

# SPATIAL DISTRIBUTION AND CHARACTERIZATION OF CONSUMERS OF E-GROCERY SERVICES IN SICILY: INSIGHTS FOR SUSTAINABLE URBAN LOGISTICS

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## Abstract:

*The present research aims to provide new insights into e-commerce patterns. The study investigates the correlations between variables related to demographics, residence and online food and beverage purchasing habits. Data was acquired through the administration of an online questionnaire in 2022. The results helped identify the location of the city most affected by the analyzed phenomenon. The novelty of the research focused on the analyzed area of island type characterized by the strong food and wine traditions and the need to want to analyze what possible effects the growth in demand for e-grocery may have on certain parts of the city. The results laid the foundations for more profound studies on demand for e-grocery relative to an island context. Moreover, the findings make it possible to investigate in subsequent steps different types of correlations between socio-demographic and spatial variables connected to the dislocation of homes and the main poles of attraction for the purchase of physical and virtual food and drink markets.*

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## 1 Introduction

In recent years, a growing demand for e-commerce has emerged, which increases the need to focus on analyzing the transformation potential of personal mobility patterns, freight transport operations and practices. Also, in recent years, there has been a growing research interest in the area of last-mile logistics [1, 2]. However, few studies have focused on environmental aspects and even fewer on analyzing the portions of cities most affected by these phenomena. Therefore, it is necessary to look for green solutions for last-mile deliveries in the e-commerce market and know whether certain parts of the city are more attractive and characterized by higher user demand and a higher frequency of online purchases [3]. Providing empirical data at the individual and household level is crucial for local authorities to plan and implement urban transport and logistics measures. In general, some studies consider e-grocery as an environmentally friendly channel, while others note that the energy consumption of this emerging channel is higher than that of alternative channels. A study by [4] showed that in almost all European countries, the percentage of e-grocery shoppers is that of shoppers in other product categories. However, due to the pandemic, it has increased significantly in the last two years, with consequences that are difficult to understand and estimate. It raises some considerations on the relationship between e-grocery and energy consumption. Moreover, it offers some reflections for e-grocery, logistics operators, and policymakers interested in developing sustainable urban plans and promoting less environmentally impactful distribution/configurations of food delivery systems in city logistics [5]. Several studies encourage the integration of passenger and freight transport planning considering urban planning and emphasize the need to integrate regulation and good practice [6, 7]. In several cases, urban planners may find

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it challenging to monitor and follow the changing technological development of e-commerce and promptly address its repercussions.

The spread of more online channels and the exemplification of shopping have also attracted more users because online shopping is more competitive due to relatively lower costs [8]. While retail is closely related to mass purchases, e-commerce emphasizes fragmentation and customization. Therefore, traditional combined transport from centralized warehouses of the past has been replaced by order-level deliveries sent directly to consumers. Regarding logistics, online retailers build massive logistics centres on the outskirts of large cities. Still, they tend to locate smaller warehouses as city sorting centres to reduce delivery cycle times and act as customer pick-up points. A study by [9] shows that the factors influencing users for e-grocery applications are trust in e-grocery, perceived value and attitude. Busy lifestyles, urbanization, the recent pandemic and an ageing population are other factors that have stimulated the spread of e-grocery.

The recent pandemic, in particular, has promoted the use of various technological positives to carry out a range of daily activities such as working, attending classes and buying products [10-12]. The spread of such online activities has changed the travel habits of many users in different parts of the world [13]. While the demand for transport has changed, there is always the need to better analyze the criticalities of last-mile delivery by making it greener and more efficient. In several European countries, the e-grocery sector faced logistical problems and reluctant consumer behaviour even before the pandemic. A study in Germany pointed out that delivery and product availability are the main challenges for online grocery retailers. Furthermore, overall customer satisfaction seems relatively low, as many comments for both companies are negative. Therefore, retailers should emphasize improving delivery and product availability to increase consumer satisfaction and loyalty [14]. In Italy, there are over 23,000 e-commerce sites with a regional distribution mainly in the Centre-North, i.e., Lombardy (4,406), Veneto (1,620), Emilia Romagna (1,694) and Lazio (2,762). The only region in the South is Campania, with 3,084 sites [15]. The areas of Northern Italy, where almost half of the Italian population resides, are home to more than 62 per cent of people looking for online shopping services and nearly 52 per cent of those inclined to food delivery. These regions are now the most urbanized and have the most extensive spread of large retail chains (large organized distribution) where food delivery platforms are most present. They are also the regions hardest hit by COVID-19 [16, 17].

E-commerce refers to buying and selling products and services via the web, and more simply to online shopping. It is a business model involving a set of commercial transactions and operations:

- Business-to-Business (B2B),
- Business-to-Consumer (B2C),
- Consumer-to-Consumer (C2C) or Consumer-to-Business (C2B)

Food delivery is nothing more than the home delivery of food and beverage (drinks).

Figure 1 shows the distribution of e-commerce online shopping and food delivery trends in four Italian areas.

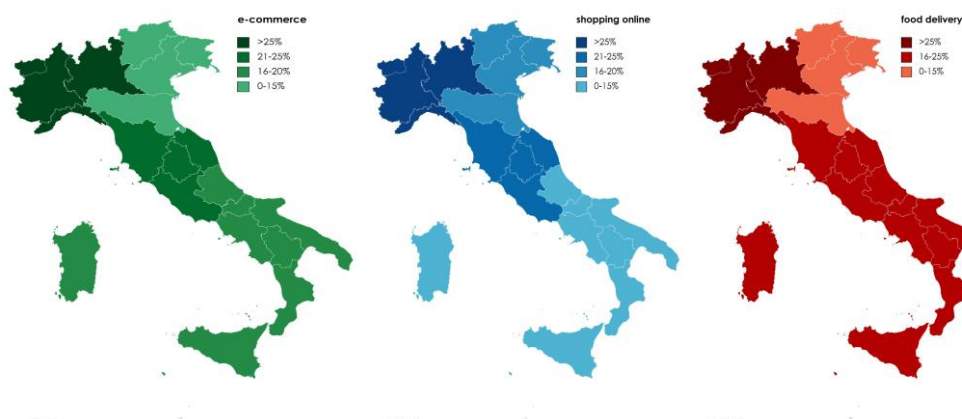


Figure 1. Distribution of e-commerce (green)shopping online (blue) & food delivery (red) in Italy[18]

The causes of this numerical disparity between regions can be seen in the different commercial structures and the catering industry, which prefers delivery modes managed independently by the individual restaurant, but also in further penetration of the COVID-19 epidemic. The pandemic has had the effect of relaunching and creating such habits from Internet shopping to catering, such as the start-up and strengthening of initiatives that have promoted the consolidation of exciting food and wine projects, the development of innovative services and the rapid expansion of the ready meal segment. There are three main reasons for the preference for digital over traditional purchasing methods: convenience, price comparability and convenience [19]. In the grocery sector (which includes food and beverages, personal care and household products), the possibility of home delivery, easy price comparison of different brands and stores and access to a broader assortment are the main advantages online shoppers highlight. In choosing the e-commerce site to buy from, price competitiveness, service conditions, reliability, and browsing experience are essential. Product delivery policies also play a significant role. If the convenience of shipping costs is the first factor to consider when choosing an e-commerce site, the high costs of delivery services lead to its immediate abandonment. Poor site reliability and unattractive prices can also lead to one out of two buyers discontinuing the purchasing process [20-22]. The development of e-commerce in food is suitable for the entire B2C (business-to-consumer) e-commerce in Italy, both for the direct and indirect effects in the other product sectors, increasing the maturity, trust and awareness of the online buyer [23].

The present work aims to define a first step of investigation at a regional scale related to the propensity to use e-grocery services concerning spatial and socio-demographic characteristics of a sample of users analyzed through the chain sampling method. After a brief description of the evolution of the development of e-commerce and e-grocery in Italy, attention is focused on the regional scale of Sicily by defining a sampling of users subjected to the administration of a questionnaire that investigated four different types of variables. The results provide an initial overview of the aforementioned regional context by providing the basis for improving e-commerce services and urban planning strategies to implement policies akin to developing more sustainable and smarter cities.

## 2 The spread of e-grocery in Italy

Food & Grocery includes several product types, food and non-food. The main component is food (about 87%) containing several product categories: Fresh, Dry, Spirits, Beverages and Frozen. The remaining 13% is associated with personal and household care products (Health & Care) sold through the online initiatives of supermarkets or branded industries. The main segments are:

- Grocery Food, i.e., online supermarket shopping
- Food and wine and typical quality products
- Online takeaway food, i.e., the purchase of ready meals at home.

Regarding geographic coverage, 73% of Italians can now do their supermarket shopping online, although there are some discrepancies between different geographic areas. Online supermarket shopping services are available in historically better-covered regions (e.g. Lombardy, Lazio, Piedmont) and those less well-served (e.g. Abruzzo, Liguria, Sicily). E-grocery is less accessible in areas with lower population densities. Moreover, such initiatives decrease drastically as one travels through Italy from North to South. On the other hand, even before the pandemic, food and wine was the most mature segment online, with an offer capable of reaching national territorial coverage. In the case of Food Delivery, there is provincial coverage throughout the territory, although only slightly more than 67% of inhabitants have potential access to these services. These trends are fundamental to analyzing aspects related to urban development and peripheral areas and simultaneously being able to manage last-mile logistics better. The present study investigates the Sicilian regional scale.

The data provided by the National Institute of Statistics Italy (ISTAT) confirm the positive trend in e-commerce in Sicily: e-commerce accounts for about 6.5% of the Italian gross domestic product and more than 3% of Sicily's gross domestic product, with 3,500 enterprises having opted for e-commerce. The sector that seems to be the driving force is the food and wine sector. The sale of cosmetics is also very successful. The largest concentration of online buyers of cosmetic articles is registered in the big cities and in those small conurbations where normal distribution struggles to arrive. The growth of e-commerce and the changes in consumer purchasing behaviour, therefore, have been accelerated by the COVID-19 pandemic [24]. The consolidation of this trend is producing, not only in terms of employment but also territorially, imbalances and criticalities: in urban areas, the phenomenon of commercial desertification is exacerbated, shopping centres

and retail parks, large sales areas are entering a crisis, and there is a certain amount of wait-and-see in the real estate investment sector, traffic flows are changing and impacting on infrastructure and air quality, land consumption is not being stopped, new needs are emerging for workers in the sector that are not being met in the areas where warehouses are located (residential, services). From the point of view of infrastructure planning, especially for logistics serving e-commerce, a regulatory vacuum makes it difficult to govern the territory, allowing it to be located in production areas rather than commercial ones.

The result of planning paths oriented more towards meeting production and manufacturing needs, with outdated logic, than those of the commercial distribution chain. It also affects the competition between the fixed premises trade and the online trade chain in favour of the latter. The phenomenon is there for all to see, although there is no observatory at the national level to record it, with specific attention to urban and planning issues. Even the recent approval by the Council of Ministers, on 4 November, of the annual draft law for the market and competition does not contemplate the problem of the governance of logistical settlements serving commercial distribution. While waiting for this issue to be addressed in the revision of the articulation of the urban planning laws are still struggling to be defined. Currently, the growth of the logistics sector at the e-commerce service in Italy is taking place without any urban planning regulation based on contemporary needs. However, the twentieth-century regulatory system, the national recovery and resilience plan NRRP, and the drive to modernize the sector will significantly influence its development. On the other hand, it seems necessary and no longer postponing that this growth should be accompanied by an overall and transversal rethinking of urban planning to respond proactively to the changes and transformations underway. This work also wanted to investigate the e-grocery sector to understand the regional distribution on the urban scale.

The article aims to investigate mainly two aspects: the diffusion of e-grocery in Sicily, a lagging region, and the relationships that e-grocery can have with spatial characteristics. In particular, a key element of the research is to verify whether there is a relationship between the propensity to purchase on e-groceries with the area of residence, the distance from the restaurant businesses and the time necessary to reach the businesses themselves.

### 3 Methodology

The present research focused on creating and administering a short online questionnaire with the chain method. The results collected for about two months made it possible to define a descriptive statistical overview of the variables analyzed in the Sicily context. Sicily was chosen as the geographical area of reference due to its conditions of development delay. Finally, the research focused on the correlation of dependence between the variables mentioned above, considering related socio-demographic aspects to the potential consumers of e-grocery interviewed and variables relating to the characterization of commercial services. Figure 2 illustrates the methodological steps followed for this research.

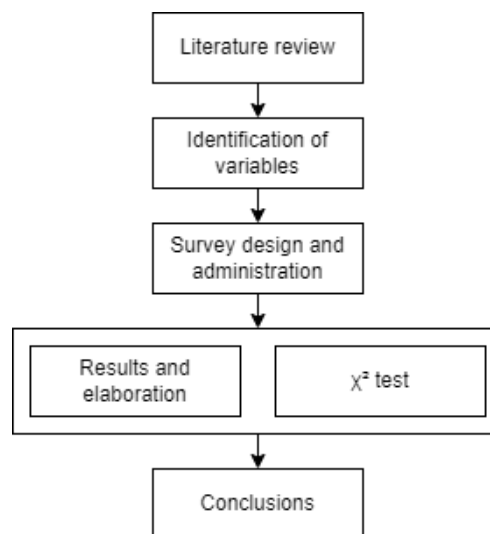


Figure 2. Methodology steps

### 3.1. Realization and administration of an online questionnaire with the snowball sampling technique

The sample of users was acquired through snowball or chain sampling. It is defined as a non-probability sampling technique in which samples have rare-to-find characteristics. In our case study, the rarity consists of investigating subjects who are not usually categorized as e-commerce users and who consider different segments of the population that are often not easily explored (think, for example, of users who do not use social networks). Therefore, the aforementioned sampling technique was applied in which existing subjects provided references to recruit the samples needed for a research study. This sampling method requires a primary data source to nominate other potential data sources that may participate in research studies. The snowball sampling method relies solely on reports, which is how the researcher can generate a sample. In this specific case, a linear type of sampling was used. The sample group started with a single subject who provided information on only one other subject, and then the chain continued with a single referral by one subject. Therefore, a survey was administered during July and September 2022. The tool used for administration was Google Forms. As regards the data, an online questionnaire consisting of the sections represented in Table 1 was implemented.

Table 1. Variables used in the questionnaire

User variables					
Section S1	Socio-demographic	Age	Gender	Level of Education	Employment status
Section S2	Residential	Province of Residence		Urban area of residence	
Section S3	Economic	Annual family income bracket	Main payment method used for in-store purchases	Main payment method used for online purchases	Main payment method used for online purchases
Section S4	Vehicle own	car	motorcycle	bicycle	e-scooter
Shopping details					
Section S5	Purchases	The average number of weekly food purchases (online)		The average number of weekly food purchases (grocery store/retail)	
Section S6	Distance	Distance from the nearest grocery store	Distance from the nearest restaurant/fast food	Grocery store distance time (minutes)	Restaurant/fast food time (minutes)

All variables predicted responses of a single type. Each user took less than 10 minutes on average to complete the questionnaire. After analyzing the data as mentioned earlier in statistical-descriptive terms, the primary and secondary variables were identified, and the presence or absence of interdependence between two sets of variables was analyzed. The probabilistic independence of the variables was tested using Pearson's chi-squared test. The starting formulation of the chi-squared test is the following:

$$H_0 : P(AB) = P(A)P(B) \quad (1)$$

$$H_1 : P(AB) \neq P(A)P(B) \quad (2)$$

where,

$H_0$  is the null hypothesis;

$H_1$  is the alternative hypothesis;

A and B are two variables whose independence must be tested.

The equation used to define the  $\chi^2$  is:

$$\chi^2 = \sum_{i=1}^g \sum_{j=1}^k \frac{(n_{ij} - E_{ij})^2}{E_{ij}} \quad (3)$$

where

$n_{ij}$  is the number of cases observed in sample  $j$  and which correspond to the  $i$ -th modality;

$E_{ij}$  is the number of cases expected in sample  $j$  and for the  $i$ -th modality in case the null hypothesis was true;

$g$  is the number of ways in which the nominal variable is expressed;

$k$  is the number of samples.

The number of expected cases, due to the hypothesis of independence of the samples, is determined as:

$$E_{ij} = \frac{n_{.j} n_{i.}}{n} \quad (4)$$

where

$n_{.j} = \sum_{i=1}^g n_{ij}$  is the numerosity of each of the  $k$  samples;

$n_{i.} = \sum_{j=1}^k n_{ij}$  is the number of each sample.

## 4 Results

This research was founded on a sample of 260 people in Sicily. Considering a total population of 5 million people in Sicily, and according to Cochran's formula [25], results show a sample size with a Precision level of 7% and a Confidence interval of 95%, resulting in a good sample size. The separation between the western provinces (Palermo, Trapani, Agrigento, Enna and Caltanissetta) and the central-western provinces (Catania, Messina, Ragusa, Syracuse) reflects the geographical, political and economic composition of Sicily, divided into two large basins, one on Palermo and another on Catania, with a significant territorial discontinuity between the two areas. Just over half of the respondents (53.3 per cent) come from the central-western provinces of the island (Palermo, Trapani, Enna, Caltanissetta, Agrigento), while just under half (46.4 per cent) from the eastern provinces (Catania, Ragusa, Syracuse, Messina). An important territorial datum relates to the kind of residence within the municipality it belongs to. Three typologies into which the sample is divided are considered: about half comes from the "historic centre", while the remaining half, which belongs to the other two categories, "expansion" and "isolated houses", is divided almost equally. Most respondents, over 60 per cent, live in households of 3 or 4 people, in line with the regional demography, which sees expanded households and young people who leave home late. Considering that the survey in question refers to e-commerce and the entire universe, it can be assumed that the overall figure is similar. Aggregate data confirm this trend: over 40% of respondents own two private cars in their household, while more than 19% own 3. Lower numbers for motorcycles and bicycles: in the latter case, it is essential to point out how almost half of the respondents own 0 bicycles per household, also in line with the regional trend, which sees mobility on bicycles as marginal (Source: Plan for Infrastructure and Mobility PIIM 2015).

The results referring to scooters are negligible. Regarding payment methods, the sample shows a clear prevalence of credit/debit cards over cash, even in the case of physical purchases. In contrast, the contribution of cash for online purchases is negligible (5.8 per cent of respondents). Interesting data concern the answers relating to the e-grocery. Significant is that only 20.8 per cent buy on average once a week on platforms such as Just Eat, while the contributions of those who buy more than once a week are negligible (3.3 per cent from 2 more). The sample would instead seem to show a propensity for classic food; almost 40 per cent of respondents go to a restaurant once a week, and over 20 per cent more than once. These percentages are significant despite the answers relating to income (less than 30,000 €/y for almost half of the respondents). It would seem to indicate a particular affection for the traditional ways of using restaurants. The distance from the nearest restaurant/fast food shows an exciting distribution: over 50 per cent of respondents live less than 1

km from the nearest restaurant, while over 90 per cent live less than 5 km. The sample responses show a picture in which commercial catering activities are also present in peripheral areas.

The travel times to the nearest restaurant, with the different modes of transport, return a result that confirms a favourable context for the use of the individual vehicle but which could be limiting for the diffusion of online platforms. Over 70 per cent of respondents take less than 10 minutes to reach the nearest restaurant/fast food by car; over 40 per cent take less than 10 minutes on foot. The only means of transport not contemplated for these journeys is Local Public Transport: more than 35 per cent of respondents indicated that Public Transport was unavailable or that the journey time exceeded one hour. Concerning the distance from grocery stores, over 66 per cent of respondents live less than 1 km from the nearest supermarket/shop, "weakening" the need to buy food online. In general, all the answers relating to the times required to reach the most immediate supermarket/shop show values on average lower than those for getting to the nearest restaurant. Results show that more than 50 per cent on foot take less than 10 minutes against 43.3 per cent in the restaurant; by car, over 80 per cent take less than 10 minutes against 73 per cent. It indicates how commercial activities have a greater diffusion structure and are better for selling necessities since they must be more readily available. The analysis of the variables relating to the user highlighted an almost equal distribution of the sample regarding gender. Statistics reveal a predominance of users between 18 and 26 years (39 per cent) and between 27 and 35 years (29 per cent). Figure 3(a) shows the distribution of the gender in the sample.

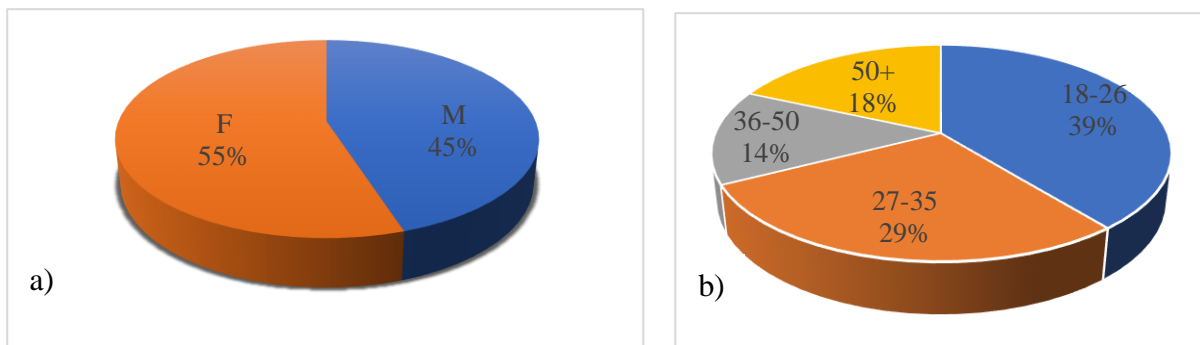


Figure 3. a) Gender distribution in the sample, b) and age distribution in the sample

Regarding the spatial distribution of the users' residences, statistics indicate an almost equal distribution at the regional level and a higher percentage of users who mostly live in historical centers (about 49 per cent). At the same time, the remainder is equally distributed between the scattered houses and the urban expansion areas (UEA).

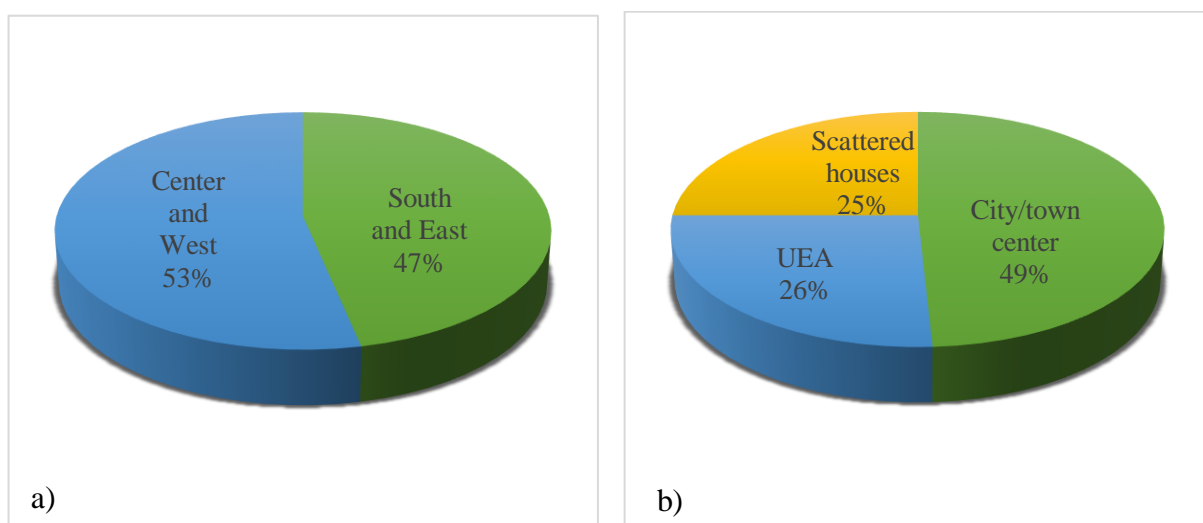


Figure 4. a) Regional distribution in the sample, b) residential context in the sample

As regards the characterization of travel habits, first of all, the possession of vehicles was investigated, obtaining that over 80 per cent of the sample frequently had a vehicle with an engine available. Considering section S2, it is possible to note how each household mostly has 1-2 cars, and only 30 per cent have mopeds. Regarding sustainable mobility, over 45 per cent of the sample does not own bikes. Over 90% do not currently own e-scooters. From an economic point of view, about half of the users investigated are workers with an annual salary of fewer than 30,000 euros.

The primary payment method for purchases is by credit card, while an almost equal distribution of the sample uses debit cards or cash payment. Instead, for online purchases, only 5.8 per cent of users pay in cash or with cash on delivery. As regards the different types of food purchases, it was found that weekly. Over 75 per cent of the sample does not purchase food online. On average, only 20.8 per cent make one purchase and less than 3 per cent 2 or 3 times. The sample distribution regarding food purchases in shops is distributed with a value greater than 30% more than four times a week. Almost 40% of the sample purchases food from a restaurant or pizzeria weekly, while nearly 32% do not purchase takeaway food from restaurants or pizzerias. The offer of small shops and specialized food and wine shops is widespread thanks to Sicily's tradition and numerous quality raw materials. The diffusion of the main supermarket chains is developing in the expansion areas of the city. However, the distribution of restaurant chains is struggling in different parts of Sicily to take off also due to the numerous trattorias and takeaway food places in the main metropolitan cities such as Palermo or Catania. Regarding delivery, services also take off in inner cities such as Enna and Caltanissetta. However, this service is still struggling in small towns. Considering the spatial distance between home and shop, it is possible to note that over 66 per cent of the sample have a grocery store less than 1 km away, just as over 50 per cent have a restaurant or pizzeria near their home. Moreover, the time distance on board of different modes of transport was investigated to analyze the accessibility of the home-food point-of-sale itinerary. Statistics indicate the average walking distance is under 10 minutes for over 52 per cent of the sample. Almost 70 per cent of users reach a food shop by scooter in less than ten minutes.

The most significant criticality occurs when public transport is used: around 35 per cent of the sample takes more than 1 hour, or the service cannot reach the destination. Almost 37 per cent of the respondents instead use public transport and reach their destination in about 10 minutes. Regarding the restaurant/fast food destination, around 43% of the sample reaches the destination in about 10 minutes, and almost 36 per cent between 10 and 30 minutes. About 55 per cent of the sample used the bike to reach their destination in 10 minutes. As far as motor-driven vehicles are concerned, however, it is recorded that over 60 per cent of the sample manages to reach their destination on a moped in 10 minutes. However, around 21per cent fail, if not before an hour or fail altogether. By car, over 73 per cent of the sample takes less than ten minutes. Also, in this case, the mode of transport which is least successful in connecting the origin and destination is public transport. About 33 per cent succeed in less than minutes, while over 35per cent fail before an hour or do not have this type of connection. Summarising the data, it is possible to underline that:

- the average user is an adult under 35, mostly female.
- weekly, around 23% of the sample made at least one purchase on the online platform;
- although serious infrastructural and connection difficulties characterize the analyzed context with the rest of Italy and with internal connections difficulties, places for buying food, such as small shops and takeaway food, are prevalent.
- on average, these places are easily added. This is also connected to the food and wine tradition of the region which allows in many contexts to have small restaurants or shops available.
- there is ample availability of individual private means of transport, while the use of public transport is limited. This is confirmed by the studies elaborated in the PIIM of the Sicilian Region.

#### 4.1. The chi-square test of independence

The variables considered as study elements are summarised in Table 2.



Table 2. Variables incorporated in the data analysis

Variables	Possible reply
Age	18-26:27-50:>51
Annual family income bracket	< 30.000 €/y, >30.000 €/y
Continued availability of use of a motor vehicle	Yes/no
The urban area of residence	Historic Centre Expansion Area Scattered Houses
Distance from the nearest restaurant/fast food (km)	<1km 1-5 km > 5 km
Restaurant/fast food walking time (minutes) by car	<10min 10-60 min >60min
Restaurant/fast food time by car (minutes)	method unavailable <10min 10-60 min >60min
Province of residence	method unavailable East Sicily; West Sicily

The three age groups identified show great internal homogeneity. 26 is the average age students finish their studies in Italy; therefore, 27 is considered the starting age for work. The age range 27-50 instead summarizes the phase of professional ascent. Less significant are the results related to classes over 50 years of age, probably due to a lower propensity of the older population. These classes have been merged into one. The two income clusters are identified as €30,000/y in Italy is considered middle income. The subdivision, therefore, intends to verify the presence of a greater incidence of the use of e-commerce among high incomes. The urban area is a geographic information necessary for this study. It was asked to indicate whether the provenance is in a historic urban centre, therefore in a central area traditionally more supplied with services, in an area of expansion, an area generally with a greater dispersion of services; moreover, the possibility of indicating isolated houses or small villas makes it possible to aggregate those who live in reality not in direct contact with the rest of the town.

The classes relating to questions on distance (<1 km, 1-5 km, >5 km) have been identified as integers which can also provide indications on the way. 1 km of distance generally indicates a close distance that can be easily accomplished on foot; more than 5 km is a distance that typically requires a motorized vehicle. 1-5 shows an intermediate situation. Similarly, the travel time from the restaurant/fast food restaurant, both on foot and by car, was also asked to represent the perception of travel. The limit values of the clusters (10 min and one h) make it possible to understand the proximity perceived by users to restaurant businesses, both on foot and by car. The answer "Mode of transport not available" is used to quantify the possibility that a user cannot go to the restaurant with the mode of transport explicitly requested in the question. As previously stated, clusterization of Sicilian provinces is mainly based on geographical and economic reasons.

Table 3 shows the results of the chi-square tests, considering  $\alpha=0.05$  and  $\alpha=0.01$ .

Table 3. chi-square test results considering e-grocery variables

Other variable	n	$c^2_{\text{test}}$	p-value	0,05 $c^2_{\text{theor}}$	0,01 $c^2_{\text{theor}}$
Age	2	12,16207	0,002286	5,99	9,21
Annual family income bracket	1	0,731465	0,392409	3,84	6,64
Continued availability of use of a motor vehicle	1	0,454718	0,500103	3,84	6,64
Urban area of residence	2	10,81452	0,004484	5,99	9,21
Distance from the nearest restaurant/fast food (km)	2	0,170867	0,918114	5,99	9,21
Restaurant/fast food time by car (minutes)	2	2,584214	0,274691	5,99	9,21
Restaurant/fast food walking time (minutes)	2	6,14791	0,046238	5,99	9,21
Province of residence	1	0,562435	0,375309	3,84	6,64

The correlation of the age variable with the percentages of buyers shows a context in which online purchases are mainly linked to the central bracket, 27-50. In contrast, the other two brackets, both the very young and those over their 50s, tend to buy Less. The income variable does not show a significant relationship, and it is impossible to make the inference. Most respondents have an income of less than €30,000/y; it is possible to define that income is not a driver variable for e-grocery purchases for the reference population.

The urban area of residence shows some exciting results. The null hypothesis of statistical independence is rejected for both values of  $\alpha$ . The results show that residents in the historic centre tend to buy more from e-groceries than residents of the suburbs and isolated areas. It was also noted that the distance in km and the driving time from the nearest restaurant show no significant results.

The dependence between e-grocery purchases and the walking distance to the nearest restaurant is significant for  $\alpha=0.05$ . There is a higher percentage of e-grocery shoppers among those who live further away from restaurants. Notably, several tests for the sample studied rejected the null hypothesis. Therefore, the profile of the variables that seem to interact most with purchases on e-groceries are:

- the age variable shows a greater propensity of the young to leave home and a lower propensity of the over-50s towards technology. Therefore, it emerges that the intermediate category (27-50) is the one that buys more food online;
- the area of residence highlighted by other studies in the literature shows a greater propensity of those living in urban centres to buy e-grocery due to more services such as wifi, delivery services etc.
- the time it takes to travel from home to the nearest restaurant is also a variable that indicates an urban geospatial location and also provides information on the mobility condition of the area of residence;

Therefore, the results of this research also show how the propensity to buy food online increases proportionally as the distance home-restaurant increases. The research shows how the categories of the area of residence and the walking time relate to each other. The two variables considered are the most significant from a spatial point of view among those analyzed. The area of residence allows you to have an immediate picture of where the resident lives, while the time spent on foot will enable you to identify the perception of distance from services. It has been identified that both categories present a statistical interdependence with e-grocery purchases. By

suitably merging the clusters to make their visualization more complicated, the relationship between the four categories found is represented in Figure 5.

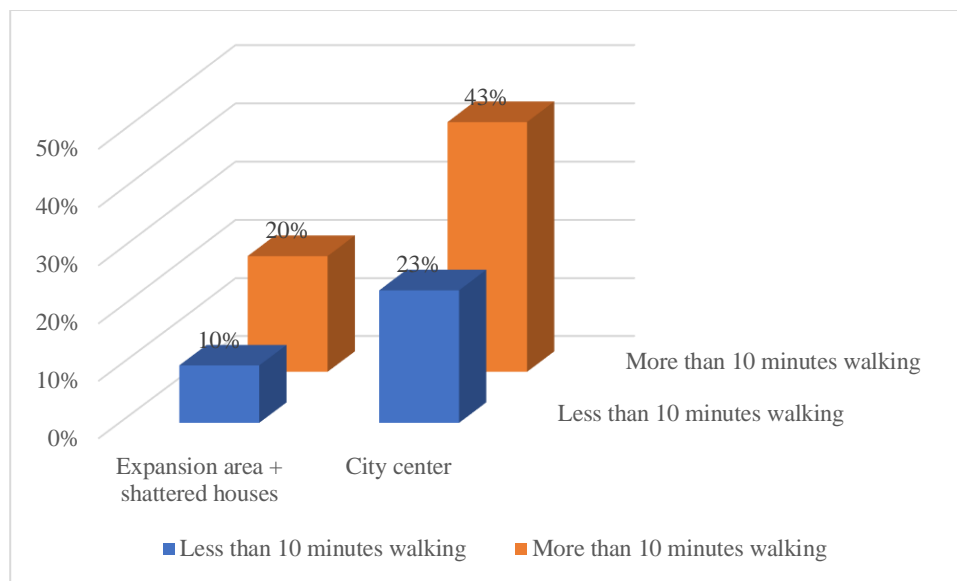


Figure 5. Synthetic distribution of walking time to the closest restaurant and residential area (Percentage of people purchasing online for each reference category)

Each of the four values represents the percentage of total respondents from one of the four categories. As can be seen, the percentage value of users who purchase at least once on e-groceries increases with two spatial parameters: life in the historic center and the pedestrian distance from the nearest restaurant. The category least affected by e-grocery comprises those who live in an expanding area or isolated houses and live relatively close to a restaurant, while the most interested category is those who live in the historical center and relatively far away.

## 5 Discussion and conclusion

The recent pandemic and the continuous technological and logistical evolution are facilitating the rise of e-commerce services. Therefore, it has contributed to the growth in demand for users who want to buy online. Several studies state that there is no similar trend for all the purchased products. However, the studies also show that the food component has grown significantly in recent years to the detriment of the "personal care" category. Furthermore, especially during the lockdown phase, there is a widespread propensity to purchase essential ingredients online (flour, sugar, yeast, etc.), commodities, ethnic specialities, fresh milk and cream, takeaway food, food, and wine. By shopping online, users have been able to experience several benefits, including the convenience of home delivery, the ability to compare prices and have a wide assortment to choose from, and access to exclusive promotions. On the one hand, this online trend has contributed to a growth in purchases in general. On the other, it is inconveniencing physical commercial activities, primarily in small shops and workshops, resulting in the closure of various shops and creating more significant urban voids.

The results obtained from this first step of the investigation allow us to make a double reflection: from the point of view of urban planning and last-mile logistics. It is essential to understand which portions of the city may be more subject to this phenomenon to implement space recovery strategies and support for small businesses. It is also vital to characterize the user profile better to improve purchasing and delivery services. The case study examined outlines a first layout in a regional context of the island type in some ways of the "confined" type characterized by a series of areas where there is a reduced possibility of connection (especially for internal areas) to date. The study defines the first step of the investigation through simple statistical analysis. Secondly, it analyzed the correlation of dependence between some of the investigated variables, such as, for example, the location of residences in urban areas and not concerning the propensity to buy food online. The study presents itself as a first evaluation of the characteristics of e-grocery in Sicily. The statistical-descriptive nature analysis highlights prominent features, some of which are found in regional trends. An initial

survey reveals the profile of the female e-grocery user, characterized by an adult age but under 35 who easily reaches physical places for purchases such as supermarkets or restaurants but who uses the services at least once a week online, especially when residing in areas of the historical center and not in the suburbs. Therefore, user profiling is essential to exemplify the online purchase steps and ensure that the devices can represent a tool for integrating physical and online channels, starting from the smartphone, one of the most used tools for online shopping. The questionnaire submitted highlights some characteristics of the sample that should be recalled. In particular, it is interesting to note that just over 20 per cent of users periodically and systematically use e-grocery platforms. This result will likely increase due to the diffusion of outlets and the coverage of online services. Furthermore, the presence of a particularly dense fabric of restaurant activities emerges, which can represent an obstacle to expansion, but at the same time, an opportunity for the diffusion of the network covered by online e-grocery platforms.

The evaluation of the interdependence between the variables has highlighted that the historic urban centres of Sicily are where the use of e-grocery services takes place most. Therefore, these parts of the city need to be given the most attention both in terms of possible closures of commercial activities and the location of spaces (for example, loading and unloading areas, presence of lockers) and services (for example, strengthening of wifi networks) to improve the delivery of goods. Therefore, the study results can be a basis for further research to implement strategies for preparing Sustainable Urban Logistics Plans (SULPs) integrated and qualifying the current Urban Sustainable Mobility Plans (SUMP) as foreseen in Italian since 2017. Moreover, the findings suggest a series of measures and actions that contribute to reducing energy consumption and the environmental impact of urban logistics while simultaneously allowing the economic sustainability of the related service. The greatest demand for e-grocery services was recorded starting from the share of respondents residing in city centres. The greater use of this part of the urban reality has different implications:

- The research lays the foundations for a qualitative and quantitative evaluation of the quantity of e-grocery services required. Within historical centers and cities, therefore, the need arises to evaluate whether the services cover this demand;
- From the perspective of the use of urban spaces, it is necessary to verify whether there is an appropriate presence of loading and unloading areas so that handling operations do not interfere with the vehicular flow, increasing congestion, or even with the pedestrian flow;
- Similarly, from the perspective of services, the assessment must also consider the characteristics of vehicle fleets in terms of emissions;
- Verify the extent of the modifications induced by the vehicular flows generated by the e-grocery.

Instead, as regards the context of peripheral areas (shattered houses and urban expansion areas) in which the adoption of e-groceries has been less, greater attention will have to be paid to:

- Verify the goodness of the connections with the historic center, a traditional pole of attraction for home-leisure trips;
- Reduce the digital divide and improve wifi services to make e-grocery services more usable even in peripheral areas;
- Extensive and in-depth evaluation of the catering service networks to be able to study the optimization of distances for the deliveries of perishable products;
- Improve pedestrianization of peripheral areas.

The research is beneficial for various stakeholders: for catering businesses, which can thus have different information on business strategies, evaluating, in particular, the possibility of relying, if possible, on an e-grocery platform also with the area of cities in which they are located; for territorial planners and public Authorities, who can better define the strategies for the use of public spaces and the consequent legislation. The usefulness of this work, in particular, is important for the planning of Sulp and Sump because, on the one hand, they allow to plan a reduction of carbon and, on the other hand, they allow to reduce road accidents. This research represents a first step and, in particular, is limited to a specific geographical area. The research can evolve with the calibration of a choice model, which allows us to act more incisively in predicting movements for e-groceries, and with the extension of the study to other geographical areas, similar or different to Sicily.

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