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Consumer stated preferences for dairy products with carbon footprint labels in Italy

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(Article begins on next page)

Agricultural and Food Economics

Consumer stated preferences for dairy products with carbon footprint labels in Italy --Manuscript Draft--

Manuscript Number:	JAFE-D-18-00087R1
Full Title:	Consumer stated preferences for dairy products with carbon footprint labels in Italy
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Abstract:	<p>Carbon footprint (CF) labels on agri-food products represent one of the most important tools to convey information to consumers about the greenhouse gases emissions associated with their purchase behaviour.</p> <p>Together with the growing interest of consumers in CF labels, the subject has gained attention also in the scientific literature, and formal evaluations of consumer response to carbon labelling have been published. Studies in this area aim at analysing consumers' preferences for buying products with a lower CF label or their willingness to pay (WTP) for these products.</p> <p>The objective of this paper is twofold. First, the study proposes a review of the literature that so far has analysed consumer WTP for CF label, focusing on Italian consumers. Second, it uses the results of two surveys of consumers' attitudes towards dairy products with a lower CF label to analyse the factors determining a positive stated WTP. Results point out that a positive WTP for lower CF products is more likely to be declared by respondents who believe that buying products with less environmental impact can combat climate change. Conversely, highly price-sensitive consumers are less likely to be willing to pay more for CF labelled products.</p>
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Response to Reviewers:	<p>Revision notes of manuscript submitted to Agricultural and Food Economics (JAFE-D-18-00087), entitled "Consumer stated preferences for dairy products with carbon footprint labels in Italy"</p> <p>We would like to thank the three anonymous referees and the Editor for their useful comments and suggestions. This revised version aims to address all the remarks received and thus substantially differs from the previous version. The overall consequence of these major revisions is that the paper is now a little longer. This revision work is detailed as point-by-point replies to the referees' remarks.</p> <p>Point-by-point reply to reviewers' comments: Reviewer #1</p>

The paper tackles a topical theme, it is clearly written and well structured. I suggest a re-reading of the whole text to correct and clarify some passages. See for example: line 74 "her social responsibility"; line 76 "an important driver for change, is"; lines 93-94 "the European commission has identified 129 public (both public and private) information plans"; line 131 "Secondly, the search of abstract"; lines 139-138 "Table 1 summarizes the main aspects of the research selected"; line 177 "that that"; lines 201-203 "The questionnaires [...] were composed of four sections [...], environmental and CF labels"; lines 219-220 "Given this different approach in the elicitation of the WTP in the two studies"; lines 262-263 "If the respondent [...] she is more likely to evaluate it positively"; line 295 "their uptake"; line 298 "to incentivise firms testing"; line 303 "a private initiative in the field are promising"; line 323 ""it is not rare"

Reply:

We are grateful to the reviewer for the comments and suggestions. The text has been thoroughly revised in order to improve the quality of the English language use and grammar, the clarity of explanations and to eliminate errors, typos and unclear sentences like those pointed out by the reviewer, which have all been addressed.

Reviewer #2

#1) [...] your literature review is limited. By only using Elsevier's "sciencedirect.com" I found a number of important publications that were not even mentioned in your literature review. Just to give you some examples:

Atsushi Kimura, Yuji Wada, Akiko Kamada, Tomohiro Masuda, Masako Okamoto, Shoji Goto, Daisuke Tsuzuki, Dongsheng Cai, Takashi Oka, Ippeita Dan, Interactive effects of carbon footprint information and its accessibility on value and subjective qualities of food products, *Appetite*, Volume 55, Issue 2, 2010, Pages 271-278

A.C. Hoek, D. Pearson, S.W. James, M.A. Lawrence, S. Friel, Healthy and environmentally sustainable food choices: Consumer responses to point-of-purchase actions, *Food Quality and Preference*, Volume 58, 2017, Pages 94-106

Ellen J. Van Loo, Vincenzina Caputo, Rodolfo M. Nayga, Han-Seok Seo, Baoyue Zhang, Wim Verbeke, Sustainability labels on coffee: Consumer preferences, willingness-to-pay and visual attention to attributes, *Ecological Economics*, Volume 118, 2015, Pages 215-225

Mohamed M. Mostafa, Egyptian consumers' willingness to pay for carbon-labeled products: A contingent valuation analysis of socio-economic factors, *Journal of Cleaner Production*, Volume 135, 2016, Pages 821-828

I assume, if I would dig deeper, a large number of further publications could be found. I suggest to go back to critically investigate international literature.

Reply:

The reviewer is right in noticing some of the cited references were missing. To this respect, it should be noticed that, among the paper suggested by the reviewer, the one by Kimura et al. (2010) was already included in the literature review carried out, while all other suggested references have been included.

As indicated in the manuscript (section 3) "Articles were selected by checking against pre-determined criteria for eligibility and relevance. Firstly, keywords have been identified as the following: "footprint" (and its possible variation "foot-print"), "consumer", "food", together with their Italian translations". This specification allows the reader to reproduce the search at the date of data extraction. We acknowledge that this might have caused the exclusion of some relevant papers on the same themes and, in fact, some of the papers suggested by the reviewer unfortunately did not have all these keywords in the abstract. For example, the paper by Mustafa (2016) does not clearly state in the abstract if the evaluation of the WTP for a carbon-labelled product is performed on a food product. In fact, also in the manuscript, there is a generic indication of an evaluation of "Egyptian consumers' willingness to pay (WTP) for carbon-labeled products". However, rather than excluding this paper from our analysis we now incorporate it highlighting that the product was unspecified.

However, to better acknowledge this likely failure in covering all the relevant literature, now the manuscript more clearly stresses that point in footnote #6.

#2) Second: Your empirical results are not really delivering trustworthy, new results.

The sample is problematic (university degree of respondents etc.), the logic model you used delivers results that are almost explaining nothing (Pseudo R2 is really low). And even the interpretation is wrong - you write: "Results indicate that being a female positively affects the probability to be willing to pay more for CF labelled milk". Even if the significance is close to 0.05 - it is above this critical value and the relation should therefore not be accepted confirming usual convention in research. Also taking into account the limitations mentioned above your "gender" conclusion was really surprising for me. As your empirical data cannot be changed, this limitation of your contribution is critical which is the main reason for my rejection.

Reply:

The reviewer is right in noticing that the sample analysed is problematic, in the sense that the sampling method has undoubtedly affected the demographic characteristics of the respondents and thus the sample is not representative of the whole Italian consumers. This is now more clearly specified in the paper, as in section 4 it is stated "Though the use of web instruments to administer the questionnaire has facilitated reaching a high number of respondents, it raises the issue of representativeness of the sample, because this sampling method tends to gather self-selected respondents. Consequently, it usually generates a biased sample, in which younger people with a higher level of education or web literacy are overrepresented [...]. Therefore, the samples cannot be considered representative of Italian consumers; nevertheless, they allow obtaining quite interesting information about the relationship among the variables analysed. In fact, though WTP estimations based on a non-representative samples, cannot be used to extend WTP results to the population analysed, as figures would be obviously biased, the relationships among the socio-economic characteristics of respondents the positive WTP eventually expressed, still remain valid."

As regards the goodness-of-fit of the model, please note that logistic regression is fundamentally different from linear regression. This is the reason why its performance is evaluated using a "Pseudo" R2. As McFadden states about Pseudo R2 "its values tend to be considerably lower than those of the R2 index [...] For example, values of 0.2 to 0.4 for rho-squared represent excellent fit" McFadden (1979: 307). Thus, values like the one of the estimated model (i.e. 0.12) are typical of fairly fitting models. These values are not as low as they would be if compared to analogous values of the usual coefficient of determination (R2) deriving from a linear regression since they are not to be interpreted as a share of variance explained.

Besides, the area under the Receiver Operating Characteristic (ROC) curve in the model is 0.73 and this is a quite good value as this figure be higher than 0.5 (but lower than 1) to indicate a satisfactorily fitting model.

As regards results discussion, the reviewer is right in noticing that the comment on female results was not correct according to convention in research.

Following the suggestion of the reviewer, the text has been revised to highlight that females show a slightly higher WTP than males, but that this result is significant only at the 0.10 level. Hence, even if this result goes in the direction of what was found in previous work (e.g., Steiner et al., 2017; Vecchio and Annunziata, 2015), its statistical significance is quite poor.

Reference

McFadden D (1979) Quantitative Methods for Analyzing Travel Behaviour on Individuals: Some Recent Developments, in Behavioral Travel Modelling (eds.) Hensher D, Stopher P, Croom Helm, pp. 279-318

#3) Third: After your empirical analysis you write: "Results may have interesting policy implications". I really don't see how you derived some of the suggestions to politics out of your limited empirical results.

Reply:

The reviewer is right in noticing that strong policy conclusions cannot be drawn from poorly representative samples in terms of WTP estimation. However, as mentioned, relationships between variables analysed (excluding those statistically poorer) still remain valid.

The concluding section has been substantially reviewed. It now more clearly stresses that first of all, results should be confirmed by larger and more representative samples

to give unambiguous policy suggestions.
Secondly, it is now clarified that what the authors would like to underline, is that the results highlight the importance of tackling climate change with a dual approach that looks both a demand and supply-side options. To this respect, examples are provided.

Reviewer #3

[...] the premises suggest that the paper will describe the whole experiment but it is not. In fact, the results presented in the following paper represent only a part (a small and final part) of the study. Moreover, they are based on a result that belongs to another research paper (as stated by the authors) that has not yet been published. For this reason, I believe that the authors should include all the data (collected through the surveys and elaborated) in the following work, in order to provide all the elements necessary to justify and validate their results. The article should be revised (major revisions are suggested) in order to be published. The paper also needs a thorough review of the language.

Reply:

The reviewer is right in noticing that the paper presents only a small part of two biggest experiments, but both for space limitation and to be in line with the scope of the analysis, the overall description of the two surveys was not included in the previous version of the manuscript.

In the revised section it is first of all more clearly explained that one of the objectives of the study is to present only some of the results of two case study analysed, focusing the attention on the positive WTP estimation using the common variables among the two surveys.

Secondly, following the reviewer suggestion, the revised version of the paper now presents all variable gathered by both the surveys analysed. However, as the questionnaires used by the two surveys, were similar, but not identical, these data are presented separately. Section 4 now presents a new table (Table 2) which shows the descriptive statistics of the replies to the question that differed among surveys, and a revised Table 3 which shows all the common items analysed.

Moreover, the results that belong to another research paper have now been published and the relative reference is correctly cited, thus the reader can refer to the published paper for an in-depth evaluation.

Finally, following the reviewer suggestion, the text has been thoroughly revised in order to improve the quality of the English, the clarity of explanations and to eliminate errors, typos and unclear.

Additional Information:	
Question	Response

Consumer stated preferences for dairy products with carbon footprint labels in Italy

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Abstract

Carbon footprint (CF) labels on agri-food products represent one of the most important tools to convey information to consumers about the greenhouse gases emissions associated with their purchase behaviour.

Together with the growing interest of consumers in CF labels, the subject has gained attention also in the scientific literature, and formal evaluations of consumer response to carbon labelling have been published. Studies in this area aim at analysing consumers' preferences for buying products with a lower CF label or their willingness to pay (WTP) for these products.

The objective of this paper is twofold. First, the study proposes a review of the literature that so far has analysed consumer WTP for CF label, focusing on Italian consumers. Second, it uses the results of two surveys of consumers' attitudes towards dairy products with a lower CF label to analyse the factors determining a positive stated WTP. Results point out that a positive WTP for lower CF products is more likely to be declared by respondents who believe that buying products with less environmental impact can combat climate change. Conversely, highly price-sensitive consumers are less likely to be willing to pay more for CF labelled products.

Keywords: carbon footprint label, environmental labels, willingness to pay, consumer preferences, dairy products, logistic regression

JEL codes: D12, Q54, Q01

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Consumer stated preferences for dairy products

with carbon footprint labels in Italy

Abstract

Carbon footprint (CF) labels on agri-food products represent one of the most important tools to convey information to consumers about the greenhouse gases emissions associated with their purchase behaviour.

Together with the growing interest of consumers in CF labels, the subject has gained attention also in the scientific literature, and formal evaluations of consumer response to carbon labelling have been published. Studies in this area aim at analysing consumers' preferences for buying products with a lower CF label or their willingness to pay (WTP) for these products.

The objective of this paper is twofold. First, the study proposes a review of the literature that so far has analysed consumer WTP for CF label, focusing on Italian consumers. Second, it uses the results of two surveys of consumers' attitudes towards dairy products with a lower CF label to analyse the factors determining a positive stated WTP. Results point out that a positive WTP for lower CF products is more likely to be declared by respondents who believe that buying products with less environmental impact can combat climate change. Conversely, highly price-sensitive consumers are less likely to be willing to pay more for CF labelled products.

Keywords: carbon footprint label, environmental labels, willingness to pay, consumer preferences, dairy products, logistic regression

JEL codes: D12, Q54, Q01

1. Introduction

Climate change mitigation is one of the key environmental goals of agricultural production worldwide (Gerber et al., 2013). Moreover, in Europe, climate change mitigation objectives and the contribution that agriculture is expected to provide, have reached the top of the political agenda (European Commission, 2016). Climate action is one of the main priorities of the Common Agricultural Policy (CAP) and agricultural greenhouse gases (GHG) emissions' mitigation has become both an objective of the new architecture of the First Pillar payments and a focus area of the actual Rural Development Policy programming period (Council of the European Union 2013a and 2013b).

According to many studies in this field, however, supply-side options alone, i.e. options that tackle production aspects of GHG mitigation, are not sufficient to reach the ambitious mitigation targets set by European and international climate policy agenda (European Commission 2011 and 2016). In addition, though the most cost-effective ways to reduce GHG are carbon taxes and cap and trade systems (Nordhaus, 2013; Stern, 2007), these economic instruments are unlikely to be implemented in the near future in the agricultural sector, both in the EU (Coderoni and Esposti, 2018) and in the United States (Shewmake et al., 2015). Thus, demand-side solutions to climate change, which consist of more sustainable consumption patterns, are becoming important tools to curb agricultural GHG emissions (Garnett , 2011; Bajželj et al., 2014; Armel et al 2011; Brunelle et al., 2017; Creutzig et al., 2016; de Boer et al., 2016).

In this respect, the so-called “sustainable labels”, i.e. types of labels that are designed to convey to the consumer concepts related to all the facets of sustainability, are the most common tools supporting changes in consumption patterns (Vermeir and Verbeke 2006; Zander and Hamm 2010). When sustainable labels try to show to consumers the overall

1 47 impact of the product converting it into a standardised measure of carbon dioxide
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3 48 emissions, they are referred to as “carbon footprint” (CF) labels. CF labels in practice
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5 49 indicate the quantity (in grams) of carbon dioxide equivalent (CO_{2e})¹ emitted into the
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8 50 atmosphere throughout all the life cycle of a product or service, which comprises
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11 51 production, transport, transformation, distribution and purchase (Kohnle 2013). The
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13 52 rationale for these labels, when applied to food products, is that they may help to orient
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15 53 the consumer towards buying more GHG saving agricultural products and thus mitigating
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18 54 agriculture’s contribution to global warming.

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20 55 Despite the potentially relevant role of demand-side options in tackling climate change,
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23 56 there have been a few consumer studies on WTP for carbon footprint labels (Hoek et al.,
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25 57 2017), especially for Italian agriculture, where the bulk of the empirical literature has
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28 58 focussed on the potential and effectual role of the production processes to mitigate
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30 59 agricultural GHG emissions.² Thus, it would be essential to analyse consumers’
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33 60 preferences for purchasing products with a label showing a lower CF, to understand what
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35 61 drives their choices, and to recognise to what extent there is a mitigation potential deriving
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38 62 from Italian consumers’ choices for the Italian agricultural sector.

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40 63 In this context, the objective of this paper is twofold. First, we review the literature that
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42 64 until 2018 has analysed consumer preferences and WTP for CF label, with a focus on
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45 65 Italian consumers. Second, we illustrate some of the results of two separate pilot surveys

50 ¹ CO_{2e} is a term that describes different greenhouse gases in a common unit. A quantity of non-CO₂ GHG
51 (i.e. methane or nitrous oxide) can be expressed as CO_{2e} by multiplying the amount of the GHG by its
52 global warming potential (GWP).
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56 ² For Italian agriculture case study, both micro and macro level have been explored (see among others: Rete
57 Rurale Nazionale 2012; Coderoni and Esposti 2014; Baldoni *et al.*, 2017 and 2018).
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1 66 aimed at detecting whether consumers state a positive WTP for dairy products with a CF
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3 67 label.

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7 68 The remainder of the paper is structured as follows: Section 2 introduces some definition
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9 69 of sustainable labels, specifically referring to CF; Section 3 presents the literature review;
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11 70 Section 4 shows the case studies analysed, while Section 5 presents and discusses the
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13 71 results of the analysis; Section 6 finally proposes some concluding policy remarks and
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15 72 future research guidelines.
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19 20 73 **2. Carbon Footprint labels in the agri-food sector**

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23 74 According to Miranda-Ackerman and Azzaro-Pantel (2017: 1) “*New consumer*
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25 75 *awareness is shifting industry towards more sustainable practices, creating a virtuous*
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27 76 *cycle between producers and consumers enabled by eco-labelling*”.

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29 77 This consumer awareness is the foundation of sustainable consumption, which is
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31 78 grounded in a decision-making process that takes into account not only individual needs
32
33 79 and wants, but also their social responsibility. In fact, as De Pelsmacker et al. (2003: 2)
34
35 80 have found, when dealing with sustainability concerns, an important driver for change is
36
37 81 the inclination of the “*ethical consumer [that] feels responsible towards society and*
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39 82 *expresses these feelings by means of his purchase behaviour*”.³
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45 83 The concept of sustainability has deeply evolved from the primer environmentalist
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47 84 approach (Kumar et al., 2012) and now it comprises, in its most widespread use, three
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49 85 different aspects: the economic, the environmental and the social one (Vermeir and
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54 ³ Nevertheless, studies have found that convenience, value for money, habit, personal health concerns,
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56 hedonism and individual responses to social and institutional norms are still relevant aspects driving
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58 everyday consumption practices (SDC, 2003).
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1 86 Verbeke, 2006). Sustainable products are those products whose characteristics respect
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3 87 one or more of these aspects (Vackier et al., 2002).

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6 88 Eco-labelling, or environmentally sustainable labels, are a means to inform consumers of
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8 89 the environmental performance of either the products or the production systems they
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11 90 come from, and they can also inform the consumer on measures taken by the producers
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13 91 to minimise the product's environmental impact.

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15 92 One particular type of sustainable label is the so-called CF label, which is an indicator of
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18 93 the total amount of CO₂, or the equivalent of CO₂ in the case of the emission of other
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21 94 GHG (usually expressed in grams), emitted into the atmosphere along the whole "life
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23 95 cycle" of a particular product or service (Kohnle 2013). Thus, the calculation comprises
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25 96 not only production but also transport, transformation, distribution, use and disposal.

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28 97 In the agri-food sector, the European Commission has identified 129 (both public and
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30 98 private) information plans concerning the concept of sustainability (Grunert et al., 2014).

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32 99 Among these labels, the organic brand (referred to also as "bio") is the most widely used
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35 100 in the Italian market. Local production, however, is gaining popularity among Italian
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38 101 consumers, even though a universal label for the definition of such products has not yet
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40 102 been established (Bazzani and Canavari, 2013 and 2017).

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42 103 CF labels are rarely present in the agri-food market⁴, and only recently, consumers have
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45 104 occasionally had access to information about the CF of products, both in Italy and in most
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48 105 European countries. Tesco experience is exemplary in this field: the retailer, together with
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50 106 the Carbon Trust, has started introducing the first CF label in food retailing in 2009,
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52 107 claiming that they would have labelled all the 50,000 own-brand products (The
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56 ⁴ Instead, for other products (like home appliances, paper products, detergents, etc.), there is abundance of
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58 eco-labelling initiatives.
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1 108 Economist, 2011). However, in 2012, when they only have been able to label 500
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3 109 products, they had to give up the project. The reasons for this failure were that: consumers
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5 110 found the labels complicated and difficult to understand (so the company was looking for
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7 111 alternatives to replace the CF); the process of labelling the products revealed much more
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9 112 time consuming than planned and other retailers were slow in adopting CF labelling.
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11 113 Thus, the uptake of the label could not reach the desired critical mass (Financial Times,
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13 114 2012).
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17 115 Nowadays, there are only a few CF labels that have continued in the marketplace.
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19 116 However, as mentioned by Peschel et al. (2016) and Grebitus et al. (2015), Eurobarometer
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21 117 survey's results have found 72% of EU citizens agreeing that CF information on products
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23 118 should be mandatory (European Commission, 2009). More recently, about 90% of EU
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25 119 citizens have declared that buying environmentally-friendly products can bring real
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27 120 benefits to the environment (European Commission, 2012).
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31 121 In this context, it should be of much interest to investigate the drivers and the socio-
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33 122 economic characteristics of respondents that can influence a positive WTP of consumers
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35 123 towards CF labelled products.
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41 124 **3. A literature review of WTP studies on CF for food products**

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44 125 Consumers' preferences for lower CF label products have not yet been widely explored
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46 126 in the literature (Vanclay et al. 2011), also because of scarce market presence and uptake,
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48 127 and only recently there has been a growing body of literature proposing formal
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50 128 evaluations of consumer response to carbon labelling.
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1 129 We performed a literature review to examine the works available in the Italian and
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3 130 international scientific literature that so far have analysed consumer preferences and WTP
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5 131 for CF label.⁵
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8 132 Articles were selected by checking against pre-determined criteria for eligibility and
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10 133 relevance. Firstly, the following keywords have been identified: “footprint” (and its
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12 134 possible variation “foot-print”), “consumer”, “food”, together with their Italian
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14 135 translations. Secondly, a search for the abstracts of the articles has been done based on
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16 136 these keywords in the primary databases for scientific relevant literature (Scopus, Web of
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18 137 Knowledge, AgEconSearch, EconPapers), and thus pertinent articles have been selected.⁶
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20 138 Approximately 300 articles have been consulted (including 150 references from Scopus
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22 139 and 130 from the Web of Knowledge, largely overlapping). Those papers went through a
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24 140 screening process that made emerge only 27 of them for an in-depth analysis, as they
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26 141 were in line with the specific goals of the review. These low figures reinforce the
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28 142 argument that the topic has not been widely explored in the empirical literature so far, in
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30 143 particular for the Italian consumers. Table 1 summarises the main aspects of the selected
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32 144 studies: country, products of reference, the methodology used and the main findings.
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45 ⁵ This literature review is an update until early 2018 of the review performed by Canavari and Bazzani
46 (2016), which covers articles published until 2014. For more details on methodological aspects related to
47 some of the cited papers, the reader can refer to the aforementioned work.
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51 ⁶ We acknowledge that the criteria used for the selection of the papers might have caused the exclusion of
52 some important works on the topic analysed. Thus, the literature review has also considered papers that
53 were cited by the ones selected, even if they did not contain the chosen keywords, to allow a more
54 comprehensive analysis of the phenomenon.
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1 145 Most of these studies show that in general consumers are responsive to CF on different
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3 146 products indicating lower emissions, than conventional ones. However, as Vanclay *et al.*
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5 147 (2011) found, CF labels are most effective when combined with lower prices.
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8 148 Moreover, Akaichi *et al.* (2013) and Onozaka and Mcfadden (2011) highlighted that
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10 149 consumers have been particularly likely to buying low-CO₂ products in case they were
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12 150 also labelled with local origin, and according to Hoek *et al.*, (2017), the combination of a
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14 151 health and carbon logo has a more positive effect than the logos separately or no logo. An
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16 152 interesting result is that from Sewmake *et al.* (2015) that have shown how even if CF
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18 153 labels can lower GHG emissions, they can also have the potential to incur in the opposite
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20 154 effect if their implementation does not account for consumer beliefs as well as
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22 155 complementary and substitute relationships among different products.
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25 156 Among the sorted articles, only the works by Caputo and co-authors (Caputo *et al.*, 2012;
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27 157 2013b), Vecchio (2013), Vecchio and Annunziata (2015), Lombardi *et al.* (2017) and
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29 158 Colantuoni *et al.* (2016) focused specifically on the Italian market.
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32 159 Caputo *et al.* (2012) provided information on the presence of food miles' labels and the
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34 160 level of GHG emissions related to transport, finding a positive influence of both
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36 161 information on consumers' utility. Caputo *et al.* (2013b) found that Neapolitan consumers
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38 162 interviewed have shown a greater WTP for transport distance information label (food
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40 163 miles) rather than for the more comprehensive CF label. This finding suggests that the
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42 164 local origin of the product might have an impact on the Italian consumers' purchasing
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44 165 choice. Italian consumers could thus be more concerned with labels related to a concept
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46 166 of sustainability together with the local origin.
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49 167 Vecchio (2013) and Vecchio and Annunziata (2015) evaluate young consumers' attitude
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51 168 towards sustainability labels. Vecchio (2013) found a positive young adult wine drinkers'
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1 169 WTP for CF labelled wine. Vecchio and Annunziata (2015) found a positive (1.41€) WTP
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3 170 for CF labelled chocolate bars and identified some factors positively affecting WTP for
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5 171 CF label: age (younger individuals express a higher WTP); gender (female respondents);
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8 172 intensity of trust in the specific labels and the preference for food obtained in an
9
10 173 environmentally friendly way.
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12 174 Lombardi et al. (2017) analyse consumers' preferences when buying fresh milk and find
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14 175 an average premium price of 0.55€ per litre.
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16 176 On the contrary, Colantuoni et al. (2016) explore the market potential of domestic early
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18 177 potato and find that Italian (and German) respondents were unwilling to pay more for CF
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20 178 certification. Marginal WTP estimated was, in fact, negative and higher for Italians than
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22 179 for Germans.
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28 180 **[Table 1 near here]**
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30 181 As regards the type of product, the preference for low CF product has been found for both
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32 182 livestock and vegetable foodstuff. Echeverría et al. (2014), have analysed the WTP of
33
34 183 Chilean consumers for both a product of vegetable origin (bread) and an animal product
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36 184 (milk) and found that respondents showed greater sensitivity when evaluating animal
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38 185 products as they were more likely to pay for lower CF for milk than for bread. To this
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40 186 respect, product origin (animal or vegetal) can be acknowledged as an additional aspect
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42 187 that could potentially affect the preferences of Italian consumers for CF labels: e.g.,
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44 188 Canavari and Nayga (2009) have shown that Italian consumers exhibit differentiated
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46 189 behaviours when consumer choice is related to GMO products of vegetable origin rather
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48 190 than of animal origin.
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52 191 As regards the methodological aspect, the WTP for low CF products was primarily
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54 192 estimated by hypothetical choice experiments. Only five studies out of 27 have used non-
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1 193 hypothetical methods (i.e., experimental auctions in four cases and a real choice
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3 194 experiment in one case).

6 195 **4. The two case studies in the dairy sector: data and method**

9 196 The two case studies carried out dealt with consumers' habits related to dairy foodstuffs
10
11 197 purchasing and were performed through two different surveys aimed at evaluating
12
13 198 consumer understanding, knowledge, and preference for low CF products. Besides, they
14
15 199 aimed at identifying the products' characteristics that influence purchasing behaviour and
16
17 200 the consumers' WTP for the purchase of one litre of fresh milk with a lower CF label in
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19 201 comparison to a conventional one. The focus on dairy foodstuff was driven by the
20
21 202 importance of livestock products in the debate at international level for their higher
22
23 203 contribution to climate change with respect vegetable foodstuff production (Gerber et al.,
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25 204 2013; GRAIN and IATP, 2018).

26
27 205 The two studies were conducted among Italian consumers from December 2016 to
28
29 206 February 2017, in both cases using an online questionnaire gathering information on
30
31 207 consumption choices and socio-economic characteristics for 393 consumers interviewed
32
33 208 (215 in case study A and 178 in case study B, respectively). The questionnaires were
34
35 209 similar but not identical, and they were composed of four sections: the first on consumers'
36
37 210 habits, the second on their environmental awareness, the third about their knowledge of
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39 211 environmental and CF labels, and a section dealing with personal socio-demographic
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41 212 information (Author 1 et al., 2018).

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43 213 Though the use of web instruments to administer the questionnaire has facilitated
44
45 214 reaching a high number of respondents, it raises the issue of representativeness of the
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47 215 sample, because this sampling method tends to gather self-selected respondents.
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49 216 Consequently, it usually generates a biased sample, in which younger people with a higher
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1 217 level of education or web literacy are overrepresented (Canavari et al., 2005). Therefore,
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3 218 the samples cannot be considered representative of Italian consumers; nevertheless, they
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5 219 allow obtaining quite interesting information about the relationship among the variables
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7
8 220 analysed. Though WTP estimations based on a non-representative sample, cannot be used
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10 221 to extend WTP results to the population analysed, as figures would be biased, the
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12 222 relationships among the socio-economic characteristics of respondents the positive WTP
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14 223 eventually expressed, remain valid.
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16
17 224 Table 2 and 3 show the descriptive statistics of the surveys analysed. As mentioned, the
18
19 225 questionnaires were similar, but not identical. Thus, Table 2 shows the replies to the
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21 226 question that differed among surveys, while Table 3 shows only the shared items
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23 227 analysed.
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28 **[Table 2 and 3 near here]**
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30 229 As regards methodological aspects, WTP analysis was conducted with different
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32 230 approaches. In the case of study A, the survey used the open-ended contingent valuation
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34 231 method that relies upon asking directly to consumers to state their WTP for the product
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36 232 considered. In the case of study B we relied upon a dichotomous choice contingent
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38 233 valuation, that is, a hypothetical purchase situation has been proposed to estimate the
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40 234 WTP, by comparing product 1 (milk bottle with 200gr of CO_{2e} emissions) at the fixed
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42 235 price of 1.30€ with product 2 (bottle of milk with 150gr of CO_{2e} emissions). Respondents
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44 236 were asked to state their preference between the two products according to a price
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46 237 variation of 0.10€ of product 2, up to a maximum value of 2.00€. Given these different
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48 238 approaches for the elicitation of the WTP in the two studies, the consumer's preference
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50 239 has been evaluated considering whether the choice of the respondent (individual outcome
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52 240 variable) was to state a positive WTP for lower CF products, or not. A logit model has
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1 241 been estimated to investigate the determinants of the probability for consumers to declare
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3 242 a positive WTP for products with lower CF, based on explanatory variables, as responses
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5 243 shared to both surveys, expressing some socio-demographic characteristics and attitudes
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8 244 of the consumers interviewed. For the sake of brevity, we only report the variables that
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10 245 were significant (Table 4).

14 246 **5. Results discussion**

17 247 Table 2 shows the answers to both the surveys to the different questions analysed. As
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19 248 regards Survey A, interestingly, almost all the respondents declare to know the climate
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21 249 change phenomenon, are (on average) interested in it and think that the consumption of
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23 250 products with an environmental label helps contrasting climate change. This survey also
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25 251 reported a set of questions on which tools could be used to promote the knowledge and
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27 252 dissemination of CF labels and the web instruments and education were judged the most
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29 253 important, followed by campaigns, advertising, the label itself and newspapers.

34 254 As regards Survey B, the majority of respondents consider it important to have a CF label
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36 255 to inform purchase decisions in an environmental sense and thinks that buying organic
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38 256 food helps to reduce GHG emissions. However, it seems that the majority of the
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40 257 respondents does not read the label but gives importance to the sensory quality or
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42 258 expiration date when buying food.

46 259 Table 3 summarises some descriptive statistics of the pooled sample analysed, made by
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48 260 the common questions. As mentioned, being the sample self-selected and based on an
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50 261 online survey, some demographics reflect the nature of the data source. The respondents
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52 262 are 64% female. Almost all the respondents have at least a high school diploma, and 52%
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54 263 have a university degree (or higher). Despite the low presence of CF label in the Italian
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56 264 market, a majority of subjects declared to know the concept of CF labels.

1 265 As regards WTP, results indicate that only 24% of the total sample states not to be willing
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3 266 to pay more for a litre of milk with lower CF. This figure is likely underestimated since
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6 267 it is based on a stated preference survey, and the sample is self-selected.
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8 268 For respondents that declared a positive WTP, in case study A an average 9% premium
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10 269 price for lower CF milk has emerged, with maximum values of 50%. The premium price
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13 270 was on average 0.19€, assuming an average price of 2€. In case-study B, the average WTP
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15 271 was more than 30%. The consumer is likely to pay € 1.68 per bottle of low CF milk and
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18 272 therefore, compared to the high-impact product proposed at the price of € 1.30, the surplus
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20 273 difference is € 0.38 (Author 1 et al., 2018).
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23 274 The results of the logit model estimation summarised in Table 4 allow identifying the
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25 275 drivers behind this positive WTP.

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28 **Table4.** Estimations results
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Variable	Coefficients estimates	p-values	Standard errors
Gender (female)	0.490	0.060	0.261
Low impact products	0.890	0.001	0.265
Price Sensitivity	-0.837	0.001	0.257
Survey_B	1.008	0.000	0.287
Constant	0.475	0.058	0.251

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41 277 LR $\chi^2(4) = 51.23$; Prob $> \chi^2 = 0.000$; Pseudo $R^2 = 0.12$; Hosmer-Lemeshow $\chi^2(7) = 6.29$; Prob $> \chi^2 = 0.506$;
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43 278 Area under ROC curve = 0.735.
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45 279 Results indicate that in the sample analysed, if a respondent gives high importance to low
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48 280 impact products to tackle climate change, this trait positively affects the probability to be
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50 281 willing to pay more for CF labelled milk. Also, the format of the different surveys may
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52 282 matter: survey B respondents are more likely to show a positive WTP compared to survey
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55 283 A respondents.
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1 284 As regards socio-demographic variables, respondents who are more sensitive to price
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3 285 when buying products (about 40% of the sample) are less likely to be willing to pay more
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5 286 for products with a lower CF label; this result is consistent with what other authors in this
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8 287 field have found (see among others Vanclay et al. 2011).
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10 288 Instead, the only knowledge of the CF concept does not seem to be relevant in
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12 289 determining the stated perception of value. Also, age and education do not affect the WTP
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14 290 of consumers, similarly to what was found from the detailed analysis of case study A
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16 291 published in another article (Author1 and Author2, 2019).
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18 292 As regards gender, females show a slightly higher WTP than males, but this result is
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20 293 significant only at the 0.10 level. Hence, even if this result goes in the direction of what
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22 294 found in previous work (e.g., Steiner et al., 2017; Vecchio and Annunziata, 2015), its
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24 295 statistical significance is quite poor.
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31 **6. Conclusions and policy implications**

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34 297 CF labels represent one of the most important tools to help to tackle climate change through
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36 298 consumers' informed purchases behaviour.
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38 299 Despite their relevance for demand-driven mitigation options, their presence is still scarce
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40 300 in the Italian food sector, and so it is also for studies aimed at investigating Italian
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42 301 consumers' WTP for products with lower CF. From the literature review, a positive WTP
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44 302 for lower CF products seems to emerge, though not for all products and respondents'
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46 303 socio-economic characteristics.
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48 304 The two pilot case studies presented, focused on Italian consumers' habits when
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50 305 purchasing milk, allowed us to make a rough evaluation of their preferences for low-
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52 306 carbon labelled dairy products.
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1 307 Results, though based on convenience and probably biased samples and stated
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3 308 preferences, suggest that interest of consumers in CF labels may exist. Findings are
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5 309 generally in line with previous studies indicating that respondents that give high
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7 310 importance to foodstuff produced with low environmental impact to mitigate GHG
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9 311 emissions have shown to be more willing to attribute a positive premium price to CF
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11 312 labelled products. Also, the data confirm that CF labels could be most effective when
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13 313 combined with prices lower than (or at least equal to) conventional products (Vanclay et
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15 314 al. 2011), as more price-sensitive consumers are less prone to perceive a higher value for
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17 315 lower CF products.
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19 316 Those results, if confirmed by larger and representative samples, may have interesting
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21 317 policy implications. In fact, they would suggest that a policy framework aiming at
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23 318 promoting demand-side mitigation options in the agricultural sector, should tackle both
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25 319 the consumers' side, informing consumers about the environmental impact of food
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27 320 production and the potential of environmental label in reducing it, and the producers'
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29 321 side, helping the food supply chain reducing its GHG emission in a cost-effective way.
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31 322 About the consumers' side, policies should aim at both enhancing consumers' awareness
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33 323 about climate change challenge and ensure that the system of certification is reliable and
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35 324 easily interpretable by consumers. To this respect, the initiative of the European
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37 325 Commission (2013) on "*building the single market for green products facilitating better*
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39 326 *information on the environmental performance of products and organisations*", is of
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41 327 utmost importance.
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43 328 As regards the production side, results would suggest to producers that a lower CF would
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45 329 be appealing if offered at the same or a lower price. Indeed, the possibility to couple lower
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47 330 prices with lower GHG emissions in the agricultural sector is not rare, because technical
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1 331 studies on the mitigation potential of agri-food productions have found many of the so-
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3 332 called “win-win solution” to climate change, i.e. strategies that allow saving both GHG
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6 333 emissions and production costs (Coderoni et al. 2015). When a win-win solution is
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8 334 adopted, thus, lower CF products can be produced at lower costs⁷ that could, in turn, be
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11 335 translated into lower selling prices, as entrepreneurs participating to the CF labelling
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13 336 scheme have declared to be willing to do (Coderoni and Pontrandolfi, 2016). If these
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15 337 solutions are applied, thus, CF products uptake could be easily enabled.
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18 338 Also, Rural Development Programmes funds could be used to reduce farmers’ costs of
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20 339 adopting GHG saving techniques, as they provide incentives for both for GHG calculation
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22 340 and certification and farms’ investments to implement mitigation strategies identified.
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25 341 This should be made taking into account the likely evolution of the food systems as a
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27 342 whole (Macombe, 2018).
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30 343 Given the limitations of this study, more in-depth analysis is needed to estimate Italian
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32 344 consumers’ WTP for CF labels accurately. Future research should on one side, rely upon
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34 345 a larger and nation-wide representative sample to avoid the problems linked to self-
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36 346 selected and biased samples; on the other side, it should focus on non-hypothetical
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38 347 techniques, such as experimental auctions to obtain reliable estimations of WTP (Lusk
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40 348 and Shogren, 2007). In fact, the studies based on hypothetical choices, generally, tend to
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42 349 overestimate the WTP and the experience of Tesco with CF labelled products seems to
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44 350 confirm this gap between stated and real behaviour. A further research avenue could be
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46 351 the consideration of a more comprehensive framework for the analysis of the
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48 352 environmental impact of food consumption, covering not only the GHG emissions
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56 ⁷ For example, because the product certification procedures allow highlighting hot spot in energy
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1 353 generated, but also the use of resources such as water and land, and the generation of
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3 354 waste (Candy et al, 2018).

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5
6 355 **Declaration statements**

7
8 356 **Availability of data and materials**

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11
12
13 358 corresponding author on reasonable request.

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595 **Table 1:** Published articles regarding WTP evaluations for CF labels: country, products of reference, methodology used and main findings

Citation	Product	Country	Methods	Main findings
Akaichi et al., 2013	Rice	USA	EA	WTP 22% higher when giving information about local origin or lower CF
Akaichi et al., 2016	Banana	Scotland, The Netherlands, France	DCE	Positive WTP for bananas with lower CF combined with other aspects (fair trade and organic)
Caputo et al., 2012	Tomato	Italy	DCE	Positive propensity to purchase products labelled with low CF
Caputo et al., 2013a	Tomato	USA	DCE	Avg. WTP for low transport CF ranging from 0.31€ to 3.13€ depending on the latent class
Caputo et al., 2013b	Tomato	Italy	DCE	Avg. WTP for low transport CF: 0.76€
Chen et al., 2017	Purified bottled water	China	EA	Avg. premium price of 0.274RMB for purified water with CF label
Colantuoni et al. 2016	Potato	Germany Italy	DCE	Both Germans and Italians were unwilling to pay more for CF certification. (avg. marginal WTP estimates for the attribute CF were negative, -0.13€/kg for German and -0.41€/kg for Italian respondents)
Drichoutis et al., 2016	Eggs, olive oil	Greece	Inferred and CV	WTP premiums for carbon neutral label of up to 28% for eggs and 23% for olive oil
Echeverría et al., 2014	Milk and bread	Cile	CV	Avg. WTP for low CF: 29% more for milk and 10% more for bread

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Grebitus et al., 2012	Meat	Canada	DCE	WTP not estimated. The presence of information about a higher CF reduces the likelihood of choice
Grebitus et al., 2015	Potato	Germany	DCE	WTP not estimated. Overall respondents tend to buy products with CF label
Grebitus et al., 2016	Beef, yoghurt, potatoes	Canada and Germany	DCE	Respondents are willing to choose products with higher CF if compensated by discounted prices: Germans most discount potatoes (-1.45 €/Kg of CO ₂), yoghurt (-0.73€) and ground beef (-0.23€); Canadians most discounts yoghurt (Canadian \$-0.66), potatoes (Canadian \$-0.46), and ground beef (Canadian \$ -0.11).
Hoek et al., 2017	Rice, meat, tomato	Australia	DCE	WTP not estimated. The combination of a health and environmental logo have a more positive effect than the logos separately or no logo.
Kimura et al., 2010	Chocolate bar; chips; candy; juice	Japan	DCE	WTP in the read-only condition is smaller (from 127 to 167 yen) than that in the active-search condition (from 103 to 196 yen)
Kohnle, 2013	Apple and chocolate	Germany	DCE	Premium label for low CF for apples = 0.19€ Premium for low CF label for Chocolate = 0.32€
Koistinen et al., 2013	Minced meat	Finland	DCE	WTP for beef = 24.50 €/kg; Lower WTP of 1.6% for beef with information on CF WTP for beef = 23.65 €/kg; WTP greater than 2.2% for pig meat with information on CF
Li et al. 2016	Beef	US	DCE	Avg. WTP \$306 among consumers supporting a hypothetical “Raised Carbon Friendly” beef certification program and \$64 among all beef-consuming households
Lombardi et al., 2017	Milk	Italy	DCE	Avg. price premium for CF labelling is 0.55€

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Michaud et al., 2012	Flowers	France	Non-hypotetical DCE	Premium eco-label: 1.73 €/piece Premium low CF: 4.09 €/piece
Mostafa et al., 2016	Not specified	Egypt	DCE	Premium price of 75 up to 90 Egyptian pounds (EP) for carbon-labelled products depending on the evaluation technique
Mueller-Loose and Remaud, 2013	Wine	UK, France, Germany US East Coast, US Midwest, Anglophone Francophone Canada	DCE	Premium for “Carbon Zero” label: UK = 0.20£; France = -0.24€; Germany = -0.02€; US East Coast = 1.02\$; US West Coast = 0.53\$; USA Midwest = 0.44\$; Anglophone Canada = 0.36\$
Onozaka and McFadden, 2011	Apple and tomato	USA	DCE	Negative WTP for products with a CF higher than 10%: -0.01 for apples and -0.02 for tomatoes (in \$ per pound)
Steiner et al., 2017	Yoghurt	Germany	DCE	WTP not estimated. The presence of information about a lower CF slightly increases the utility of the “ecologically oriented” group of respondents
Van Loo et al., 2014	Chicken breast	Belgium	DCE	Premium price of 18% and 24% respectively for the 20% and 30% CO ₂ -reduction, for the low-income group
Van Loo et al., 2015	Coffee	Northwest Arkansas	CE	No significant premium price for the Carbon Footprint label
Vecchio, 2013	Wine	Italy	EA	Avg. WTP for low CF wine: 3.24€ (avg. WTP for conventional wine: 2.50€)
Vecchio and Annunziata 2015	Chocolate bars	Italy	EA	Avg. WTP 1.41€ for CF labelled bar. Factors affecting WTP for CF label: young individuals express a 10% higher WTP; female respondents: 9 cents more; intensity of trust in the specific labels: 16 cents more

596 Note: EA= Experimental auctions; DCE= Discrete choice experiment; CV= Contingent valuation

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598 **Table 2.** Descriptive statistics of the questions differing between the two surveys

Survey A					
Variable	Type of variable	Obs.	Description	Possible values	Mean
Knows CC	Binary	215	If the respondent knows climate change phenomenon	Yes (1) No (0)	0.99
Interest in CC	Ordered	215	If is interested in climate change	From 1 to 5	3.92
Recycle	Ordered	215	If thinks that recycling products helps mitigating climate change	From 1 to 5	4.01
Label	Ordered	215	If thinks that the consumption of products with an environmental label helps mitigating climate change	From 1 to 5	3.23
Trust	Ordered	215	If gives importance to trust in the retailer when buying a food product	From 1 to 5	3.37
Nutritional information	Ordered	215	If gives importance to nutritional information when buying a food product	From 1 to 5	3.52
CF label valuation	Ordered	215	How clear evaluates the information on the CF label	From 1 to 5	2.46
WTP	Continuous	215	Premium price (%) that is available to pay for lower CF products	From 1 to 5	0.06

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Web tool	Ordered	215	If thinks that the web tools can help promoting knowledge and dissemination of CF labels	From 1 to 5	4.10
Advertising tool	Ordered	215	If thinks that advertising can help promoting knowledge and dissemination of CF labels	From 1 to 5	3.53
Education tool	Ordered	215	If thinks that education can help promoting knowledge and dissemination of CF labels	From 1 to 5	4.09
Campaigns tool	Ordered	215	If thinks that campaigns can help promoting knowledge and dissemination of CF labels	From 1 to 5	3.65
Label tool	Ordered	215	If thinks that labes can help promoting knowledge and dissemination of CF labels	From 1 to 5	3.46
Newspapers tool	Ordered	215	If thinks that newspapers can help promoting knowledge and dissemination of CF labels	From 1 to 5	3.05
Survey B					
Shops	Ordered	178	If does food shopping for the family	From 1 (always) to 4 (never)	2.39
Label	Ordered	178	If reads food labeling before buying	From 1 to 4	1.99
Shop frequency	Ordered	178	How many times per week does food shop	From 1 to 3	1.75
Sensory quality	Ordered	178	If gives attention to sensory quality when choosing a dairy product at the supermarket	From 1 to 5	3.72
Discounts	Ordered	178	If gives attention to discounts when choosing a dairy product at the supermarket	From 1 to 5	2.97
Aesthetics	Ordered	178	If gives attention to aesthetics when choosing a dairy product at the supermarket	From 1 to 5	2.21
Expiration date	Ordered	178	If gives attention to expiration date when choosing a dairy product at the supermarket	From 1 to 5	3.88

Certification	Ordered	178	If gives attention to certification when choosing a dairy product at the supermarket	From 1 to 5	3.11
Individual behaviour	Ordered	178	If thinks that individual behaviour can help fighting climate change	From 1 to 5	3.29
Organic	Ordered	178	If thinks that buying organic is important to help reducing GHG emissions	From 1 to 5	3.29
Importance CF	Ordered	178	If thinks that is important to have a CF label to inform purchase decisions	From 1 to 5	4.03
Family	Continuous	178	Number of family members	>0	2.77
Age < 14	Continuous	178	For how many people younger than 14 shops for	>0	0.28

599 Source: Authors' elaborations.

600 **Table 3.** Descriptive statistics of the questions asked in both surveys

Variable	Type of variable	Obs.	Description	Possible values	Percentage/Mean
Age	Continuous	391	Age of the respondent	Min (21) Max (75)	Mean 39.5
Graduate	Binary	393	The respondent is graduated	Yes (1) No (0)	52.4 47.6
Gender	Binary	393	Sex of the respondent	Female (1) Male (0)	64 36
High Income	Binary	393	The respondent belongs to high-income class	Yes (1) No (0)	24.9 75.1
Knows CF	Binary	393	The respondent knows the CF label	Yes (1)	31.6

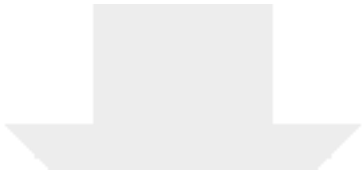
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				No (0)	68.4
Price Sensitivity	Binary	393	Importance of price when purchasing products (from 1 to 5)	Important (scores 4 and 5: 1)	38.9
				All other responses (scores 1-3: 0)	61.1
Brand Sensitivity	Binary	393	Importance of brand when purchasing products (from 1 to 5)	Important ^a (scores 4 and 5: 1)	63.6
				All other responses (scores 1-3: 0)	36.4
Origin	Binary	393	Importance of product origin when buying food	Important ^a (scores 4 and 5: 1)	31.2
				All other responses (scores 1-3: 0)	68.8
Km 0	Binary	393	Importance of food at Km 0 in mitigating climate change (from 1 to 5)	Important ^a (scores 4 and 5: 1)	67.4
				All other responses (scores 1-3: 0)	32.6
Low impact	Binary	393	Importance of food produced with low impact processes in mitigating climate change (from 1 to 5)	Important ^a (scores 4 and 5: 1)	50.9
				All other responses (scores 1-3: 0)	49.1
No packaging	Binary	393	Importance of reducing packaging to have a positive impact on CF reduction	Important ^a (scores 4 and 5: 1)	60.6
				All other responses (scores 1-3: 0)	39.4
WTP	Binary	393	The respondent expresses a positive WTP	Yes (1)	76.08
				No (0)	23.92
Survey_B	Binary	393	Survey	B (1)	45.2
				A (0)	54.8

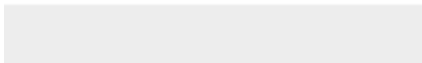
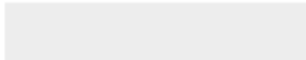
601 Source: Authors' elaborations.

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602 ^a After careful consideration of some originally ordinal variables' distribution and performances in the model, they have been converted into dichotomous variables, with
603 value one when respondents judge the characteristics analysed being "important" or "extremely important" (original response equal to 4 or 5) and value zero to all other
604 responses (original response from 1 to 3). The recoding allows emerging the behaviour of the respondent that give more importance to the specific characteristic; results
605 do not notably change when considering the original responses as categorical variables.

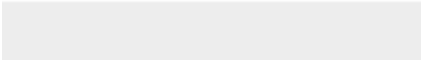


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