

T.C.
BAHCESEHIR UNIVERSITY
GRADUATE SCHOOL
THE DEPARTMENT OF BUSINESS ADMINISTRATION

**AN EXPLORATORY STUDY OF FOOD WASTE MANAGEMENT
PRACTICES AT CONSUMER AND RETAILER LEVEL**



MASTER'S THESIS
LUBNA KASIM ALI AL-RUSHDY

ISTANBUL, 2024

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

AN EXPLORATORY STUDY OF FOOD WASTE MANAGEMENT PRACTICES AT CONSUMER AND RETAILER LEVEL

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Master of Business Administration

Thesis Advisor: Assist. Prof. Dr. Markus C. Slevogt

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This study seeks to add to the food waste study literature that evaluates and assesses the efficacy of different types of increasing consumers' awareness and responsibility for reducing food waste. A quantitative online consumer survey with Sample (n=247) is representative of adults living in Türkiye. The data collected from the consumers through an online survey showed that poor consumer awareness, and lower sense of responsibility towards food waste has a negative Impact on consumers ' intention to reduce food waste. Education and age were identified to have an influence on intentions to reduce food waste. A second set of data are also based on a series of observations which were conducted in a retail supermarket located in Türkiye, conducting interviews on how the managers are planning to reduce their day-to-day food waste. The data which was focused on the waste of fresh fruit and vegetables within a three-month observation period concluded that, Grapes; Tomatoes; Potatoes; peaches and cucumbers are the main categories which had the highest amount of wasted quota. The study demonstrated that although retail stores and shareholders are recognizing the food waste problem, it is not seen as a crucial problem that must be addressed in the near future or at least that the waste needs to be processed in a different way that is more sustainable. this study demonstrates the economic and financial impact of avoidable food loss and high waste when it comes to fresh fruits and vegetables.

Keywords: Fruit and Vegetables Waste, Waste Prevention, Consumers Intentions, Retailer, Food Waste Awareness

ÖZ

MÜŞTERİ VE PERAKENDECİ DÜZEYİNDE GIDA ATIK YÖNETİMİ UYGULAMALARINA İLİŞKİN

Lubna Kasim Ali Alrushdy
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Bu çalışma, gıda israfını azaltma konusunda tüketicilerin farkındalığını ve sorumluluğunu artırmanın farklı türlerinin etkinliğini değerlendiren ve değerlendiren gıda israfı çalışma literatürüne katkıda bulunmayı amaçlamaktadır. Örneklem (n=247) ile yapılan nicel bir çevrimiçi tüketici anketi, Türkiye'de yaşayan yetişkinleri temsil etmektedir. Çevrimiçi bir anket yoluyla tüketicilerden toplanan veriler, zayıf tüketici bilincinin ve gıda israfına karşı daha düşük sorumluluk duygusunun, tüketicilerin gıda israfını azaltma niyeti üzerinde olumsuz bir etkisi olduğunu göstermiştir. Eğitim ve yaşın, gıda israfını azaltma niyetleri üzerinde etkisi olduğu tespit edildi. İkinci bir veri seti de Türkiye'de bulunan bir perakende süpermarkette gerçekleştirilen ve yöneticilerin günlük gıda israfını nasıl azaltmayı planladıklarına dair görüşmeler yapan bir dizi gözleme dayanmaktadır. Üç aylık bir gözlem süresi içinde yaş meyve ve sebze israfına odaklanan veriler, Üzümlerin; Domatesler; Patates; Şeftali ve salatalık israf kotasının en yüksek olduğu ana kategorilerdir. Çalışma, perakende mağazaları ve hissedarların gıda israfı sorununu kabul etmelerine rağmen, bunun yakın gelecekte ele alınması gereken önemli bir sorun olarak görülmediğini veya en azından atıkların daha sürdürülebilir olan farklı bir şekilde işlenmesi gerektiğini göstermiştir. Bu çalışma, taze meyve ve sebzeler söz konusu olduğunda önlenemez gıda kaybının ve yüksek israfın ekonomik ve finansal etkisini göstermektedir.

Anahtar Kelimeler: Meyve ve Sebze İsrafı, İsrafın Önlenmesi, Müşteri Niyetleri, Perakendeci, Süpermarketler, Gıda İsrafı Bilinci.

One of God's blessings is a life based on Knowledge. I would like to dedicate my thesis to my late father Kasim Ali, it has been 20 years and I hope you are proud of me.

None of this would have been possible without my Mam who has spent a lifetime teaching us that nothing is impossible; that every cloud has a silver lining. My sister Zahra Alrushdy as she was the one who kept pushing me to follow my passion and has been my moral compass guiding me towards the light.

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LIST OF ABBREVIATIONS

FW	Food Waste
FFV	Fresh Fruits and Vegetables
UN	United Nations
FAO	Food and Agriculture Organization
SDG	Sustainable Development Goals
CI	Consumer Intention
CA	Consumer Awareness
CR	Consumer Responsibility
CF	Carbon footprint
GHG	Greenhouse Gas

Chapter 1

Introduction

Over a billion people work in the global food and agriculture sector: making it a third of the global workforce (ILO 2014). The population growth is predicted to reach 9 billion people in 2075 according to the United Nations; Food demand is expected to increase about 60% by 2050 (FAO, 2013; UNDESA, 2017). which means that food production needs to increase by 15% of its current level to meet the demand of the growing population. The clear contradiction between wasted edible food and the ever-increasing demand for food poses a threat to food security (Parfitt et al., 2010; Schneider, 2013; Garnett, 2014). Food waste is a global problem that affects each pillar of sustainable development which are environment, social and economic (FAO, 2013) Reducing food waste which helps in creating a secure global food system. Around 1.3 billion tons of food is being wasted per year globally according to the Food and Agriculture Organization for United Nations (Gustavsson et al., 2011). The fact that around a billion people are severely hungry makes food waste management a significant part that affects the environment and social aspects as well (FAO, 2013). Mitigation of food waste means taking in consideration the global socio-economic and environmental impacts (Waste & Resources Action Program- WRAP 2013)

Food waste can be reused as fertilizer for plants or to generate energy (Pongrácz, E.; Pohjola, V.J., 2004). The waste and Resources Action Program (WRAP) defines food waste inside homes as two types one is avoidable waste that includes food and drink which was at some point was edible, possibly avoidable waste includes food and drinks that some people eat and others don't or food losses that is thrown away during food preparations, Unavoidable waste which comes from food and drinks preparation that is not edible under normal conditions (Quested, T.; Johnson, H., 2012). One of the United Nations SDG goals is to halve food waste by both retail and consumer end and reduce the food losses during production and supply (UN, 2015).

Consumers behavior towards food waste has been linked to many factors researchers found that women were found to compose more food waste than men when while they are shopping for grocery and households with the kids was found to compose more food waste (Jorissen et al., 2015; Sinvennoinen et al., 2014).

Other studies have showed that the older population tend to reduce food waste better than young population (Jorissen et al., 2015; Quedsted et al., 2013) while younger people tend to know more information regarding food losses and recycling and its negative impact on the environment (Zepeda and Balaine, 2017). increasing awareness and educational campaigns, preparing shopping lists and tips to use food scraps were found useful to reduce food waste (China; Ghiuta, 2018).

The United Nations Climate Change Conferences which were held this year in the UAE one of the largest conferences in the world discussing climate change, limit emissions and halt global warming discussed many key issues, food security was on the agenda of this year taking in consideration natural resources over 130 countries which represents over 5.7 billion people, 70% of the food we eat and around 500 million farmers and 76% of total emissions are from the global food system. COP28 UAE has released a declaration on Sustainable Agriculture, Resilient Food Systems, and Climate Action (COP28, 2023).

In this study a questionnaire was shared with participants to collect data regarding their Awareness and Responsibility, and Intention to reduce food waste. The online questionnaire which was shared online in November 2023 with a sample size of (n = 247). The questionnaires which reflect the variables were answered in a 1–5 Likert scale (higher number indicates higher frequency)

The second part of the research which was an observation to the practices of the retailer (Supermarket) to tackle the food waste in their day-to-day tasks and how they can get down on the losses which is caused by food waste, the data which was

collected along three months period of time where the focus was on fresh fruits and vegetables focusing on the ones with short lifecycle and shelf life.

There was a conducted interviews with the regional manager; area manager and store manager along with FFV sales personnel to understand the workflow on the fresh fruits and vegetables section: from the season planning an in store sales budget to FFV waste target(the target for this specific retailer is 4.5 per yearly quarter) and FFV margins (the achieved margins for fresh fruits and vegetables section for this specific retailer is an average of 50.6% per month with 1.6 million Turkish Lira gross profit while the total store profit 9.6 million Turkish Lira in October 2023).

An observation was made during regular store visits to check the store process for FFV waste management. Sadly, since there are no laws to enforce proper waste management in Türkiye, FFV waste are disposed of into the metropolitan city waste bins. Analyzing the data based on their daily losses and the practices the managers are using to limit their waste from an economical perspective to decrease the losses and sustain a low ecological impact from FFV.

Fresh fruits and vegetables, especially considering 100% organic farming, is a dynamic field where the season, supply chain conditions, weather and climate change affects the lifespan and quality of the FFV. In the recent years, more people are getting more concerned about what they eat and put in their bodies while at the same time looking for reasonable prices with green sourcing and farming. One way to increase the lifespan of FFV is to use bio coatings; new technology where natural coating for FFV is used to increase the lifespan of the fresh product without affecting the chemical and the nutrients combinations of the fresh fruits; it was recently published that fresh blueberries with bio coating have higher levels of Vitamin C compared with the ones with no coatings.

1.1 Important Definitions

- Food waste: Refers as any substance (Food and Drink) that is intended for human consumption whether processed or raw used in the manufacturing, preparation or treatment food that has been spoiled and is no longer fit for human consumption
- Food loss: which refers to all the crop and livestock human-edible commodity and products that is directly or indirectly exit the post-harvest, production, retail, and supply chain,

1.2 Statement of the Problem

The fundamental purpose of this study is to investigate how Awareness and responsibility of consumers is affecting their intention to reduce food waste; and to explore how supermarkets are disposing of fruits and vegetables waste on daily basis and what kind of practices are being employed to prevent food waste or decrease it as well to measuring the economic impact of the FFV waste for the retailers to encourage shareholders to take serious actions towards decreasing the financial losses and have positive PNL numbers (profit and losses reports) by finding more sustainable solutions of sourcing; packaging and selling.

1.3 Purpose of the Study

Analyze and understand the following:

1. To know how food waste is affecting retailers and how they are planning to reduce waste in their day-to-day strategy
2. To assess the benefits and drawbacks of consumers' awareness, responsibility, and intentions of consumers on food waste reduction

1.4 Hypotheses

H1: Positive Consumer awareness towards food waste have a positive influence on their intention to reduce food waste

H2: Consumer responsibility towards food waste is positively associated with their intentions to reduce food waste.

H3: Adopted corporate and managerial approaches to food waste reduction at the retailers; however basic.



Chapter 2

Literature Review

2.1 Food Waste Background

Food waste is determined as the food which is suitable for consumption but discarded by personal choice or is has been spoiled or expired ; based on the Food and Agriculture Organization of the United Nations (FAO); Buzby, Hyman, Stewart and Wells (2011) defined food waste as a result of edible product that is not consumed and while an average person needs 2,200 kilocalories on daily basis ; a study in the United Kingdom showed that the average kilocalories was around 3,100 per person which indicates that large amount of food were wasted by consumers, suppliers, and distributors (Wenlock; Buss; & Derry, 1980). Boston Consulting Group calculated that the food waste will increase by one-third in 2030 (Hegnsholt et el., 2018) and so many approaches arose to reduce food waste, the wasted food was fed to animals for example as a way to reduce the food waste and its negative impact on the climate (Bruttini, 1923); however those efforts were counterfeited by new trends and the focus on the `Perfect Fruit` demand by supermarkets and retailers.

Supermarket chains developed standards for the products, fruit and vegetables must be well-shaped, proper color, many were considered as waste because it didn't measure to the standers (Stuart, 2009), the supply chains were granted the chance of shipping food products to other countries because of the developing of food packaging which prevents food from getting spoiled, foil; cans; bottles; and jars which preserved food for long term consumptions however since the suppliers and consumers alike couldn't see, smell or touch the products which helped them to check if it's still eatable ; waste after shipping have increased and hence the `Food Labeling` have started : labeling which gave consumers and suppliers a date indicating when the product was produced, and shelf life (Newsome et al., 2014).

There are five main stages where Food Waste is happening: agricultural production, postharvest handling, storage, processing, distribution, and consumption (Gustavsson et al., 2011). Comparing developing countries with industrialized countries where in developing countries most of food waste and loss occurs in the earlier phases of the supply chain, agriculture, post-harvest, and processing while more than 40% of the food waste and loss is happening at the retail and consumer levels, in industrialized countries.

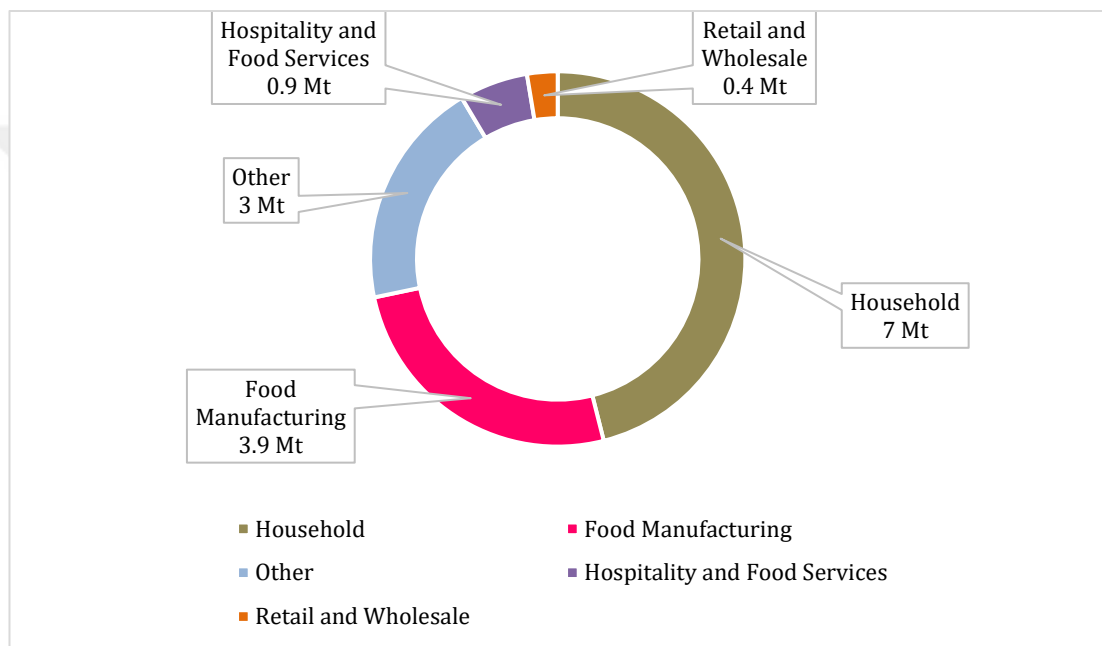


Figure 1. Amount of food waste arise in the UK based on sector.

2.2 Food Waste and Environmental Impact

FLW Management is a crucial part to reduce the negative effects it has on the economy and environment. Food waste is considered one of the biggest contributors responsible for carbon footprint which is equal to 3.3 billion tons of carbon dioxide making the food waste the third emitter after United States of America and China (FAO, 2013). Grizzetti et al. (2013) research showed that food waste is linked to nitrogen emissions.

Food waste has become a challenge to sustainability as it affects natural resources and greenhouse gas emissions which are linked to food production (FAO, 2019).

Previous studies focused on food waste at the consumer end in the household taking into consideration family size and shopping habits but (Yang et al., 2019) found that 62% of the total food waste at the consumer side in China is generated from outside of the home dining (restaurants). Globally, about 1.3 billion tons of food is being wasted and research showed that around 129 million tons of food waste were generated from Europe (Caldeira et al., 2019).

In some countries, food waste accounts for around 50% of the total solid waste produced (Adema, 2018), in the United States alone around 4,200 calories were produced per person, around half of the food available is wasted (USDA, 2010). All of which is promoting climate change since the food industry alone is accountable for 26% of greenhouse emissions (Lipinski et al., 2013). In 1973 William Rathje, an American archaeologist conducted many studies on landfills for several decades where food waste was the largest component of solid waste (Harrison et al., 1975; Rathje 1984; Rathje & Murphy, 2001), Methane gas is produced by food waste landfills which presents a global warming effect of 25 times higher than CO₂ (Adams et al., 2016).

2.3 Food Waste Within the Supply Chain

Food waste happens in every stage of the supply chain from suppliers and producers, customers to the retailers, FAO defines food waste as food which is suitable for consumption but has been thrown away because it is spoiled, expired, or neglected (FAO, 2014). While much research focused on the loss of food post-harvest losses since food waste happens mainly at the consumer and retailer's end. Food losses and waste (FLW) which is defined as "the edible parts of plants and animals produced for human consumption but are not ultimately consumed by people" (FAO, 2014).

The difference between food waste and losses is food waste represents the parts of food that is not consumed for some reason while food losses refer to the food which is lost along the supply chain before reaching the final consumer.

Supply chains must work on new technologies on both production and logistics stages that can help reduce food waste especially in developing countries (Parfitt et al., 2010). Fruit and vegetables amount for 30-50% shares of the food waste in European research (Gustavsson et al., 2011) and around 15-30% cooked food (Schmidt et al., 2018), fresh meat and fish make up 4% (Cox, J.; Downing, p, 2007).

2.3.1 Consumers' role in food waste reduction.

Around 50% of food losses and waste can be avoided by consumers (Schmidt et al., 2018). consumers are responsible for a great portion of food waste loss in the supply chains for developing and developed economies (Gustavsson et al., 2011). Post-consumer food waste is analyzed by factors such as consumer's choices and socio-economic factors that impact the consumer's behavior. In Europe, the food waste produced in the households' accounts for 53-71% of the total wasted followed by Food manufacturing 17-30% and retailer outlet 2-9% (FUSIONS 2016; Goldenberg 2016; WRAP 2017).

In Türkiye the average amount of wasted food per household and per person was 816.4g and 318.8g respectively and on the other hand the food waste is around 10% of the average daily energy requirement (2000 kcal) per person in Türkiye (Pekcan et al., 2006). Average household-related food waste per capita in Europe was 79 kg (Kemna, R. et al, 2017). Consumer food waste can be connected to cooking and preparing an extra amount and not consuming food in the due time and the lack of proper storage (Schmidt et al., 2018). Guilt was found to be an important factor for avoiding food losses and waste (Septianto et al., 2020).

Consumers actions play a crucial role in food waste in developed states, in addition to the food losses that occur during production, supplier and harvesting (ASchemann-Witzel et al., 2017). It was concluded that consumer with high individual environmental consciousness reduce food waste (Diaz-Ruiz el al., 2018). Food waste and losses starts from farms to households and studies show that preparing shopping

lists before going to grocery shopping can help reduce food waste (Quested et al., 2013). Researchers and scholars carried out several studies regarding food waste with consideration to different angles, (Graham-Rowe, 2015) suggested that people will not take actions to reduce food waste unless they are motivated.

In *Dive*, a documentary which was released in 2009, Jeremy Seifert draws the public's attention to the amount of wasted food in the United States; Jeremy filmed dumpster divers in Los Angeles supermarkets. The movie quoted Noam Chomsky: "Change doesn't trickle down from above, it grows from below" (Lenneman, 2013). An equivalent of 170 million CO₂ is being produced every year from around 88 million tons of food is being wasted from both retailers and consumer side in the United States (Buzby & Hyman, 2012). Food waste coexists with excessive consumption, according to the World Health Organization. Research shows that the behavioral aspect of consumers along with awareness and environmental attitude is an important factor to increase consumer engagement in restaurant food waste (Filimonau, 2019).

Many governments have started to create public campaigns to draw attention to the consumption habits; the French Environment and Energy Management Agency began an anti-food waste campaign in 2010 which included Tv, radio spots, advertisement. France created a target to cut their food waste in half by 2020 (ADEME, 2010); a similar campaign was launched by the Spanish Ministry of Agriculture which gave direction to consumers and catering services to reduce their food waste. More recent researchers have shown that lack of knowledge on food waste has a significant importance (Porpino et al., 2016). Routine related to planning, shopping is one of the drivers of food waste (Mattar et al., 2018) Older people are more skilled when it comes to leftovers usage (Davenport Et al., 2019; Evans, 2011; Visschers, 2016). Food waste from the consumers side was found to be the result of consumer behavior (Fanelli, R.M, 2019).

2.3.2 Government's role and impact.

Around 8-9% of global greenhouse gas emissions are generated from food waste (Mbow et al., 2019). Governments have a major role in minimizing FW and some countries have started taking serious actions towards the issue. Some countries started focusing on increasing the awareness at the consumer level; in United Kingdom, Food waste was found happening in both manufacturing and consumptions stages alike; the government made an effort to increase consumer awareness regarding the cost of food being wasted and how it can affect the environment negatively; by promoting some guidelines which helps the consumer on how to prevent the food waste. In the U.S., the government was focused on increasing the awareness of consumers and shed light on excessive ordering and consumption of food (Okumus, 2020).

Some focused on creating new laws and regulations; Korea for example, is making regulations to prevent or limit the amount of food wasted; by establishing a partnership between the NGO KZWMN, and other government authorities, general public and private sector to reduce the amount of food waste by 20% ; Korea also recycles 95% of its food waste, they created a system where the households pay for the food they throw away, creating a financial incentive to reduce waste (Hogan, 2015).

Japan passed the Food Recycling Law, it encouraged business on creating a cyclical manufacturing process to reduce and recycle waste or reuse it by turning into a compost or animal feed (Marra, 2014).

Politicians were also conducting studies about FW; In 1979 Ad Lansink, a Dutch politician, constructed a Waste Ladder with five stages: disposal, recovery, recycling, reuse, and prevention. The concept of “circular economy” was released in the 1980s (Pearce & Turner, 1990) and in the beginning of 1990s, Germany developed a project in anaerobic digestion plants, generating renewable energy from FW.

In 2008 EU established the Waste Framework Directive, it defined bio-waste as “biodegradable park waste, households, restaurants, and retail premises which laid the foundation of recycling society (European Commission, 2008).

The economic crisis between 2005 and 2007 caused an increase of 75% on food prices, milk, oilseeds, and other basic products which had a direct effect on commodity prices that have increased up to 200% in 2007 (FAO, 2009); and with many countries still suffering from the covid-19 effect; the crisis with Russia and Ukraine has made it more difficult for the world to recover from the shortage of food production and increase of prices due to global inflation. The Economist’s food price index showed that it was on the highest level since it was created in 1845” they chose “the end of cheap food” as their title (Economist, 2007). Food waste management have been one of the biggest issues to tackle to the extent that the United Nations created a day to focus on the awareness of Food loss, the 29th of September was named the International Day of Awareness on Food Loss and Waste Reduction. A day to educate the world on food waste impact; take collective actions and reinforce the connection that we all share this planet (UN, 2022). Each year, The United Nations, select a theme for the International Day of Awareness on Food Loss and Waste Reduction where the theme for 2023 was “Reducing food loss and waste: Taking Action to Transform Food Systems“, where it represented a call for the public, private sector, and the local authorities to take sustainable actions towards reducing food waste.

Now, more than ever solutions to tackle food waste are needed. The current estimation of food waste value is more than 400 billion USD yearly with 3.3 billion tons of greenhouse gas emissions (GHGs) per year; an estimate of 7% of all global greenhouse gas emissions (GHGs). A 2% decrease of GHGs which is one billion tons yearly can be achieved with an estimated saving between 120 to 300 billion USD per year if we can have a reduction in wasted food at the consumer level by 20% - 50% by 2030 based on WRAP estimations.

Those numbers are creating a motive for the world-leaders to legislate new laws in favor of decreasing food waste and its negative impact on the climate and helping the economy as well as sustaining the environment.

Developing new prevention plans in every step of the food supply chain (sourcing, retailing and consumers level) to reduce food loss and waste lies with the governments and businesses alike. At the consumer level for example, creating actions to reduce the food waste like addressing the labeling of the date on the fruits and their misunderstanding that leads to thrown away good food that could have been avoided (WRAP, 2015).

2.3.3 Retailers and the financial impacts.

The retail sector (grocery) produces a significant amount of food waste. Shopping behavior in stores affects food waste, research showed that consumer is unwilling to purchase suboptimal products and prefer fresh products which increase food waste (Aschemann-Witzel et al., 2015; De Hooge et al., 2017)

Discount products by retailers might encourage consumers to purchase more products that exceed their needs while (Radzimska et al., 2016) found that people who purchase product on offers tend to waste more, (Jorissen et al., 2015; Silvennoinen et al., 2014) found the opposite. Expiration date labeling was found misleading to consumers and causes edible food being wasted (McCarthy and Liu, 2017; Wilson et al., 2017).

Since food losses and waste exists in every step of the food value chain so increasing the awareness of food waste and creating more initiatives is not only a social and environmental priority but an economical one; minimizing food waste means increasing profit for the foodservice sector since food waste costs around EUR 2,4 trillion annually around the world (FAO, 2014) ;24 million tons of waste food comes from production, food services, wholesale, and retailers in developed markets (Stenmarck et al., 2016).

Adams et al. defines SOI (Sustainability Oriented Innovations) as a type of innovation that requires “making intentional changes to an organization’s philosophy and values, as well as to its products and environmental value in addition to economic returns”. Technology is considered to be an important factor in providing business with the necessary tools to assess the true value of waste (Wen, 2016).

2.4 Fresh Fruits and Vegetables Waste in Supermarkets and its Financial Impact.

In agricultural, 415 million tons are wasted: 600 million tons of food are wasted after harvest and at the mile of sales which is equal to 340 billion USD while 280 million tons are wasted on consumer level which is 170 billion USD (FAO, 2013). Around a third of all the edible food which is produced is currently being wasted and where fruit and vegetables account for 40-50% of the total wasted food (Gustavsson et al., 2011).

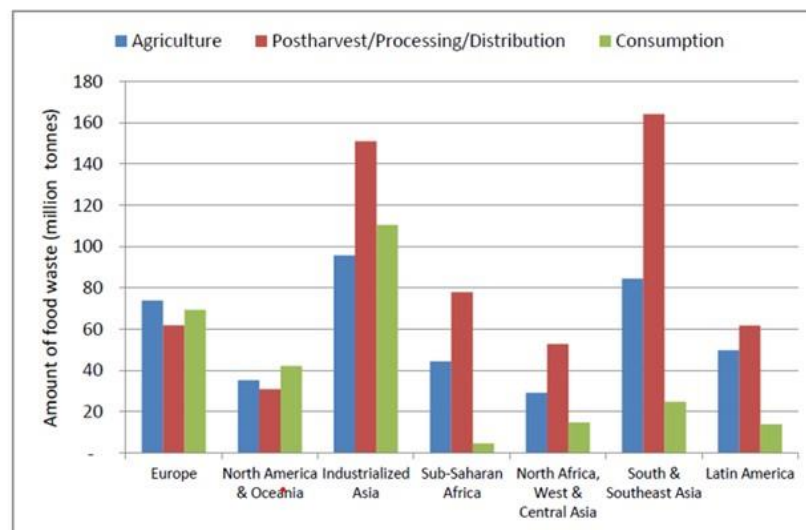


Figure 2. The amounts of food wasted arising by region and supply chain phase (FAO, 2011).

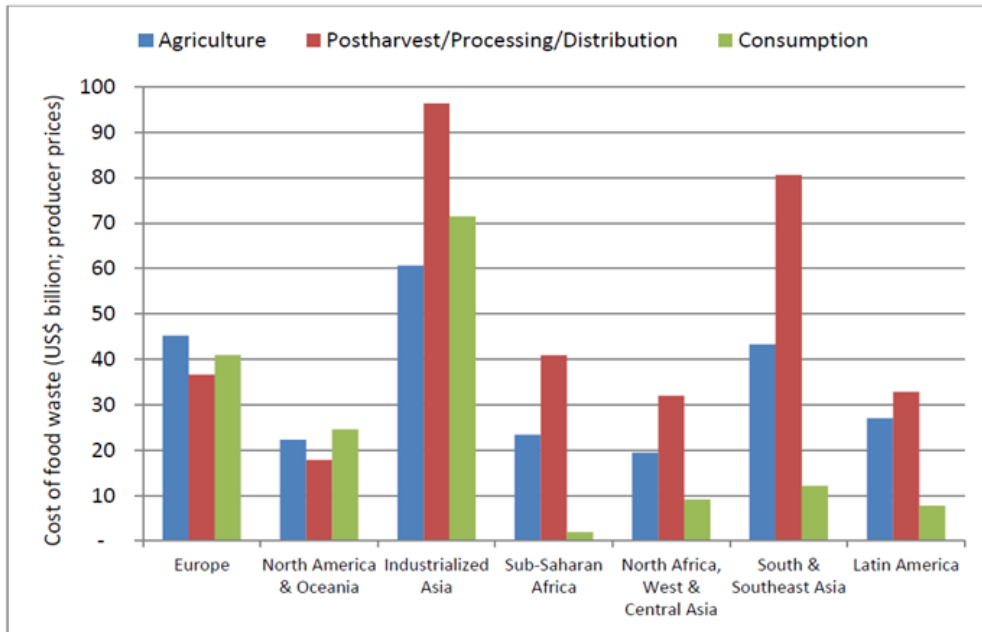


Figure 3. GHG emissions that linked to food waste arising by region and supply chain phase (FAO, 2011).

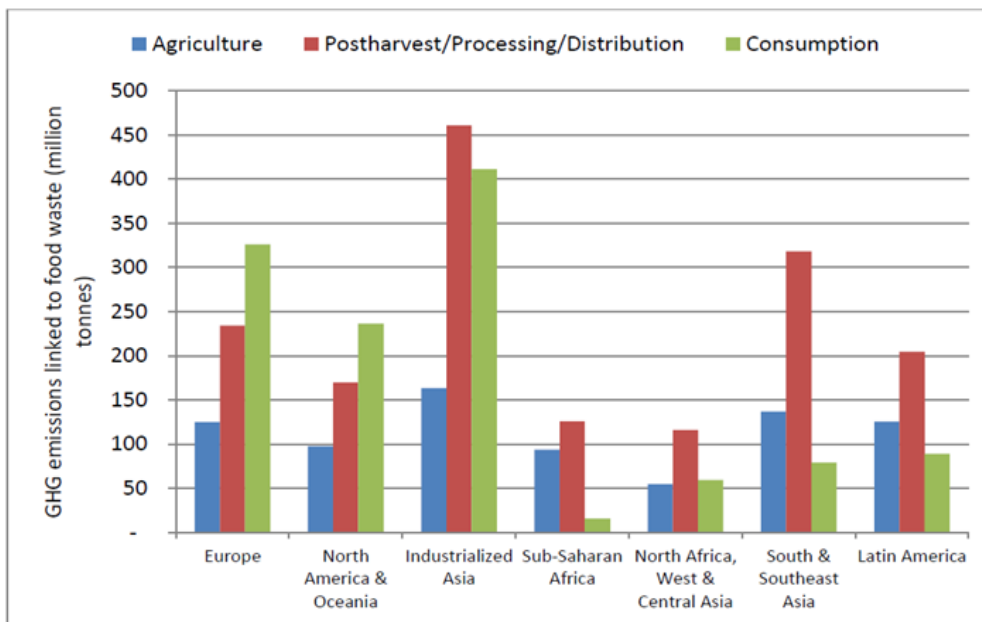


Figure 4. Cost of food waste arising (producer prices) by region and supply phase (FAO, 2011).

2.5 The Life Cycle Assessment (LCA) Method

The Life Cycle Assessment (LCA) method was developed during the 1990s, which has been proven that it is quite useful in terms of weighing two or more options in their possible environmental impacts. Applications of the LCA method to evaluate the food waste has been widely popular in the last few years and it consists of four stages: (1) goal and scope definition, (2) life cycle inventory, (3) life cycle impact and assessment and (4) interpretation. (Levis & Barlaz, 2011).

Caputo et al. 2014 conducted research to evaluate the food waste within the food chain and their impact on the environment, the study suggested converting FW into energy sources, such as bio-methane and biodiesel. The LCA method was also used to calculate the FW produced by the mass retail sector. Brancoli et al. 2017 analyzed the FW produced by a supermarket in Sweden, research calculated which kind of product has the major impact on the environment. The research showed that bread had the largest share considering both economical losses as well to negative environmental impact.

2.6 Factors Influencing Food Waste Behaviors

Several studies have searched into the factors which affect the consumers such as social influence (Comber and Thieme, 2013) and habits of food shopping and their hold on food waste (Farr-Wharton et al., 2014) which is shown in (Table 1).

Table 1

Previous Research on Food Waste Factors

Research	Key factors affecting food waste behaviors
Stefan et al, (2013)	Shopping routines and intention to reduce food waste
Sinvennoinen et al., (2014)	Gender and attitudes towards food waste
Scondi et al., (2015)	Education level, living areas and attitudes towards food waste
De Hooge et al., (2017)	Demographics, engaging in shopping and food preparation
Zepeda and Balaine (2017)	Protecting the environment and awareness of food waste
Bravi et al., (2020)	Food management and eating habits

The Theory of Planned Behavior (TPB) which is widely applied in previous studies has been used to analysis the consumer behavior which takes in consideration factors such as attitudes which represent positive or negative assessment of self-performance for a specific behavior and attitude. norms on the other hand are an indicator of the social pressures while intentions represent the willingness to behave and act in a certain way. (Graham-Rowe et al. 2015) studied consumers' food waste at the household using the TPB theory and discovered that intention to reduce waste of fruit and vegetables in the household is predicted by norms, attitudes, and perceived behavioral control. Food reduction behavior analysis found that older people are more likely to reduce waste than younger (Hanssen et al., 2016) females more likely than male (Secundi, 2015). There are many aspects impacting the food waste at the consumer end such as shopping at the supermarkets and consumption behavior, consumers characteristics, product labeling, product packaging, and product itself (Jorissen et al., 2015; McCarthy and Liu, 2017; Quested et al., 2013; Sinvennoinen et al., 2014; Visschers et al., 2016).

Food waste related behaviors can be definitive towards certain food (Aschemann-Witzel et al., 2015; Wilson et al., 2017). Fresh vegetables and fruits for example accounts for most of the food wasted in the household (Laurentiis et al., 2018). Other studies have provided a number of factors that are related to food waste behavior such as lifestyle research has found that those who eat together at households reduced food waste (Chakona and Shackleton, 2017). Previous research found that individuals with higher income tend to waste more food, on the other hand people who live in rural areas produce less waste (Marangon et al., 2014; Secondi et al., 2015).

SDG 12.3 which focuses on food lost or wasted around the supply chain, which is split into two factors, what measures a key commodity across the supply chain and not including retail is the Food Loss Index, and the Food Waste Index which sizes the food and inedible parts wasted at the consumer and retail ends. the World Bank countries income grouping estimates sectors based on countries found that household (consumers) was the highest among income groups which is seen in the Table 2 below

Table 2

World Bank Income Classification (UNEP,2022)

World Bank Income group	Household (Consumer)	Food Service	Retail	Total no. of countries in classification
High-income countries	28	18	20	81
upper middle-income countries	12	3	2	55
lower middle-income countries	10	2	1	50
low-income countries	2	0	0	29
Total	52	23	23	215

2.7 Food Labels and Biotechnology Coatings

Making better use of the food packaging that has been designed to protect food to remain fresh, and of the guidance on the label whether the date label (showing the food expiry date and production dates) or the bio coating label that can increase the lifespan of FFV, could dramatically reduce the amount of food thrown away, it might come at a financial cost. These costs are however substantially balanced by the reductions in food waste. According to (Vieira, 2021) using edible plant-derived coating onto fresh produce helps to increase the LCA of products which helps reduce waste by stores. a technology which was tested by Appel, The Appel products was found to reduce waste at the retailer stage and the environmental impacts

The reduction of waste which effects climate change, fresh water, and fossil resources. taking in consideration that fruit shelf-life changes based on many factors such as seasonality, weather, and supply chain dynamics. many methods which are used to reduce waste in supply chain such as cold storage, controlled atmosphere shipping containers (SJ. James; C. James, 2010). nonetheless there is a significant amount of food which is being wasted in the retail and consumers end (Porter et al., 2016).

Chapter 3

Methodology

Quantitative research was conducted in this research to size and explain the connection between variables (Creswell, J., & Creswell, D., 2018). Food waste on the consumer's end represents a higher percentage from the food wasted with respect to other parts of the food chain. The Food and Agriculture Organization of the United Nations (FAO) expects that around 3 billion people will not have the ability to afford a healthy diet (FAO, 2020). An online survey was shared with the respondents through a link which. After the participants click on the received link it will open the Google Forms, the questions were displayed in sections, the first section which consisted of the participants' demographics, the second section was to measure awareness of participants towards food waste (De Groot, 2009). The third section which measured how consumers feel responsible towards food waste (De Groot, 2009), the fourth questionnaire which is to measure the intention of the consumer to reduce food waste (Sun, 2012), the questionnaire was a reflection from previous studies (Emel, A. et al., 2018) and (Wang et al., 2022).

And the last part was to know how informed participants were to food prevention technologies (Appendix A). The questions in the survey covered the following topics which is related to food waste-:

- Consumer awareness of food waste
- Consumer responsibility towards food waste
- Consumer's intention to reduce food waste

3.1 Research Design

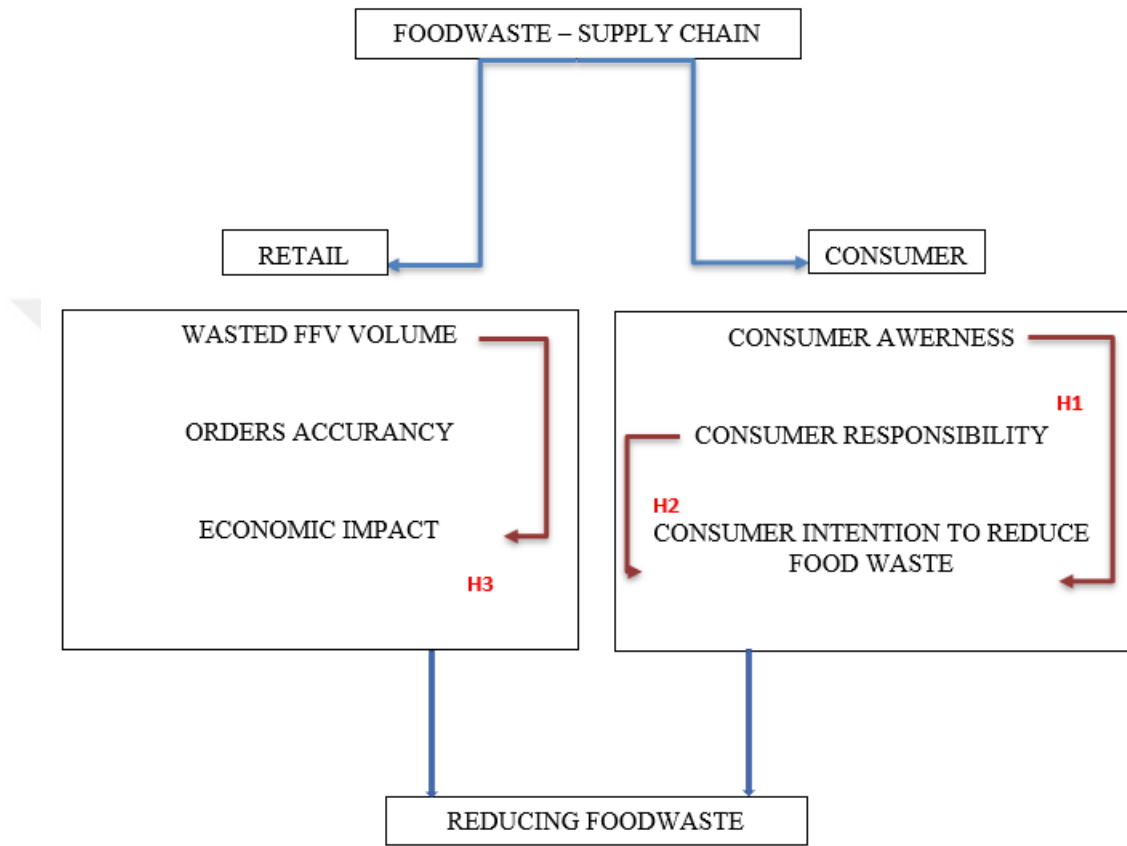


Figure 5. Research model.

Table 3

Questionnaire Items Used in the Analysis

Section Name	No.	Question Description
Demographics	Q1	What is your gender?
	Q2	What is your marital status?
	Q3	Indicate your birth year
	Q4	Indicate your level of education
	Q5	What is your current professional status
Consumer's awareness in regard to food waste	Q6	Food waste will cause a tremendous loss of resources such as fresh waste and oil
	Q7	Food waste will accelerate resources depletion
	Q8	Food loss and waste negatively affect climate change, poverty, and trade
	Q9	Raising awareness amongst consumers can help with the prevention of food waste
	Q10	Food waste is mainly linked to the behavior of retailers and consumers
Consumer's responsibility towards food waste	Q11	Reducing food waste and solving environmental problems such as climate change is the responsibility of governments and enterprises mainly
	Q12	I share the responsibility of reducing food waste to help reduce its effect on environmental resources
	Q13	Food waste is a personal choice, and it has nothing to do with responsibility?
	Q14	Food waste and loss represent economic losses for all factors along food supply chains, including consumers
	Q15	Throwing food away make you feel guilty
	Q16	I have an obligation to reduce food waste
	Q17	Buying the only needed amount of food from the supermarket is easy for you
	Q18	It's important to promote and encourage people to reduce food waste

Consumer's Intention to reduce of food waste	Q19	I will actively share my ideas and information with others on how to reduce food waste
	Q20	I will do my best to help reduce food waste in my house and encourage others to reduce food waste as well
	Q21	I will emphasize on the importance of reducing food waste and how it is affecting our resources and climate change to my family and friends
	Q22	I intend to generate as little food waste as possible
Consumer's Awareness of Food Preservation Technologies	Q23	I have previous knowledge of some of the food prevention technology where fruit and vegetables are wrapped with bio-coating materials that helps preserve nutrients and natural shape for a longer time
	Q24	Food preservation technology does not cause any potential danger on human health upon consumption
	Q25	Food prevention technology such as bio-coating are helping reducing food waste
	Q26	I would consider buying bio-coating materials since it helps limiting the loss of resources and reducing food waste
	Q27	Food prevention technologies are not well known, and most consumers such as me are not well informed of their benefits of this technology

3.2 Data Collection and Sampling

De Vos (1998:191) a sample is the logical and rational choice for research where it is impossible to identify all possible members of a population. In this research an online survey was used in obtaining the data, the target sample was consumers. and while we are trying to find and size the relationship between the variables, the researcher decided that the targeted population should share the same circumstances in order to accomplish this target. The research sample was consumers who are based and living in Türkiye. The survey form consisted of 27 questions which were shown in five sections that the participants were required to fill (Appendix A).

3.3 Retail Store Analysis

This research was conducted at one of the biggest retail stores in Osman Bey-Istanbul. The observations started in August 2023 with exploratory structured interviews (interview method is described by Kvale and Brinkmann, 2014) and participating observations (method is described by Yin, 2009) for store staff and store managers in Fresh Fruits and Vegetables Section of the store. A method to measure the waste economic and Environmental impact was based on (Matsson et al.,2018). Sales data: Order data and process along with in store waste data were collected for three months from September 2023 till December 2023 in an extract format from the store database. Personnel working hours and food waste management procedures if any, were obtained by the researcher observation at the FFV sections for total of 10 days at the store to determine and assess the personnel cost while handling FFV waste and in order to not affect the workflow of the employees ; they were informed to continue their daily duties and not change their routines for the research, the total observed employees was 3 from FFV section that were observed and 2 senior managers were interviewed



Figure 6. A flow chart from the FFV at the store retailer level and the different stages of waste.

3.3.1 The stores.

The store included in the research; the retailer who asked that the study be published anonymously is one of the three biggest retailers in Türkiye. The store is located in Osman Bey Şişle, Kurtuluş store where the average customer count entering FFV section makes a total of 25% of store entry count: an average of 1700 people visit FFV section on daily basis. Store square meter is 1500 with 1050 square meter for the sales area with 120 m² for FFV section. The store's monthly net profit is 9.3 million Turkish Lira with 1.6 million from FFV sales; a total of 17% of the store total net profit with a margin for FFV section is 50.6% for this store. The staff headcount is 32 personnel with 3 for FFV section with average salary of 22.500 TL for 45 working hours per week for December 2023. The FFV have sourcing with 80% inside Turkey domestic and 20% international for the exotic fruits. The orders for FFV happen three days a week where the orders are delivered after two days to the store. Orders are made based on last year sales and the availability of FFV offered by the procurement team. The FFV waste for this store is on average 4.5% of total order quantities.

Chapter 4

Findings

4.1 Demographics

Table 4

Profile of Respondents (n=247)

	Item	Frequency	Percentage (%)
Gender	Male	127	51.6
	Female	115	46.7
	I do not want to specify	4	1.6
Marital Status	Married	118	48.0
	Unmarried	128	52.0
Education	less than senior high school	7	2.8
	University	163	66.3
	Graduate school and higher	76	30.9
What is your professional status?	Employed	79	32.1
	Retired	162	65.9
	Student	3	1.2
	Unemployed	2	.8

The above table shows the respondents rate related to their gender specification. The total frequency of females is 127% which shows the majority of the respondent's rate almost 51% while 46.7% are male and only 4% those who do not want to specify their gender. the marital status of respondents from which 52% are those individuals who are unmarried and 48% are married. While the level of education of participants. Majority of the participants are from university as shown in the table. Almost 66.3% are from university level and 30.9% from graduate school and higher.

Almost 2.8% are those who have senior high school level qualification. This survey also conducted the profession of participants as shown in table. Most of the respondents are employed almost 65.9%, 32.2% are students and only 1.2% are unemployed respondents.

Table 5

Demographics Analysis

Participants Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	127	51.6	51.6	51.6
	Male	115	46.7	46.7	98.4
	I do not want to specify	4	1.6	1.6	100.0
	Total	246	100.0	100.0	

Participants Marital Status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Married	118	48.0	48.0	48.0
	Unmarried	128	52.0	52.0	100.0
	Total	246	100.0	100.0	

Participants education level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than senior high school	7	2.8	2.8	2.8
	University	163	66.3	66.3	69.1
	Graduate school and higher	76	30.9	30.9	100.0
	Total	246	100.0	100.0	

Participants Occupation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Student	79	32.1	32.1	32.1
	Employed	162	65.9	65.9	98.0
	Unemployed	3	1.2	1.2	99.2
	Retired	2	.8	.8	100.0
	Total	246	100.0	100.0	

4.2 Correlations Between Variables

Table 6

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Consumer Awareness	246	1.00	5.00	4.1333	.75557
Consumer's Responsibility	246	1.20	5.00	3.3098	.53953
Consumer's Intention	246	1.00	5.00	4.0767	.61949
Food_Preservation_Technologies	246	1.00	5.00	3.4049	.56854
Valid N (listwise)	246				

Descriptive statistics is a key function of statistics that targets to summarize and describe a given data set in a compact and understandable way. The most used forms include the mean, median, and mode as they add important judgements into both the central tendency and variability of data.

As shown in the table the maximum value is 5 and minimum is 1. Meaning the minimum value is 3.309 and maximum is 4.13. Similarly, standard deviation minimum value is 0.53 and maximum 0.75.

Table 7

Correlations Between Variables

		Consumer Awareness	Consumer's Responsibility	Consumer's Intention	Food Preservation Technologies
Consumer Awareness	Pearson Correlation	1	.332**	.533**	.309**
	Sig. (2-tailed)		.000	.000	.000
	N	246	246	246	246
Consumer's Responsibility	Pearson Correlation	.332**	1	.347**	.276**
	Sig. (2-tailed)	.000		.000	.000
	N	246	246	246	246
Consumer's Intention	Pearson Correlation	.533**	.347**	1	.446**
	Sig. (2-tailed)	.000	.000		.000
	N	246	246	246	246
Food Preservation Technologies	Pearson Correlation	.309**	.276**	.446**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	246	246	246	246

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

The point of this research is to find the main connection between the dependent variable (Consumer's intention) with the independent variables (Consumer's Awareness, Consumer's Responsibility). The connection made here helps us to make a better understanding of the way the consumer creates the choice of what to buy in terms of fresh fruits and vegetables.

Table 7 views like this make it very evident that sigma "p" values for two-tailed tests are less than 0.05 and that Pearson correlation coefficients are much bigger than p-values set at 0.00. These two results are noteworthy. Conversely, rejecting the null hypothesis that the two variables are unrelated yields a non-significant p-value.

4.3 Regression

Table 4.5 shows the outcome we had from the regression techniques. SPSS program was used as the main statistical analysis platform where the "enter" method worked as the starting point of this analysis. The F-test importance is defined by the value of 56.301 which was significant at the p level of 0.01, as shown in the table below. The figures show the chances of those circumstances actually occurring is extremely slight (Saunders et al. 2009). table 8 represents the statistical importance of the miniature. The table shows that R² is 0.317; the value represents the complete strong connection between the dependent variable (Consumer's intention) with the independent variables (Consumer's Awareness, Consumer's Responsibility) (Shiu 2009, p. 585).

Table 8

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.563 ^a	.317	.311	.51421	2.153

a. Predictors: (Constant), Consumer's Responsibility, Consumer Awareness

b. Dependent Variable: Consumer's Intention

This indicates that around 31% of the variance in customer perceptions may be explained by this regression model.

Table 9

Dependent and Independent Variables

ANOVA^a

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	29.773	2	14.886	56.301	.000 ^b
	Residual	64.251	243	.264		
	Total	94.024	245			

a. Dependent Variable: Consumer's Intention

b. Predictors: (Constant), Consumer's Responsibility, Consumer Awareness

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.758	.237		7.431	.000
	Consumer Awareness	.385	.046	.469	8.348	.000
	Consumer's Responsibility	.220	.065	.192	3.407	.001

a. Dependent Variable: Consumer's Intention

Our two-hypothesis related to this model have been affirmed (H1 and H2) based on the previous results obtained by both regression and correlation analyses. The analysis has found that there is zero to no connection between consumer awareness and consumer intention. This outcome indicates that any changes in the consumer intention will not change the awareness of that consumer. We came to a conclusion that our two hypothesis was correct since the proportionality connection of the retargeting and the other factors are very visible regardless of the substantial correlation between consumer responsibility and consumer intention.

4.4 Participants View on Food Prevention Technologies

Model:

Consumer intention = Independent Variable

Food Preservation Technologies = Dependent variable

Table 10

Food Prevention Technologies Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.446 ^a	.199	.196	.50983	1.718

a. Predictors: (Constant), Consumer's Intention

b. Dependent Variable: Food Preservation Technologies

The above table shows the strength of the model where R² is 0.199, it means that around 19% of the variance in customer perceptions may be explained by this regression model. The results show consumer intention has a significant relation with Food Preservation Technologies.

Table 11

Food Prevention Technologies Correlations with CI

ANOVA^a

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	15.771	1	15.771	60.675	.000 ^b
Residual	63.423	244	.260		
Total	79.194	245			

a. Dependent Variable: Food Preservation Technologies

b. Predictors: (Constant), Consumer's Intention

Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	1.735	.217		8.004	.000
Consumer's Intention	.410	.053	.446	7.789	.000

a. Dependent Variable: Food Preservation Technologies

Table 12

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Consumer's Awareness	247	1.00	5.00	4.1333	.75557
Consumer's Responsibility	247	1.20	5.00	3.3098	.53953
Consumer's Intention	247	1.00	5.00	4.0767	.61949
Food Preservation Technologies	247	1.00	5.00	3.4049	.56854
Valid N(listwise)	247				

The definition of Descriptive statistics is a key and significant function of statistics that aspires to summarize and describe a given set of data in a compact and understandable way. The most used forms include the mean, median, and mode as they add important judgements into both the central tendency and variability of data.

As shown in the table the maximum value is 5 and minimum is 1. Meaning the minimum value is 3.309 and maximum is 4.13. Similarly, standard deviation minimum value is 0.53 and maximum 0.75.

4.5 Analysis of Variance (ANOVA)

Analysis of Variance (ANOVA) is a statistical tactic employed to define if there are important differences in means among two or more groups. It is particularly useful when comparing means across various levels of a categorical variable. The fundamental premise involves testing the null hypothesis, which posits no significant differences in group means. ANOVA dissects the total variance within a dataset into between-group variability (differences among group means) and within-group variability (variance within each group). The comparison is expressed through the F-statistic, which is the quota of between-group variance to within-group variance. Higher F-statistics indicate more substantial differences among group means. The degrees of freedom associated with these variances are crucial in the F-test. A significance level, typically set at 0.05, determines whether the obtained F-statistic is statistically significant. If so, post hoc tests may be employed to pinpoint specific group differences. ANOVA is widely utilized in experimental and observational studies, assuming normal distribution and homogeneity of variances. If these assumptions are violated, alternative approaches or transformations may be considered.

Table 13

Comparison With Demographics

ANOVA Comparison with Gender

		Sum of Squares	df	Mean Square	F	Sig.
Consumer's Responsibility	Between Groups	2.575	2	1.288	4.552	.011
	Within Groups	68.741	243	.283		
	Total	71.317	245			
Consumer Awareness	Between Groups	.934	2	.467	.816	.043
	Within Groups	138.933	243	.572		
	Total	139.867	245			

ANOVA Comparison with marital status

		Sum of Squares	df	Mean Square	F	Sig.
Consumer's Responsibility	Between Groups	.142	1	.142	.486	.006
	Within Groups	71.175	244	.292		
	Total	71.317	245			
Consumer Awareness	Between Groups	2.217	1	2.217	3.930	.049
	Within Groups	137.650	244	.564		
	Total	139.867	245			

ANOVA Comparison with age

		Sum of Squares	df	Mean Square	F	Sig.
Consumer's Responsibility	Between Groups	.102	3	.034	.115	.951
	Within Groups	71.202	241	.295		
	Total	71.304	244			
Consumer Awareness	Between Groups	2.122	3	.707	1.237	.297
	Within Groups	137.727	241	.571		
	Total	139.849	244			

4.6 Kaiser-Meyer-Olkin (KMO)

Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test are statistical techniques commonly employed in the context of factor analysis to find the suitability and reliability of the data for such analyses. KMO is a measure of sampling test adequacy that evaluates how well the data set is suited for factor analysis. with ranges from 0 to 1, with higher values indicating higher suitability and, the lower values show lower compability. A KMO value closer to 1 suggests that the variables in the dataset share enough common variance to proceed with factor analysis.

On the other hand, Bartlett's test is used to examine whether the observed variables in a dataset have significant correlations, which is a prerequisite for factor analysis. The test assesses the null hypothesis that the correlation matrix is an identity matrix, implying no correlations among variables. A low p-value (typically below a chosen significance level, such as 0.05) in Bartlett's test indicates that the correlations between variables are not due to chance, supporting the suitability of the data for factor analysis. Below table shows that KMO has greater than 0.05 value.

Table 14

KMO and Barlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.711
Bartlett's Test of Approx. Chi-Square		181.005
Sphericity	Df	6
	Sig.	.000

4.7 Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA) is a statistical technique used in the field of structural equation modeling to test and validate a hypothesized factor structure within a dataset. Unlike exploratory factor analysis, which identifies latent factors without preconceived notions, CFA is hypothesis driven. In CFA, researchers specify a theoretical model that outlines the relationships between observed variables and latent factors based on existing theory or prior research. The model is tested against the observed data to assess how well it fits. The key objective of CFA is to confirm or refute the proposed factor structure and to examine the strength and significance of the relationships between the observed variables and latent factors. Fit indices, for an example the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), and the Root Mean Square Error of Approximation (RMSEA), are commonly used to evaluate the goodness of fit. A well-fitting model suggests that the hypothesized factor structure adequately represents the underlying relationships in the data. CFA is widely applied in psychology, social sciences, and other disciplines to validate theoretical constructs and refine measurement models. It provides a rigorous approach for assessing the validity of a priori assumptions regarding the latent structure of observed variables. Below table shows the factor loading, Cronbach alpha, composite reliability, and AVE of this study where all the values are sufficient.

Table 15

Correlation Between CA, CR, and CI

		Consumer's Awareness	Consumer's Responsibility	Consumer's Intention	Food preservation technologies
Consumer's Awareness	Pearson Correlation	1	.332**	.533**	.309**
	Sig. (2-tailed)		.000	.000	.000
	N	247	247	247	247
Consumer's Responsibility	Pearson Correlation	.332**	1	.347**	.276**
	Sig. (2-tailed)	.000		.000	.000
	N	247	247	247	247
Consumer's Intention	Pearson Correlation	.533**	.347**	1	.446**
	Sig. (2-tailed)	.000	.000		.000

	N	247	247	247	247
Food preservation technologies	Pearson Correlation	.309**	.276**	.446**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	247	247	247	247
** Correlation is significant at the 0.01 level (2-tailed)					

The main target of this research is to find the main connection between the dependent variable (Consumer's intention) with the independent variables (Consumer's Awareness, Consumer's Responsibility). The connection made here helps us to make a better understanding of the way the consumer creates the choice of what to buy in terms of fresh fruits and vegetables.

Table 4.12 views like this make it very evident that sigma "p" values for two-tailed tests are less than 0.05 and that Pearson correlation coefficients are much bigger than p-values set at 0.00. These two results are noteworthy. Conversely, rejecting the null hypothesis that the two variables are unrelated yields a non-significant p-value.

4.8 PLS-SEM

Partial Least Squares Structural Equation Modeling (PLS-SEM) is a statistical technique used for analyzing relationships between latent variables in a structural equation model. PLS-SEM is particularly useful in situations where the sample size is small, the data are non-normally distributed, or the model is complex. Unlike traditional covariance-based SEM, PLS-SEM is a variance-based approach that focuses on maximizing the explained variance in the dependent variables. It works by iteratively estimating the latent variables and the paths between them to minimize the difference between the observed data and the model-implied data. PLS-SEM is often employed in fields such as management, marketing, and information systems for assessing complex relationships among constructs. It is known for its flexibility and ability to handle formative and reflective measurement models, making it suitable for exploratory research or situations where theory development is ongoing. PLS-SEM also allows for the inclusion of observed indicators with different measurement scales, which enhances its applicability in real-world scenarios. Researchers commonly use PLS-SEM to evaluate and validate theoretical models, making it a valuable tool for advancing knowledge in various disciplines.

Table 16

Hypothesis Coefficient

	Hypothesis	Standard Coefficient	CR Value	P	Results
H1	Consumer' awareness towards the consequences of Food waste is more likely to develop intention to reduce food waste	0.243	3.455	0.000	Accepted
H2	Consumers' responsibility towards food waste has a positive influence on their intention to reduce food waste	0.321	4.222	0.000	Accepted

4.9 Data Analysis for the Retail Store

4.9.1 Wasted mass.

The store counts the in-store waste for both packed and unpacked FFV; the store has an internal process to follow up on the waste quota and reduce them. The in-store waste data has the information for the wasted FFV; type; packed or unpacked; weight and the purchase price for each type. Sadly, in Türkiye there is no waste process for FFV; the store simply takes out the waste into the nearest dump and throws them.

The retailer has decreased the number of wastes for what we call Ugly Fruit by offering 50% discount on the fruits that have had some damage to its look (Fruits that have been in the sales area for more than 3 days). The waste mass information was obtained by the store directly.

4.9.2 Economic cost.

Here the economic cost is calculated as the summation of the wasted products cost and the cost of personnel handling the FFV products. The equation to calculate the economic waste is defined as: $\text{Economic cost} = \text{Wasted produce cost FFV} + \text{Cost of personnel removing the FFV from sales floor and waste management}$.

The working hours cost, including the sorting and removal of bad produce as well as the purchase price for FFV was collected from the store

4.9.3 Cost of waste versus cost of personnel time.

Since the time spent by the personnel in arranging FFV: taking them from the storage area to sales area; rotating the stocks; sorting the unwanted FF in package to sell them with discount and the removing of wasted FFV is critical in calculating the in-store waste (Lagerberg Fogelberg et al., 2011).

For this study, the researcher observed that no extra hours were given at the store as a management decision which has led to few personnel in the sales area. The hours spent by the staff for collecting the waste products were an average of 1.3 hours per day.

4.9.4 Data analysis.

The quantitative data was collected and analyzed using mathematical calculations. The data were checked and controlled manually and when any discrepancies were detected; they were checked with the store directly. The outcomes for the observations and interviews were summarized and categorized with the data of waste management at FFV section.

Table 17

The Highest Wasted Mass and Economic Costs Along with Their Wasted Quotes Coming from The Top Forty Fresh Fruits and Vegetables Categories in Turkish Supermarkets In 2023

Wasted Mass KG			Economic Impact		
Category	Wasted Mass	Wasted Quota	Category	Wasted Mass	Wasted Quota
Patates Yemeklik Kg	875	9.6%	Üzgm Çekirdeksiz	31.358	13%
Soğan Kuru Kg	672	7.3%	Domates Eko Kg	14.796	6%
Domates R10	608	6.6%	Şeftali	13.649	6%
Domates Eko Kg	587	6.4%	Patates Yemeklik Kg	11.829	5%
Üzgm Çekirdeksiz	583	6.4%	Salatalık	9.774	4%
Mandalına KG	334	3.6%	Nekarin	9.028	4%
Salatalık	331	6.4%	Patlıcan Kemer Pazar	8.576	4%
Şeftali	324	3.5%	Fasulye Taze	8,421	4%
Patlıcan Kemer Pazar	294	3.2%	İncir Siyah	7.558	3%
Kavun Kırkağaç Kg	272	3.0%	Kabak Sakız	7.472	3%
Karpuz Kg	270	2.9%	Salatalık Çeneğlköy	6.714	3%
Fasulye Taze	236	2.6%	Domates Salkim	6.187	3%
Domates Salkım	215	2.3%	Üzüm Red Globe	5.406	2%
Mandalına Satsuma	213	2.3%	Domates Rio	4.964	2%

Nekarin	209	2.3@	Mandalina Kg	4.758	2%
Limon Mayer	200	2.2%	Soğan Kuru Kg	4.661	2%
Salatalık Çeneğlköy	189	2.1%	Muz Yerli Kg	4.075	2%
Kabak Sakız	172	1.9%	Armut Deveci	4.066	2%
İncir Siyah	167	1.8%	Domates Pembe	3,753	2%
Muz Yerli Kg	161	1.8%	Nar	3.359	1%
Karayğdı Armudu Kg	151	1.6%	Erik Angelica	3.217	1%
Armut Deveci	135	1.5%	Kavun Kırkağaç Kg	3.201	1%
Domates Pembe	130	1.4%	Mandalina Satsuma	3.049	1%
Elma Gala Ekonomik	119	1.3%	Karpuz Kg	2.867	1%
Portakal Wshington	117	1.3%	Karayğdı Armudu Kg	2.571	1%
Nar	109	1.2%	Erik Frezee	2.432	1%
Üzüm Red Globe	100	1.1%	Erik Angelica	2.155	1%
Limon Lamas	99	1.1%	Limon Mayer	2.146	1%
Limon Natural	98	1.1%	Elma Gala Ekonomik	2.122	1%
Erik Frezee	92	1.0%	Elma Gala	1.874	1%
Elma Gala	82	0.9%	Portakal Washington	1.861	1%
Domates Kokteyl	72	0.8%	Portakal Sikmalik	1.768	1%
Erik Mürdüm	66	0.7%	Domates Kokteyl	1.762	1%
Erik Angelica	61	0.7%	Biber Dolma	1.690	1%
Üzüm Siyah	56	0.6%	Biber Sivri	1.673	1%
Portakal Sıkmalık	54	0.6%	Limon Lamas	1.572	1%
Biber Sivri	49	0.5%	Biber Kapy	1.565	1%
Biber Kapy	48	0.5%	Armut Santa Maria	1.557	1%
Biber Çarliston	47	0.5%	Üzüm Razaki	1.332	1%
Soğan Mor	46	0.5%	Mantar 300G	1.203	1%

4.10 Retail Store Results

The highest wasted mass and economic costs along with their wasted quotes coming from the top forty Fresh Fruits and Vegetables categories in Turkish supermarkets in 2023. Table 17.

4.10.1 Wasted mass.

In the observed period, the wasted amount of FFV in the store was 9.159 Kilograms with an average of 1.1% of wasted quota. 75% of the total waste gravity with 73% of the economic costs comes from the top 20 categories in account to wasted mass (Table 17). Potatoes; onion; tomatoes and grapes have the largest impact when checking the FFV categories at in-store waste (see Figure 8a). Potatoes hold the highest amount of wasted mass, potatoes wasted amount estimates to 872 KG and corresponded to 9.7% of the total wasted volume (see Figure 7).

4.10.2 Economic cost.

The total economic value of the in-store waste for three months starting from September 2023 till 1st of December 2023 was 235,294 TL which is around 8,556 USD (an average of 27.5 TL for each one USD were taken for these calculations). Grapes; Tomatoes; Peach; Potatoes and Cucumber have the largest impact when checking the top 20 FFV categories at in-store waste (see Figure 8b). The fruit with the highest economic impact in Grapes; Grapes have more than double the economic cost to Tomatoes which is placing second in the highest economic cost (see Figure 8b).

4.10.3 Hotspot categories.

From a total of 101 categories of FFV; there were categories that have created the highest impact when checking wasted mass and economic cost. It was established that there were five main categories which could be referred to as “hotspot categories” when checking the first top ten FFV categories of the two axes of wasted mass and economic cost. see Figure 8.

The five “hotspot categories” are Grapes; Tomatoes; Potatoes; Peach and Cucumber; those categories make up to 2.700 Kilograms and 81.406 TL (2.960 USD) which accounts for 29% of the total wasted mass and 35% of the economic cost. Fig.3 shows the percentages of the “hotspot categories” of the total waste along with the economic cost.

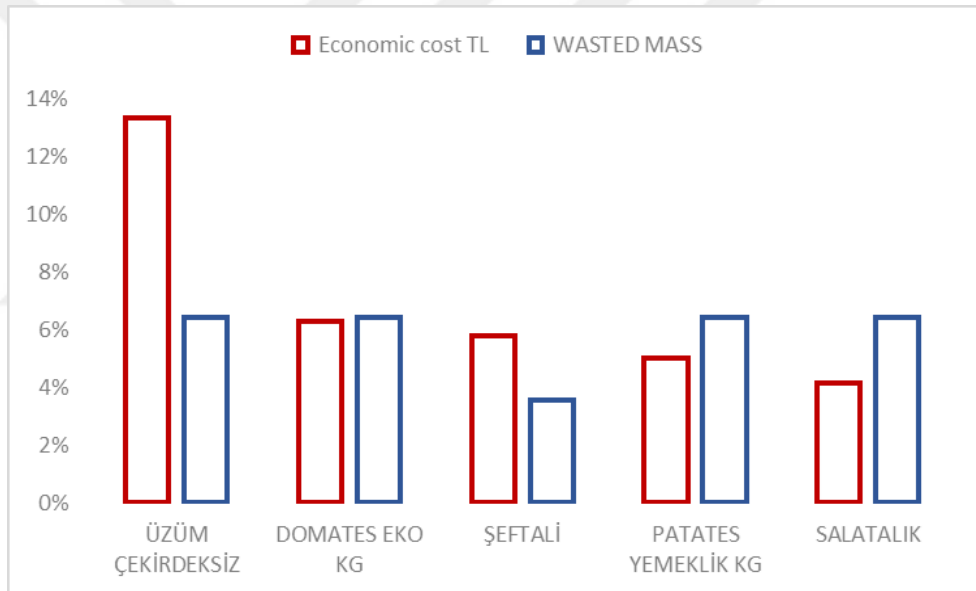
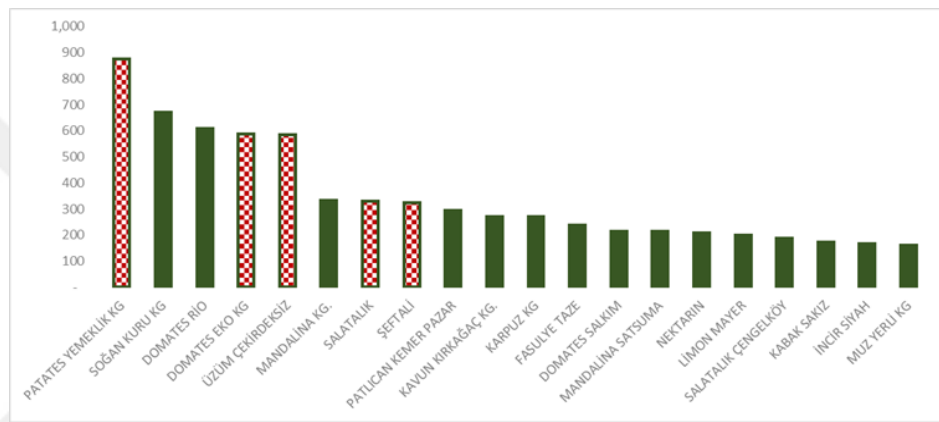


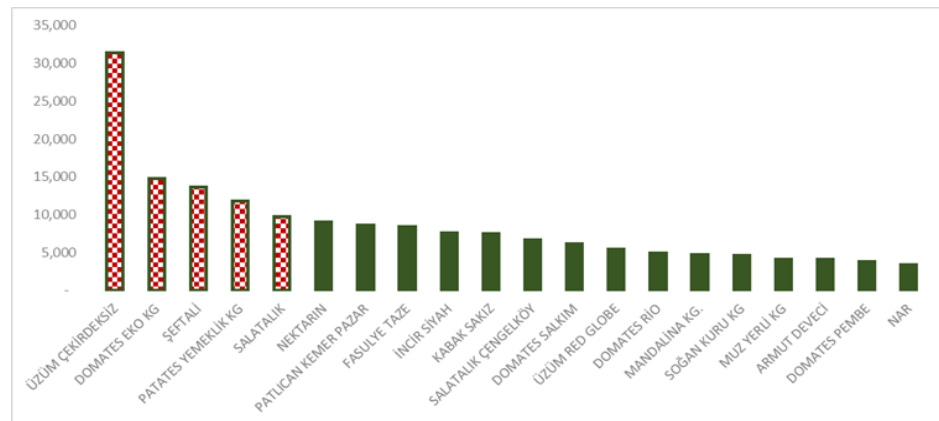
Figure 7. Share of wasted mass and the economic cost effect for the “hotspot categories” as percentage of the total waste.

4.10.4 Waste quota.

The amount of in store waste for FFV for three months from September 2023 till 1st of December 2023 was 2.159 Kilograms which is equivalent to 1.1% waste quota. The highest waste quota of FFV categories (see Table 17) are sweet potatoes (9.6%), Onions (7.3%), Tomatoes (6.6%), Grapes (6.4%), Mandarin (3.6%), Cucumbers (6.4%), and Cherries (3.5%). The lowest waste quota of FFV categories were Orange, Green Pepper, Charleston Pepper, and Black grapes with an average waste quota of 0.5%. Fruits take up to 57% when checking the first twenty categories while vegetables make up to 43%.



a. Wasted Mass Kilograms



b. Economic Waste TL

Figure 8. AB took into account the top 20 categories of FFV which have generated the largest amount of in store waste (a), and economic cost (b) where the highlighted categories represent the “hotspot categories”.

4.10.5 Cost benefit analysis.

The correlation between personnel cost and the economic value of the instore waste are shown in Figure 9 (Waste disposal cost was neglected as the store did not have one as mentioned earlier). 7.1% of the total costs comes from the personnel cost while the rest of costs which is 92.9% comes from the economic costs.

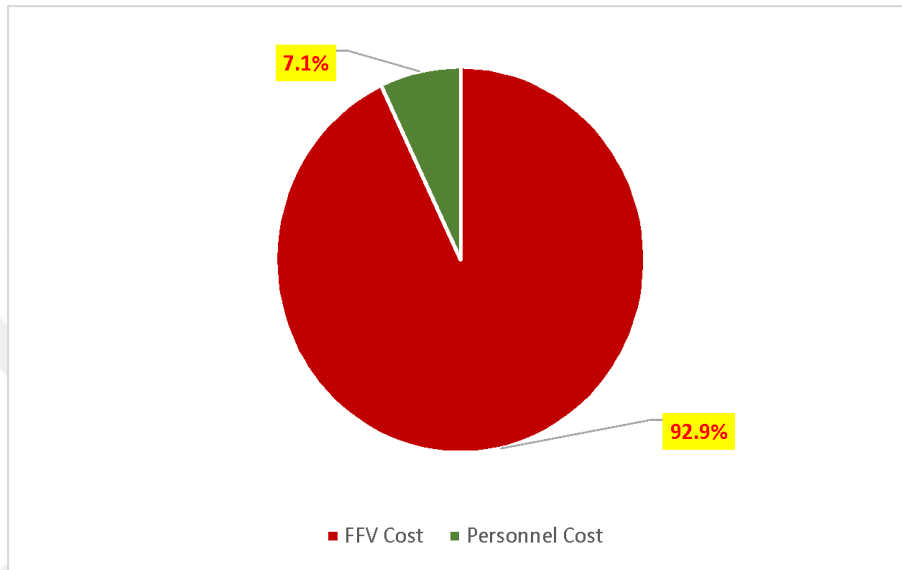


Figure 9. The correlation between personnel cost and the economic value of the instore waste at the largest Turkish retail store in 2023.

Chapter 5

Discussions

Food waste occurs in all stages of the food chain and about 35% of food waste and losses is accounted for by consumers (Lipinski et al., 2013). Which means that raising the awareness of consumers is a key factor in enhancing food waste (Evans 2011; Farr Wharton et al. 2014; Stancu et al. 2016; Stangherlin and Barcellos 2018).

In this study we applied two types of data collection, the first one which concluded an online survey collecting consumer feedback about food waste and measuring their willingness to take actions towards decreasing food waste as well as trying new tactics that can help to decrease food losses like bio coating technology that can help keep fresh fruits and vegetables “Fresh” for a longer period of time. the study unveiled a significant correlation amid demographic factors and consumer intentions to minimize food waste.

The online questionnaires which were shared via an online link with the respondents included a combination of one option and multiple-choice questions. It was developed into 4 sections. The results of this study showed that consumer awareness affects how they are reducing food waste and demonstrate the higher the consumers feel responsible is an important factor to reducing food waste. Our results positively concluded the connection of the effect of consumer awareness and responsibility on food waste Intention. When proposing ways and methods to reduce food waste, the results should be taken into account to reduce food waste at the individual consumer’s level. And to reduce food waste at the consumer segment, we need to increase consumers' awareness regarding the negative effects of food waste and losses on the environment, the social impact and the economical as well.

The results of the survey indicated the role of demographic factors in understanding consumer awareness; Participants belonged to the different demographics reflected a shared commitment towards lessening food waste, stressing upon the need of acknowledging responsible consumption.

While certain demographic groups may reflect nuanced variations in their respective intentions, the trend on the whole points to willingness at collective level to bring reduction in food waste.

Out of the total number of participants, 127 males participated the research activity along with 115 females. Male dominated the actions with the percentage of 51% whilst female participation remained 46%. Two categories of person participated the research activity unmarried persons are 128 and married persons are 118. Under education demographic, university persons are 163, graduate school and higher persons are 76 and less than senior high school persons are 7. The professional demographics of retired persons belongs to 162, whilst employed persons are 79 and student and unemployed persons are 3 & 2.

Demographic factors such as that critically influence consumer awareness concerning food waste. Respondents having higher levels of qualification such as M.Sc, PhD (20%) reflected an escalating awareness about the environmental outcome of food waste. Similarly, technically qualified respondents (13.4%) and university degree holders (42%) showed high turnover.

Our results have been able to uncover a nuanced association amid demographic factors with perceptive consumer responsibility in relation to reducing food waste. Whilst a consensus was found on the question of mitigating food waste taken as a shared responsibility, a lot of variations was found regarding responsibility at individual level. Respondents with high degree of qualification illustrated high commitment towards mitigating food waste, recommending that attaining education serves to influence perceived responsibility. This lays the need of educational interventions in framing attitudes towards personal responsibility in managing food waste.

Moreover, the study has been able to highlight the necessity of targeted awareness campaigns, specifically amongst demographics having lower levels of education shown at 0.6%. In order to cover the awareness gap, customized educational initiatives can be followed to make sure that knowledge is judiciously distributed amid different demographic groups.

The second part of this study was related to retailers and the economic and financial impact of food waste in FFV section on the business plans and the profit and losses report for stores. Identifying the biggest five wasted categories to create a downturn strategy to decrease the wasted quota and their impact on the businesses of retailers; a set of recommendations was recently published to support the stores with this (Xue et al., 2017).

The purpose of this research and observation is to investigate how much does the supermarkets in Türkiye are wasting in fresh fruits and vegetables and if the managers of the stores along with the retailers' shareholders are planning to address the problem which have a negative economic, environmental, and social impact in their day-to-day operations.

Furthermore, the food waste results by supermarket showed that potatoes had the highest waste counts followed by Grapes; Tomatoes; Potatoes; peaches and cucumbers. A total loss was calculated to be equivalent 8.556\$ which is an average 9.159 Kilogram per month which is the equivalent to the to the minimum daily requirements of fruit and vegetables for 22.897 people according to the World Health Organization where they state that the average adult needs five portions of fruit and vegetables on daily basis which is a minimum of 400 grams.

The work of this study has also found that there must be a strong set of laws that needs to be enforced by the government and metropolitan to make sure that Food wastes are dealt in a sustainable way; currently the access of left fruits and vegetables are being thrown with other wastes in public bins which means they are handled all together with no reconsideration of the ecological impact on the environment. This represents an opportunity to local and international holdings including the retailers to start new departments to deal with access FFV by recycling them, feeding them to livestock or decomposing them into fertilizers. Since this business is untapped one in Türkiye. It has a lot of potential of profit and with great mission towards green businesses.

Chapter 6

Conclusion and Future Steps

Food waste which is thrown was linked to climate change, water loss, biodiversity, soil degradation and hunger (Thyberg; Tonjes, 2013). The estimated yearly amount of food waste by household in Türkiye is 7.762.575 tons (UNEP, 2022)

Much previous research recommended ways to prevent food losses and waste by consumers such as information campaigns and This study has found that awareness and responsibility of consumers was found to have a major impact and effect on their intention and willingness to reduce food waste. The research has been able to highlight the necessity of targeted awareness campaigns, specifically amongst demographics having lower levels of education shown at 0.6%. Many ways are used to increase consumers' awareness regarding food waste such as public events, social media, and workshops. Information which is meant to enrich the knowledge of consumers regarding the consequences of wasting food and how a change in their behavior can produce food waste. Awareness campaigns have found that it can influence food waste (Priefer, 2016) and have had huge success in some countries. Denmark, for example, has had a success rate to reduce the food waste for 50% of the population after active campaigns that promoted eradicating food waste (Stop Wasting Food 2013). To cover the awareness gap, customized educational initiatives can be followed to make sure that knowledge is judiciously distributed amid different demographic groups.

Food waste is a global problem, and which is the main concern for researchers and scholars as it affects us and the future generations, respectively. The results of this study reflected that the higher consumer awareness and responsibility towards food waste the higher the intention to reduce it, and in this cause increasing awareness of consumers which was found to be significant to reduce food waste.

While the regulations of governments can help to reduce food waste. It is noticed that the weak laws in regarding food waste have a significant impact in the poor disposal of fresh fruits and vegetables of both retailers and consumers.

In this case we are recommending that the retailers in particular should consider new ways and technologies that can help increase the live shelf of the products rather than just the regular pre-planning of the required amount of fruit and vegetables in regard to previous data and sales. New bio coating technology that increases the lifespan of the fruits by an average of 10 days; this can have a positive impact on the accuracy of the planning for the orders of FFV as we as lowering the wastes of fruits.



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