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The Millennials' Concept of Sustainability in the Food Sector

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Abstract: The aim of this study is to analyze the perception of the meaning of sustainability in the food sector. A sample of 268 University students belonging to the Millennial generation was identified and a survey was carried out to assess the interaction between this kind of Millennials and food sustainability. Collected data were explored with descriptive statistics, followed by multivariate statistical techniques to get an integrated vision of relationships among the variables. Outcomes evidence four groups of Millennials with specific peculiarities, i.e., "Socio-Nature Sensitives", characterized by a high level of attention for the socio-economic dimension and sustainable ways of food production; "Info-Supporter", very sensitive to labeling and warranty systems; "Proactive-Oriented", interested in innovative activities; "Indifferent Millennials", assigning the issue in general a low level of importance. Results provide useful information and some contribution to public institutions and private stakeholders so as to implement new rules and new tools in the food sector, so as to reach the target of reducing waste and pollution. Substantial literature on interaction between Millennials and sustainability in the food sector has not yet been developed; the aim of this pioneer study is to offer some contribution to the debate among stakeholders on driving choices towards new consumption rules and production patterns.

Keywords: sustainability; labeling; food industry; university students; Millennials; cluster analysis; factor analysis

1. Introduction

The relationship between human activities and the Earth can be summarized in the depletion of resources and its consequences, i.e., environment pollution, global temperature increase, acidification of oceans, thinning of the ozone layer, deforestation, excessive waste of water, reduction of living species. In this context, the food supply chain and its phases can be considered very important users of resources and producers of environmental pollution and, indeed, in recent decades food operators have carried out several initiatives to reduce the environmental impact of the food sector e.g., increasing biodiversity, safeguarding the environment, reducing food waste and improving consumers' awareness on these topics [1–8].

Currently, the Earth is characterized by high wastage of food: every year about 1/3 of the global food production, equal to 1.3 billion tons for a commercial value of about 1 trillion dollars, is not consumed by the world population or is lost due to inefficient collection, conditioning and transport practices. This situation heavily affects the environment because the overproduction of food has serious

consequences in terms of excessive consumption of energy and degradation of other resources such as soil and aquatic environments [9,10].

In this context, the European Commission is working on a document dedicated to the sustainability of the food system, since it has been highlighted that its policy shows some inconsistencies and gaps on this topic. Indeed, a radical overhaul of the current infrastructure is needed, leading to different types of results, recognizing the multidimensionality of the sustainability performance of a food system, including aspects such as safeguarding health and ethics in food processes, and involving the food chain operators in the promotion of sustainable food standards and in the adoption of corporate social responsibility procedures [11,12].

Recently, food supply chain operators have raised questions concerning the interpretation of the term sustainability within the chain's processes, considering sustainability a declining of the concept of quality. Peri [13] proposed a model identifying the various food quality requirements consumers look for in food products. Especially psychological requirements, i.e., production context and ethical rules, respond to a mainly emotional need but take on a central role when consumers question the meaning of sustainability in the agro-food sector [14–22].

These issues are linked to the achievement of the three objectives of sustainable development, i.e., the triple bottom line sometimes supported by institutional interventions [23–28], with the aim of pursuing economic growth while safeguarding conservation of natural resources by integrating the concept of circular economy.

To integrate these concepts, there is a need to revise consumption patterns that influence both the dynamics leading to the creation of products, and the ways in which they are consumed. High-income per capita countries seem to have taken the path of change supported by the phenomenon of qualitative substitution [29] which, in its most virtuous connotation, highlights a feasible strategy for maintenance of food expenditure with a reduction of waste also through the return to a circular economy [30] now forgotten, such as the peasant one [31].

However, the so-called sustainable food products suffer from cost constraint, which tends to be higher than for conventional products, and consequently excludes low-middle income consumers and limits diffusion of these products [5,32–35]. Moreover, difficulties in finding them and bounded consumer knowledge of the subject further reduce the potential commercial success of these products [36–38]. Nonetheless, some consumers are approaching more sustainable consumption patterns. The reasons determining the change can be *ethical*, e.g., respect for animal welfare, *environmental*, e.g., the pressure generated by intensive farming, *health-linked*, e.g., reduced intake of saturated fats, or *cultural*, e.g., the Mediterranean diet [39–46].

Supporting these requests, public and private operators have developed different strategies to improve consumption in the food sector, e.g., the European quality system related to organic production [47,48] and certification and labeling schemes underlining the sustainability of a food product [49–52]. On the one hand, these new market dynamics in terms of product and related services play a central role in the transformation processes of the system. Indeed, they can contribute to creating value for the various stakeholders. On the other hand, it seems appropriate to inquire about users' interest and perception concerning the various initiatives.

Based on the aforementioned considerations, the purpose of this work is to understand whether Millennial University students are sensitive or not to social and ecological sustainability in the food sector and related issues e.g., animal welfare, ecological agriculture, waste management. Above all, it aims at identifying the different attitudes they can have when dealing with issues related to the ethical and production context in the food sector. Given that the meaning of sustainability is considered to be a multidimensional concept, the research questions of the paper are to find out whether Millennial students have different approaches to food sustainability perception and also to indicate the main characteristics related to the perception of sustainability in the food sector.

This paper is organized as follows. The first section provides some indications on stakeholder approaches to sustainable agro-food products and related aspects, as well as Millennials' knowledge and

perception of the sustainability concept. The second section introduces to the selected methodological approach, i.e., data collection by survey followed by data analysis by descriptive statistics and multivariate statistical techniques. The data collection was carried out through a structured questionnaire with several perspectives as to food sustainability. In this case, multivariate analysis is especially indicated to highlight the relationships among the different perspectives of the study, bringing into evidence the joint characteristics of similar groups of respondents. The third section describes the main results achieved, highlights the main differences on food sustainability perception among Millennial students and reports the interpretation of collected data in the light of related literature review. Moreover, it discusses policy implications on the basis of empirical results obtained. The final part of the paper provides the main considerations and indicates some suggestions to stakeholders as well as directions in order to improve the research. The originality of this paper lies in the investigation of the different dimensions of the concept of sustainability in the food sector, as perceived by Millennial students.

Literature Review

A holistic approach seems to be appropriate to consider the different dimensions of sustainability. Indeed, EU food policy should address, on the one hand, food industry, agriculture and trade and, on the other hand, food quality and all its variations including cultural, social and environmental aspects. In particular, the agro-food system should give proper weight to values such as protection of biodiversity, conservation of natural resources and inclusive development [53]. Some authors have identified related topics e.g., increasing food diversity, safeguarding the environment or food waste reduction, as transformations needed in the food sector also in term of awareness [54–57]. In general, sustainability "can be defined as the characteristic of something that is ecologically sound, economically viable, socially fair and culturally acceptable" [53]. In the food sector, sustainability is a part of various quality requirements [13] and can be defined as a system able to be pleasing as a whole i.e., socially, culturally, environmentally and economically [53]. In this study, environmental and social sustainability is the main topic.

Several authors have studied stakeholder approaches towards sustainable agro-food products and related aspects, e.g., labeling, animal welfare or organic production. Food labeling has been explored in various cases: e.g., Tanner and Kast [14] brought into evidence that positive consumer attitudes towards sustainable characteristics facilitate purchases of green products; Vermeir and Verbeke [15,16] highlighted the importance of several variables, e.g., personal attitudes or perceived social influences, in stimulating consumption of sustainable foodstuffs; however, Grunert et al., [58] mentioned that sustainability labels have a secondary value in the purchase process and their importance is linked to the level of perception of sustainability in the food sector. Massaglia et al., [59] proved that consumers require detailed labels to easily recognize sustainable food production i.e., animal welfare. Sometimes, the information provided by labeling is not very clear: e.g., Gadema and Oglethorpe [60] and Hartikainen et al., [61] evidenced confusion among consumers reading carbon footprint labels, Bollani et al., [51] underlined lesser knowledge of climate labels, Van Loo et al., [49] and Hartikainen et al., [61] showed lesser interest in carbon footprints, Polonsky et al., [62] evidenced doubts on carbon offset labels. Meanwhile, Vecchio and Annunziata [63] and Cholette et al., [64] highlighted the importance of identifying consumers interested in food sustainability in order to obtain real benefits.

Animal welfare is another important aspect related to food sustainability and safeguarding the environment [65,66]. The previous interpretation of a set of external requirements contributing to increasing cattle profitability has been substituted by a new consideration, i.e., animals are sentient beings [67]. Indeed, consumers search for healthy foodstuffs obtained through sustainable animal welfare processes and reduction of conventional meat consumption [68–72]. At the same time, food supply chain operators use animal welfare as a marketing tool in order to promote their corporate image and diversify the business [73–77].

Organic production and organic certification are further important tools for improving food sustainability and consumer behavior. On the one hand, personal and social norms, perceived availability and consumer sustainability orientation positively influence a conscious purchasing behavior that therefore can positively affect organic food consumption [20]; consumers' preferences for organic produces also drive organic wine purchases [78]; moreover, consumers with higher levels of education are more prone than others towards purchasing organic products, mainly for health, product quality and environmental protection reasons [79]. On the other hand, organic production can be perceived in a different way. Green skepticism can negatively affect organic food consumption [20], health aspects of organic extra virgin olive oil influence Italian consumers more than production process sustainability [80], price is a barrier to purchasing organic products [34]. These types of production are regulated by public and private rules resorting to communication tools, i.e., "*production labels*": such rules may be defined as production rules aimed at making natural life less artificial, as to animal breeding, and closer to natural cycles, as to agricultural production, with a view to reducing the impact on environment, of which all living creatures are part [58,81].

Moreover, Sama et al., [21] evidence that origin and type of production are two aspects to which consumers assign a high value, and that consumers recognize positive utility in socially and environmentally sustainable products rather than in conventional ones. Annunziata and Mariani [82] identify three consumer segments characterized by different sustainability attributes, such as organic production and local food. Siegrist and Hartmann [22] prove that some aspects, e.g., low meat consumption and perception about the high environmental impact of meat, stimulate consumption of meat substitutes. Baudry et al., [83] recognize different reasons, e.g., health, price or taste, determining consumers' food choice.

This study is developed around the Millennials' perceptions of sustainability in the food sector. In literature, several studies analyze the relation between Millennials and the meaning of sustainability. Sometimes authors highlight the Millennials' knowledge of ecology principles and their adoption in consumption and lifestyle [84–88]. In other cases, Millennials are investigated to assess their interaction by ICT, e.g., the assessment of computer games to reach the triple bottom line [89,90] or their attitude towards sustainability and information technologies [91].

However, a few studies deal with Millennials' attitudes toward food and beverage. Spain et al., [92] suggest that mainly US Millennials would be willing to seek out higher welfare products if they trusted label claims. Yoon and Chung [93] suggest that hygienic and environmental risks and hedonic benefits influence Millennials' attitudes and visit intentions towards food-truck dining experiences. Moreover, on the one hand, Cavaliere and Ventura [94] prove that eco-friendly Millennial students can perceive innovation technologies in food products as a safety risk, on the other hand, Öz et al., [95] highlight that Millennials, with higher levels of education as to biotechnology concerns, remark less risk and have fewer safety concerns than non-Millennials towards genetically modified technology and products. Lastly, Harun et al., [96] evidence that Millennials are not influenced in their fast food purchase intention by Corporate Social Responsibility (CSR) and Bollani et al., [51] underline that climate labels are not well-known by Italian Millennials; Thompson and Barrett [97] evidence that Millennials believe that wine increases enjoyment of food and conviviality; Pomarici and Vecchio [98] show that female and older Millennials who live in an urban area are more interested in buying labelled sustainable wines than others; Henley et al., [99] underline the importance of some labeling information, as sensorial characteristics, in influencing Millennials' wine purchase intentions.

In a nutshell, several specific sustainability characteristics, e.g., origin or type of production, and specific tools, such as sustainability labels, can influence consumers' behavior in their food choices and food purchasing process [17,20,21,51,68,82,83,98,100,101].

2. Materials and Methods

A survey was carried out to detect the perception of the concept of sustainability in the agro-food industry among Millennials chosen in the University world. The sample was recruited directly at the

Turin, Cuneo and Biella campuses of the School of Management and Economics of Turin University at the beginning of 2016. In this case, three locations were considered, i.e., one metropolitan area (Torino) and two smaller areas (Biella and Cuneo), in order to gain a wider variability. The analysis was based on a two-stage sampling strategy, i.e., classes were considered first stage units, and were chosen; the second stage units, i.e., all willing Millennial students present in each class, were involved in the study. They received the required privacy information according to the Italian Legislative Decree of 30 June 2003. This way of sampling represents an easy access to a significant number of individuals with specific characteristics, i.e., mainly young age and at least high school diploma, according to other studies [16,51,63]. Moreover, the survey design considered as main element the opportunity to have a direct interaction with the respondents in the administering phase. The sample consisted of Millennials, i.e., young adults born between 1980–1996, who are considered an important generation in order to assess consumption of goods. Interviewees replied to a structured questionnaire taking an average of 20 min. An explanation of the questionnaire was given before its distribution.

A pre-test of the first version of the questionnaire was carried out on 90 University students to avoid any mistakes or structural weaknesses of the inquiry [51,63,102]. This step was helpful in order to detect some aspects which were not very clear, i.e., familiarity with sustainability labels used in the Italian food market and introduction of new kinds of sustainability labels. In the first case, the relevant queries were rephrased to improve their clarity; in the second case, the section dedicated to new kinds of labels was eliminated. Therefore, a few adjustments were made and—subsequently—a new version was set up.

The final version of the questionnaire was structured into 6 sections. The first five sections were composed of various statements that were evaluated by a seven points Likert scale (Appendix A).

The first part foresees a series of 7 statements which should be given a numeric value on the basis of their connection to the various meanings (environmental and social) of the term sustainability, i.e., promotion of sustainable agriculture, equilibrium between economic development and use of renewable resources, better waste management, reduction of human land use, reduction of all kinds of pollution, reduction of energy consumption, substitution of conventional resources in favor of renewable ones.

The second one is composed of 10 statements and investigates which attributes of food products should be considered sustainable, i.e., use of renewable resources in production processes, use of bio-compostable packaging, animal welfare information, reduction of greenhouse gases in production processes, support to the local economy, support to developing countries, waste reduction in production processes, reduction of pollution from transports, use of sustainable fishing, promotion of organic agriculture.

The third part presents 5 statements related to waste management, i.e., reduction of weight of packaging, reuse of food packaging, importance of waste recycling, importance of a reuse of food products, importance of using packaging and food products for energy production.

The fourth part regards a request of evaluation of some information related to sustainable aspects and the importance of communicating sustainability by labels. There are 7 statements addressing the distance between production site and commercialization site of food products, the importance for a product to be local or regional, the quantity of gas emission due to the production of food products, the importance of sustainable agricultural systems, the importance of a relative reduction of the environmental impact, the importance of agricultural systems reducing the use of chemical additives and chemical fertilizers, the importance of initiatives aimed at gas emission compensations.

The fifth part is devoted to particular aspects related to animal welfare and connected livestock and to avoiding genetically modified organism (GMO) use in food production processes. The questionnaire ends with a sixth part dedicated to socio-demographic information.

The collected data were explored with descriptive statistics, followed by multivariate statistical techniques in order to get an integrated vision of relationships among the variables.

Given the high number of considered variables, some Principal Component Analysis (PCA) was carried out in each of the first four parts of the questionnaire, where the Likert scale is presented. It was applied to sets of variables corresponding to questions, thus summarizing the most important quantitative variables. This technique reduces most of the information contained in the original variables (which were standardized to account for differences in size) to a limited number of new ones, called *dimensions* or *factors*. The dimensions were calculated as linear combinations of the original variables, using normalized weights, to preserve the maximum of variance among them.

The first PCA dimensions (which represent at least 75% of the explained variance) were then used as input for a Hierarchical Cluster Analysis (HCA). In HCA, the square Euclidean distance as a measure of similarity and the Ward method to aggregate respondents were used. The number of clusters, chosen for each HCA, depended on the cutting level of the corresponding dendrogram, i.e., hierarchical tree. The partition generated cutting the dendrogram was the one determined by the higher relative loss of the within-cluster inertia, descending along the tree.

To achieve a comprehensive overview of these four parts, a global PCA was also carried out, so as to bring into evidence individual preferences for each interviewee along all their answers. Therefore again a HCA was performed with the same purpose as above. These clusters were then considered levels of a qualitative variable in further analyses.

Concerning animal welfare and GMO free variables, the seven points Likert scale was summarized into three levels, i.e., low (level from 1 to 3), medium (4 to 5) and high (6 to 7).

In order to consider all qualitative variables thus obtained within a single framework, a multiple correspondence analysis (MCA) was performed in order to identify the underlying structures of the dataset. R software, FactoMineR [103] and CA [104] packages were used for the analyses. All qualitative variables and related items considered in the MCA are shown in Table 1.

Table 1. Variables and related items used in multiple correspondence analysis (MCA).

Variables	Items	Descriptions
DefSust	DefSust: High	High awareness of sustainability definition
	DefSust: Med	Medium awareness of sustainability definition
	DefSust: Low	Low awareness of sustainability definition
CharFoodProd	CharFoodProd: High	A food product must have certain characteristics in order to be considered sustainable
	CharFoodProd: Med	A food product should have certain characteristics in order to be considered sustainable
	CharFoodProd: Low	A food product does not need to have certain characteristics in order to be considered sustainable
WasteManage	WasteManage: High	Waste management is very important to preserve environment
	WasteManage: Med	Waste management is averagely important to preserve environment
	WasteManage: Low	Waste management is not important to preserve environment
Label	Label: High	Food labeling is very important to communicate sustainable activities
	Label: Med	Food labeling is averagely important to communicate sustainable activities
	Label: Low	Food labeling is not important to communicate sustainable activities
GMOFree	GMOFree: High	GMO free products are very sustainable
	GMOFree: Med	GMO free products are averagely sustainable
	GMOFree: Low	GMO free products are not sustainable
AnimalWelfare	AnimalWelfare: High	Animal welfare is very useful for foodstuff sustainability

Table 1. *Cont.*

Variables	Items	Descriptions
	AnimalWelfare: Med	Animal welfare is averagely useful for foodstuff sustainability
	AnimalWelfare: Low	Animal welfare is not useful for foodstuff sustainability
Warranty	Warranty: Yes	Labeling, certification schemes and sustainable land use are very important for sustainability of food products
	Warranty: No	Labeling, certification schemes and sustainable land use are not important for sustainability of food products
Ethics	Ethics: Yes	Supporting developing countries, local economies and animal welfare is very important for sustainability of food products
	Ethics: No	Supporting developing countries, local economies and animal welfare is not important for sustainability of food products
Innovation	Innovation: Yes	Increasing renewable energy, reducing waste and energy consumption are very important for sustainability of food products
	Innovation: No	Increasing renewable energy, reducing waste and energy consumption are not important for sustainability of food products

In summary, the analytic process was structured as presented in Figure 1. First, it considered a set of quantitative variables, one for each of the first four sections of the questionnaire, and transformed each set into a qualitative variable with a PCA followed by HCA technique. The cluster output was considered such as levels of the obtained qualitative variables. Secondly, all the quantitative variables considered before were scaled in terms of individual preferences and then a new PCA-HCA process was conducted to produce another classification. Additionally, this output was considered as levels of another qualitative variable. Thirdly, two quantitative variables, i.e., "Animal welfare is useful for foodstuff sustainability" and "GMO free products are sustainable", were transformed into qualitative variables. Lastly, using the qualitative variables collected in the previous stages, a global MCA-HCA process was performed to summarize the entire questionnaire as a whole.

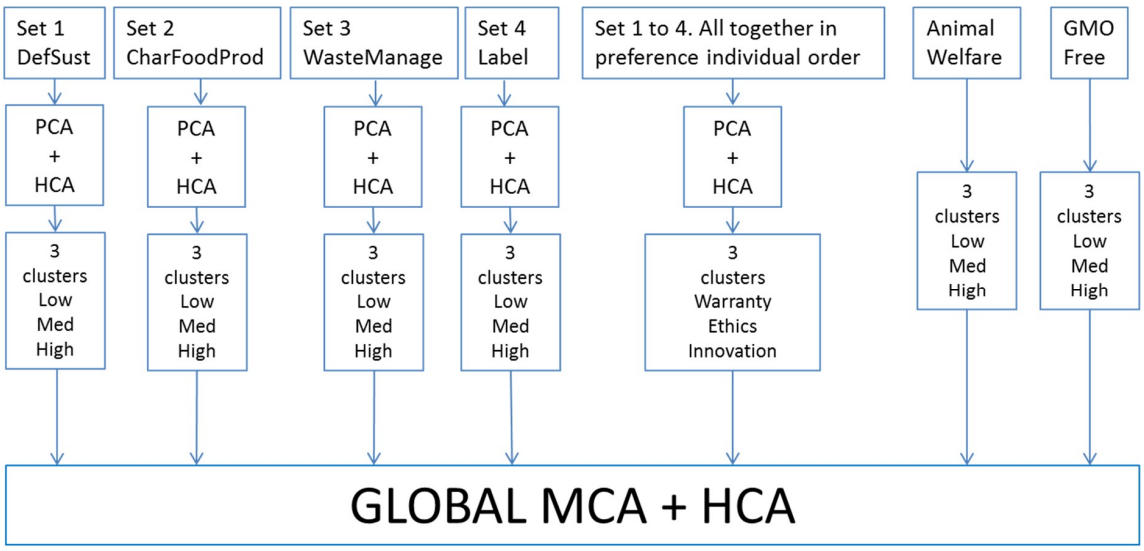

Figure 1. Elaboration process flow chart.

3. Findings and Discussion

The sample was made up of 268 individuals, 24.3% of which aged between 19 and 20, 48.1% between 21 and 23, 23.9% between 24 and 28 and 1.9% over 28. No answer was given by 1.9% of the interviewees. 61.9% of the interviewees was female, 38.1% male (Table 2).

Table 2. Demographic and personal characteristics.

Demographic and Personal Characteristics	No.	% of the Total
Gender		
Male	102	38.1%
Female	166	61.9%
Age		
19–20	65	24.3%
21–23	129	48.1%
24–28	64	23.9%
>28	5	1.9%
No reply	5	1.9%

Firstly, four groups of quantitative variables—expressed in a seven points Likert scale—were considered in relation with the parts of the questionnaire presented above. For each group a PCA was performed and its dimensions were used as input for a HCA, obtaining a set of clusters, as follows:

- Group 1, related to the meanings of the term sustainability; three clusters were obtained, based on progressive awareness of the definition of sustainability
- Group 2, related to the characteristics a food product should display in order to be considered sustainable; three clusters were obtained, based on progressive request of characteristics needed in order to consider a product sustainable
- Group 3, related to waste management; three clusters were obtained, based on progressive importance bestowed on waste management within the concept of sustainability
- Group 4, related to the importance of labels in sustainability; three clusters were obtained, based on progressive importance given to labels for sustainability communication.

Finally, a global PCA was also carried out, so as to bring into evidence individual preferences of each interviewee along all their previous answers, and again a HCA was consequently performed, obtaining the three clusters shown in Figures 2 and 3.

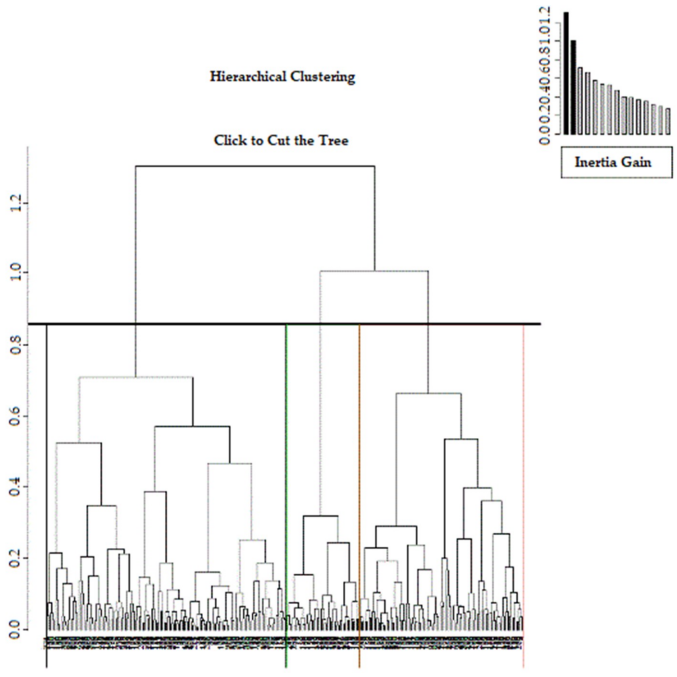

Figure 2. Hierarchical Cluster Analysis (HCA) dendrogram. It shows the distance level chosen to identify clusters.

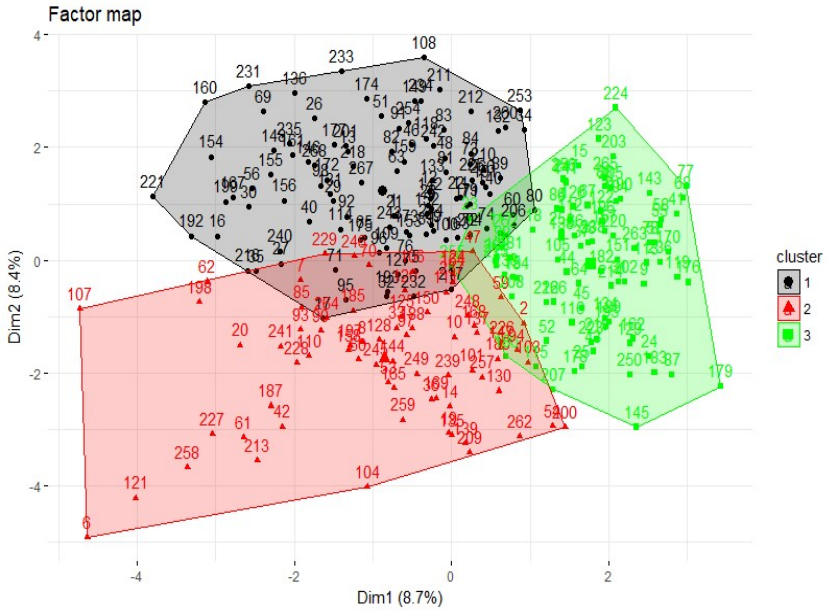

Figure 3. Factor map. Each cluster is represented with its specific elements.

A brief description of this set of clusters follows:

Cluster 1—Warranty: it is characterized by a particular attention to the environment and warranty claims, in terms of respect and reduced impact on the environment, avoiding or reducing chemical additives and gas emissions (or, if necessary, introducing compensations), maintaining a low human impact on land, promoting sustainable organic farming, considering also distances for transports, and finally promoting low energy consumption and reuse of waste. Students belonging to this cluster are sensitive to the human tools that reduce environmental impact.

Cluster 2—Ethics: it is characterized by particular attention to the support of developing countries and the local economy, to the importance of preserving and staying informed about animal welfare, to preserving and respecting the environment in many ways, such as avoiding or reducing chemical additives, transport pollution and greenhouse gases (or, if necessary, introducing compensations), to promoting recycling, reuse and energy recovery. The components of this cluster are sensitive to safeguarding environment in order to preserve the Earth and supporting other people in different geographical areas.

Cluster 3—Innovation: it is characterized by a particular interest in renewable resources, also considering a balance with traditional ones, and generally with a good use of resources; as regards land use, there is a demand to maintain a low human impact, support organic farming and support the local economy; as to energy aspects, the focus is on low energy consumption, on reducing pollution, while—as regards waste—it is important to maintain control by reducing weight and enhancing reuse of packaging (with high preference for biodegradability) and in general by waste sorting.

Each set of clusters described above was then considered as a qualitative variable and used as input for a MCA—as explained in the methodology paragraph (Table 1)—also including animal welfare and GMO-free information.

The MCA output is presented in Figure 4. Following the horizontal axis from right to left, the figure shows a progressive interest for food products' characteristics, waste management and labeling related to the concept of sustainability (*CharFoodProd*; *WasteManage*; *Label*), while increasing renewable energy, reducing waste and energy consumption tend to lose importance (*Innovation*). Moreover, the vertical axis, from bottom to top, suggests increasing interest in issues related to, on the one hand, diffusion of animal welfare and GMO free products (*AnimalWelfare*; *GMOFree*), and on the other hand, support to local economies and developing countries (*Ethics*); while, from the top to the bottom, a

progressive interest can be observed in warranty tools oriented to low environmental impact and sustainable food labeling (*Warranty*).

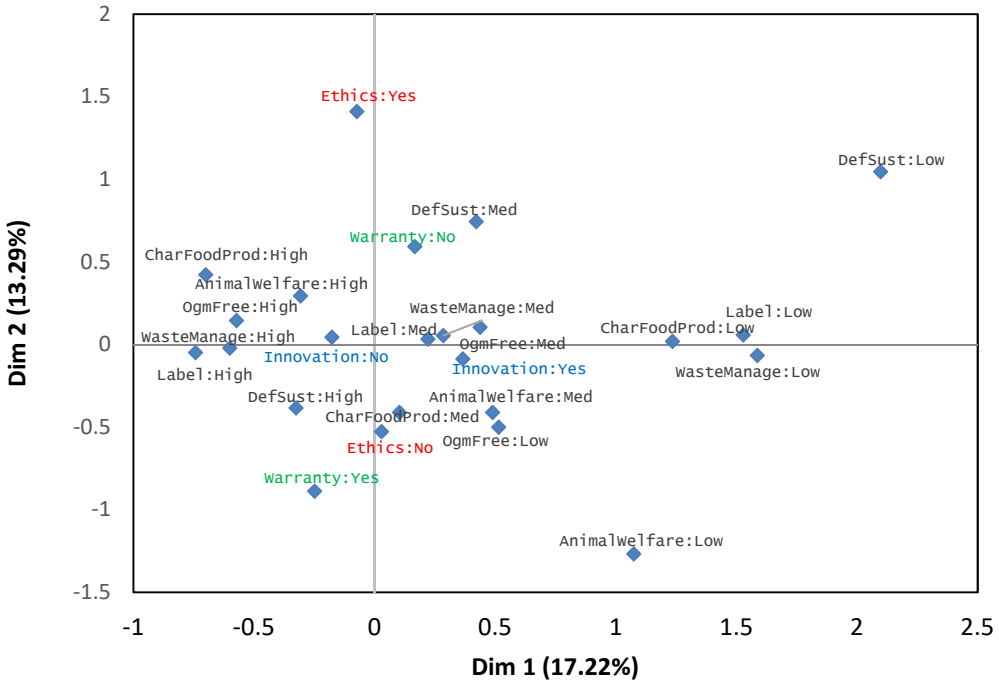

Figure 4. MCA factor map. It shows the interaction amongst items of different variables.

The MCA coding scheme leads to underestimate the percentage of inertia explained by the first dimensions [105]. Therefore, two revaluation methods, for the dimensions shown in Figures 4–6, are performed as follows. The Benzecri revaluation [106] recalculated a percentage of inertia explained by 55.05% from the first dimension and by 21.68% from the second. The Greenacre revaluation [107], which is more parsimonious, obtained 39.46% for the first dimension and 15.54% for the second.

The Factorial dimension found through the MCA suggested further in-depth analysis; consequently, a cluster analysis was carried out in order to differentiate the main groups of samples based on different behaviors. The factorial dimensions are the same in Figures 4–6. The graphical output of the cluster analysis is shown in Figures 5 and 6.

FIRST CLUSTER (Socio-Nature Sensitives). It is characterized by a high level of importance given to supporting developing countries and local economies, as well as implementing agricultural systems careful of animal welfare (*Ethics.Yes*; *AnimalWelfare_High*). Furthermore, a food product must have specific characteristics in order to be considered sustainable (*CharFoodProd_High*) and some information by labeling must be communicated (*Label_High*). This cluster is constituted by 22.76% of the whole sample.

SECOND CLUSTER (Info-Supporter). The characteristics of the second cluster are following: labeling, certification schemes and sustainable land use policy are very important to sustainability of food products (*Warranty.Yes*; *Label_High*) and there is high awareness of the definition of sustainability (*DefSust_High*). This cluster is constituted by 36.94% of the sample.

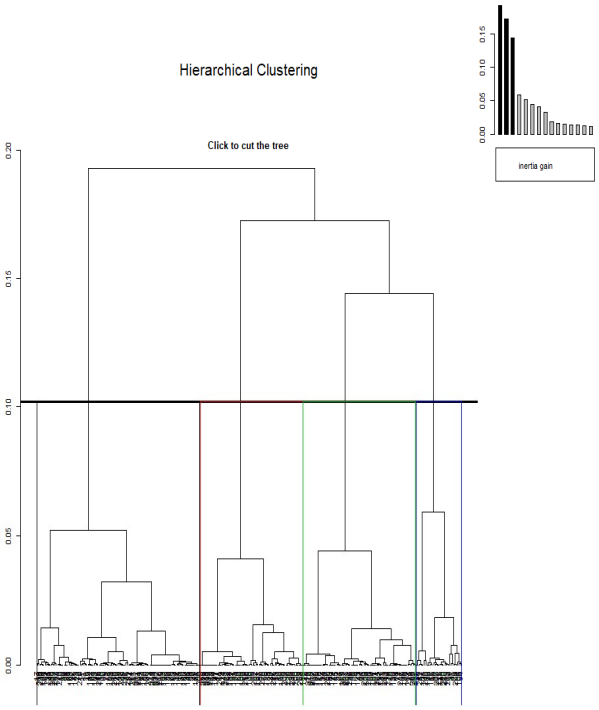

Figure 5. HCA dendrogram. It shows the distance level used to identify clusters.

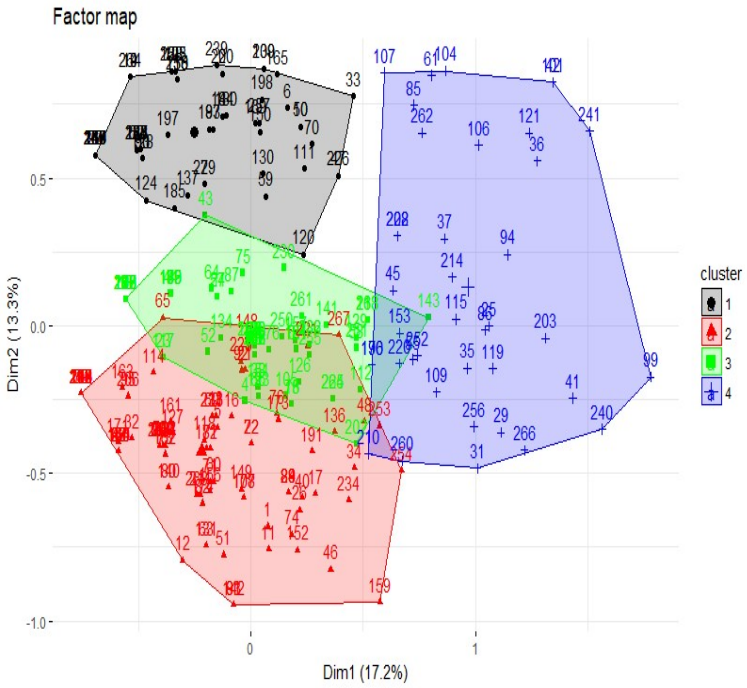

Figure 6. Factor map, with the elements that belong to each cluster.

THIRD CLUSTER (Proactive-Oriented). The characteristics of the third cluster are following: increase of renewable energy, reduction of waste and energy consumption. They are very important for the sustainability of food products (*Innovation.Yes*) and in this group there is high awareness of the definition of sustainability (*DefSust_High*). Moreover, this cluster assigns a high level of importance to waste management (*WasteManage_High*) and a medium level of importance to labeling (*Label_Med*) and characteristics of food products (*CharFoodProd_Med*). This cluster is constituted by 25.75% of the sample.

FOURTH CLUSTER (Indifferent) The fourth cluster gathers a group that assigns a low level of importance to labeling (*Label_Low*), characteristics of food products (*CharFoodProd_Low*), waste management (*WasteManage_Low*), animal welfare (*AnimalWelfare_Low*) and GMO free (*GMOFree_Low*). Also, it shows a low/medium awareness of the definition of sustainability (*DefSust_Low/DefSust_Med*), but increase of renewable energy, reduction of waste and energy consumption seem to be very important for the sustainability of food products (*Innovation.Yes*). This cluster is constituted by 14.55% of the sample.

Each phase of the food supply chain may affect resources and generate several direct and indirect environmental and social impacts. In this context, consumers seem to be the main actors who should be sensitized in order to change negative trends in the food process. In previous studies, consumers are assessed e.g., based on type of production and origin of products, i.e., local and regional [21], or in terms of perception of sustainability attributes [82]. In the first case, three consumer clusters were identified, i.e., "Fair Trade Consumers" who assign more value to this type of produce, "Local Consumers" who assign more value to the local origin of products and "Price Sensitive Consumers" who are less ready to pay for sustainable products. In the second case, consumers were divided into three groups: the most numerous was "egocentric-oriented", the medium was "environmental sustainability-oriented" and the smallest was allover "sustainability-oriented".

On the one hand, the present study evidences three groups with specific peculiarities, i.e., "Info-Supporter" Millennials, very sensitive to labeling and warranty systems; "Proactive-Oriented" Millennials, interested in innovation activities, i.e., reducing energy consumption and improving food waste management; "Indifferent" Millennials, assigning a low level of importance to all the above. In particular, it remarks that low sensitivity for nature, i.e., low interest in labeling, characteristics of food products, waste management, animal welfare and GMO free, is balanced by innovation and that, therefore, the tech-ability of humans is sufficient to solve environmental concerns, partially in line with Öz et al., [95]. On the other hand, it highlights that the first cluster of Millennial respondents, i.e., "Socio-Nature Sensitives", is characterized by a high level of attention to the socio-economic dimension and sustainable patterns of food production, along with "Fair Trade Consumers" [21] and the "Sustainability-Oriented" cluster [82]. Moreover, findings evidence that "Socio-Nature Sensitives" support the importance of food labeling in order to communicate sustainable activities and integrate the concept of sustainability in the food sector in line with the second cluster i.e., "Info-Supporter", that underlines the importance of labeling and warranty tools. Therefore, the majority of respondents, i.e., first and second clusters, shows a sensitive approach to food sustainability, is sustainability-oriented with different levels of interest and stresses the importance of communicating information on food sustainability by labeling and certification schemes.

The food supply chain heavily affects environment and society by overproduction of food, which causes excessive consumption of energy, degradation of other resources such as soil and aquatic environments and social inequalities. The European Union food policy shows some inconsistencies and gaps on this topic; transformations in the food system are needed, as suggested by other authors [11,53]. In this context, substantial literature on interaction between Millennial students and sustainability in the food sector has not yet been developed. The founded dimensions of the concept of sustainability in the food sector among Millennial students allow to discuss their perception as to the food sustainability concept, dividing them into four different groups with specific peculiarities.

Findings shows that Millennial students are sensitive to sustainability concerns, believe in labeling and certification systems as means of communication in order to convey information on types of production, and hope innovation processes will reduce the environmental impact. These indications are a good basis in order to implement a change of consumers' habits towards a revision of the food system. Therefore, findings provide useful information and some contribution to assist public institutions in implementing new rules and new tools in the food sector. On the one hand, these results suggest the introduction of new rules to improve the food production system, e.g., implement animal welfare requirements and/or education systems dedicated to more sustainable consumption. On the

other hand, some certification and labeling schemes are needed to better explain the characteristics of food products during the purchase phase, e.g., labeling dedicated to providing some information on food waste management and/or sustainable production process.

On top of this, food producers, food supply chain operators and private institutions should use this information in order to design a new interpretation of the food supply chain. Indeed, on the one side, they should apply the aforementioned new compulsory and voluntary rules to improve the consumers' knowledge and perception of sustainability in the food production process. On the other side, they should support the integration of the concept of circular economy with new materials and food products having low impact on the environment, e.g., introducing compostable packaging and supporting animal welfare production systems. Consequently, all stakeholders should cooperate in supporting such change.

4. Conclusions, Limitations and Future Research

This study investigated the interaction between Millennial students and the meaning of sustainability in the food sector with the scope to collect information feeding the debate among stakeholders on driving choices towards new consumption rules and production patterns. Findings showed that Millennial students are sensitive to sustainability concerns, believe in labeling and certification systems as means of communication in order to convey information on types of production, and hope innovation processes will reduce the environmental impact. Moreover, results showed how the younger generations could make an essential contribution to the debate among stakeholders on driving choices towards new production and consumption patterns. Indeed, on the one side, public institutions could discuss and implement new policies and new tools aligned with the new trends requested by an increasingly attentive part of consumers whilst, on the other side, private stakeholders, i.e., food companies, should redesign the food supply chain highlighting these new drivers of sustainability. However, the study displays some limitations, such as the number of selected respondents and the sites where the survey was carried out. The survey design was drafted by the purposive sampling method in the choice of the first-stage units to satisfy the need of a public questionnaire introduction before its distribution and then a direct interaction with the respondents in the administering phase. An extension of the study area and an enlargement of the sample should be carried out in order to improve and compare findings, as well as focus on the stakeholders' activities which need to be implemented. It should be acknowledged that the present results are the first outcomes of an extended research which, in a second phase, will focus on an analysis of conventional patterns of food production and alternative processes.

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Appendix A

Main survey questions. The questionnaire was organized in parts as explained in "Materials and methods". Respondents were asked to answer using a seven-point Likert scale to the statements of the following blocks (an "I do not know" answer was also allowed for each statement).

Part I—DEFINITION OF SUSTAINABILITY

Sustainability is the ability to satisfy the needs of present generations without compromising those of future generations. Express a degree of relevance for the following statements:

- Promote forms of sustainable agriculture
- Reconcile economic growth and use of natural resources
- Promote and encourage separate waste collection, re-use packaging, reduce waste
- Limit use of land for human needs (e.g., deforestation, urbanization, pastures, crops)

- Limit the different forms of pollution (chemical, atmospheric, water, acoustic, etc. ...)
- Reduce consumption of energy resources
- Use more renewable resources as opposed to non-renewable ones

Part II—SUSTAINABILITY AND AGRO-FOOD PRODUCTS
How important are each of the following characteristics for a sustainable food product?

- Use renewable energies during the production process
- Packaging composed of biodegradable materials
- Animal welfare information
- Reduce greenhouse gas emissions during the production process
- Contribute to the development of the local economy
- Contribute to the progress of developing countries
- Limit waste during production
- Reduce the transport phase to limit polluting emissions
- Use sustainable fishing methods
- Promote organic farming

Part III—SUSTAINABILITY AND ENVIRONMENTAL IMPACT
To reduce the environmental impact deriving from waste from the agro-food sector, how much do you think each of the following activities is effective?

- Packaging weight reduction
- Reuse of food packaging
- Waste recycling
- Reuse of food products
- Recovery of packaging and food products for energy production

Part IV—SUSTAINABILITY AND LABELING
How important do you think the following information on the labeling of food products is?

- The number of kilometers travelled for transporting the food product from the place of production to the place of marketing
- The proximity of the place of production of a product (e.g., "local" or "regional")
- The quantity of climate-altering gases emitted for the production of a given food product
- The indication of methods of agricultural production more respectful of the environment than conventional production (e.g., crop rotation)
- The indication of the percentage reduction of the environmental impact during the production of a given product
- Use of agro-food production methods with low environmental impact (e.g., eliminate chemical additives, reduce fertilizers)
- Initiatives aimed at offsetting greenhouse gas emissions during production

PART V—SUSTAINABILITY, ANIMAL AND GMO WELL-BEING
To reduce the environmental impact deriving from agricultural production, how effective do you think each of the following activities is?

- Breeding of animals in conditions that respect their needs
- Ban on the use of genetically modified organisms

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