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Impact of COVID-19 on Residential Waste Streams of Montclair Township

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Abstract

The COVID-19 pandemic has been found to have numerous impacts on day-to-day life, everywhere around the globe. One important sector which is particularly being affected is the waste management sector. Reports from the Solid Waste Association of North America (SWANA) showed possible variations in the source and volume of solid waste generated due to the enforcement of lockdown by the authorities to contain the coronavirus outbreak (Kulkarni & Anantharama, 2020). Food waste specifically is one of the most discussed topics in the world nowadays. About one-third of the food produced for humans ends up in the trash (Nusaka, 2020). It has become a critical issue. Studies demonstrated that the COVID-19 pandemic affected consumers' food consumption and that it varies with elements such as the price of foodstuff, level of income, and so on (Aday & Aday, 2020). The study focuses on the impact of COVID-19 on the residential waste stream in Montclair, a suburban municipality located in the New York Metropolitan Region. Research questions investigated are: have residential food waste streams increased or decreased during COVID-19 pandemic, and whether household plastic waste generation has increased or decreased. Using a survey targeting Montclair residents, data was collected about their food and plastic waste generation. A secondary research pursuit was to study the impact of COVID-19 on Montclair restaurants' generation of non-food waste, mostly plastic, into the household waste stream. The methodology used fo this pursuit was to investigate any increase in food deliveries during COVID-19, and an interview of the Vice-President of Operations of a restaurant in Montclair.

The results of the survey and the interview revealed that the quantity of food waste being generated in Montclair households remained the same during the pandemic. Food

categories such as bread increased the most. Another finding was that residential non-food waste streams, mostly plastic, increased.

Keywords: Covid-19, food waste, montclair

MONTCLAIR STATE UNIVERSITY

Impact of COVID-19 on residential waste streams of Montclair Township

by

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Contents

List of Tables

List of Figures

Chapter 1: Introduction

Background

The consequences of the Covid-19 pandemic are numerous for the economy, employment, and day-to-day life. Early research demonstrates that it is also affecting waste quantities in households. Limited US data suggest that announcements of public health states of emergency and lockdowns due to COVID-19 have caused an increase in total municipal waste, across garbage, recycling, and organics streams, although some US municipalities paused their diversion programs. A survey conducted in late May 2020 in England revealed that the majority of local authorities (more than 90%) were reporting higher than usual garbage and recycling while food waste increased up to 75% (Ikiz et al., 2021). Reports from the Solid Waste Association of North America (SWANA) showed potential changes in the volume and source of solid waste generated due to the enforcement of lockdown by the authorities to contain the coronavirus outbreak (Kulkarni & Anantharama, 2020). Such a change brings opportunities to explore the correlates of food waste (Rodgers et al., 2021).

It is also likely that the impacts of Covid-19 will differ from one place to another depending on factors such as epidemiological situation and socio-economic development (Tarek Ben et al., 2020). In this respect, the case of Montclair township in Northern New Jersey is particularly interesting. Montclair is a township in Essex County in the state of New Jersey. It covers a total area of 16.3 km^2 and has a population of 39 227. Montclair has busy business districts that are flush with restaurants, movie theatres, nightlife, and shops that attract visitors from all over the region. The township also serves as an example for Sustainable Communities. It was designated a *Clean Energy Leader* by N.J. Board of

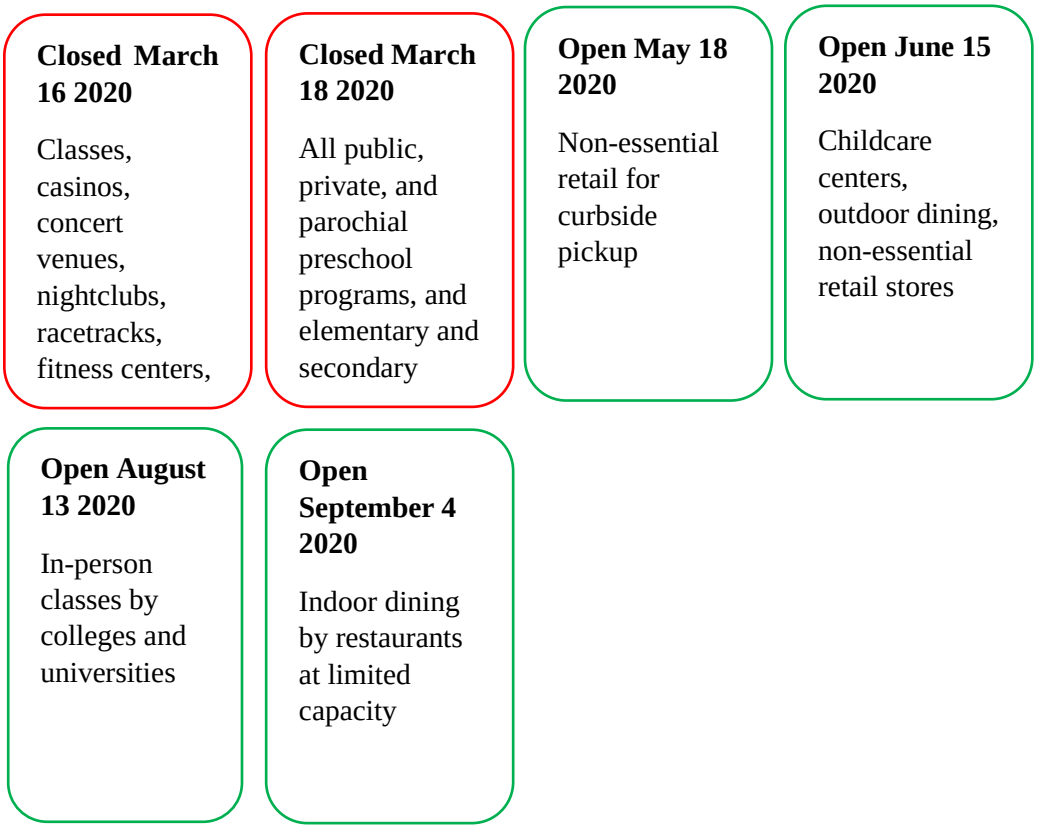
Public Utilities and *Climate Showcase Community* by the U.S. EPA, with dynamic home composting and recycling programs. Montclair comprises environmental and conservation elements in its Master Plan, active walk and bike advocacy, a booming farmers market in its 28th season, a green business recognition program, and a hub of public charging stations for pluggable electric vehicles. (Montclair, 2021).

The first Covid-19 case recorded in Montclair was on March 12, 2020 (Montclair Local, 2020). As of May 5th, 2021, the confirmed cumulative amount of Covid-19 cases in Montclair is 2634 and the number of persons who died from the virus is 73 (Montclair NJ, 2021).

The following figure shows some of the lockdown and re-opening phases in Montclair (State of New Jersey Governor Phil Murphy, 2020).

Figure 1

Lockdown and Reopening phases in Montclair **(State of New Jersey Governor Phil Murphy, 2020)**



At the time of this study, businesses have reopened, with general indoor gatherings limited to 50% capacity and outdoor dining not subject to any numerical capacity limitation (Governor Phil Murphy, 2021).

The current pandemic comes with many unprecedented impacts and it is expected that municipal waste management (MSW) practices gain more concerns as time passes by. So far, only a few research works have addressed MSW during the pandemic. Research has been done on the short-term and long-term changes in plastic waste management practices due to the disturbance caused by Covid-19. The focus of the study was on plastic waste management and generated some insights on MSW handling. Others have assessed

the effects of Covid-19 on wastewater service and waste sectors. The study underlined the associated risk of disease transmission through the non-hazardous waste coming from healthcare facilities. Solid waste management-related studies are distributed across different disciplines (e.g. disaster operations management and management science, and so on). Hence, there is a need to have detailed studies that evaluate various aspects of MSW management during pandemics and generate a background for further research in this field (Kulkarni & Anantharama, 2020).

A recent conceptual framework and systematic review identified some elements as crucial drivers of household food waste, hence providing a conceptual framework that helps guide investigations changes concerning the Covid-19 pandemic. Precisely, elements related to food purchasing, such as overbuying was identified as imperative behavioral factors. Authors pointed out that research related to many of such factors is fragmented and inconsistent (Rodgers et al., 2021). Therefore, this study primarily aims at examining variations in household food waste since the beginning of the pandemic. The hypothesis was that in general, people would report apparent changes in their food waste behaviors since the pandemic started.

Secondly, the study wants to identify potential mechanisms of changes in food waste. It was assumed that access to grocery shopping would change and the hypothesis was that those changes would be associated with changes in the quality and quantity of food waste. Other factors that are believed to influence household food waste during the pandemic include food preparation and cooking habits and skills at individual level. For instance, cooking at home more versus ordering food from outside, has been associated with changes in household food waste (Rodgers et al., 2021).

The third goal of this study was to find the possible relationship between an increase in online food delivery and an increase in plastic usage. When the pandemic hit, the online food delivery service has become another way of earning revenue for restaurants. Its working operation is based on the fact that restaurants register with the digital platform wherein customers can order food via an application. Delivery drivers then pick up the food and deliver it to the customer. This business model allows restaurants to continue their operations during the lockdown periods and it also causes less foot traffic to the restaurants. By focusing on online food delivery, it requires that restaurants use more takeout containers and packaging.

This study hence aims to generate data on food waste at household level which remains quasi-inexistent for Montclair Township despite the growing number of studies being done. This research seeks to bridge this gap, and particularly seeks to determine the effects of the coronavirus pandemics on such data.

Food Waste

Food waste is among the most discussed topics in the world today. It has become a critical issue since the beginning of urbanization and the consequent movement from farming to industrialized economies. Out of the food produced for human consumption, about one-third goes to trash. It is also forecasted that food production will increase by 60% towards 2050 to meet the growing demands (Nusaka, 2020). Food waste reduction has hence been encompassed among the 17 goals Sustainable Development Goals of the UN's 2030 Agenda and more precisely in target 12.3 which aim is to: "halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains" by 2030 (Principato et al., 2020).

Environmentally speaking, food waste is a critical issue since food production contributes greatly to the emission of greenhouse gases. As food is deposited in landfills to rot, methane is also produced. Methane is a strong greenhouse gas with direct consequences for global warming. Simultaneously, food waste in landfills releases toxic elements into the soil with negative impacts on groundwater (Pappalardo et al., 2020). Food wastes and losses amounted to about US$ 680 billion in developed countries and US$ 310 billion in developing countries (Jribi et al., 2020). Big portions of food are wasted at the end of the food supply chain in the Global North. This is primarily due to incorrect consumer behavior, attitudes, and habits. As such, annually, the food waste generation rate per capita is about 39% in North America and 31% in Europe (Principato et al., 2020). A study demonstrated that about one pound of food is wasted by Americans per day, that is 225 – 290 pounds annually. This is equivalent to 20% of all food put on the plates of Americans being sent to trash annually, or enough to feed 2 billion extra people per year (Forbes, 2018).

Previous studies also demonstrated that food waste is related to consumer demographic characteristics, and the decisions to throw food away vary with contextual factors. Therefore, to better understand food waste behavior, focus should be laid on the practices, habits, and routines of consumers given the hidden nature of the food waste issue. Moreover, food waste poses consequent ethical issues since more than 820 million people in the world do not have sufficient food and many more eat low-quality diets that cause micronutrient deficiencies and health problems. The reduction of food waste has been a priority in the research sector, and several recommendations have been made related to

giving respect for food and cooking skills or by encouraging a mindset of flexibility in light of unforeseen events (Pappalardo et al., 2020).

Food waste has been defined differently according to different perspectives. Generally, food waste is any food that is prepared for human consumption but ends up being discarded or lost or wasted instead for several reasons (intentionally and unintentionally) at any stage of the supply chain. As previously mentioned food waste provokes a big loss of sustainability. Hence much research on how to diminish the impact of food waste from the supply chain perspective has been done. Many papers have been dedicated to studying food waste at distinct levels of the supply chain. Most studies suggest that among all the members of a food supply chain (producers, distributors, retailers, and consumers), consumers contribute the most to food wastage. However, consumers often do not recognize their roles in contributing to avoidable food waste. Surveys revealed that 69% of Americans believe that they discard almost no food and 63% of Australians think that they throw away minimal amount of food. A survey done in the United Kingdom in 2006 revealed that “90% of consumers stated that they thought they wasted very little or no food at all” (Nusaka, 2020). In general, households are the biggest contributors to food waste and Covid-19 has had significant impact on food insecurity and hunger. It is hence important to determine whether households have increased or decreased food waste during the pandemic (Pappalardo et al., 2020).

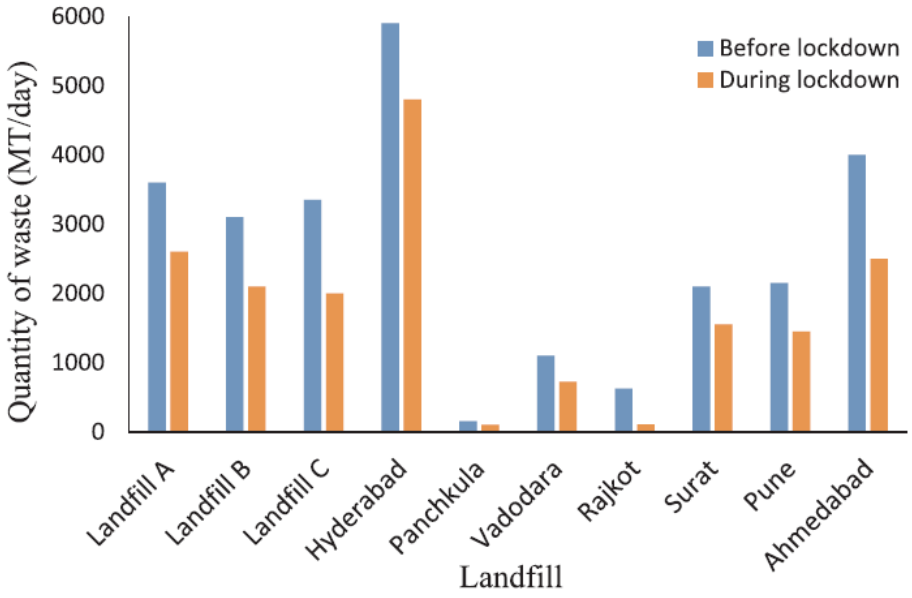
Chapter 2: Literature Review

Practices in MSW management during COVID-19 pandemic worldwide

The coronavirus pandemic has affected industry in several ways. In the United States (U.S.), food producers suffered due to the closure of restaurants, schools, and other institutions that normally bought large food quantities. There was a significant amount of food waste being generated during initial lockdown period. In response to that significant amount, the United States Environmental Protection Agency (US EPA) released guidelines for sustainable management of food waste and recycling during the COVID-19 public health emergency. Food waste management at institutions, households, and business levels was hence addressed (Kulkarni & Anantharama, 2020). In India, some changes arose following the announcement of lockdown which caused waste generation to drop significantly. Big changes were seen in the amount of waste reaching the dumpsites/landfills in May and June 2020. This may be associated with the closure of all the malls, restaurants, and so on, during the lockdown period. A notable reduction in the quantity of dry waste was detected due to the closure of malls, shops, offices, and others. The decreased waste quantities may also be associated with poor collection efficiency since the number of employees working in the waste management sector has reduced. After lockdown has been declared, many waste-pickers could not pick up waste for two reasons. Firstly, there were restrictions by the police and secondly by apartment societies. The following figure shows the quantity of waste reaching dumpsites/landfills before and during lockdowns in ten landfills in India (Somani et al., 2020).

Figure 2

Waste reaching landfills before and during the lockdown period **(Somani et al., 2020)**



The chart shows that around 20-40% decrease is observed in the amount of waste at most landfills /dumpsites after the lockdown. There was a drastic reduction (> 80%) in the generation of waste at Rajkot. This may be due to the migration of the workers to their home states from the industry-dominated city.

The amount of waste arriving in Delhi's dumpsites ranged between 3000 and 3700 MT/day in normal days (before lockdown) while it diminished to 1800-2500 MT/day during the lockdown period. Similarly, the quantities of waste reaching landfills found in Hyderabad, Pune, and Panchkula were 5800-6000, 2100-2200, and 150-160 MT/day respectively before the lockdown. The figures decreased to 4700-4900, 1400-1500, and 100-100 MT/day respectively during the lockdown. The total waste being generated by the

four cities of Gujarat (Ahmedabad, Vadodara, Surat, and Rajkot) has decreased approximately by 20-80% during the lockdown period, as shown in figure 2 (Somani et al., 2020).

An increase in the volume of recyclables and waste produced from the residences was noticed during Covid-19 outbreak. An estimate from SWANA in late April suggested that the household waste volume in the United States increased at national level at about 20% higher than normal, with some localities seeing an increase of more than 30%. Since residential recyclables and waste volumes increased higher, some local governments suspended their curbside recycling collection programs for some time to make sure that all the waste was collected and managed efficiently. While the volume of curbside mixed waste has peaked, return levels in waste deposit systems have temporarily decreased due to limited mobility, and the fact that residents were afraid of contagion. Moreover, since lockdowns, industrial activity also diminished substantially across countries. This decrease in industrial activity has significantly reduced the supply of high-value material from post-industrial waste (Kulkarni & Anantharama, 2020).

Current coronavirus pandemic is challenging to municipal waste management practices and procedures such as health measures for employees, waste treatment requirements, and general procedures due to coronavirus for the waste sector. Governments highlighted the importance of MSW management during the coronavirus outbreak and have taken many measures to tackle the problem. For example, to avoid burdening the municipal waste system during this pandemic, Austrians are asked to diminish waste generation and segregate waste as far as they can. At the beginning of the outbreak, guidelines were issued for the citizens to efficiently carry out waste reduction

and segregation, without putting their health and safety at risk. Tokyo has seen an increase in household combustible waste by 3.10% due to a rise in the number of people consuming food at home. The British government issued a publication on COVID-19 regulatory position statements for local authorities and waste collectors. These statements concentrate on waste stream prioritization, expansion in the temporary waste storage, waste segregation, adaptation of MSW incinerator to process COVID-19 infectious waste, and communication with residents (Kulkarni & Anantharama, 2020).

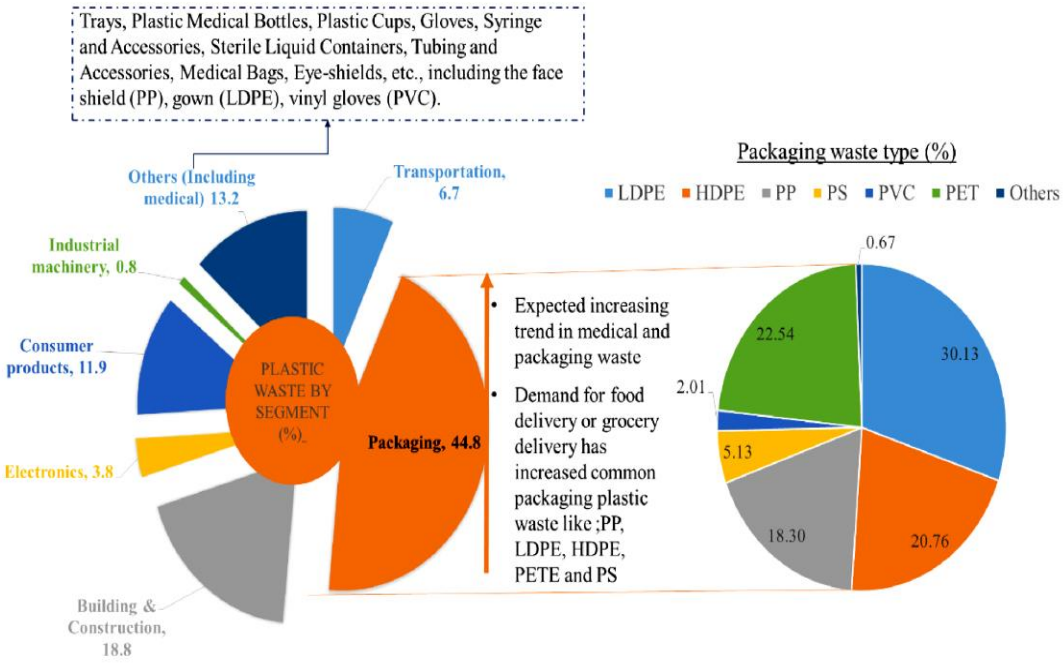
European Commission provided a document that served as a guide for waste management in the context of the coronavirus crisis. In the document, the overall continuity of proper MSW management services, including separate collection and recycling according to EU law is accentuated. It further states that if the services were to be decreased it must be ensured that the frequency of collection of residual and biodegradable waste is sufficient and continued for the final disposal. The US occupational safety and health administration (OSHA) has pre-defined safety guidelines for staff involved in waste management. In response to the pandemic, MSW management was recognized as an essential service, and staff involved in MSW management were mandated to implement those precautions. However, the management of MSW is still being overlooked. Municipal waste management is a crucial and routine service that is indispensable. Services of MSW management play a very important role in mitigating infectious disease transmission but are not often mentioned in public health crisis response communication (Kulkarni & Anantharama, 2020).

Consequences of lockdown restrictions due to COVID-19 pandemic on the generation of plastic waste: Do people throw away more?

People became concerned about hygiene and safety during the pandemic. Those concerns led to a significant increase in plastic packaging with expected implications on the world's sustainability effort to limit plastic pollution. The virus also caused paranoia among populations and caused people to stockpile food and other groceries having long shelf life irrationally, causing unwanted demand for packaged goods worldwide (Sharma et al., 2020). In South Korea for instance, online food purchases rose by 92.5% and daily necessities rose by 44.5% as compared to last year during the COVID-19 pandemic. Similarly, online shopping increased in countries such as India (55%), Vietnam (57%), Italy (31%), China (50%), and Germany (12%) during the same period. The increase in demand for plastics is mostly due to food and grocery packaging made of film, foam, and multi-layered plastics and is very concerning because of their low recyclability. The following figure shows segments of plastic waste, with an anticipated rise in the trend in medical and food packaging plastic (Sharma et al., 2020).

Figure 3

Segments of plastic waste (Sharma et al., 2020)



Disruptions due to COVID-19 have restored extensive usage of single-use plastic bags due to public health concerns. There have been rollbacks and pushbacks of policies against single-use plastic bags in many parts of the United States because of public opinion about sanitary concerns amid cross-contamination. Disposable bags are considered to be superior sanitary-wise as compared to reusable bags. However, the promotion of disposable bags by local governments as a way of being cautious could propagate strong environmental liability (Sharma et al., 2020). As a result, researchers promoted the practice of better bag sanitation after every use which could be even continued after the pandemic ends. Disposing rapidly of single-use products is often viewed as positive for staff and consumer health. However, the resulting peak in waste generation increases the challenges faced by already-strained waste management systems.

Consumer behaviors are likely to be affected by this temporary relaxation on single-use plastic ban in the long term. Considering plastic as protection against contamination could reframe the minds of consumers such that they could break their sustainable behavioral patterns which would consequently encourage the normalization of single-use plastics again (Sharma et al., 2020).

With the increase in the use of plastics, industries and governments have been called by WHO to increase the manufacture of plastics by 40% to meet increasing demand globally. The post-COVID-19 fall in oil prices can be viewed as being detrimental to the growth of the plastics recycling sector. The slump in the production cost of virgin plastics squeezes in the demand for post-consumer polymers having an indirect effect on the corporate sustainable packaging commitments of leading consumer firms. The comparatively higher price of recycled plastics creates a demand void in the market for waste recycling. Additionally, the staff is concerned about being exposed to COVID-19. Consequently, they do not show up in smaller recycling facilities making it difficult to operate for constant periods leading to disruptions in their cash flow. In developing countries like India where most of the recycling takes place through the unorganized sector, the challenges are huge. With movement across borders now being limited, transportation of goods to and from the recycling plants also turns out to be one of the major concerns affecting the recycling company (Sharma et al., 2020).

As we project ourselves to a post-COVID-19 future, addressing fear-driven perceptions against hygienic of reused and recycled products would be a major concern. Investments in safety-gear and physical infrastructure for sorting, collection, and recycling can re-install trust in the safety of waste handling to sanitation workers and can result in

clean, homogenous plastic streams for recyclers. Blending in automation and innovations in existing and emerging technologies like inculcating artificial intelligence into collection and segregation would help reduce the load on the manual systems and efficiently cater to waste management services. Designing eco-friendly products such as bioplastics and funding technologies fostering circular economic principles should be the priority of the future to ensure sustainability (Sharma et al., 2020).

Impacts of COVID-19 on consumer behavior (food waste generation)

The consequences of the COVID-19 pandemic on consumers' food demand were seen to vary with the price of foodstuffs, socio-demographic situation, consumers' income level, consumption, time constraints, and so on. A change in the frequency of visits to the food store and the spending of money on food per visit was observed (Aday & Aday, 2020).

As restaurants and limited-service eating places closed, the eating/purchasing habits of people changed and resulted in an uncommon shift from food service to retail. It was observed that purchasing food from supermarkets and using food services had the same ratio as 50% before the outbreak. However, it is almost 100% for supermarkets While the number of visits to food stores was diminished, the spending of money on food increased per visit (Aday & Aday, 2020). There was a shortage of some categories of food as lockdown restrictions were put into place because of the pandemic. In European countries, for instance, flour which is a staple food was no longer found on shelves since people home-baked more as a means to spend time with family. However, bread and baked products did not run out in supermarkets. Consumers tend to focus on foodstuffs with long shelf life such as canned or dried foods, frozen foods, and pasta since they were more convenient and facilitated daily cooking at home. A tendency to stock food was also

observed, whereby people turned to home baking but were also receiving misleading information about the availability of certain products (Aday & Aday, 2020). Moreover, consumers favored takeaway and home delivery options because of social distancing measures and shut down of restaurants. Interestingly, it was noted that the scarcity of eggs for instance was not only due to increased demand but also to a lack of packaging for retail. An increase of 40% was observed in the household egg consumption in Argentina since March 2020 and sales of eggs increased by 44$ as compared to last year in the U.S. The U.S. Food and Drug Administration rendered the packaging and labeling of eggs more flexible due to the insufficient availability of appropriately labeled retail packages to fulfill the demand and facilitate the distribution of eggs during the Covid-19 pandemic (Aday & Aday, 2020).

The incidence of an event such as Covid-19 pandemic increases the demand for food globally. In a study where demand data in European countries due to Covid-19 were assessed, it was found that fresh bread demand peaked by 76%, and frozen vegetables increased by 52% in the week when the pandemic was declared. On the other hand, the demand for alcoholic beverages did not increase, except one month after the pandemic announcement when it doubled (Aday & Aday, 2020).

The behavior of Italian citizens on food choices was studied under COVID-19 quarantine. With a response from approximately 2900 people from all areas of Italy, it was found that consumption of healthy food and beverage increased for vegetables (33%), fruits (29%), legumes (26.5%), and extra virgin olive oil (21.5%) (Aday & Aday, 2020). It was also determined that 44.5% of respondents had more sweet consumption and 16% drank more wine. In the U.S., 630 consumers participated in a survey in May. The survey revealed

that 70% of consumers reduced their number of visits to the supermarket and favored online shopping due to the pandemic. In the U.S., 56% of consumers expressed worries about not finding particular foods they wanted to purchase in-store or forgetting to purchase something (Aday & Aday, 2020). 70% of consumers stated that they consumed more food while at home. In terms of healthy consumption, 43% of consumers stated that they consume more fruits, 42% more vegetables, and 30% more protein-containing foods (meat, chicken, or fish). Additionally, when questioned about their unhealthy consumptions, 47% of consumers stated that they had more sweets, 24% fewer vegetables, 21% consumed fewer fruits, and 19% consumed less protein (Aday & Aday, 2020).

Consumers are key players in the food supply chain. Therefore, changes in consumer behavior strongly affect the food supply chain. COVID-19 outbreak resulted in an important increase in food price related to lockdown restrictions accompanied by panic buying, as well as supply chain disruptions. Some consumers will be more proactive in reducing their food waste to combat food insecurity. The opposite scenario may also happen since many perishable foods were discarded since restaurants, processing plants or schools closed. Additionally, transportation problems during lockdown or overbuying of perishable items because of panic buying resulted in higher food waste levels (Aday & Aday, 2020).

Environmental, Economic, and Social impact of online food delivery on restaurants during COVID 19 pandemic

Online food delivery has gained increased popularity worldwide. In 2018, the revenue from online food delivery was over $34 billion. In the US, it was predicted that the online food delivery revenue will surpass $26 billion in 2020. Estimates forecast that the gross revenue of the global online food delivery market will double at $82 billion by 2025 (Niu et al., 2021).

Grubhub was the first online food delivery company created in 2004. Its goal was to eradicate paper menus and replace them with a single website. Following that, other online food delivery platforms such as Postmates and Doordash were founded. Consumers using online food delivery services were found to have a few empirically quantified characteristics. The percentage at which consumers order home delivery is 86%, and 74% of sales occur on weekends. A study conducted in 2017 observed that 43% of individuals who ordered with online delivery services state that it is an alternative for an in-person meal at a restaurant. This percentage was 38% the year before suggesting that there is incremental cannibalization with the arrival of online channels (Collison, 2020). There is this common statement that online food delivery services provide supplementary sales to restaurants. A survey of several thousand restaurateurs revealed that offering online delivery has generated additional sales for 60% of restaurant operators. While it is true that online food delivery services provide incremental sales, the profitability of restaurants is declining as online delivery increases. The reason is that there are high fees that online food delivery charges, not only ad delivery and service charges to consumers, but also to the restaurant. The majority of online delivery services charge the restaurant between 20 –

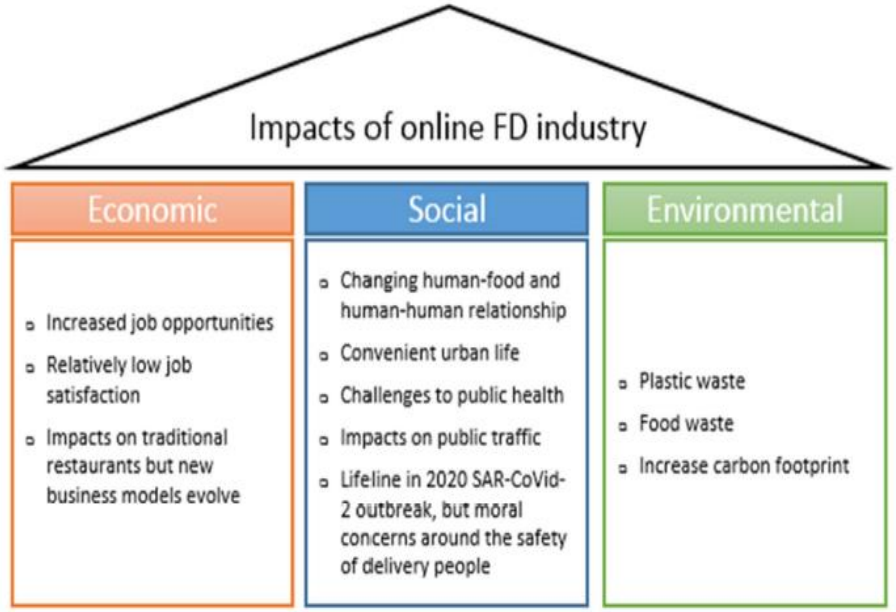
30 % of each purchase. It is often the case that online delivery represents a big portion of business for restaurants, therefore cutting online sales channels is out of question (Collison, 2020).

During the pandemic, there has been an increase in online food delivery services. As a matter of fact, in China, online food delivery orders surged 20 % during January alone. Companies such as Doordash have even started diminishing or eliminating their fees when faced with the surge that is beginning in the United States. It is expected that consumers will still increase their usage of online food delivery services so long as there are lockdowns and in-person dining remain closed. However, it is unlikely that this will replace pre-pandemic restaurant spending. As the pandemic progresses as well as its impacts in the United States, the demand for non-contact food delivery services will probably continue to increase like in China (Collison, 2020).

Especially during the covid 19 pandemic, the advantages of online food delivery are apparent, as it makes it easier for consumers to get prepared meals and enables food businesses to keep running. However, some problems associated with online food delivery have been noticed. From an economic point of view for instance, while online food delivery provides sales and job opportunities, critics have pointed out the high commission that restaurants are charged and questionable working conditions for delivery people. From a social point of view, online food delivery impacts the relationship between consumers and their food, as well as impacting traffic systems and public health outcomes. Environmental effects include its high carbon footprint and considerable generation of waste. The following picture shows the impacts of online food delivery according to the three pillars of sustainability (Li et al., 2020).

Figure 4

Message house of the impacts of online food delivery (Li et al., 2020)



As previously mentioned, the pandemic has significantly affected restaurant-related plastic consumption. As more restaurants adopted online food delivery services, this shift led to more extensive use of takeout containers and packaging. This results to a greater environmental footprint. The readily available materials that can be employed for takeaway and packaging nowadays are paper plastic laminates (PPL) and plastic containers (Janairo, 2021). Alternative container types are being marketed as green alternatives, such as bagasse-based containers and bioplastics. PPLs are typically used for paper bowls and paper cups. The material consists of a cellulose exterior and consists of an internal coat of a thin plastic film that enables the material to retain liquids. While PPL-based containers are cheap and are regularly used as takeout containers, they are not easy to effectively recycle and cause many environmental problems (Janairo, 2021). For instance, studies have

shown that PPL-based containers leach microplastics when exposed to hot water (Ranjan et al., 2021). Moreover, this form of container has a carbon footprint of 75kt of carbon dioxide equivalents, which can be compared to car manufacturing. As options for food take-out, plastic-based microwaveable containers are also very popular. They are more presentable and have more sturdiness than PPL-based containers. They can be reused but it is unsure how many are actually reused and are thrown away right after a meal. Both plastic-based microwaveable containers and PPL-based containers are regularly found in marine litter. This points out their widespread consumption, poor disposal management and limited reusability. Such containers are also possibly hazardous for the health of the consuming public. Additionally, wildlife also ingests plastic debris found in marine environments for instance, and dies (Janairo, 2021).

Restaurants have slowly been switching to bioplastics-food-based containers. Many materials can be used to make bioplastics. The common type is made from polylactic acid (PLA). Renewable sources such as crops are used to make PLA. Studies revealed that cups made from sugarcane-based bioplastics display lower global warming and fossil fuel depletion impacts compared with petroleum-based plastics. To recycle and do material recovery, bioplastics need special temperature-controlled facilities to facilitate biodegrading. Without those facilities, bioplastics can take a long time to degrade, especially if they are in landfills (Janairo, 2021). Another barrier preventing the wider adoption of bioplastics is the price. The price of bioplastics can be 2-5 times greater than that of conventional packaging materials. This can be due to the early developmental stage of bioplastics innovation landscape and the fact that there are no dominant market players. Bagasse-based containers have recently become popular as eco-friendly packaging

material. Fibers and pulp of crops such as sugarcane are used to make such materials. Bagasse-based materials can be composted within days and under natural conditions, on the contrary of PLA bio-plastics. The price of bagasse-based materials is not competitive compared with PPL and plastic takeout containers because they are being produced at a relatively small scale. Additionally, bagasse-based containers cannot always be used for every food application since these materials may not be suitable for serving hot liquids such as soup. Hence, there is a need to develop innovative materials to decrease our dependence on plastic (Janairo, 2021).

This study hence attempts to contribute to existing literature by adding to it information on the quality and quantity of food being wasted at household level with Montclair township as a case study, as well as evaluating changes in the amount of plastic waste generated due to a possible increase in online food shopping.

Research Questions

This study aims at understanding the impact of Covid-19 on the amount of food waste generated by Montclair residents. The main research questions to be answered are:

(i) How did the Covid-19 pandemic affect food waste quantities?

(ii) Did eating at home more often than usual affect food waste quantities?

(iii) Is the context in which individuals live related to these changes?

(iv) Has there been an increase in plastic usage related to an increase in online food delivery?

Chapter 3: Methodology

Survey Design

The first part of the study consisted of a survey. A self-administered questionnaire was used to conduct the survey. It was circulated from 31st March 2021 to April 26th, 2021 during the Covid-19 pandemic. The respondents were approached by electronic means, that is, social media, more precisely Facebook. The survey was circulated in groups where the was a big concentration of New Jersey and Montclair residents. The questionnaire was designed based on an extensive study of relevant literature for similar contributions. As such, insights about the type of questions to be asked to respondents were obtained from Principato et al. (2020).

The recipients of the survey invitation were on the scale of thousands, whereby groups such as Secret Montclair count more than 13 000 members. The target was to collect at least 200 valid questionnaires. SPSS 25 was used to generate a general picture of frequencies of variables and Regression Analysis was performed to analyze the relationship between different variables. The null hypothesis is that there is no relation between tested variables (socio-demographic characteristics, situational and social factors, and food management and waste habits). Data generated from Qualtrics was used for analysis. The variable “median income” was obtained from 2010 census tract estimates available from ESRI. Population and income data were aggregated for census tracts within the Montclair neighborhood. Excel was used to perform a Regression Analysis and a Chi-Square test between “median income” for the different districts in which respondents live and the amount of food waste they reportedly generate.

Structure of the questionnaire

The questionnaire consisted of 11 questions structured into 3 sections: Socio-demographic characteristics, Situational and social factors, and Food management and waste habits before and during the pandemic. These sections were drawn from relevant literature on food waste at household level. Section 1; Socio-demographic characteristics focused on the socio-demographic features of the respondents. The first and second questions hence asked about the place of residence of the respondents. The study focused on Montclair and having data for the different districts that can be used for the policy decision-making process. The third question which was about the place of residence of respondents who were not in Montclair was added to examine any difference between food waste data from Montclair and non-Montclair locations. The fourth question asked about the number of people in the respondents' households. Studies revealed that larger households waste more than smaller ones, although it was noticed that the amount of food waste per capita decreased as the number of family members increases (Principato et al., 2020). The fifth question asked about the respondents' highest degree or level of education they completed. There is a known relationship between individuals' level of education and the amount of food waste he/she generates: the higher the level of education, the bigger the amount of food waste generated (Principato et al., 2020).

It is believed that the wasteful behavior of individuals is also driven by situational and social factors; and by incorrect behaviors and habits during the food management process, that is during the food planning, in-store, pre-consumption, and disposition phases (Principato et al., 2020). There is proof that those factors influence an individual's wasteful

behaviors, and these factors have hence been considered in section 2 of the questionnaire, that is questions 6 to 9.

The last section: food management and waste habits asked respondents to report any change in categories of food waste (pasta-rice, meat-fish-eggs, milk and dairy products, vegetables, fruits, and bread). The last question in this section asked respondents to report changes in their plastic waste streams. The hypothesis is that there has been an increase in residential plastic waste streams since it is believed that online food delivery has increased. The last question will allow conclusions to be drawn on a possible relationship between the two variables.

Interview Design

Interviews were also conducted with restaurant owners of Montclair to have information about their plastic waste related to online food delivery services. Recruitment for the interviews was done via email and phone. The interviews were expected to last between 15 to 20 minutes and were video recorded. Respondents could skip questions they did not wish to answer or stop the interview at any time. 11 questions were prepared for the interview but the aim was to create a conversation with the interviewee. Questions 1, 2, and 3 asked about the type of restaurant managed by the interviewee as well as the location and the number of tables they serve. This is to have an idea of the different types of restaurants sampled for the interview, to be able to compare data with other restaurants. Questions 4 and 5 were about online food delivery services. It was important to know whether the restaurant managers noticed a change in the amount of online food delivery services they offer during the pandemic. The hypothesis is that the latter has increased during the pandemic. Questions 6, 7, and 8 discussed costs and forms of packaging being

used by the restaurants. The aim was to assess any change in the costs of packaging as the pandemic hit. In question 9, the respondent was asked to estimate changes in volume and composition of plastic waste streams that occurred during the pandemic. Again, this was to verify the hypothesis that plastic waste streams have increased because of an increase in online food delivery services. Question 10 was about the willingness of restaurant managers to shift to more sustainable types of packaging provided they were made available at a reasonable cost. It was important to determine whether restaurants would be willing to adopt new sustainable practices if backed up by relevant policies. Finally, the last question was to obtain an insight on other ways in which online food delivery services have affected businesses during the pandemic.

Chapter 4: Results

Interview

One interview was successfully conducted with the Vice President of Operations of a restaurant in Montclair. She is familiar with plastic waste trends and the local restaurant industry. The restaurant is a traditional Japanese restaurant with one location in Montclair. A the time of the study, it was serving 7 people (indoor) due to pandemic restrictions. The restaurant offers online food delivery services. When asked whether online food delivery services have increased during the pandemic, the respondent answered yes. The restaurant never did online food delivery before the pandemic therefore it went from 0% online food delivery services to almost 100%. The restaurant does mostly online food delivery (80%) and the rest is dining (20%). The next question was about the expenses of the restaurant associated with packaging and delivering food during the pandemic. The respondent replied that it depends on the size of the order. Delivery platforms such as Doordash charge 20% of sales but with Grubhub the fee for just being on the platform is 25-26% of sales. This is just the cost to get it to the customer. As for packaging, again it depends on the size of the order, but it is around $1 per order or more. There are different packaging required (the restaurant serves ramen for example): packaging for the broth, for the noodle, chopsticks, and the bag. When asked about the type of packaging used for online food delivery (plastic, paper, Styrofoam, or other), the interviewee responded that most of the materials they use are paper and there are some plastics as well. The respondent also responded that packaging expenses increased as a whole since they did not do online food delivery services before. Before the pandemic, they had a few containers for people to pack food to-go if they did not finish their food, but it was a minimal amount that they had. The

respondent was next questioned about changes in volume and composition of plastic waste streams that occurred during the pandemic. She replied that it was hard for her to quantify since it is not “really their waste” as people get their order at home. Concerning waste associated with food preparation, she replied that it was pretty much the same now as compared to before the pandemic. It is pretty much the case for plastic waste as well. However, since they have more packaging, they have more boxes and their cardboard waste is more. The respondent also stated that she would be interested in testing out biodegradable packaging if it was made available at a reasonable cost. The restaurant is concerned about the environment and supports sustainability initiatives. However, there is one challenge that the restaurant would have to face with biodegradable packaging. The challenge is that most of the time this type of packaging cannot withstand the heat of food. The respondent also pointed out how expensive such packaging is. It would be hard to invest in such type of packaging without passing on that cost to the customers. The respondent hopes that more choices of biodegradable materials for packaging become available and that the price goes down so that it is easier to use them. Finally, when asked about other ways in which online food delivery affected her business during the pandemic, the respondent responded that they would not have been able to open if there has not been online food delivery. When they first reopened during the pandemic, the only orders the restaurant was getting were from online food delivery platforms since indoor dining was not allowed. The restaurant also wanted to be careful and limit the number of people they interacted with during the pandemic, and to create a safe place where people are comfortable. Therefore online food delivery ensured that their Montclair location (the

restaurant has branches in other towns) stayed open for business, specifically since they could not offer even outdoor dining due to lack of space.

Survey

Participant's characteristics

With 57 responses recorded for the question of "Are you a Montclair resident?", 56 people responded "Yes", and 1 person lived outside of Montclair. Out of the 56 Montclair residents, the majority lived in the South End district of Montclair. The following table shows the districts in which the respondents live, as well as the median income level (ESRI, 2021).

Table 1

Montclair districts in which respondents live

District	%	Count	Population	Median Income ($)
Upper Montclair	21.05%	12	10986	281113
Watchung Plaza	15.79%	9	3954	266815
Frog Hollow	1.75%	1	889	71115
Walnut Street	7.02%	4	3000	108882
Montclair Center	22.81%	13	6772	234631
South End	31.58%	18	8555	115221
Total	100%	57	34156	

The table demonstrates that a big share of the respondents are from the South End area of Montclair. The median income for South End is $115221 which makes it a lower-

income area as compared to neighborhoods such as Upper Montclair whose median income equals $281113.

The survey also showed that 52.63% of the respondents have more than 3 people in their household and 41.38% of them completed a master's degree as the highest degree level completed.

Figure 5

Number of people in household

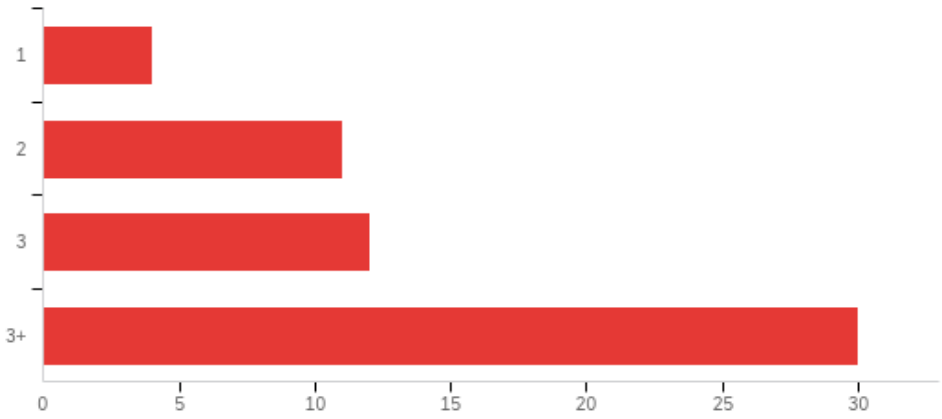
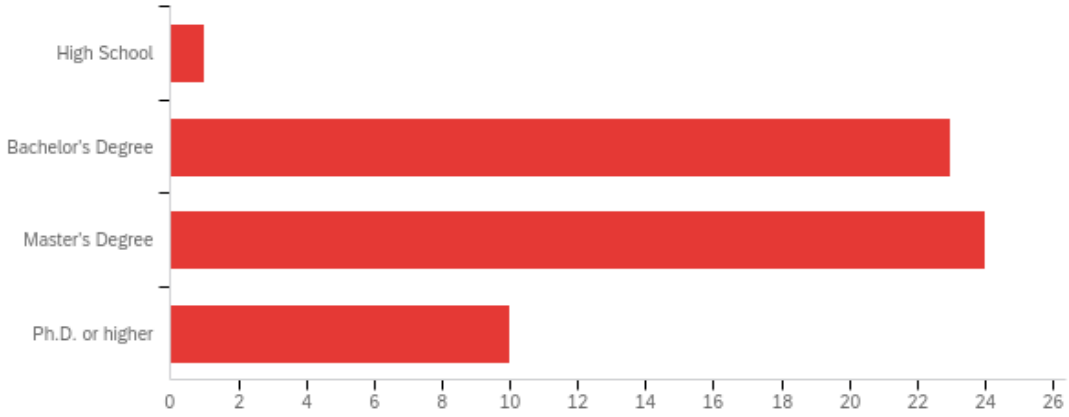


Figure 6

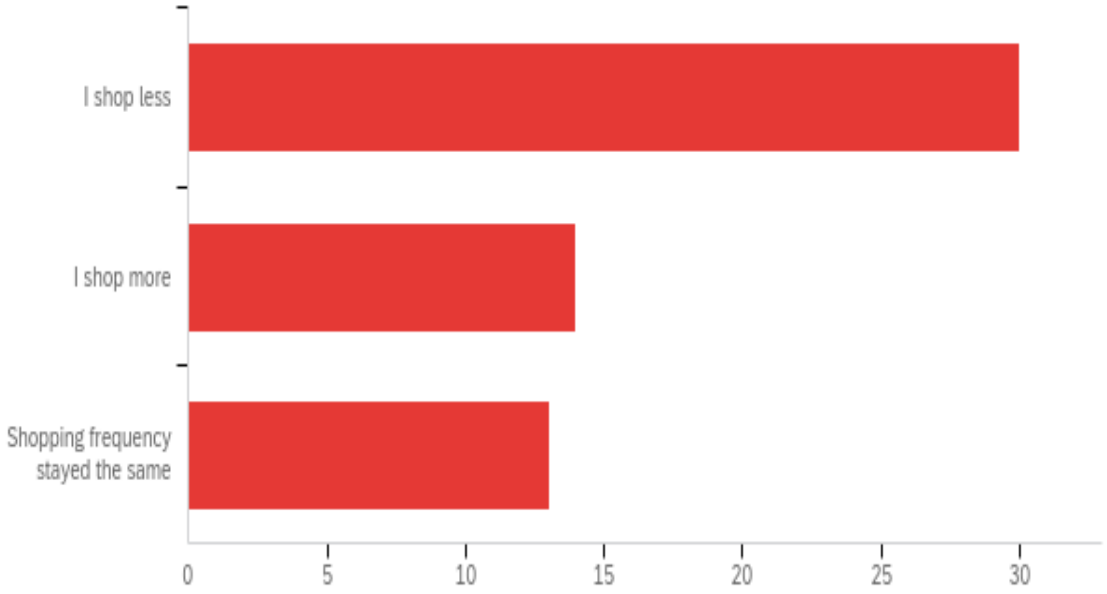
Education Level



Question 7 of the survey asked about any change in shopping frequency during the pandemic as compared to before the pandemic. Most of the respondents (52.63%) replied that they shop less during the pandemic as shown in the following chart:

Figure 7

Shopping frequency



Research Question 1: How did the COVID-19 pandemic affect food waste quantities?

The results of the survey enabled the assessment of the effect of Covid-19 on food waste quantities in households. It was noticed that most of the respondents reported that all food waste categories except bread, stayed the same. 44.8% of the respondents reported an increase in their bread consumption.

Table 2

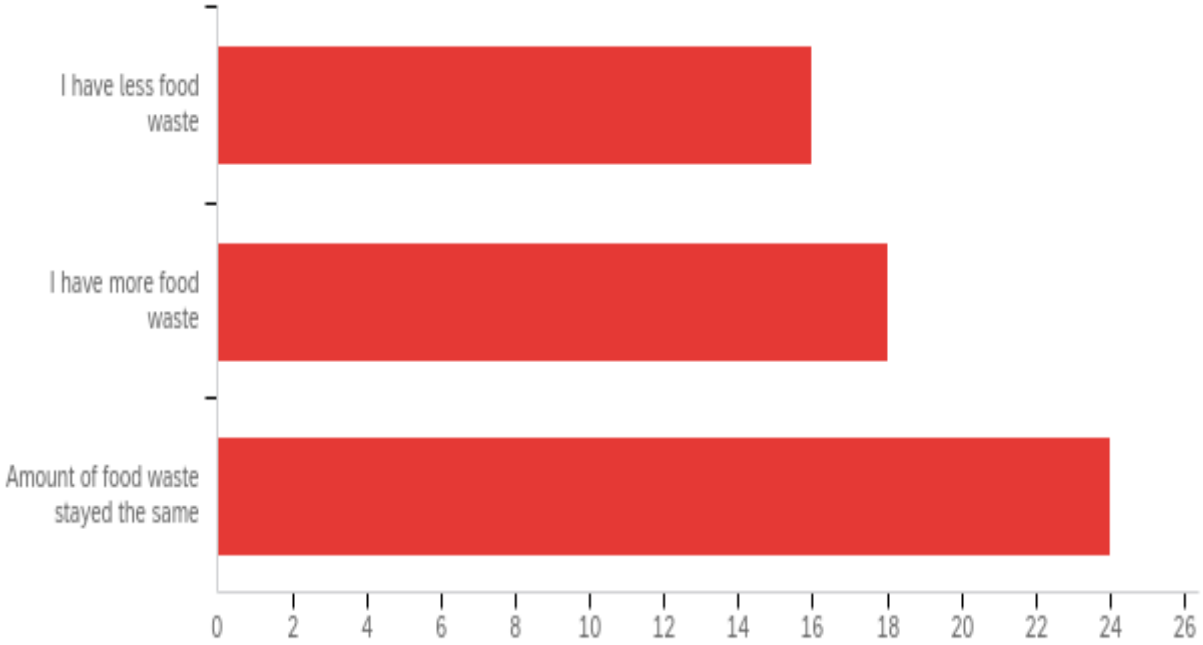
Changes in food waste categories

Food Category	Increased		Decreased		Stayed the same		Total
Pasta/rice	39.66%	23	6.90%	4	53.45%	31	58
Meat-fish-eggs	25.86%	15	22.41%	13	51.72%	30	58
Milk-dairy products	24.14%	14	13.79%	8	62.07%	36	58
Vegetable	41.38%	24	12.07%	7	46.55%	27	58
Fruits	43.10%	25	8.62%	5	48.28%	28	58
Bread	44.83%	26	13.79%	8	41.38%	24	58

The following graph shows how most the respondents declared that their amount of food waste stayed the same during the pandemic:

Figure 8.

Changes in food waste quantities



Research Question 2: Did eating at home more often than usual affect food waste quantities?

To answer this question, a regression analysis is done between the variables “Do you have more food waste during the pandemic than before the pandemic?” and “Are you eating at home more during the pandemic as compared to before the pandemic?”. The null hypothesis is that there is no supported relationship between the two variables. The results are as follows:

Table 3

Model Summary 1

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.246[a]	.060	.044	.808

a. Predictors: (Constant), Are you eating at home more during the pandemic as compared to before the pandemic?

Table 4

Coefficients 1

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.273	.988		.276	.784
	Are you eating at home more during the pandemic as compared to before the pandemic?	.909	.479	.246	1.898	.063

a. Dependent Variable: Do you have more food waste during the pandemic than before the pandemic?

From Table 3, an R square value of 0.060 indicates that the “Are you eating at home more during the pandemic as compared to before the pandemic” variable accounts for only 6.0% for the variation in the “Do you have more food waste during the pandemic than before the

pandemic?" variable, which is quite weak. Table 4 shows that the p-value equals 0.063 which is greater than 0.05. Therefore, the null hypothesis is retained; there is no relationship between people eating less or more at home during the pandemic, and the amount of food waste produced during the pandemic.

Research Question 3: Is the context in which individuals live related to these changes?

Regression analysis was used to answer this question. The relationship between respondent's place of residency, number of people in the households, level of education, income level, and changes in food waste quantity was tested. The null hypothesis is that there is no supported relationship between:

a. The respondents' place of residency and changes in food waste quantity,
b. The number of people in household and changes in food waste quantity,
c. Level of education and changes in food waste quantity,
d. Income level and changes in food waste quantity.

The results are shown below:

i. Relationship between the place of residency and changes in the amount of food wasted during the pandemic.

Table 5

Model Summary 2

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.143[a]	.021	.003	.824

a. Predictors: (Constant), Are you a Montclair resident?

Table 6

Coefficients 2

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.214	.853		1.423	.160
	Are you a Montclair resident?	.893	.831	.143	1.074	.288

a. Dependent Variable: Do you have more food waste during the pandemic than before the pandemic?

Table 5 demonstrates that only 2.1% (R = 0.021) of the variable “Are you a Montclair resident?” accounts for the variability in the variable “Do you have more food waste during the pandemic than before the pandemic?”. Tables 6 confirms that there is no relation between the 2 variables since the p-value equals 0.288 which is greater than 0.05.

ii. Relationship between the number of people in household and changes in food waste quantity.

Table 7

Model Summary 3

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.123[a]	.015	-.003	.826

a. Predictors: (Constant), Including yourself, how many people currently live in your household?

Table 8

Coefficients 3

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.794	.373		4.815	.000
	Including yourself, how many people currently live in your household?	.103	.112	.123	.923	.360

a. Dependent Variable: Do you have more food waste during the pandemic than before the pandemic?

With an R square value of 0.015, only 1.5% of the variable “Including yourself, how many people currently live in your household?” accounts for the variable “Do you have more food waste during the pandemic than before the pandemic?”. The p-value is 0.360 which is less than 0.05. Therefore there is no supported relationship between the 2 variables.

iii. Relationship between level of education and changes in food waste quantity

Table 9

Model Summary 4

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.030[a]	.001	-.017	.833

a. Predictors: (Constant), What is the highest degree or level of education you have completed?

Table 10

Coefficients 4

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.049	.412		4.979	.000
	What is the highest degree or level of education you have completed?	.032	.145	.030	.223	.824

a. Dependent Variable: Do you have more food waste during the pandemic than before the pandemic?

R square equals 0.01 which means that only 0.1% of the variable “What is the highest degree or level of education you have completed?” accounts for the changes in the variable “Do you have more food waste during the pandemic than before the pandemic?”. With a p-value of 0.824 ($\alpha < 0.05$), it can be concluded that there is no supported relationship between the 2 variables.

iv. Relationship between income level and changes in food waste quantity

The following table shows the average income for each district in which respondents live (ESRI, 2021).

Table 11

Median Income for Montclair Neighborhoods (ESRI, 2021)

District	Median Income ($)
Upper Montclair	281113
Watchung Plaza	266815
Frog Hollow	71115
Walnut Street	108882
Montclair Center	234631
South End	115221

The results of the Regression Analysis between the variable "Median Income Level" and "Do you have more food waste during the pandemic than before the pandemic" are as follows:

Table 12

Regression Statistics

Regression Statistics	
Multiple R	0.156056365
R Square	0.024353589
Adjusted R Square	0.006931332
Standard Error	0.823204552
Observations	58

Table 13

Coefficients 5

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	2.459944308	0.293026044	8.394968	1.73865E-11	1.872942606	3.046946011	1.872942606	3.046946011
Median Income ($)	-1.63752E-06	1.38502E-06	-1.1823	0.242080836	-4.41206E-06	1.13702E-06	-4.41206E-06	1.13702E-06

An R Square value of 0.024 means that only 2.4 % of the variable “Median Income” accounts for the variation in the variable “Do you have more food waste during the pandemic than before the pandemic. The p-value (0.24) is greater than 0.05. Therefore, there is no statistical relationship between the two variables.

A Chi-Square test was also performed to test the significance between the two variables. The null hypothesis was that the variables “Do you have more food waste during the pandemic than before the pandemic” and income level are independent.

Cross-Tabulation was first performed to determine the number of people earning different incomes per neighborhood:

Table 14

Cross tabulation data

If yes, which district do you live in/are you closest to? * Do you have more food waste during the pandemic than before the pandemic? Crosstabulation				
Count				
		Do you have more food waste during the pandemic than before the pandemic?		
		I have less food waste	I have more food waste	A mount of food waste stayed the same
If yes, which district do you live in/are you closest to?	Upper Montclair	2	5	5
	Watchung Plaza	4	3	2
	Frog Hollow	0	1	0
	Walnut Street	1	1	2
	Montclair Center	5	3	5
	South End	4	5	9
Total		16	18	23

The Chi-Square test was then performed in excel to determine the correlation between the variables “Do you have more food waste during than before the pandemic?” and income level. The results are as follows:

Table 15

Observed Values

Observed	$281113	$266815	$71115	$108882	$234631	$115221	Total
I have less food waste	2	4	0	1	5	4	16
I have more food waste	5	3	1	1	3	5	18
Amount of food waste stayed the same	5	2	0	2	5	9	23
Total	12	9	1	4	13	18	57

Table 16

Expected Values

Expected	$281113	$266815	$71115	$108882	$234631	$115221	Total
I have less food waste	3.368421	2.526316	0.280702	1.122807	3.649123	5.052632	16
I have more food waste	3.789474	2.842105	0.315789	1.263158	4.105263	5.684211	18
Amount of food waste stayed the same	4.842105	3.631579	0.403509	1.614035	5.245614	7.263158	23
Total	12	9	1	4	13	18	57

Expected frequency in row I and column j = (Grand total row i) (Grand total column j)/ Total number of observation

(Keshminder, 2020)

Table 17

Chi Square Test

Chi Square	$281113	$266815	$71115	$108882	$234631	$115221	Total
I have less food waste	0.555921	0.859649	0.280702	0.013432	0.500084	0.219298	2.429087
I have more food waste	0.386696	0.008772	1.482456	0.054825	0.297571	0.082359	3.973492
Amount of food waste stayed the same	0.005149	0.733028	0.403509	0.092296	0.0115	0.415332	1.660814
Total							8.063392

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

(Navlani, 2019)

Calculated p-value = 0.78.

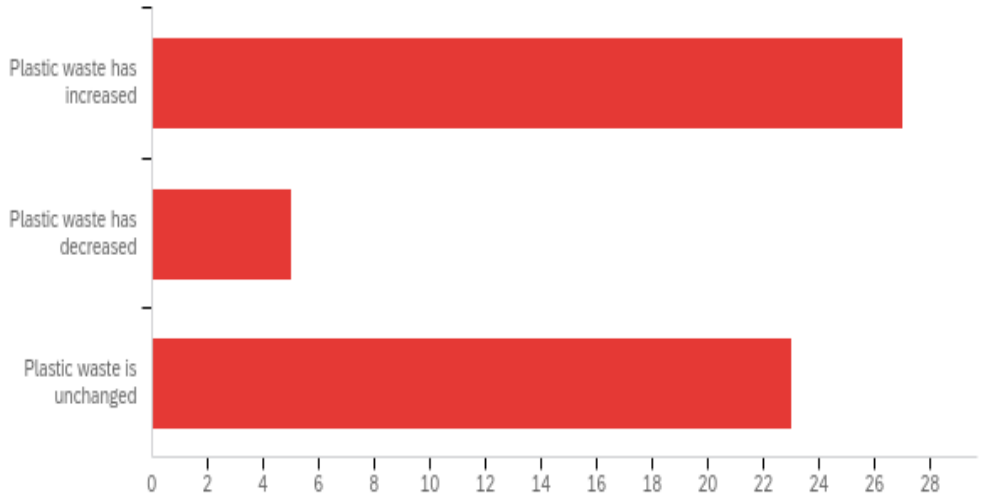
Given that the p-value is greater than $\alpha = 0.05$. There is no correlation between the variables “Do you have more food waste during the pandemic than before the pandemic?” and income level.

Research Question 4: Has there been an increase in plastic usage related to an increase in online food delivery?

Simple descriptive statistics were obtained from the Qualtrics report to answer this question. It was found that most of the respondents' plastic waste streams (49.09% from 55 responses recorded) have increased during the pandemic. This is showed in the following graph:

Figure 9

Changes in plastic waste streams



From the data gathered from the interview with the restaurant's vice president of operations, it was found that the restaurant noticed an increase in online food delivery. Assuming it is the case for other restaurants, this may explain the increase in plastic waste observed by the respondents.

Chapter 5: Discussions

The survey resulted in relatively small sample size and it would hence not be right or justifiable to make a broad generalization with the data. However, the research gives an insight into how food and plastic wastage have been affected by the pandemic in Montclair. The interview revealed that as expected, restaurants might be noticing an increase in their online food delivery services. At the time of the study, the restaurant was doing 80% online food delivery services and 20% dining. The results of the survey showed that most respondents noticed an increase in their plastic waste streams.

The survey aimed to investigate the effect of the COVID-19 pandemic on food waste, particularly food waste categories. Results revealed that the food categories that people considered to have increased the most were bread. If this is compared to Europe, a similar scenario happened whereby the demand for fresh bread peaked by 76% when the pandemic was declared, as mentioned in previous literature (Aday & Aday, 2020). The survey also showed that 94.83% of people eat at home more during the pandemic. However, the Regression Analysis did not show a significant relationship between the variables " "Are you eating at home more during the pandemic as compared to before the pandemic" and "Do you have more food waste during the pandemic than before the pandemic?".

Research question 3 aimed to investigate whether people's characteristics, that is, the context in which individuals lived affected the quantity of food waste they generate. No statistical relationship was found with any of the variables although literature suggests that there is a relationship between the individuals' level of education and the amount of

food she/he wastes. According to the study, the higher the level of education, the larger the quantity of food waste generated (Principato et al., 2020).

Chapter 6: Conclusion

Based on the research process, it can be concluded that the overall amount of food waste generated in Montclair households stayed the same during the pandemic. While this is better than an increase in food waste, actions can be taken to create a reduction in household food waste in Montclair. People are already eating at home more and further campaigns such as intervention programs can be done with families to promote home cooking and food preparation. Moreover, food sharing apps and food rescue and delivery options could be developed so that people can donate their food surplus to people who need it based on a circular economy approach (Principato et al., 2020).

The increase in plastic waste is a problem. This can be addressed if more sustainable packaging such as bioplastics and bagasse-made containers are made available to restaurant operators at an affordable cost. While the interview conducted may not be a direct representation of all restaurants in Montclair, it might be right to assume that Montclair restaurants will be willing to shift to more sustainable packaging under previously mentioned conditions. Furthermore, Montclair Township has a strong commitment to sustainability and may support restaurants in this direction. Moreover, campaigns could be done to encourage people to adopt reusable grocery shopping bags.

The study includes some limitations. The first limitation is that small sample size was obtained for the survey. The sample is not representative of the general population. In the future, incentives can be offered to ensure a higher response rate. Secondly, more valid and reliable tools can be used to measure food waste in future work.

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Chapter 8: Appendices

Questionnnaire

Section 1: Socio-demographic characteristics

1. Are you a Montclair resident?

   -Yes

   -No

2. If Yes, which district do you live in/are you closest to?

   - Upper Montclair
   - Watchung Plaza
   - Frog Hollow
   - Walnut Street
   - Montclair Center
   - South End

3. If No, in which part of New Jersey do you reside?

   - North Jersey
   - Central Jersey
   - South Jersey

4. Including yourself, how many people currently live in your household?

   - 1
   - 2

- 3
- 3+

5. What is the highest degree or level of education you have completed?
   - High School
   - Bachelor's Degree
   - Master's Degree
   - Ph.D. or higher

Section 2: Situational and social factors

6. Whether you shop at the store or online, has your shopping frequency changed during the pandemic as compared to before the pandemic?
   - I shop less
   - I shop more
   - Shopping frequency is unchanged

7. Are you shopping more online or in store during the pandemic as compared to before the pandemic?
   - Online
   - In store

8. Do you have more food waste during the pandemic than before the pandemic?
   - I have less food waste

- I have more food waste
- Amount of food waste is unchanged

9. Are you eating more at home during the pandemic as compared to before the pandemic?
   - I eat at home less
   - I eat at home more
   - My eating habits stayed the same

Section 3: Food management & waste habits before and during pandemic

10. Please indicate whether the following food categories increased, decreased, or remained during the pandemic as compared to before the pandemic:

	Increased	Decreased	Stayed the same
Pasta/Rice			
Meat-fish-eggs			
Milk-dairy products			
Vegetable			
Fruits			
Bread			

11. Please indicate whether your plastic waste stream has changed during the pandemic as compared to before the pandemic.
    - Plastic waste has increased

- Plastic waste has decreased
- Plastic waste is unchanged

Interview Script

Interview is expected to last between 15 to 20 minutes and will be video recorded. Interviewee can skip questions that they do not want to answer or stop the interview at any time.

Q1. What type of restaurant do you own/manage? (traditional American, Chinese, Mediterranean, and so on)

Q2. Where is your restaurant located?

Q3. How many tables does your restaurant serve?

Q4. Do you offer online food delivery services?

Q5. Have online food delivery services increased during the pandemic? (very much, not so much, unchanged)

Q6. How much is it costing your restaurant to package and deliver food during the pandemic?

Q7. Is your packaging for online food delivery mainly plastic, paper, Styrofoam or other?

Q8. Which area of packaging increased the most?

Q9. Can you estimate the changes in volume and composition of plastic waste streams that occurred during the pandemic?

Q10. If biodegradable packaging was made available at a reasonable cost, would you be interested into changing to that type of packaging?

Q11. In what other ways has online food delivery affected your business during the pandemic?

Qualtrics Report

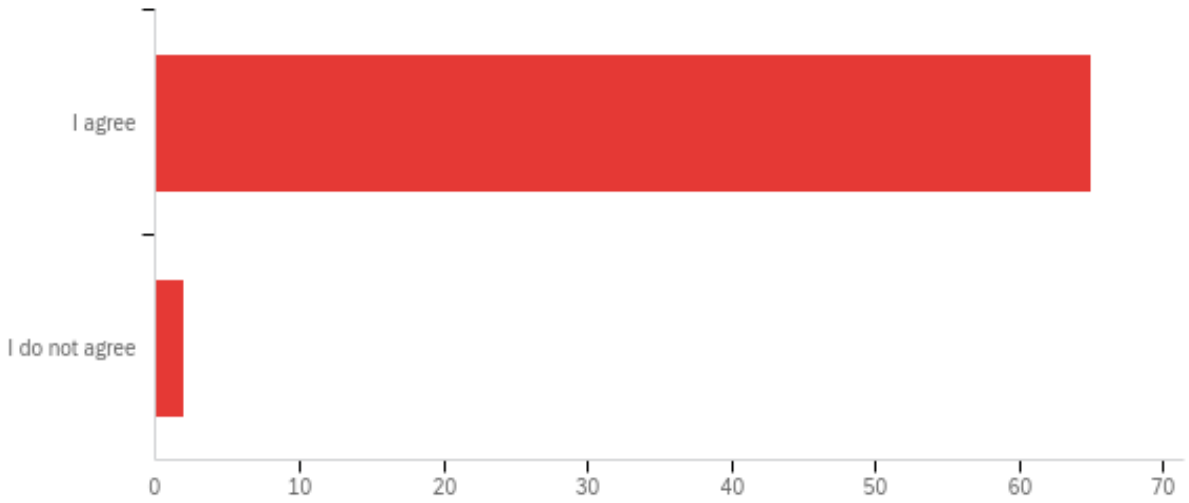
Default Report

Impact of COVID-19 on residential waste streams of Montclair Township

April 26th, 2021, 12:57 pm MDT

Q1 - IRB NUMBER: IRB-FY20-21-2134 Dear New Jersey resident, You are invited to participate in a study about the impacts of COVID-19 on residential waste streams with a focus on Montclair Township. I hope to learn how food waste was affected by the COVID-19 lockdown. If you choose to participate, you will complete a survey. The survey is designed to understand the impact of the pandemic restrictions on the quantity and type of household waste. It will take about 10-15 minutes. You will be asked to answer questions about your grocery shopping habits and food consumption habits, among others. Food waste data about other regions of New Jersey will be collected for comparison purposes. You may not directly benefit from this research. However, we hope this research will provide an understanding of how Montclair residents' behavior about the management of household food waste has shifted during the pandemic. This study will enable us to make recommendations about the way food waste is being managed in Montclair. Any discomfort or inconvenience to you may include the time taken to complete the survey. Data will be collected using the Internet. There are no guarantees on the security of data sent on the Internet. Confidentiality will be kept to the degree permitted by the technology

used. We strongly advise that you do not use an employer-issued electronic device, laptop, phone or WIFI to respond to this survey, as many employers monitor use of all devices. If you decide to participate, you are free to stop at any time. You may skip questions you do not want to answer. You can leave the study at any time. Please feel free to ask questions regarding this study. You may contact me if you have additional questions at 973 842-6869and perrinej1@montclair.edu. Any questions about your rights may be directed to Dr. Dana Levitt, Chair of the Institutional Review Board at Montclair State University at reviewboard@mail.montclair.eduor 973-655-2097. Thank you for your time. Sincerely, Jeanne Huguette Perrine Department of Earth and Environmental Studies College of Science and Mathematics Montclair State University By clicking the link below, I confirm that I have read this form and will participate in the project described. Its general purposes, the particulars of involvement, and possible risks and inconveniences have been explained to my satisfaction. I understand that I can discontinue participation at any time. My consent also indicates that I am 18 years of age. [Please feel free to print a copy of this consent.] The study has been approved by the Montclair State University Institutional Review Board.



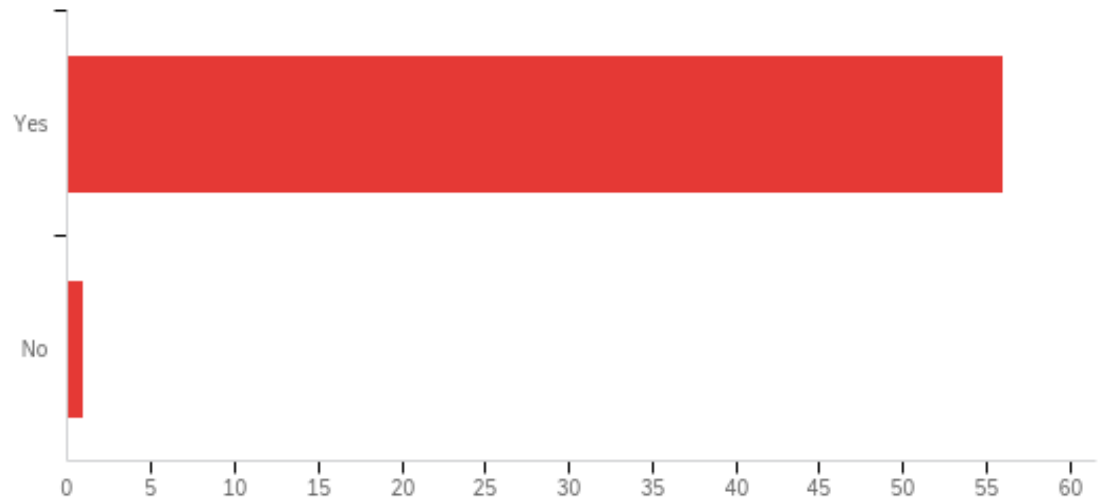
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	IRB NUMBER: IRB-FY20-21-2134 Dear New Jersey resident, You are invited to participate in a study about the impacts of COVID-19 on residential waste streams with a focus on Montclair Township. I hope to learn how food waste was affected by the COVID-19 lockdown. If you choose to participate, you will complete a survey. The survey is designed to understand the impact of the pandemic restrictions on the quantity and type of household waste. It will take about 10-15 minutes. You will be asked to answer questions about your grocery shopping habits and food consumption habits, among others. Food waste data about other regions of New Jersey will be collected for comparison purposes. You may not directly benefit from this research. However, we hope this research will provide an understanding of how Montclair residents' behavior about the management of household food waste has shifted during the pandemic. This study will enable us to make recommendations about the way food waste is being managed in Montclair. Any	1.00	2.00	1.03	0.17	0.03	67

	discomfort or inconvenience to you may include the time taken to complete the survey. Data will be collected using the Internet. There are no guarantees on the security of data sent on the Internet. Confidentiality will be kept to the degree permitted by the technology used. We strongly advise that you do not use an employer-issued electronic device, laptop, phone or WIFI to respond to this survey, as many employers monitor use of all devices. If you decide to participate, you are free to stop at any time. You may skip questions you do not want to answer. You can leave the study at any time. Please feel free to ask questions regarding this study. You may contact me if you have additional questions at 973 842-6869and perrinej1@montclair.edu. Any questions about your rights may be directed to Dr. Dana Levitt, Chair of the Institutional Review Board at Montclair State University at reviewboard@mail.montclair.eduor 973-655-2097. Thank you for your time.Sincerely,Jeanne Huguette PerrineDepartment of Earth and Environmental StudiesCollege of Science and MathematicsMontclair State University By						

	clicking the link below, I confirm that I have read this form and will participate in the project described. Its general purposes, the particulars of involvement, and possible risks and inconveniences have been explained to my satisfaction. I understand that I can discontinue participation at any time. My consent also indicates that I am 18 years of age. [Please feel free to print a copy of this consent.] The study has been approved by the Montclair State University Institutional Review Board.						

#	Answer	%	Count
1	I agree	97.01%	65
2	I do not agree	2.99%	2
	Total	100%	67

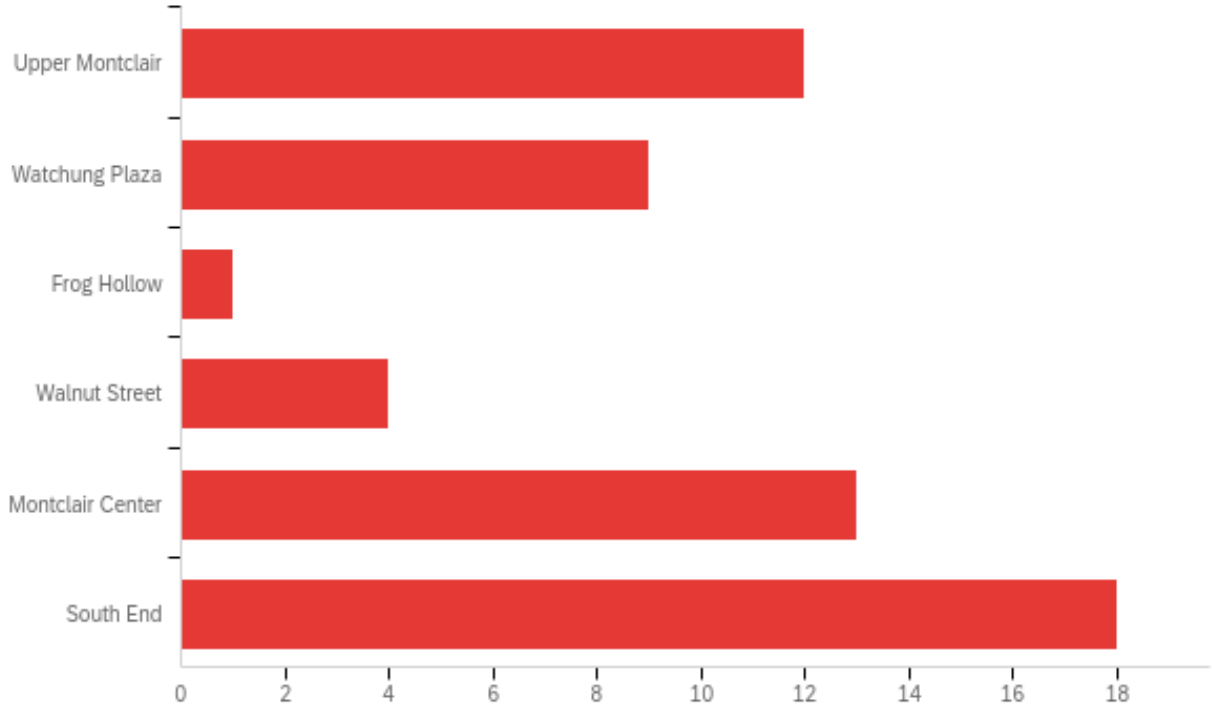
Q2 - Are you a Montclair resident?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Are you a Montclair resident?	1.00	2.00	1.02	0.13	0.02	57

#	Answer	%	Count
1	Yes	98.25%	56
2	No	1.75%	1
	Total	100%	57

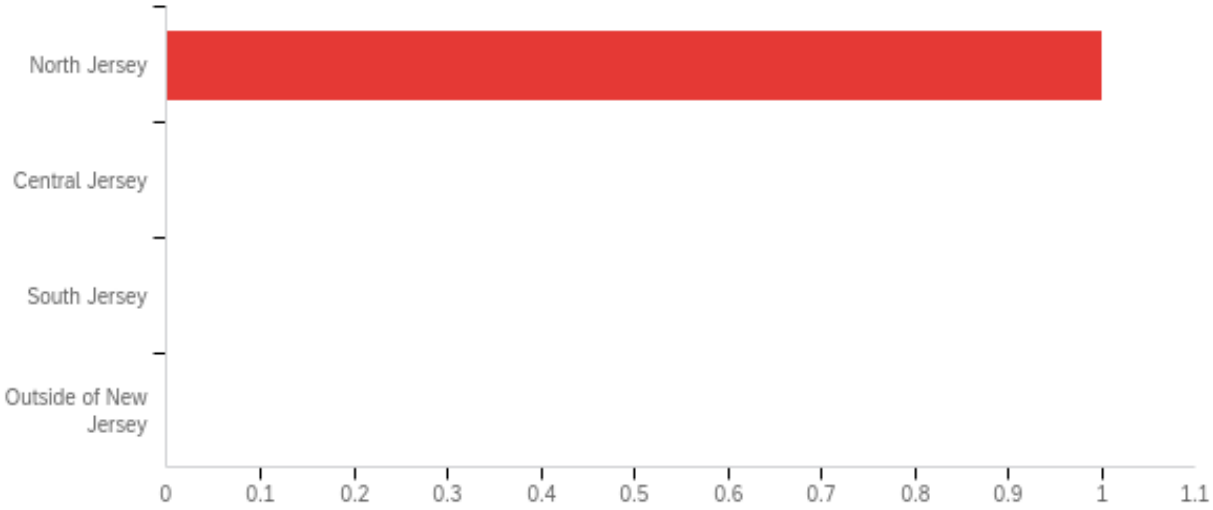
Q3 - If yes, which district do you live in/are you closest to?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	If yes, which district do you live in/are you closest to?	1.00	6.00	3.89	2.01	4.02	57

#	Answer	%	Count
1	Upper Montclair	21.05%	12
2	Watchung Plaza	15.79%	9
3	Frog Hollow	1.75%	1
4	Walnut Street	7.02%	4
5	Montclair Center	22.81%	13
6	South End	31.58%	18
	Total	100%	57

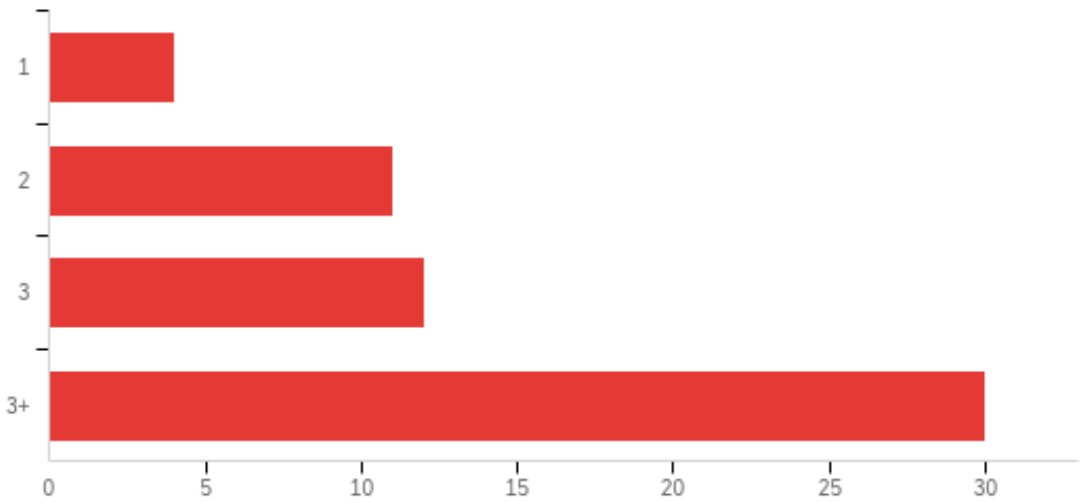
Q4 - If No, in which part of New Jersey do you reside?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	If No, in which part of New Jersey do you reside?	1.00	1.00	1.00	0.00	0.00	1

#	Answer	%	Count
1	North Jersey	100.00%	1
2	Central Jersey	0.00%	0
3	South Jersey	0.00%	0
4	Outside of New Jersey	0.00%	0
	Total	100%	1

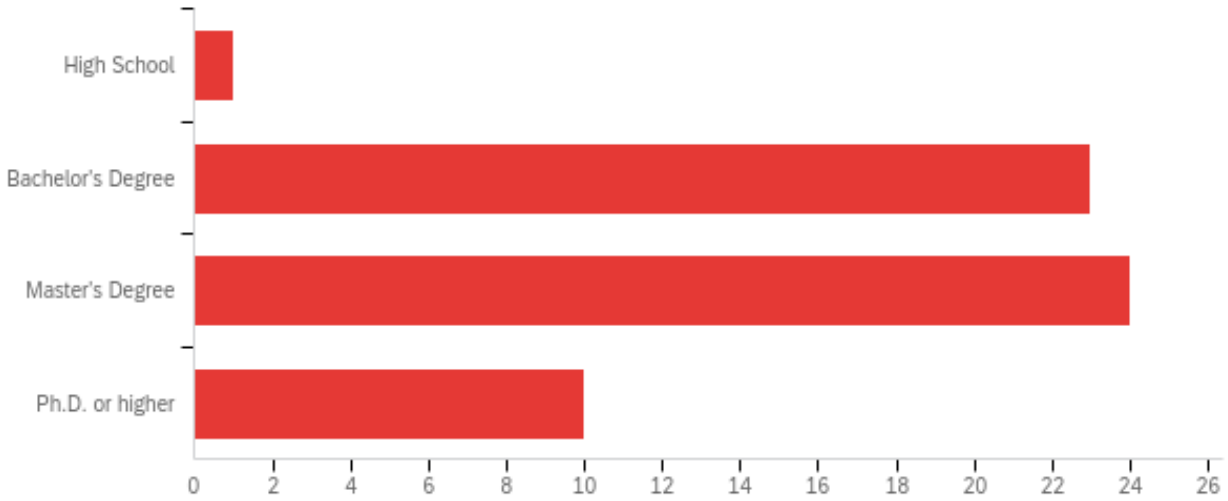
Q5 - Including yourself, how many people currently live in your household?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Including yourself, how many people currently live in your household?	1.00	4.00	3.19	0.98	0.96	57

#	Answer	%	Count
1	1	7.02%	4
2	2	19.30%	11
3	3	21.05%	12
4	3+	52.63%	30
	Total	100%	57

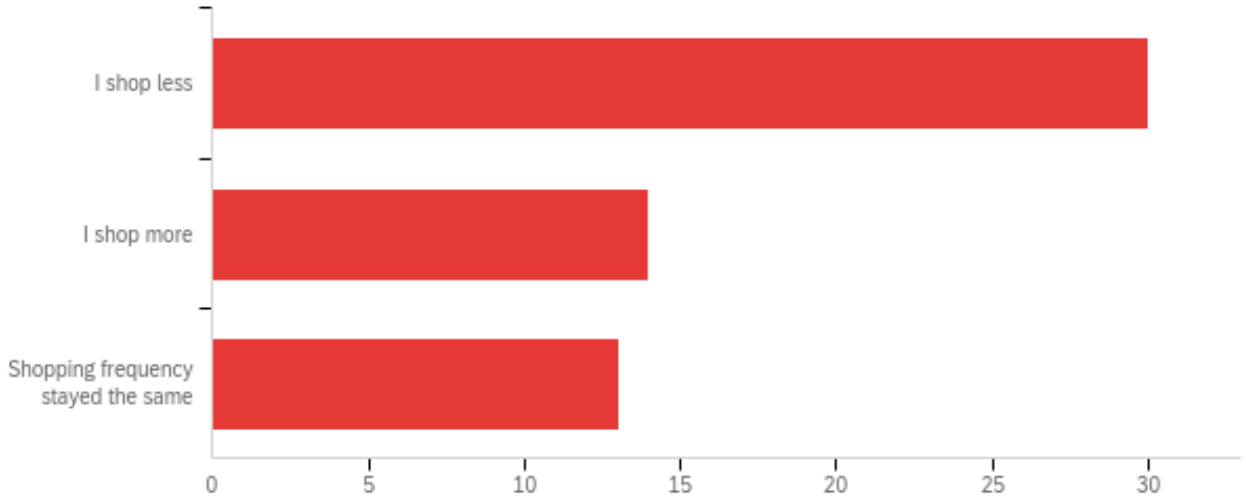
Q6 - What is the highest degree or level of education you have completed?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	What is the highest degree or level of education you have completed?	1.00	4.00	2.74	0.76	0.57	58

#	Answer	%	Count
1	High School	1.72%	1
2	Bachelor's Degree	39.66%	23
3	Master's Degree	41.38%	24
4	Ph.D. or higher	17.24%	10
	Total	100%	58

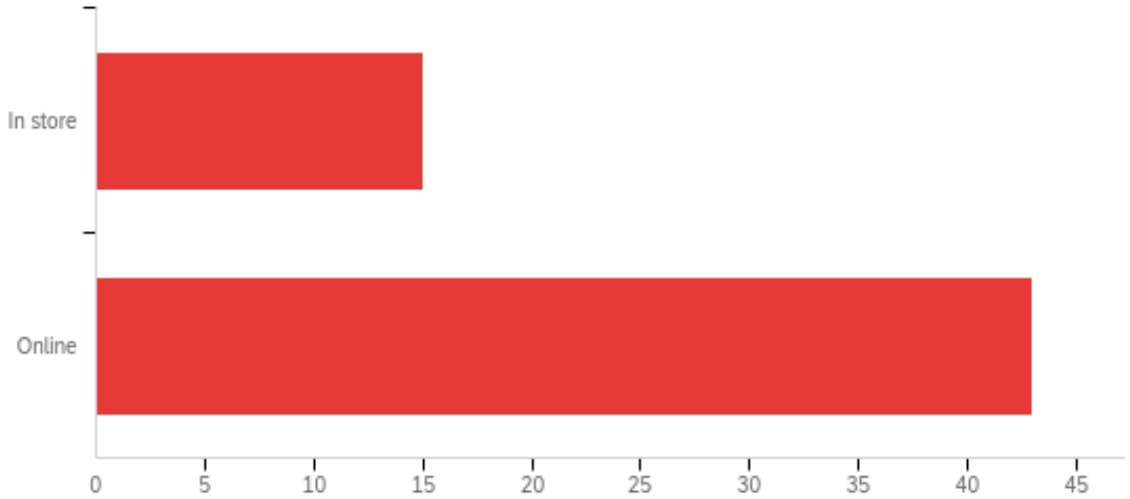
Q7 - Whether you shop at the store or online, has your shopping frequency changed during the pandemic as compared to before the pandemic?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Whether you shop at the store or online, has your shopping frequency changed during the pandemic as compared to before the pandemic?	1.00	3.00	1.70	0.82	0.67	57

#	Answer	%	Count
1	I shop less	52.63%	30
2	I shop more	24.56%	14
3	Shopping frequency stayed the same	22.81%	13
	Total	100%	57

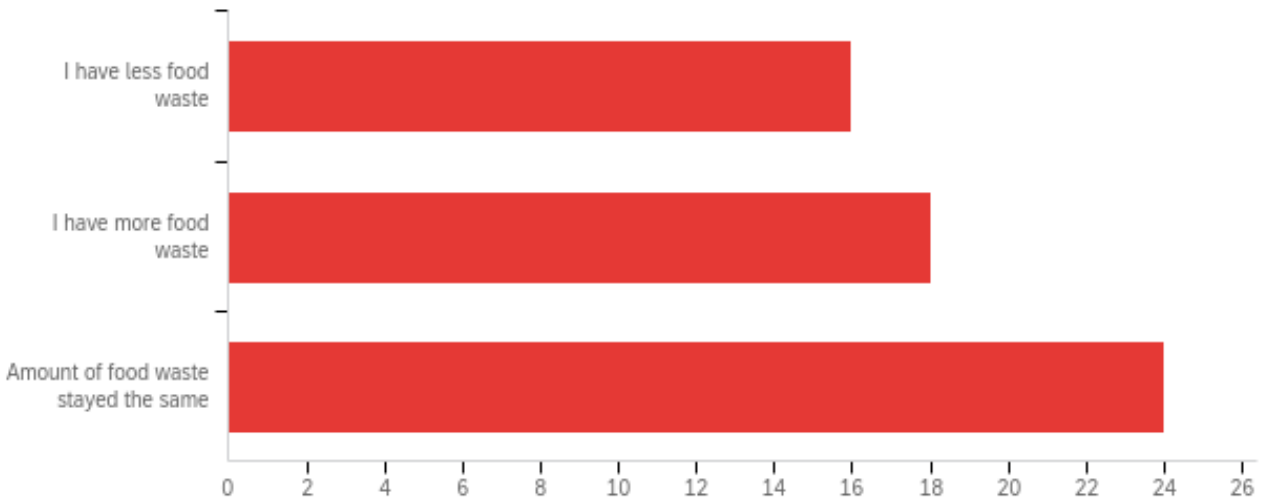
Q8 - Are you shopping more online or in store during the pandemic as compared to before the pandemic?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Are you shopping more online or in store during the pandemic as compared to before the pandemic?	1.00	2.00	1.74	0.44	0.19	58

#	Answer	%	Count
1	In store	25.86%	15
2	Online	74.14%	43
	Total	100%	58

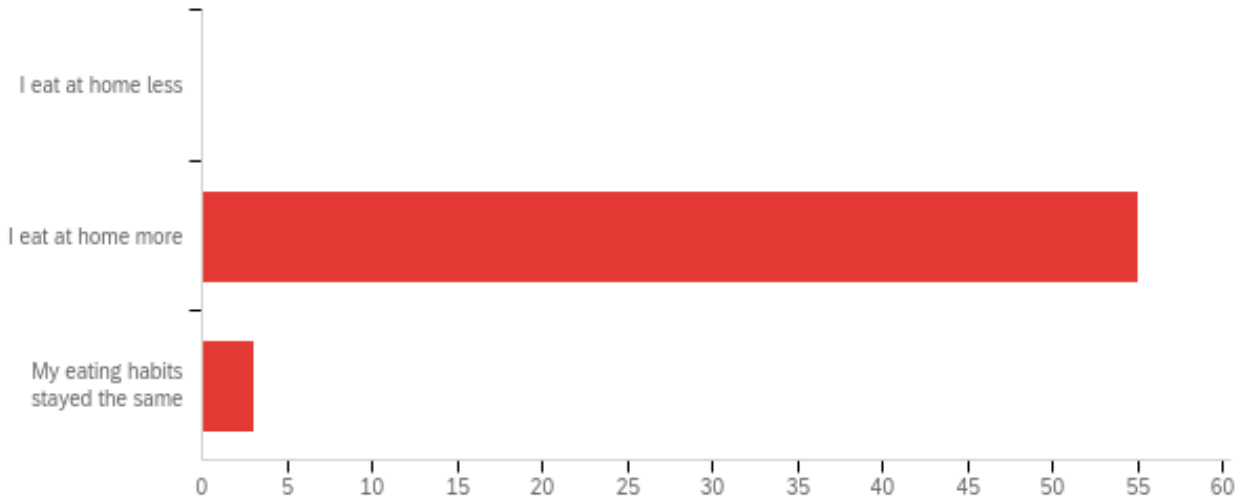
Q9 - Do you have more food waste during the pandemic than before the pandemic?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Do you have more food waste during the pandemic than before the pandemic?	1.00	3.00	2.14	0.82	0.67	58

#	Answer	%	Count
1	I have less food waste	27.59%	16
2	I have more food waste	31.03%	18
3	Amount of food waste stayed the same	41.38%	24
	Total	100%	58

Q10 - Are you eating at home more during the pandemic as compared to before the pandemic?



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Are you eating at home more during the pandemic as compared to before the pandemic?	2.00	3.00	2.05	0.22	0.05	58

#	Answer	%	Count
1	I eat at home less	0.00%	0
2	I eat at home more	94.83%	55
3	My eating habits stayed the same	5.17%	3
	Total	100%	58

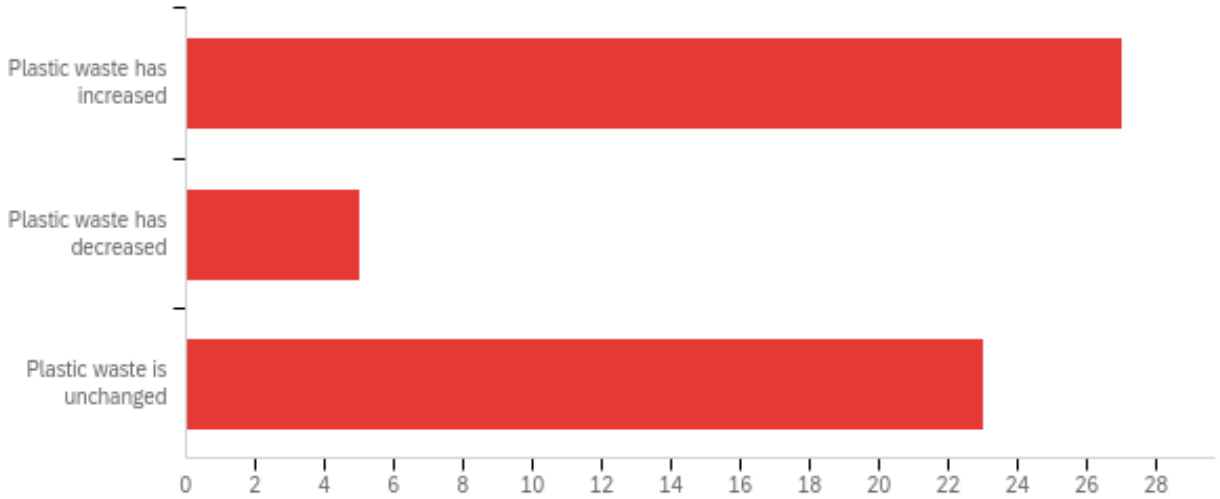
Q11 - Please indicate whether the following food categories increased, decreased, or remained unchanged during the pandemic as compared to before the pandemic:

#	Answer	%	Count
1	Increased	39.66%	23
2	Decreased	6.90%	4
3	Stayed the same	53.45%	31
	Total	100%	58

#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Pasta/rice	1.00	3.00	2.14	0.95	0.91	58
2	Meat-fish-eggs	1.00	3.00	2.26	0.84	0.71	58
3	Milk-dairy products	1.00	3.00	2.38	0.85	0.72	58
4	Vegetable	1.00	3.00	2.05	0.94	0.88	58
5	Fruits	1.00	3.00	2.05	0.95	0.91	58
6	Bread	1.00	3.00	1.97	0.93	0.86	58

#	Question	Increased		Decreased		Stayed the same		Total
1	Pasta/rice	39.66%	23	6.90%	4	53.45%	31	58
2	Meat-fish-eggs	25.86%	15	22.41%	13	51.72%	30	58
3	Milk-dairy products	24.14%	14	13.79%	8	62.07%	36	58
4	Vegetable	41.38%	24	12.07%	7	46.55%	27	58
5	Fruits	43.10%	25	8.62%	5	48.28%	28	58
6	Bread	44.83%	26	13.79%	8	41.38%	24	58

Q12 - Please indicate whether your plastic waste stream has changed during the pandemic as compared to before the pandemic.



#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Please indicate whether your plastic waste stream has changed during the pandemic as compared to before the pandemic.	1.00	3.00	1.93	0.95	0.90	55

#	Answer	%	Count
1	Plastic waste has increased	49.09%	27
2	Plastic waste has decreased	9.09%	5
3	Plastic waste is unchanged	41.82%	23
	Total	100%	55