corporate retailers when it comes to supply chain efficiency, but the difference is smaller than for absolute food waste quantities (15% versus 12%). In addition, understanding the order-of-magnitude of the difference between the two allowed for a rough comparison of pre-consumer and post-consumer food waste across traditional and corporate retailers. This comparison suggested that with respect to FFV purchases, households shopping at corporate retailers need to be more than twice as wasteful as those buying from traditional retailers in order to erase the difference in pre-consumer food waste—an unlikely scenario. This finding indicates that overall, retail modernization in all likelihood contributes to a net reduction in the amount of FFV food waste.

These findings reinforce existing discourses about the need for technological investments for reducing pre-consumer food waste in developing countries. But, this chapter presents another facet to this argument by identifying the potential benefits of having a diversity of channels for food distribution, which may not only reduce the incidence of unsold produce at the system level, but also permit the sale of out-graded produce. Although distribution channel diversity is not mutually exclusive from the modernization of agricultural production and distribution systems, the two have been historically linked. This is because the resources that enable technological modernization are often introduced into developing markets by foreign direct investment on the part of corporate retailers (Reardon et al., 2009), who then exert competitive pressures on traditional retailers. Policy implications emerging from this chapter therefore not only call for continued modernization of traditional retailers and wholesale markets through investments in refrigeration, but also the need for policymakers, both in South Korea and abroad, to pay attention to the vitality of alternative distribution channels.

The recommendations made in this chapter should be footnoted not only with the caveat that further research is required, but also with several limitations to the research. The first and most obvious is that the focus has been limited to FFV, when other food groups, particularly processed food and dairy products, are associated with large quantities of food waste as well. Limiting the analysis to FFV has permitted a more focused discussion of the issues at hand; nevertheless, a thorough assessment of pre-consumer food waste throughout the entire FFV distribution system is not possible in this space due to differences in the production, distribution, and retail of different types of FFV. I have therefore risked overgeneralizing the information garnered from field interviews about specific types of FFV or distribution system players. In this sense, deeper

research that focuses on specific crops would be greatly complementary to the high-level findings presented here.

Additionally, due to resource limitations, I was unable to focus as much as I would have liked on waste occurring from storage and from overproduction. These are important areas to fill out in order to create a more complete picture of the issues being explored. The limitations presented above also extend to the model, which, like the percentage estimates of food waste it is built on, should be considered a purely indicative and directional assessment of food waste. Nonetheless, this chapter achieves its goal of exploring if and how food retail modernization has driven differences in the extent and nature of food waste between traditional and corporate retailers.

Chapter 9 – Conclusion

9.1 Dissertation summary

The goal of my dissertation has been to assess the contribution of retail modernization to the generation of food waste throughout the food supply chain, focusing on retailers as a node of influence within the food system. This objective was informed by Chapter 2's review and synthesis of the respective academic literatures on food waste, consumer behavior, and retail modernization, which suggested that 1) food-related practices, including grocery shopping, food storage, and meal preparation, have evolved together with the growing dominance of corporate retailers in the food retail sector, and 2) corporate retailers have altered and shaped food distribution networks via reform of supplier relationships and increased investment in infrastructure and logistics. Accordingly, I developed the following two research questions:

RQ1. What effect does shopping for groceries at different kinds of food retailers have on the quantities of avoidable food waste discarded by households in industrialized nations? How are these differences related to the effects of food retail modernization on food-related practices?

RQ2. How has retail modernization affected the quantity and nature of pre-consumer food waste for corporate and traditional retailers in industrialized nations?

With respect to RQ1 and household food waste, I hypothesized that shopping at corporate retailers may increase consumers' exposure to marketing tactics, store layouts, packaging, and other environmental factors that may encourage over-purchasing, thereby contributing to greater spoilage at home. Furthermore, corporate retailers may be more strongly associated with store formats, locations, and land use patterns that necessitate longer travel times to the grocery store, increased car use, and lower shopping frequencies—all of which may contribute to over-purchasing by way of an "opportunity cost" effect, in which the increased inconvenience of having to return to the grocery store makes households buy more "just in case" to avoid just such a contingency. Furthermore, car use was hypothesized to contribute to over-purchasing and household food waste by making it easier for households who drive to transport more food home compared to households who walk or take public transportation.

With regards to pre-consumer food waste and RQ2, the influence of corporate retailers was theorized to have two separate and opposite effects on food waste. The first effect involved reducing food waste via improved cold-chain infrastructure and logistics capabilities that minimize spoilage and improve demand forecasting accuracy. The second effect stemmed from corporate retailers' increased buying power, which allows them to develop direct procurement relationships with suppliers and apply stricter quality standards. Both potentially increase pre-consumer food waste, either by encouraging suppliers to over-produce to avoid penalties for not filling orders, or by allowing corporate retailers to reject larger quantities of food that does not meet their standards but is otherwise edible.

To address my research questions and test my hypotheses, I developed a mixed-methods research design discussed in detail in Chapter 3. For RQ1, I designed a household study, consisting of a survey, diary study, and interviews, that together collected data on the quantities of food waste households discarded and relevant data including household demographics/characteristics, attitudes, diet and food consumption patterns, food-related competencies, grocery shopping behavior, shopping trip characteristics, waste management habits, and aspects of the volume-pricing system. Quantitative data on food waste was collected in several forms. The survey asked households to estimate the quantity of food waste they discarded on average over the three months prior to the survey, using South Korea's volume-based food waste pricing system as their frame of reference.

The diary study required households to record information about food waste they discarded over a one-week period, noting not only quantities, but also where the discarded food was originally obtained, why it was discarded, and whether it had been prepared or not. Although qualitative research is vital for understanding the mechanisms and processes by which household food waste is generated and has been much more common in practice theory-oriented studies of food waste, a quantitative approach was chosen. This was necessary because of the highly complex web of behaviors and factors that contribute towards the generation of household food waste. In other words, it permitted the quantitative assessment of the relative magnitude of retail modernization's influence on household food waste in relation to and on top of the contributions of other drivers. However, to provide additional color on how food-related practices are related to retail modernization and consumers' everyday lifestyles, qualitative data was also collected from diary participants via semi-structured interviews.

Chapter 4 discussed this dissertation's research context, providing an overview of waste management policy and discussing the origins, trends, and outcomes of retail modernization in South Korea. This cemented the relevance of the systems of provision (SOPs) concept as a theoretical perspective, set the scene for the later chapters, and justified South Korea's selection as the research site on the basis of the country's diverse retail environment and the advantages its volume-based pricing system lent to data collection. The chapter also showed how retail modernization has taken on distinctively Korean characteristics as a result of South Korean consumers' preferences. Applying practice theory and the concept of SOPs together with analysis of Korean Time Use Survey data, Chapter 4 went on to argue that corporate retailers' successes stem partly from their adaption to societal characteristics and trends, such as the gender division of labor, shrinking households, long working hours, and lengthy commutes.

As a key factor enabling this adaptation, the convenience offered by SOPs was a strong theme in Chapter 4, as evinced by corporate retailers' sale of convenience ingredients and extended opening hours, which could be linked to changes in South Korean households' performances of various food-related practices. The chapter also highlighted how familial SOPs, i.e. relatives, supplement households' grocery shopping routines by supplying precooked food or pre-prepared ingredients. A third theme was the contribution of SOPs to greater meanings of leisure in food-related practices such as grocery shopping and cooking. Drawing from interviews with 13 households, the chapter then discusses the relevance of these trends for household food waste, focusing on the uncertainties associated with convenience foods, the conundrum faced by

households in dealing with sometimes excessive food from relatives, and the potential for leisure-oriented food practices to contribute to increased household food waste in the future.

Overall, Chapters 5, 6, and 7 provided a range of evidence to support the hypotheses that linked retail modernization to household food waste, albeit in different ways. Chapter 5 examined my survey data, with the aim of identifying the key drivers of per-person household food waste. The results indicated firstly that different food retail formats could be linked to shopping trip characteristics including per-trip spending, fresh fruit and vegetable (FFV) buying frequency, travel time, and mode choice. In particular, hypermarkets were characterized by higher per-trip spending, longer travel times, lower FFV buying frequency, and more car use, whereas small-scale formats, including traditional markets, supermarkets, and family stores, tended to be associated with the opposite: lower per-trip spending, shorter travel times, higher FFV buying frequency, and more walking. Following multivariate regression analysis, longer travel times were connected to more avoidable food waste, while FFV buying frequency exhibited a quadratic relationship in which avoidable food waste increased and then decreased as FFV buying frequency increased. These two effects were consistent with the hypotheses that grocery shopping frequency and travel times influence per-trip spending, and that higher per-trip spending may be connected to food waste via over-purchasing. Interestingly, the analysis did not implicate car use for grocery shopping as a contributor towards household food waste.

Chapter 6's analysis of the food waste diary data revealed differences in household food waste patterns and relied primarily on comparisons of two metrics, mass percentages and odds ratios, for various categories of food waste across different types of food retailer. The focus of the analysis was on avoidable unprepared food waste. This was defined as edible or previously edible food that was discarded in an unused or partially-used state, which was theorized to most directly reflect over-purchasing behavior. Contrary to expectations, there were no statistically significant differences in the percentage nor odds of avoidable unprepared food waste when comparing the four major retail formats: hypermarkets, supermarkets, traditional markets, and family stores. To explore further, the analysis then focused in on the main reasons contributing to avoidable unprepared food waste: food discarded due to obvious spoilage, deemed too old for safe consumption, or the sell-by date (collectively, "SOD"). In these comparisons, traditional markets had a statistically significant association with higher odds of spoilage, while hypermarkets were statistically associated with higher odds of discards due to the sell-by date. This was the clearest distinction identified when comparing food waste across the retail formats that diary participants visited; it was theorized to reflect how food bought at hypermarkets is more likely to have sell-by dates than food bought at traditional markets, and this finding may suggest that the presence of sell-by dates leads to the discard of food before it has had the chance to develop signs of spoilage.

Chapter 7 attempted to connect Chapter 6's various metrics of food waste and households' survey responses using an approach similar to Chapter 5's—by analyzing bivariate relationships between household food waste and various independent variables before moving on to multivariate regression analyses. The six measures of household food waste analyzed in this chapter included per person mass, percentage, and count data for avoidable food waste and avoidable unprepared food waste. These measures were correlated with each other to varying extents, meaning that analyzing each of them in parallel would provide similar yet contrasting

analytical perspectives. Unlike Chapter 5's analysis of survey data, the results did not provide consistent evidence to link household food waste to specific retail formats or grocery trip characteristics theorized to affect over-purchasing, such as buying frequency and travel time. For example, although the regression analyses identified an inverse relationship between FFV buying frequency and households' avoidable food waste (percentage and count data), this was not the case for any measure of avoidable unprepared food waste, which in theory should be more sensitive to over-purchasing. Similarly, when households were grouped according to where they bought FFV most frequently, households who bought FFV most often at modern retailers generated more avoidable food waste (mass per person) than households who bought FFV most often at traditional retailers, but this relationship was absent when looking at measures of avoidable unprepared food waste. Travel time was not significant when regressed against any of the six measures of food waste, but in bivariate analyses, it was positively correlated with avoidable unprepared food waste caused by SOD (percentage). In contrast to the survey data, the regression analyses found that car use was positively correlated with avoidable food waste (count); as was the importance of parking availability in a household's choice of grocery retail destination. Oddly however, the importance of parking availability was inversely correlated with the avoidable unprepared food waste (percentage).

Overall, Chapters 5, 6, and 7's results illustrated the challenges of unpacking the complexities associated with household food waste. There were nonetheless several important takeaways from these chapters that directly address RQ1. Firstly, households' grocery shopping trip characteristics, including buying frequency, mode choice, and travel time, were correlated with retail format, although these relationships differed slightly from my original hypotheses. Rather than being demarcated between corporate and traditional retailers, these factors tended to be aligned more with the land use and transportation characteristics of different retail formats. For instance, despite hypermarkets and supermarkets both being corporate retail formats, trips to the former were less frequent, required longer travel times, and involved driving, whereas trips to the latter more resembled traditional retail shopping trips by being more frequent, requiring shorter travel times, and involving walking more often than driving.

The other key finding from the household study was that grocery shopping trip characteristics, including buying frequency and travel time, could be correlated with household food waste, as shown in a number of statistical tests. Several of the correlations uncovered were intuitive and consistent with the hypotheses (e.g. the positive relationship between travel time and avoidable food waste). However, there were others that were counterintuitive (e.g. the absence of a linkage between avoidable unprepared food waste and FFV buying frequency). Despite their counterintuitive nature, it was possible to identify reasonable, albeit speculative, explanations for these relationships, which only further emphasized the complexity of food-related practices contributing to food waste and illustrated the value of supplementing quantitative research with in-depth qualitative work in the future.

Other key findings of note from the household data highlighted the influences of familial SOPs, food-related practices, and the volume-based waste pricing system on household food waste. Familial SOPs were a clear contributing factor towards increased household food waste, as first discussed in Chapter 4 and then evidenced in analyses of diary data in Chapters 6 and 7. Oddly though, this practice of receiving food from relatives was not implicated when analyzing the

survey data alone. Food-related practices, e.g. meal planning, pre-shopping fridge checks, and making lists, have been discussed widely in prior research as important for mitigating food waste. As such, it was not only interesting that meal planning was the sole significant factor correlated with household food waste in the survey and diary data, but that it was by and large a positive correlation.

A less controversial finding was that factors representing the consumption of leftovers appeared consistently in the regression analyses of survey and diary data, emphasizing the importance of proper portioning and the appropriate management of leftovers. This finding, together with Chapter 6's findings that leftovers comprised a significant portion of a households' food waste, also served as a reminder that while grocery shopping routines are an important influence on household food waste, it is also vital to address food discards that occur due to improper portioning and management of cooked food. That being said, it will also be instructive in the future to examine the relationships between grocery shopping routines and these food-related practices—for example, it may be possible that households deliberately cook extra-large portions just to use up excess ingredients on the verge of perishing. Further relationships between grocery shopping routines and other food-related practices should be explored as well, e.g. the possibility that high-frequency shopping may reduce the importance of meal planning for mitigating food waste.

Finally, there was evidence to suggest that the volume-based food waste pricing system may be an effective waste-reduction policy, given the negative correlation found between per-liter disposal prices and avoidable food waste in regression analysis of the survey data. However, this finding was not repeated when analyzing the diary data, which may reflect the "lumpy," or potentially unrepresentative nature of the diary data. It was also noteworthy that different payment systems for food waste disposal were not associated with differences in avoidable food waste.

Moving beyond the household realm, Chapter 8 addressed RQ2 by examining the causes and nature of pre-consumer food waste, i.e. food waste occurring in supply chains and at retail locations. I chose a case study approach here primarily due to practical limitations that precluded the quantitative approach used for RQ1. These limitations included the difficulty of obtaining enough data on food waste in the distribution network to perform a statistical analysis. As such, the effect of retail modernization on supply chain food waste was assessed by comparing the causes of supply chain food waste for corporate and traditional retailers. Where possible, the case study also compared the percentages of food discarded in each stage of corporate and traditional retailers' respective supply chains. The case study focused on FFV due to their fragile and perishable nature and in order to limit the study's scope. Based on interviews with a range of stakeholders in the food supply chain, it became clear that retail modernization has increasingly differentiated the FFV supply chain for traditional and corporate retailers with respect to technology and the lengths of their supply chains.

Differences in technology between traditional and corporate retailers were manifested in two ways: storage conditions and procurement. Corporate retailers were found to have more access to cold chain technology, which increases the amount of time that FFV is transported and stored under optimal conditions, including temperature and humidity. This reduces spoilage and

damage by protecting FFV from adverse weather conditions such as heat and frost. With respect to procurement, corporate retailers were found to have access to demand forecasting systems that improve their ability to procure the right quantities of FFV to meet customer demand, thereby minimizing food waste that arises from unsold produce. In contrast and unsurprisingly, traditional retailers had much less access to refrigeration and had to estimate how much inventory to procure on a daily basis; as such, they were found to be very vulnerable to conditions that either increase FFV spoilage rates or adversely affect customer demand, increasing the potential for food waste as a result of unsold produce. Additionally, the direct procurement systems used by corporate retailers to cut out wholesalers and other middlemen have shortened their supply chains considerably, meaning that FFV arriving at corporate retail locations have a much longer remaining shelf life than FFV sold via traditional retailers. As a result of the above differences, less FFV food waste is attributable to corporate retailers than traditional retailers in the pre-consumer stages of the food supply chain.

Where the case study's findings differed from the hypothesized effects of retail modernization on food waste was with regards to corporate retailers' use of strict private standards in procurement. However, prior government investment in agricultural modernization contributed to the development of quality standards and construction of common-use sorting facilities for FFV. This means that virtually all domestically produced FFV passes through the same grading processes, regardless of where it is eventually sold. Additionally, corporate retailers mainly make use of existing government-issued standards. Even though corporate retailers primarily buy produce graded into the top quality tiers, the remaining grades of produce are sold either via wholesalers and traditional markets, or by informal channels (e.g. markets in rural areas). Consequently, food waste occurring as a result of out-grading could not solely be attributed to corporate retailers. However, it was hypothesized that this situation has been made possible only due to the current diversity of retailers in South Korea's FFV distribution system; should corporate retailers continue to grow their market share, it is unclear whether alternative channels can continue preventing food waste by allowing the sale of out-graded produce. Further research should test this hypothesis by examining trends in corporate retailers' use of private standards in addition to trends in the sale and distribution of out-graded produce. Furthermore, the implications of continued mechanization and increased average farm size—both likely prospects in light of South Korea's aging farm population—for food waste should be examined in conjunction with the expected growth in corporate retailers' share of the grocery retail market.

9.2 Reflections on a practice theory approach

As an occurrence that is routine and heavily embedded into multiple aspects of households' everyday lives, food waste has proven to be a highly suitable topic of analysis for the application of practice theory, which has heavily informed this dissertation's approach to the issue. The particular aspects of practice theory that have proved most useful include its treatment of convenience and time-use in everyday life, as well as its conceptualization of SOPs as one of the key structural influences on how individuals perform practices. Also critical has been the light that practice theory has been able to shine on the nature of consumption—specifically, Warde's (2005) argument that resource consumption is not a practice in and of itself, but rather, a necessary moment in every practice. Together with Evans' (2012) ethnographic work on the often unavoidable occurrence of food waste in everyday life , this notion has helped to draw

attention to how food waste emerges from the interaction of multiple practices in consumers' everyday lives, thereby drawing attention to the importance of examining grocery shopping routines, meal preparation, other food-related practices, and even seemingly unrelated practices such as commuting, leisure, or childcare, for understanding the phenomenon of household food waste. Lastly, Pred's (1981) work on time-geography, together with the conceptual linkages others have drawn between time-geography and practices (Røpke, 2009), has permitted the addition of a spatial dimension to this dissertation's theoretical framework, thereby facilitating the connections I have drawn between household practices, food retailing, and the spatial considerations often made by urban planners.

The vast majority of practice theory-informed studies, whether on food waste or other topics in sustainable consumption, have been qualitative in nature, which most likely reflects practice theory's focus on practices as ontological units of analysis when trying to understand social phenomena (Halkier, Katz-Gerro, & Martens, 2011). There is a strong emphasis in practice theoretical sustainable consumption studies on understanding how practices are reproduced over time, which is theorized to occur as a result of changing structural influences, such as SOPs, as well as individual expression (Warde, 2005). Understanding "how" practices are reproduced over time lends itself best to ethnography, or qualitative case study research in the style of Chapter 4. In this respect, there is less room reserved for quantitative approaches, and it is therefore worthwhile to reflect for a moment on their application in this dissertation.

Qualitative research employing a practice theoretical approach has been invaluable for understanding how practices have changed over time in ways that are more or less sustainable, as defined by their proclivity to fuel resource consumption (Shove, 2003a). Similarly, such research is critical for understanding the various pathways by which practices generate unsustainable outcomes--the growing body of literature using practice theory to understand household food waste that I reviewed in Chapter 2 being a case in point. However, where it is in society's interest to mitigate such unsustainable outcomes via policy or other such interventions, a quantitative approach is useful in order to be able to assess their effectiveness and in so doing, help prioritize the allocation of resources, i.e. economic, political, and social capital, towards supporting the most effective interventions. Restating this in the context of practice theory and the theories of change it engenders—if we are to identify future pathways along which we want practices to evolve, assessing the various forms that practices might take on with respect to the outcomes we are trying to influence is very important. In the context of this dissertation's investigation of household food waste, the goal has been to focus in on several food-related practices known to affect food waste and assess the extent to which variations in these practices contribute to the amount of food waste generated, so as to understand what the most sustainable versions of such practices might look like with respect to the goal of mitigating household food waste.

Achieving this objective necessitated overcoming another theoretical hurdle to applying practice theory in a quantitative study, which was this dissertation's focus on households as its unit of analysis—something that is, at first glance, incompatible with practice theory's aforementioned focus on practices. However, it is important to note that my survey design deliberately focused on whether and how households performed different food-related practices, with particular emphasis on the temporal and spatial characteristics of their grocery shopping practices. Each

household in the sample exhibited slightly different performances of food-related practices, and in this way, each household also became a proxy for particular variations in food-related practices. As a result, even with households as the formal unit of analysis, it was possible to retain a focus on understanding how and to what extent variations in the performance of food-related practices contributed to the generation of household food waste.

Beyond overcoming the challenge of pairing practice theory with a quantitative approach, this dissertation has also contributed theoretically by attempting to further elucidate the relationships between households' everyday practices and SOPs. As discussed first in Chapter 2 and then contextualized in Chapter 4, this dissertation has contributed to the theory linking systems of provision and everyday practices. Whereas prior work established how SOPs are important enablers or constraints on how individuals perform practices (Southerton, Warde, & Hand, 2005), Chapters 2 and 4 articulated this relationship by arguing that one way this takes place is via the provision of convenience. Additionally, the discussion these chapters offer of convenience, SOPs, and food waste further support Shove's (2003a) work on how growing reliance on convenience may contribute towards lock-in towards resource-intensive norms of everyday life.

Additionally, my dissertation has reinforced the utility of a practice-oriented approach, and especially one that adopts SOPs as a key theoretical perspective, for investigating the problem of household food waste—the concept of SOPs was critical for being able to connect small-scale household behaviors to a broader trend like retail modernization. There is much potential for the SOP concept to be applied further to more closely connect sustainable consumption studies with the field of urban planning and design, in light of how urban development involves the design, construction, and governance of multiple SOPs; most readily, these include basic infrastructure networks governing the provision of water, power, waste, and transportation services. Whereas much academic and practitioner work on the built environment is already focused on the sustainable transformation of these infrastructures, a practice theory approach offers additional value through its emphasis on practices as mediators between inhabitants of the built environment and structural influences (Shove, Pantzar, & Watson, 2012).

This ability to occupy the theoretical middle ground between individual choice and structure is especially relevant for research in planning and geography that relies on the analysis of human activity patterns. Fox (1995, p. 107) writes that such research is united by a focus on understanding "how people allocate their time among different activities and how they deal with the constraints of time and space in linking these various activities," while noting that, at its theoretical roots, such research is divided in its conceptualization of activity as either the outcome of individual choice, in the tradition of Chapin (1968) or the outcome of geographic constraints, in the tradition of Hägerstraand (1970). It may be thus be valuable to explore greater theoretical confluence between human activity research and practice theory, which would produce more nuanced and comprehensive understandings of how the built environment and other contextual factors, e.g. culture, institutions, technology, and the economy, interact with individual behaviors, with improved outcomes for sustainable urban planning and design.

9.3 Implications for research and policy

I have already discussed this dissertation's policy implications for food waste management and policy in the South Korean agricultural and food retail sectors in the relevant chapters. However, it is valuable not only to broadly revisit these implications, but also to discuss them within the context of sustainable development and urban policy more generally, both in developed and developing country contexts.

9.3.1 Agricultural modernization

The state has played a significant role in South Korea's agricultural modernization, as evidenced by its establishment of the country's primary agricultural cooperative, the National Agricultural Cooperative Federation (NACF), which was instrumental in providing the cheap financing that helped farmers adopt modern agricultural production techniques and increase mechanization rates. The government's development of agricultural processing centers (APCs) and rice processing centers (RPCs), construction of wholesale markets, and implementation of food quality and safety standards too, were critical investments that helped modernize agricultural production, improving supply chain efficiencies and contributing to increased availability of high-quality produce for South Korean consumers. With the majority of APC construction beginning in 1993, this facet of agricultural modernization preceded, but also overlapped with retail modernization in South Korea, which began after trade liberalization in 1996. As a result, we cannot ignore the possibility that these two processes were significantly interconnected. State-led investment in agricultural infrastructure may have facilitated corporate retailers' establishment of their local supply networks, making it easier to execute the strategies known to be employed by corporate retailers elsewhere—in particular, product differentiation and direct procurement systems (Reardon & Hopkins, 2006). This suggests that the South Korean case of retail modernization is potentially unusual since such assistance from the state may not have existed in less-industrialized countries, where corporate retailers may have needed to invest much more to ensure that suppliers could meet their quality standards.

Despite the state's role in agricultural modernization, its policies governing farm ownership have mostly inhibited farm consolidation, contributing to South Korea's small average farm size. This is interesting to consider in light of prior research's assertions that retail modernization may exclude some smallholder farmers from urban markets if they fail to meet corporate retailers' higher quality standards. This does not appear to have happened in the South Korean case, which may not only be attributable to state-led agricultural modernization, but also due to South Korean farmers' access to infrastructure like APCs and markets via NACF membership. Additionally, the lack of big players in South Korea's fragmented agricultural sector may have forced corporate retailers to work with smallholders in order to develop their supply networks even if they found it challenging or inefficient to do so.

South Korea's experience with retail modernization is also important to consider in concert with findings from research on retail modernization elsewhere in East Asia, which suggest that its extent and effects in the region may be overstated. In particular, studies indicate that corporate retailers in East Asian countries may never overcome the cultural preferences that may keep consumers purchasing FFV at traditional retailers (Humphrey, 2007). Chapters 4 and 5 offered evidence to support this notion by showing that, despite their loss of market share, South Korea's traditional retailers still compete well with corporate retailers as places to buy FFV. Despite the

influence of these cultural preferences, the state must be recognized again as a key player in South Korea's retail modernization experience, in light of its efforts to protect traditional retailers' livelihoods by regulating corporate retailers' store locations, operating hours, and product offerings.

Although my dissertation research could not unequivocally establish whether retail modernization helps reduce food waste or exacerbates the problem, one emergent theme has been how the state has directly or indirectly supported the continued viability of small-scale actors in the FFV production and distribution sectors. Their persistence in the South Korean food system raises more questions than answers with respect to food waste. With less state investment in agricultural modernization, would private investments from corporate retailers have led to farm consolidation or generated equivalent levels of supply chain efficiency? Together with the wholesale market, how much pre-consumer food waste do traditional retailers potentially mitigate by providing sales channels for lower-quality produce? Has NACF membership and representation shielded smallholder farmers from abusive practices on the part of corporate retailers, and to what extent has this mitigated food waste associated with failed quality standards?

These questions raise interesting implications regarding the role of the state in agricultural and retail modernization. The first concerns the financing of the investments in technology, infrastructure, and know-how that are often-touted remedies to the food waste problem in developing economies. While the South Korean state has played a large role in this regard, poorer nations may opt to supplement state investment with that from corporate retailers, who would stand to benefit from access to growing consumer markets while helping to improve food distribution infrastructure through the establishment of their supply networks. However, depending on the answers to the above questions, it may be prudent for governments opting for this route in countries with smallholder-dominated agricultural sectors to also take appropriate policy measures so as to ensure that retail modernization eventually contributes to net reductions in pre-consumer and household food waste. For instance, it may be important to regulate and monitor private quality standards, preserve diversity in distribution channels through support for the traditional retail sector and its suppliers, and require corporate retailers to maintain minimum levels of domestic procurement so as to ensure that domestic agriculture and its distribution networks benefit from any corporate investment.

The state's role in promoting agricultural and retail modernization is also important to consider in the context of "land grabs" in Africa, which refer to the increasing tendency for developed nations, including South Korea, to buy up arable land in African countries to grow crops for export back to their home countries—a strategy to bolster food security (Hall, 2011). The broader trend of land grabbing suggests that, after state-led and corporate retail-led investment in agricultural modernization, investment from foreign governments may be an important consideration for agricultural development that is different from more traditional foreign aid. The outcomes of such land grabs in Africa are theorized to depend on not only the associated changes in land use, but also whether they involve a change in social relations (Hall, 2011), and this is likely to be true in relation to food waste as well. Foreign investment in African agriculture by wealthy nations could bring more sophisticated crop production techniques, higher-quality seeds and agricultural inputs, mechanization, and associated infrastructure investment. Crops produced for export by foreign actors on African soil would therefore be less exposed to the causes of food

waste normally associated with developing countries presented in Chapter 2. While this suggests that a smaller proportion of agricultural production sponsored by foreign states in Africa will wind up as waste, thereby improving supply chain efficiencies, African farmers may not benefit from these improvements if there is limited engagement between land grabbers and domestic farmers that enables the transfer of knowledge and technology.

The outcomes may be different in cases where land grabs take place as part of broader development assistance efforts. For instance, the South Korean government's respective purchases of arable land in Sudan and Tanzania for wheat and rice production reportedly occurred as part of bilateral cooperation agreements between the two countries (Lisk, 2013). Under such arrangements, it is easier to envision partnerships between foreign and domestic farmers that could result in the transfer of knowledge and/or technology that reduce food waste in the pre-consumption stages of the food supply chain. Therefore, unlike retail modernization, in which corporate retailers most commonly engage directly with domestic producers to boost quality, the potential for land grabs to contribute to agricultural modernization may be more limited. Further research should explore the outcomes of land grabbing for food waste by evaluating and comparing the different approaches taken by foreign governments in Africa.

9.3.2 Food retail hybridization?

It is also important to consider the evidence in my dissertation that suggests how helping traditional retailers maintain market share could mitigate food waste in the households of their customers. The extent and nature of potential state support for the traditional retail sector is an open question for urban policy—are South Korean-style regulations on corporate retailers the best way forward? In the South Korean case, cynics might argue that, in the face of inevitable takeover by corporate retailers, state-sponsored support for traditional retailers' livelihoods amounts to little more than an elaborate welfare program. Certainly, the diffusion of corporate retailers through South Korea and their corresponding growth in market share over the last two decades point to this eventuality. However, as has been mentioned already, research on retail modernization, particularly in East Asia, has yet to definitively show that traditional retailers cannot co-exist with their corporate counterparts (Goldman, Krider, & Ramaswami, 1999; Goldman, Ramaswami, & Krider, 2002). As such, the path forward in developing countries where retail modernization is nascent or in-progress may depend on the particular cultural, institutional, and economic circumstances that will lead to one of two likely outcomes: co-existence, which presumes the long-term vitality of the traditional retail sector and that corporate retailers' foothold in the market is maintained primarily through large-format stores such as hypermarkets; and extinction, in which corporate retailers eventually dominate the food retail sector with a trifecta of large, medium, and small-format stores: hypermarkets, supermarkets, and convenience stores.

The main policy implications that follow this dissertation's findings apply under both outcomes with respect to household food waste, but are arguably even more important for the extinction outcome: 1) regulate marketing tactics and packaging such that consumers can more frequently buy the right quantities needed and 2) implement consumer education initiatives to help improve consumers' competencies with food management practices, such as their ability to incorporate leftover ingredients into meal planning and shopping practices, or their understandings of the nuances associated with sell-by dates. It may also be beneficial to implement policies that make

it easier for consumers' grocery shopping practices to default to high-frequency, low-volume shopping trips. Achieving the latter will be the greatest challenge and will require a deeper understanding of the forces that determine consumers' grocery shopping practices, but preliminary knowledge from this dissertation suggests that, all else being equal, providing high physical access to small-format stores, traditional or corporate, may prompt more high-frequency low-volume shopping and potentially less food waste.

Consequently, urban planning that promotes density and supports the development of small-format retail may be important for mitigating food waste. In developing nations, planners may need to pay closer attention to existing clusters of traditional retailing in order to support their competitiveness and development in a co-existence scenario; if extinction cannot be avoided, then corporate retailers must be encouraged to first build out networks of small-format stores rather than rely on hypermarkets—no small challenge, considering the economies of scale that they would forego as a result. A further possibility that Chapter 3 raised, but which was not empirically assessed in this dissertation, is how consumers chain grocery shopping trips with other travel, e.g. on the way home from work. If such behavior is connected with high-frequency, low-volume shopping, transit-oriented development involving food retailers may be an important consideration as well.

Interventions targeting pre-consumer food waste will have different priorities depending on the eventual competitive outcome. With co-existence, urban governments should focus on upgrading technology and infrastructure in order to address traditional retailers' challenges with demand forecasting and inadequate access to cold-chain technology (both in-store and at wholesale), as well as to shorten FFV supply chains to match those of corporate retailers—effectively, modernization without corporate ownership. One challenge for research and policymaking pertains to the future role of wholesale markets, which at present may act as clearinghouses for lower-quality produce while also representing an additional stage in the supply chain that, if removed, would improve remaining shelf life for FFV in stores and households.

The extinction outcome's implications have been presaged in Chapter 8; even if farmers raise the average quality of their produce to comply with corporate retailers' demands, they may still produce a minimum percentage of produce that is edible, but which retailers reject on the grounds of failed quality standards. Although recent negative media coverage has prompted some corporate retailers to voluntarily accept and sell such produce (Godoy, 2014), policymakers must be prepared to step in to prevent discards of edible out-graded produce and temper the increased buying power that corporate retailers would necessarily enjoy in this scenario. It will also be important to address consumers' expectations over the appearance of food, which have already been inflated in the West and will follow suit in developing countries as they become accustomed to the perfect aesthetics of FFV that corporate retailers often prefer. As such, consumer education initiatives that aim to recalibrate expectations over the appearance of FFV will also be critical for minimizing waste from edible but out-graded produce by obviating the need for aesthetically-oriented grading systems. Lastly, corporate retailers must be encouraged or required to donate expiring or nearly perished food. Urban planners must take greater responsibility to help solve the logistical challenges that may inhibit corporate retailers from connecting with urban food banks and other charities.

It is also important to take a step back and consider whether policymakers, particularly those in the cities of the developing world, have the capability to redefine what we understand by retail modernization—for instance, is there scope for the "hybridization" of food retailing? Keeping in mind the important interlinkages between practices and SOPs, it will be critical for cities to pursue development pathways that avoid lock-in into systems of production and consumption in which food waste is an accepted outcome, whether as a cost of doing business or as a guilt-inducing, yet seemingly unavoidable daily household occurrence. Hybridization would thus require shaping SOPs to naturally redefine and reinforce food-related practices in ways that are most conducive to food waste mitigation. At the most basic level, this might involve figuring out how to combine the best facets of corporate and traditional retailing, as we now know them, to cancel out their respective shortcomings.

Various means of doing this have been touched upon and may already exist. For example, some South Korean grower organizations have learned from corporate retailers' vertically integrated procurement models and have begun to establish a retail presence in Seoul and other South Korean cities. These shops sit at the end of significantly shortened supply chains, often feature the same level of refrigeration technology as corporate retailers, and allow consumers to buy high-quality produce directly from farmers without having to leave their neighborhoods. As such, they are distinct from Hanaro Mart, the hypermarket chain currently run by the NACF. However, because they primarily market organic produce at higher prices, they are currently frequented by a small proportion of South Korean households. As such, expanding their network and improving their economic accessibility without increasing their physical store footprints should be explored as a policy option. Partnerships between corporate and traditional retailers may also be a viable means of hybridization. For example, since traditional retailers may have a competitive advantage for FFV sales in South Korea due to their greater proximity to residential neighborhoods and South Korean consumers' cultural preferences for more frequent FFV shopping, it may be beneficial for corporate retailers to sell FFV via traditional retailers. This would potentially be an important option in developing world cities, where corporate retailers may struggle to locate stores in dense urban areas due to small land parcels and resistance from local businesses.

9.3.3 Technological revolution and food practices

While retail hybridization offers a pathway for reducing food waste, it remains unclear whether this will be enough to change grocery shopping practices and if so, to what extent. This dissertation initially focused on how various SOPs, namely refrigeration, large-format retailers, and car-oriented development, helped turn grocery shopping from a high-frequency, low-volume, multi-sited practice to one that involves buying a lot in one location and one time. Chapters 4 and 5 illustrated how the reality is more complex, as grocery shopping practices in the South Korean context take on diverse temporal and spatial characteristics. This diversity stems not only from cultural preferences, but also from the unique circumstances of everyday life in which households struggle to coordinate grocery shopping and food-related practices with competing practices' demands on their finite resources, most notably time. Given modern technology's role in fragmenting daily life schedules (Shove, 2003b), not everyone will be able to turn back the clock on grocery shopping practices such that they only buy the food they need on a highly regular basis. For consumer societies like South Korea's that face growing time-scarcity, yet continue to value home-cooking, retail hybridization may not be enough.

Beyond hybridization is revolution, not only in what we understand by grocery shopping practices, but also in whom we understand as the key players in SOPs like food distribution and retailing. Chapter 4 hinted at these changes when describing how corporate food retailers have reshaped cooking practices by providing convenience ingredients to busy South Korean households, but more so when describing Homeplus' trial of virtual grocery stores ("Tesco builds virtual shops for Korean commuters," 2011), which offered a means of entirely reconfiguring temporal and spatial understandings of grocery shopping. In a way, this revolution is already underway with the advent of online grocery shopping, as most recently crystallized by the acquisition of the Whole Foods supermarket chain in the US by Amazon, a giant online retailer. Amazon had already expanded into grocery retailing; not only with its selection of groceries available online, but with experiments such as its "Dash" button, a physical device that allows consumers to press a button and automatically place an order on Amazon for specific household items, including food ("Push my buttons," 2016). Its acquisition of Whole Foods is expected not only to help Amazon expand into grocery retailing, but will permit experimentation with how customers buy food online and in-stores, e.g. by letting customers walk out of Whole Foods supermarkets without checking out ("An industry shudders as Amazon buys Whole Foods for $13.7bn," 2017). Similarly, the emergence of services in the US, South Korea, and elsewhere that regularly deliver recipes and pre-portioned ingredients to households, represent the potential of SOPs like the food retail system and the internet to fundamentally transform the nature of food-related practices such as grocery shopping, ingredient management, cooking, and eating.

At present, such services rely on consumers to choose the meals or ingredients they want delivered, as well as the frequency and timing of such deliveries. However, with enough data on consumers' demographics, preferences, schedules, purchasing practices, and past food waste occurrences, in addition to sophisticated predictive algorithms, one could imagine a system in which consumers provide companies with a modicum of information that is used to develop tailored menus and delivery schedules that provide households with all the food they need exactly when they need it and in just the right amounts. Furthermore, the development of "smart," sensor-loaded refrigerators may eventually be able to alert consumers to looming expiry dates or the growth of mold. Such systems would reverse the historical logic of provisioning practices, with food coming to consumers instead of consumers going to food.

Accompanying this also would be the transformation in the competencies required to perform meal preparation practices; consumers would no longer need to know how to estimate ingredient quantities, prepare ingredients for consumption, or manage perishable ingredients. The technology that would simplify this complex web of practices to pressing buttons on a smart device would eliminate human error, contributing in the process to the near eradication of household food waste. Instead, the burden of avoiding food waste will be moved to the delivery service providers, who may be more effective at doing so given their economies of scale and access to more sophisticated logistics and demand management systems. Furthermore, because ingredients delivered by such services might be completely pre-prepared, i.e. peeled, chopped, diced, etc., consumers might never see what the produce actually looks like, and thus these services may be able to make greater use of produce that fails aesthetic quality standards, thereby preventing their wastage.

In practice however, totally eliminating food waste, especially in households, will be difficult for a number of reasons. First, although customized grocery delivery services will appeal to households who are particularly time-strapped or have less interest in developing food-related competencies, it seems likely that other consumers will be less enthusiastic due to the diverse meanings that are embedded in food-related practices. Chapter 3 has shown how the practices of grocery shopping and home cooking can take on meanings of culture or leisure. Others may find that "outsourcing" everything to grocery delivery services conflicts with their understanding of what it means to be a competent provider of nutrition to their families (Evans, 2012). This connects to the second reason—the complexity of practices and occurrences that contribute towards household food waste. My dissertation has questioned whether and how the food retailing system is set up to generate food waste, while also assessing the effectiveness of particular household practices for avoiding it. However, food waste often happens in everyday life due to contingencies entirely beyond one's control (Evans, 2014). The inherently time-sensitive nature of food management means that households must consume ingredients at regular intervals, and breaking this regularity most often results in spoilage and discard.

As a result, whereas it is already clear that food-related SOPs must be fixed such that they aid, rather than hinder consumers' efforts to buy and prepare food in the right portions, it will also be critical to design them in ways that ensure the timely consumption of food. As hinted at already, technology-enhanced food delivery services could play a role here by helping households buy not only the right amount of food, but at the right time as well. However, just as Chapter 3 showed how familial SOPs play an important role in household provisioning, it may be just as important to consider whether communal systems, in conjunction with technology, might play a role in facilitating the consumption of perishing food. This idea is already being applied in Berlin, where the Foodsharing network allows individuals to offer excess food on its website for others to claim; the network's volunteers also collect extra food from food retailers and restaurants to place in communal fridges and cupboards located around the city, which anyone can then claim (Nelson, 2014). Integrating the infrastructure that enables food sharing into urban construction may become an important consideration for research, design, and policy.

Although food sharing at the city or neighborhood scale may be the most efficient in terms of matching excess food with demand, it could also be valuable to enable such opportunities at a smaller scale to take advantage of mutual trust that may already exist within smaller communities. One way to fuse communal systems with technology would be to fit apartment complexes with large communal smart fridges or larders, each serving a cluster of households. Each household would be entitled to some secured food storage space, monitored from a smart device. This space would serve as the primary food storage space for perishable foods. In the event that a household realizes that it will not be able to consume something in time, it could notify other households in its cluster via the smart device, which would then provide a temporary access code that would allow that household to access the storage space and consume the food in question. Alternatively, households could opt for smart communal fridges to send out notifications automatically, depending on the quantity of food left or how long it has been in the fridge. Ultimately, it seems likely that a combination of technology, social, and economic innovation will be required to reconfigure SOPs in ways that more naturally inhibit food waste.

9.3.4 Gender and the domestic division of labor

One perspective that this dissertation has used to approach the issue of household food waste has been that of convenience, which SOPs provide and which shapes the performance of food-related practices, with ensuing consequences for food waste. In this regard, it would be remiss not to discuss future implications with respect to gender roles, given their entanglement with time use and mobility (Hanson, 2010; Kwan, 1999), as well as this chapter's suggestion that heightened physical access to food retail may help mitigate household food waste. The success of corporate retailer formats described in Chapter 4 illustrated how, even with South Korean society's relatively strong adherence to traditional gender roles in the household, convenience in food provisioning and meal preparation has become increasingly important.

This has generated contradictory questions and implications for household food waste. On the one hand, the provision of convenience ingredients in predetermined portions promises to aid households with buying the right quantities, yet the rise of convenient, but infrequent, one-stop-shopping at hypermarkets may itself be correlated with over-purchasing and household food waste. There are also theoretical contradictions when considering time-use among South Korean housewives; they may have more time to shop every day, buying smaller amounts each time, but the luxury of time may also permit more frequent experimentation with recipes that call for seldom-used ingredients. The presence of children in households is another complicating factor with effects on food waste as a result of their potential fussiness and propensity to magnify competition between a household's goals and practices concerning nutrition, food safety, and food waste avoidance.

The complexities highlighted above illustrate the importance of further research on how gender roles, particularly their increasing fluidity with respect to household labor, affect food practices and food waste. The outcomes of such research would potentially affect whether increased physical accessibility to food retail contributes to waste mitigation or not. In societies where female labor force participation is rising and traditional gender roles persist, it may be increasingly difficult for women to maintain high-frequency, low-volume grocery shopping practices due to the increased time pressures they face. In such cases, food retail development that allows grocery shopping trips to be more seamlessly integrated into working commutes may be just as important as ensuring high accessibility to food retail from residential areas. The food delivery services discussed in the previous section of this chapter will also be increasingly important given their ability to alleviate time pressures.

However, in societies unlike South Korea, where men may bear more responsibility for grocery shopping and meal preparation, or where household gender roles are becoming more interchangeable, future research could examine how men interpret and perform food-related practices differently from women. Such differences could lie in their approaches to grocery shopping, meal planning, the consumption of leftovers, or more broadly, how they coordinate food-related practices in everyday life alongside other everyday practices such as childcare, work, and leisure. For example, whether pre-trimmed ingredients are more or less preferred by men may affect where they shop and what they buy. These potential differences could play an important role in designing food retail and related SOPs.

It may also be valuable for future research to examine how the gendered division of labor between provisioning and meal preparation versus the disposal of food waste affects waste-related behavior in households. In cases where one partner buys and prepares the food but the other is solely responsible for waste segregation and disposal, there may be a perceptual disconnect within the household between food shopping and management practices and the generation of waste, particularly if the person in charge of disposal does not pay much attention to how much or what food is being thrown away. Similarly, if the person responsible for food provisioning is not the sole earner in single-income households, there again may be a perceptual disconnect between the notion of food waste and avoidable economic loss that reduces the impetus for waste prevention.

9.3.5 Food waste pricing systems and policy

Besides its diverse retail environment, a defining characteristic of South Korea's policy environment and an important SOP that shapes waste-related household practices is its volume-based food waste pricing system. Together with mandatory waste segregation and volume-based pricing for general waste, it is an integral aspect of South Korea's waste management system that has gradually become accepted by South Korean households into their everyday routines. As to its effectiveness as a tool for reducing food waste, the mixed evidence provided by my analyses of household survey and diary data indicates the need for further research in this direction.

Whereas the traditional "polluter-pays" principle suggests that making households pay for food waste disposal will reduce their food waste, empirical evidence to support this with respect to general waste is mixed. In particular, it has proven difficult to assess whether purported reductions in waste are the result of behavioral change or due to greater diversion of general waste to alternate channels including greater re-use (e.g. gifting, donations, repurposing), composting and or illegal disposal (e.g. burning, dumping) (Dahlén & Lagerkvist, 2010). As already touched upon in Chapter 4, the above is true for food waste too, which presents an added challenge because households can dry their food waste before disposal, thereby generating artificial reductions in food waste generation. Furthermore, it has been noted in the South Korean context that such reductions may vanish as households acclimate to the system and return to old behavioral patterns (Park, 2014). In such circumstances, it may be necessary to raise waste disposal prices regularly in order to maintain the system's effectiveness.

There is also evidence to suggest that the reductions in food waste from waste pricing may be accompanied by technological problem shifting. This refers to the emergence of a market for food waste drying machines that households and small businesses can use to dry their food waste, reducing its weight and volume, and accordingly, their costs of food waste disposal. Such machines are potentially problematic from the perspective of sustainability. Not only do they allow households to sidestep the food waste pricing system, undermining policymakers' waste reduction efforts, but they also create additional demand for electricity. Depending on the quality and composition of the processed food waste that these machines output, it may also be important to consider the impacts on the South Korean agricultural system because of the potential to affect the flow of animal feed and fertilizer currently being generated from food waste. Should they be widely adopted, the overall environmental impacts of food waste drying machines will need to be interrogated with life-cycle assessment studies, and policymakers may need to take action accordingly.

Even if the above issues prove inconsequential or can be overcome, several important considerations must be made before food waste pricing systems can be recommended to policymakers in other countries. First, volume-based food waste pricing's dependence on mandatory waste segregation laws must be recognized, simply because no-one would pay to dispose of their food waste if they could do so for less via their general waste stream. Therefore, any implementation of food waste pricing must be accompanied by mandatory waste segregation laws, which may be politically unpopular and difficult to enforce. One alternative that may help policymakers sidestep this challenge would be to charge more for general waste disposal than for food waste disposal. Such differential pricing schemes are known to sometimes incentivize increased separation of recyclables from general waste streams (Dijkgraaf & Gradus, 2004; Hong, 1999), and the same effect may apply for food waste segregation if the price differential is large enough. This measure could be used to pave the way for a transition to a mandatory waste segregation system.

Next, there are significant costs involved with the implementation of a volume-based waste pricing system. Among these are the infrastructure and necessary apparatus that households and other municipal waste sources will need in order to be able to segregate and pay for their waste. In addition to providing households with the necessary waste receptacles, more extensive municipal waste collection services will be needed. Although developed countries may already have systems in place to handle segregated waste streams, the same cannot be said for many cities in developing countries, where general waste collection, let alone collection of sorted waste, remains unreliably due to lack of policymaker awareness and expertise and budgetary shortfalls that translate into insufficient access to equipment and technology (Guerrero, Maas, & Hogland, 2013).

Implementing a waste pricing system will present further cost considerations because of the need to set up an effective payment system, as will the need for proper enforcement. These costs may be especially high in cities with large populations living in high-rise buildings. The initial exemption of many households living in apartment complexes from paying directly for their food waste is a case in point. Instead, they dispose of their food waste in common waste bins and pay a fixed monthly fee that is calculated off of the quantity of food waste disposed by their entire apartment complex. This essentially allows households who generate large quantities of food waste to partially free-ride on the disposal fees paid by households who generate less. While unfair, this system most likely exists due to the difficulty of enforcing food waste disposal via volume-rate plastic bags or sticker/chip systems in large high-rise apartment blocks with hundreds of households sharing a few large bins. The RFID system gradually being rolled out in apartment complexes across South Korea has begun to address this issue, but is notably more expensive due to the investment required in physical capital such as machines and the administrative costs of fee collection via households' utility bills. Consequently, governments in dense urban cities that are considering the implementation of waste pricing, whether for food waste or general waste, will find much value in learning from the South Korean case. This connection between high-rise development and waste management policy also underscores the importance of understanding how urban form and infrastructural needs are related to household practices.

As discussed in Chapter 7, it will also be valuable to study the nature and extent of consumer education campaigns that were implemented together with the roll-out of volume-based food waste pricing in South Korea. Such research should investigate government efforts to provide advice to households on how to avoid food waste. Although some households may naturally understand that modifying their grocery shopping practices may help reduce their food waste, my casual conversations and observations from the field provided anecdotal evidence to suggest that this connection may not be as obvious to others, perhaps due to possible "perceptual disconnects" identified in section 9.3.4. If these are real, then educational initiatives may be crucial for improving the effectiveness of food waste pricing schemes by providing households with tangible avenues for reducing food waste, thereby helping to reduce the incidence of illegal disposal.

Finally, the technological innovation represented by the South Korean government's application of RFID technology to waste pricing is significant because of its ability to raise the visibility of households' food waste behaviors and create feedback loops for behavioral change. Although volume-rate plastic bag and sticker/chip systems arguably also raise households' awareness of their food waste, the RFID system goes one step further by offering a visible indicator of households' food waste generation in the form of an additional line item on their utility bills. It will be valuable and interesting to explore ways of further leveraging this data to reinforce and tighten the feedback loop between households' food waste bills and their everyday practices.

One simple way of achieving this might be to provide households with an indicator of their food waste performance relative to the average quantities discarded by similar households in its community. This leverages the power of social norms to shape behavior and has been an effective tactic for reducing household energy consumption (Costa & Kahn, 2013). The power of information technology could be used to further supplement the effectiveness of waste pricing and consumer education initiatives by connecting households' food waste performance to their grocery shopping practices, particularly in South Korea and developed nations that apply similar approaches to charge for food waste. In other words, it may be valuable to go beyond simply making households aware of how much food waste they discard by linking their food waste performance to their grocery shopping practices.

For example, whether embedded in credit cards or in standalone payment cards, RFID technology is already in use in South Korea and other developed countries as a payment method in venues like public transportation, fast food restaurants, and convenience stores. Assuming that these card systems can be connected to data on households' food waste performance, such systems could be used to incentivize waste reduction. This could involve providing discounts that reward households for reductions in or consistently low levels of food waste. Of course, where such discounts are made available and their value should be carefully assessed in order to avoid creating a rebound effect, which describes the possibility for decreased consumption in one domain to stimulate increased consumption elsewhere (Sahakian & Wilhite, 2014). If, for example, we reward households for "good" food waste performance with discounts at convenience stores, they may increase their consumption of pre-packaged convenience foods, which would mean that any reductions in household food waste will be accompanied by increases in packaging waste. Regardless, there is strong potential to take advantage of the data that RFID machines are currently collecting on individual households' food waste generation;

creating feedback loops between household practices and their food waste outputs should be a basic tenet of effective waste mitigation policy.

9.4 Sustainable urban planning and food systems

The main contribution of my dissertation has first been to explicitly conceptualize and then test some of the possible effects that retail modernization has had on pre-consumer and household food waste. In doing so, it has demonstrated how the rise and expansion of corporate retailers has had upstream and downstream impacts in the food supply chain. The upstream effects comprise retailer-induced transformations in distribution network structure, supply chain infrastructure, and supplier relationships, which, in the South Korean case, appear to have contributed to significant reductions in pre-consumer food waste. However, questions linger over whether the current status of pre-consumer food waste in South Korea is contingent upon the level of diversity in its food distribution and retailing system—whether or not the disappearance of traditional food retailers will change things remains to be seen.

The downstream effects appear to be far more complex; while my dissertation has provided evidence to suggest that large-format food retail formats may be associated with food waste-inducing patterns of grocery shopping, the analyses have raised more questions pertaining to the relationships between households' performances of food-related practices, where they shop, and their food waste. My dissertation has not extensively addressed, for instance, the possibility that the performance of food-related practices such as making lists, checking inventory, or meal planning is related in itself to the characteristics of grocery shopping trips such as frequency, mode choice, and travel distance. There is also much more to explore with respect to the interactions between food retailing, households' dietary tendencies, and food waste. Finally, as discussed extensively above, the implications of grocery delivery services will be very important to explore—although they promise to reduce household food waste stemming from portioning errors, households' everyday lives are jumbled with irregularities and contingencies that may or may not mesh well with the pre-planned timing and pre-determined ingredients offered by such services, nor is it clear whether they will remain popular in the long run.

It is interesting to reflect on how the foregoing discussion of implications for future policy and urban retail development presented above relates to existing approaches to sustainability planning and policy. For instance, the notion of promoting high physical accessibility to food retail meshes strongly with urban sustainability discourses such as smart growth and New Urbanism, which promote compactness by way of mixed-use and transit-oriented development (Echenique, Hargreaves, Mitchell, & Namdeo, 2012). Technology-enabled solutions such as delivery services that depend upon smart fridges and predictive algorithms might be classified alongside design-oriented technological fixes that feature regularly in greenfield eco-city developments, such as wastewater re-use systems or energy efficient design (Premalatha, Tauseef, Abbasi, & Abbasi, 2013). As with compact city approaches to urban sustainability, the eco-city ideal has been criticized as falling into what Harvey (1997, p. 2) describes as the modernist trap of "privileging spatial forms over social processes" (Pow & Neo, 2010). This refers to the tendency for such approaches to reproduce and reinforce an expansionist and capitalistic economic paradigm, i.e. one built around continuing economic growth. In the context of food waste, the influence of this paradigm is most obvious in how food waste is a necessary

occurrence for corporate profit generation, as seen in how out-graded produce exists so that corporate retailers can sell only the best quality produce, farmers produce excess crops in order to safeguard their valuable direct supplier status with corporate retailers, or in how corporate marketing efforts promote over-purchasing without regard for whether customers actually consume the food or not (Gille, 2012).

These shortcomings reinforce the importance of considering increased support for traditional food retailers, particularly cooperative-run stores, in conjunction with stronger regulation of corporate retailing and improved community-based systems for food sharing and redistribution. Such strategies align more closely with localization-oriented urban sustainability approaches, which are theorized to create a greater sense of place and social cohesiveness by improving the alignment between local and regional economies' environmental impacts and their surrounding area's ecological carrying capacity (North, 2010). This perspective is not without its shortcomings, among them the "local trap"—blind faith in the sustainability of local production and consumption (Born & Purcell, 2006)—and the inherent challenges associated with quantifying concepts such as "environmental impacts" and "carrying capacity." While complete localization, i.e. autarky, seems unrealistic considering the extent of globalization, the basic thrust of such approaches emphasize the importance of recognizing urban economies' connections to their surrounding hinterlands via supply chains and resource flows. This is a notion crystallized by urban metabolism studies that conceptualize cities as dissipative structures that take in resources from their hinterlands and "metabolize" them into economic activity and waste, usually sending the latter back to these hinterlands (Barles, 2010; Satterthwaite, 1997) for disposal. This understanding of cities and their impacts highlights the importance of transgressing scale in urban planning.

My dissertation puts this into context by sketching the nature of some of the scale-transgressing relationships that connect urban food retail development and, in one direction, national agricultural production, and in the other, household behaviors. These relationships underscore how sustainable urban planning is not just about addressing urbanization's direct impacts, such as pollution, but also about understanding how urban development engenders particular consumptive patterns that drive change beyond traditional urban borders, often with consequences for sustainability. Just as critically, this dissertation has identified the trade-offs associated with retail modernization's impact on food waste, which would have been less visible if this dissertation's scope was limited only to either household or pre-consumer food waste. Lastly, it is important to recognize that addressing food waste is just one aspect of the transition towards a more sustainable food system. A systems-thinking approach in this regard highlights not only the importance of thinking across scales, but also across issues—in this case, it is critical to bear in mind the interconnections between food waste and food justice, as laid out in Chapter 1. Networks of urban actors, including planners and activists, are increasingly challenging the global corporate food system as a source of systemic inequity in access to healthy foods (Wekerle, 2004). These efforts are highly complementary to the system-level changes that are required to address food waste, and it will be important for planners and other parties with interest in either issue to find common ground and work together towards food system reform.

Together, the trans-scalar and trans-issue interconnections discussed only reinforce the importance of approaching urban problems with a systems-thinking approach. In particular, the identification of retail modernization as a possible driving force behind broader trends in food waste mirrors the importance of identifying the "leverage points" within a system, which, when acted upon, have disproportionate potential to drive change throughout the broader system (Meadows, 1999). Situated at the heart of the food system, and with its upward, downward, and lateral connections across scales and issues, the food retail sector is one of these leverage points.

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Appendix A – Household survey instruments

A.1 Household survey instrument (English translation)

Q1 <Informed Consent document inserted here>

- ❍ Agree
- ❍ Disagree

Q2 Welcome! Thank you for participating in our survey about your household's food waste-related behaviors. Through your responses, we hope to develop a better understanding of how much and why food waste is discarded. Your answers are very important to us, so please try and answer as accurately as possible. As a reminder, we will not maintain any link between your responses and your identity. If you need or wish to temporarily stop taking the survey at any time, simply close the window and return at a later point using the same link. Your answers will be automatically saved so you will not have to start over. To begin the survey, please click the blue button on the right.

Q3 Are you the person responsible for at least half of the food-related tasks in your household (e.g. buying groceries, managing food supplies, preparing meals, etc.)?

- ❍ Yes
- ❍ No

Q4 What is your gender?

- ❍ Male
- ❍ Female

Q5 How old are you?

- ❍ 18-30
- ❍ 31-40
- ❍ 41-50
- ❍ 51-60
- ❍ 60+

Q6 In which city is your primary residence?

- ❍ Seoul
- ❍ Busan
- ❍ Incheon
- ❍ Daegu
- ❍ Daejeon
- ❍ Other (please indicate) _____

Q7 In which gu is your primary residence in Seoul?

- ❍ Gangnam-gu
- ❍ Gangdong-gu
- ❍ Gangbuk-gu
- ❍ Gangseo-gu
- ❍ Gwanak-gu
- ❍ Gwangjin-gu
- ❍ Guro-gu
- ❍ Geumcheon-gu
- ❍ Nowon-gu
- ❍ Dobong-gu
- ❍ Dongdaemun-gu
- ❍ Dongjak-gu
- ❍ Mapo-gu
- ❍ Seodaemun-gu
- ❍ Seocho-gu
- ❍ Seongdong-gu
- ❍ Seongbuk-gu
- ❍ Songpa-gu
- ❍ Yangcheon-gu
- ❍ Yeongdeungpo-gu
- ❍ Yongsan-gu
- ❍ Eungpyeong-gu
- ❍ Jongno-gu
- ❍ Jung-gu
- ❍ Jungnang-gu

Q8 In which dong in Seoul is your primary residence in Seoul?

Q9 What is your household composition?Please note that "children" can be any age, even over 18.

- ❍ Single, no children living at home
- ❍ Single, with children living at home
- ❍ Married or living with partner, no children living at home
- ❍ Married or living with partner, with children living at home
- ❍ Unrelated adults living together, no children in the home
- ❍ Unrelated adults living together, with children in the home
- ❍ Widowed / widower
- ❍ Other (please specify) _____

Q10 How many people in total (including yourself) usually live in your household? Please enter a whole number.

Q11 Please indicate the number of children in your household in each of the following age groups.

	0	1	2	3	4	5	6	7	8	9	10
18 years and older	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
13-17 years	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
6-12 years	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
0-5 years	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Q12 Which of the following best describes your employment status?

- ❍ Full-time worker
- ❍ Part-time worker
- ❍ Self-employed
- ❍ Unpaid / volunteer worker
- ❍ Student
- ❍ Stay-at-home parent / homemaker
- ❍ Retired
- ❍ Unemployed (looking for work)
- ❍ Long-term sick / disabled
- ❍ Other (please specify) _____

Q13 Excluding yourself, how many of the other adults (aged 18+) who live in the household fall into the following categories?

	0	1	2	3	4	5	6	7	8	9	10
Full-time worker	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Part-time worker	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Self-employed	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Unpaid / volunteer worker	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Student	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Homemaker / housewife	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Retired	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Unemployed (looking for work)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Long-term sick / disabled	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Other	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Q14 On average over the last three months, how many times did you cook and prepare the following meals for your household members to eat on weekdays?

	0	1	2	3
Number of times you cooked breakfast	❍	❍	❍	❍
Number of times you cooked lunch	❍	❍	❍	❍
Number of times you cooked dinner	❍	❍	❍	❍

Q15 On average over the last three months, how many times did you cook and prepare the following meals for your household members to eat on weekends?

	0	1	2
Number of times you cooked breakfast	❍	❍	❍
Number of times you cooked lunch	❍	❍	❍
Number of times you cooked dinner	❍	❍	❍

Q16 On average over the last three months, how many household members (including yourself) regularly ate a meal that you cooked and prepared a meal at home on weekdays?

	0	0	1	2	3	4	5	6	7	8	9
Number of household members at breakfast	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Number of household members at lunch	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Number of household members at dinner	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Q17 On average over the last three months, how many household members (including yourself) regularly ate a meal that you cooked and prepared at home on weekends?

	0	0	1	2	3	4	5	6	7	8	9
Number of household members at breakfast	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Number of household members at lunch	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Number of household members at dinner	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Q18 Over the last three months, how often on average did you prepare and cook a meal to eat at home with guests?

- ❍ Never
- ❍ Less than once a month
- ❍ Once a month
- ❍ 2-3 times a month
- ❍ Once a week
- ❍ 2-3 times a week
- ❍ Every day

Q19 Over the last three months, how often on average did you buy pre-prepared food or order take-out food to eat at home?

- ❍ Never
- ❍ Less than once a month
- ❍ Once a month
- ❍ 2-3 times a month
- ❍ Once a week
- ❍ 2-3 times a week
- ❍ Every day

Q20 To what extent do you agree or disagree with the following statements about cooking?

	1	2	3	4	5	6	7
Cooking is a chore and I would only do it if necessary	❍	❍	❍	❍	❍	❍	❍
I spend a lot of time thinking about and researching what to cook	❍	❍	❍	❍	❍	❍	❍
I am confident in my ability to cook tasty meals	❍	❍	❍	❍	❍	❍	❍

Q21 How often do you do the following food-related things?

	Never	Less than once a month	Once a month	2-3 times a month	Once a week	2-3 times a week	Every day
Please select "once a week"	❍	❍	❍	❍	❍	❍	❍
Receive food from parents, in-laws, or other relatives who do not live with you	❍	❍	❍	❍	❍	❍	❍
Cook and prepare food to give to your children or other relatives who do not live with you	❍	❍	❍	❍	❍	❍	❍
Cook and prepare food in advance for yourself or other household members to bring to school or work	❍	❍	❍	❍	❍	❍	❍

Q22 Please think about the food you typically have stored at home (e.g. in the fridge, freezer, cupboard, veranda, or elsewhere). What percentage of your food stored at home belongs to the following categories? The total must sum to 100.

_____ Fresh fruit and vegetables
_____ Fresh meat and meat products
_____ Fresh seafood and seafood products
_____ Dairy (including milk), eggs, and soy products
_____ Cereals, grains, and bread products
_____ Pre-prepared or pre-cooked food (e.g. banchan)
_____ Leftover cooked food
_____ Less perishable foods (e.g. dried, canned, frozen, snack, processed food, sauces etc.)
_____ Other (please specify)

Q23 Please think back to the meals you have cooked and eaten at home over the last three months. In comparison to other Korean households, how often did you cook and eat the following kinds of food at home? For example, if your household eats much more fresh fruit than other Korean households, then select "7" for fresh fruit.

	1	2	3	4	5	6	7
Leafy vegetables	❍	❍	❍	❍	❍	❍	❍
Roots and tubers	❍	❍	❍	❍	❍	❍	❍
Meat and meat products	❍	❍	❍	❍	❍	❍	❍
Seafood and seafood products	❍	❍	❍	❍	❍	❍	❍
Fresh fruit	❍	❍	❍	❍	❍	❍	❍
Dairy (including milk), eggs, and soy products	❍	❍	❍	❍	❍	❍	❍
Cereals, grains, and bread products	❍	❍	❍	❍	❍	❍	❍
Other (please specify)	❍	❍	❍	❍	❍	❍	❍

Q24 How often do the following things apply when you cook and prepare meals at home?

	1	2	3	4	5	6	7
I try cooking something I have never cooked before	❍	❍	❍	❍	❍	❍	❍
I make a conscious effort to use up random uncooked ingredients in the fridge (e.g. half a radish, etc.)	❍	❍	❍	❍	❍	❍	❍
I do my best to use up ingredients which are most likely to go bad soon	❍	❍	❍	❍	❍	❍	❍
There are leftovers after eating	❍	❍	❍	❍	❍	❍	❍

Q25 How often would the following reasons explain why you have leftover food when you cook and prepare food to eat at home? This includes food you prepared that wasn't served as well as food leftover on the table.

	1	2	3	4	5	6	7
Unintentionally cooked too much	❍	❍	❍	❍	❍	❍	❍
Intentionally cooked more so there is food to eat later in the day / week	❍	❍	❍	❍	❍	❍	❍
Intentionally cooked more because it's better to have too much than not enough	❍	❍	❍	❍	❍	❍	❍
My cooking did not taste good	❍	❍	❍	❍	❍	❍	❍
We were not as hungry as expected	❍	❍	❍	❍	❍	❍	❍

Q26 Where / how do you store the following kinds of food? (select all that apply)

	Fridge	Freezer	Veranda / balcony	Indoors at room temperature (e.g. cupboard, sideboard, etc.)	Other
Fresh meat and seafood products	❑	❑	❑	❑	❑
Bananas	❑	❑	❑	❑	❑
Leafy vegetables	❑	❑	❑	❑	❑
Roots and tubers (e.g. garlic, onions, sweet potatoes)	❑	❑	❑	❑	❑
Dairy, eggs, and soy products	❑	❑	❑	❑	❑
Cereals, grains, and bread prodcts	❑	❑	❑	❑	❑
Pre-prepared or pre-cooked food (e.g. banchan)	❑	❑	❑	❑	❑
Leftover cooked food	❑	❑	❑	❑	❑

Q27 For each refrigerator (including kimchi refrigerators and standalone freezers) you own at home, please tell us the total volume in liters. Please also tell us how full each refrigerator has been on average over the past three months.

	Extent used	Total volume
	% filled	Liters
Refrigerator 1		
Refrigerator 2		
Refrigerator 3		
Refrigerator 4		
Refrigerator 5		

Q28 Have you ever, or do you grow food your own food to eat?

- ❍ We have previously grown some of our food to eat
- ❍ We currently grow some of our own food to eat
- ❍ We have never tried growing our own food to eat

Q29 You mentioned that you currently grow your own food to eat.Out of the food eaten by your household, approximately what percentage do you grow by yourself?

_____ Percentage of food that you grow yourself

Q30 Over the past three months, how often did you do the following things when you shopped for groceries?

	1	2	3	4	5	6	7
Write a shopping list for the food you need to buy (this does not include a mental list)	❍	❍	❍	❍	❍	❍	❍
Please select "2"	❍	❍	❍	❍	❍	❍	❍
Check what food you already have at home	❍	❍	❍	❍	❍	❍	❍
Plan what you will eat for each meal over the next few days or week	❍	❍	❍	❍	❍	❍	❍
Avoid buying perishable food in large quantities	❍	❍	❍	❍	❍	❍	❍
Avoid buying perishable foods on impulse	❍	❍	❍	❍	❍	❍	❍

Q31 Within the last three months, did you regularly buy groceries (i.e. food that you intend to prepare and eat at home) from any of the following?

- ❑ Chain supermarket (e.g. GS Supermarket, Homeplus Express)
- ❑ Family / independently owned grocery store
- ❑ Department store supermarket
- ❑ Hypermarket (e.g. E-Mart, Homeplus, Costco)
- ❑ Convenience store (e.g. CU, GS25) / mini-mart
- ❑ Traditional market / roadside stall
- ❑ Internet grocery shopping
- ❑ Other (please specify) _____

Q32 Over the past three months, how much did you spend on each trip, on average, to the following kinds of shops? Please only include money spent on food items.

Chain supermarket (e.g. GS Supermarket, Homeplus Express)
Family / independently owned grocery store
Department store supermarket
Hypermarket (e.g. E-Mart, Homeplus, Costco)
Convenience store (e.g. CU, GS25) / mini-mart
Traditional market / roadside stall
Internet grocery shopping
Other (please specify)

Q33 You indicated that you visited a chain supermarket (e.g. GS Supermarket, Homeplus) to buy groceries regularly in the last three months. How often did you buy the following kinds of foods when you visited chain supermarkets to buy groceries?

	Never	Monthly	2-3 times a month	Weekly	2-3 times a week	Daily
Fresh fruits and vegetables	❍	❍	❍	❍	❍	❍
Fresh meat and meat products	❍	❍	❍	❍	❍	❍
Fresh seafood and seafood products	❍	❍	❍	❍	❍	❍
Dairy, eggs, and soy products	❍	❍	❍	❍	❍	❍
Cereals, grains, and bread products	❍	❍	❍	❍	❍	❍
Pre-prepared or pre-cooked food (e.g. banchan)	❍	❍	❍	❍	❍	❍
Less perishable foods (e.g. dried, canned, frozen, snack, processed food, sauces etc.)	❍	❍	❍	❍	❍	❍
Other (please specify)	❍	❍	❍	❍	❍	❍

Q34 You indicated that you visited a family / independently-owned grocery store to buy groceries regularly in the last three months. How often did you buy the following kinds of foods when you visited family / independently-owned grocery stores to buy groceries?

	Never	Monthly	2-3 times a month	Weekly	2-3 times a week	Daily
Fresh fruits and vegetables	❍	❍	❍	❍	❍	❍
Fresh meat and meat products	❍	❍	❍	❍	❍	❍
Fresh seafood and seafood products	❍	❍	❍	❍	❍	❍
Dairy, eggs, and soy products	❍	❍	❍	❍	❍	❍
Cereals, grains, and bread products	❍	❍	❍	❍	❍	❍
Pre-prepared or pre-cooked food (e.g. banchan)	❍	❍	❍	❍	❍	❍
Less perishable foods (e.g. dried, canned, frozen, snack, processed food, sauces etc.)	❍	❍	❍	❍	❍	❍
Other (please specify)	❍	❍	❍	❍	❍	❍

Q35 You indicated that you visited a department store supermarket to buy groceries regularly in the last three months. How often did you buy the following kinds of foods when you visited department store supermarkets to buy groceries?

	Never	Monthly	2-3 times a month	Weekly	2-3 times a week	Daily
Fresh fruits and vegetables	❍	❍	❍	❍	❍	❍
Fresh meat and meat products	❍	❍	❍	❍	❍	❍
Fresh seafood and seafood products	❍	❍	❍	❍	❍	❍
Dairy, eggs, and soy products	❍	❍	❍	❍	❍	❍
Cereals, grains, and bread products	❍	❍	❍	❍	❍	❍
Pre-prepared or pre-cooked food (e.g. banchan)	❍	❍	❍	❍	❍	❍
Less perishable foods (e.g. dried, canned, frozen, snack, processed food, sauces etc.)	❍	❍	❍	❍	❍	❍
Other (please specify)	❍	❍	❍	❍	❍	❍

Q36 You indicated that you visited a hypermarket (Emart, Homeplus, Costco) to buy groceries regularly in the last three months. How often did you buy the following kinds of foods when you visited hypermarkets to buy groceries?

	Never	Monthly	2-3 times a month	Weekly	2-3 times a week	Daily
Fresh fruits and vegetables	❍	❍	❍	❍	❍	❍
Fresh meat and meat products	❍	❍	❍	❍	❍	❍
Fresh seafood and seafood products	❍	❍	❍	❍	❍	❍
Dairy, eggs, and soy products	❍	❍	❍	❍	❍	❍
Cereals, grains, and bread products	❍	❍	❍	❍	❍	❍
Pre-prepared or pre-cooked food (e.g. banchan)	❍	❍	❍	❍	❍	❍
Less perishable foods (e.g. dried, canned, frozen, snack, processed food, sauces etc.)	❍	❍	❍	❍	❍	❍
Other (please specify)	❍	❍	❍	❍	❍	❍

Q37 You indicated that you visited a convenience store (e.g. CU, GS 25) to buy groceries regularly in the last three months. How often did you buy the following kinds of foods when you visited convenience stores to buy groceries?

	Never	Monthly	2-3 times a month	Weekly	2-3 times a week	Daily
Fresh fruits and vegetables	❍	❍	❍	❍	❍	❍
Fresh meat and meat products	❍	❍	❍	❍	❍	❍
Fresh seafood and seafood products	❍	❍	❍	❍	❍	❍
Dairy, eggs, and soy products	❍	❍	❍	❍	❍	❍
Cereals, grains, and bread products	❍	❍	❍	❍	❍	❍
Pre-prepared or pre-cooked food (e.g. banchan)	❍	❍	❍	❍	❍	❍
Less perishable foods (e.g. dried, canned, frozen, snack, processed food, sauces etc.)	❍	❍	❍	❍	❍	❍
Other (please specify)	❍	❍	❍	❍	❍	❍

Q38 You indicated that you visited a traditional market / roadside stall to buy groceries regularly in the last three months. How often did you buy the following kinds of foods when you visited traditional markets / roadside stalls to buy groceries?

	Never	Monthly	2-3 times a month	Weekly	2-3 times a week	Daily
Fresh fruits and vegetables	❍	❍	❍	❍	❍	❍
Fresh meat and meat products	❍	❍	❍	❍	❍	❍
Fresh seafood and seafood products	❍	❍	❍	❍	❍	❍
Dairy, eggs, and soy products	❍	❍	❍	❍	❍	❍
Cereals, grains, and bread products	❍	❍	❍	❍	❍	❍
Pre-prepared or pre-cooked food (e.g. banchan)	❍	❍	❍	❍	❍	❍
Less perishable foods (e.g. dried, canned, frozen, snack, processed food, sauces etc.)	❍	❍	❍	❍	❍	❍
Other (please specify)	❍	❍	❍	❍	❍	❍

Q39 You indicated that you bought groceries via internet grocery shopping regularly in the last three months. How often did you buy the following kinds of foods via internet grocery shopping?

	Never	Monthly	2-3 times a month	Weekly	2-3 times a week	Daily
Fresh fruits and vegetables	❍	❍	❍	❍	❍	❍
Fresh meat and meat products	❍	❍	❍	❍	❍	❍
Fresh seafood and seafood products	❍	❍	❍	❍	❍	❍
Dairy, eggs, and soy products	❍	❍	❍	❍	❍	❍
Cereals, grains, and bread products	❍	❍	❍	❍	❍	❍
Pre-prepared or pre-cooked food (e.g. banchan)	❍	❍	❍	❍	❍	❍
Less perishable foods (e.g. dried, canned, frozen, snack, processed food, sauces etc.)	❍	❍	❍	❍	❍	❍
Other (please specify)	❍	❍	❍	❍	❍	❍

Q40 You indicated that you bought groceries regularly in the last three months from ${q://QID71/ChoiceTextEntryValue/8}. How often did you buy the following kinds of foods when you buy groceries from ${q://QID71/ChoiceTextEntryValue/8}?

	Never	Monthly	2-3 times a month	Weekly	2-3 times a week	Daily
Fresh fruits and vegetables	❍	❍	❍	❍	❍	❍
Fresh meat and meat products	❍	❍	❍	❍	❍	❍
Fresh seafood and seafood products	❍	❍	❍	❍	❍	❍
Dairy, eggs, and soy products	❍	❍	❍	❍	❍	❍
Cereals, grains, and bread products	❍	❍	❍	❍	❍	❍
Pre-prepared or pre-cooked food (e.g. banchan)	❍	❍	❍	❍	❍	❍
Less perishable foods (e.g. dried, canned, frozen, snack, processed food, sauces etc.)	❍	❍	❍	❍	❍	❍
Other (please specify)	❍	❍	❍	❍	❍	❍

Q41 Which reasons best explain why you chose to buy groceries at each of the following places in the last three months? You can select up to three reasons for each location.

	Product selection	Food quality / freshness	Value for money	Atmosphere / shopping experience	Customer service	Convenient opening hours	Conveniently located	Easy parking	Other (please specify)
Chain supermarket (e.g. GS Supermarket, Homeplus Express)	❑	❑	❑	❑	❑	❑	❑	❑	❑
Family / independently owned grocery store	❑	❑	❑	❑	❑	❑	❑	❑	❑
Department store supermarket	❑	❑	❑	❑	❑	❑	❑	❑	❑
Hypermarket (e.g. E-Mart, Homeplus, Costco)	❑	❑	❑	❑	❑	❑	❑	❑	❑
Convenience store (e.g. CU, GS25) / mini-mart	❑	❑	❑	❑	❑	❑	❑	❑	❑
Traditional market / roadside stall	❑	❑	❑	❑	❑	❑	❑	❑	❑
Internet grocery shopping	❑	❑	❑	❑	❑	❑	❑	❑	❑
Other (please specify)	❑	❑	❑	❑	❑	❑	❑	❑	❑

Q42 Over the past three months, have you ever bought more food than planned when grocery shopping? This could refer to times when you bought items that were not on your shopping list, or you bought larger quantities than you originally intended to.

❍ Yes

❍ No

Q43 Over the past three months, how often did you buy more food than planned when visiting each of the following kinds of stores?

	1	2	3	4	5	6	7
Chain supermarket (e.g. GS Supermarket, Homeplus Express)	❍	❍	❍	❍	❍	❍	❍
Family / independently owned grocery store	❍	❍	❍	❍	❍	❍	❍
Department store supermarket	❍	❍	❍	❍	❍	❍	❍
Hypermarket (e.g. E-Mart, Homeplus, Costco)	❍	❍	❍	❍	❍	❍	❍
Convenience store (e.g. CU, GS25) / mini-mart	❍	❍	❍	❍	❍	❍	❍
Traditional market / roadside stall	❍	❍	❍	❍	❍	❍	❍
Internet grocery shopping	❍	❍	❍	❍	❍	❍	❍
Other (please specify)	❍	❍	❍	❍	❍	❍	❍

Q44 How often do the following reasons explain why you bought more food than planned or food that you did not intend to buy when grocery shopping?

	1	2	3	4	5	6	7
The food item was only sold in larger packaging or portions than I needed	❍	❍	❍	❍	❍	❍	❍
I wanted to take advantage of a promotion (e.g. 1+1, discount, shopping points, etc.)	❍	❍	❍	❍	❍	❍	❍
The food item looked or smelled really good	❍	❍	❍	❍	❍	❍	❍
I suddenly felt like trying something new	❍	❍	❍	❍	❍	❍	❍
I needed the item but forgot to put it on my list	❍	❍	❍	❍	❍	❍	❍
Other (please specify)	❍	❍	❍	❍	❍	❍	❍

Q45 How do you make sure you buy the right amount of food when you go grocery shopping? Please select all that apply.

- ❑ Always buy less if I'm not sure about the quantity
- ❑ Always buy more if I'm not sure about the quantity
- ❑ Avoid taking my children along to avoid them pestering me to buy things
- ❑ Only buy long-life products if I'm not sure about the quantity
- ❑ I usually know from past experience
- ❑ I base my decision on the packaging sizes provided in the shop
- ❑ I only buy food sold loosely or by the weight so I can buy the exact amount needed
- ❑ Only buy groceries after eating
- ❑ I don't have a specific method for managing how much I buy
- ❑ Other method (please explain) _____

Q46 When you bought groceries within the last three months at the following locations, which form of transportation did you mainly use?

	Public transit	Car	Walk	Bicycle / Motorcycle / Scooter	Taxi	Other	N/A
Chain supermarket (e.g. GS Supermarket, Homeplus Express)	❍	❍	❍	❍	❍	❍	❍
Family / independently owned grocery store	❍	❍	❍	❍	❍	❍	❍
Department store supermarket	❍	❍	❍	❍	❍	❍	❍
Hypermarket (e.g. E-Mart, Homeplus, Costco)	❍	❍	❍	❍	❍	❍	❍
Convenience store (e.g. CU, GS25) / mini-mart	❍	❍	❍	❍	❍	❍	❍
Traditional market / roadside stall	❍	❍	❍	❍	❍	❍	❍
Internet grocery shopping	❍	❍	❍	❍	❍	❍	❍
Other (please specify)	❍	❍	❍	❍	❍	❍	❍

Q47 How long does it take you to get from your home to each of your grocery shopping locations (one-way)?

	<10 mins	10-15 mins	16-30 mins	31-45 mins	46-60 mins	>60 mins	N/A
Chain supermarket (e.g. GS Supermarket, Homeplus Express)	❍	❍	❍	❍	❍	❍	❍
Family / independently owned grocery store	❍	❍	❍	❍	❍	❍	❍
Department store supermarket	❍	❍	❍	❍	❍	❍	❍
Hypermarket (e.g. E-Mart, Homeplus, Costco)	❍	❍	❍	❍	❍	❍	❍
Convenience store (e.g. CU, GS25) / mini-mart	❍	❍	❍	❍	❍	❍	❍
Traditional market / roadside stall	❍	❍	❍	❍	❍	❍	❍
Internet grocery shopping	❍	❍	❍	❍	❍	❍	❍
Other (please specify)	❍	❍	❍	❍	❍	❍	❍

Q48 After purchasing groceries in-store, do you make use of home delivery services?

- ❍ Never, home delivery service is not available
- ❍ Never, even though home delivery service is available
- ❍ Yes, regardless of how much I bought
- ❍ Only after buying heavy items (e.g. bottled water, rice)
- ❍ Other (please explain) _____

Q49 Is there a shop near home that you can walk to quickly to buy fresh food if it is urgently needed?

- ❍ Yes
- ❍ No
- ❍ Don't know

Q50 What is the food waste disposal payment system in your neighborhood?

- ❍ RFID machine (pay according to weight)
- ❍ Volume-rate plastic bags
- ❍ Chip / sticker and container system
- ❍ My household pays a flat rate to my apartment complex
- ❍ My household does not have to pay at all for food waste disposal
- ❍ Don't know

Q51 Think back over the past few months or so about your household's food waste. On average, how much did you pay each time and how often did you dispose of food waste using the RFID system? Please indicate the amount you paid each time and whether it was each week or each month. The amount is likely to be displayed on the monthly utilities bill you receive from your apartment complex.

	How often		Payment amount
	Weekly	Monthly	(KRW)
RFID payment and frequency	❍	❍	

Q52 Think back over the past three months about your household's food waste. On average, how many full volume-rate plastic bags of food waste did your household throw away each week/month?Please indicate the volume and number of bags thrown away and whether it was each week or month.

	Plastic bag information		How often	
	Volume (L)	No.	Weekly	Monthly
Volume, number and how often volume-rate plastic bags used			❍	❍

Q53 Think back over the past three months or so about your household's food waste. On average, how many food waste stickers / chips did your household use to pay for food waste (per week or per month)?Please indicate the volume, number of stickers / chips, and whether it was each week or month.

	Payment sticker / chip		How often	
	Volume (L)	No.	Weekly	Monthly
Volume, number and how often food waste stickers / chips used			❍	❍

Q54 How much did you pay to your apartment complex each month on average for food waste disposal? This fee is likely to be displayed on the monthly utilities bill that you receive from your apartment complex.

❍ Fee paid (KRW) _____

❍ Don't know

Q55 On average over the past three months, how many full plastic bags of food waste did your household throw away per week or per month? Please indicate the approximate volume, number, and how often.

	Plastic bag information		How often		
	Volume (L)	No.	Weekly	Monthly	Don't know
Volume, number, and how often plastic bags used			❍	❍	❍

Q56 How many times a week does a waste collection company collect food waste from your place of residence?

- ❍ 1
- ❍ 2
- ❍ 3
- ❍ 4
- ❍ 5
- ❍ 6
- ❍ 7
- ❍ Don't know

Q57 On average over the past three months, how many times a week did you take out food waste to throw away?

- ❍ Less than once a week
- ❍ 1
- ❍ 2 times
- ❍ 3 times
- ❍ 4 times
- ❍ 5 times
- ❍ 6 times
- ❍ Less than once a week

Q58 On average over the past three months, how much of your household's food waste was originally edible vs. inedible?

Edible food waste: food that was thrown away because it was moldy, expired, didn't taste good, leftover, etc.

Inedible food waste: the part of your food that is originally inedible, e.g. bones, peel, seeds, etc.

The total must be 100%.

_____ Edible food waste (%)
_____ Inedible food waste (%)

Q59 Thinking back to those times when you threw away food over the past three months, how often did you throw away the following kinds of food? Please do not include any inedible portions. For example, if you threw away rib bones after meal, do not include those under "partially-used food" or "leftover cooked food."

	1	2	3	4	5	6	7
Unused / unopened food	❍	❍	❍	❍	❍	❍	❍
Half-used ingredients	❍	❍	❍	❍	❍	❍	❍
Cooked food, immediately after a meal	❍	❍	❍	❍	❍	❍	❍
Cooked food, several days after it was first cooked	❍	❍	❍	❍	❍	❍	❍

Q60 Thinking back to those times when you threw away food over the past three months, how often did you throw away food due to the following reasons?

	1	2	3	4	5	6	7
Prepared or cooked too much	❍	❍	❍	❍	❍	❍	❍
Bought too much	❍	❍	❍	❍	❍	❍	❍
Didn't taste good	❍	❍	❍	❍	❍	❍	❍
Didn't look good (but was not moldy)	❍	❍	❍	❍	❍	❍	❍
Please select "2" for this statement	❍	❍	❍	❍	❍	❍	❍
Concerned that it wasn't safe to eat (but not moldy)	❍	❍	❍	❍	❍	❍	❍
Was clearly moldy / rotten	❍	❍	❍	❍	❍	❍	❍
Past the expiry date	❍	❍	❍	❍	❍	❍	❍
Other (please specify)	❍	❍	❍	❍	❍	❍	❍

Q61 You indicated that there have been times when you threw away food because you were concerned that it wasn't safe to eat, was moldy / rotten, or was past the expiry date.How often would you say this happened because of the following reasons?

	1	2	3	4	5	6	7
Forgot that it was there (e.g. got lost at the back of the fridge)	❍	❍	❍	❍	❍	❍	❍
Only needed a small amount, but had to buy more than that (e.g. due to packaging/portion size)	❍	❍	❍	❍	❍	❍	❍
Didn't feel like eating it until it was too late	❍	❍	❍	❍	❍	❍	❍
Didn't have enough time to cook and/or eat it	❍	❍	❍	❍	❍	❍	❍
Bought too much because it was on promotion (e.g. 1+1, discounted price, etc.)	❍	❍	❍	❍	❍	❍	❍
Other (please specify)	❍	❍	❍	❍	❍	❍	❍

Q62 Over the past three months, how often did you clean out your refrigerator, cupboards, and other food storage areas?

- ❍ Never
- ❍ Less than once a month
- ❍ Once a month
- ❍ 2-3 times a month
- ❍ Once a week
- ❍ 2-3 times a week
- ❍ Daily

Q63 Of your household members who regularly eat at home (including yourself), how many would eat food in the following situations?

	None of us	Some of us	All of us
Eat leftover food that has been in the fridge for a few days, as long as it smells or looks ok	❍	❍	❍
Eat food on its expiry date	❍	❍	❍
Eat food that is a few days past its expiry date	❍	❍	❍
Eat food that is up to a week past its expiry date	❍	❍	❍
Eat food regardless of how long it has past its expiry date, as long as it smells or looks ok	❍	❍	❍

Q64 In addition to just disposing of food waste via the volume-based pricing system, please indicate if you do any of the following waste-related things.Please select all that apply.

- ❑ Use a food waste drying machine
- ❑ Leave food waste in farm fields as fertilizer
- ❑ Give food waste to houseplants as fertlizer
- ❑ Flush food waste down the toilet
- ❑ Pour food waste down the sink
- ❑ Use a food waste disposal unit to grind up food waste in your sink

Q65 To what extent do you agree with the following statements?

	1	2	3	4	5	6	7
I am always conscious about the amount of food we throw away at home	❍	❍	❍	❍	❍	❍	❍
I could do a lot more to reduce how much food we throw away at home	❍	❍	❍	❍	❍	❍	❍
Throwing away food makes me feel uncomfortable	❍	❍	❍	❍	❍	❍	❍

Q66 To what extent do you agree with each of the following statements about food waste?

	1	2	3	4	5	6	7
Wasting food is morally acceptable	❍	❍	❍	❍	❍	❍	❍
Wasting food is bad for the environment	❍	❍	❍	❍	❍	❍	❍
Wasting food is socially acceptable	❍	❍	❍	❍	❍	❍	❍
Wasting food is a waste of money	❍	❍	❍	❍	❍	❍	❍
There is nothing inherently wrong with wasting food	❍	❍	❍	❍	❍	❍	❍

Q67 In order to research food waste further, we are looking for people to participate in a diary study about household food waste. Your participation in the diary would provide valuable information that could help reduce the environmental impacts of food waste in Korea and other countries.The diary study would require you to write down information every day about your household's food waste over one week. If you complete the diary study, you will receive compensation worth KRW 40,000. If you are interested in participating in the diary study, please select "Yes" below. You will then be contacted to with more information and to confirm your participation. Participation in the diary study is completely voluntary. You will not be penalized in any way if you choose not to participate.

❍ Yes

❍ No

Q68 Why did you not want to participate in the diary study? (please select all that apply)

- ❑ I am too busy and don't have time
- ❑ I have enough time, but the diary seems like too much effort
- ❑ The compensation is not enough
- ❑ Food waste is too disgusting
- ❑ I don't throw away any food waste at home
- ❑ Other (please specify) _____

Q69 What is the highest level of education you have completed?

- ❍ Did not finish high school
- ❍ Finished high school
- ❍ Bachelor's degree
- ❍ Master's or PhD degree
- ❍ I'd rather not say

Q70 What is your household's monthly income?

- ❍ Less than KRW 1,000,000
- ❍ KRW 1,000,000 – 1,999,999
- ❍ KRW 2,000,000 – 2,999,999
- ❍ KRW 3,000,000 – 3,999,999
- ❍ KRW 4,000,000 – 4,999,999
- ❍ More than KRW 5,000,000
- ❍ g. Rather not say

Q71 Are you financially independent (i.e. you do not depend on financial support from your parents or others?)

- ❍ Yes
- ❍ No
- ❍ I'd rather not say

Q72 What is the monthly household income of the people who support you financially?

- ❍ Less than KRW 1,000,000
- ❍ KRW 1,000,000 – 1,999,999
- ❍ KRW 2,000,000 – 2,999,999
- ❍ KRW 3,000,000 – 3,999,999
- ❍ KRW 4,000,000 – 4,999,999
- ❍ More than KRW 5,000,000
- ❍ Rather not say

A.2 Household survey instrument (Korean translation)

Q1 <informed consent document inserted here>

- ❍ 동의함
- ❍ 동의하지 않음

Q2 환영합니다! 저희 음식물 쓰레기 설문조사에 참여해주셔서 감사합니다! 저희는 귀하의 설문조사 결과를 통해 음식물 쓰레기량과 배출에 대하여 더 자세히 이해하려고 합니다. 귀하의 응답은 저희의 연구에 매우 중요하오니 가능한 정확하게 대답해주시기 바랍니다. 저희는 귀하의 개인정보와 설문응답을 연결하여 보관하지 않기 때문에 정보 보안에 대해 안전하다는 것을 다시 한 번 알려드립니다.일시적으로 설문조사 응답을 중지하는 경우, 귀하의 설문 응답이 자동적으로 저장되기 때문에 처음부터 새롭게 다시 시작하실 필요없이 이전 설문 문항에 이어서 답변하실 수 있습니다.설문조사를 시작하기 위하여 아래 오른쪽 버튼을 클릭하십시오.

Q3 귀하는 가정에서 식품과 관련한 집안일을 (예: 장보기, 요리, 분리수거 등) 50% 이상 담당하고 계십니까?

- ❍ 네
- ❍ 아니오

Q4 귀하의 성별은 무엇입니까?

- ❍ 남성
- ❍ 여성

Q5 귀하의 만 나이는 어떻게 되십니까?

- ❍ 18 세 미만
- ❍ 18-30
- ❍ 31-40
- ❍ 41-50
- ❍ 51-60
- ❍ 60+

Q6 귀하가 거주하고 계신 시에 대해 말씀해주십시오.

- ❍ 서울특별시
- ❍ 부산광역시
- ❍ 인천광역시
- ❍ 대구
- ❍ 대전
- ❍ 기타 (적어주십시오) _____

Q7 귀하가 서울에 거주하고 계신 구(區)에 대해 말씀해주십시오.

- ❍ 강남구
- ❍ 강동구
- ❍ 강북구
- ❍ 강서구
- ❍ 관악구
- ❍ 광진구
- ❍ 구로구
- ❍ 금천구
- ❍ 노원구
- ❍ 도봉구
- ❍ 동대문구
- ❍ 동작구
- ❍ 마포구
- ❍ 서대문구
- ❍ 서초구
- ❍ 성동구
- ❍ 성북구
- ❍ 송파구
- ❍ 양천구
- ❍ 영등포구
- ❍ 용산구
- ❍ 은평구
- ❍ 종로구
- ❍ 중구
- ❍ 중랑구

Q8 귀하가 서울에 거주하고 계신 동(洞)에 대해 말씀해주십시오.

Q9 귀하의 가족 형태는 어떻게 되십니까?여기서 "자녀"란 모든 연령에 해당합니다 (만 18 세 이상 성인 자녀 포함).

- ❍ 미혼/이혼, 자녀 없음
- ❍ 미혼/이혼 + 자녀
- ❍ 부부, 자녀 없음
- ❍ 부부 + 자녀
- ❍ 관계 없는 성인, 자녀 없음
- ❍ 관계 없는 성인 + 자녀
- ❍ 미망인 / 홀아비
- ❍ 기타 (적어주십시오) _____
- ❍ 대답하고 싶지 않음

Q10 귀하를 포함한 가족 구성원은 몇 명인지 말씀해주십시오.숫자로 기재해주십시오.

Q11 귀하 가정의 자녀 (모든 연령, 만 나이) 가족구성원이 속한 연령대에 맞는 인원을 말씀해주십시오.

	0	1	2	3	4	5	6	7	8	9	10
18 세이상	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
13-17 세	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
6-12 세	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
0-5 세	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Q12 귀하의 직업 형태는 무엇입니까?

- ❍ 정규직
- ❍ 아르바이트
- ❍ 사업 / 자영업
- ❍ 무급 / 자원봉사자
- ❍ 학생
- ❍ 전업 주부
- ❍ 은퇴자
- ❍ 무직 (현재 구직 중)
- ❍ 환자 / 장애우
- ❍ 기타 (적어주십시오) _____

Q13 귀하를 제외한 가정의 성인 (만 18 세 이상) 가족구성원이 속한 그룹에 맞게 알맞은 인원을 말씀해주십시오.

	0	1	2	3	4	5	6	7	8	9	10
정규직	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
아르바이트	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
사업 / 자영업	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
무급 / 자원봉사자	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
학생	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
전업 주부 / 재택 자	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
은퇴자	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
무직 (현재 구직 중)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
환자 / 장애우	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
기타	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Q14 지난 3 개월 동안, 귀하는 일주일 기준, 평일(월-금요일)에 평균적으로 몇 번 식구들을 위해 요리하고, 아래의 식사를 준비하셨습니까?

	0	1	2	3	4	5
아침 식사	❍	❍	❍	❍	❍	❍
점심 식사	❍	❍	❍	❍	❍	❍
저녁 식사	❍	❍	❍	❍	❍	❍

Q15 지난 3 개월 동안, 귀하가 일주일 기준으로 주말에 평균 몇 번 정도 식구들을 위해 요리하고, 아래의 식사를 준비하셨습니까?

	0	1	2
아침사 식사	❍	❍	❍
점심 식사	❍	❍	❍
저녁 식사	❍	❍	❍

Q16 지난 3 개월 동안, 귀하를 포함한 몇 명의 식구들이 평일(월-금요일)에 귀하가 가정에서 요리하고 준비한 식사를 정기적으로 먹었습니까?

	0	1	2	3	4	5	6	7	8	9	10
아침 식사를 한 가구원수	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
점심 식사를 한 가구원수	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
저녁 식사를 한 가구원수	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Q17 지난 3 개월 동안, 귀하를 포함한 몇 명의 식구들이 주말에 귀하가 가정에서 요리하고 준비한 식사를 정기적으로 먹었습니까?

	0	1	2	3	4	5	6	7	8	9	10
아침 식사를 한 가구원수	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
점심 식사를 한 가구원수	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
저녁 식사를 한 가구원수	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Q18 지난 3 개월 동안, 귀하는 평균적으로 얼마나 자주 손님들과 식사를 위해 가정에서 요리하고 식사를 준비하셨습니까?

❍ 없음

❍ 한 달에 한 번 미만

❍ 한 달에 한 번

❍ 한 달에 2-3 번

❍ 매주 한 번

❍ 매주 2-3 번

❍ 매일

Q19 지난 3 개월 동안, 평균적으로 얼마나 자주 미리 준비되어 있는 식품들을 집에서 먹으려고 구매하거나, 음식 포장/배달을 주문하셨습니까?밖에서 먹는 것을 포함하지마십시오.

- ❍ 없음
- ❍ 한 달에 한 번 미만
- ❍ 한 달에 한 번
- ❍ 한 달에 2-3 번
- ❍ 매주 한 번
- ❍ 매주 2-3 번
- ❍ 매일

Q20 아래 요리에 대한 서술을 읽고, 동의하시는 정도를 말씀해주십시오.

	1	2	3	4	5	6	7
요리는 허드렛일이고 부득이 해야 할 때만 하는 것이다	❍	❍	❍	❍	❍	❍	❍
무엇을 요리할 지에 대해 생각하고, 어떻게 요리할 지 연구하기 위해 시간을 많이 보낸다	❍	❍	❍	❍	❍	❍	❍
맛있는 요리를 준비할 수 있다는 자신감을 갖고 있지 않다	❍	❍	❍	❍	❍	❍	❍

Q21 아래의 식품과 관련된 일이 얼마나 자주 일어나는 편입니까?

	없음	매달 한 번 미만	매달 한 번	매달 2-3 번	매주 한 번	매주 2-3 번	매일
"매주 한 번"이라고 답변해주십시오	❍	❍	❍	❍	❍	❍	❍
부모 (친정, 시댁, 처가 등) 또는 다른 친척에게 음식/식품을 받는 것	❍	❍	❍	❍	❍	❍	❍
자녀 또는 다른 곳에 살고 있는 친척에게 귀하가 요리한 음식/식품을 주는 것	❍	❍	❍	❍	❍	❍	❍
식구들이 학교/직장에 가져갈 도시락을 위해 음식을 요리하고 준비하는 것	❍	❍	❍	❍	❍	❍	❍

Q22 귀하가 가정에서 보통 보관하는 식품과 음식을 떠올려 보십시오 (예 냉장고, 냉동고, 찬장, 베란다, 등).귀하가 가정에서 보관하는 식품과 음식들은 아래 구분에 속하는 퍼센트를 적어주십시오.총 합계는 100%가 되어야합니다.

_____ 신선한 과일 및 채소
_____ 신선한 고기 및 식육 가공품
_____ 신선한 생선 및 해산물
_____ 유제품 (우유 포함), 계란 및 콩 제품
_____ 쌀, 곡물 및 빵 제품
_____ 조리된 음식 및 식품 (예 마른 반찬)
_____ 남은 음식
_____ 쉽게 변질되지 않는 음식 및 식품 (예 동조림 식품, 가공식품, 조미료, 냉동식품, 등)
_____ 기타 (적어주십시오)

Q23 지난 3 개월 동안 가정에서 요리하고 준비한 식사들을 떠올려 보십시오.다른 가정과 비교하여, 아래 종류의 음식을 얼마나 자주 요리하고 드셨습니까?예) 귀하 가정은 다른 가정보다 신선한 과일을 아주 많이 드시면, 신선한 과일이라는 항목에 "7"를 선택해주십시오.

	1	2	3	4	5	6	7
잎채소	❍	❍	❍	❍	❍	❍	❍
뿌리채소	❍	❍	❍	❍	❍	❍	❍
고기 및 식육가공품	❍	❍	❍	❍	❍	❍	❍
신선한 생선 및 해산물	❍	❍	❍	❍	❍	❍	❍
신선한 과일	❍	❍	❍	❍	❍	❍	❍
유제품 (우유를 포함), 계란 및 콩 제품	❍	❍	❍	❍	❍	❍	❍
쌀, 곡물 및 빵 제품	❍	❍	❍	❍	❍	❍	❍

Q24 요리 및 식사 준비시에 아래와 관련된 것이 얼마나 자주 해당됩니까?

	1	2	3	4	5	6	7
새로운 음식을 요리하고 준비해본다	❍	❍	❍	❍	❍	❍	❍
의식적으로 냉장고에 있는 남은 재료를 사용하려고 노력한다	❍	❍	❍	❍	❍	❍	❍
곧 상할 수 있는 재료를 우선 사용하려고 노력한다	❍	❍	❍	❍	❍	❍	❍
식사 후에 남는 음식이 없다	❍	❍	❍	❍	❍	❍	❍

Q25 가정에서 식사한 후에 남는 음식이 있을 때, 얼마나 자주 아래의 이유들로 인하여 남는 음식이 있는 지 말씀해주십시오.식탁에 덜어 놓은 음식들 뿐만 아니라 모든 준비한 음식을 포함해주십시오.

	1	2	3	4	5	6	7
우연히 많은 양을 요리하고 준비했다	❍	❍	❍	❍	❍	❍	❍
당일 또는 이번주에 먹기 위해 일부러 더 요리하고 준비했다	❍	❍	❍	❍	❍	❍	❍
음식이 부족한 것 보다 차라리 음식이 남는 것이 낫다	❍	❍	❍	❍	❍	❍	❍
내가 요리하고 준비한 음식이 맛 없었다	❍	❍	❍	❍	❍	❍	❍
가족들이 생각보다 배고프지 않았었다	❍	❍	❍	❍	❍	❍	❍
기타 (적어주십시오)	❍	❍	❍	❍	❍	❍	❍

Q26 아래 종류의 음식/식품을 어떻게 보관하십니까? (중복 응답 가능)

	냉장고	냉동고	베란다 / 발코니	상온보관 (예: 찬장, 식탁 등)	기타
신선한 고기 및 식육가공품	❑	❑	❑	❑	❑
신선한 생선 및 해산물	❑	❑	❑	❑	❑
바나나	❑	❑	❑	❑	❑
다른 과일	❑	❑	❑	❑	❑
잎채소	❑	❑	❑	❑	❑
뿌리채소	❑	❑	❑	❑	❑
유제품 (우유 포함), 계란 및 콩 제품	❑	❑	❑	❑	❑
쌀, 곡물 및 빵	❑	❑	❑	❑	❑
조리된 음식 및 식품 (예: 마른 반찬)	❑	❑	❑	❑	❑
남는 조리된 음식	❑	❑	❑	❑	❑

Q27 귀하는 가정에 보유하고 계신 모든 냉장고 (김치 냉장고, 냉동실 포함) 의 크기(L) 적어주십시오.또한 각 냉장고마다 지난 3 개월동안 평균적으로 음식물이 보관된 정도를 %로 작성해주십시오.

	음식물이 보관된 정도	냉장고 전체 크기	모른다
	% 가득	리터 (L)	
1.			❍
2.			❍
3.			❍
4.			❍
5.			❍

Q28 귀하는 귀하의 가정에서 소비하기 위한 농작물 (예. 상추, 마늘, 쌀, 콩 등) 또는 동물 (예. 닭 (계란 포함), 돼지 등)을 키워보신 적 있으십니까?

❍ 예전에 길러본 적 있다

❍ 현재 기르고 있다

❍ 길러본 적 없다

Q29 귀하는 귀하 가정에서 소비하기 위한 농작물 (예. 상추, 마늘, 쌀, 콩 등) 또는 동물 (예. 닭 (계란 포함), 돼지 등)을 기르고 있다고 말씀하셨습니다. 귀하 가정에서 소비하는 식품들 중에서 직접 기르고 있는 농작물이나 동물은 몇 퍼센트 차지하고 있습니까?

_____ 가정에서 소비하는 식품 중 현재 키우고 있는 농작물 또는 축산물의 퍼센트

Q30 지난 3 개월동안 장 보러 가실 때, 아래의 설명된 행동을 얼마나 자주하시는지 말씀해주십시오.

	1	2	3	4	5	6	7
구매해야 하는 식품을 쇼핑리스트 작성하기 (직접 쇼핑 리스트를 작성하지 않고, 기억만 하는 것은 포함하지 않습니다)	❍	❍	❍	❍	❍	❍	❍
숫자 "2"를 선택해주십시오	❍	❍	❍	❍	❍	❍	❍
구매해야 하는 식품을 미리 기억하기 (실테로 작성한 쇼핑리스트는 포함하지 않습니다)	❍	❍	❍	❍	❍	❍	❍
장 보러 가기 전 이미 구입한 식품을 미리 확인하기	❍	❍	❍	❍	❍	❍	❍
앞으로 며칠 또는 한 주동안 요리할 식단을 미리 계획하기	❍	❍	❍	❍	❍	❍	❍
쉽게 상하는	❍	❍	❍	❍	❍	❍	❍

식품을 대량으로 구매하기							
쉽게 상하는 식품을 충동 구매하기	❍	❍	❍	❍	❍	❍	❍

Q31 지난 3 개월 동안, 귀하는 정기적으로 아래의 장 보는 장소를 통해서 가정에서 요리하거나, 바로 먹기위한 식품을 구매를 한 적 있으십니까?

- ❑ 기업형 슈퍼마켓 (예: 홈플러스 익스프레스, GS 슈퍼마켓)
- ❑ 가족 / 개인 식품 소매점
- ❑ 백화점 슈퍼마켓
- ❑ 대형마트 (예: 이마트, 홈플러스, 코스트코)
- ❑ 기업형 편의점 (예: GS25, CU)
- ❑ 재래시장 / 노점상
- ❑ 인터넷 쇼핑
- ❑ 기타 (적어주십시오) _____

Q32 지난 3 개월동안 아래의 장소에 가실 때 마다 평균 구매하신 금액은 얼마였습니까?식품을 구매 금액만 포함해주십시오.(원 (₩) 단위로 작성해 주십시오)

기업형 슈퍼마켓 (예: 홈플러스 익스프레스, GS 슈퍼마켓)
가족 / 개인 식품 소매점
백화점 슈퍼마켓
대형마트 (예: 이마트, 홈플러스, 코스트코)
기업형 편의점 (예: GS25, CU)
재래시장 / 노점상
인터넷 쇼핑
기타 (적어주십시오)

Q33 귀하는 지난 3 개월동안 정기적으로 기업형 슈퍼마켓 (예: GS 슈퍼마켓, 홈플러스 익스프레스)에서 장을 봤다고 말씀하셨습니다. 아래 종류의 식품들을 얼마나 자주 기업형 슈퍼마켓에서 구매하십니까?

	없음	매달 한 번 미만	매월	매월 2-3 번	매주	매주 2-3 번	매일
신선한 과일 및 채소	❍	❍	❍	❍	❍	❍	❍
신선한 고기 및 식육 가공품	❍	❍	❍	❍	❍	❍	❍
신선한 생선 및 해산물	❍	❍	❍	❍	❍	❍	❍
유제품, 계란류 및 콩 제품	❍	❍	❍	❍	❍	❍	❍
쌀, 곡물 및 빵 제품	❍	❍	❍	❍	❍	❍	❍
미리 조리된 음식 및 식품 (예. 마른반찬, 장아찌 등)	❍	❍	❍	❍	❍	❍	❍
쉽게 상하지 않는 식품 (예. 건조식품, 통조림, 가공식품 및 소스류 등)	❍	❍	❍	❍	❍	❍	❍
기타 (자세히 적어주세요)	❍	❍	❍	❍	❍	❍	❍

Q34 귀하는 지난 3 개월동안 정기적으로 가족 / 개인 식품 소매점에서 장을 봤다고 말씀하셨습니다. 아래 종류의 식품들을 얼마나 자주 가족 / 개인 식품 소매점에서 구매하십니까?

	없음	매월 한 번 미만	매월	매월 2-3 번	매주	매주 2-3 전	매일
신선한 과일 및 채소	❍	❍	❍	❍	❍	❍	❍
신선한 고기 및 식육 가공품	❍	❍	❍	❍	❍	❍	❍
신선한 생선 및 해산물	❍	❍	❍	❍	❍	❍	❍
유제품, 계란류 및 콩 제품	❍	❍	❍	❍	❍	❍	❍
쌀, 곡물 및 빵 제품	❍	❍	❍	❍	❍	❍	❍
미리 조리된 음식 및 식품 (예. 마른반찬, 장아찌 등)	❍	❍	❍	❍	❍	❍	❍
쉽게 상하지 않는 식품 (예. 건조식품, 통조림, 가공식품 및 소스류 등)	❍	❍	❍	❍	❍	❍	❍
기타 (자세히 적어주세요)	❍	❍	❍	❍	❍	❍	❍

Q35 귀하는 지난 3 개월동안 정기적으로 백화점 슈퍼마켓에서 장을 봤다고 말씀하셨습니다. 아래 종류의 식품들을 얼마나 자주 백화점 슈퍼마켓에서 구매하십니까?

	없음	매월 한 번 미만	매월	매월 2-3 번	매주	매주 2-3 번	매일
신선한 과일 및 채소	❍	❍	❍	❍	❍	❍	❍
신선한 고기 및 식육 가공품	❍	❍	❍	❍	❍	❍	❍
신선한 생선 및 해산물	❍	❍	❍	❍	❍	❍	❍
유제품, 계란류 및 콩 제품	❍	❍	❍	❍	❍	❍	❍
쌀, 곡물 및 빵 제품	❍	❍	❍	❍	❍	❍	❍
미리 조리된 음식 및 식품 (예. 마른반찬, 장아찌 등)	❍	❍	❍	❍	❍	❍	❍
쉽게 상하지 않는 식품 (예. 건조식품, 통조림, 가공식품 및 소스류 등)	❍	❍	❍	❍	❍	❍	❍
기타 (자세히 적어주세요)	❍	❍	❍	❍	❍	❍	❍

Q36 귀하는 지난 3 개월동안 정기적으로 대형마트 (예: 이마트, 홈플러스, 코스트코)에서 장을 봤다고 말씀하셨습니다. 아래 종류의 식품들을 얼마나 자주 대형마트에서 구매하십니까?

	없음	매월 한 번 미만	매월	매월 2-3 번	매주	매주 2-3 번	매일
신선한 과일 및 채소	❍	❍	❍	❍	❍	❍	❍
신선한 고기 및 식육 가공품	❍	❍	❍	❍	❍	❍	❍
신선한 생선 및 해산물	❍	❍	❍	❍	❍	❍	❍
유제품, 계란류 및 콩 제품	❍	❍	❍	❍	❍	❍	❍
쌀, 곡물 및 빵 제품	❍	❍	❍	❍	❍	❍	❍
미리 조리된 음식 및 식품 (예. 마른반찬, 장아찌 등)	❍	❍	❍	❍	❍	❍	❍
쉽게 상하지 않는 식품 (예. 건조식품, 통조림, 가공식품 및 소스류 등)	❍	❍	❍	❍	❍	❍	❍
기타 (자세히 적어주세요)	❍	❍	❍	❍	❍	❍	❍

Q37 귀하는 지난 3 개월동안 정기적으로 기업형 편의점 (예. CU, GS25)에서 장을 봤다고 말씀하셨습니다. 아래 종류의 식품들을 얼마나 자주 기업형 편의점에서 구매하십니까?

	없음	매월 한 번 미만	매월	매월 2-3 번	매주	매주 2-3 번	매일
신선한 과일 및 채소	❍	❍	❍	❍	❍	❍	❍
신선한 고기 및 식육 가공품	❍	❍	❍	❍	❍	❍	❍
신선한 생선 및 해산물	❍	❍	❍	❍	❍	❍	❍
유제품, 계란류 및 콩 제품	❍	❍	❍	❍	❍	❍	❍
쌀, 곡물 및 빵 제품	❍	❍	❍	❍	❍	❍	❍
미리 조리된 음식 및 식품 (예. 마른반찬, 장아찌 등)	❍	❍	❍	❍	❍	❍	❍
쉽게 상하지 않는 식품 (예. 건조식품, 통조림, 가공식품 및 소스류 등)	❍	❍	❍	❍	❍	❍	❍
기타 (자세히 적어주세요)	❍	❍	❍	❍	❍	❍	❍

Q38 귀하는 지난 3 개월동안 정기적으로 재래시장 / 노점상에서 장을 봤다고 말씀하셨습니다. 아래 종류의 식품들을 얼마나 자주 재래시장 / 노점상에서 구매하십니까?

	없음	매월 한 번 미만	매월	매월 2-3 번	매주	매주 2-3 번	매일
신선한 과일 및 채소	❍	❍	❍	❍	❍	❍	❍
신선한 고기 및 식육 가공품	❍	❍	❍	❍	❍	❍	❍
신선한 생선 및 해산물	❍	❍	❍	❍	❍	❍	❍
유제품, 계란류 및 콩 제품	❍	❍	❍	❍	❍	❍	❍
쌀, 곡물 및 빵 제품	❍	❍	❍	❍	❍	❍	❍
미리 조리된 음식 및 식품 (예. 마른반찬, 장아찌 등)	❍	❍	❍	❍	❍	❍	❍
쉽게 상하지 않는 식품 (예. 건조식품, 통조림, 가공식품 및 소스류 등)	❍	❍	❍	❍	❍	❍	❍
기타 (자세히 적어주세요)	❍	❍	❍	❍	❍	❍	❍

Q39 귀하는 지난 3 개월동안 정기적으로 인터넷 쇼핑으로 장을 봤다고 말씀하셨습니다. 아래 종류의 식품들을 얼마나 자주 인터넷 쇼핑으로 구매하십니까?

	없음	매월 한 번 미만	매월	매월 2-3 번	매주	매주 2-3 번	매일
신선한 과일 및 채소	❍	❍	❍	❍	❍	❍	❍
신선한 고기 및 식육 가공품	❍	❍	❍	❍	❍	❍	❍
신선한 생선 및 해산물	❍	❍	❍	❍	❍	❍	❍
유제품, 계란류 및 콩 제품	❍	❍	❍	❍	❍	❍	❍
쌀, 곡물 및 빵 제품	❍	❍	❍	❍	❍	❍	❍
미리 조리된 음식 및 식품 (예. 마른반찬, 장아찌 등)	❍	❍	❍	❍	❍	❍	❍
쉽게 상하지 않는 식품 (예. 건조식품, 통조림, 가공식품 및 소스류 등)	❍	❍	❍	❍	❍	❍	❍
기타 (자세히 적어주세요)	❍	❍	❍	❍	❍	❍	❍

Q40 귀하가 지난 3 개월동안 ${q://QID71/ChoiceTextEntryValue/8}에서 정기적으로 장을 봤다고 말씀하셨습니다. 아래 종류의 식품들을 얼마나 자주 ${q://QID71/ChoiceTextEntryValue/8}에서 구매하십니까?

	없음	매월 한 번 미만	매월	매월 2-3 번	매주	매주 2-3 번	매일
신선한 과일 및 채소	❍	❍	❍	❍	❍	❍	❍
신선한 고기 및 식육 가공품	❍	❍	❍	❍	❍	❍	❍
신선한 생선 및 해산물	❍	❍	❍	❍	❍	❍	❍
유제품, 계란류 및 콩 제품	❍	❍	❍	❍	❍	❍	❍
쌀, 곡물 및 빵 제품	❍	❍	❍	❍	❍	❍	❍
미리 조리된 음식 및 식품 (예. 마른반찬, 장아찌 등)	❍	❍	❍	❍	❍	❍	❍
쉽게 상하지 않는 식품 (예. 건조식품, 통조림, 가공식품 및 소스류 등)	❍	❍	❍	❍	❍	❍	❍
기타 (자세히 적어주세요)	❍	❍	❍	❍	❍	❍	❍

Q41 귀하가 아래 장소에서 장을 보는 이유는 무엇입니까?각 장소마다 최대 3 가지 이유까지 선택 가능합니다.

	식품선정	식품 품질 / 신선도	분위기 / 쇼핑경험	고객 서비스	편한 영업시간	편한 위치 / 교통	주차 편의	기타
기업형 슈퍼마켓 (예: 홈플러스 익스프레스, GS 슈퍼마켓)	❑	❑	❑	❑	❑	❑	❑	❑
가족 / 개인 식품 소매점	❑	❑	❑	❑	❑	❑	❑	❑
백화점 슈퍼마켓	❑	❑	❑	❑	❑	❑	❑	❑
대형마트 (예: 이마트, 홈플러스, 코스트코)	❑	❑	❑	❑	❑	❑	❑	❑
기업형 편의점 (예: GS25, CU)	❑	❑	❑	❑	❑	❑	❑	❑
재래시장 / 노점상	❑	❑	❑	❑	❑	❑	❑	❑
인터넷 쇼핑	❑	❑	❑	❑	❑	❑	❑	❑
기타 (적어주십시오)	❑	❑	❑	❑	❑	❑	❑	❑

Q42 귀하는 지난 3 개월동안 장을 볼 때 계획한 양보다 더 많은 양을 구매해본 적 있으십니까?쇼핑리스트에 없는 것을 구매하거나 원래 계획한 양보다 많이 구매하신 경우들을 일컬 수 있습니다.

- ❍ 네
- ❍ 아니오

Q43 지난 3 개월동안, 아래 장소에서 장을 볼 때 얼마나 자주 계획한 양보다 많이 구매하셨습니까?

	1	2	3	4	5	6	7
기업형 슈퍼마켓 (예: 홈플러스 익스프레스, GS 슈퍼마켓)	❍	❍	❍	❍	❍	❍	❍
가족 / 개인 식품 소매점	❍	❍	❍	❍	❍	❍	❍
백화점 슈퍼마켓	❍	❍	❍	❍	❍	❍	❍
대형마트 (예: 이마트, 홈플러스, 코스트코)	❍	❍	❍	❍	❍	❍	❍
기업형 편의점 (예: GS25, CU)	❍	❍	❍	❍	❍	❍	❍
재래시장 / 노점상	❍	❍	❍	❍	❍	❍	❍
인터넷 쇼핑	❍	❍	❍	❍	❍	❍	❍
기타 (적어주십시오)	❍	❍	❍	❍	❍	❍	❍

Q44 계획한 양보다 더 많이 구매하거나 계획하지 않은 식품을 구매할 때, 얼마나 자주 아래의 이유들로 인하여 구매하시는지 말씀해주십시오.

	1	2	3	4	5	6	7
필요한 양보다 더 큰 포장 / 양으로 판매했다	❍	❍	❍	❍	❍	❍	❍
상품 프로모션(예: 1+1, 할인, 포인트 적립)을 이용하고 싶었다	❍	❍	❍	❍	❍	❍	❍
진짜 맛있게 보였다 / 맛있는 냄새가 났다	❍	❍	❍	❍	❍	❍	❍
갑자기 새로운 식품을 먹어 보고 싶었다	❍	❍	❍	❍	❍	❍	❍
원래 필요했지만 잊고 있었다. 그러나 장을 보면서 기억했다	❍	❍	❍	❍	❍	❍	❍
기타 (적어주십시오)	❍	❍	❍	❍	❍	❍	❍

Q45 귀하는 장을 볼 때 적당한 양을 구매하는지 어떻게 확인할 수 있으십니까?(복수 응답 가능)

- ❑ 양에 대해 확실하지 않는 경우, 덜 구매한다
- ❑ 양에 대해 확실하지 않는 경우, 더 많이 구매한다
- ❑ 양에 대해 확실하지 않은 경우, 오랫동안 보관할 수 있는 식품 (장류, 통조림 등)만 구입한다
- ❑ 아이가 식품을 사 달라고 조르는 것을 피하기 위해 아이들 없이 장을 본다
- ❑ 이전의 경험에 의해서 결정한다
- ❑ 판매하는 포장 크기를 바탕으로 결정한다
- ❑ 필요한 양 만큼만 구입하기 위해 갯수 또는 무게로 판매하는 식품만 구매한다
- ❑ 장 보는 동안 배가 고파지는 것을 피하기 위해 식사한 후에만 장을 보러간다
- ❑ 구매하는 양을 결정하기위한 특별한 방법이 없다
- ❑ 다른 방법 (설명해주십시오) _____

Q46 지난 3 개 월동안, 아래 장소에 장 보러 가실 때, 어떤 이동 수단을 주로 이용하시는지 말씀해주십시오.

	대중교통	자동차	도보	자전거 / 오토바이 / 스쿠터	택시	기타	해당 없음
기업형 슈퍼마켓 (예: 홈플러스 익스프레스, GS 슈퍼마켓)	❍	❍	❍	❍	❍	❍	❍
가족 / 개인 식품 소매점	❍	❍	❍	❍	❍	❍	❍
백화점 슈퍼마켓	❍	❍	❍	❍	❍	❍	❍
대형마트 (예: 이마트, 홈플러스, 코스트코)	❍	❍	❍	❍	❍	❍	❍
기업형 편의점 (예: GS25, CU)	❍	❍	❍	❍	❍	❍	❍
재래시장 / 노점상	❍	❍	❍	❍	❍	❍	❍
인터넷 쇼핑	❍	❍	❍	❍	❍	❍	❍
기타 (적어주십시오)	❍	❍	❍	❍	❍	❍	❍

Q47 귀하의 댁에서 아래 장 보는 목적지까지 소요되는 시간을 말씀해주십시오 (편도 기준).

	10 분 이하	10-15 분	16-30 분	31-45 분	46-60 분	60 분 이상	해당 없음
기업형 슈퍼마켓 (예: 홈플러스 익스프레스, GS 슈퍼마켓)	❍	❍	❍	❍	❍	❍	❍
가족 / 개인 식품 소매점	❍	❍	❍	❍	❍	❍	❍
백화점 슈퍼마켓	❍	❍	❍	❍	❍	❍	❍
대형마트 (예: 이마트, 홈플러스, 코스트코)	❍	❍	❍	❍	❍	❍	❍
기업형 편의점 (예: GS25, CU)	❍	❍	❍	❍	❍	❍	❍
재래시장 / 노점상	❍	❍	❍	❍	❍	❍	❍
인터넷 쇼핑	❍	❍	❍	❍	❍	❍	❍
기타 (적어주십시오)	❍	❍	❍	❍	❍	❍	❍

Q48 식품 도•소매 상점에서 구입하신 식품을 귀하의 댁까지 배송 시키십니까?(인터넷 쇼핑으로 구매하시는 경우는 포함하지마십시오.)

- ❍ 배송 서비스가 없기 때문에 이용하지 않는다
- ❍ 배송 서비스가 있지만 이용하지 않는다
- ❍ 구매한 양에 상관 없이 배송 서비스를 이용한다
- ❍ 무거운 식품을 (예: 생수, 쌀) 구입하는 경우에만 이용한다
- ❍ 기타 (설명해주십시오) _____

Q49 신선한 식품이 급하게 필요한 경우, 그 식품을 구입하기 위해 귀하의 가정 근처에 걸어 갈 수 있는 식품점이 있습니까?

- ❍ 네
- ❍ 아니오
- ❍ 모름

Q50 귀하 동네에서 쓰는 음식물 쓰레기 종량제 방식은 무엇입니까?

- ❍ RFID 기기 종량제
- ❍ 전용 음식물 쓰레기 종량제 봉투
- ❍ 납부 필증(스티커/칩) 부착 방식
- ❍ 공동주택 거주하며, 매월 일정 금액 지불
- ❍ 우리가 음식물 쓰레기 배출 요금 필요 없음
- ❍ 모름

Q51 지난 3 개월 간 가정에서 배출된 음식물 쓰레기에 대해 생각해 보십시오. RFID 방식으로 음식물 쓰레기를 버릴 때마다 평균적으로 지불하는 요금과 버리는 횟수를 알려주십시오. 버릴 때마다 지불하는 요금을 적어주시고, 단위가 매주 또는 매월인지 알려주십시오.(지불하신 요금은 보통 아파트 단지에서 받으신 관리비 고지서에서 확인할 수 있습니다.)

	횟수		요금
	매주	매월	(원)
지불하는 배출 요금과 횟수를 적어주십시오	❍	❍	

Q52 지난 3 개월 가정에서 배출되는 음식물 쓰레기에 대해 생각해 보십시오. 평균적으로 매주 또는 매월 음식물 쓰레기가 가득한 전용 종량제 봉투를 몇 개 버리십니까? 버리시는 봉투의 용량과 개수를 적어주시고, 단위가 매주 또는 매월인지 알려주십시오.

	봉투 정보		횟수	
	용량 (L)	개수	매주	매월
용량, 개수 와 횟수를 적어주십시오			❍	❍

Q53 지난 3 개월 가정에서 배출되는 음식물 쓰레기에 대해 생각해 보십시오. 평균적으로 매주/매월 몇 개의 음식물 쓰레기 납부 스티커/칩을 사용하십니까?사용하시는 납부 스티커/칩들의 납부된 용량과 개수를 적어주시고, 단위가 매주 또는 매월인지 알려주십시오.

	납부 스티커/칩 정보		횟수	
	용량(L)	개수	매주	매월
용량, 개수 와 횟수를 적어주십시오			❍	❍

Q54 음식물 쓰레기를 버리기 위해 매월 아파트 단지에 지불하는 일정 금액은 얼마입니까?(지불하시는 요금은 보통 아파트 단지에서 받으신 관리비 고지서에서 확인할 수 있습니다.)

❍ 금액 (원) _____

❍ 모름

Q55 지난 3 개월 간 가정에서 배출되는 음식물 쓰레기에 대해 생각해 보십시오. 평균적으로 매주/매월 음식물 쓰레기가 가득한 봉투를 몇 개 버리십니까? 버리시는 봉투들의 용량과 개수를 작성해주시고, 단위가 매주 또는 매월인지 알려주십시오.

	봉투 정보		횟수	
	용량 (L)	개수	매주	매월
용량, 개수 와 횟수를 적어주십시오			❍	❍

Q56 음식물 쓰레기 수거 담당 업체는 매주 몇 번 음식물 쓰레기 수거하는 것입니까?

- ❍ 매주 한 번 미만
- ❍ 1 번
- ❍ 2 번
- ❍ 3 번
- ❍ 4 번
- ❍ 5 번
- ❍ 6 번
- ❍ 7 번
- ❍ 7 번 이상
- ❍ 모름

Q57 지난 3 개월 간 귀하 가정에서 버리게되는 음식 중에 원래 먹을 수 있는 상태와 원래 먹을 수 없는 상태의 비율(%)을 알려주십시오. 원래 먹을 수 있는 음식물 쓰레기: 상함 / 유통기한 지남 / 맛이 없음 / 남음 등 때문에 버리게 되는 음식 원래 먹을 수 없는 음식물 쓰레기: 원래 못 먹는 부분, 예: 뼈, 껍질, 시앗, 등 합계는 100% 이어야 합니다.

_____ 원래 먹을 수 있는 음식물 쓰레기 (%)

_____ 원래 먹을 수 없는 음식물 쓰레기 (%)

Q58 지난 3 개월 동안 음식을 버리게 된 경우에 대해 생각해보십시오. 아래 종류의 음식을 얼마나 자주 버리는 지 알려주십시오. 원래 먹을 수 없는 부분을 포함하지 마십시오.예: 식사 후에 고기 뼈를 버렸으면, "부분적으로 사용된 식품" 또는 "남는 조리된 음식"에 포함하지 마십시오.

	1	2	3	4	5	6	7
사용하지 않은 / 개봉하지 않은 식품	❍	❍	❍	❍	❍	❍	❍
개봉된 / 부분적으로 사용된 식품	❍	❍	❍	❍	❍	❍	❍
숫자 "6" 을 선택해주십시오	❍	❍	❍	❍	❍	❍	❍
식사 후 바로 버리는 조리된 음식	❍	❍	❍	❍	❍	❍	❍
조리된지 며칠 후에 버리는 조리된 음식	❍	❍	❍	❍	❍	❍	❍

Q59 지난 3 개월동안 귀하는 평균적으로 매주 몇 번 음식물 쓰레기를 버리십니까?

- ❍ 매주 한 번 미만
- ❍ 1 번
- ❍ 2 번
- ❍ 3 번
- ❍ 4 번
- ❍ 5 번
- ❍ 6 번
- ❍ 7 번
- ❍ 7 번 이상
- ❍ 모름

Q60 지난 3 개월 동안 음식을 버렸던 경우에 대해 생각해보십시오. 얼마나 자주 아래 이유로 음식을 버리셨습니까?

	1	2	3	4	5	6	7
너무 많은 양을 준비하거나 요리했다	❍	❍	❍	❍	❍	❍	❍
너무 많은 양을 구매했다	❍	❍	❍	❍	❍	❍	❍
맛이 없었다	❍	❍	❍	❍	❍	❍	❍
음식 상태가 좋지 않게 보였다 (그러나 곰팡이 피지 않았다)	❍	❍	❍	❍	❍	❍	❍
먹으면 안전하지 않을 거라고 생각했다 (그러나 곰팡이 피지 않았다)	❍	❍	❍	❍	❍	❍	❍
곰팡이가 폈다 / 상했다	❍	❍	❍	❍	❍	❍	❍
유통기한 지났다	❍	❍	❍	❍	❍	❍	❍
기타 (적어주십시오)	❍	❍	❍	❍	❍	❍	❍

Q61 귀하는 음식을 섭취하기에 안전하지 않다고 걱정 / 곰팡이 피거나 상함 / 유통기한이 지난 이유로 음식물을 버렸다고 말씀하셨습니다.이런 경우는 얼마나 자주 아래와 같은 이유로 발생했는지 알려주십시오.

	1	2	3	4	5	6	7
그 식품이 있었는 지 잊었다 (예: 냉장고 맨 뒤에 숨어있었다)	❍	❍	❍	❍	❍	❍	❍
그냥 먹고 싶지 않았었다	❍	❍	❍	❍	❍	❍	❍
요리하거나 먹을 시간이 없었다	❍	❍	❍	❍	❍	❍	❍
작은 양을 필요로 했지만 그보다 더 많이 구매해야 했다 (예: 포장 크기 때문에)	❍	❍	❍	❍	❍	❍	❍
상품 프로모션 때문에 너무 많은 양을 구매했다 (예: 1+1, 할인, 등)	❍	❍	❍	❍	❍	❍	❍
다른 이유로 많은 양을 구매했다	❍	❍	❍	❍	❍	❍	❍
기타 (적어주십시오)	❍	❍	❍	❍	❍	❍	❍

Q62 지난 3 개월 동안, 귀하는 냉장고, 찬장과 기타 음식을 보관하시는 곳을 얼마나 자주 정리하거나 청소하셨습니까?

- ❍ 없음
- ❍ 매월 한 번 미만
- ❍ 매월 한 번
- ❍ 매월 2-3 번
- ❍ 매주 한 번
- ❍ 매주 2-3 번
- ❍ 매일

Q63 가정에서 정기적으로 식사하는 식구들은 (귀하 포함) 아래의 상황에 음식을 먹을 거라고 생각하십니까?

	없음	몇 명	모두
맛/냄새/모습이 괜찮다면 냉장고에 며칠동안 들어있는 남은 음식 먹기	❍	❍	❍
맛/냄새/모습이 괜찮다면 유통 기한 날짜에 식품을 먹기	❍	❍	❍
맛/냄새/모습이 괜찮다면 유통 기한이 며칠 지난 식품을 먹기	❍	❍	❍
맛/냄새/모습이 괜찮다면 유통기한이 일주일 지난 식품을 먹기	❍	❍	❍
맛/냄새/모습이 괜찮다면 유통기한이 지난 시간에 상관없이 먹기	❍	❍	❍

Q64 음식물 쓰레기를 종량제 시스템으로 버리는 것 이외에 아래의 음식물 쓰레기에 괜한 행동을 하시는 지 알려주십시오.(복수응답 가능)

- ❑ 음식물 쓰레기 건조기를 사용하기
- ❑ 음식물 쓰레기를 비료로 사용하여 논밭에 주기
- ❑ 음식물 쓰레기를 비료로 사용하여 화분에 주기
- ❑ 음식물 쓰레기를 변기에 넣고 물 내리기
- ❑ 음식물 쓰레기를 싱크대에 붓기
- ❑ 싱크대에서 설치되는 음식물 쓰리기 처리기로 음식물 쓰레기를 갈아버리기
- ❑ 위에 것들 중 아무것도 없다

Q65 아래 서술을 읽고, 동의하시는 정도를 말씀해주십시오.

	1	2	3	4	5	6	7
가정에서 버리는 음식에 대해 항상 의식하고 있다	❍	❍	❍	❍	❍	❍	❍
가정에서 버리는 음식을 줄이기 위해 더 많이 노력할 수 있다	❍	❍	❍	❍	❍	❍	❍
음식을 버리는 것은 나와 상관없는 문제이다	❍	❍	❍	❍	❍	❍	❍

Q66 아래 서술을 읽고, 동의하시는 정도를 말씀해주십시오.

	1	2	3	4	5	6	7
음식을 버리는 것은 도덕적으로 괜찮다	❍	❍	❍	❍	❍	❍	❍
음식을 버리는 것은 환경에 나쁜 영향을 미친다	❍	❍	❍	❍	❍	❍	❍
음식을 버리는 것은 사회적으로 용인할 수 있다	❍	❍	❍	❍	❍	❍	❍
음식을 버리는 것은 돈을 낭비하는 것이다	❍	❍	❍	❍	❍	❍	❍
음식을 버리는 것은 본질적으로 나쁜 것은 아니다.	❍	❍	❍	❍	❍	❍	❍

Q67 저희는 음식물 쓰레기 배출하는 경우에 대해 더 연구하기 위하여 음식물 쓰레기 일기조사 참여자들 모집합니다. 일기조사에 참여하신다면 귀하가 제공하는 소중한 정보를 통하여 한국과 다른 나라들의 음식물 쓰레기가 환경, 사회, 경제적인 영향을 감소시키는데 도움이 될 것 입니다. 일기조사는 일주일동안 가정에서 배출하는 음식물 쓰레기에 대한 정보를 작성하는 것이며 일주일간 참여하시는 경우, AIP 의 이포인트

(Epoints) 시스템으로 40,000 원 상당의 보상을 사례로 받으실 것 입니다. 참여하실 의향이 있으시고 참여 정보를 받으시고 싶은 경우에 아래 "네"라고 응답하시기 바랍니다. 더 자세한 정보를 드리고 귀하의 참여를 다시 확인하기 위해 연락을 드리겠습니다. 귀하의 일기조사 참여는 전적으로 자발적인 것입니다. 귀하가 일기조사에 참여하지 않아도 귀하에게 어떠한 불이익도 없을 것입니다.

❍ 네

❍ 아니오

Q68 일기조사에 참여하고 싶지 않으신 이유는 무엇입니까?(중복 응답 가능)

❑ 바쁘고 시간이 부족하다

❑ 시간이 부족하지 않았지만 일기조사에 참여하는 것은 너무 부담스러울 것 같다

❑ 보상금액이 부족하다

❑ 음식물 쓰레기가 너무 더럽다 / 징그럽다

❑ 가정에서 음식을 거의 버리지 않는다

❑ 기타 (설명해주십시오) _____

Q69 귀하의 교육수준 어떻게 되십니까?

❍ 중학교 이하

❍ 고등학교

❍ 대학교

❍ 대학원 (석사 / 박사)

❍ 대답하고 싶지 않음

Q70 귀하 가정의 월평균 소득 금액에 대해 말씀해주십시오.

- ❍ 100 만원 이하
- ❍ 100 – 199 만원
- ❍ 200 – 299 만원
- ❍ 300 – 399 만원
- ❍ 400 – 499 만원
- ❍ 500 만원 이상
- ❍ 대답하고 싶지 않음

Q71 귀하는 경제적으로 독립하셨습니까? (즉, 부모님이나 다른 사람들에게 재정지원을 받지 않음)

- ❍ 네
- ❍ 아니오
- ❍ 대답하고 싶지 않음

Q72 귀하에게 재정지원을 하는 가족구성원들의 월평균 소득 금액에 대해 말씀해주십시오.

- ❍ 100 만원 이하
- ❍ 100 – 199 만원
- ❍ 200 – 299 만원
- ❍ 300 – 399 만원
- ❍ 400 – 499 만원
- ❍ 500 만원 이상
- ❍ 대답하고 싶지 않음
- ❍ 모름

Appendix B – Household diary instruments

B.1 Household diary instrument (English translation)

Seoul Household Food and Drink Waste Diary Study 2015

Study period:

6/26 (Thu) – 7/1 (Wed)

Instruction calls:

6/22 (Mon) – 6/24 (Wed)

Please do not start filling in the diary until after we call you to provide instructions

Please return the completed diary to us using the provided envelope in order to claim your reward

Welcome to your household's food and drink waste diary

Please Read!
Please read these tips and advice carefully as they will help you complete the diary.

First of all, thank you once again for agreeing to take part in this research project, which is being carried out with support from the Center for Korean Studies at the University of California, Berkeley, USA.

This research will help us understand what types of food and drink are thrown away and why.

We hope that you will help us by filling the diary in as fully as possible for everything you throw away, no matter what it is or how much.

Included in your pack there is also a measuring jug for estimating the food or drink waste; this is yours to keep and use after the week.

It's really important that you write down all the food and drink that is thrown away:

- by all the people in your household;
- no matter what it is - even if it is food which normally is not eaten, such as vegetable peelings, bones, leftover stew, or kimchi water;
- no matter what the reason is for throwing it away;
- no matter how much or how little is being thrown away;
- in your home only (so not what you throw away at school, work or in a restaurant);
- not only food waste as required by your district government, but also any food or drink waste that you throw into other waste streams, down the sink or drain, or fed to birds or other animals

If it ended up in one of these, we need to know about it!					
					
Sticker-chip disposal	RFID food waste machine	Volume-rate plastic bag / other food waste disposal	General waste stream	Down the sink	Fed to animals

Some do's:

- Start your diary on 6/25 (Thu) and finish it on 7/1 (Mon). Please make sure to observe these dates (don't start the diary early!)
- Do what you would normally; so if you normally clear out your fridge or cupboards after a weekly shopping trip or when housekeeping, carry on as usual and record these items in the diary.
- Remember, no-one is judging what your household throws away so don't worry that you're throwing away too much.
- If anything unusual occurs - for example, if you had a party or were ill – please provide details in the 'daily comments and thoughts' table.
- Describe the waste as fully as possible, filling in all of the required boxes on each row.
- Where there is a mixture, state the ingredients as fully as possible, e.g. "Beef curry: potatoes, carrots, onions, Moguchon brand ham, beef brisket, 1 packet of Ottogi brand curry" or "Instant Maxim-brand black coffee with two teaspoons of brown sugar."
- If you throw away uneaten food from a delivery or takeaway meal in your household waste please record this. However, do not record any food or drink waste disposed of outside of the home for example, at school, work or in a restaurant.
- If any member of your household does grocery shopping on any day, please record the approximate amount spent. Please do not include any purchases of food or drink consumed outside of the home (such as a morning takeaway pastry or a lunchtime salad at work).
- If there are days when there is no food waste to record, tick one of the reasons at the top of the page. Don't leave any pages blank.
- Use the extra tables at the end of this booklet if you run out of space.
- If the item was bought for human consumption but then fed to a pet or wildlife, please record it. Don't include food purchased with the intention of being fed to animals, such as pet food.
- It is best to record the waste as it occurs, although you or other household members may occasionally find it useful to put aside your waste until you can record it in the diary.

And some don’ts:

Don’t record any food or drink waste disposed of outside of the home for example, at school, work or in a restaurant.

Don’t include food purchased with the intention of being fed to animals, such as pet food.

Don’t leave any pages blank. Instead, tick one of the reasons at the top of the page if there is nothing to record that day.

How to measure the amount of food and drink waste that is thrown away

It is really important that the amount of waste thrown away is recorded as accurately as possible:

- Do not include any packaging or containers that the food or drink is in when weighing it.
- Use the measuring jug to help you, or use your own scales or other measuring containers.
- Remember to write in the unit that you’re using, e.g.
    - Liter (L) / milliliter (mL)
    - Gram (g) / kilogram (kg)
    - Number of items (e.g. 1 *tong*, 2 *mari,* 3 *sohn*, etc.)
    - Teaspoon, table spoon
    - Flat handful, heaped handful
    - Cup, tumbler, wine glass, bowl

Volume (ml, liters)

Weight (g, kg)

A tablespoon

A heaped handful

Number (1 apple)

We need to know about it all!

There might be occasions when you think that that little bit of chili paste in the bottom of the tub is not worth recording. However, it adds up to a lot of chili paste if everyone in Seoul throws away a little bit. Please make sure you write down everything that is thrown away, otherwise our results will not be accurate.

Where you originally got your food and drink matters to us

Please do your best to recall where you originally got the food or drink that you are throwing away.

Where your food might have come from:	
Chain / department store supermarket	• Corporate-owned, chain super-supermarkets (SSM) (e.g. Homeplus Express, Emart Everyday, Lotte Super, GS Supermarket) • Supermarkets located in department stores (e.g. Hyundai, Shinsegae, Lotte Department Store)
Hypermarket	Stores larger than supermarkets and selling a large variety of products (e.g. Homeplus, Emart, LotteMart, Costco, Hanaro Club)
Family / independently owned grocery store	• Grocery stores that are not owned by large corporations (usually located in residential neighborhoods)
Convenience store (corporate owned)	Corporate-owned chain convenience stores (e.g. MiniStop, GS25, CU)
Traditional market / roadside stalls	• Vendors in traditional market complexes (e.g. Yongdeungpo market, Gwangjang market, Garak market) • Temporary stalls by the roadside or in apartment complex • Mobile fruit and vegetable vendors
Restaurant / takeaway / delivery	Select this option any time you brought home leftovers, ordered takeaway, or had a meal delivered
Internet shopping / virtual store	Includes any food you ordered online or via a smartphone that was delivered to your home
Other	Select this option if your food came from somewhere not mentioned on this list. Examples might include: • Food received from in-laws • Food purchased or picked directly on farms • Food you grew yourself

Important!

Please fill out the diary according to the above guidelines to the best of your ability.
We reserve the right to withhold or only provide partial compensation if your diary entries are incomplete.

For example—if you write a description but do not provide other information about quantity, where it was bought, etc., or if you leave a page blank without checking any of the boxes at the top of the page.

Thank you for your help!

At the end of the week, please return the entire booklet using the prepaid envelope provided (no stamps needed) **by 7/5** to the following address:

[redacted]

Once our research team has verified that your diary has been received and been completed according to the guidelines in this booklet, you will receive your compensation via AIP's Epoints system to say thank you for your time and efforts. If you are unsure about anything at all, please call our research team at [redacted] and we will be pleased to help.

You and your household will not be identified by this research and all your responses will be kept confidential and only shared anonymously. No-one else will contact you as a result of the information that you provide in this diary.

Example of Completed Entries

1. Morning Meal

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal. Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	
Steamed Egg custard	4 eggshells			✓						Can't eat eggshells
Cabbage Kimchi	Small piece of cabbage and 25g of radish					✓				My husband was late for work and didn't have time to eat it all
Stir-fried anchovies with green chili peppers	35g								✓	I served too much
White rice with multi grains	150g	✓								My son accidentally knocked a bowl of rice onto the floor
Apples, Nonghyup washed Hongro	2 cores		✓							Can't eat the core
Cereal (Special K Berries) + Low fat milk, Maeil	Milk 100ml				✓					My son doesn't like drinking the leftover milk from cereal

Need help? Call our research team at [redacted]

Example of Completed Entries

2. Midday Meal

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☑ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal. Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	
Everyone at work or school										

Need help? Call our research team at [redacted]

Example of Completed Entries

3. Evening Meal

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal. Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	
Bean paste soup with bean paste, potatoes, chili peppers, onions, zucchini, and tofu	30g of chili peppers, onions					✓				We normally don't eat the solid leftover ingredients from miso soup
Rind from pork belly barbeque	55g		✓							We are trying to eat less fat and not eat burnt meat
White rice with brown rice	50g	✓								I served too much, usually when we have BBQ, we eat small portion of rice
Cabbage Kimchi	110g cabbage and 80g radish					✓				My husband and son don't like eating shredded radish kimchi
Tuna Kimbap	50g						✓			My son bought as a snack on his way home from school but didn't finish it

Need help? Call our research team at [redacted]

Example of Completed Entries

4. All other food/drink waste

(e.g. from clearing out cupboards/fridge/freezer or from snacks)

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal. Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	
Tofu (Pulmuone, Firm tofu)	300g container		✓							Past its use-by date
Hidden Valley's Ranch dressing	1/2 jar						✓			I was cleaning out my fridge to put away today's shopping. It was separated and congealed as the lid wasn't put on properly
Small pumpkin	1/2 *tong*				✓					Growing mold at the back of the fridge
Boiled beansprouts	30g	✓								Leftovers from last week, not sure if still safe to eat or not.
Fried anchovies	250g							✓		Forgotten after Thanksgiving. Not sure if safe to eat or not.

Daily comments and thoughts

Please tell us about any unusual circumstances today or your thoughts on food and drink waste

We had more than waste than usual today because I cleared out the fridge and cupboards. Also I wasn't originally planning on making pork belly BBQ, but both my husband and son really felt like it tonight. I had already cooked the rice otherwise I wouldn't have made so much.

Any household food or drink shopping today?

Please write in an approximate amount spent on groceries today. Exclude food and drink purchased for consumption while at work, school or out and about.

Amount spent: **KRW** 67,000

These example pages are here to show you the level of detail we would like to know. It's important that you give as much detail as possible, especially for the amounts.

Need help? Call our research team at [redacted]

DAY 1 **1. Morning Meal**

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal. Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

DAY 1

2. Midday Meal

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

DAY 1

3. Evening Meal

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal. Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

DAY 1

4. All other food/drink waste

(e.g. from clearing out cupboards/fridge/freezer or from snacks)

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Daily comments and thoughts

Please tell us about any unusual circumstances today or your thoughts on food and drink waste

Any household food or drink shopping today?

Please write in an approximate amount spent on groceries today. Exclude food and drink purchased for consumption while at work, school or out and about.

Amount spent: **KRW**

Even things you can't eat?

Yes. Teabags, banana skins, fish bones - we want to know about it all!

Need help? Call our research team at [redacted]

DAY 2 **1. Morning Meal**

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal. Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

DAY 2 **2. Midday Meal**

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

DAY 2 **3. Evening Meal**

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal. Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

DAY 2

4. All other food/drink waste

(e.g. from clearing out cupboards/fridge/freezer or from snacks)

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Daily comments and thoughts

Please tell us about any unusual circumstances today or your thoughts on food and drink waste

Any household food or drink shopping today?

Please write in an approximate amount spent on groceries today. Exclude food and drink purchased for consumption while at work, school or out and about.

Amount spent: **KRW**

Remember to write it down!

It may only be two pieces, but if everyone in Seoul throws them out, that's a lot of prawn crackers!

Need help? Call our research team at [redacted]

DAY 3 **1. Morning Meal**

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

DAY 3

2. Midday Meal

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

DAY 3 **3. Evening Meal**

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal. Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

DAY 3

4. All other food/drink waste

(e.g. from clearing out cupboards/fridge/freezer or from snacks)

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Daily comments and thoughts

Please tell us about any unusual circumstances today or your thoughts on food and drink waste

Any household food or drink shopping today?

Please write in an approximate amount spent on groceries today. Exclude food and drink purchased for consumption while at work, school or out and about.

Amount spent: **KRW**

If they ate it, we need to know!

Need help? Call our research team at [redacted]

DAY 4 **1. Morning Meal**

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

DAY 4 **2. Midday Meal**

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

DAY 4 **3. Evening Meal**

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

DAY 4

4. All other food/drink waste

(e.g. from clearing out cupboards/fridge/freezer or from snacks)

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Daily comments and thoughts

Please tell us about any unusual circumstances today or your thoughts on food and drink waste

Any household food or drink shopping today?

Please write in an approximate amount spent on groceries today. Exclude food and drink purchased for consumption while at work, school or out and about.

Amount spent: **KRW**

Don't forget the drinks!

Need help? Call our research team at [redacted]

DAY 5 **1. Morning Meal**

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

DAY 5 **2. Midday Meal**

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

DAY 5 **3. Evening Meal**

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

DAY 5

4. All other food/drink waste

(e.g. from clearing out cupboards/fridge/freezer or from snacks)

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Daily comments and thoughts

Please tell us about any unusual circumstances today or your thoughts on food and drink waste

Any household food or drink shopping today?

Please write in an approximate amount spent on groceries today. Exclude food and drink purchased for consumption while at work, school or out and about.

Amount spent: **KRW**

Every crumb of detail!

Completeness and accuracy is vital if we are to build a complete picture of food and drink waste in Seoul.

Need help? Call our research team at [redacted]

DAY 6 **1. Morning Meal**

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal. Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

DAY 6 **2. Midday Meal**

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

DAY 6 **3. Evening Meal**

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal. Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

DAY 6

4. All other food/drink waste

(e.g. from clearing out cupboards/fridge/freezer or from snacks)

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Daily comments and thoughts

Please tell us about any unusual circumstances today or your thoughts on food and drink waste

Any household food or drink shopping today?

Please write in an approximate amount spent on groceries today. Exclude food and drink purchased for consumption while at work, school or out and about.

Amount spent: **KRW**

How will you…

…spend your shopping vouchers?

Need help? Call our research team at [redacted]

DAY 7 **1. Morning Meal**

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal. Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

DAY 7 **2. Midday Meal**

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

DAY 7 **3. Evening Meal**

If no food or drink waste, please say why: All food consumed: ☐ Meal not eaten at home: ☐ Other (write in):

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal. Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

DAY 7

4. All other food/drink waste

(e.g. from clearing out cupboards/fridge/freezer or from snacks)

What was wasted? Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
		Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Daily comments and thoughts

Please tell us about any unusual circumstances today or your thoughts on food and drink waste

Any household food or drink shopping today?

Please write in an approximate amount spent on groceries today. Exclude food and drink purchased for consumption while at work, school or out and about.

Amount spent: **KRW**

Thank you!

You're all done. All that's left to do now is to send us your diary in the prepaid envelope provided - more details are on the back cover. Why not take a moment to check back over your diary to see if there's anything you missed?

Need help? Call our research team at [redacted]

Overflow pages

Please use this sheet to record anything you didn't have space for

Date? Which day did you throw away this food or drink waste on?	**What was wasted?** Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal. Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
			Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

Overflow pages **Please use this sheet to record anything you didn't have space for**

Date? Which day did you throw away this food or drink waste on?	**What was wasted?** Please give a full description of the food or drink waste. (If you run out of space you can use the overflow pages at the back of the diary)	**How much was wasted?** What was the weight, volume, number or amount?	**Where did it come from?** Please tell us what kind of store you originally bought or received the food/ingredients from (mark with a ✓)								**Why was it thrown away?** Please give the reason for disposal Some possible answers may be: Bought too much, pack too big, went off it, passed use-by date, cooked/served too much, didn't taste nice, didn't feel like it, other (write in)
			Chain / department store supermarket	Hypermarket	Family owned/ independent grocery store	Convenience store	Traditional market / roadside stall	Restaurant / take-out / delivery	Internet shopping	Other (e.g. in-laws)	

Need help? Call our research team at [redacted]

Thank you for your time!

Please be sure to return the completed diary promptly to the following address using the prepaid envelope provided:

[redacted]

Berkeley
UNIVERSITY OF CALIFORNIA

B.2 Household diary instrument (Korean translation)

서울 가정 음식물 쓰레기
일기조사 2015

조사 기간:

6 월 25 일 (목) – 7 월 1 일 (수)

작성안내전화:

6 월 22 일 (월)- 6 월 24 일(수)

안내전화로 설명을 들으신 후 작성해 주세요.

작성이 끝난 일기책자를 동봉된 봉투에 넣어
보내 주셔야 포인트가 지급됩니다.

귀하 가정의 음식물 쓰레기 일기조사에 참여하시게 되어 환영합니다

읽어 주세요!

여기에 써있는 조언과 안내는 일기를 작성하실 때 도움이 될 것 입니다. 꼼꼼히 읽어주십시오.

미국 캘리포니아 버클리 대학교 한국학 연구소가 지원하는 연구에 참여해주셔서 감사합니다.

이 연구는 가정에서 어떤 종류의 식품과 음료가 쓰레기로 배출되는지 또한 왜 버리는 지 이해하는 데 많은 도움이 될 것입니다.

귀하가 아주 적은 양의 식품을 버리는 경우가 있더라도 작성 부탁 드립니다. 매일 버리는 식품과 음료에 대해 가능한 자세히 작성 부탁 드립니다.

버리게 되는 식품 양을 측정하기 위해 계량컵을 일기책자와 함께 동봉했습니다. 이 계량컵은 일기 작성이 완료된 후에도 댁에서 사용하시기 바랍니다.

본 일기 작성과 관련하여, 작성기간 전에 안내전화를 드립니다. 안내전화로 주의 사항을 모두 들으신 후에, 작성기간을 엄수하여 기록하여 주십시오.

귀하가 버리는 모든 식품과 음료에 대해 작성하시는 것은 매우 중요합니다:

- 귀하의 가정에서 모든 가족 구성원들이 버리는 것;
- 평소 섭취하지 않는 것들도 포함 예: 채소 및 과일껍질, 뼈, 먹다 남은 국물, 김치 국물 등처럼 보통 안 먹는 것;
- 어떤 이유로든 버리는 모든 음식물;
- 버리는 양에 상관없이 (아주 적거나 많은) 배출한 모든 음식물;
- 귀하 가정에서만 버리는 모든 음식물 (학교, 직장, 음식점에서 버리는 음식물 제외);
- 귀하가 거주하는 지역에서 수거하는 음식물 쓰레기 뿐만 아니라 다른 방법(일반 쓰레기, 싱크대 배수구 등)으로 버리는 식품과 음료 및 원래 가족들이 먹으려고 구입/요리했지만 애완동물에게 준 식품

이 아래 중에 하나 이상 이용하여 버리고 계신 것들을 저희는 반드시 알아야 합니다!					
					
납부 칩/스티커 종량제 방식	RFID 종량제 시스템	음식물 쓰레기 종량제 전용봉투 / 다른 음식물 쓰레기 배출 방식	일반 쓰레기	싱크대/ 배수구/변기	동물 / 식물

작성 기간 동안 해야 할 것:

- 일기를 정확하게 6 월 25 일(목)부터 작성을 시작해주시고 7 월 1 일(수) 에 끝내주십시오. 작성기간을 엄수해 주십시오 (작성기간 전에 미리 작성하지 말아주세요!)
- 평소와 똑같이 해주십시오. 예를 들어서 장을 본 후 또는 집 정리를 한 다음 보통 냉장고나 찬장을 청소하신다면 평소와 같이 하시고, 청소하고 버리게 된 식품 또는 음료에 대해 일기에서 작성해주십시오.
- 귀하 가정이 무엇을, 얼마나 버리는 지 아무도 판단하지 않습니다. 그러니 버리는 식품 양이 너무 많은지, 조금 버리는 지 걱정하지 마십시오.
- 만약 특별한 상황 (집에서 파티 또는 아파서 집안일 못함)이발생하는 경우 일기의 “오늘의 의견 및 특이 사항”란에 구체적으로 적어주십시오.
- 버리게 되는 식품에 대해 가능한 구체적으로 묘사해주시고, 각 빈 칸에 빠짐없이 작성해주십시오.
- 혼합물을 버리시는 경우, 모든 재료에 대해 최대한 구체적으로 적어주십시오. 예: “쇠고기 카레: 감자, 당근, 양파, 목우촌 햄, 쇠고기 양지, 오뚜기 백세카레 1 봉지” 또는 “맥심 블랙커피 한잔과 황설탕 2 티스푼.” 예시처럼 구체적으로 적어주신다면 저희는 버리는 음식물에 대해 더욱 잘 이해할 수 있을 것입니다.
- 만약 배달 또는 포장 음식 중에 남은 음식물을 버리는 경우, 일기에 작성해주십시오. 그러나 가정 이외에 학교, 직장, 식당 또는 기타 가정이 아닌 곳에서 버린 음식물에 대해서는 작성하지 마십시오.

귀하를 비롯한 가족구성원들이 언제든 장을 볼 때마다 그 지출비용을 적어주십시오. 그러나 가정 밖에서 구입하고, 외부에서 소비한 식품 또는 음료를 (예: 아침식사를 위해 출근길에 구입한 빵 또는 점심으로 먹은 샐러드) 포함하지 마십시오.

어떠한 식품도 버리지 않은 날이 있었다면, 그 페이지 맨 위에 있는 이유들 중에 하나 골라주십시오. 빈 페이지를 남기지 마십시오.

만약 제공해드린 일기 페이지가 부족한 경우, 이 책자의 뒷부분에 추가로 제공하는 일기표에 작성해주십시오.

원래 가족들이 먹으려고 구입/요리했지만 애완동물에게 준 식품에 대해 일기에 적어주십시오. 그러나 애완동물 사료 또는 애완동물을 위해 구입한 식품에 대해서는 작성하지 마십시오.

식품을 버리게 될 때마다 곧바로 일기를 작성하는 것이 가장 좋은 방법입니다. 그렇지만 귀하 또는 가족들이 일기를 작성할 때까지 잠시동안 다른 버리게 되는 식품과 분리하여 보관하시는 것도 일기 작성에 도움이 될 수 있습니다.

작성 기간동안 하지 말아야 할 것:

가정 이외에 학교, 직장, 식당 또는 기타 가정이 아닌 곳에서 버린 음식물에 대해서는 작성하지 마십시오.

애완동물 사료 또는 애완동물을 위해 구입한 식품은 기재하지 마십시오.

빈 페이지로 남겨두지 마십시오. 만약 작성하실 내용이 없다면 그 날의 일기 작성 페이지 상단에 있는 이유들 (“다 먹었다” 또는 “집에서 안먹었다”) 중에서 하나를 체크해주십시오.

버리는 식품과 음료를 측정하는 방법

귀하가 버리게 되는 식품과 음료를 가능한 정확하게 적어주시는 것은 정말 중요합니다.

- 식품과 음료의 무게를 측정할 때, 포장 또는 용기를 포함하지 마십시오.
- 제공해드리는 계량 컵 또는 갖고 계신 저울, 계량 용기를 사용해 보십시오.
- 사용하신 단위를 기입해주십시오. 하실 수 있는 만큼 그램(g) / 킬로그램 (kg) 또한 다른 무게 단위를 사용해주십시오.

- 그러나, 무게 단위로 측정하기 가능하지 않으신다면 다른 단위로 버리게 되는 식품 양을 추산해주시고 사용해주십시오. 예:
    - 리터 (L) / 밀리리터 (mL)
    - 숫자로 표시 (예: 1 통, 2 마리, 3 손 등)
    - 컵, 와인 잔, 그릇
    - 티스푼, 테이블스푼
    - 한 움큼, 한 줌

용량
(L, mL)

중량
(g, kg)

테이블 스푼

움큼 가득

숫자 (사과 1 개)

저희는 모든 것에 대해 알고 싶습니다!

귀하는 일기를 작성하실 때, “용기 맨 밑에 조금 남아있는 고추장을 적지 않아도 된다” 라고 생각할 수도 있지만, 서울 주민들 모두 고추장을 조금씩 버린다면… 그 고추장 양은 정말 많을 것입니다. 저희 연구 결과를 더 정확하게 하기 위해 귀하 댁에서 버리게 되는 식품 내용을 빠짐없이 모두 작성해주시길 부탁 드립니다.

귀하께서 식품을 어디서 구입하셨는지 저희에게 중요합니다

버리게 되는 음식 또는 음료를 원래 어디서 구입하셨는지 가급적으로 기억해주십시오.

귀하 가정의 식품은 아마 아래 것에서 오는 것입니다	
기업형 슈퍼마켓/ 백화점	• 전국적인 기업형 슈퍼마켓 (또한 SSM), 예) 홈플러스 익스프레스, 이마트 에브리데이, 롯데슈퍼, GS 슈퍼마켓 • 백화점의 식품관, 예) 현대, 신세계, 롯데 백화점
대형마트	슈퍼마켓보다 보통 식품을 비롯하여 온갖 종류의 상품을 파는 큰 기업형 가게, 예) 홈플러스, 이마트, 롯데마트, 하나로 클럽
동네 슈퍼마켓/ 소매점	• 기업이 소유하지 않은 점포 (보통 거주 동네에 있음) • 자영업 미니 슈퍼마켓 또는 소형 가게를 포함
편의점	• 전국적인 편의점, 예) 미니스톱, GS25, CU
재래시장 / 노점상	• 소형 판매점들이 모여있는 전통적인 시장, 예) 영등포시장, 광장시장, 가락시장 • 길거리에 세운 일시적인 판매점
식당 포장 / 배달	이 것은 아래 경우를 포함합니다: • 귀하께서 식당에서 음식을 포장하시는 경우 • 완성된 음식을 배달시키셨을 경우 (인터넷, 전화, 스마트폰어플을로 시키기 포함)
인터넷 / TV 홈쇼핑	이것은 귀하께서 TV, 인터넷 또는 스마트폰으로 주문하고 집으로 배송받은 식품을 포함합니다. • 식사 포장/배달을 포함하지마십시오.
기타	식품은 위의 카테고리에 해당하지 않는 곳에서 왔다면 이것을 체크하세요. 예) • 친정/시댁 등 친척들에게 받으신식품 • 직접 농장에서 따거나 구매하신 식품 • 직접 재배하신 식품

중요합니다!

위의 안내 내용에 따라 최대한 자세하게 일기를 작성해 주십시오. 귀하가 작성하신 일기가 미완성일 경우에는 약속된 포인트가 지급되지 않을 수 있습니다.

예) 귀하가 버린 식품을 묘사하셨지만 다른 정보 (양, 구매하신 장소 등)을 작성하지 않으셨다면 저희는 이것을 미완성된 일기 작성이라고 간주하겠습니다.

도와주셔서 감사합니다!

일주일 간의 일기 작성이 완료된 후, 이 책자를 동봉된 봉투(우표 붙어있음)를 이용하여 7 월 5 일까지 아래 주소로 다시 보내주십시오.

[redacted]

저희 연구팀은 귀하의 일기를 받고 위에 설명드린 안내 기준으로 작성된 지 확인한 후 AIP 의 포인트 (Epoints) 시스템으로 40,000 원 상당의 보상을 감사의 의미로 드리겠습니다. 만일 일기조사에 관련한 어떠한 질문이 있으시면 저희 연구팀 [redacted]으로 문의해주십시오.

이 연구에서 귀하와 귀하의 가정은 익명으로 암호화되어 신분 비밀보호가 될 것입니다. 저희는 귀하의 응답을 비밀보장을 할 것이며, 이 연구에서 얻어진 개인 정보가 학회지나 학회에 공개될 경우 귀하의 이름과 다른 개인식별정보는 사용되지 않을 것입니다. 귀하의 정보는 제 3 자에게 제공되지 않을 것이며, 제공하신 정보는 연구 이외의 용도로 사용되지 않을 것 입니다.

작성 페이지의 예

1. 아침 식사

버리게 되는 식품이 없다면 이유를 선택해주십시오: 다 먹었다 ☐ 집에서 안 먹었다 ☐ 기타 (적어주십시오):

무엇을 버리게 됐습니까? 버리게 되는 식품을 구체적으로 작성해주십시오. (작성란이 부족할 경우, 책자 뒷부분에 제공된 표에 작성해주십시오)	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
		마켓 / 백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓 /	편의점	노점상 재래시장 /	배달 식당 포장 /	TV 홈쇼핑 인터넷 /	기타 (예: 시댁 / 친정)	
계란찜	달걀껍질 4 개			✓						달걀껍질은 먹지 못함
배추김치	배추김치 조각 작은 것 1 개와 무채 25g					✓				남편 출근시간이 촉박하여 아침식사를 마치지 못했음
멸치고추볶음	35g								✓	너무 많이 접시에 꺼내 놓았음
잡곡밥	150g	✓								큰아들이 밥 먹다가 밥그릇을 바닥에 떨어뜨렸고, 밥이 다 쏟아졌음
농협세척 사과, 홍로	씨 있는 부분 2 개		✓							아들과 나는 사과를 다 먹었으나, 씨 있는 부분은 먹을 수 없었음
매일 저지방우유와 스페셜K 딸기 시리얼	우유 100ml				✓					작은 아들은 시리얼 먹을 때 남은 우유를 마시는 걸 좋아하지 않음

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

작성 페이지의 예

2. 점심 식사

버리게 되는 식품이 없다면 이유를 선택해주십시오: 다 먹었다 ☐ 집에서 안 먹었다 ☑ 기타 (적어주십시오):

무엇을 버리게 됐습니까? 버리게 되는 식품을 구체적으로 작성해주십시오. (작성란이 부족할 경우, 책자 뒷부분에 제공된 표에 작성해주십시오)	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
		마켓/백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓/	편의점	노점상 재래시장/	배달 식당 포장/	TV 홈쇼핑 인터넷/	기타 (예: 시댁/친정)	
가족들 모두 회사 또는 학교에 있었다										

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

작성 페이지의 예

3. 저녁 식사

버리게 되는 식품이 없다면 이유를 선택해주십시오: 다 먹었다 ☐ 집에서 안 먹었다 ☐ 기타 (적어주십시오):

무엇을 버리게 됐습니까? 버리게 되는 식품을 구체적으로 작성해주십시오. (작성란이 부족할 경우, 책자 뒷부분에 제공된 표에 작성해주십시오)	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
		마켓/백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓/	편의점	노점상 재래시장/	배달 식당 포장/	TV 홈쇼핑 인터넷/	기타 (예: 시댁/친정)	
감자, 양파, 애호박 및 두부를 넣은 된장찌개	풋고추와 양파건더기 30g					✓				우리가족은 보통 된장찌개의 작은 건더기를 먹지 않음
돼지고기 삼겹살의 기름부분	55g									우리가족은 고기의 비계 부분을 덜 먹으려고 노력하고 있으며, 탄 부분을 먹지 않음
			✓							
현미와 섞은 쌀밥	350g	✓								보통 삼겹살 구이를 먹을 때, 우리가족은 밥을 조금 먹는 편인데 내가 너무 많이 밥을 퍼서 주었음
배추김치	배추김치 110g 과 무채 80g					✓				남편과 아들들은 김치 양념 (무채)를 먹지 않는 편임
참치김밥	110g						✓			작은아들이 집에 오는 길에 간식으로 사갖고 왔는데 결국 끝까지 먹지 못하고 남겼음

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

작성 페이지의 예

4. 다른 버리게 되는 식품

(예: 냉장고 또는 찬장을 청소할 때 버리는 것 또는 간식)

무엇을 버리게 됐습니까? 버리게 되는 식품을 구체적으로 작성해주십시오. (작성란이 부족할 경우, 책자 뒷부분에 제공된 표에 작성해주십시오)	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
		마켓/백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓/	편의점	노점상 재래시장/	배달 식당 포장/	TV 홈쇼핑 인터넷/	(예: 시댁/친정) 기타	
두부 (풀무원, 부침용)	300g 짜리 두부포장		✓							유통기간이 많이 지남
랜치드레싱 (오뚜기)	1/2 병						✓			오늘 장 본 것을 냉장고에 넣기 위해 냉장고 정리를 하다보니 기름이 분리되어 있고,
										뚜껑이 드레싱 기름으로 굳어있었다
단호박	1/2 통				✓					냉장고 뒷 편에서 곰팡이 핀 것을 발견
데친 콩나물	30g	✓								지난주에 요리하고 남은 것으로, 지금 먹어도 안전할지 확실하지 않았음
멸치볶음	250g							✓		지난 추석 때 남고 잊었다. 먹어도 안전할지 확실하지 않았음

오늘의 의견 및 특이사항

특별한 경우 또는 음식물 쓰레기에 대한 의견 있으시면 아래 적어주십시오.

오늘 냉장고 정리해서 평소보다 버리는 것이 더 많았다. 원래 저녁에 삼겹살을 먹을 예정이 아니었지만 남편과 아들이 요청해서 삼겹살구이를 하게 되었다. 삼겹살을 먹을 계획이 아니었기 때문에 저녁 밥을 평소만큼 준비해서 밥이 많이 남았다.

오늘 식료품을 구입하셨습니까?

오늘 식료품 구입시 지출하신 비용을 대략 적어주십시오. 가정 밖에서 구입하고 먹은 식품 또는 음료를 (예: 아침식사로 회사에서 먹은 샌드위치) 포함하지 마십시오.

지출비: 67,000 원

이 페이지들은 저희가 알고자 하는 내용을 예로 표현한 것입니다. 가능한 자세히 (특히 분량) 작성 부탁드립니다.

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 1: 6 월 25 일 (목요일) 1. 아침 식사

버리게 되는 식품이 없다면 이유를 선택해주십시오: 다 먹었다 ☐ 집에서 안 먹었다 ☐ 기타 (적어주십시오):

무엇을 버리게 됐습니까? 버리게 되는 식품을 구체적으로 작성해주십시오. (작성란이 부족할 경우, 책자 뒷부분에 제공된 표에 작성해주십시오)	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
		마켓/ 백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓/	편의점	노점상 재래시장/	배달 식당 포장/	TV 홈쇼핑 인터넷/	기타 (예: 시댁/ 친정)	

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 1: 6 월 25 일 (목요일) 2. 점심 식사

버리게 되는 식품이 없다면 이유를 선택해주십시오: 다 먹었다 ☐ 집에서 안 먹었다 ☐ 기타 (적어주십시오):

무엇을 버리게 됐습니까? 버리게 되는 식품을 구체적으로 작성해주십시오. (작성란이 부족할 경우, 책자 뒷부분에 제공된 표에 작성해주십시오)	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
		마켓/ 백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓/	편의점	노점상 재래시장/	배달 식당 포장/	TV 홈쇼핑 인터넷/	(예: 시댁/ 친정) 기타	

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 1: 6 월 25 일 (목요일) 3. 저녁 식사

버리게 되는 식품이 없다면 이유를 선택해주십시오: 다 먹었다 ☐ 집에서 안 먹었다 ☐ 기타 (적어주십시오):

무엇을 버리게 됐습니까? 버리게 되는 식품을 구체적으로 작성해주십시오. (작성란이 부족할 경우, 책자 뒷부분에 제공된 표에 작성해주십시오)	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
		마켓 / 백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓 /	편의점	노점상 재래시장 /	배달 식당 포장 /	TV 홈쇼핑 인터넷 /	(예: 시댁 / 친정) 기타	

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 1: 6 월 25 일 (목요일)

4. 다른 버리게 되는 식품

(예: 냉장고 또는 찬장을 청소할 때 버리는 것 또는 간식)

무엇을 버리게 됐습니까? 버리게 되는 식품을 구체적으로 작성해주십시오. (작성란이 부족할 경우, 책자 뒷부분에 제공된 표에 작성해주십시오)	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
		마켓/백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓/	편의점	노점상 재래시장/	배달 식당 포장/	TV 홈쇼핑 인터넷/	(예: 시댁/친정) 기타	

오늘의 의견 및 특이사항

특별한 경우 또는 음식물 쓰레기에 대한 의견 있으시면 아래 적어주십시오.

오늘 식료품을 구입하셨습니까?

오늘 식료품 구입시 지출하신 비용을 대략 적어주십시오. 가정 밖에서 구입하고 먹은 식품 또는 음료를 (예: 아침식사로 회사에서 먹은 샌드위치) 포함하지 마십시오.

지출비: _____원

못 먹는 것도요?

네. 바나나 껍질, 티백, 생선뼈 등... 모두 알고 싶습니다!

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 2: 6 월 26 일 (금요일) 1. 아침 식사

버리게 되는 식품이 없다면 이유를 선택해주십시오: 다 먹었다 ☐ 집에서 안 먹었다 ☐ 기타 (적어주십시오):

무엇을 버리게 됐습니까? 버리게 되는 식품을 구체적으로 작성해주십시오. (작성란이 부족할 경우, 책자 뒷부분에 제공된 표에 작성해주십시오)	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
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도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 2: 6 월 26 일 (금요일) 2. 점심 식사

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도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 2: 6 월 26 일 (금요일) 3. 저녁 식사

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도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 2: 6 월 26 일 (금요일)

4. 다른 버리게 되는 식품

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지출비: _____원

잊지 말고 꼭 쓰세요!

새우깡 두 개 라도 모든 서울 시민이 버린다면 많은 양이 잖아요!

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 3: 6 월 27 일 (토요일) 1. 아침 식사

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		마켓 / 백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓 /	편의점	노점상 재래시장 /	배달 식당 포장 /	TV 홈쇼핑 인터넷 /	기타 (예: 시댁 / 친정)	

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 3: 6 월 27 일 (토요일) 2. 점심 식사

버리게 되는 식품이 없다면 이유를 선택해주십시오: 다 먹었다 ☐ 집에서 안 먹었다 ☐ 기타 (적어주십시오):

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DAY 3: 6 월 27 일 (토요일)

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오늘의 의견 및 특이사항

특별한 경우 또는 음식물 쓰레기에 대한 의견 있으시면 아래 적어주십시오.

오늘 식료품을 구입하셨습니까?

오늘 식료품 구입시 지출하신 비용을 대략 적어주십시오. 가정 밖에서 구입하고 먹은 식품 또는 음료를 (예: 아침식사로 회사에서 먹은 샌드위치) 포함하지 마십시오.

지출비: _____원

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 4: 6 월 28 일 (일요일) 1. 아침 식사

버리게 되는 식품이 없다면 이유를 선택해주십시오: 다 먹었다 ☐ 집에서 안 먹었다 ☐ 기타 (적어주십시오):

무엇을 버리게 됐습니까? 버리게 되는 식품을 구체적으로 작성해주십시오. (작성란이 부족할 경우, 책자 뒷부분에 제공된 표에 작성해주십시오)	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
		기업형 슈퍼 마켓 / 백화점	대형 마트	동네 슈퍼마켓 / 소매점	편의점	재래시장 / 노점상	식당 포장 / 배달	인터넷 / TV 홈쇼핑	기타 (예. 시댁 / 친정)	

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 4: 6 월 28 일 (일요일) 2. 점심 식사

버리게 되는 식품이 없다면 이유를 선택해주십시오: 다 먹었다 ☐ 집에서 안 먹었다 ☐ 기타 (적어주십시오):

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		마켓 / 백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓 /	편의점	노점상 재래시장 /	배달 식당 포장 /	TV 홈쇼핑 인터넷 /	기타 (예. 시댁 / 친정)	

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 4: 6 월 28 일 (일요일) 3. 저녁 식사

버리게 되는 식품이 없다면 이유를 선택해주십시오: 다 먹었다 ☐ 집에서 안 먹었다 ☐ 기타 (적어주십시오):

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		마켓 / 백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓 /	편의점	노점상 재래시장 /	배달 식당 포장 /	TV 홈쇼핑 인터넷 /	기타 (예. 시댁 / 친정)	

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 4: 6 월 28 일 (일요일)

4. 다른 버리게 되는 식품

(예: 냉장고 또는 찬장을 청소할 때 버리는 것 또는 간식)

무엇을 버리게 됐습니까? 버리게 되는 식품을 구체적으로 작성해주십시오. (작성란이 부족할 경우, 책자 뒷부분에 제공된 표에 작성해주십시오)	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
		마켓/백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓/	편의점	노점상 재래시장/	배달 식당 포장/	TV 홈쇼핑 인터넷/	기타 (예: 시댁/친정)	

오늘의 의견 및 특이사항

특별한 경우 또는 음식물 쓰레기에 대한 의견 있으시면 아래 적어주십시오.

오늘 식료품을 구입하셨습니까?

오늘 식료품 구입시 지출하신 비용을 대략 적어주십시오. 가정 밖에서 구입하고 먹은 식품 또는 음료를 (예: 아침식사로 회사에서 먹은 샌드위치) 포함하지 마십시오.

지출비: _____원

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 5: 6 월 29 일 (월요일) 1. 아침 식사

버리게 되는 식품이 없다면 이유를 선택해주십시오: 다 먹었다 ☐ 집에서 안 먹었다 ☐ 기타 (적어주십시오):

무엇을 버리게 됐습니까? 버리게 되는 식품을 구체적으로 작성해주십시오. (작성란이 부족할 경우, 책자 뒷부분에 제공된 표에 작성해주십시오)	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
		마켓 / 백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓 /	편의점	노점상 재래시장 /	배달 식당 포장 /	TV 홈쇼핑 인터넷 /	기타 (예: 시댁 / 친정)	

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 5: 6 월 29 일 (월요일) 2. 점심 식사

버리게 되는 식품이 없다면 이유를 선택해주십시오: 다 먹었다 ☐ 집에서 안 먹었다 ☐ 기타 (적어주십시오):

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		마켓 / 백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓 /	편의점	노점상 재래시장 /	배달 식당 포장 /	TV 홈쇼핑 인터넷 /	기타 (예: 시댁 / 친정)	

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 5: 6 월 29 일 (월요일) 3. 저녁 식사

버리게 되는 식품이 없다면 이유를 선택해주십시오: 다 먹었다 ☐ 집에서 안 먹었다 ☐ 기타 (적어주십시오):

무엇을 버리게 됐습니까? 버리게 되는 식품을 구체적으로 작성해주십시오. (작성란이 부족할 경우, 책자 뒷부분에 제공된 표에 작성해주십시오)	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
		마켓 / 백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓 /	편의점	노점상 재래시장 /	배달 식당 포장 /	TV 홈쇼핑 인터넷 /	기타 (예: 시댁 / 친정)	

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 5: 6 월 29 일 (월요일)

4. 다른 버리게 되는 식품

(예: 냉장고 또는 찬장을 청소할 때 버리는 것 또는 간식)

무엇을 버리게 됐습니까? 버리게 되는 식품을 구체적으로 작성해주십시오. (작성란이 부족할 경우, 책자 뒷부분에 제공된 표에 작성해주십시오)	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
		마켓/백화점 기업형 슈퍼	대형마트	소매점 동네 슈퍼마켓/	편의점	노점상 재래시장/	배달 식당 포장/	TV 홈쇼핑 인터넷/	(예: 시댁/친정) 기타	

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지출비: _____원

부스러기까지!

저희에게 서울의 음식물 쓰레기를 완전하게 이해하기 위해 완전성과 정확성은 필수적인 것입니다.

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 6: 6 월 30 일 (화요일) 1. 아침 식사

버리게 되는 식품이 없다면 이유를 선택해주십시오: 다 먹었다 ☐ 집에서 안 먹었다 ☐ 기타 (적어주십시오):

무엇을 버리게 됐습니까? 버리게 되는 식품을 구체적으로 작성해주십시오. (작성란이 부족할 경우, 책자 뒷부분에 제공된 표에 작성해주십시오)	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
		마켓 / 백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓 /	편의점	노점상 재래시장 /	배달 식당 포장 /	TV 홈쇼핑 인터넷 /	기타 (예. 시댁 / 친정)	

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 6: 6 월 30 일 (화요일) 2. 점심 식사

버리게 되는 식품이 없다면 이유를 선택해주십시오: 다 먹었다 ☐ 집에서 안 먹었다 ☐ 기타 (적어주십시오):

무엇을 버리게 됐습니까? 버리게 되는 식품을 구체적으로 작성해주십시오. (작성란이 부족할 경우, 책자 뒷부분에 제공된 표에 작성해주십시오)	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
		마켓 / 백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓 /	편의점	노점상 재래시장 /	배달 식당 포장 /	TV 홈쇼핑 인터넷 /	기타 (예: 시댁 / 친정)	

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 6: 6 월 30 일 (화요일) 3. 저녁 식사

버리게 되는 식품이 없다면 이유를 선택해주십시오: 다 먹었다 ☐ 집에서 안 먹었다 ☐ 기타 (적어주십시오):

무엇을 버리게 됐습니까? 버리게 되는 식품을 구체적으로 작성해주십시오. (작성란이 부족할 경우, 책자 뒷부분에 제공된 표에 작성해주십시오)	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
		마켓 / 백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓 /	편의점	노점상 재래시장 /	배달 식당 포장 /	TV 홈쇼핑 인터넷 /	기타 (예. 시댁 / 친정)	

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 6: 6 월 30 일 (화요일)

4. 다른 버리게 되는 식품

(예: 냉장고 또는 찬장을 청소할 때 버리는 것 또는 간식)

무엇을 버리게 됐습니까? 버리게 되는 식품을 구체적으로 작성해주십시오. (작성란이 부족할 경우, 책자 뒷부분에 제공된 표에 작성해주십시오)	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오) 마켓/백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓/	편의점	노점상 재래시장/	배달 식당 포장/	TV 홈쇼핑 인터넷/	기타 (예: 시댁/친정)	**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)

오늘의 의견 및 특이사항

특별한 경우 또는 음식물 쓰레기에 대한 의견 있으시면 아래 적어주십시오.

오늘 식료품을 구입하셨습니까?

오늘 식료품 구입시 지출하신 비용을 대략 적어주십시오. 가정 밖에서 구입하고 먹은 식품 또는 음료를 (예: 아침식사로 회사에서 먹은 샌드위치) 포함하지 마십시오.

지출비: _____원

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 7: 7 월 1 일 (수요일) 1. 아침 식사

버리게 되는 식품이 없다면 이유를 선택해주십시오: 다 먹었다 ☐ 집에서 안 먹었다 ☐ 기타 (적어주십시오):

무엇을 버리게 됐습니까? 버리게 되는 식품을 구체적으로 작성해주십시오. (작성란이 부족할 경우, 책자 뒷부분에 제공된 표에 작성해주십시오)	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
		마켓 / 백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓 /	편의점	노점상 재래시장 /	배달 식당 포장 /	TV 홈쇼핑 인터넷 /	기타 (예. 시댁 / 친정)	

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 7: 7 월 1 일 (수요일) 2. 점심 식사

버리게 되는 식품이 없다면 이유를 선택해주십시오: 다 먹었다 ☐ 집에서 안 먹었다 ☐ 기타 (적어주십시오):

무엇을 버리게 됐습니까? 버리게 되는 식품을 구체적으로 작성해주십시오. (작성란이 부족할 경우, 책자 뒷부분에 제공된 표에 작성해주십시오)	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
		마켓 / 백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓 /	편의점	노점상 재래시장 /	배달 식당 포장 /	TV 홈쇼핑 인터넷 /	기타 (예. 시댁 / 친정)	

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 7: 7 월 1 일 (수요일) 3. 저녁 식사

버리게 되는 식품이 없다면 이유를 선택해주십시오: 다 먹었다 ☐ 집에서 안 먹었다 ☐ 기타 (적어주십시오):

무엇을 버리게 됐습니까? 버리게 되는 식품을 구체적으로 작성해주십시오. (작성란이 부족할 경우, 책자 뒷부분에 제공된 표에 작성해주십시오)	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
		마켓 / 백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓 /	편의점	노점상 재래시장 /	배달 식당 포장 /	TV 홈쇼핑 인터넷 /	기타 (예: 시댁 / 친정)	

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

DAY 7: 7 월 1 일 (수요일)

4. 다른 버리게 되는 식품

(예: 냉장고 또는 찬장을 청소할 때 버리는 것 또는 간식)

무엇을 버리게 됐습니까? 버리게 되는 식품을 구체적으로 작성해주십시오. (작성란이 부족할 경우, 책자 뒷부분에 제공된 표에 작성해주십시오)	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
		마켓/ 백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓/	편의점	노점상 재래시장/	배달 식당 포장/	TV 홈쇼핑 인터넷/	(예: 시댁/ 친정) 기타	

오늘의 의견 및 특이사항

특별한 경우 또는 음식물 쓰레기에 대한 의견 있으시면 아래 적어주십시오.

오늘 식료품을 구입하셨습니까?

오늘 식료품 구입시 지출하신 비용을 대략 적어주십시오. 가정 밖에서 구입하고 먹은 식품 또는 음료를 (예: 아침식사로 회사에서 먹은 샌드위치) 포함하지 마십시오.

지출비: _____원

수고하셨습니다!

다 끝났습니다. 이제 마지막 페이지에 안내하고 있는 주소로 보내주시기 바랍니다. 보내시기 전에 다시 한번 일기를 훑어보시고 놓친 부분이 있는지 확인해보실까요?

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

여분의 페이지

작성란이 부족할 경우, 이 페이지에 적어주십시오

날짜? 어느 날에 버리게 돈 겁니까?	**무엇을 버리게 됐습니까?** 버리게 되는 식품을 구체적으로 작성해주십시오.	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
			마켓/ 백화점 기업형 슈퍼	대형 마트	소매점 동네 슈퍼마켓/	편의점	노점상 재래시장/	배달 식당 포장/	TV 홈쇼핑 인터넷/	(예 시댁/ 친정) 기타	

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

여분의 페이지

작성란이 부족할 경우, 이 페이지에 적어주십시오

날짜? 어느 날에 버리게 돈 겁니까?	**무엇을 버리게 됐습니까?** 버리게 되는 식품을 구체적으로 작성해주십시오.	**얼마를 버리게 됐습니까?** 중량, 부피, 수량, 분량은 뭐였습니까?	**어디서 구입하신 것입니까?** 원래 음식/재료를 아래의 보기 중의 어떤 가게에서 구입하셨는지 알려주십시오 (✓로 적어주십시오)								**버리게 된 이유는 무엇입니까?** 왜 버리셨는 지 적어주십시오 예를 들어서: 너무 많이 구입했다, 구입시 포장된 분량이 너무 컸다, 유통기간이 지났다, 너무 많이 요리/준비했다, 맛이 없었다, 먹기 싫어했다, 다른 이유 (적어주십시오)
			기업형 슈퍼 마켓/ 백화점	대형 마트	동네 슈퍼마켓/ 소매점	편의점	재래시장/ 노점상	식당 포장/ 배달	인터넷/ TV 홈쇼핑	기타 (예 시댁/ 친정)	

도움이 필요하세요? 저희 연구팀에게 전화하세요: [redacted]

시간을 내주셔서 감사합니다!

작성하신 책자는 반드시 저희가 드린 봉투(우표 붙어있음) 를
이용하여 다음 주소로 보내주십시오:

[redacted]

Berkeley
UNIVERSITY OF CALIFORNIA

Appendix C - Household interview questions

C.1 Household interview questions (English translation)

1. Please tell me about the different members of your household.

2. What roles and responsibilities do you have in the day-to-day life of your household?

3. What does your typical day look like in terms of managing things like work, childcare, and household chores?

4. What kinds of roles and responsibilities do other members of your household have in the day-to-day life of your household?

5. Where do you prefer to buy groceries? What best explains your choice(s)?
    a. If needed, ask about price, convenience, ambience, proximity, quality, freshness

6. How often do you go grocery shopping? Are there specific reasons why this schedule works well for your household?

7. Do you often use online shopping or delivery services for groceries? Why or why not?

8. Do you usually check what you have before you go shopping and use shopping lists? If not, why not?

9. How often do you buy food that you did not intend to buy? Why or why not?

10. Are you usually able to buy groceries in the quantities you want? Why or why not?

11. Are you generally conscious of possible wastage when you buy groceries?

12. Do you think where you buy your food makes a difference to the amount of food waste you throw away?

13. Do you plan your meals in advance? If so, how far in advance? If not, why not?

14. How often do you eat together as a family at home?

15. How do you store different kinds of food?
    a. If needed, ask about fresh vegetables, fruit, meats, and seafood in particular

16. Do you have a specific system for keeping track of what kinds of food you have and when it's going to go bad?

17. How often do you have leftover food at home?

18. What is the main cause of leftover food at home?

19. What do you normally do with leftover food at home?

20. What are some of the reasons you throw away foods?

21. What kinds of food do you throw away most?
    a. Ask both about food categories and also the state of the food

22. How does throwing away food make you feel?
    a. Why do you feel that way?

23. Is it easy to predict how much food you throw away each week? Why or why not?

24. Would you say you are generally conscious about the food you throw away? What about the rest of your household?

25. Do you and members of your household do anything in particular to avoid wasting food?

26. Do you believe it is possible to reduce the amount of food your household throws away? Why or why not?

27. Would you say your household throws away more or less food waste than the other families in the neighborhood?

28. Would you say you have a complete understanding of your district's volume-based food waste pricing system?

29. Would you say that the volume-based pricing system and separate collection of food waste has increased your household's efforts not to waste food?

30. Besides the volume-based food waste pricing, are you aware of any other government efforts to reduce food waste?

31. Who was in charge of filling out the diary?

32. How long did filling out the diary take you every day?

33. Do you think your household's completed diary accurately describes a week in the life of your household? If not, why not?

34. Did participating in the diary study alter your consciousness of the food that gets thrown away in your household?

35. Did participating in the diary study alter your views on food and food waste? If so, how?

36. Did participating in the diary lead to any changes in your household's routines? If so, could you describe how?

C.2 Household interview questions (Korean translation)

1. 가족분들에 대해 간단한 소개 부탁드립니다.

2. 일상 생활시 가정에서 어떻게 가사분담을 하시나요??

3. 주로 집에서 하시는 일이 어떻게 되세요? (재택근무, 육아, 요리 등..)

4. 다른 가족분들은 집에서 맡은 가사분담은 무엇인가요?

5. 주로 어디서 장을 보세요? 거기를 선택하신 이유는 무엇입니까?
    a. 필요하면 가격, 편리, 분위기, 가까움, 품질, 신선도에 대해 물어 보는 것

6. 얼마나 자주 장을 보시는 편인가요? 이 주기가 가정에게 적당하다고 생각하시는 이유는 무엇인가요?

7. 인터넷쇼핑이나 식품 배달을 자주 이용하세요? 이유는 무엇인가요?

8. 장을 보시기 전에 집에 이미 있는 식품을 확인해보시는 것입니까? 안 하신다면 이유는 무엇입니까?

9. 구입을 계획하지 않은 식품을 얼마 자주 구입하시는 편인가요? 이유는 무엇인가요?

10. 장을 보실 때 보통 식품을 원하는 양만큼 구매할 수 있으세요? 이유는 무엇인가요?

11. 식품을 구매하실 때, 대체적으로 남아서 버리게 될 가능성에 대해 인지하고 구입하시는 편인가요?

12. 장을 보는 곳이 집에서 나오는 음식물 쓰레기 양에 영향을 미친다고 생각하세요?

13. 보통 미리 식사 계획을 세우시는 편이세요? 보통 며칠 전에 세우시는 건가요? 안 하시는 이유는 무엇입니까?

14. 얼마나 자주 집에서 가족끼리 같이 식사하세요?

15. 다양한 종류의 식품들이 있는데, 각각 어떻게 보관하세요?
    a. 필요하면.. 채소, 과일, 고기, 생선류 등

16. 여러가지 종류의 식품들을 보관하고 계시는데, 이 식품들의 보관기간을 관리하시는 방법이 있나요?

17. 가정에서 얼마나 자주 남는 음식이 발생되나요?

18. 음식이 남는다면 주요 이유가 무엇입니까?

19. 남은 음식 있으면 보통 어떻게 하세요?

20. 음식이나 음료를 버리게 되는 주요 이유는 무엇입니까?

21. 제일 자주 버리는 식품의 종류들은 무엇입니까?
    a. 식품 및 음료 부문과 버리는 음식의 상태에 대해 물어 보는 것

22. 음식이나 음료를 버리실 때, 어떤 생각이 드세요?
    a. 그렇게 생각하시는 이유는 무엇인가요?

23. 매주에 버리는 음식물 쓰레기의 양을 쉽게 예상하실 수 있으세요? 이유는 무엇입니까?

24. 귀하께서 일반적으로 버리는 식품이나 음료의 양과 종류에 대해 많이 알고 계신다고 생각하세요? 생각하시기에 다른 가족분들도 자세히 알고 계신다고 보세요?

25. 귀하와 다른 가족분들께서 음식이나 음료를 버리지 않기 위해 특별히 하시는 게 있으십니까?

26. 가정에서 배출하는 음식물 쓰레기의 양을 줄이는 게 가능하다고 생각하십니까? 이유는 무엇입니까?

27. 참여자분의 가정은 같은 동네 다른 가정에 비해 음식물 쓰레기 배출양이 많은 편인가요? 아니면 적은 편인가요?

28. 현재 거주하고 계신 지역(구)의 음식물 쓰레기 종량제 제도를 잘 이해하신다고 생각하세요?

29. 종량제 제도와 음식물 쓰레기 분리수거는 가정에서 음식물을 줄이는 노력을 하게 만들었다고 생각하세요?

30. 음식물 쓰레기 종량제를 제외하고 음식물 쓰레기를 줄이려는 정부의 다른 정책이나 노력에 대해 알고계세요?

31. 가정에서 누가 일기를 작성하셨어요?

32. 매일 일기를 작성하시는 건 몇 분이나 걸리셨어요?

33. 작성하신 일기는 귀하 가정생활의 일주일을 정확하게 나타낸다고 생각하세요? 만약 아니라고 하시면 그 이유는 무엇인가요?

34. 이 일기조사 참여를 통해서 가정에서 버리게 되는 음식 또는 음료에 대한 의식이 높아졌다고 생각하세요?

35. 이 일기조사에 참여하시는 것은 귀하께서 식품과 음식물 쓰레기에 대해 평소 갖고 계신 생각이 변했다고 생각하세요? 만약 변했다면 어떻게 변했습니까?

36. 이번 일기조사 참여하시면서 가정의 평소 습관 또는 패턴이 바뀌게 됐어요? 만약 바뀌었다면 어떻게 바뀌었는 지 설명해주세요.

Appendix D - Pre-consumer case study interview questions

D.1 Homeplus interview questions (English translation)

1. What is Homeplus' official definition of food waste?

2. What initiatives and plans does Homeplus have in place to reduce food waste in the following parts of the food value chain:
    a. Pre-distribution center
    b. Distribution centers
    c. In-transit
    d. Stores
    e. Customers' households

3. Do Homeplus office and store employees receive any training on best practices that help reduce food waste?

4. Does Homeplus have a system for keeping track of its food waste? If so, please describe this sytem.

5. What are the reasons that lead to food not being sold in Homeplus' stores?

6. When is food considered unsuitable for sale and is required to be taken off the shelves and thrown away?

7. What percentage of Homeplus food waste is thrown away in stores because it is:
    a. Past expiry date
    b. Close to expiry date
    c. Does not look appealing to customers
    d. Overstocking problem
    e. Spoilage or damage
    f. Other reasons?

8. What percentage of Homeplus food waste is thrown away in its supply chain because it is:
    a. Past expiry date
    b. Close to expiry date
    c. Does not look appealing to customers
    d. Overstocking problem
    e. Spoilage or damage
    f. Other reasons?

9. What happens to food that is unsold in Homeplus? How much gets:
    a. Sent for recycling (i.e. conversion into animal feed, fertilizer, or anaerobic digestion)
    b. Donated to charity
    c. Other?

10. How much food is thrown away by all Homeplus/Homeplus Express operations each year/month/week, broken down according to:
    a. Pre-distribution center
    b. Distribution centers
    c. Stores
    d. In-transit

11. Is there data on food waste by product category? (e.g. fruits, vegetables, meat, fish, dairy, canned food, etc.)

12. Is there clearly one food that has much higher food wastage than others?

13. Has Homeplus had any experiences with people scavenging through its waste for food to eat? If so, what is Homeplus' official policy towards such people?

14. Do Homeplus and Homeplus Express operate off the same supply chain and distribution centers?

15. How many distribution centers does Homeplus have, and where are they located?

16. Are there any products which are not delivered to distribution centers and instead delivered directly to Homeplus' stores?

17. What were the challenges faced by Homeplus when it first entered the Korean market with respect to procurement of food products?

18. What investments has Homeplus made since entering the Korean market to improve the efficiency of its domestic supply chain operations?

19. Which of these investments have helped to reduce food waste? Have any increased food waste?

20. What kind of systems does Homeplus have in place to improve sharing sales information with procurement officers and suppliers?

21. What parts of Homeplus' supply operations are outsourced?

22. How does Homeplus decide what is to be outsourced and what is not?

23. Can you please provide data on what percentage of Homeplus stock (value and tonnage) is bought:
    a. Directly from farmers
    b. From farmer cooperatives
    c. From the wholesale market (e.g. Garak wholesale market)
    d. From specialized wholesalers (i.e. middlemen who help you source tomatoes/onions)
    e. Other sources?

24. How far in advance does Homeplus place orders for tomatoes/onions?

25. How does Homeplus prevent untimely shortages?

26. What happens to the excess if Homeplus orders too much and it cannot be sold in time?

27. Does Homeplus have a preferred supplier system for buying directly from farmers?

28. What incentives do farmers have to sell directly to Homeplus?

29. What percentage of procurement is done under preferred supplier contracts/agreements?

30. How many farmers are currently listed under Homeplus' preferred supplier system for tomatoes/onions?

31. Is there a typical length, monetary value, sale amount covered under a preferred supplier contract?

32. What are the conditions for farmers to be considered/continue being part of the preferred supplier system?

33. Does Homeplus provide any technical/financial assistance to farmers in its preferred supplier system?

34. How often do farmers in the preferred supplier system fail to meet Homeplus' orders? Are these farms penalized in any way?

35. Does Homeplus have its own set of quality standards for tomatoes/onions on top of official government quality standards? If so, would it be possible to obtain a copy of the documentation for these standards?

36. What is the process for enforcing these standards? Is grading done by hand? Machine? Is it done directly on farms or elsewhere?

37. How does the grading process differ if not buying directly from farmers?

38. Does Homeplus have a system in place to buy up outgraded tomatoes/onions for other uses? (e.g. private label processing for other foods)

39. Does Homeplus have private label packaging for tomatoes and onions? Is there any difference in procurement for these than with other tomatoes and onions?

40. Is there data on the amount of tomatoes/onions purchased per day/week/month, and how much of it gets sold vs. thrown away?

41. I would like to pay a visit to the Homeplus distribution center if there is the chance. Would this be possible?

D.2 Homeplus interview questions (Korean translation)

아래 질문에서 '홈플러스'는 홈플러스와 홈플러스 익스프레스를 나타내는 것입니다.

1. 홈플러스에서 자체적으로 정의하고 있는 "음식물 쓰레기"의 개념과 범주를 가지고 있습니까? 가지고 있다면 무엇입니까?

2. 홈플러스는 음식물 쓰레기를 줄이기 위해 특별한 계획 또는 프로그램을 가지고 있는지요? 그리고 이를 유통 단계 중 어느 과정에서 진행(혹은 예정)하고 있습니까?
    a. 유통센터 이전에
    b. 유통센터 내에서
    c. 운송 중에
    d. 상점 내에서
    e. 고객의 가정에서

3. 홈플러스의 본사 및 매장 직원들은 음식물 쓰레기를 줄일 수 있는 모범경영을 위하여 어떠한 훈련을 받고 있습니까?

4. 홈플러스는 음식물 쓰레기를 추적하기 위한 시스템을 가지고 있는지요? 있다면 어떤 시스템을 사용하고 있는지 설명해주십시오.

5. 홈플러스 매장에서 진열된 식품들이 판매 되지 못하는 주요한 원인들은 무엇입니까?

6. 진열된 식품들이 판매에 부적합하다고 판단하여 상품을 진열대에서 치우게 되는 경우가 있다면 어떤 경우인가요?

7. 홈플러스 매장에서 배출되는 음식물 쓰레기 중에서 다음과 같은 이유로 배출하는 경우는 각각 어느 정도의 비율을 차지하고 있습니까? (%로 설명 부탁 드립니다.)
    a. 유통기한이 지났음
    b. 유통기한에 근접함
    c. 고객들에게 매력적이지 않음
    d. 재고과잉 때문임
    e. 식품 부패 또는 손상
    f. 기타 다른 이유?

8. 홈플러스 공급망(supply chain)에서 배출되는 음식물 쓰레기 중에서 다음과 같은 이유로 배출하는 경우는 각각 어느 정도의 비율을 차지하고 있습니까? (%로 설명 부탁 드립니다.)
    a. 유효기간이 지났음
    b. 유효기간이 거의 지났음
    c. 고객들에게 매력적이지 않음
    d. 재고과잉 때문
    e. 식품 부패함 또는 손상함
    f. 기타 다른 이유?

9. 홈플러스에서 판매되지 못한 음식물은 어떤 방법으로 처리되며 각 방법으로 처리되는 양은 어느 정도의 비율 입니까? (%로 설명 부탁 드립니다.)
    a. 음식물 쓰레기 재활용 (예: 사료, 퇴비, 혐기성 소화)
    b. 자선단체 기부
    c. 기타 다른 방법?

10. 홈플러스의 운영을 위한 여러 과정 중 각 단계에서 배출되는 음식물 쓰레기 양은 매년/매월/매일 어느 정도 발생됩니까? (kg , ton 또는 원 단위)?
    a. 유통센터 이전에
    b. 유통센터 내에서
    c. 운송 중에
    d. 상점 내에서

11. 음식물 쓰레기 데이터는 식품 종류별로 구분되어 있습니까?

12. 홈플러스가 판매하는 식품들 중에서 음식물 쓰레기로 가장 많이 배출되는 종류는 무엇입니까?

13. 사람들이 홈플러스가 폐기한 음식물 중에 먹을 만한 식품을 찾기 위하여 뒤지는 경우가 있습니까? 있었던 경우에는 이런 행위에 대해서 홈플러스에서는 공식적인 정책을 가지고 있습니까? 있다면 내용을 설명해주십시오.

14. 홈플러스와 홈플러스 익스프레스는 동일한 유통 공급망을 이용하여 영업활동을 합니까?

15. 홈플러스는 몇 개의 유통센터를 가지고 있고 어디에 있습니까? 일 평균 거래물량은 어느 정도 입니까?

16. 유통센터를 통하지 않고 직접 매장으로 배송되는 식품들이 있습니까?

17. 홈플러스가 처음 한국 유통시장에 진출했을 때, 식품 구매/조달(procurement)에 대해 어떤 어려움들이 있었습니까?

18. 홈플러스가 한국의 유통시장에 진출한 후 국내 공급망 운영 효율을 높이기 위해 투자한 것은 무엇입니까?

19. 상기한 투자들 중에서 음식물 쓰레기를 줄이는 데 도움이 된 것이 있습니까? 아니면 반대로 음식물 쓰레기를 증가시킨 것은 있습니까?

20. 홈플러스에는 공급자와 구매 담당자의 판매 정보공유를 개선하기 위한 제도 혹은 시스템이 마련되어 있습니까?

21. 홈플러스의 공급망에서 어떤 부분을 아웃소싱하고 있습니까?

22. 홈플러스는 아웃소싱 여부를 어떻게 결정하고 계십니까?

23. 홈플러스에서 판매하는 토마토/양파 중에서 몇 퍼센트(%)를 아래의 거래처를 통해 구매하시는지 말씀해주십시오. (가장 근래의 경우 혹은 지난 몇 년간의 자료인지를 밝혀주십시오.)
    a. 농장 (농장 직거래)
    b. 농업 협동조합
    c. 도매시장 (예: 가락 시장)
    d. 전문적인 도매업자
    e. 기타 거래처

24. 홈플러스는 판매하기 며칠 전에 토마토/양파를 미리 주문합니까?

25. 어떤 방법으로 수요량을 예측하십니까?

26. 만약 과잉 주문의 이유로 판매하고 남은 식품의 재고가 발생한 경우, 그 재고들은 어떻게 처리하십니까?

27. 홈플러스는 농장 또는 농업 협동조합에서 직접 구매를 하기 위한 우선 공급자 시스템이(preferred supplier system) 있습니까?

28. 농부/농장주/농업 협동조합에게 농장-홈플러스 직거래를 위한 인센티브가 있습니까?

29. 여러 가지 토마토/양파 구매방법 중에 우선 공급자 계약/동의서(preferred supplier contracts/agreements)를 통한 구매가 몇 퍼센트(%)를 차지합니까?

30. 홈플러스의 토마토/양파 우선 공급자 시스템 (preferred supplier system) 내에 몇 개의 농장들이 포함되어 있습니까?

31. 우선 공급자 동의서 내용에(preferred supplier agreement) 주요 기간, 금액, 수량 등 포함되어 있습니까?

32. 농부들이 홈플러스의 우선 공급자 시스템 (preferred supplier system)에 포함되거나 유지하기 위한 조건들은 무엇입니까?

33. 홈플러스는 우선 공급자 시스템 (preferred supplier system)에 등록된 공급자에게 재정 지원 또는 기술 지원을 제공합니까?

34. 홈플러스의 우선 공급자 시스템 (preferred supplier system)에 등록된 공급자들은 얼마나 자주 홈플러스의 주문량을 조달하지 못합니까? 이 경우에는 어떤 처분이 생깁니까?

35. 홈플러스는 정부의 공식적인 농산물 표준 규격 뿐만 아니라 홈플러스 자체의 품질 기준을 (private quality standards)가지고 있습니까? 만약 그렇다면, 홈플러스의 자체적인 품질 기준 매뉴얼을 제공 받을 수 있을까요?

36. 홈플러스는 어떤 방법으로 본 회사의 자체적인 기준규격을 시행하고 있습니까? 상품에 대한 등급 분류 작업은 수작업을 통해서 하십니까? 아니면 기계를 이용하십니까? 등급 분류 작업은 농장에서 하십니까? 아니면 다른 장소에서 합니까?

37. 만약 생산품을 농장에서 직접 구입/조달하지 않는 경우, 등급 분류 작업은 현지에서 직접 구입/조달하는 작업과 어떻게 다릅니까?

38. 홈플러스의 기준에 미달된 토마토와 양파를 다른 용도로 사용하기 위한 구매시스템이 있습니까? (e.g. 자체 상표(PB) 상품용 ex. 토마토주스, 토마토 스파게티 소스 등)

39. 홈플러스는 자체 상표를 가진 토마토와 양파를 판매하고 있습니까? 자체 상표의 토마토와 양파의 조달은 판매중인 다른 토마토/양파의 조달 방법과 어떠한 차이가 있습니까?

40. 홈플러스로 매일, 매주, 매월 조달되는 토마토/양파의 양과 판매량, 판매되지 못하고 버려지는 양에 대한 자료가 있습니까?

41. 기회가 되면 홈플러스의 유통센터에 방문하고 싶습니다. 가능할까요?

D.3 Traditional market interview questions (English translation)

1. How much food waste do you throw away every day?
2. How do you dispose of your food waste?
3. From where and when do you procure your produce?
4. How do you transport the produce back to your store?
5. How much are your daily sales, roughly?
6. How do you decide how much to procure every day?
7. What proportion of your produce can you sell every day?
8. What do you do with the produce that you cannot sell?
9. Do you have a refrigerator?

D.4 Traditional market interview questions (Korean translation)

1. 매일에 음식물 쓰레기가 얼마나 나옵니까?
2. 나오는 음식물 쓰리기를 어떻게 처리하십니까?
3. 물건을 언제 어디에서 구입하십니까?
4. 물건을 구입한후에 어떻게 가게로 운밤하십니까?
5. 하루 매출액은 대충 얼마입니까?
6. 하루에 수입 물량을 어떻게 예측하십니까?
7. 하루에 물건을 얼마나 판매하십니까?
8. 팔리지 않은 물건을 어떻게 처리하십니까?
9. 냉장이나 쟁동창고는 있으십니까?

Appendix E – Assumptions used to quantify household food waste diary data

ITEM	VALUE	UNITS	SOURCE
Density values			
Food waste - solid/partially solid	0.568	g/ml	Korean Ministry of Environment data
Food waste - liquid	1	g/ml	Standard value
Container-specific values			
Cup (Korean)	200	ml	Standard value
Cup (US cup)	236	ml	Standard value
Coffee mug	325	ml	Standard value
Paper cup	200	ml	http://vita500000000.tistory.com/120
Rice bowl	300	ml	http://www.fao.org/docrep/017/ap815e/ap815e.pdf
Soy sauce dish (종지)	25	ml	http://terms.naver.com/entry.nhn?docId=1300015&cid=40942&categoryId=32154
Spoon, (Korean)	10	g	Standard value
Teaspoon	5	g	Standard value
Tablespoon	15	g	Standard value
Eggs, soy, and dairy			
Cheese			
Slice, unspecified	20	g	http://emart.ssg.com/item/itemView.ssg?itemId=0000007718090
Egg, chicken			
Shell	11	g	Averaged from other diary entries
Whole, boiled	50	g	http://everydaylife.globalpost.com/average-weight-boiled-egg-41047.html
Fried	45	g	http://nutritiondata.self.com/facts/dairy-and-egg-products/116/2
Yolk	17	g	http://convert-to.com/722/chicken-egg-yolk-conversion-plus-nutrients-values.html
Egg, quail			
Whole	9	g	http://www.calorieking.com/foods/calories-in-eggs-quail-egg-fresh-raw_f-ZmlkPTY4OTQ1.html
Shell	0.7	g	http://www.calorieking.com/foods/calories-in-eggs-quail-egg-fresh-raw_f-ZmlkPTY4OTQ1.html
Tofu			
Whole packet	300	g	http://emart.ssg.com/item/itemView.ssg?itemId=0000007452331
Piece	10	g	Assume 30 pieces of tofu from 1 block, cut Korean style
Tofu skin (유부) - 1 piece	9.5	g	http://blog.naver.com/liveseven/220482863595

ITEM	VALUE	UNITS	SOURCE
Rice, wheat, and grain products			
Bread			
Slice	43	g	Averaged from other diary entries
Crust from 1 slice	14	g	Averaged from other diary entries
Loaf	440	g	https://www.paris.co.kr/product/product_view.jsp?id=4646&cid=PDC00000008
Bagel	100	g	http://emart.ssg.com/item/itemView.ssg?itemId=1000017084951
Bun			
Pizza bread	130	g	http://www.paris.co.kr/product/product_view.jsp?id=18&cid=PDC00000011
Red bean stuffing (from Paris Baguette)	105	g	http://www.paris.co.kr/product/product_view.jsp?id=4709&cid=PDC00000005
Sausage (from Paris Baguette)	100	g	http://www.paris.co.kr/product/product_view.jsp?id=4271&cid=PDC00000011
Steamed	120	g	http://emart.ssg.com/item/itemView.ssg?itemId=1000016053227
Castella Cake - 1 slice	50	g	https://www.paris.co.kr/product/product_view.jsp?id=4108&cid=PDC00000017
Dinner roll	40	g	http://www.quinzanisbakery.com/dinnerrolls.html
Donut	43	g	https://www.google.com/search?q=doughnut&oq=doughnut&aqs=chrome..69i57j0l5.6994j0j4&sourceid=chrome&ie=UTF-8
Noodles			
1 Strand	2	g	Assumption from personal experience
Handful	67	g	http://www.livestrong.com/article/307428-the-serving-size-of-spaghetti-noodles/
1 portion	100	g	http://emart.ssg.com/item/itemView.ssg?itemId=0000008410642
Noodles, cup	100	g	Averaged from other diary entries
Noodles, ramen	110	g	http://emart.ssg.com/item/itemView.ssg?itemId=0000007183261
Pound cake (from Tous Les Jours) - 1 slice	67	g	http://www.tlj.co.kr/product/detail.asp?gubun=list&ref=3&cg_num=&prod_num=2012&page=18
Rice			
Bowl, cooked	210	g	http://47kg.kr/contents/caldic/calorybook_part_food.php?category=001001009
Handful, cooked	42	g	Assumes 5 handfuls in a bowl
Grain, raw	0.06	g	http://www.wolframalpha.com/input/?i=1+grain&lk=1
Rice cake (떡)			
Rice cake for soup (떡국떡), cooked - 1 piece	5	g	Assumption from personal experience
Plain rice cake (백설기떡) - 1 handful	55	g	Assumption from personal experience
Ddeokbokki rice cake (떡볶이) - 1 piece	20	g	Averaged from other diary entries
Mugwort rice cake (쑥떡) - 1 piece	45	g	http://emart.ssg.com/item/itemView.ssg?itemId=1000017202896
Square rice cake (절편떡) - 1 piece	23	g	http://www.bizeun.co.kr/pages/goods/product_view.aspx?pSeq=34
Stick rice cake (인절미) - 1 piece	14	g	http://staz.egloos.com/m/4063354
Rice paper - 1 sheet	7	g	http://www.amazon.com/Three-Ladies-Spring-Paper-Wrappers/dp/B00437EN2C
Red bean paste bread (파리바게트)	94	g	http://www.paris.co.kr/product/product_view.jsp?id=8&cid=PDC00000005
Tiramisu cake - 1 slice	72	g	http://www.twosome.co.kr/menu/detail.asp?f_product_idx=583&rank=3&c_prt_cate_idx=63&c_prt_cate_idx2=

ITEM	VALUE	UNITS	SOURCE
Meat and meat products			
Beef			
Bone from stew	64	g	Averaged from other diary entries
Chicken			
Breast meat - 1 piece	116	g	http://www.calorieking.com/foods/calories-in-chicken-chicken-breast-without-skin-raw_f-ZmlkPTY4Mjc1.html
Bones, raw - 1 chicken	308	g	http://emart.ssg.com/item/itemView.ssg?itemId=0000006882281
Nugget, cooked	70	g	http://www.quora.com/How-much-does-a-Chicken-McNugget-weigh
Fried - Breast	178	g	http://www.nutrition-charts.com/kfc-nutrition-facts-calorie-information/
Fried - Breast bones	34	g	http://www.aqua-calc.com/calculate/food-weight-to-volume
Fried - Wing	52	g	http://www.nutrition-charts.com/kfc-nutrition-facts-calorie-information/
Fried - Wing bones	16	g	http://www.aqua-calc.com/calculate/food-weight-to-volume
Fried - Drumstick	56	g	http://www.nutrition-charts.com/kfc-nutrition-facts-calorie-information/
Fried - Drumstick bones	17	g	http://www.aqua-calc.com/calculate/food-weight-to-volume
Fried - Thigh	110	g	http://www.nutrition-charts.com/kfc-nutrition-facts-calorie-information/
Fried - Thigh bones	33	g	http://www.aqua-calc.com/calculate/food-weight-to-volume
Duck			
Cooked and chopped - 1 piece	28	g	http://www.calorieking.com/foods/calories-in-duck-roasted-domesticated-duck-with-skin_f-ZmlkPTk2Nzc1.html
Cooked and chopped - skin from 1 piece	8	g	http://www.calorieking.com/foods/calories-in-duck-roasted-domesticated-duck-with-skin_f-ZmlkPTk2Nzc1.html
Pork			
Ham - 1 slice	40	g	http://lhtcmy.blog.me/40099338813
Trotters (large portion) - bones	1,200	g	http://www.calorieking.com/foods/calories-in-variety-meats-by-products-offals-pork-feet-trotters-simmered_f-ZmlkPTYzNDU3.html
Trotters (medium portion) - bones	900	g	http://www.calorieking.com/foods/calories-in-variety-meats-by-products-offals-pork-feet-trotters-simmered_f-ZmlkPTYzNDU3.html
Trotters (small portion) - bones	600	g	http://www.calorieking.com/foods/calories-in-variety-meats-by-products-offals-pork-feet-trotters-simmered_f-ZmlkPTYzNDU3.html
Meat, unspecified			
Small piece	25	g	Assumption from personal experience
Meatball, Korean style	20	g	http://emart.ssg.com/item/itemView.ssg?itemId=1000005923818
Spam			
Can	340	g	http://www.ssg.com/item/itemView.ssg?itemId=1000013082867
Piece	3	g	Assumption from personal experience

ITEM	VALUE	UNITS	SOURCE
Seafood			
Anchovies, dried			
1 Dried anchovy	2	g	http://job.jisiklog.com/qa/4431035
1 Handful	15	g	Assumption from personal experience
Fish bones from 1 fish (unspecified)	58	g	Averaged from other diary entries
Freshwater snail (우렁이)			
Without shell	7	g	http://www.xn--3e0bp4rgzlpwau2q.com/bbs/board.php?bo_table=sub02_02&wr_id=21
Shell only	29	g	http://www.urungee.com/bbs/board.php?bo_table=sub02_01&wr_id=3
Clam			
Whole, no shell	4	g	http://blog.naver.com/j_yea0211/220380742451
Whole, with shell	10	g	http://blog.naver.com/eunhwahaha/220588162919
Handful, with shells	200	g	http://www.viva100.com/main/view.php?key=20160210010002240
Shells only - 1 handful	120	g	Calculated
Crab, blue (used in 개장) - shell	45	g	https://www.bluecrab.info/buying_hards.htm
Croaker (조기)			
Whole	250	g	http://emart.ssg.com/item/itemView.ssg?itemId=1000006335659
Bones and head from 1 fish	35	g	Averaged from other diary entries
Hairtail (갈치)			
1 piece, cooked (토막)	150	g	http://emart.ssg.com/item/itemView.ssg?itemId=0000010458403
Bones from 1 piece (토막)	50	g	http://emart.ssg.com/item/itemView.ssg?itemId=0000010458403
Mackerel (고등어)			
Whole	300	g	http://emart.ssg.com/item/itemView.ssg?itemId=1000015310208
Skin and bones from 1 fish	82	g	Averaged from other diary entries
Skin, bones, and head from 1 fish	160	g	http://moonsungsil.com/140190877534
Bones from 1 piece (토막)	10	g	Averaged from other diary entries
Saury (꽁치)			
Whole	120	g	http://emart.ssg.com/item/itemView.ssg?itemId=1000009566788
Canned, 1 piece	47	g	http://board.miznet.daum.net/gaia/do/cook/recipe/mizr/read?articleId=42937&&bbsId=MC001&pageIndex=1
Bones and head from 1 fish	27	g	Averaged from other diary entries
Sashimi - 1 plate	300	g	Assumption from personal experience
Shrimp			
Without shell and head	37	g	https://www.thespruce.com/shrimp-counts-per-pound-and-serving-sizes-3054059
Shell and head	18	g	https://www.chowhound.com/post/surprising-yield-shrimp-peeled-unpeeled-866293

ITEM	VALUE	UNITS	SOURCE
Squid			
Whole	250	g	http://emart.ssg.com/item/itemView.ssg?itemId=1000004502649
Bone, eyes, skin	63	g	Averaged from other diary entries
Tuna, canned - 1 can	100	g	http://emart.ssg.com/item/itemView.ssg?itemId=0000006610166
Vegetables			
Bell pepper			
Whole	200	g	http://www.calorieking.com/foods/calories-in-fresh-or-dried-vegetables-green-sweet-peppers-raw_f-ZmlkPTcwOTM1.html
Seeds, core, and stem	20	g	Averaged from other diary entries
Slice	5	g	Assumption from personal experience
Bak choy (청경채) - whole	50	g	http://emart.ssg.com/item/itemView.ssg?itemId=1000015332787
Broccoli			
Crown	200	g	http://emart.ssg.com/item/itemView.ssg?itemId=0000006843114
Stalk	78	g	http://www.calorieking.com/foods/calories-in-fresh-or-dried-vegetables-broccoli-raw_f-ZmlkPTYzMzM0.html
Beansprout - 1 sprout	0.5	g	Assumption from personal experience
Cabbage, Napa - whole (통)			
Stem and outer leaves	140	g	http://lhtcmy.blog.me/40099338813
Outer leaf	15	g	Assumption from personal experience
Cabbage, Red - whole (통)	839	g	https://ndb.nal.usda.gov/ndb/foods/show/2890?fgcd=&manu=&lfacet=&format=&count=&max=35&offset=&sort=&qlookup=11112
Cabbage, Western			
Whole (통)	800	g	http://job.jisiklog.com/qa/15518003
Outer leaves	91	g	http://www.calorieking.com/foods/calories-in-fresh-or-dried-vegetables-cabbage-raw_f-ZmlkPTYzMzEy.html
Carrot peel	23	g	Averaged from other diary entries
Chives, Asian (부추)			
Bunch (단)	500	g	http://emart.ssg.com/item/itemView.ssg?itemId=1000012633712
Chopstickful	10	g	Assumption from personal experience
Chili pepper			
Whole	45	g	http://www.wolframalpha.com/input/?i=chili+pepper&a=*MC.~-_*ExpandedFood.dflt-&a=*MC.~-_*ExpandedFood.dflt-&a=*MC.~-_*ExpandedFood.dflt-&a=*DPClash.ExpandedFoodE.chili+pepper-_*HotGreenChiliPepper-
Slice	3	g	Assume 1 chili pepper makes 15 slices
Stem	5	g	Assumption from personal experience
Stems - 1 handful	50	g	Assume 10 in 1 handful

ITEM	VALUE	UNITS	SOURCE
Corn			
Grains, cooked - 1 handful	30	g	Assumption from personal experience
Cob	50	g	http://www.calorieking.com/foods/calories-in-frozen-vegetables-corn-sweet-white-kernels-on-cob-boiled-drained-without-salt_f-ZmlkPTYyNzM5.html
Cucumber			
Whole	150	g	Averaged from other diary entries
Peel	16	g	Assumes similar skin-peel ratio as persimmon
Stem	4	g	Assumption from personal experience
Pickled, - 1 slice	8	g	http://calorielab.com/foods/cucumbers/149
Pickled (오이지) - 1 piece	100	g	http://blog.naver.com/nana9648/20109914788
Eggplant			
Peel	86	g	http://www.calorieking.com/foods/calories-in-fresh-or-dried-vegetables-eggplant-aubergine-raw_f-ZmlkPTcwODIw.html
Stem	10	g	Assumption from personal experience
Garlic clove, whole	3	g	http://www.wolframalpha.com/input/?i=garlic+clove&dataset=
Kelp (다시마)			
Sheet	10	g	Assumption from personal experience
Piece, from soup (미역국)	2	g	Assumption from personal experience
Kimchi			
1 Piece	22	g	Averaged from other diary entries
1 Handful	109	g	Assumes 5 pieces in one handful
Leek, Korean (대파)			
Bunch (단)	1,000	g	http://www.interpark.com/product/MallDisplay.do?_method=detail&sc.shopNo=0000100000&sc.dispNo=021770039003&sc.prdNo=1149255314&evtNo=
Pickled (락교) - 1 piece	2	g	http://blog.naver.com/sorami78/220430246243
Lettuce			
Whole	619	g	http://www.calorieking.com/foods/calories-in-fresh-or-dried-vegetables-lettuce-cos-or-romaine-raw_f-ZmlkPTcwODk3.html
Stem and core	37	g	http://www.calorieking.com/foods/calories-in-fresh-or-dried-vegetables-lettuce-cos-or-romaine-raw_f-ZmlkPTcwODk3.html
Leaf	5	g	http://lhtcmy.blog.me/40099338813
Stem from 1 leaf	2	g	Assumption from personal experience
Lettuce salad - 1 handful	40	g	Assume 8 lettuce leaves in a handful
Lotus root – Peel	28	g	http://www.calorieking.com/foods/calories-in-fresh-or-dried-vegetables-lotus-root-raw_f-ZmlkPTcwODMx.html

ITEM	VALUE	UNITS	SOURCE
Mushrooms, Enoki (팽이버섯)			
Bunch	150	g	http://www.ssg.com/item/itemView.ssg?itemId=1000011346589
Stems from 1 bunch	24	g	http://www.calorieking.com/foods/calories-in-fresh-or-dried-vegetables-enoki-mushrooms-raw_f-ZmlkPTE1MjA1MQ.html
Mushrooms, King Oyster (새송이버섯)			
Whole	50	g	http://www.ssg.com/item/itemView.ssg?itemId=0000008640693
Stem	5	g	Assumption from personal experience
Mushrooms, Shiitake			
Whole	19	g	http://www.calobonga.com/calorieCounter/food/11238/1/calorie-counter.lz
Stem	2	g	http://blog.naver.com/witchyoli/220381908775
Onion			
Whole	93	g	http://www.calorieking.com/foods/calories-in-fresh-or-dried-vegetables-onions-boiled_f-ZmlkPTEyNzMyNg.html
Peel	33	g	Averaged from other diary entries
Slice, 3 cm	10	g	http://www.calorieking.com/foods/calories-in-fresh-or-dried-vegetables-onions-boiled_f-ZmlkPTEyNzMyNg.html
Potato			
Whole	210	g	http://www.calorieking.com/foods/calories-in-fresh-or-dried-vegetables-potatoes-raw-flesh-skin_f-ZmlkPTcwOTY5.html
Peel	31	g	Averaged from other diary entries
Pumpkin			
Whole	1,000	g	http://www.homeplus.co.kr/app.product.GoodDetail.ghs?comm=usr.detail&good_id=112579299
Stem	10	g	Assumption from personal experience
Radish, Korean (무)			
Pickled young (알타리무) - 1 piece	500	g	http://webcache.googleusercontent.com/search?q=cache:n9TThKLyM4kJ:www.jangboja.com/shop/goods/goods_view.php%3Fgoodsno%3D20034%26category%3D051001+&cd=29&hl=en&ct=clnk&gl=us
Sesame leaf			
Whole	2	g	http://blog.naver.com/dusrhkdbs/220391213051
Stem	2	g	Assumption from personal experience
Soy bean, cooked	4	g	http://www.calorieking.com/foods/calories-in-fresh-or-dried-vegetables-edamame-green-soybeans-boiled_f-ZmlkPTExMTA1OA.html
Spinach - 1 stalk and leaf	10	g	http://www.ssg.com/item/itemView.ssg?itemId=1000016150641
Spring onion			
Bunch (단)	800	g	http://emart.ssg.com/item/itemView.ssg?itemId=1000012631307
Whole	200	g	Assumes 4 spring onions in 1 dan
Root only	5	g	Assumption from personal experience
Root and peel	17	g	Averaged from other diary entries
Chopped piece	2	g	Assumption from personal experience

ITEM	VALUE	UNITS	SOURCE
Sweet potato (고구마)			
Whole	160	g	http://emart.ssg.com/item/itemView.ssg?itemId=0000010732157
Peel	48	g	Averaged from other households' diary entries
Vegetables (unspecified)			
Leaf	5	g	Assumption from personal experience
Julienned - 1 sliver	2	g	Assumption from personal experience
Zucchini			
Whole	200	g	http://lhtcmy.blog.me/40099338813
Peel	32	g	Assumes similar skin-peel ratio as persimmon
Stem	17	g	Averaged from other households' diary entries
Fruits			
Apple			
Whole	196	g	http://www.calorieking.com/foods/calories-in-fresh-fruits-apples-raw-with-skin_f-ZmlkPTYzODc4.html
Peel and core	40	g	Averaged from other diary entries
1 Slice	25	g	Assume 8 slices, Korean style
1 Seed	0.7	g	http://www.livescience.com/44686-apple-nutrition-facts.html
Apricot			
Whole	35	g	http://calorielab.com/foods/apricots/63
Seed	3	g	http://www.calorieking.com/foods/calories-in-fresh-fruits-apricots-raw_f-ZmlkPTYzODc0.html
Banana			
Whole	182	g	http://www.calorieking.com/foods/calories-in-fresh-fruits-bananas-raw_f-ZmlkPTczMzI5.html
Peel	76	g	Averaged from other diary entries
Stem	20	g	Assumption from personal experience
Blueberry, whole	0.5	g	http://www.ask.com/food/much-blueberries-weigh-57bab2a5951e0942
Cantaloupe			
Whole	814	g	https://ndb.nal.usda.gov/ndb/foods/show/2274?fgcd=&man=&lfacet=&count=&max=35&sort=&qlookup=09181&offset=&format=Full&new=&measureby=
Peel and seeds	399	g	https://ndb.nal.usda.gov/ndb/foods/show/2274?fgcd=&man=&lfacet=&count=&max=35&sort=&qlookup=09181&offset=&format=Full&new=&measureby=
Cherry			
Whole	8	g	http://www.calorieking.com/foods/calories-in-fresh-fruits-sweet-cherries-raw_f-ZmlkPTYzODAz.html
Stem	0.3	g	Assumption from personal experience
Stem and seed	0.7	g	http://www.calorieking.com/foods/calories-in-fresh-fruits-sweet-cherries-raw_f-ZmlkPTYzODAz.html

ITEM	VALUE	UNITS	SOURCE
Cherry tomato			
Whole	11	g	http://www.cockeyed.com/science/weight/cherry-tomato.html
Stem	7	g	Assumption from personal experience
Chestnut - shell	3	g	Assumption from personal experience
Cranberry, whole	1	g	Assumption from personal experience
Grape			
Bunch	400	g	http://lhtcmy.blog.me/40099338813
Peels from 1 bunch	136	g	http://www.calorieking.com/foods/calories-in-fresh-fruits-grapes-american-slip-skin-raw_f-ZmlkPTYzNzg0.html
Stems from 1 bunch	8	g	http://www.calorieking.com/foods/calories-in-fresh-fruits-grapes-american-slip-skin-raw_f-ZmlkPTYzNzg0.html
Whole grape (averaged)	4	g	http://www.calorieking.com/foods/calories-in-fresh-fruits-grapes-red-or-green-european-type-raw_f-ZmlkPTYzNzQ4.html
Grapefruit			
Whole	328	g	http://www.calorieking.com/foods/calories-in-fresh-fruits-grapefruit-average-all-varieties-raw_f-ZmlkPTYzNzY5.html
Section	25	g	Assumes 13 sections in 1 fruit
Kiwi			
Peel	23	g	http://www.calorieking.com/foods/calories-in-fresh-fruits-kiwi-fruit-chinese-gooseberries-raw_f-ZmlkPTYzNzYy.html
Lemon			
Slice	9	g	http://howmanyhowmuch.com/?p=891
Seed	1	g	Assumption from personal experience
Peel and seeds	39	g	https://ndb.nal.usda.gov/ndb/foods/show/2255?fgcd=&man=&lfacet=&count=&max=&sort=&qlookup=&offset=&format=Full&new=&measureby=
Melon, Korean			
Whole	350	g	http://db.gba.go.kr/sub02/sub01_view.php?info_no=134&kind_code=04
Peel and seeds	87	g	Averaged from other diary entries
Orange			
Peel	106	g	Averaged from other diary entries
Peach			
Whole	120	g	http://lhtcmy.blog.me/40099338813
Seed	5	g	http://www.calorieking.com/foods/calories-in-fresh-fruits-peaches-raw_f-ZmlkPTYzNzA3.html
Skin	5	g	Assume skin is similar mass to the pit
Pear, Korean			
Whole	550	g	http://emart.ssg.com/item/itemView.ssg?itemId=0000010372752
Core	50	g	http://www.calorieking.com/foods/calories-in-fresh-fruits-asian-pears-raw_f-ZmlkPTYzNjA3.html
Peel	20	g	Assumption from personal experience

ITEM	VALUE	UNITS	SOURCE
Persimmon			
Whole	200	g	http://www.calorieking.com/foods/calories-in-fresh-fruits-persimmons-japanese-raw_f-ZmlkPTYzNjYw.html
Skin and seeds	32	g	http://www.calorieking.com/foods/calories-in-fresh-fruits-persimmons-japanese-raw_f-ZmlkPTYzNjYw.html
Dried	40	g	http://emart.ssg.com/item/itemView.ssg?itemId=1000012555506
Plum			
Whole	83	g	http://www.freshfactory.kr/?mid=gallery&page=1&document_srl=3889&ckattempt=1
Seed	5	g	http://www.calorieking.com/foods/calories-in-fresh-fruits-plums-raw_f-ZmlkPTYzNjM4.html
Plum, Japanese - whole	25	g	http://blog.daum.net/kcm2367/143
Strawberry, Korean			
Whole	19	g	http://www.calorieking.com/foods/calories-in-fresh-fruits-strawberries-raw_f-ZmlkPTYzNjMy.html
Stem and leaves	1	g	http://www.calorieking.com/foods/calories-in-fresh-fruits-strawberries-raw_f-ZmlkPTYzNjMy.html
Tangerine			
Peel	25	g	Averaged from other diary entries
Tomato			
Whole	83	g	http://emart.ssg.com/item/itemView.ssg?itemId=1000009780282
Peel	15	g	Assumption from personal experience
Watermelon			
Whole	5,909	g	http://www.calorieking.com/foods/calories-in-fresh-fruits-watermelon-raw_f-ZmlkPTYzNjA1.html
Cube, 2 cm sides	1	g	Calculated based on flesh density
Peel from 1 melon	1,773	g	http://www.watermelon.org/FoodService/Watermelon-Basics
Peel from 1 piece	11	g	Assumes 1 melon sliced into 16 wedges, each wedge sliced 10 times
Seed	0.2	g	http://askville.amazon.com/watermelon-seed-weigh/AnswerViewer.do?requestId=80965069
Liquids			
Canned coffee, Starbucks - 1 can	200	g	http://emart.ssg.com/item/itemView.ssg?itemId=1000019284020
Packaged radish *kimchi* liquid - 1 pack	112	g	http://blog.daum.net/_blog/BlogTypeView.do?blogid=0CETz&articleno=16617494
Rice wine, unfiltered (막걸리)	200	g	http://www.naturei.net/COMMUNITY/cindex.html?access=view&search_access=&search_word=&search_type=&bbsid=43&code=1295&page=8
Yakult - 1 bottle	65	g	http://emart.ssg.com/item/itemView.ssg?itemId=0000008069274
Yoghurt drink (불가리스) - 1 bottle	150	g	http://emart.ssg.com/item/itemView.ssg?itemId=0000007141873
Miscellaneous			
Almond - 1 nut	1	g	http://www.thecaloriecounter.com/foods/1200/12061/food.aspx
Biscuits			

ITEM	VALUE	UNITS	SOURCE
Ace (에이스) biscuits - 1 piece	20	g	http://www.ssg.com/item/itemView.ssg?itemId=1000017462032
Binch (빈츠) chocolate biscuits - 1 piece	9	g	http://emart.ssg.com/item/itemView.ssg?itemId=0000009014185
Cheese Sand (치즈샌드) biscuits - 1 piece	15	g	http://emart.ssg.com/item/itemView.ssg?itemId=0000009527662
Lotte Sand (롯데샌드) biscuits - 1 piece	17	g	http://www.consumernews.co.kr/?mod=news&act=articleView&idxno=404032&page=&total=
Cocktail sausage - 1 link	8	g	http://www.calorieking.com/foods/calories-in-franks-wieners-sausages-smoked-sausage-cocktail-smokies-made-with-pork-chicken_f-ZmlkPTE2Mjc3OA.html
Dumpling	15	g	https://www.fatsecret.com/calories-nutrition/generic/pot-sticker
Fish cake - Rectangular slice	100	g	http://www.ssg.com/item/itemView.ssg?itemId=1000012691565
French fry			
Generic, large - 1 fry	18	g	http://www.ssg.com/item/itemView.ssg?itemId=1000012587986
McDonald's French fry	2	g	http://www.mcdonalds.co.kr/www/kor/menu/menu_view.do?cate_cd=150&product_cd=ss01&group_seq=257
Ginseng root, red - 1 slice	10	g	Assumption from personal experience
Laver, dried			
Big sheets - 1 pack	20	g	http://emart.ssg.com/item/itemDtl.ssg?itemId=1000005877266
Big sheets - 1 sheet	2	g	http://emart.ssg.com/item/itemDtl.ssg?itemId=1000005877266
Small sheets - 1 sheet	0.5	g	http://emart.ssg.com/item/itemView.ssg?itemId=1000015719558
Kalopanax (엄나무) - 1 stem	5	g	Assumption from personal experience
Kimbap - 1 piece	19	g	http://totheno1.egloos.com/1843879
Laver stuffed with noodles (김마리) - 1 piece	50	g	http://www.myfitnesspal.com/food/calories/-183472043
Pancake, Korean style (전)			
Buckwheat pancake (메밀전)	120	g	http://emart.ssg.com/item/itemView.ssg?itemId=1000017833430
Zucchini pancake (whole)	250	g	Assumption from personal experience
Zucchini/mushroom pancake - 1 piece	20	g	Assumption from personal experience
Vegetable pancake - 1 piece	88	g	Averaged from other diary entries
Pancake, Western style (핫케익) - whole	77	g	http://www.calorieking.com/foods/calories-in-pancakes-buttermilk-pancake-prepared-from-recipe_f-ZmlkPTE0NzcyMw.html
Peanuts			
Whole - 1 handful	28	g	https://idph.iowa.gov/Portals/1/Files/WIC/svg_size_engligh.pdf
Shells - 1 handful	25	g	http://proceedings.spiedigitallibrary.org/proceeding.aspx?articleid=1341520
Pizza			
Generic pizza - 1 slice	150	g	http://news.kukinews.com/article/view.asp?arcid=0009854270
Mr. Pizza Regular Combo - 1 slice	80	g	http://www.mrpizza.co.kr/menu/productView
Mr. Pizza Regular Combo - crust from 1 slice	21	g	Calculated
Red date (대추)			
Whole	15	g	http://fruitspecies.blogspot.com/2007/09/jujube.html
Seed	1	g	http://www.calorieking.com/foods/calories-in-fresh-fruits-jujube-raw_f-ZmlkPTYzNzYw.html

ITEM	VALUE	UNITS	SOURCE
Snack, dried (unspecified) - 1 piece	0.5	g	Assumption from personal experience
Sesame seed - 1 seed	0.004	g	http://www.bluebulbprojects.com/measureofthings/singleresult.php?comp=weight&unit=gms&amt=0.0044&i=367
Soup residues - 1 handful	30	g	Assumption from personal experience
Teabag, used	15	g	Assumption from personal experience