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28 February 2025

Article

Measuring the Effects of an Anti-Food-Waste Digital Application from the Operators' Perspective in Urban Contexts

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Abstract: This paper presents an empirical study focused on the use of TooGoodToGo smartphone applications by urban food retailers and HoReCa sector owners, evaluating their satisfaction levels with using this app and identifying the most relevant business levers that might convince other operators to adopt anti-waste programs and more sustainable behaviors. To this end, a survey questionnaire is administered to a sample of respondents. Data are statistically analyzed using the Kruskal–Wallis test to consider the different perspectives of the identified subsamples. The results reveal that business operators claim to have a high level of satisfaction with exploiting the service provided by the app and that it is a lever for increasing the number of customers served, even if there is not a high positive effect on revenue. However, retailers with more years of operations, who can be considered more experienced, can better exploit the opportunities of the TGTG business. This study contributes to a better understanding of the benefits of using web application services to decrease waste from urban food retailers. Consequently, levers for convincing new operators to adopt the service and their role in increasing customer awareness are identified and discussed.

Keywords: food waste; web applications; urban retail; HoReCa; survey

1. Introduction

Currently, an increasing number of initiatives are aimed at overcoming the problem of world hunger, which is also one of the United Nations' Sustainable Development Goals included in the 2030 Agenda [1]. It affects 9.9% of the world's population, for a total amount of 768,000,000 people involved [2]. However, approximately 1.3 billion tons of food are lost or wasted annually globally, accounting for approximately one-third of all food produced [3]. These losses are mainly due to food loss and waste. In particular, the term food loss is associated with a decrease in the quantity or quality of food resulting from decisions and actions by food suppliers in the chain. It occurs from the post-harvest to (but does not include) the retail level [4]. This issue is mainly relevant to highly developed countries where high living standards also often mean high (animal) product consumption and food waste [5].

By contrast, food waste refers to a decrease in the quantity or quality of food resulting from the decisions and actions of retailers, food service providers, and consumers [4]. Food waste might also be viewed in the form of over-consumption and obesity in some parts of the world while, at the same time, billions of the world's poorest people are malnourished [6]. The 931 million tons (about 70%) of food wasted worldwide [3] can be divided into waste produced by stores (13%); waste produced by restaurants, canteens, catering, and food services in general (26%); and waste produced by private citizens (61%). Consequently, most initiatives tend to focus on influencing consumers' behavior in the cooking process, consumption, and waste management [7] and on increasing their awareness of healthier diets [8] and waste policies [9].

Therefore, in recent years, the demand for meal delivery services in urban areas has grown tremendously, doubling in size early in the COVID-19 pandemic [10], and in the wake of the great success achieved by food delivery apps and platforms operating at a hyperlocal level (e.g., Foodora, Deliveroo, JustEat) [11], many apps and platforms have been developed to support citizens in reducing food waste and generating new value from food to prevent waste.

In particular, this study focuses on TooGoodToGo, an application with great success in Europe, which helps retailers, HoReCa activity owners, and their customers in the sale and purchase of prepared food, which risks remaining unsold and consequently being discarded. Within a few years of its founding in 2016, this application has become the leading application dedicated to food waste. However, it is still unclear what benefits HoReCa and the retail industry derive from this web application in addition to decreasing urban waste production. Consequently, this study's first goal is to evaluate the level of satisfaction of urban retailers operating in the food sector with using the TooGoodToGo application in their business (RQ1). The second goal of this research is to investigate the aspects that can be leveraged to convince members of this sector to actively participate in green and anti-waste initiatives and adopt more sustainable behaviors (RQ2).

These two research questions become of great importance considering that, according to [12], "a large percentage of the (retailers and HoReCa) managers/owners/staff tend to underestimate the size of the problem and consequently be sceptical about food waste initiatives' impacts on profit or cost reduction". This skepticism is particularly widespread in Italy, where many managers do not see food waste reduction as a potential lever for cost reduction or revenue increase [13].

The research presented in this paper attempts to answer these research questions based on the results of a questionnaire administered to a group of retail and HoReCa activity owners in a major city in northern Italy.

The remainder of this paper is organized as follows. The theoretical background in Section 2 reconstructs the main food recovery initiatives adopted to date, focusing on the HoReCa sector, retailers operating in urban environments, and apps and platforms dedicated to food waste reduction. Section 3 describes the research methodology in detail. Section 4 presents the results in detail. Finally, the conclusions are presented in Section 5.

2. State of the Art

The sources of waste generation can be found at different levels of the food chain: it can be stated that from harvesting to the arrival of processed products on the table, a certain amount of waste is produced in each step, mainly due to problems in managing and storing food products. This waste can be recovered in several ways. There is a hierarchy of preferred anti-waste solutions; treating food waste in landfills and composting centers is the least favored solution. Using potential food waste to produce biomass products [14] or to feed people and animals is a better solution; however, reducing potential food waste at the source is preferable. Consequently, numerous studies have been conducted in recent years to decrease food waste at the source in all the phases of the supply chain, especially at the private citizen and consumer levels [15–17].

Therefore, applications that target customers or connect consumers and business owners in the retail and HoReCa sectors are crucial. Real-time connectivity allows for quickly meeting customers' needs [18]. They are part of the recovery measures that act to reduce one of the possible sources of waste production (e.g., unsold products approaching their expiration date) by matching customer demands and supplier offers. Some studies have examined these aspects from the customers' point of view [19] or in the entire supply chain [20]. However, to the best of our knowledge, few scientific studies have been conducted on the benefits of mobile apps and platforms in urban food waste reduction by combining the communication of demand (customers) with supply (restaurateurs and retailers) and creating greater awareness regarding food waste. In particular, Section 2.1. describes the strategies applied in the food retail and HoReCa sectors to prevent food waste.

In contrast, Section 2.2 describes web platforms and apps such as TooGoodToGo, which aim to increase food waste reduction

2.1. Food Waste Reduction Strategies in the Retail and HoReCa Sectors

In recent years, many strategies have been deployed to reduce the potential sources of food waste generated in supermarkets, grocery shops, and the HoReCa sector. The interest in these activities is not only due to the percentage with which they contribute to the production of food waste but also because of their contribution to the general waste generated in the urban environment. Urban waste is defined in [21] as "the waste collected from households and other sources, where such waste is similar in nature and composition to waste from households, thus also including commercial and institutional activities." In particular, considerable attention has been paid to packaging product strategies and optimizing storage and inventory operations [22] to extend the shelf life of products. Another efficient strategy in the retail sector is expiration date-based pricing, which involves charging different prices for perishable products approaching their expiration date [23]. In contrast to the retail sector, where mostly packaged, raw, or pre-cooked products are sold, in the HoReCa sector, it is possible to examine three different stages in which food waste can occur: pre-kitchen (i.e., food storage), in-kitchen (i.e., meal preparation), and post-kitchen (i.e., food on a plate) [24]. In the first phase, food waste prevention follows the same strategy as that observed in the retail sector. Regarding the second in-kitchen phase, several strategies can be adopted to reduce food waste, such as measuring food waste [25], engaging staff, reducing overproduction, and rethinking inventory and purchasing practices [12,18]. Scholars have focused on conservation and preparation operations, suggesting approaches derived from the manufacturing sector such as applying the lean manufacturing principle [26] or introducing digital solutions [12]. In the third phase, it is impossible to eliminate food waste at the source and alternative strategies related to reselling cooked products or donations must be implemented [24]. In this case, it is necessary to put the HoReCa sector in contact with possible customers or final recipients (i.e., in the case of donations) who may constitute a second final destination for the food produced.

2.2. Platform and APP Helping with Food Waste Reduction

Web-based technologies and applications are increasingly used as tools for food waste reduction. For example, [27] identified IT platforms for wood waste prevention as both concrete and beneficial. Many apps and digital services have profoundly changed how citizens shop for groceries [28]. In particular, web-based technology and applications should help match supply and demand in the case of reselling or donating already-cooked meals. Moreover, platforms can connect different stakeholders operating in the city (e.g., HoReCa, retailers, consumers, NGO associations, and private citizens), enabling different strategies and activities to give new life to food products (cooked or not) close to becoming food waste. Table 1 shows the main web-based platforms and apps addressed by scientific research to date, divided by the primary purpose of the platform and stakeholders involved.

Table 1. Leading web-based platforms and apps from the scientific literature.

Main Goals	Involved Stakeholders	App/Web-Based Platforms	References
Persuade users to consume their food by alerting them of their food's best-before dates, indicating the date after which the food should no longer be consumed, and suggesting recipes.	Consumers, private citizens	Save the Kiwi	[29]
Allow restaurants, supermarkets, and retailers to donate and share their foods and leftovers with people in need.	Retailers and HoReCa sector, NGOs	FoodReduction App, NoFoodWasted	[30]

Table 1. *Cont.*

Main Goals	Involved Stakeholders	App/Web-Based Platforms	References
Provide the leftover and unused food (e.g., close to the expiry date, slightly damaged or with aesthetic defects) at a low price with respect to the original one. Consumers can book and buy products taken in at the selling point.	Retailers, the HoReCa sector and consumers	11th Hour, NoFoodWasted, MyFoody, Last Minute Sotto Casa, FlashFood, Food For All, TooGoodToGo	[27,30,31]
Food-sharing among citizens	Private citizens	Ratatouille, iFoodShare, S-Cambia Cibo	[27]
Facilitate food donations from people, organizations or public institutions to NGOs working in food collection and redistribution to needy people.	Private citizens, NGOs, retailers and HoReCa sector	FameZero, Breading, Bring the Food, SeVa	[27]
Increase the awareness of citizens' food waste, including daily images and information about waste quantity, waste reasons and destination.	Private citizens	FoodImage, Mobile Food Record	[32,33]

In particular, the main web-based platforms and applications aim to provide leftover and unused food at a low price with respect to the original price, matching the demand for food and suppliers. One of the most successful matches in recent years is "TooGoodToGo". TooGoodToGo is a leading application for food waste reduction. It was born in Denmark in 2016, at the initiative of various young European entrepreneurs. The app aims to create a link between customers and producers so that producers can sell their leftovers rather than throwing them away [31]. According to the data provided by the company on its website, the TGTG app was the 10th most downloaded food app in Europe in 2022, and it is available in 14 countries, with a total of 20 million users in Europe and 33,000 partners (https://toogoodtogo.org/en) (Accessed in 12 December 2023).

The working mechanism is straightforward: retailers that have joined the TooGood-ToGo service on a daily basis can offer their food products to customers that have been registered on the app. Thus, customers can buy some "Surprise Bags" from different retailers/restaurants via the app. Customers do not know the content of the box until the time of collection, which is often scheduled at the end of the working day (depending on the products consumed and leftovers of the day). However, general information regarding the types of products inside the boxes is available in the application (e.g., bakery products). In addition, the customer is allocated a pick-up time slot to visit the store for the final collection. The customer then shows the staff members the order previously placed on the app and picks up their surprise bag to avoid creating queues in shops and restaurants. Customers can also rate the service according to several criteria, such as staff courteousness, food quality, and food quantity. The difference between TooGoodToGo and the other similar apps shown in Table 1 is that it does not only operate as a last minute app but allows the customer to have a window of a couple of days to plan the pick-up, it is dedicated to different types of businesses (HoReCa sector, retailers and supermarkets) and it is immediately designed to ensure its scalability at an international level (it operates on a local basis, but the management is centralized, which facilitates its economic sustainability by strengthening its business model).

3. Methodology

This study sought the opinions of HoReCa and store owners currently participating in the TGTG service in order to answer RQ1 and RQ2. This topic is under development because the retail and HoReCa sectors are still implementing measures to reduce urban food waste. Therefore, the most frequently used methodology to study this topic is the survey method, which is mainly used in exploratory research [34]. Surveys are excellent for measuring unobservable data such as companies' preferences and behaviors [35]. More-

over, surveys are economical and allow for remote data collection from a population that is too large to directly observe and detect minor effects, even when analyzing multiple variables [35], such as the impact of food waste reduction initiatives. Another strength of the survey methodology is that it is easy to replicate, even after a long period, making it more straightforward to perform a longitudinal analysis suitable for studying the development process [36]. Various questionnaires concerning customer behavior regarding food waste have been published in the literature concerning customer behavior regarding food waste [37]. For instance, a survey developed according to the random sampling technique proposed by [38] investigated consumers' intentions to use online food delivery services (OFDS) in a shared economy.

A structured questionnaire survey was selected as a suitable methodology (asking respondents to select an answer from a set of choices) administered through interviews. This type of choice allows for the right choice of strengths of the survey listed above and guarantees higher response rates [39]. The survey methodology has some disadvantages. In particular, surveys are affected by some bias due to the low response rate (non-response bias), the respondent sample (sampling bias), the fact that many respondents tend to avoid negative opinions or embarrassing comments about their companies (social desirability bias), and finally, respondents' motivation, memory, and ability to respond (recall bias) [34,40].

Therefore, a robust survey research process is required to prevent and overcome such biases. This process involved topic identification, definition, and creation. To ensure replicability and consistency in the application of the survey methodology, the guidelines proposed by [40] were followed for the implementation of the survey research and operations management (Figure 1).

Step 1: Link to the theoretical level

First, several dimensions were identified to assess how the application performance was judged based on the actual benefits experienced by users when retrieving data to answer RQ1. In particular, user-friendliness has been defined as a feature concerning "the easy to learn, to use, to understand or deal with" of a web application [41,42], while revenue growth "illustrates sales increases/decreases over time and is used to measure how fast a business is expanding" [43,44]. Customer growth stems from "customer-centric companies using successful customer engagement strategies to optimize the customer experience to offer products tailored to customers' needs and interests" [45,46], while customer satisfaction is a measurement that determines "how happy customers are with a company's products, services, and capabilities" [22,47]. Finally, waste reduction is defined as "all the waste prevention strategies that prevent or decrease the amount of waste" [9,13]. The sample was defined by selecting 54 businesses (between retail and HoReCa activities) registered with the TGTG app operating in the center of Turin. Turin, located in northwest Italy, was chosen because it is one of Italy's first cities where TGTG was launched, and it is representative of mid-sized European towns (i.e., between 100,000 and 250,000 inhabitants according to [48]). Thus, in a preliminary study, it can be considered representative of other urban contexts, given the importance of the role of small and medium-sized towns in Europe [49].

Step 2: Survey design

The first step in the questionnaire design was to define strategies to avoid these biases. To avoid sampling bias, the interviews with shop and restaurant owners were conducted early in the morning or evening. This strategy also helped avoid non-response data because the questionnaire was completed in person during the interviews. To avoid social desirability bias, the questionnaire included no direct questions on company performance or employer satisfaction. Finally, to avoid recall bias, the survey was tested by three authors' colleagues, who are experts in this sector. This pilot test aimed to guarantee the readability and consistency of the questions as well as the time necessary to complete the entire questionnaire. After an analysis of the business owners using TooGoodToGo, we identified the 54 most active companies in terms of boxes offered on the platform and then invited them to participate to the survey. After receiving an invitation to participate and

read the questionnaire, 36 of the 54 selected companies made themselves available for interviews. To correlate the app evaluation dimensions identified in the previous step with the characteristics of the business activities surveyed, it was necessary to include questions concerning the area of the city where the store runs its business, the activity size, the age of the store, the year of the subscription to the app TGTG, and the average number of boxes sold daily. Respondents were then invited to provide a score for each dimension (Table 2). These dimensions were assessed using a Likert scale (from 1 = Very Low Impact to 5 = Very High Impact). This scale has been broadly adopted in surveys to evaluate better answers in questionnaire research [50].
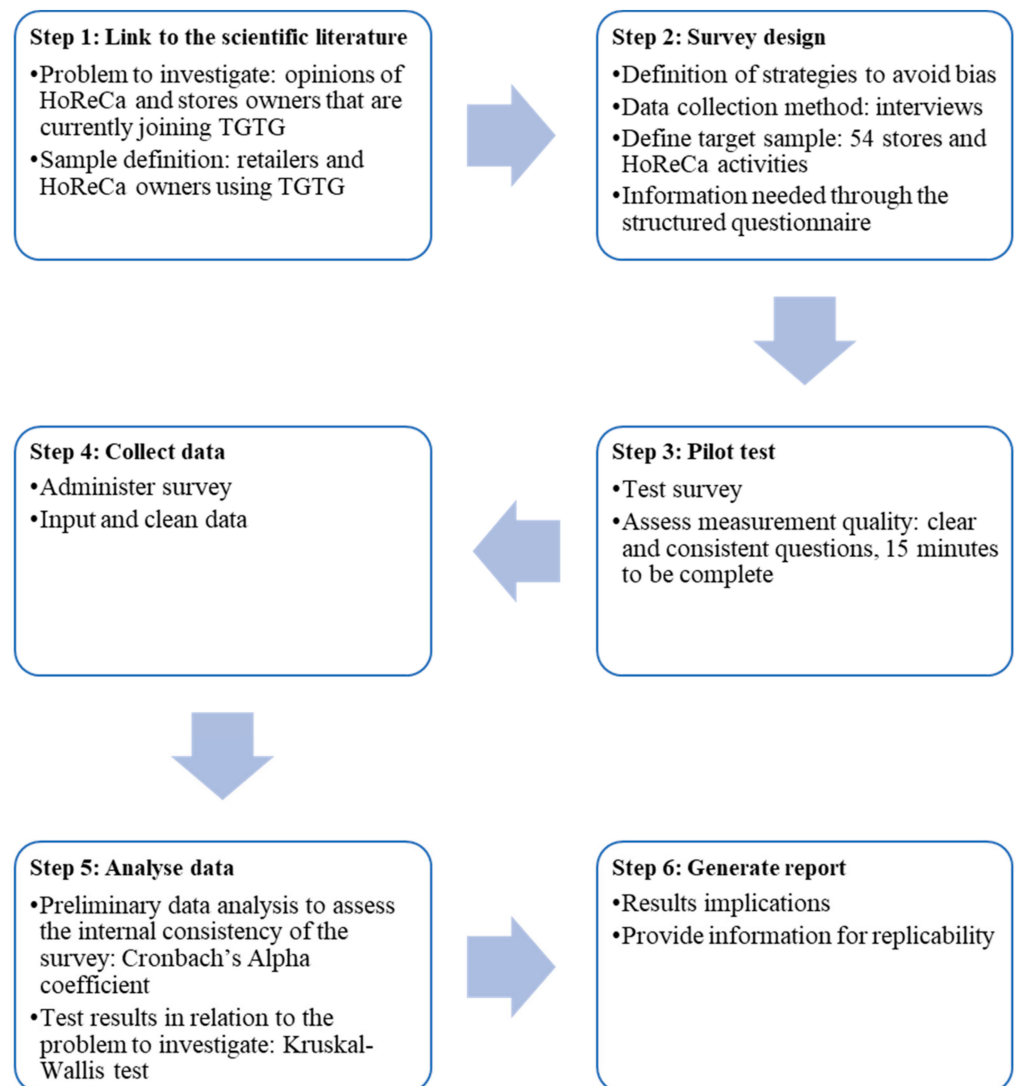

Figure 1. Survey research framework (authors adaptation from [40]).

Table 2. Cronbach's alpha coefficient.

Item	Cronbach's Alpha
User-friendliness	0.681
Revenue growth	0.678
Customer growth	0.578
Customer satisfaction	0.684
Decrease in waste	0.654

Step 3: Pilot test

Following [40]'s guidelines, it was necessary to conduct a survey to assess the questionnaire's measurement quality. In particular, it is necessary to understand whether the questions asked are clear and consistent, whether any fundamental questions have been forgotten, and whether they are easy to complete. The test was conducted using a catering business and a sample of three field experts. Based on the pilot test, the duration of questionnaire completion was estimated to be approximately 15–20 min.

Step 4: Collect data

The questionnaire was administered from 7 January 2022 to 31 January 2022. The survey was conducted by one researcher at a time, and the interviews ranged from a minimum of 7 min to a maximum of 25 min. The surveyor recorded the data on paper during the interviews and subsequently reported them in an Excel file prepared to analyze the results. In this case, data cleaning was not necessary.

Step 5: Analyze data

First, a statistical model was developed to obtain relevant and robust insights from the survey outcomes. However, as a preliminary step, a control related to data consistency was required. To this end, Cronbach's alpha coefficients were computed. A test was conducted to verify the validity of the results. It is a measure of internal consistency that assesses the reliability of the surveys. This coefficient can be computed according to [51] using the following Equation (1).

$$\alpha = \frac{N}{N-1} * \left(\frac{\sigma_x^2 - \sum_{i=1}^{N} \sigma_{Y_i}^2}{\sigma_x^2} \right) \tag{1}$$

where:

N = number of survey items in the scale
σ_x^2 = variance of the observed total scores
$\sigma_{Y_i}^2$ = the variance of item i for person y

A value higher than 0.58 is considered satisfactory because the items evaluate the same construct [51]. The data collected through the survey were statistically analyzed. To identify an appropriate empirical approach, it is worth noting that the data were not normally distributed because the collected information is related to categorical aspects (e.g., the city area and store size). In addition, quantitative aspects are referred to as Likert-scale evaluations that cannot provide a normal distribution of records. Indeed, the selected Likert scale adopted to allow respondents to express their level of agreement or disagreement with a specific statement is ordinal to the extent that one cannot guarantee that the distance between four and five is the same as that between one and two [52]. Therefore, a non-parametric approach was selected to properly deal with the data at issue. The Kruskal–Wallis test was performed. The Kruskal–Wallis test has been broadly adopted with ordinal or ranking data to assess the differences among different sample groups [53]. The Kruskal–Wallis statistic [53] that is then used for assessing the medians among different groups is presented in Equation (2):

$$K = \frac{(N-1)\sum_{i=1}^{g} n_i \left(\overline{r}_i - \overline{r} \right)^2}{\sum_{i=1}^{g} \sum_{j=1}^{n_i} \left(r_{ij} - \overline{r} \right)^2} \tag{2}$$

where:

n_j = number of observations in group i
r_{ij} = rank (among all observations) of observation j from group i
N = total number of observations across all groups

$$\overline{r}_i = \frac{\sum_{j=1}^{n_i} r_{ij}}{n_i}$$

$\overline{r}_i = \frac{1}{2}(N+1)$ is the average for all the r_{ij}.

This statistic tests the null hypothesis that the sample populations have the same median, implying that no differences might be observed among the groups. If the test shows a *p*-value lower than the significance threshold (typically 5%), the null hypothesis must be rejected, favoring the alternative.

Step 6: Generate report

The contents of the report are set out in Section 4.

4. Results and Discussion

This section reports the results of the survey analysis (Section 4.1) and provides a discussion concerning the main considerations that emerged from the analysis (Section 4.2).

4.1. Results

This study included 36 stores that agreed to participate in the survey out of the 54 preliminaries contacted, with a response rate of 67%. This value can be considered acceptable for carrying out further analysis of the responses, as it is close to that reported in previous studies [40]. As a preliminary analysis, the survey outcomes were qualitatively evaluated. Fifteen respondents run their businesses in the HoReCa sector (40%) and twenty-one are food retailers operating in an urban environment (60%). In particular, 23 (60%) stores run their businesses in the city center in the sample at issue, and the remaining 13 stores are outside the city center (40%): 11 are small shops (30%) with less than 60 square meters of usable floor area, 16 are medium-sized stores (34%), and the remaining 9 have more than 100 square meters available (26%). A total of 26 respondents had been running their businesses for less than 10 years, while 8 had started between 10 and 30 years ago, and the last 2 were more than 30 years old. This demonstrates that recent businesses are more willing to include innovation in their operations [54]. In addition, 22 respondents have been collaborating with TGTG since 2019, while other 14 have since 2020, indicating that the growth rate of this service is quite relevant. Finally, only three respondents proposed more than four boxes daily. In contrast, seventeen shops sold fewer than two boxes daily. Similarly, sixteen retailers sold between two and four boxes each day.

Before undertaking the empirical study, the preliminary phase of the analysis aimed to evaluate the robustness of the data gathered by using Cronbach's alpha tests has been carried out. The coefficient was computed each time, as reported in Table 2.

The test outcomes indicate that the present questionnaire was appropriately designed to capture retailers' opinions on adopting TGTG.

Therefore, it was possible to perform further analyses. The Kruskal–Wallis test was broadly adopted with ordinal or ranking data to assess the differences between different sample groups [53], as stated in Step 5 in Section 3.

Table 3 shows the Kruskal–Wallis test results for different answers to the questionnaire. In bold significant relationships with a *p*-value lower than 5% are presented. The results showed that all the respondents agreed about the app's user-friendliness, which is broadly considered very easy and effective. This is relevant because user-friendly technology simplifies user operation processes [41]. This result is consistent with the customers' high satisfaction levels. This app effectively addresses food waste issues and is economically convenient [31]. By observing revenue growth, it can be observed that the oldest stores claim to have the highest positive impact on revenue. This result may depend on the reputation of these shops. However, in general, the respondents did not observe a relevant revenue increase when using TGTG. In this context, TGTG can be seen as an effective lever for enlarging the catchment customer population. Retailers are also attracted to customer satisfaction and an increase in customer growth, along with an important impact on the level of waste. The results show that shops offering more than four boxes daily obtained the most noteworthy increase in the number of customers. Respondents who had recently joined the TGTG services underlined a more relevant decrease in waste. The lower scores assigned by shops that have participated in TGTG for a longer time might depend on the fact that the positive effect related to TGTG becomes less evident after the first period.

Table 3. Kruskal–Wallis test results.

	User-Friendliness	*p*-Value	Revenue's Growth	*p*-Value	Customers' Growth	*p*-Value	Customer Satisfaction	*p*-Value	Waste Reduction	*p*-Value
Kind of business										
Horeca	5	0.418	2	0.396	2	0.142	5	0.965	4	0.342
Retail	5		2		2		5		4	
Area of the city										
Downtown	5	1	2	0.581	3	0.091	5	0.874	4	0.797
Suburbs	5		2		2		5		4	
Usable Floor Area										
<60 m^2	4	0.068	2	0.239	2	0.911	5	0.061	3	0.812
60 m^2 ÷ 100 m^2	5		2		2		5		4	
<100 m^2	5		2		2		5		4	
Age of the store										
Less than 10 years	5	0.443	2	**0.048**	1.5	0.115	5	0.748	4	0.775
Between 10 and 30 years	5		1.5		2		5		4	
More than 30 years	5		4		4		5		3.5	
Years of TGTG subscription										
2019	5	0.823	2	0.24	2	0.346	5	0.982	3.5	**0.011**
2020	5		2		2		5		5	
Average quantity of boxes sold daily										
Less than 2	5	0.613	2	0.07	1	**0.001**	5	0.442	3	0.18
Between 2 and 4	5		2		3		5		4	
More than 4	5		2		4		5		3	

4.2. Discussion

Most initiatives related to urban food waste have been promoted by public policy-makers in terms of donations, market incentives, and food campaign awareness. However, from a business perspective, it is important to consider that waste reduction decreases costs and improves retailers' financial performance. In this context, it is worth noting that retailers might play a crucial role in determining consumers' behavior toward sustainability. Food retailers can pursue sustainability goals owing to their direct impact on production and consumption [55]. In this context, a digital platform, such as TGTG, might be considered a good practice, and the present study proves a high level of satisfaction from the retailers' perspective. This type of partnership can be viewed as a lever for achieving sustainability-oriented innovation. The results can increase confidence in the awareness of the waste issue, and innovative digital initiatives can be successfully used outside urban borders with lower anthropization and population density. This path is observable in the present analysis, which proves that there are no significant differences between businesses operating in urban systems and those operating in the neighborhood. In addition, it is important to note that waste reduction is more relevant during the first period of service adoption. This trend tended to become more consolidated after a certain period.

The present study, through an assessment of the satisfaction level of retailers with TGTG, demonstrates that initiatives aimed at reducing food waste might be considered a business opportunity, and they can be easily adopted and used. By answering RQ1, it can be observed that the retailers' and HoReCa owners' satisfaction regarding TGTG is high. Even if no revenue growth has been observed, the user-friendliness of the app and the increase in the number of customers and their satisfaction are sufficient to ensure that the questionnaire respondents are satisfied with the service provided by the app. In addition, customers' increasing awareness of these issues makes adopting a food waste

project an effective marketing lever. The results of the proposed analysis confirm this statement, as they show that the daily sales of boxes are the drivers of the increase in customers. Furthermore, retailers with more years of operations, who could be considered more experienced, can better exploit the opportunities of the TGTG business, as they observe a more relevant increase in revenue and customer satisfaction. In response to RQ2, it can be seen that not only is the ability to increase the number of customers (and consequently revenue) a relevant factor for HoReCa retailers and business owners but also customer satisfaction, especially in an era where the reputation of businesses on social media and websites reporting customer reviews is critical for differentiating themselves from competitors. Consequently, increasing customer satisfaction can be used as leverage to increase sustainable behavior by retailers and HoReCa business owners and encourage them to join more initiatives geared toward enhance sustainability. From an academic perspective, the proposed research contributes to the evaluation of the level of satisfaction of retailers and HoReCa business owners regarding the TGTG app. It attempts to identify some crucial drivers that might foster the adoption of sustainable initiatives, such as an increase in the number of customers and their satisfaction. Therefore, they can be integrated into a promising research stream.

5. Conclusions

This study analyzed the perspectives of local food retailers and HoReCa owners who have adopted the TGTG app to reduce waste. A questionnaire survey was administered to a group of business retailers and homeowners in the food sector of Torino (Italy). The results demonstrated high satisfaction with using this service to increase the number of customers, especially if the number of daily boxes sold was high, and it was an effective lever for improving the food waste issue. Statistical analysis based on the Kruskal–Wallis test also highlighted that older food retailers showed a more relevant revenue increase. The present research outcomes appear promising and provide a certain level of confidence in the future. There is more awareness of the food waste problem, especially in the urban context, which has also begun to be considered a potential lever to enhance the attractiveness of a business. Furthermore, this study highlights the importance of projects aimed at reducing food waste at the urban level, as this phenomenon is relevant in cities. In addition, it is worth noting that after years of initiatives supported by public authorities, this study demonstrates that privates can now develop projects to reduce feasible food waste by leveraging the potential expressed by new technologies. In this sense, food retailers may support the transition to a more sustainable food system with a lower environmental impact. Retailers can be considered facilitators for enhancing consumers' awareness about food waste reduction practices. Several theoretical and practical implications may arise from this research. In particular, from an academic perspective, this work contributes to the body of knowledge in the stream of research focusing on the assessment of food anti-waste initiatives in urban environments by means of an empirical investigation. In fact, this research is aimed at tracing a systematic picture of the level of awareness and level of satisfaction of a group of retailers and HoReCa owners operating in urban areas in a business aimed at reducing their food waste in such a way. The present study might inspire studies on other operators that have been joined the TooGoodToGo services, such as small supermarkets. This is quite important as it means that this business is still growing, being scalable with more relevant environmental and economic effect. In addition, this study, might pave the way for research on the quantitative assessment of the food waste reduction and in turn on the environment, not only at a local level but also at the European one. From a practical point of view, the proposed study can be considered a support to urban food retailers in driving the decision to undertake structured anti-waste initiatives. The outcomes of the empirical analysis might suggest to food retailers the levers to be focused on to promote and advance their profit and their base of customers by decreasing their share of waste at the same time. Such an aspect has been acquiring particular relevance considering the increasing level of prices that retailers are facing in recent years due to unexpected bad events such as the

COVID-19 pandemic and the Ukraine and Middle East wars. As a preliminary analysis, the results of this study have some limitations: the results are limited to a single city and to only a small sample of retailers and HoReCa owners. Future research will be conducted by increasing the sample size and evaluating the effects of anti-food-waste initiatives in other urban environments and less populated areas, where these kinds of projects are still limited and their efficacy is still not proven.

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