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Sustainable Agri-Food Consumption in Italy: Consumer Profiles, Certification Knowledge, and Purchasing Behaviour

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Abstract

This study investigates the extent to which socio-demographic characteristics, knowledge of sustainability – related information, and purchasing contexts influence consumer engagement with sustainable agri-food products in Italy. Using survey data from 1,000 consumers, the research applies analysis of variance ANOVA and principal component analysis to examine generational differences in sustainability knowledge, education-related variations in purchasing frequency, and the latent dimensions tracing certifications and retail behaviours. The results show that sustainable consumption cannot be reduced to a single, homogeneous "green consumer" profile. Rather, engagement with sustainable agri-food products is significantly associated with levels of education, socio-economic resources, familiarity with certification schemes, and distribution channels. Younger and middle-aged respondents demonstrate higher knowledge than older consumers, while certifications and purchasing behaviours are organized around distinct technical versus consumer-facing labels and mainstream versus proximity-based retail logics. These findings suggest the importance of developing more targeted communication and market strategies to foster sustainable food choices.

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Introduction

Sustainability has progressively become a central to the agri-food sector, amid environmental concerns, evolving consumer expectations, and demand for responsible production and consumption patterns.

Agri-food systems have major environmental and social impacts, including greenhouse gas emissions, resource depletion, and biodiversity loss (FAO, 2018; Willett *et al.*, 2019).

Policymakers and market actors therefore promote practices and products capable of addressing environmental, social, and economic sustainability challenges (Zarbà *et al.*, 2026). Consumers' purchasing decisions can influence production models, drive responsible supply chains, and foster the diffusion of sustainability-oriented business practices (Grunert, 2005; Vermeir & Verbeke, 2006).

Growing sustainable agri-food market reflects a broader shift toward consumption patterns that integrate ethical, environmental, and health-related considerations (Testa *et al.*, 2018). Products often feature organic production, environmental protection, animal welfare, and fair labour practices, communicated through sustainability labels and certification schemes.

Research identifies psychological, social, and contextual factors, including environmental attitudes, perceived consumer effectiveness, and social norms shaping consumer choices (Thøgersen, 2010; Verain *et al.*, 2016).

The Theory of Planned Behaviour (TPB) explains sustainable food choices in terms of attitudes, subjective norms, and perceived behavioural control, which jointly shape behavioural intentions (Ajzen, 1991). Value-Belief-Norm (VBN) theory links pro-environmental behaviour to values, environmental beliefs, and the activation of personal norms (Stern, 2000). Recent research supports the TPB's relevance to sustainable food consumption, while also emphasising the importance of socio-demographic and contextual heterogeneity (Randall *et al.*, 2024). Consumers increasingly assess food through ethical and environmental attributes alongside price and quality (Aschemann-Witzel & Zielke, 2017).

Engagement remains heterogeneous: age, education and income may influence purchasing behaviors (Diamantopoulos *et al.*, 2003; Grunert *et al.*, 2014).

Cross-country and Italian evidence also links purchasing frequency, certification attention and knowledge to demographics and purchasing contexts (Diamantopoulos *et al.*, 2003; Mota-Gutierrez *et al.*, 2024; Sparacino *et al.*, 2025).

Generational differences appear to affect knowledge and consumption. Younger consumers often display greater environmental awareness, which

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does not necessarily yield consistent purchasing behavior (Grunert *et al.*, 2014; Vermeir & Verbeke, 2006).

Older consumers may exhibit more stable consumption patterns and greater trust in certified products, highlighting the complexity of demographic influences (Verain *et al.*, 2016).

Knowledge of sustainability attributes and certifications also influences consumption.

Certifications signal, compliance with environmental or social standards, reducing producer-consumer information asymmetry (Testa *et al.*, 2018). Their effectiveness depends on their recognition, comprehensibility, credibility and purchasing relevance. Understanding is often limited and eco-labels effect vary across products and contexts (Cook *et al.*, 2023; Tiboni-Oschilewski *et al.*, 2024). Such "label confusion" can encourage reliance, on simplified heuristics or trust when purchasing (Aschemann-Witzel & Zielke, 2017).

Purchasing also reflects latent dimensions, including sustainability attitudes, perceived product quality, ethical motivations, price sensitivity, and distribution channels accessibility (Vermeir & Verbeke, 2006).

Availability varies across supermarkets, specialized retailers, and alternative food networks such as farmers' markets or direct sales, making distribution channels relevant to choice (Aschemann-Witzel & Zielke, 2017).

Understanding these dimensions is therefore essential for identifying the drivers of consumer behavior and for informing both policy interventions and marketing strategies promoting sustainable consumption.

Three gaps remain: limited joint analysis of socio-demographics, knowledge, and purchasing behaviour; context-dependent evidence on age differences in knowledge; and insufficient exploration of latent certification perceptions and purchasing patterns across channels. These gaps motivate two directional hypotheses are formulated:

- H1: higher educational attainment is positively associated with the self-reported purchasing frequency of sustainability and quality-related agri-food products.
- H2: younger and middle-aged consumers report higher levels of knowledge of sustainable agri-food products than older consumers.

The remaining objectives are retained as research questions because the principal component analyses are exploratory and seek to identify latent structures rather than test predetermined causal relationships.

The present study investigates consumer attitudes and behaviors toward sustainable agri-food products through a quantitative analysis based on survey data.

Specifically, it addresses four research questions:

- RQ1: To explore the socio-demographic characteristics associated with the consumption of sustainable agri-food products, with the aim of identifying the main consumer profiles.

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- RQ2: Does self-reported knowledge of sustainable agri-food products differ across age groups?
- RQ3: To investigate the latent dimensions underlying consumer knowledge and perceptions of sustainability certifications to better understand how such information is interpreted and evaluated.
- RQ4: To analyse the latent patterns characterizing purchasing behaviors related to sustainable agri-food products and the distribution channels through which these products are acquired.

Research has examined socio-demographic determinants of sustainable food consumption (Diamantopoulos *et al.*, 2003; Attieh & Ayoubi, 2023; De Marchi *et al.*, 2024), certifications understanding and use (Grunert *et al.*, 2014; Peschel *et al.*, 2016; Rejman *et al.*, 2023), and retail influences (Coucke *et al.*, 2019; Mancini *et al.*, 2019), but has rarely integrated these domains within one empirical setting.

This study examines three forms of heterogeneity among 1,000 Italian consumers. First, it assesses age and educational differences in self-reported sustainability knowledge and purchasing frequency Second, it explores the latent organization of consumer familiarity with multiple certification schemes to make it possible to distinguish between relatively technical or production-oriented schemes and more recognizable consumer-facing labels. Third, the study considers reported product-purchasing frequencies and retail-channel use within the same PCA, thereby examining how sustainable and quality-related products are associated with different purchasing contexts.

Its novelty lies in integrating consumer characteristics, certification interpretation, and retail context, extending analyses of individual labels, attitudes, intentions, or willingness to pay. The exploratory, cross-sectional design identifies associations and latent structures, not causal relationships or definitive segments. TPB and VBN provide interpretive frameworks, not complete empirical tests, since not all constructs were measured.

1. Backgrounds

Food systems generate roughly one third of global anthropogenic greenhouse gas emissions and substantial impacts land, water, biodiversity, and pollution. Sustainable agri-food transitions therefore require changes in consumption patterns as well in production (Crippa *et al.*, 2021; Poore & Nemecek, 2018).

TPB application span organic purchasing, sustainable diets and meat consumption, with constructs varying in importance across cultural and purchasing contexts (Randall *et al.*, 2024). Value-Belief-Norm theory links environmental values and beliefs to personal norms encouraging pro-

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environmental behaviour (Stern, 2000). Both provide perspectives here rather than fully tested models, because not all constructs were measured. Reviews motivational, cognitive, and situational barriers, including limited information, perceived cost, low availability, and uncertainty about "sustainability" (Van Bussel *et al.*, 2022; Principato *et al.*, 2025).

Sustainable food consumers vary in socio-demographic conditions, levels of knowledge, and personal values. Education and familiarity can help to improve consumers' capacity to understand environmental information and to incorporate it into food choices. Italian evidence links sustainability knowledge to preferences and willingness to pay for food attributes, indicating its practical decision-making role (De Marchi *et al.*, 2024). Socio-demographic influences are neither linear nor universal, which makes it necessary to examine how age, education and socio-economic conditions interact in specific national contexts (Peschel *et al.*, 2016; De Marchi *et al.*, 2024).

Claims, labels and certifications schemes and models convey sustainability information's, translating complex production attributes into visible signals that consumers can use at the point of purchase, reducing information asymmetry (Selvaggi *et al.*, 2023) However, the effectiveness of these labels depends heavily on whether consumers understand and trust them. Quality labels influence consumer perceptions and preferences, while clear and credible communication and comprehension are associated with willingness to pay a premium price (Reitano *et al.*, 2025). Reviews nevertheless report limited comprehension and heterogeneous behavioural effects (Cook *et al.*, 2023; Tiboni-Oschilewski *et al.*, 2024).

Labels proliferation can create confusion, selective attention, and comparison difficulties, especially when products carry multiple claims covering different dimensions of sustainability (Peschel *et al.*, 2016; Li & Kallas, 2021; Katt & Meixner, 2020).

Retail visibility, placement, accessibility, supply chains and purchasing contexts also influence sustainable choices (Coucke *et al.*, 2019).

Short supply chains offer proximity, reduced intermediation and more direct producer-consumer relationships. These may strengthen perceived transparency, authenticity, local embeddedness and trust by connecting territorial identity, production methods and ethical value, making sustainability attributes more credible and visible (Mancini *et al.*, 2019; Jia *et al.*, 2024).

Longer, structured supply chains and large-scale retail support wider diffusion of sustainable food products. (Melovic *et al.*, 2020; Coucke *et al.*, 2019) Although these channels are less based on interpersonal trust and direct proximity, they increase the routine availability, comparability and accessibility of sustainable products within everyday purchasing practices.

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Mainstream adoption thus depends on integration into everyday shopping as well as niche markets, making retail context central to how sustainability informs food choice (Coucke *et al.*, 2019; Mancini *et al.*, 2019; Jia *et al.*, 2024).

These studies support integrating consumer profiles, certification knowledge, and purchasing patterns beyond isolated attitudes or intentions. Such joint analysis remains limited and is particularly relevant in Italy, where sustainability claims coexist with origin, quality, and branded-food traditions (Van Bussel *et al.*, 2022; Principato *et al.*, 2025; Ammann *et al.*, 2023).

2. Materials and methods

A cross-sectional online survey was administered in June 2025 and administered by a professional marketing agency. Respondents were randomly selected within an existing online consumer panel. The random selection procedure therefore operated among panel members rather than through a probability-based sampling frame covering the entire Italian population. The final analytical sample comprised 1,000 respondents aged between 18 and 74 years.

No demographic or geographical quotas were applied during recruitment, and no post-stratification or calibration weights were used. All statistical analyses were therefore conducted on unweighted observations. The dataset supplied by the marketing agency contained 1,000 fully completed questionnaires, each identified by a unique panel identifier, with no duplicate records or blank item-level responses.

The marketing agency provided only the final dataset and did not disclose the total number of panel members invited to participate, the number of questionnaires initiated, the number of break-offs or any exclusions made before delivery of the data. Consequently, a response rate could not be calculated. Detailed information concerning the overall panel size, panel-recruitment channels, incentive mechanisms and panel-maintenance procedures was also unavailable. Although the achieved sample included respondents from all four Italian macro-regions, it should be regarded as an unweighted, non-quota, panel-based sample with national territorial coverage rather than as a statistically representative sample of the Italian population.

The questionnaire included both categorical and Likert-scale items to capture multiple dimensions of consumer attitudes and behaviors.

The questionnaire was composed exclusively of closed-ended questions, including both dichotomous and multiple-choice formats to ensure standardization and comparability of responses.

The questionnaire was organized into three distinct sections.

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The first section collected detailed socio-demographic information, including gender, age, area of residence (urban or non-urban), household size and income level.

These variables enabled the inclusion of socio-economic factors in the analysis, allowing for a richer interpretation of the results in relation to consumer segmentation.

The second section examined respondents' knowledge of and engagement with agri-food sustainability issues, as well as their familiarity with major certifications and sustainability claims.

The third and final section collected detailed information on sustainable food consumption and purchasing behaviour, including the frequency of visits to different retail channels.

The questionnaire was developed by drawing conceptually on Grunert *et al.* (2014) and Vermeir and Verbeke (2006), rather than by directly reproducing their original scales. Grunert *et al.* (2014) informed the sections concerning familiarity with sustainability certifications and sustainability-related product attributes. Three of the labels examined in their study Fairtrade, Rainforest Alliance, and Carbon Footprint were retained, while the list was expanded to include certification schemes relevant to the Italian agri-food context. Their objective assessment of label understanding and seven-point response scales were reformulated as a three-category self-assessed knowledge measure and five-point agreement or importance items. Vermeir and Verbeke (2006) provided the conceptual basis for examining sustainable-consumption attitudes, perceived consumer effectiveness, and product availability. These concepts were operationalised through items addressing the perceived economic, environmental, and social consequences of sustainable consumption and respondents' reported purchasing frequency across product categories and retail channels. Additional items concerning Italian quality schemes, direct and solidarity-based purchasing channels, private-label and manufacturer-brand products, and the justification of a price premium were developed specifically for the present study. Consequently, the questionnaire represents a contextual and conceptual adaptation of previous research rather than the direct application of previously validated scales. The data collection protocol complied fully with national ethical standards and with the General Data Protection Regulation (GDPR) 2016/679. All data were collected anonymously and handled in strict accordance with applicable privacy regulations, ensuring the confidentiality and protection of personal information throughout the research process.

Once the data were collected, an ANOVA and a PCA were developed to process the information provided on the different variables considered in the agri-food consumer (Aertsens *et al.*, 2011; Tobler *et al.*, 2011).

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The ANOVA was performed following standardized protocols for statistical data analysis using the IBM SPSS software (Park, 2015; Park, 2009; Albright & Marinova, 2015).

The analytical procedure began with data cleaning, during which data integrity was verified to identify missing values and potential entry errors. Subsequently, an exploratory data analysis was carried out to assess the distribution of variables and detect deviations from normality, as well as the presence of outliers.

- Variance between groups

$$MS_{between} = \frac{SS_{between}}{df_{between}}$$

- Variance within groups.

$$MS_{within} = \frac{SS_{within}}{df_{within}}$$

The statistical test is expressed through the F statistic, which measures the ratio between these two sources of variability:

$$F = \frac{MS_{between}}{MS_{within}}$$

A statistically significant result is obtained when the p-value associated with the *F* statistic is lower than the selected significance level, commonly set at 0.05.

In this study, ANOVA results were interpreted using a 5% significance threshold, allowing the identification of statistically significant differences in knowledge levels and purchasing behaviors across the socio-demographic groups considered.

For the purposes of the analysis, the independent variables (factors) and the dependent variable (outcome) were clearly specified.

The sample was subsequently subjected to a principal components analysis (PCA) in order to summarise consumer perceptions of sustainable agri-food products and identify their consumption habits.

The PCA is expressed by the following formula:

$$Y_i = W_{i1}X_1 + W_{i2}X_2 + \ldots + W_{ip}X_p$$

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Where $X_1, X_2, \ldots X_p$ are the originally standardized variables and $W_{i1}, W_{i2}, \ldots W_{ip}$ are the weight related to each one of them.

This analysis is structured to find out a new set of smaller dimensions than the original variables, capable of expressing "common" information.

To facilitate clearer and more accurate interpretation of the data, the Varimax method was chosen to perform orthogonal rotation of the factors that permits a simpler and more correct interpretation of the variables. (Kaiser, 1960).

The extraction of the components was followed by the calculation of the factor scores for each case.

The higher the factor loading, the more the variable is decisive for that factor.

The model was also validated using Bartlett's Test of Sphericity and the KMO (Kaiser-Meyer-Olkin) measure, to determine whether the theorised model was valid.

Furthermore, only factors with loadings of no less than 0.4 were considered, a value identified as significant by Hair *et al.* (2009).

Internal consistency was assessed using Cronbach's alpha for the multi-item groupings identified in the socio-demographic variables certification-knowledge and purchasing-context analyses.

To reduce subjectivity, the resulting labels were also compared with the literature on socio-demographic consumer profiles, sustainability-certification knowledge, and food-purchasing contexts (Grunert *et al.*, 2014; Mancini *et al.*, 2019; Mota-Gutierrez *et al.*, 2024).

Beyond statistical adequacy, the retained factors were selected for managerial and policy usefulness, enabling evidence-based consumer segmentation and prioritisation of communication and labeling interventions.

The variables used in the study are described in Table 1.

Table 1 - Summary of the main variables

Variable		**Nature**	**Type of attribute**
Socio-demographic	*Gender*	Nominal	Intrinsic
	Age	Ordinal	Intrinsic
	Residential area	Nominal	Intrinsic
	City size	Ordinal	Extrinsic
	Instruction level	Ordinal	Extrinsic
	Income bracket	Ordinal	Extrinsic
	Employee (Public and private)	Nominal	Extrinsic
	Entrepreneur	Nominal	Extrinsic

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Variable		Nature	Type of attribute
	Teacher	Nominal	Extrinsic
	Manager	Nominal	Extrinsic
	Student	Nominal	Extrinsic
	Homemaker	Nominal	Extrinsic
	Unemployed	Nominal	Extrinsic
	Retired	Nominal	Extrinsic
Sustainability knowledge	*Sustainability certification knowledge*	Ordinal	Intrinsic
	Sustainability certification consideration	Ordinal	Intrinsic
	SNQPI	Ordinal	Extrinsic
	BIO	Ordinal	Extrinsic
	Rainforest	Ordinal	Extrinsic
	Fair Trade	Ordinal	Extrinsic
	Green in Italy	Ordinal	Extrinsic
	Equalitas	Ordinal	Extrinsic
	Carbon Footprint	Ordinal	Extrinsic
	Water Footprint	Ordinal	Extrinsic
Agri-food products	*Organic agri-food products*	Ordinal	Extrinsic
	Agri-food products with environmental sustainability certification	Ordinal	Extrinsic
	Agri-food products with designation of origin	Ordinal	Extrinsic
	Traditional products with supermarket brand	Ordinal	Extrinsic
	Traditional, well-known and advertised company brand	Ordinal	Extrinsic
Consumption behaviour	*GDO*	Ordinal	Extrinsic
	Discount	Ordinal	Extrinsic
	Traditional retail	Ordinal	Extrinsic
	Specialized retail	Ordinal	Extrinsic

Source: Our elaborations.

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3. Data analysis

Table 2 summarizes the socio-demographic characteristics of the sample (n = 1,000).

Table 2 - Socio-demographic variables (n = 1,000)

Variables	n.	%
Gender		
Male	496	49.60
Female	504	50.40
Age bracket		
18-34	241	24.10
35-54	374	37.40
55-74	385	38.50
Residential area		
North-West	195	19.50
North-East	270	27.00
Centre	198	19.80
South and Islands	337	33.70
City size		
Up to 50,000 inhabitants	476	47.60
From 50,000 to 100,000 inhabitants	213	21.30
From 100.000 to 500.000 inhabitants	148	14.80
Over 500.000 inhabitants	163	16.30
Family unit		
Single	272	27.20
Single with children	61	6.10
Couples	225	22.50
Couples with children	442	44.20
Education level		
Elementary school diploma	6	0.60
First Grade High School Diploma	85	8.50
Secondary School Diploma	510	51.00
Graduate Diploma	297	29.70
Post graduation	102	10.20
Employment		
Employee (Public and Private)	519	51.90
Entrepreneur	51	5.10
Teacher	49	4.90

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Variables	n.	%
Homemaker	87	8.70
Retired	125	12.50
Student	34	3.40
Unemployed	69	6.90
Manager	66	6.60
Income bracket		
Less than 15.000	128	12.80
Between 15.001 and 30.000	358	35.80
Between 30.001 and 50.000	270	27.00
Over 50.001	163	16.30
I prefer not to answer	81	8.10

Source: Our elaborations.

The gender distribution of the sample is substantially balanced, with a slight prevalence of women (50.4%) over men (49.6%).

Older age groups predominate: (38.5%) are aged 55-74, (37.4%) are 35-54, and (24.1%) are 18-34.

Territorial coverage spans South and Islands (33.7%), North-East (27.0%), Centre (19.8%) and North-West (19.5%)

Municipalities have up to 50,000 inhabitants (47.6%) of respondents, 50,000-100,000 (21.3%), 100,000-500,000 (14.8%), and over 500,000 (16.3%).

Households comprise couples with children (44.2%), single individuals (27.2%), couples without children (22.5%) and single parents (6.1%).

Education is relatively high: 51.0% hold an upper secondary diploma and 39.9% a graduate or postgraduate degree; lower qualifications are uncommon.

Occupations include public/private employees (51.9%), retirees (12.5%), homemakers (8.7%), managers (6.6%), unemployed respondents (6.9%), entrepreneurs (5.1%), teachers (4.9%) and students (3.4%).

Annual income is concentrated in the lower-middle and middle brackets: €15,001-€30,000 (35.8%) and €30,001-€50,000 (27.0%). A further 16.3% earn over €50,001, 12.8% below €15,000 and 8.1% did not disclose income.

Respondents were asked to indicate from 1 (“low”) to 5 (“high”) which sustainability-related characteristic could justify a higher price for agri-food products.

Environmental and ethical-social attributes justify price premiums more strongly than aesthetic label elements (Figure 1).

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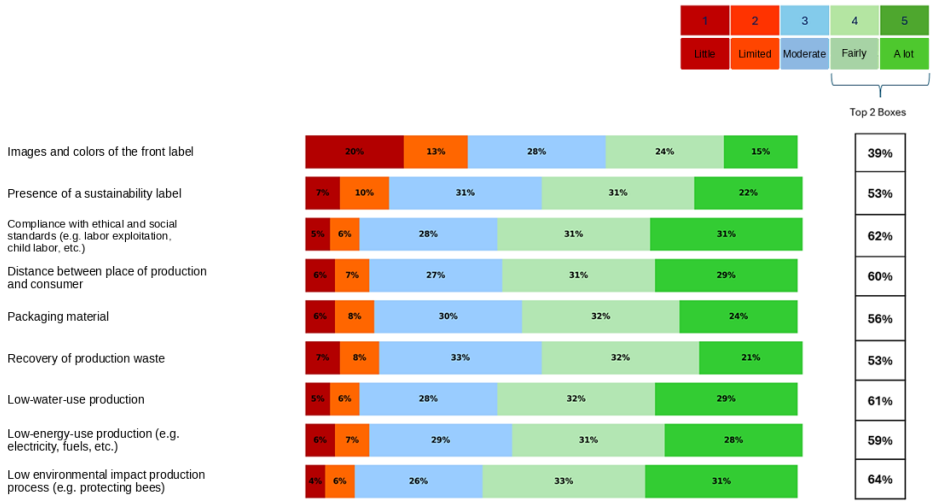
Figure 1 - Characteristics that may justify a higher price



Sources: Our elaborations.

To further explore the relationships between respondents' socio-demographic characteristics and their behaviors or levels of knowledge regarding agri-food sustainability, a one-way ANOVA was conducted (Table 3) to examine whether the knowledge level regarding sustainable agri-food products differed across the three age groups considered (18-34, 35-54, and 55-74 years).

The analysis revealed a statistically significant difference among the groups ($p = 0.002$).

Table 3 - Knowledge level of sustainable products by age group

Age	**Knowledge level**
	Mean
18-34	4.65
35-54	4.61
55-74	4.19
Total	4.46
Sign.	0.002
F. (2; 997)	6.277

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Age	Knowledge level
η^2	0.012
Median-centered Levene test	*0.111*
Tukey HSD post hoc	18-34 > 55-74: MD = 0.265, p = .021; 35-54 > 55-74: MD = 0.286, p = .003; all other pairwise comparisons were not significant.

Source: Our elaborations by IBM SPSS software.

Knowledge means were similar for ages 18-34 (M = 4.65) and 35-54 (M = 4.62), and lower for ages 55-74 (M = 4.19), indicating greater knowledge among younger and middle-aged respondents.

ANOVA links education to purchasing frequency in table 4 with statistically significant difference for organic products ($p = 0.006$).

Graduates and postgraduates exhibit a higher purchase frequency compared to less educated respondents, particularly those with lower secondary qualifications; means rise from 3.0 in the latter group to 3.790 among postgraduates.

The same pattern holds for designation of origin products ($p = 0.002$), with more educated respondents reporting more frequent PDO/PGI purchases.

Supermarket-branded PAT purchasing does not differ significantly by education ($p > 0.05$).

Company-branded PAT purchasing increases significantly with education ($p < 0.001$).

Means rise from 2.72 among lower secondary school respondents, the least oriented toward these purchases, to 3.63 among postgraduates.

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Table 4 - Purchase frequency of sustainable products by education level

Instruction level	Organic products	Products with sustainability certification	Products with designation of origin	PAT products with large-scale retail brand	PAT products with company brand
	Mean	Mean	Mean	Mean	Mean
Elementary school diploma	3.500	3.500	3.833	n.s*	4.000
First Grade High School Diploma	3.000	2.941	3.247	n.s*	2.717
Secondary School Diploma	3.392	3.198	3.549	n.s*	3.276
Graduate Diploma	3.515	3.357	3.670	n.s*	3.347
Post graduation	3.794	3.569	3.922	n.s*	3.627
Total	3.473	3.263	3.599	n.s*	3.290
Sign.	<0.001	0.006	0.002	0.123	<0.001
F (4, 995)	4.970	3.650	4.160	1.82	6.870
h^2	0.020	0.014	0.016	0.007	0.027
Median-centred Levene test	0.154	0.929	0.289	0.775	0.886
Tukey HSD post hoc	Graduate > lower secondary: MD = 0.515, *p* = .009; postgraduate > lower secondary: MD = 0.794, *p* < .001; postgraduate > upper secondary: MD = 0.402, *p* = .030.	Postgraduate > lower secondary: MD = 0.627, *p* = .007.	Graduate > lower secondary: MD = 0.423, *p* = .036; postgraduate > lower secondary: MD = 0.675, *p* = .001; postgraduate > upper secondary: MD = 0.373, *p* = .036.	n.s	Upper secondary > lower secondary: MD = 0.559, *p* = .002; graduate > lower secondary: MD = 0.629, *p* < .001; postgraduate > lower secondary: MD = 0.910, *p* < .001.

* n.s: Not significant

Source: Our elaborations by IBM SPSS software.

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The socio-demographic PCA identifies a two-dimensional structure which satisfactorily summarizes the original information.

KMO index is equal to 0.605, a value acceptable according to Kaiser's classification, indicating compactness in the correlations among variables and a moderate level of intercorrelation.

Bartlett's Test of Sphericity yields a $\chi^2 = 491.045$ and $p < 0.001$ statistically justifying it.

The two-component solution explains 51.733% of the total variance, distributed relatively evenly between the two components.

Table 5 - Socio-demographic variable rotated matrix

Variables	**Factors**	
	A1	**A2**
Age	0.709	
City size		0.649
Educational level		0.654
Income bracket		0.720
Employed (private/public)	–0.685	
Retired	0.815	
Total variance explained	28.754	22.979
Cronbach's alpha	–0.022	0.401
KMO Test	0.605	
Bartlett's Test of Sphericity	491.045	
Sign.	<0.001	
Factors with values below 0.4 are excluded		

Source: Our elaborations by IBM SPSS software.

In Table 5, A1, which explains 28.754% of the total variance, can be associated with a demographic and occupational dimension.

Age (0.709) and retirement (0.815) load positively on this component, while *Employed (private/public)* shows a negative loading (-0.685).

This life-cycle and employment-status continuum contrasts older, retired respondents at the positive pole with economically active respondents at the negative pole.

A2, which explains 22.979% of the total variance, captures a dimension related to socio-economic and territorial status. Positive loadings are observed for city size (0.649), education level (0.654), and income (0.720).

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It reflects socio-economic status and urbanization: greater economic and cultural resources are associated with larger, more structured urban environments.

The consumer opinions and certifications PCA shows an excellent KMO index of 0.903, indicating a very high level of sampling adequacy and strong coherence among the correlations of the variables.

Bartlett's Test of Sphericity supports the model, with a $\chi^2 = 3499.865$ and $p < 0.001$.

The factor solution explains a total of 56.117% of the variance, distributed relatively evenly between B1 (29.376%) and B2 (26.741%).

Table 6 - Sustainability knowledge rotated matrix

Variables	**Factors**	
	B1	**B2**
Consumer opinion		
Knowledge of Sustainability Certifications		0.644
Consideration of Sustainability Certifications		0.521
Sustainability certifications		
SNQPI	0.663	
BIO		0.788
Rainforest		0.702
Fair Trade		0.651
Green in Italy	0.756	
Equalitas	0.811	
Carbon Footprint	0.603	0.459
Water Footprint	0.756	
Total variance explained	29.376	26.741
Cronbach's alpha	0.781	0.832
KMO Test	0.903	
Bartlett's Test of Sphericity	3499.865	
Sign.	<0.001	
Factors with value below 0.4 are excluded		

Source: Our elaborations by IBM SPSS software.

B1 has significant loadings for several certifications, including SNQPI (0.663), Green in Italy (0.756), Equalitas (0.811), Carbon Footprint (0.603), and Water Footprint (0.756).

No significant loadings are observed for variables related to consumers' actual knowledge and consideration of sustainability labels, possibly because its certifications concern firm-level practices less familiar to the public.

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B1 groups SNQPI (0.663), Green in Italy (0.756), Equalitas (0.811), Carbon Footprint (0.603), and Water Footprint (0.756).

Knowledge and consideration of sustainability labels show no significant loadings on B1, possibly because its certifications concern firm-level practices less familiar to the public.

B2 (26.741% of variance) groups Organic (0.788), Rainforest Alliance (0.702), Fairtrade (0.651), declared certification knowledge (0.644), and consideration in purchasing (0.521).

The structure is not completely simple: Carbon Footprint loads on B1 (0.603) and B2 (0.459), a difference of 0.144. It shares variance with both, with a stronger B1 association but a substantively relevant B2 loading and was not decisive in assigning either label.

Table 7 presents the exploratory PCA applied to the variables related to the types of products purchased and the places of purchase, that identifies C1 and C2.

The KMO index is 0.878, indicating strong sampling adequacy and a high degree of compactness in the correlations among the variables considered.

Bartlett's Test of Sphericity confirms the suitability of the solution, with $\chi^2 = 3352.507$ and $p < 0.001$.

Table 7 - Purchased products and places of purchase rotated matrix

Variables	**Factors**	
	C1	**C2**
Products		
Organic agri-food products	0.673	0.408
Agri-food products with environmental sustainability certification	0.706	
Agri-food products with designation of origin	0.809	
Traditional products with a supermarket brand	0.774	
Traditional, well-known and advertised company brand	0.751	
Place of purchase		
GDO	0.564	
Discount		0.613
Traditional retail		0.732
Specialised retail		0.808
Total variance explained	35.726	22.551
Cronbach's alphas	0.837	0.687
KMO Test	0.878	
Bartlett's Test of Sphericity	3352.507	
Sign.	<0.001	
Factors with values below 0,4 are excluded		

Source: Our elaborations by IBM SPSS software.

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The two-factor solution explains a total of 58.277% of the overall variance.

C1 has high, relatively homogeneous loadings for designation-of-origin products (0.809), supermarket-branded traditional products (0.774), well-known and advertised company-branded traditional products (0.751), environmentally certified products (0.706), and organic products (0.673).

Large-scale retail distribution (GDO) loads moderately (0.564), associating certified and quality-product purchasing with organized retail environments.

C2 groups specialized retail (0.808), traditional retail (0.732), and discount stores (0.613).

This component reflects purchasing channels distinct from large-scale retail, including alternative or proximity-based outlets.

Organic products also load on C2 (0.408), indicating purchases across retail contexts and segmentation in purchasing behaviours.

Organic purchasing thus cross-loads on C1 (0.673) and C2 (0.408), both above the 0.40 threshold. It is not exclusive to C1, although the 0.265 difference indicates a clearer primary association than for Carbon Footprint.

4. Discussion

Sustainable agri-food consumption reflects educational attainment, life-cycle stage, familiarity with sustainability-related information and purchasing context rather than a homogeneous "green consumer" profile.

This supports evidence that sustainable and organic choices depend on heterogeneous attitudes, knowledge structures, information access, and market conditions (Hughner *et al.*, 2007; Rana & Paul, 2017; Ran *et al.*, 2022).

PCA labels are used as descriptive summaries of the variables with the highest absolute loadings rather than as independently validated theoretical constructs. Interpretation follows empirical patterns in relevant literature and explicit recognition of cross-loadings (Abdi & Williams, 2010; Jolliffe & Cadima, 2016; Greenacre *et al.*, 2022).

Regarding RQ1, education and broader socio-economic and territorial resources differentiate profiles associated with frequent sustainable purchasing.

ANOVA identifies education differences for organic, sustainability-certified, designation-of-origin, and company-branded traditional products, but not supermarket-branded traditional products.

Socio-demographic PCA yields an "age and employment-status contrast", separating older/retired from economically active respondents and a "city size, education, and income profile". These descriptive labels accord

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with evidence of joint but heterogeneous, non-deterministic demographic influences on knowledge and purchasing (Diamantopoulos *et al.*, 2003; Mota-Gutierrez *et al.*, 2024). The findings suggest that cultural and economic capital facilitate sustainable purchases, while less differentiated products span education groups

Education and knowledge can improve interpretation of sustainability signals while socio-economic resources facilitate translating values into food choice (Attieh & Ayoubi, 2023; De Marchi *et al.*, 2024).

It also aligns with evidence that urban consumers' responses to certification labels vary according to education, income, and broader socio-demographic background (Kaczorowska *et al.*, 2021).

For RQ2, knowledge differs significantly by age: scores are similarly high at 18-34 and 35-54, and lower at 55-74.

Younger and middle-aged respondents may encounter more sustainability discourse, food information, and certification communication, while older respondents may rely more on established routines.

Evidence of higher objective organic-food knowledge and responsiveness to sustainability communication among younger consumers supports this interpretation, without implying that the attitude-behaviour gap disappears (Attieh & Ayoubi, 2023; Rossi & Rivetti, 2020).

For RQ3, B1 groups SNQPI, Green in Italy, Equalitas, Carbon Footprint, and Water Footprint as "specialised production and footprint-related schemes". B2 combines Organic, Rainforest Alliance and Fairtrade with declared knowledge and purchasing consideration as "Organic, Fairtrade and Rainforest Alliance knowledge and engagement". These labels are descriptive summaries of the dominant loading and not validated categories. They accord with consumer-knowledge literature, linking prior to recognition, understanding, and use of product information, and documenting uneven label comprehension and use (Grunert *et al.*, 2014; Cook *et al.*, 2023; Sparacino *et al.*, 2025).

Carbon Footprint bridges B1 (0.603) and B2 (0.459) and does not alone either component.

Label proliferation, uneven familiarity and limited standardization can generate confusion and selective use of recognizable cues (Rejman *et al.*, 2023; Sonntag *et al.*, 2023).

Labels influence perceived food quality and purchase evaluation only when their meaning is clear, credible and compatible with consumers' prior awareness of sustainability issues (Kaczorowska *et al.*, 2021).

Poorly known labels may remain ineffective in purchasing or price evaluation even among positively oriented consumers (Kaczorowska *et al.*, 2019).

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For RQ4, C1, "sustainable/quality-product purchasing and supermarket use", combines designation-of-origin, branded traditional, environmentally certified and organic products with supermarket/hypermarket use and C2, "specialised, traditional, and discount channel use", follows the loading pattern more closely than "alternative or proximity-based purchasing logic", since discount stores do not fit that description.

These components are not mutually exclusive consumer segments. Organic products also load on C2 (0.408), spanning contexts; this secondary loading was acknowledged but did not determine C2's label.

Channel development and point of sale visibility support sustainable food uptake, while retail formats attract different consumers (Melovic *et al.*, 2020; Coucke *et al.*, 2019).

Associations between specialized or proximity channels and quality-oriented consumption also accord with short-chain research emphasizing trust, territorial embeddedness, and perceived fairness (Mancini *et al.*, 2019).

The four research questions indicate that pro-environmental motivations alone do not explain sustainable consumption. TPB and VBN theory links values, attitudes, and perceived behavioural control to sustainable intentions, and the findings suggest reported purchasing behaviour also depends on interpreting certification signals and encountering them in retail contexts (Ajzen, 1991; Stern, 2000; Grunert *et al.*, 2014). Age and education indicate that sustainability information is not processed under equivalent individual conditions. The certification components likewise suggest uneven signal effectiveness: reducing information asymmetry depends on their recognisability, comprehensibility and perceived relevance (Testa *et al.*, 2015). Retail settings may facilitate or constrain translating knowledge and intentions into purchases.

Integrating these factors extends motivational explanations without directly testing their complete causal mechanisms. Managerial and policy communication should therefore be differentiated, with simpler explanations of technical certifications.

Older consumers may need targeted education because their knowledge gap is greater.

Channel-specific visibility and in store communication also matter. Environmental and ethical-social attributes justify premiums more strongly than aesthetic label elements, suggesting greater responsiveness to substantive sustainability content.

Sustainable food choices thus appear differentiated and mediated by information-processing capacity rather than uniformly distributed.

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Conclusions

This study integrates socio-demographic, cognitive and behavioural dimensions through four research questions. Sustainable agri-food engagement varies with education, life-cycle stage, sustainability knowledge, and retail context, rather than following one consumer profile.

For RQ1, higher education is associated with more frequent organic, environmentally certified, designation of origin, and company-branded traditional purchases, but not supermarket branded traditional purchases. The age/employment and city size/education/income components suggest that cultural and economic resources facilitate sustainable consumption, although some categories span social groups.

For RQ2, knowledge is similarly high at ages 18-34 and 35-54 and lower at 55-74. Greater familiarity with sustainability information among younger and middle-aged consumers, and older consumers' reliance on routines, may explain a gap that limits wider sustainable consumption.

For RQ3, technical and production-oriented schemes (SNQPI, Green in Italy, Equalitas, Carbon Footprint, and Water Footprint) differ from Organic, Rainforest Alliance, and Fairtrade, which align with declared knowledge and engagement. Labels thus operate as specialized production signals or more familiar cues in purchase evaluation.

For RQ4, certified and quality-product purchasing aligns with large-scale retail, alongside a component grouping specialized, traditional, and discount channels. Organic purchasing spans both, indicating partially overlapping mainstream and niche pathways.

Communication should reflect familiarity: older consumers need accessible, non-technical explanations; unfamiliar schemes need concise accounts of what is certified, compliance verification, and environmental or social benefits. Familiar labels can reinforce credibility through transparent standards and verification. Supermarkets should improve visibility, clarity, and comparability; specialized and traditional retailers can emphasize origin, proximity, staff interaction, product identity and trust. Discount stores need simple, comparable cues without presenting sustainability as exclusive. Organic products' presence across components supports cross-channel strategies. Environmental and ethical-social content should take priority over aesthetic label elements in communicating price premiums. Public authorities can support consumer education, label literacy and coherent, comparable schemes. These are directions for differentiated communication and sustainable marketing, not fixed market segments.

Limitations concern design, measurement, sampling and exploratory analysis.

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Cross-sectional data identify associations, not causal effects or change over time. Self-reported knowledge, purchasing frequency, and channel use capture declarations rather than observed behaviour and may involve recall errors and social desirability, including overstated sustainable purchases.

Online-panel coverage and self-selection may also bias findings. Selection was random within the panel, not population-based; no quotas or post-stratification weights were used, and response-rate information was unavailable. Findings are not nationally representative and require cautious generalization.

PCA components and labels are exploratory, sample-dependent descriptions, particularly given cross-loadings. Future research should use longitudinal or experimental designs, objective purchasing data, probability-based samples and confirmatory analyses in independent samples.

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