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Eco-packaging and fresh food products. Analysis of demand and consumer behavior in Italy

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Abstract

This paper presents the first results of marketing studies for the positioning of a new sustainable biobased plastic packaging for fresh food, as part of the research project "CItrus waste ReciCLing for added valuE products – CIRCLE" for improving the sustainability of the citrus processing production chain through the valorization of processing waste. The present study, conducted on Italian consumers, contributes to the flow of literature on consumer demand of sustainable food packaging, highlighting the preferences, concerns, and skepticism, the factors that explain behaviors, and the role of information on their choices. Findings may be of interest for firms and Public Institutions to promote circularity behaviors among citizens and to consolidate their ethical motivations through correct information and experience.

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Introduction

Demand for plastics is increasing worldwide, and the European Commission predicts that global production will double in the next 20 years (European Commission, 2018). About half of global demand for plastics is for packaging, but only 14% of plastic-based packaging is recycled. Huge amounts end up in landfills or are incinerated (European Commission, 2018; Jambeck *et al*., 2015). Plastic packaging not only consumes limited fossil resources, but also contributes to large amounts of waste that damage marine and freshwater ecosystems (Macht *et al*., 2023).

Against this backdrop, on the one hand, companies in the food industry have for years been working to reduce the amount of plastic packaging used and investing in research to find solutions that impact the environment as little as possible (Ada *et al*., 2023a).

Concomitantly, in the very last few years, consumer interest in environmentally sustainable packaging has grown, including in relation to fresh food products, due to growing concerns about the effects of global pollution (Wandosell *et al*., 2021). Research is geared toward finding materials for fresh produce packaging that can ensure food preservation. The choice of sustainable and biodegradable food-saving wrappers is growing from wax-weaved cotton sheets to bioplastics derived from corn or fish waste (Ada *et al*., 2023b). Nevertheless, studies on bio-based packaging as an alternative as well as on consumers' purchase intention for different bio-based food packaging alternatives are scarce. Especially the comparison of different food product categories is lacking – yet highly recommended (Herrmann *et al*., 2022).

The Italian sector of disposable biodegradable plastics is on the move. In general, there is not enough biodegradable plastic on the market for rigid products because demand is many times greater than European supply. Instead, there is strong availability of soft bioplastics, the kind used in shopping bags (Assobioplastiche, 2023).

Italians are increasingly aware of issues related to climate change (European Investment Bank, 2021). Due to the high cost of living that has continued to erode the purchasing power of Italian households in recent years, with impacts in food preferences also, the citizen's ethical environmental choices could be influenced by the actual availability and possibility of paying a higher price for food products with environmentally sustainable packaging. Nevertheless, eco-friendly packaging is absolutely a crucial aspect to make a food product sustainable (Nomisma, 2024).

Some recent studies explored consumer perceptions and purchase intentions for different alternatives of sustainable packaging and bioplastics (Herbes *et al*., 2018; Taufik *et al*., 2020; Wensing *et al*., 2020). These studies

conclude that bioplastics are perceived positively by consumers mainly due to their perceived eco-friendliness. Moreover, studies to date highlight that consumers infer the sustainability and quality of a food product from the packaging material (Herrmann *et al*., 2022; Liem *et al*., 2022; Magnier *et al*., 2016). In particular, regarding organic fruit and vegetables, it has been shown that unpackaged products are preferred to packaged ones (Herrmann et al, 2022; Van Herpen *et al*., 2016).

A study comparing the perception of different plastic packaging solutions for fruit juice bottles, i.e. recyclable, recycled and compostable plastic (Testa *et al*., 2021), found that consumers are not able to evaluate one solution as superior to the others. With regard to recyclability, there is evidence that reusable packaging for online meal kits is perceived positively by consumers (Yoon *et al*., 2022).

Many studies examined the sphere of the consumer's behavior and factors that may influence purchasing and recycling behaviors by consumers with respect to sustainable packaging (Martinho *et al*., 2015; Boz *et al*., 2020; Rusyani *et al*., 2021).

Consumers' attitude to choose sustainable food packaging are shaped by various variables (Yin *et al*., 2022), including premium price and their familiarity with it (Patel *et al*., 2020). Herrmann *et al.* (2022) in a recent study highlighted found a negative willingness to pay for grapes packaged in bioplastic packaging. Nevertheless, there are very few studies in Italy on sustainable packaging as an alternative for consumers as well as on consumers' purchase intentions and motivations to choose sustainable packaging for different products. In particular, some authors (Herrmann *et al*., 2022) highly recommended further studies on the comparison between different product categories. Moreover, so far, studies on communication of the attributes of environmentally friendly packaging are limited (Dörnyei *et al*., 2022).

Against this background, aiming to fill the actual gap in the literature, the object of this paper is to investigate the Italian consumers' demand and behavior with regard to sustainable packaging tying to discover the motivational factors driving their purchasing choices and the type of information they have.

The present study, conducted on Italian consumers, contributes to the literature stream on consumers' demand and behavior of sustainable food packaging, by answering the following research questions:

R1) What are the characteristics of sustainable packaging that are considered important for consumers and may influence their purchasing choices?

R2) What are the means of information for consumers to know about environmentally sustainable packaging? What are the consumers' characteristics that may provide information? Are there statistical

associations between consumers' characteristics? and may these associations describe their purchase behavior with regard to environmentally sustainable packaging?

R3) What factors (vectors of variables) may influence purchase intentions and behaviors?

R4) What is the ideal surcharge consumers are willing to pay for some food products with an environmentally sustainable packaging?

R5) What dimensions of communication are most effective in conveying correct information? Who is responsible for conveying information to consumers to build awareness and a sense of responsibility toward environmental sustainability?

In this paper, we present the information gathered from the first step of marketing studies for positioning of a new sustainable bio-based plastics packaging for fresh foods, as part of the research project "CItrus waste RecyCLing for added valuE products - CIRCLE". This project aimed to improve the sustainability of the citrus processing production chain by enhancing the processing waste (mainly composed of peels, pulps and seeds) as a low-cost raw material for production of various high value-added products, namely, bacterial cellulose films, perillyl alcohol, perillaldehyde and perillartin from the biotransformation of limonene, biodegradable pectin-based food packaging films.

1. Background

1.1. *European Union and Italian strategies and regulations on Circular Economy*

The improvement in the quality of life and widespread well-being that have characterized the era in which we live has, in contrast, given rise to an environmental, economic and social emergency, such as that of waste management. This issue is related to the concept of the linear production model implemented until now (the creation of a good, its use and eventually its abandonment), which today is no longer entirely sustainable because resources are not infinite, cheap and low-cost for disposal and, above all, because of the high negative impacts caused on the environment.

Plastic constitutes the third most widely used human material on Earth after steel and concrete. World plastic production has increased from 15 million in 1964 to more than 310 million today (Global Plastics Outlook, 2022). The use of plastic packaging has grown by 40% in the past 20 years, with deleterious effects on the environment (Babaremu *et al.*, 2023). Italy

is the second largest consumer of plastic at the European level; in 2020, almost 6 ml/t of plastic was consumed in our country, equivalent to 98.6 kg per person. It holds the European record for bottled water consumption, with about 221 L/year per capita, while in 1980 it was 47 L/year per capita (Gambino *et al*., 2020). This is mainly due to the change in people's lifestyles and consumption habits (e.g., habitual eating out, demand for take-out food, disposable packaging, etc.), but also because plastics are routinely used for packaging, construction and automotive (Macht *et al*., 2023; Poças *et al*., 2023).

Over the past few years, the EU has developed strategies and issued regulations aimed at discouraging the use of single-use plastics and promoting recycled and renewable, bio-based materials (European Commission, 2018). The last EU legislation on waste management is the Directive of the European Parliament and the EU Council No. 2008/98/EC of November 19, 2008. In 2018, the so-called "Circular Economy Package" (Package) was published in the Official Journal of the European Union. This Package consisted of the following four Directives:

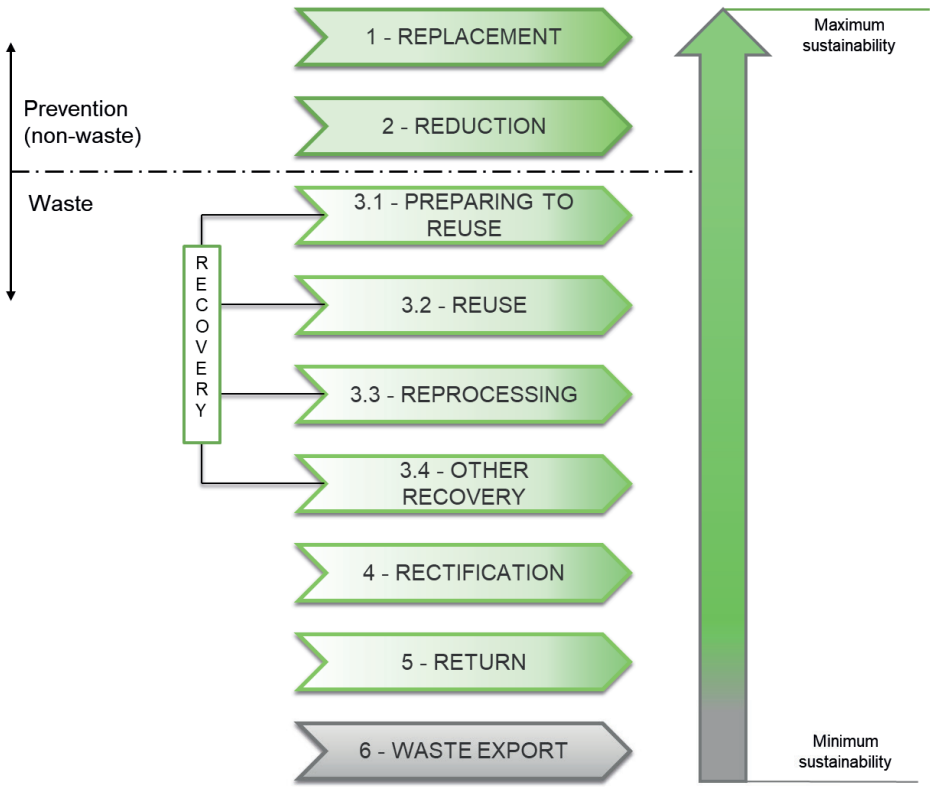
1. Directive 2018/851/EU amending the Waste Framework Directive (2008/98/EC);
2. Directive 2018/850/EU amending the Landfill Directive (1999/31/EC);
3. Directive 2018/852/EU amending the Packaging Directive (94/62/EC);
4. Directive 2018/849/EU amending the End-of-Life Vehicles (2000/53/EC), Batteries and Accumulators (2006/66/EC) and Waste Electrical and Electronic Equipment - WEEE (2012/19/EU) Directives.

With the first Directive 2018/851/EU, all Member States have committed to achieving ambitious goals and recycling targets as specified in Art. 11, i.e., to raise the preparation for reuse and recycling of municipal waste at least to 55% by 2025, to 60% by 2030, to 65% by 2035.

All these EU Directives, which constitute the Circular Economy Package, are developed around the core concept of the "Waste hierarchy". The so-called waste hierarchy defines the order of priority of waste prevention and management policies.

The waste hierarchy was initially shown as an inverted pyramid with prevention and minimization of waste generation at the apex, followed by the options of reuse, recycling, material and energy recovery, and at the last level disposal (Zhang *et al*., 2022). Subsequently, this representation has undergone developments due to the introduction of specifications such as recovery options, rectification, and return (Zhang *et al*., 2022). In this paper we aimed to make a contribution to literature by providing an authors' elaboration of the latest representation of the waste hierarchy from Gharfalkar *et al*. 2015 (Figure 1).

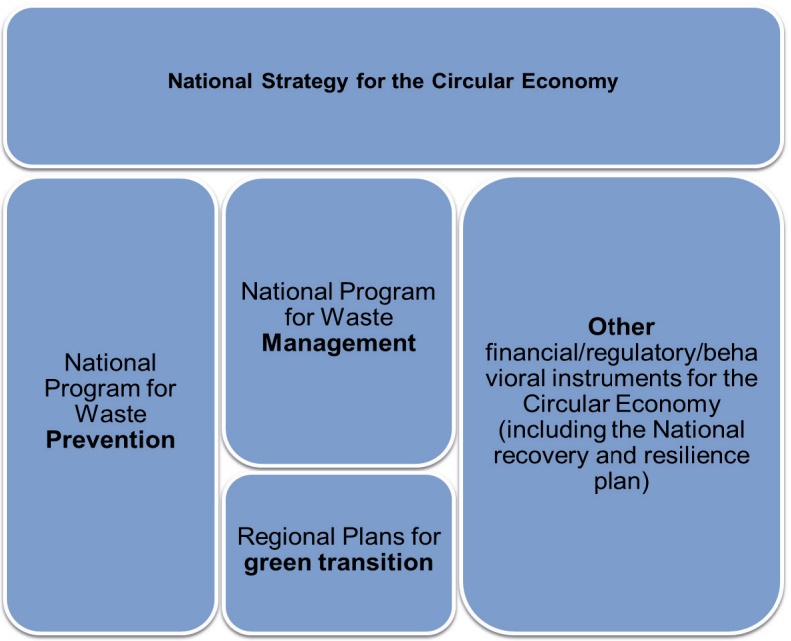
Figure 1 - Authors' elaboration of the Waste hierarchy model from Gharfalkar et al. (2015)



The implementation of the Circular Economy Package in Italy consists of four implementation decrees all issued from 2020, about waste, batteries and accumulators, electrical and electronic equipment, end-of-life vehicles, landfilled waste with a ban on landfilling, starting in 2030, all waste that is suitable for recycling or other forms of recovery. As part of the Italian "National Strategy for the Circular Economy" (Lucchi *et al.*, 2024), the "National Program for Waste Management" is the tool, provided for and defined by Article 198-bis of the Consolidated Environmental Act, to guide the Italian Regions and the Autonomous Provinces in planning waste management. This is one of the tools needed to implement the principles of the circular economy dictated by the European legislation and to meet the objectives of the National Recovery and Resilience Plan. Nevertheless, there are other national Programs and Plans in Italy that finance with public funds

investments to realize the objectives of the National Strategy for the Circular Economy (Figure 2).

Figure 2 - Authors' elaboration of visual representation of public funds (National Programs and Plans) regarding the National Strategy for the Circular Economy



1.2. *Advances in sustainable food packaging*

The transition to a circular economy model is a fundamental change that brings about a shift in production systems, business models, and most importantly, people's consumption styles, with beneficial repercussions for the environment, climate, and human health. Consumers have become more aware of environmental issues, and many companies have recognized the importance of sustainable packaging as a "green marketing" tool to gain a competitive advantage (Ahmad and Thyagaraj, 2015).

Sustainability of packaging must encompass the entire value chain, starting from the sourcing of raw materials and energy required for packaging, to the processing of components, to post-consumption. Among the most significant circular economy goals in the food sector is the use of models to prevent food waste and promote circular management of packaging used to pack and hold food over time.

In food packaging, sustainability is meant for food preservation. Traditional food packages are passive barriers designed to retard the negative effects of the environment on the food product (the role is to be as inert as possible). Several research efforts have focused on enhancing materials barrier properties for sustainable food packaging (Versino *et al*., 2023). In addition to product protection, designing the most effective and sustainable packaging is a complex process involving many sectors of the entire supply chain, including the target market (Springle *et al*., 2022). Is important to consider foods packaging ability to contain, protect, and preserve the product to extend its shelf life and ensure food safety, but also its appropriate size, ease of opening and emptying, and clearly accessible information to avoid food waste. In addition, packaging materials must meet desired mechanical and barrier properties while remaining as light as possible, safe for food, ideally reusable or recyclable, and disposed of with little or no pollution. However, the design of environmentally friendly food packaging is very complex because one must try as much as possible to preserve product quality while meeting marketing and environmental sustainability requirements (Mendes and Pedersen, 2021).

Renewable resources are needed to design eco-friendly bio-based food packaging. The term "biobased" refers to products derived from renewable organic raw materials, such as corn or grass (European Commission, 2018). Two biobased alternatives are promoted: bioplastic and paper-based packaging. These two alternatives have different advantages in terms of environmental friendliness, but it is important that consumers understand the differences, including in terms of quality characteristics.

Bioplastics are considered promising because they have some similar characteristics to petroleum-based plastics and possible benefits, including reduced carbon footprint. However, much confusion exists among consumers about bioplastics, which may be but are not necessarily biodegradable. Consequently, each bioplastic solution has to be evaluated separately (Spierling *et al*., 2018).

The advantages of paper are its recyclability and biodegradability. Paper-based packaging for fresh soft fruits or vegetables is increasingly found in supermarkets. Current research activities focus on the development of innovative paper packaging. Active materials are specifically designed to interact with the food or its environment, changing its composition or characteristics to preserve the organoleptic or sensory characteristics of the product and ensure its quality for long periods of time. Antimicrobials, antioxidants, aroma and gas scavengers, and light blockers are some examples of active substances usually used in food packaging (Amin *et al*., 2022). Nowadays, intelligent packaging materials are aimed to sense changes within the food package and to provide information about the quality of foods inside

(Cheng *et al.*, 2022). Moreover, recent studies (Amin *et al.*, 2022; Chen *et al.,* 2020) highlighted that innovative packaging and intelligent packaging may provide, in real-time, quantitative information on package integrity and food freshness, maturity, or contamination. Finally, smart packaging is derived by the mix of technologies used for intelligent and active packaging (Jamróz *et al.*, 2019). However, food packaging with the sole function of maintaining product freshness may not meet all practical requirements (Tracey *et al.*, 2022). Therefore, it seems essential to know the motivational factors that determine consumers' purchase choices for different eco-friendly packaging alternatives for many products, and their level of information about types of sustainable packaging and circular economy practices. In addition, another element to investigate is the potential willingness to pay a possible premium for these types of food packaging.

2. Materials and methods

2.1. *Study design*

For this study the reference universe was identified with the southern Italian Metropolitan cities, i.e. Catania and Palermo, as having homogeneous characteristics in terms of geographical location, number of inhabitants, population density and level of development for green transition. The sample size was calculated as a function of the error to be accepted, in the hypothesis of a Normal distribution (where p = q = 0.5), and setting Prob = 0.954. Then, with Prob = 0.954, and with an accepted error = 5%, the sample size will be n = 400. The sample was drawn by random method according to the rule $n=n_1+n_2$ i.e. 200 individuals from Catania (n_1) and 200 from Palermo (n_2).

A sample belonging to the age group of 20-60 years was chosen for this study. Stratification was carried out for the following age groups: 20-29 (young Generation Z), 30-39 (Generation Y), 40-49 (Generation XY), 50-60 (Generation X); a relatively homogeneous number of respondents was drawn across generational groups, with a slight priority given to younger people because they may contribute to and be protagonists of economic and social challenges that require a process of change by adopting choices that will impact their future (Ogiemwonyi, 2022).

2.2. *Questionnaire and measurement*

The questionnaires were prepared using Google Forms in order to send them digitally through the use of a link. They were spread through

institutional links, institutional social networks and word of mouth. The questionnaire's structure is divided into three main sections:

1. sociodemographic data (biographical information, educational qualification, subject area of studies, occupation, and average income);
2. prior knowledge of separate collection, reuse and recycling;
3. awareness of the concept of sustainable packaging, purpose of use and characteristics (general/substantial, specific, visual) of the eco-sustainable packaging, ability to recognize a bioplastic food packaging among three of which two consist of plastics;
4. ideal propensity to pay a surcharge for the purchase of some specific food products (i.e. common pasta, 100% Italian extra virgin olive oil PDO, Sicilian red oranges PGI, and cherry tomatoes PGI) with a sustainable packaging.

The questionnaire contained only closed questions. In addition, 5 qualitative variables, each with 10 items were chosen by the authors based on a review of relevant literature (Macht *et al.*, 2023; Norton *et al.*, 2023) on the topic, and a preliminary study of the characteristics of the use and consumption of environmentally sustainable packaging for food products in Italy. These items belong to 5 homogeneous macro topics (variables), each macro group consisted of 10 items (Figure 3):

1. Motivation to choose an eco-sustainable packaging – named AIM, on the topic (according to personal judgment) of the usefulness or non-usefulness of adopting correct behaviors aimed at environmental protection;
2. Characteristics of sustainable packaging – named CAR_SUST_PKG, on what should be (according to personal judgment) the main characteristics of an environmentally sustainable packaging;
3. Characteristics of eco-packaging for food products – named CAR_SUST_FOODPKG, on the importance (according to personal judgment) of the characteristics of a packaging for a food product;
4. Differentiation among packaging for different types of products – named DIFF_PRODS, on the importance (according to personal judgment) of the eco-sustainability of the packaging (use of environmentally friendly materials) for each of the following food products: Fresh food products, Long-life food products at room temperature, Frozen/frozen food products, Take-out food, Beverages Food in liquid form (e.g. oil, vinegar, milk, etc.), Electronic products and equipment, Clothing and accessories, Furniture and household appliances, Other (publishing, stationery);
5. Visual attraction – named VISUAL_ATTR, on the topic related to what were (in personal judgment) the features of a package that mainly attracted their attention.

Figure 3 - Variables and items

Variables or macro-topics	Variables' items
1. Motivation to choose an eco-sustainable packaging – labelled AIM	AIM_ Contributing to the reduction of pollution AIM_ Contributing to public awareness of the environment AIM_ Facilitating waste disposal AIM_ Having the opportunity to purchase products in recycled packaging AIM_ Reduce local taxes for municipal waste disposal AIM_ Improving air quality/reducing degradation in Metropolitan Cities AIM_ Reduce the amount of unsorted waste for disposal AIM_ Reduce the amount of toxic waste in the environment AIM_ Recovering materials through recycling (circular economy) AIM_ Encouraging the production of sustainable packaging
Variables or macro-topics	**Variables' items**
2. Characteristics of sustainable packaging – labelled CAR_SUST_PKG	CAR_SUST_PKG_ Contributes to social sustainability CAR_SUST_PKG_ Contributes to economic/environmental sustainability CAR_SUST_PKG_ Designed to create the least possible impact CAR_SUST_PKG_ Lower consumption of raw materials and energy CAR_SUST_PKG_ Reduces disposal costs CAR_SUST_PKG_ Made through the use of renewable energy CAR_SUST_PKG_ Designed packaging following rules of environmental sustainability CAR_SUST_PKG_ Facilitates recycling/reuse activities CAR_SUST_PKG_ Composed of recycled material CAR_SUST_PKG_ Adopts correct and environmentally friendly behaviors
Variables or macro-topics	**Variables' items**
3. Characteristics of eco-packaging for food products – labelled CAR_SUST_FOODPKG	CAR_SUST_FOODPKG_ Possibility to choose from different formats CAR_SUST_FOODPKG_ Practicality of disposal CAR_SUST_FOODPKG_ Nice design CAR_SUST_FOODPKG_ Presence of detailed product and packaging information CAR_SUST_FOODPKG_ Presence of information for its disposal CAR_SUST_FOODPKG_ Use of materials to ensure its good preservation CAR_SUST_FOODPKG_ Use of environmentally friendly materials CAR_SUST_FOODPKG_ Use of innovative materials (hi-tech, QR code) CAR_SUST_FOODPKG_ Possibility of recycling/reuse/composting CAR_SUST_FOODPKG_ Use of materials that do not significantly affect the final price of the product
Variables or macro-topics	**Variables' items**
4. Differentiation among packaging for different types of products – labelled DIFF_PRODS	DIFF_PRODS_ Electronics products and equipment DIFF_PRODS_ Furniture and household appliances DIFF_PRODS_ Clothing and accessories DIFF_PRODS_ Long-life food products at room temperature (pasta, dried fruits, canned products) DIFF_PRODS_ Fresh food products (fruits, vegetables, fresh-cut, etc,) DIFF_PRODS_ Food in liquid form (oil, vinegar, milk, etc), DIFF_PRODS_ Beverages DIFF_PRODS_ Frozen/frozen food products DIFF_PRODS_ Take-away food DIFF_PRODS_ Other (publishing, stationery)
Variables or macro-topics	**Variables' items**
5. Visual attraction – labelled VISUAL_ATTR	VISUAL_ATTR_ Colors and visual appeal of the Brand in general VISUAL_ATTR_ Sensations of touch (smooth, rough, etc,) VISUAL_ATTR_ Figures and designs intended to advertise the product VISUAL_ATTR_ Manageability VISUAL_ATTR_ Easy-to-use VISUAL_ATTR_ Contained volume/quantity ratio VISUAL_ATTR_ Product Certifications VISUAL_ATTR_ Materials VISUAL_ATTR_ Written information and/or particular words VISUAL_ATTR_ Overall design in general (shape, colors, materials)

For each variable, respondents were asked to give a score (using a rating scale) from 1 to 10 to each of the 10 items based on their personal opinion, where 1 = disagree or minimally agree, and 10 = totally agree or maximum agreement, in order to measure respondents' opinions, agreement or disagreement, quantitatively.

2.3. *Data analysis*

All the statistical analyses were carried out using the statistical software IBM SPSS Statistics 21.

2.3.1. Yule's association index

Yule's association index was used to calculate the association between the observed qualitative binary variables (Yule, 1912), for research question 2. This index is useful in highlighting whether there is independence between two phenomena or characters (qualitative variables) or whether they are linked by a positive (direct) or negative (inverse) association. It is commonly referred to as the coefficient of colligation:

$$Q = ad - bc \ \div ad + bc$$

The index takes the value zero in the above assumption of independence, takes the value 1 when bc = 0 (and in that case we speak of maximum direct association) and the value –1 when ad = 0, that is, when maximum inverse association (or dissociation) occurs. As Yule's Q measures the association of two events, each with two possible outcomes, we can represent all the possible outcomes in a "2x2" matrix. Within and outside behavior analysis, Yule's Q has become a recommended statistic used to quantify sequential associations between 2 events (Lloyd *et al.*, 2013).

2.3.2. Factor Analysis

Factor Analysis (FA) was used in this study because the researcher's interest was to identify a smaller number of factors underlying many observed variables and items (as in this case) (Chironi and Ingrassia, 2010; Fabrigar *et al.*, 2011; Taherdoost *et al.*, 2022; Faris *et al.*, 2022), for the research question 3. The purpose of the FA is not to perfectly reproduce variance, but rather to simplify the correlation matrix so that it can be

explained in terms of a few underlying factors (Chironi and Ingrassia, 2010; Taherdoost *et al*., 2022; Fabrigar *et al*., 2011; Faris *et al*., 2022). Therefore, the components are real dimensions, and the factors are hypothetical dimensions that are estimated from the observed variables (Chironi and Ingrassia, 2010; Fabrigar *et al*., 2011; Taherdoost *et al*., 2022; Faris *et al*., 2022). In this study, we are interested in highlighting the main factors that drive consumer's behaviors and choices with regard to ecofriendly packaging. Therefore, in this case, the Exploratory FA can better reveal the underlying dimensions of all the variables (and items) considered (Chironi and Ingrassia, 2010; Taherdoost *et al*., 2022). No data standardization was applied because the analyzed variables (and items) had the same units of measurement, that is, in this case, the rating from 1 to 10; therefore, in this study, it was imposed the same contribution of the original variables (Fabrigar *et al*., 2011; Faris *et al*., 2022).

Two tests were applied to evaluate the adequacy of data, as usual in the case of FA: the Kaiser-Meyer-Olkin (KMO) test, that is the sample adequacy test, and the Bartlett's sphericity test for measuring goodness of fit. KMO statistic is a proportion of variance among variables, which might be common variance. It ranges from zero to one, where zero is inadequate, and values close to one are adequate; literature suggests accepting index values at least equal to 0.7 or higher (Chironi *et al*., 2017). Bartlett's sphericity test compares the observed correlation matrix to the identity matrix (off-diagonal is zero). As is well known, this test provides indications about factorization goodness. In fact, when positive, it allows to reject the null hypothesis that there is no correlation between the variables. Once the formal factorization requirements of the data have been met, the chosen factorial model can be applied. Extraction refers to the process of obtaining underlying factors or components.

As far as the methods of extraction of factors are concerned, according to the literature on extraction methods (Taherdoost *et al*., 2022; Fabrigar *et al*., 2011), the Principal Components Method has been chosen, because no other methods of extraction of factors produce factors that explain a greater proportion of variance (it maximizes the variance explained). One of the most common strategies for deciding on the number of factors is the rule of "eigenvalues greater than 1" (the Guttman-Kaiser criterion allows you to select the initial eigenvalues higher than 1). Both eigenvalues greater than 1 and the "Scree" test using the decreasing graph of eigenvalues (namely the Scree Plot) were considered to identify the number of underlying factors after extraction (Chironi and Ingrassia, 2010; Taherdoost *et al*., 2022; Fabrigar *et al*., 2011; Faris *et al*., 2022). The decreasing graph of the eigenvalues allows us to identify from the graphical point of view (scree test) the number of factors that deserve to be taken into account, in this case, those whose eigenvalue is greater than 1.

The FA provides the "factor weights" for each combination of extracted factors and observed variables, which are similar to the correlation coefficients between factors and variables. It is extremely difficult to interpret the factor weights of "non-rotated" factors, regardless of the extraction method chosen. The rotation of factors helps to arrive at a simpler model of factorial weights, maximizing the high correlations and minimizing the low ones (Ingrassia, *et al*., 2022). The factors were rotated using the "Varimax" orthogonal rotation technique, which is the most widely used in the literature (Taherdoost *et al*., 2022; Fabrigar *et al*., 2011; Faris *et al*., 2022) because it provides good outputs for types of analysis like this.

2.3.3. Talcott Parsons' AGIL scheme

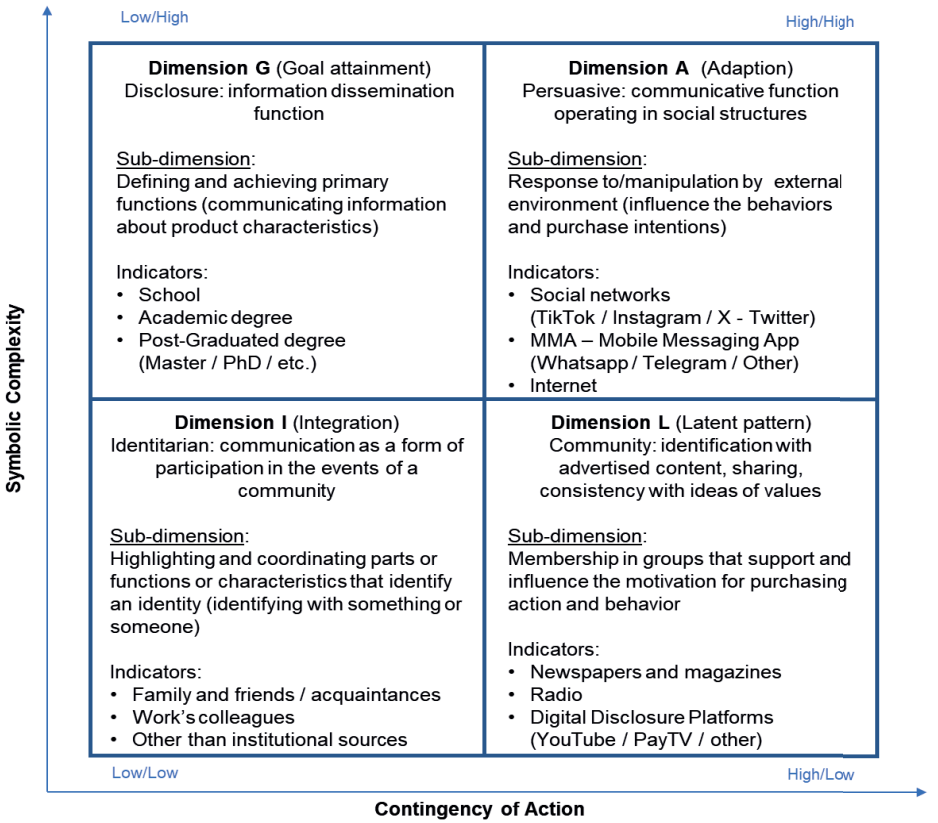
Finally, the main sources of information were identified and classified according to Talcott Parsons' AGIL scheme, for the research question 5. The AGIL method (originated from Talcott Parsons, 1961) (Parsons, 1961) is a model used to figure out and interpret the dimensions of "communication", one of the principal phenomena of social interactions and relationships (Ingrassia *et al*., 2018; Ingrassia *et al*., 2022).

In this study it was applied in order to highlight the main dimensions of consumer communication regarding the use of sustainable food packaging. Persuasive dimension (A - Adaption) is the one that evaluates the persuasive mode through the subdimension of engagement (social networks, influencers, web, internet, etc.), which is the one that evaluates the persuasive mode through the subdimension of engagement. Informational dimension (G - Goal attainment), assesses the informational mode through the subdimensions of continuity (school, university, postgraduate studies. Identitarian dimension (I - Integration) assesses the communal mode through the subdimensions of conversation (relatives, friends, acquaintances, work, other modes of information (cinema, fairs, etc.). Community dimension (L - Latent pattern) assesses the identity mode through the subdimensions of sharing (newspapers, magazines, radio, YouTube, Pay-TV). For this study, the most suitable indicators for each dimension and sub-dimension were developed to measure their effectiveness and to learn about the communicative context in which the consumers receive and exchange information about eco-friendly packaging (Figure 4).

To calculate the percent value of each Dimension's effectiveness it was used the following index:

$$\%DimEff. = \frac{\sum\ Score\ assigned\ to\ one\ Dimension}{\sum\ Scores\ assigned\ to\ all\ Dimensions} \times 100$$

Figure 4 - Authors' adaption of the AGIL scheme from T. Parsons' model, with Dimension, Sub-dimensions and Indicators



The AGIL method resulted in a very helpful and valid methodology to analyze and re-interpret the findings regarding the communication source of information, highlighting the most effective one with regard consumers' knowledge of eco-sustainable packaging.

3. Results

3.1. *Sample characteristics and declared preferences for sustainable packaging*

Table 1 shows the sample's characteristics. This first analysis of results can provide an answer to the research question number 1. The statistical

sample presents an equal distribution with regards to gender and age groups, with a slight propensity toward the younger people because, as mentioned above, they may be protagonists of future economic and social challenges that require a process of behavioral change and awareness, and also may be influenced by several external factors (Riva *et al.*, 2022; Ogiemwonyi, 2022).

Table 1 - Sample characteristics

Variables	**Variable character** (varchar)	**Frequency (%)**
Gender	Female	57.0
	Male	43.0
Age	20-29	33.7
	30-39	30.2
	40-49	15.5
	50-60	20.5
Education level	High school or less	45.0
	Degree (any level)	50.0
	Post graduate studies	5.0
Occupation	Student	25.0
	Employee (public/private)	35.5
	Researcher/Teacher/Professor	4.5
	Entrepreneur/freelancer	9.0
	Managers (public/private)	3.0
	Unemployed or inactive	23.0
Thematic Area of Studies	Economics/Justice/Political Science/Social Sciences	26.6
	Natural/Earth/Environmental/Agricultural Sciences	17.9
	Architectural/Engineering/Art Sciences	6.6
	Mathematics/Physics/Computer Science	12.5
	Humanities/Literature/Linguistics	16.4
	Pharmacy/Pharmaceutical Science and Technology	2.7
	Other	17.3
Number of cohabitants at home	3-4-person household	49.1
	Two-person households	24.6
	People living alone	16.2
	Living with large families (more than 4 persons)	10.1
Range of income	Below €25,000	65.0
	From 25.000 to 50.000 euros	19.0
	Above 50.000 euros	16.0

Regarding the education level, the sample is 45% with "high school or less", 50% with a degree and 5% with higher levels of education (with a light majority of degree and post graduate education 55%). As shown in Table 1, the sample shows different types of employment, and moreover 25% are students and 23% are unemployed or inactive. With regard to the thematic area of study, the sample shows many different types of studies, this is useful to investigate preferences and behaviors of different cultural segments of population.

According to the respondents' answers, the 58% of the respondents are part of a 3-4-person household, while 22% are two-person households; the residual part of the sample is almost equally distributed between people living alone and respondents living in larger families. 65% of respondents have an income below 25,000 euros (only 34.5% of respondents declared to have an income above 25.000 euros).

According to the respondents' answers, more than 99% of consumers thought it would be useful to make separate collection of packaging, and 78% of them wished they could reuse food packaging.

Regarding the characteristics that sustainable packaging should have, it was asked to respondents to give a score to three sets of characteristics for different types of packaging. Particularly sustainable packaging in general (Table 2), sustainable packaging for food products (Table 3), and importance of eco-sustainability of packaging (use of environmentally friendly materials) for some specific products, food and non-food (Table 4). The results showed that according to respondents (Table 2), environmentally sustainable packaging should be designed to create less impact on the environment (8.88), to facilitate recycling activities (8.79), according to the rules of environmental sustainability (8.72) and to reduce disposal costs (8.67).

According to Korhonen, 2012 and Otto *et al.*, 2021, also in this study (Table 3), the main features that consumers prefer or consider important for environmentally sustainable food products' packaging mainly concern the use of materials that ensure good preservation (8.57) and the possibility of being able to recycle/reuse/compost the packaging (8.33), as well as information about type of packaging and its disposal and practicality of use (8.31). At present, however, they are also interested in the use of environmentally friendly materials (8.18), and innovative materials such as hi tech or QR-code (6.75) and nice design (5.88).

Moreover, respondents appeared very interested (Table 4) to the use of eco-friendly packaging for fresh food products (8.60), take-away foods (8.38), long-life food products such as pasta or canned products (8.31), and generally all types of foods (beverages, liquid foods, frozen foods). However, showed a general interest for eco-packaging used for electronics products and equipment, clothing and accessories, furniture and household appliances.

Table 2 - Mean values of scores given by consumers to the characteristics that environmentally sustainable packaging should have

Desired characteristics of sustainable food packaging	**Mean values of scores given by consumers**
Designed to create the least possible impact	8.88
Facilitate recycling/reuse activities	8.79
Designed packaging following rules of environmental sustainability	8.72
Reduce disposal costs	8.67
Adopts and environmentally friendly behaviors	8.65
Lower consumption of raw materials and energy	8.64
Composed of recycled materials	8.58
Contributes to economic/environmental sustainability	8.44
Made through the use of renewable energy	8.39
Contributes to social sustainability	8.37

Table 3 - Mean values of scores given to the characteristics that environmentally sustainable food products' packaging should have

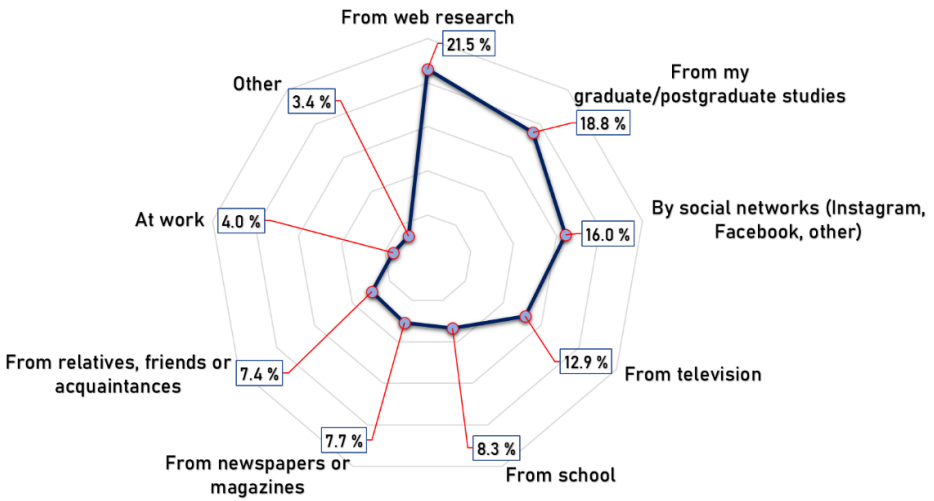
Characteristics	**Mean values of scores given by consumers**
Use of materials to ensure its good preservation	8.57
Possibility of recycling/reuse/composting	8.33
Presence of detailed product and packaging information	8.31
Practicality of disposal	8.31
Presence of information for its disposal	8.31
Use of environmentally friendly materials	8.18
Use of materials that do not significantly affect the final price of the product	8.04
Possibility to choose from different formats	7.54
Use of innovative materials (hi-tech, QR code)	6.75
Curated design	5.88

Table 4 - Mean values of scores according to the importance of eco-sustainability of packaging (use of environmentally friendly materials) for some specific products (food and non-food)

Characteristics	**Mean values of scores given by consumers**
Fresh food products (fruits, vegetables, fresh-cut, etc.)	8.60
Take-away food	8.38
Long-life food products at room temperature (pasta, dried fruits, canned products)	8.31
Beverages	8.22
Foods in liquid form (oil, vinegar, milk, etc.)	8.19
Frozen/Deep-freezing products	8.13
Other (publishing, stationery)	7.78
Electronics products and equipment	7.71
Clothing and accessories	7.66
Furniture and household appliances	7.64

Figure 5 shows the main sources of knowledge from which respondents declared that they had learned about environmentally sustainable packaging. The internet appeared to be the first one (21.5%), followed by university and post-graduate studies (18.8%), and social networks (16%). A modest number of respondents indicated schools, newspapers and magazines, relatives, friends, acquaintances, work colleagues. Television maintains a fundamental role for Italians for information acquisition (12.9%). It is interesting to highlight that, the "digital" source of information (social networks and the web), cumulatively was indicated by 37.5% respondents. And if we and if we also juxtapose the percentage of those who said they learned from television, it is observed that these three information sources alone account for 50.4%.

Figure 5 - Sources of knowledge for acquiring information/learning about eco-sustainable packaging



3.2. *Analysis of statistical associations between characters*

Following the existing literature on the influence of some qualitative variables on consumers' propensity to green sensitivity and their attitude to change behaviors toward circular economy practices (Liu, *et al.*, 2024; Lavuri, 2022a; Rusyani *et al.*, 2021), in this study it was investigated the existence of independence or alternatively, of association among some qualitative variables (characteristics of the sample) by the use of the Q Yule's index (Table 5), with the aim to answer to the research question number 2.

A high association was revealed between the character "knowledge of the meaning of environmentally sustainable packaging" (93% of the sample said they know the meaning of eco-friendly packaging) and the sources of information from which they learned the meaning, grouped by "study at school/university/higher" and "other different from study-mass media". Particularly, the index value (+69.22 Table 5) highlights a positive association of 69.22%, this means that 72% of those who say they know the meaning of environmentally sustainable packaging simultaneously claim to have learned about it through mass media (or other different from studies). The internet, and the use of social media, represent a good vehicle of information, although, the possibility of deriving incorrect information is higher than having learned about it through institutional information sources. A modest positive association was also observed between knowledge of

Table 5 - Values of Q Yules's association index for association between characters

Pairs of qualitative variables	Yule index value Q (%)
Knowledge of the meaning of "environmentally sustainable packaging" (YES/NO) - Sources of information on sustainable packaging	69.22
Knowledge of the meaning of "environmentally sustainable packaging" (YES/NO) - Education level	19.29
Knowledge of the meaning of "environmentally sustainable packaging" (YES/NO) - Time period from waste differentiation	2.72
Utility of separate collection (YES/NO) - Age groups	45.14
Utility of separate collection (YES/NO) – Education level	58.35
Utility of separate collection (YES/NO) - Income ranges (stated)	31.12
Willingness to reuse or recycle fresh food packaging (YES/NO) - Sources of information on sustainable packaging	35.95
Willingness to reuse or recycle fresh food packaging - Time period from waste differentiation	5.40
Ability to recognize the elements that distinguish "eco-sustainable" packaging - Time period from waste differentiation	5.06
Ability to recognize the elements that distinguish an "eco-sustainable packaging" - Sources of information on sustainable packaging	6.52

meaning and level of education, this confirms the previous result. The 99% of respondents declared it is useful to carry out separate waste collection, the 95% of the sample say that in the district where they live the differentiated waste collection is carried out, and the 54% of this subgroup say that the differentiated waste collection is carried out for at least 4 years. Nevertheless, a good positive association was outlined between the character "Utility of separate collection" and "Age groups" (+45.14), Education level (+58.35) and "Income ranges" (+31.12) this means the existence of other variables that influence people's behaviors and choices (Yin *et al.*, 2022). Moreover, a low index value (+5.4%) resulted for the association between "Willingness to reuse or recycle fresh food packaging" and "Time period from waste differentiation", this highlights that respondents, although effectuating waste differentiation (99%) and 59% of them for more than 3 years (data not shown), only the 43% of the sample declared they reuse and recycle yet fresh food packaging, and the 34% said they "would be liking to do this",

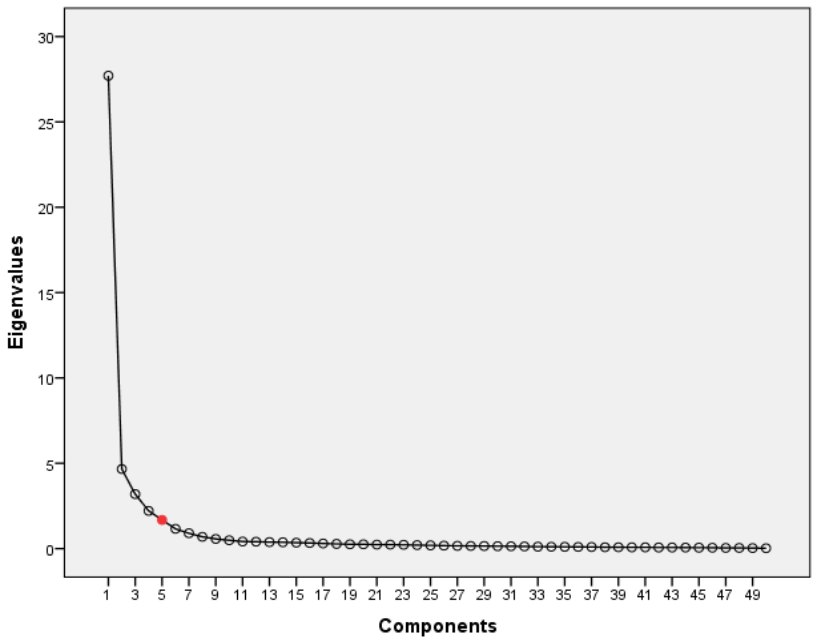
the 12% has not clear about the difference between reuse and recycling, and the remaining sample size (11%) said not to carry it out but would like to be better informed about the possible individual and community benefits of reuse/recycling. These results highlight that most of consumers say they are informed about environmentally sustainable packaging, and have been recycling for more than 3 years, the information they have is generic and specifically about fresh food packaging they need to receive information about the characteristics of these types of packaging and instructions on how to dispose of or reuse them. Contrarily, a high association emerged between the "Willingness to reuse or recycle fresh food packaging" information sources (+35.95), 71% affirm their willingness and simultaneously to have learnt from "mass media" or other information sources different from studies this highlight the social importance of these information sources.

An interesting result emerged with respect to the ability to recognize bioplastic packaging used for ready-to-eat salads. In fact, three different plastic bags of which only one had environmentally sustainable packaging (bioplastic) containing salad greens were shown to the respondents as pictures in the questionnaire. It was asked to identify the sustainable packaging (bioplastic). The results showed that 74% of the consumers correctly identified the environmentally sustainable packaging. Therefore, it was investigated whether there was an association between the ability to recognize eco-packaging and "Time period from waste differentiation" and also "Sources of information on sustainable packaging". The results show a very low association with both the characters. In the picture shown, a green logo with the word "Green" was displayed in the sustainable package. This highlights the importance of information in the packaging (not only the source of information/communication) and the quality and clarity of this information (Vilasanti Da Luz *et al*., 2020).

3.3. *Factor Analysis*

Factor analysis was applied because it was considered very useful for the research question number 3. There were extracted six main factors in 7 iterations. The KMO test resulted equal to 0.967, which shows the goodness of the data. The Bartlett's sphericity test is = 23887.472 (df = 1225; Sig. 0.000). As from Table 1, only the first 5 factors contribute noticeably to the composition of the total percentage of variance (81.219% of cumulated variance explained), and the sixth factor adds a very low percentage of variance (3.568%) to the previous ones. In addition, the Scree plot (Figure 6) shows clearly that the fifth factor is the last with eigenvalue > 1, and thus it confirms that the following factors have no statistical relevance.

Figure 6 - Scree Plot of decreasing eigenvalues (scree test of eigenvalues >1)



The first component has a total initial eigenvalue of 27.706, which is equal to 55.413% of the total variance in the case of non-rotated factors, and the18.447% after factors' rotation (Table 5). The second component has a total initial eigenvalue of 4.663, which is equivalent to a further 9.326% of the total variance for the non-rotated factors and 17.877% after rotation. Interestingly, the first factor, before rotation (Table 6, Weights of non-rotated factors), explains as much as the total variance (55.413%), while from the second factor onward the percentages of variance explained by each one are very low. The values of variance after rotation highlighted three factors having very closed percentages of variance explained (Table 6). To conclude data analysis, the first six factors have a cumulated explained variance of 81.219%, which means that they represent almost the whole information assets provided by the data, and therefore acceptably explain the phenomenon under investigation.

By analyzing the factorial coefficients (Table 7), it is possible to identify the main items for each factor extracted. These variables are those that contribute to determining the factors' variance. In particular, for example, we can observe that 69.72% (0.835^2) of the item's variance "Reduce the amount of toxic waste in the environment" is explained by the first factor, as

is 69.05% (0.831[2]) of the item "Improving air quality/reducing degradation in metropolitan cities", and so on.

Table 6 - Total explained Variance

Comp.	Initial Eigenvalue			Weights of non-rotated factors			Weights of rotated factors[1]		
	Total	Variance (%)	Cumulated (%)	Total	Variance (%)	Cumulated (%)	Total	Variance (%)	Cumulated (%)
1	27.706	55.413	55.413	27.706	55.413	55.413	9.224	18.447	18.447
2	4.663	9.326	64.738	4.663	9.326	64.738	8.939	17.877	36.325
3	3.191	6.382	71.12	3.191	6.382	71.12	8.742	17.485	53.809
4	2.211	4.421	75.541	2.211	4.421	75.541	6.444	12.888	66.697
5	1.681	3.362	78.904	1.681	3.362	78.904	5.477	10.953	77.651
6	1.157	2.315	81.219	1.157	2.315	81.219	1.784	3.568	81.219

[1] Varimax rotation

Table 7 - Matrix of rotated components

Variables' items	Factorial coefficients of extracted factors					
	Factor 1 (F1)	Factor 2 (F2)	Factor 3 (F3)	Factor 4 (F4)	Factor 5 (F5)	Factor 6 (F6)
AIM_ Reduce the amount of toxic waste in the environment	**0.835**	0.346	0.186	0.188	0.183	0.096
AIM_ Improving air quality/reducing degradation in Metropolitan Cities	**0.831**	0.336	0.190	0.179	0.198	0.055
AIM_ Reduce the amount of unsorted waste for disposal	**0.830**	0.333	0.214	0.196	0.163	0.097
AIM_ Contributing to public awareness of the environment	**0.816**	0.371	0.164	0.201	0.194	0.052
AIM_ Encouraging the production of sustainable packaging	**0.812**	0.329	0.235	0.141	0.170	0.052
AIM_ Recovering materials through recycling (circular economy)	**0.809**	0.368	0.216	0.195	0.136	0.106
AIM_ Facilitating waste disposal	**0.805**	0.339	0.228	0.164	0.148	0.145
AIM _ Contributing to the reduction of pollution	**0.800**	0.387	0.234	0.158	0.164	0.144
AIM_ Reduce local taxes for municipal waste disposal	**0.789**	0.319	0.221	0.187	0.206	-0.017
AIM_ Having the opportunity to purchase products in recycled packaging	**0.705**	0.280	0.230	0.157	0.175	-0.039

CAR_SUST_PKG_ Lower consumption of raw materials and energy	0.346	**0.808**	0.223	0.126	0.218	0.073
CAR_SUST_PKG_ Contributes to social sustainability	0.321	**0.807**	0.251	0.122	0.184	-0.003
CAR_SUST_PKG_ Facilitates recycling/ reuse activities	0.346	**0.807**	0.246	0.104	0.181	0.072
CAR_SUST_PKG_ Contributes to economic/environmental sustainability	0.321	**0.796**	0.232	0.119	0.227	0.018
CAR_SUST_PKG_ Designed to create the least possible impact	0.370	**0.792**	0.211	0.158	0.179	0.151
CAR_SUST_PKG_ Made through the use of renewable energy	0.344	**0.787**	0.233	0.144	0.187	0.007
CAR_SUST_PKG_ Reduces disposal costs	0.362	**0.782**	0.194	0.124	0.248	0.067
CAR_SUST_PKG_ Composed of recycled material	0.354	**0.779**	0.205	0.164	0.184	0.066
CAR_SUST_PKG_ Adopts correct and environmentally friendly behaviors	0.364	**0.766**	0.220	0.119	0.230	0.029
CAR_SUST_PKG_ Designed packaging following rules of environmental sustainability	0.368	**0.733**	0.260	0.112	0.184	0.243
DIFF_PRODS_ Clothing and accessories	0.127	0.227	**0.846**	0.239	0.154	-0.109
DIFF_PRODS_ Furniture and household appliances	0.136	0.240	**0.839**	0.204	0.162	-0.068
DIFF_PRODS_ Electronics products and equipment	0.115	0.207	**0.820**	0.217	0.172	-0.066
DIFF_PRODS_ Other (publishing, stationery)	0.150	0.230	**0.819**	0.222	0.147	-0.029
DIFF_PRODS_ Food in liquid form (oil, vinegar, milk, etc.),	0.196	0.222	**0.779**	0.142	0.235	0.126
DIFF_PRODS_ Frozen/frozen food products	0.276	0.179	**0.778**	0.181	0.280	0.139
DIFF_PRODS_ Beverages	0.230	0.168	**0.762**	0.159	0.225	0.175
DIFF_PRODS_ Long-life food products at room temperature (pasta, dried fruits, canned products)	0.316	0.195	**0.731**	0.198	0.284	0.167
DIFF_PRODS_ Take-away food	0.259	0.215	**0.709**	0.169	0.243	0.248
DIFF_PRODS_ Fresh food products (fruits, vegetables, fresh-cut, etc,)	0.371	0.203	**0.689**	0.130	0.308	0.267
VISUAL_ATTR_ Product Certifications	0.295	0.267	**0.440**	0.280	0.316	0.386
VISUAL_ATTR_ Colors and visual appeal of the Brand in general	0.168	0.091	0.187	**0.867**	0.083	-0.015
VISUAL_ATTR_ Overall design in general (shape, colors, materials)	0.162	0.115	0.235	**0.849**	0.096	0.005
VISUAL_ATTR_ Figures and designs intended to advertise the product	0.173	0.061	0.135	**0.840**	0.165	0.034

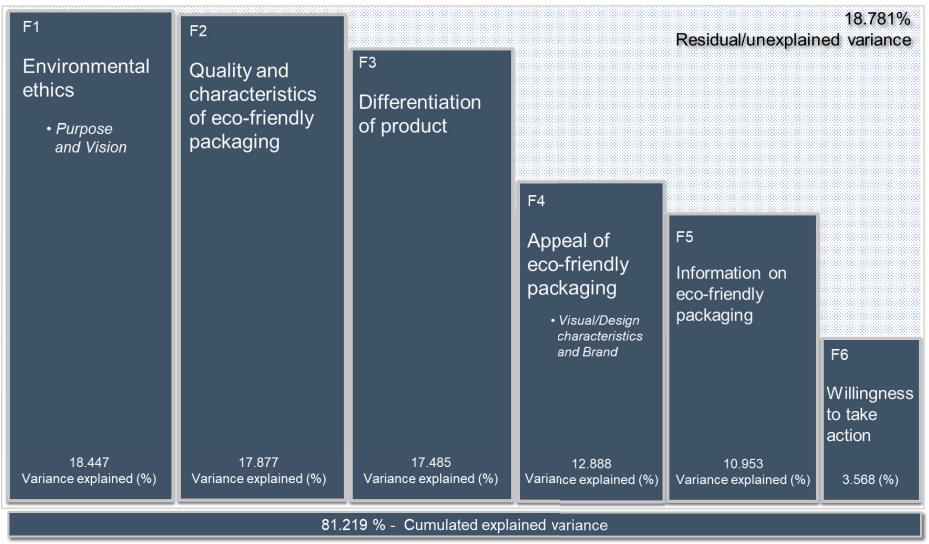
VISUAL_ATTR_ Sensations of touch (smooth, rough, etc.)	0.116	0.085	0.160	**0.767**	0.160	0.010
VISUAL_ATTR_ Written information and/ or particular words	0.197	0.189	0.173	**0.713**	0.186	0.289
CAR_SUST_FOODPKG_ Nice design	0.058	0.044	0.140	**0.630**	0.479	–0.292
VISUAL_ATTR_ Contained volume/ quantity ratio	0.273	0.184	0.285	**0.589**	0.175	0.436
VISUAL_ATTR_ Manageability	0.253	0.296	0.267	**0.586**	0.154	0.475
VISUAL_ATTR_Easy-to-use	0.312	0.280	0.266	**0.568**	0.133	0.510
VISUAL_ATTR_Materials	0.178	0.219	0.329	**0.512**	0.318	0.405
CAR_SUST_FOODPKG_ Presence of information for its disposal	0.296	0.242	0.367	0.098	**0.677**	0.131
CAR_SUST_FOODPKG_ Presence of detailed product and packaging information	0.193	0.342	0.269	0.272	**0.665**	0.173
CAR_SUST_FOODPKG_ Use of materials to ensure its good preservation	0.267	0.387	0.300	0.176	**0.664**	0.195
CAR_SUST_FOODPKG_ Practicality of disposal	0.220	0.349	0.320	0.229	**0.641**	0.078
CAR_SUST_FOODPKG_ Possibility of recycling/reuse/composting	0.278	0.291	0.420	0.154	**0.625**	0.108
CAR_SUST_FOODPKG_ Use of materials that do not significantly affect the final price of the product	0.222	0.319	0.295	0.224	**0.625**	0.076
CAR_SUST_FOODPKG_ Use of innovative materials (hi-tech, QR code)	0.160	0.065	0.299	0.365	**0.618**	–0.251
CAR_SUST_FOODPKG_ Use of environmentally friendly materials	0.302	0.221	0.460	0.088	**0.602**	0.139
CAR_SUST_FOODPKG_ Possibility to choose from different formats	0.106	0.275	0.162	0.442	**0.593**	–0.023

* KMO and Bartlett test, main component extraction method, Varimax factor rotation, SPSS software v.21.

Results of Factor analysis highlighted the main factors that explain consumers' behaviors and motivations to choose eco-sustainable packaging (Figure 7). Specifically, packaging turned out to be a key feature of the overall product that brings significant benefits. Factor analysis revealed important groups of variables describing consumers' motivations for choosing the use of environmentally sustainable packaging and their priority as well as influence with respect to a high multiplicity of influencing variables for the consumer (Figure 7).

The main factor driving consumer choices is ethical (F1). That is the purpose of preserving the Planet and the environment for future generations.

Figure 7 - Visual representation of the extracted factors with the assigned labels, percentage of variance, cumulative variance



It is a moral motivation, a vision (Zhang *et al*., 2024; Popovic *et al*., 2019; Martinho, *et al*., 2015).

The second important factor (F2) was found to be the characteristics that the packaging must have for the consumer. This factor highlights consumer interest in the effectiveness of environmentally sustainable packaging in contributing significantly to reduce environmental pollution and to sustainable development (economic. environmental and social sustainability) (Zhang *et al*., 2024; Choshaly, 2017).

In addition, consumers prefer eco-friendly packaging in particular types of products (F3). According to respondents, the eco-sustainability of materials used for packaging is important but they place more emphasis when it comes to fresh food products whose perishability/perishability could be significantly accelerated by non-plastic packaging (Macht *et al*., 2023). This highlight consumer's skepticism with regard to eco-packaging for very perishable foods and a greater acceptability of this type of packaging for other types of products (non-foods or not perishable foods).

Among the visual characteristics (F4) the overall design in general and the brand were the driving variables of the "Appeal and eco-friendly packaging" factor (Zhang *et al*., 2024).

And finally, as for the characteristics that consumers want mainly in the environmentally sustainable food packaging (F5), information about

method of waste disposal, characteristics of product and the material used for packaging resulted priorities, especially with regard to fresh food (how to maintain quality) (Macht *et al*., 2023; Lisboa, *et al*., 2022).

Therefore, it is possible to conclude that the most important factors that influence consumers to choose an eco-sustainable packaging are:

1. Environmental Ethics - Consumers today turn out to be willing to use packaging with features that meet their needs for Environmental Ethics (Nadeem *et al*., 2021);
2. Quality – Consumers are interested to the specific quality characteristics of environmentally sustainable packaging (Muralidharan *et al*., 2024);
3. Differentiation – Differentiation of preferences based on product type and visual appearance: with a little skepticism with regard to eco-packaging for fresh food products (except take-away or food-delivery of cooked foods to be consumed immediately) (Zhang *et al*., 2023; Wenting *et al*., 2022; Nekmahmud, *et al*., 2020);
4. Information quality – Consumers indicate tools and priorities for obtaining information: QR code, type of innovative, how to reuse, recycle, dispose, use (specifically for food) to improve the quality of the information about eco-sustainable packaging (Nekmahmud, *et al*., 2020; Lopes *et al*., 2024; Lee *et al*., 2002), particularly for fresh food products.

3.4. *Analysis of consumers' declared average ideal surcharge for sustainable packaging of food products*

People's intention to purchase a product with environmentally sustainable packaging can be influenced by many variables (Yin *et al*., 2022), such as people's health concerns (Tewari *et al*., 2022), premium price (Patel *et al*., 2020), familiarity (Talwar *et al*., 2021), and education about environmental issues. In this study it was observed the subjective declared ideal propensity to spend a surcharge to buy a food product with an eco-friendly packaging, in order to have the first information to continue with future studies on the declared ideal willingness to pay for these selected food products. For this study, some of the most renowned products of the Italian agri-food quality tradition were chosen (Bellia and Safonte, 2015a): a package of IGP pasta of 1 kg, a package of IGP Pachino tomatoes od 1 kg, a package of IGP Sicilian red oranges of 1 kg, and a bottle of DOP extra virgin olive oil (EVO) of 1 lt. For these products the propensity of consumers to spend a premium for the use of eco-sustainable packaging was tested. Consumers were asked to choose, for each product, a range of average surcharges that they would ideally be inclined to pay to purchase the same product with environmentally sustainable packaging. The surcharge ranges were: (+ 0 – 0.5€), (+ 0.5

– 1€), (+ 1 – 1.5€). Respondents mainly declared themselves to be ideally inclined to pay from 0.5 euros to 1 euro for all the products and only a few consumers said they were willing to pay more than 1.00 euro. Specifically, for 1 kg package of Pachino IGP tomatoes of about 4 euros on average per kg, 50.45% of consumers expressed to be ideally willing to pay a premium for an eco-friendly package of no more than 0.5 euros and 36.42% up to 1 euro (Table 8).

Table 8 - Average declared ideal surcharge consumers are willing to pay for an environmentally sustainable packaging of some selected food products

Selected food products	**Percentage of consumers for each average range of surcharge**			
	(+ 0€ – 0.5€)	**(+ 0.5€ – 1€)**	**(+ 1€ – 1.5€)**	**I would not pay more for a sustainable packaging**
1 kg of "Pomodoro di Pachino IGP" (average market price in Italy 4€)	50.45%	36.42%	7.16%	5.97%
1 kg of "Arance rosse di Sicilia IGP" (average market price in Italy 1.50€)	54.93%	33.43%	5.07%	6.57%
1 kg of common "Pasta" (average market price in Italy 1.50€)	63.58%	26.57%	2.99%	6.87%
1 lt of 100% Italian "Olio Extra Vergine d'Oliva" (average market price in Italy 7€)	32.24%	35.52%	11.34%	20.90%

For 1 kg of Sicilian PGI blood oranges (Bellia and Safonte, 2015b) in a plastic net pack costing 1.5 euros, 54.93% of consumers expressed to be ideally willing to pay a premium of 0.5 euros for an eco-friendly packaging. For the 1 kg package of common pasta that costs 1.5 euro, in the traditional plastic package, 63.58% of consumers expressed to be ideally willing to pay a premium of 0.5 euros for an eco-sustainable packaging.

For 1 kg of 100% Italian extra virgin olive oil (EVO) in a glass bottle whose price is about 7 euros, only 35.52% of consumers declared they were ideally willing to pay a premium from 0.50 euros to 1 euro to buy the EVO oil in a more sustainable packaging than the glass bottle. Moreover, 20.9% of consumers declared they would not have paid more for more sustainable packaging (brick or can) confirming a trend of preferences for

glass bottles in case of olive oil of high quality. This result may outline the consumer's perception of product quality and credence in relation to the type of packaging. In the case of extra virgin olive oil, quality it is better associated with glass bottle than with sustainable material of other types, also in relation to the places of consumption, such as in the Ho.Re.Ca. channel, mainly hotels, luxury restaurants etc. where glass packaging is more elegant and appreciated by consumers (Ugwu *et al*., 2024). Therefore, the use of 100% recyclable glass could be considered.

3.5. *Analysis of key dimensions of communication*

Having identified the main sources of information, it was possible to classify them according to Parsons' AGIL scheme and analyze the current communication model from which respondents obtain information about environmentally sustainable packaging thanks to the four communication Dimensions' meaning and calculated effectiveness. Therefore, the most effective type of information to transfer knowledge to consumers is through modern ways of communication that can engage the consumer, such as social media, like Tik ToK, Instagram, Twitter, the web, etc. (categorized as sub-dimensions found within the Persuasive dimension (A) which is found to have the highest weight (36.42%) (Mulcahy *et al*., 2024).

The second highest dimension is the Informative dimension (G), which, through the training that one can receive in school, at university, can convey information about the main functions of these packaging, creating a basic culture in the consumer (26.27%). But it is precisely in this dimension that at the school sub-dimension level, communication needs to be implemented. Channels such as newspapers, magazines, Pay TV, YouTube, are the sub-dimensions within the Community (L) dimension that weighs 20.00%. The weakest dimension is Identitarian (I) with a weight of 17.31%, indicating that a common feeling with environmental sustainability is not yet strong and established among the population observed in this study, and that a community of citizens united by common interests, behaviors and consumption preferences on the sustainability principles should be still improved (Chavis & Wandersman, 1990; Koehler & Hecht, 2006; Medina *et al*., 2023).

Table 9 - AGIL results of dimension effectiveness

AGIL dimensions	Sub-Dimensions	Indicators	%DimEff.[1]
Dimension A ADAPTION	Response to/manipulation by external environment (influence the behaviors and purchase intentions)	Social networks (TikTok / Instagram / X - Twitter) MMA – Mobile Messaging App (Whatsapp / Telegram / Other) Internet	36.42%
Dimension G GOAL ATTAINMENT	Defining and achieving primary functions (communicating information about product characteristics)	School Academic Degree Post-Graduated degree (Master / PhD / etc.)	26.27%
Dimension I INTEGRATION	Highlighting and coordinating parts or functions or characteristics that identify an identity (identifying with something or someone)	Family and friends / acquaintances Work's colleagues Other than institutional sources	17.31%
Dimension L LATENT PATTERN	Membership in groups that support and influence the motivation for purchasing action and behavior	Newspapers and magazines Radio Digital Disclosure Platforms (YouTube / PayTV / other)	20.00%

1. Percentage value of dimensions' effectiveness

4. Discussion

Prior studies have demonstrated that customer health worries may influence their attitude toward eco-friendly green goods (Tewari *et al*., 2022) and that conscious consumers will take actions that benefit the environment (Talwar *et al*., 2021). The concept of green consumption values was specifically developed by (Haws *et al*., 2014) for the consumption context.

Green consumption values are defined as "the tendency to express the value of environmental protection through one's purchases and consumption

behaviors" (Haws *et al.*, 2014). For this study, Factor analysis was applied in order to discover the existence of factors (vectors of variables) that influence consumers' purchase intentions with regard to sustainable packaging. According to previous studies (Haws *et al.*, 2014; Zhang *et al.*, 2024), also in this case, the analysis highlighted a relationship between green consumption values, defined as "Environmental Ethics – Purpose and Vision", and consumers' purchase intention for an eco-sustainable packaging. According to the egoistic value theory, the individual or family health concern (Yang *et al.*, 2022), people may be motivated to engage in environmentally friendly activities by egoistic values, such as improved health and a higher quality of life (Verma *et al.*, 2019). Following this theory, consumer health concerns have been shown to influence consumer attitudes and purchasing decisions towards environmentally friendly and locally produced products (Lavuri, 2022a; Lavuri, 2022b; Sultan *et al.*, 2021), particularly for younger generations. In addition, customers who care about their health have a higher propensity to participate in environmentally friendly practices (Kim *et al.*, 2022). Moreover, results show that according to consumers, the sustainable packaging is very important for fresh food products (like fruits, vegetables and fresh cut food) and for prepared/cooked take away food because they have concerns about the ability of this packaging to preserve the quality of foods (Table 4). Another important finding was the existence of a high positive association between the sources of information on sustainable packaging and the consumers' knowledge about the meaning of sustainable packaging, and between the education level and the declared importance to make separate collection (Table 7). With regard to the declared average ideal surcharge that consumers declared they were willing to pay for the different food products offered, results showed that that the majority of respondents were willing to pay up to 0.5 euros more than the normal price of the product (Table 8).

Findings highlight that, for consumers of the sample, information regarding eco-sustainable packaging is obtained, predominantly, from digital sources (Figure 5). Moreover, perhaps because of this, such information is often incorrect (Doerr *et al.*, 2024; Ingrassia *et al.*, 2023; Ingrassia *et al.*, 2022), as the results of this study confirmed. All these results make us reflect on the role that institutions can play in informing consumers about issues that are fundamental (Doerr *et al.*, 2024; Ingrassia *et al.*, 2023) and, if acquired, first and foremost, through school education (which was found to be modest in this study), contribute to shaping ideas and personal behavior, as is already the case in many other European countries that are more avant-garde and more sensitive to issues related to environmental education of citizens (Doerr *et al.*, 2024; Huang *et al.*, 2024). It appears of paramount importance to communicate to consumers what it actually

is, as the absence of clear, easily understandable, and most importantly, educational communication can cause considerable consumer confusion. The AGIL scheme highlighted, in fact, a very important finding, communication deficiencies at this level. It is precisely the Goal Attainment dimension (Table 9) that needs to be pushed more through the role that Public Institutions can play (e.g., through the creation of educational advertisements, with funding for schools or projects to apply concretely the circular economy practices or use eco-sustainable packaging of foods at school/university canteens), to initiate citizens into awareness of the use of this packaging. In light of the findings of the analysis through the AGIL methodology, the information that is received, is very useful in forming consumer awareness on the subject. The educational experience that starts from institutions and conveyed through education (primary and secondary schools, universities) contributes to forming knowledge which then disseminated properly through the other dimensions of communication also comes to create value through the consumption experience (Zheng, *et al.*, 2024).

Therefore, combining the findings of factor analysis with the ones of the other analyses, it was possible to outline the importance of a quality education and a correct institutional communication and marketing strategies, in agreement with recent literature (Zheng, *et al.*, 2024) and design a communication model for Public Institutions (Figure 8) that may support the green transaction process started yet.

Figure 8 - Authors' proposed communication model for Public Authorities to disseminate proper information on Circular Economy and to build society's sustainable behaviors

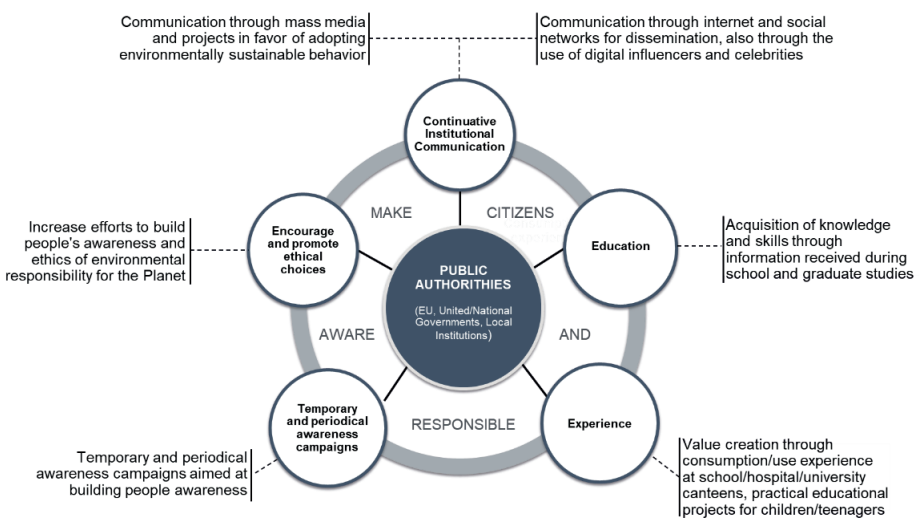


Figure 8 shows a communication model that may be considered by Public Institutions aimed to improve the citizens' information and sense of environmental ethics and responsibility toward issues related to respecting and protecting the ecosystem as a legacy to future generations. This model suggests some actions to disseminate proper information on Circular Economy and to build society's sustainable behaviors, building a community with a common sense of responsibility and making citizens aware and participative. The proposed actions should be conducted synergistically, cooperating so that information can be disseminated capillary in society and can become part of the citizens' culture.

Results show that the consumers do not intend to spend a high premium price for eco-sustainable packaging of quality food products. Nevertheless, the costs of technologies are still higher in Italy, and the firms that produce eco-packaging cannot take on the full cost of the technology. Therefore, Public Institutions should carry on supporting businesses with more funding to develop eco-sustainable technologies for packaging that take into consideration also circularity of economy, particularly in the agro-food sector.

Moreover, findings suggest that purchase intentions, toward these types of packaging, could be greatly influenced by a proper institutional information campaign with educational and explanatory advertisements that invite consumers to experience the product and its recycling or reuse mode (Shwarz *et al*., 2024). At the same time, it is of paramount importance, considering the actual Italian situation, to carry on project for creating experience and consequently knowledge in the individuals, particularly the young generations, starting with preschool, like it is in some EU Countries (Kerr *et al*., 2024). Moreover, as highlighted above, the digital world plays a key role with regard to information dissemination, in fact, for more than half of the sample surveyed (50.4%), knowledge on the issues under analysis comes from web searches, social networks, MMA and TV. Given the importance that the mass media and digital information sources have in today's communication system, public institutions should take advantage of these effective means of communication (Crapa *et al*., 2024; Masciandaro *et al*., 2024). In this scenario, it is crucial to take advantage of these channels to make the dissemination activities of public institutions more efficient and effective. Public Institutions may to take advantage also of digital influencers or opinion leaders/celebrities, who may be able to convey information that followers will receive as useful advice of daily life practices, certainly in a context of honesty and compliance with communication standards and regulations/laws.

Therefore, this model shows how institutional communication, when well conveyed, can play the role of a value multiplier for eco-sustainable packaging, together with business communication (Jha *et al*., 2024).

These findings may provide interesting insights both for agro-food enterprises to base medium-term choices of market targeting and positioning, and for policymakers at Italian and EU level, aiming to develop institutional information by awareness campaigns to the population (individuals and enterprises) to encourage the use of eco-sustainable packaging for fresh food products.

Limitations and future studies

This study, as mentioned in the introduction, is the first result, within the CIRCLE Project, resulting from a pilot investigation, i.e., a preliminary survey carried out on a set of the population for the purpose of obtaining information necessary for conducting a more complex survey through a subsequent larger sample. However, even in this first phase of the survey, the starting reference universe was established to represent as closely as possible the population residing in the Metropolitan Cities of Italy. Specifically, in this first study, for the southern Italian cities, the Metropolitan Cities of Catania and Palermo, were identified as having homogeneous characteristics in terms of geographical location, number of inhabitants, population density and level of development for green transition. Nevertheless, future studies will be carried out including other Metropolitan Cities of central and northern Italy in order to confirm and/or complete the results and the findings of this study.

Conclusions

This study has highlighted important first results useful to know the current Italian scenario regarding the current practices of home disposal and reuse of packaging with reference to eco-packaging for fresh food products, the consumption behavior, the information and communication channel used, and the ideal intentions to pay a higher price for eco-sustainable packaging for some food products. The results of the Factor analysis highlighted that the main factor that drives consumers' motivations to choose a sustainable packaging is ethical, particularly environmental ethics, that is, the importance given by consumers to the Planet's ecosystem and the desire to aim to contribute in some way to preserving it. In addition, it was discovered that there was a highly positive association between the knowledge of the meaning of sustainable packaging and the sources of information used. The AGIL method allowed to highlight that the most effective means of communication for consumers to achieve information about sustainable packaging are social networks, mobile messaging apps and the internet.

A communication model was proposed by the authors with the aim to communicate effectively to citizens, individuals and businesses, the correct information about the characteristics of eco-sustainable packaging and related advantages for the environment. This communication model could help public institutions to build an aware and responsible citizenry, i.e. people who can fully understand how much change is needed in their purchasing choices for building more environmentally friendly behaviors. Adequate and correct information and experience can foster changes in people's behavior toward more environmentally sustainable consumption styles and correct behavior patterns particularly in the younger generations, from childhood onward.

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