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Role of sustainability attributes and price in determining consumers' fruit perceived value

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ABSTRACT

This work analyses consumers' behaviour and attitudes toward products characterised by a reduced environmental impact in terms of carbon footprint (CF). Value perception was measured using a contingent valuation approach, asking consumers to state their willingness to accept (WTA) monetary compensation for a product exchange offer, particularly fruit characterised by a higher CF in place of fruit characterised by a lower CF. Field experiments were conducted to determine consumers WTA as well as factors affecting the choice. Consumers were hypothetically endowed with a punnet of fruit produced with innovative, low CF farming methods and were offered to exchange it with a punnet of regular fruit. Variables representing consumer fruit consumption habits, consumer attitude and concern towards the environment, and socio-demographics were chosen to represent factors that motivate consumers' value perception of environmentally-friendly fruit. The scale of green consumption values (GCVs) was used to model consumer concern towards the environment. Results showed that demographics affect the perceived value of fruit characterised by a lower CF and that consumers' preference for lower CF products is associated with fruit consumption habits and environmental concerns. At the same time, a positive relationship with CF levels needs further investigation.

Keywords: *carbon footprint; willingness-to-accept; interval regression; stated preference; green consumption values*

1 Introduction

Consumers are getting more aware of environmental challenges and reflect purchase decisions from value systems more oriented to sustainability issues, routinely considering social and environmental concerns into their purchase decision making (Strategic Direction, 2015). As a result, businesses have pushed to approach sustainability under a strategic point of view, adopting a broader viewpoint and long term perspectives in the form of care for natural resources or health-related issues (Gupta et al., 2013; Sheth et al., 2011). A number of high-value attributes and claims have been introduced to promote food products' added value in terms of sustainability. Over the last three decades, a wide spectrum of products has been marketed on sustainability-related information, introducing labels and logos in-store and on-pack (Grunert et al., 2014). According to cataloguer http://ecolabelindex.com, approximately 456 labelling schemes are available in 199 countries, of which 148 include standards for food. Among these, carbon index schemes like carbon footprint (CF) labels are largely diffused. A CF describes the total greenhouse gas (GHG) emissions that a product or a service's fruition will cause during its lifetime. It is widely used to describe climate change as an environmental impact category, and it is measured in terms of the mass of carbon dioxide equivalent (e.g., gCO2e). CF can be seen as a subcategory of the global warming potential in the context of a life cycle assessment (LCA) (Jolliet et al., 2003).

A relevant body of literature has been focusing on conceptualising consumers' concerns and attitudes towards sustainability issues and protecting the environment to predict purchase and consumption behaviours. The need to understand socially responsible consumption has persisted for decades and several scales designed to measure the multifaceted consumer social responsibility have been proposed (Antil, 1984; Dunlap et al., 2000; Mohr & Webb, 2005; Roberts, 1995). Concerning the environmental impact, Haws et al. (2014) developed a measure of so-called green consumption values (GCV), which aims to concisely capture consumers' issues and concerns directly related to the environment.

Many studies have analysed sustainable food choices and consumer preferences, and willingness to pay (WTP) for sustainability attributes concerning different foodstuffs, including coffee (Van Loo et al., 2015), olive oil (Torquati et al., 2021), dairy products (de-Magistris & Gracia, 2016), meat (Burnier et al., 2021), milk and bread (Echeverría et al., 2014). The results showed that embedding sustainability concerns as a food attribute could play a key role in creating product differentiation for which consumers show positive attitudes. As evidence of this, (Balcombe et al., 2007) found that the WTP for food is higher for environmental quality than for food safety.

The first study that attempted to measure consumer WTP for fruit attributes, particularly for pesticide-free fresh fruit, dates back about twenty years ago (Boccaletti & Nardella, 2000). In the years, consumers' preferences for several fruit attributes have been investigated, particularly different storage durations (Lund et al., 2006), new and already existing fruit varieties (Yue & Tong, 2011), country of origin and traceability attributes (Liu et al., 2019; Gao et al., 2014), and more widely, sustainable production methods such as organic, naturally grown, and pesticide-free (Loureiro et al., 2001; Nandi et al., 2016; Savchenko et al., 2018).

In this context, the primary goal of this study was to determine the perceived value of fruit characterised by a lower CF compared to regular fruit. More specifically, the monetary compensation consumers would ask to trade a more valuable product (i.e., with a lower CF) with a less valuable product (higher CF) was estimated. Secondary goals included investigating consumers' behaviour and attitudes for food characterised by a reduced environmental impact in CF and judging factors affecting their perceived value. To this end, consumers' habits related to food consumption, attitudes towards food expenditure, and concerns regarding the environment represented by GCVs were examined to highlight and explain possible correlations with the WTA to downgrade to a high CF fruit.

Overall, this study makes several contributions to the literature. First, we add to a small body of literature in Italy on consumer preference for fruit characterised by mitigated environmental impacts (Boccaletti & Nardella, 2000). Also, our study differs from previous studies in the consumers' preference elicitation settings. Indeed, rather than a typical WTP design, a willingness to accept (WTA) setting was used to more precisely measure the aversion towards products without sustainability attributes.

Consumer willingness to accept (WTA) is an alternative welfare measure and represents another perspective in assessing a person's perceived value of a good or a perceived attribute value. WTA is defined as the minimum monetary compensation a person would accept to give up a good or service in his/her possession. Theory suggests that WTP and WTA should be approximately equivalent if the good value is small relative to income, close substitutes exist for the good, and there is no uncertainty about a person's preference for the good (Hanemann et al., 1991). In reality, in empirical studies, WTA is often higher than WTP even though there is poor consensus regarding the nature or robustness of the so-called WTP-WTA gap (Plott & Zeiler, 2005). Also, the most suitable measure of perceived value depends on whether the person owns the rights to the good: in this

case, WTA can be an appropriate measure of perceived value; otherwise, WTP should be investigated.

The originality of this study is also expressed by another original design feature, particularly in having explained to participants that the fruit with lower CF was grown with the support of precision agriculture (PA). The goal of including PA technologies and concepts was to strengthen the CF attribute, identify the reasons behind the actual CF reduction, and make participants more aware of the sustainability attribute. PA is focused on the site-specific management of in-field variability, allowing for an accurate distribution of agricultural inputs, and thus leading to a mitigation of the negative environmental impacts arising from excessive use of agricultural inputs associated with traditional agricultural activities (Medici et al., 2019; Pedersen & Lind, 2017; Pedersen et al., 2019; Snyder et al., 2009). PA can be environmentally friendly while providing multidimensional benefits for food producers and consumers.

2 Methods

The study was conducted in two locations and considering six fruit types (apricots, nectarines, plums, apples, pears and kiwifruits) to capture potential differences in attitudes and habits across various portions of the population and during different seasons.

Field surveys were conducted between August and December 2019, generating a total sample of 220 participants. Surveys lasted several weeks to help capture various opinions regarding different varieties of fruits with different seasonality.

The locations were two supermarkets, one in the Bologna city centre and the other in the immediate periphery. These locations were chosen as a good representation of the general population, frequented from young people to elder people, and both permitted us to submit surveys at the entrance. Several participants were having breaks from work and came from the surrounding office buildings. Even if young students were not targeted in the surveys, the supermarket in the city centre was also frequented by many students, whose widespread presence is a typical city feature.

Approximately every participant spent about seven minutes on the survey. Potential participants were approached and asked if they would be willing to participate in a short study on environmental-friendly fruit. Surveys were performed in three sessions between summer and winter 2019; for each session, two fruit varieties were proposed: apricots and nectarines in summer, plums and apples in autumn, and kiwi and pears in winter. In each session, participants were randomly attributed to one fruit variety. The requirements to join the survey were that they ate the fruit, were responsible for food purchase in their family and were over 24 years old. For those agreeing, there were read the following statement regarding privacy issues:

"Dear participant, this survey aims to measure the value attributed by the consumer to products characterised by a lower environmental impact concerning conventional ones. This survey will describe your attitude towards fruit consumption and the purchase of fruit, and your concern towards the environment. The questionnaire will last about seven minutes. We remind you that your answers are anonymous and that the data collected will be processed for statistical purposes as part of a regional research project and reported in two university theses. We, therefore, ask for your consent to the processing of your personal data, reminding you that your participation is voluntary and that you have the right to withdraw from the survey at any time and for any reason, without this causing any harm."

The survey was submitted with a tablet, and participants could see text and figures displayed on the screen. The questionnaire was divided into four sections: participant attitude towards fruit consumption, WTA conventional fruit in place of fruit with a lower CF, participant concern towards the environment, and socio-economic and personal factors. Participants agreeing to join the survey were first asked the weekly frequency of fruit consumption. Then, before investigating participants' WTA, general information about PA and its ability to reduce the environmental impact was provided, in order to inform the participant about agronomic approaches underlying the fruticulture characterised by a lower impact on the environment, with the following:

"Precision agriculture allows a better distribution of agricultural inputs, being able to apply the right thing, in the right place, at the right time, and with the right amount. PA takes advantage of using practices and technologies, like sensors monitoring soils and crops and measuring the nutrients, water content, and possible crop diseases. It makes available very accurate information leading to a limitation in agricultural input applied to crops and fields, and overall can mitigate the environmental impact characterised by conventional agriculture, by reducing greenhouse gases emissions."

Table 1.
Fruit attributes (values per kilogram of fruit).
Price data source: local supermarket; CF data source: preliminary LCA based on data from Medici et al. (2020)

Type of fruit	Low CF fruit (gCO_{2e})	High CF fruit (gCO_{2e})	CF increase (%)	Price – High CF fruit (€)
Apricots	68.5	74.1	+8.2%	4.40
Nectarines	41.1	64.4	+56.7%	1.80
Plums	75.4	108.5	+43.9%	4.00
Apples	98.0	150.4	+53.5%	1.50
Pears	72.2	105.3	+45.8%	3.20
Kiwifruits	111.8	155.8	+39.4%	4.00

Participant's WTA was elicited using a hypothetical, contingent valuation approach. This method was selected since it was suitable for these field settings. The participants were first hypothetically endowed with a 1-kg punnet of fruit produced with innovative farming methods, thus characterised by a lower CF. Then they were asked their minimum compensation necessary for trading the fruit with a kilogram of the same fruit but grown conventionally, thus characterised by a higher value of CF and an average market price, based on prices that consumers could find in the supermarkets. Table 1 reports prices and estimated CFs for each fruit type, preliminarily assessed through an LCA approach. Environmental impacts, including CFs of the fruit varieties grown in the season 2018-2019, were reported in Medici et al. (2020).

The following steps were followed to determine the participant's WTA. The participant was asked to imagine being endowed with a kilogram of fruit grown with PA techniques and characterised by a certain CF level. Then, the participant was told the following:

"Imagine that you are given for free a kilogram of fruit grown with the support of PA and characterised by a reduced environmental impact. Then you were offered the possibility to trade this fruit with another kilogram fruit grown with conventional agricultural practices and characterised by a higher CF."

Hence, the participant was recommended to reflect on the characteristics of the two products and the fact that the product in his possession was characterised by a lower environmental impact than the product he could trade. Then he was asked the following open-ended question:

"How much is the minimum amount that you would be willing to accept as compensation to forgo the product with a lower CF owned by trading it for the higher CF product? If the trade were made, you would get the fruit with the higher CF, plus the monetary compensation you requested. Please remember that compensation of € 0 would indicate the two products have the same value, whereas a very high compensation would indicate high aversion, thereby no willingness to accept the higher CF fruit in place of the lower CF fruit."

Open-ended questions were used to assess participants' perceived difference in value between the higher CF fruit and the lower Cf fruit. Participants stated compensation requests using the tablet screen. Then, participants were asked questions aimed at measuring their attitude towards safeguarding the environment using a Likert scale based on 6 items evaluating the so-called green consumption values (GCV)(Haws et al., 2014):

1. It is important to me that the products I use do not harm the environment.
2. I consider the potential environmental impact of my actions when making many of my decisions.
3. My purchase habits are affected by my concern for our environment.
4. I am concerned about wasting the resources of our planet.
5. I would describe myself as environmentally responsible
6. I am willing to be inconvenienced in order to take actions that are more environmentally friendly

Participants entered values in the range 1-7 for each GCV randomised item on the tablet screen. In the last section of the survey, socio-demographic information was collected.

Table 2 shows the descriptive statistics for the 220 participants who completed the survey. All participants have attributed a non-negative value to the fruit with lower CF, with an overall median value equal to 1€. About 6% of the overall sample did request a compensation equal to 0, meaning that they were willing to attribute the same value to the fruit characterised by a higher CF, with the only exception of nectarines, for which participants requested a minimum compensation equal to 0.2€. Figure 1 displays the overall WTA variation, while Table 2 shows WTA variation by each fruit species.

Table 2.
Statistics for participants' WTA for 1 kg of fruit with a higher CF. Source: own elaboration on survey data

Fruit species	Obs	Min (€)	Min%	Max (€)	Max%	Median (€)	Mean (€)	Std dev (€)
Apricots	**38**	**0.0**	**2.6%**	**3.00**	**5.3%**	**1.00**	**1.07**	**0.70**
Nectarines	**39**	**0.2**	**12.8%**	**2.00**	**5.1%**	**0.70**	**0.78**	**0.49**
Plums	**20**	**0.0**	**5.0%**	**3.00**	**5.0%**	**1.00**	**1.02**	**0.64**
Apples	**50**	**0.0**	**16.0%**	**2.50**	**4.0%**	**0.50**	**0.75**	**0.75**
Pears	**23**	**0.0**	**4.3%**	**3.00**	**4.3%**	**1.00**	**1.05**	**0.64**
Kiwifruits	**50**	**0.0**	**6.0%**	**2.50**	**4.0%**	**1.00**	**1.12**	**0.71**
Overall	**220**	**0.0**	**8.2%**	**3.00**	**4.5%**	**1.00**	**0.95**	**0.68**

Even with differences between fruits, most of the 220 subjects' WTA offers requested compensation between 0.5 € and 1.5 €. Considering WTA median values and conventional prices, participants attributed on average the following additional monetary value to lower CF fruit compared to higher CF fruit: 22.7% for apricots, 38.9% for nectarines, 25.0% for plums, 33.3% for apples, 31.3% for pears, and 25.0% for kiwifruits.

Tables 3a and 3b show the statistics for all variables considered. Most respondents ate fruit quite often, at least nearly every day (91%). Cost concerns regarding food expenditure characterised most respondents, from moderate caution applied (60%) to significant attention in food expenditure (34%). The job situation reflected a very diverse sample composition compared with the Emilia-Romagna region's employment situation, suggesting the sampling procedure performed well. Also, sample demographics were consistent with regional demographics, given most women and the measured average age.

Opinions regarding GCV (Table 4) showed a clear concern for environmental problems and the overall participants' determination in engaging in environmentally friendly behaviours. The majority of the subjects reported medium to high levels of GCV (Figure 3). Overall, with 85.9% reporting a GCV equal to or higher than 5, environment protection was considered an important component of respondents' behaviour. Only 9.9% of the respondents showed almost indifference, while about 4.2% of respondents showed a negative approach toward environmental protection (GCV 1-3). Results are quite uniformly distributed between the six GCV items. Overall, the most negative items were GCV 2 and 3, with 7.2% and 8.6% of the respondents scaled within 1-3. The six GCV items showed a Cronbach's α equal to 0.8333, indicating a good internal consistency level.

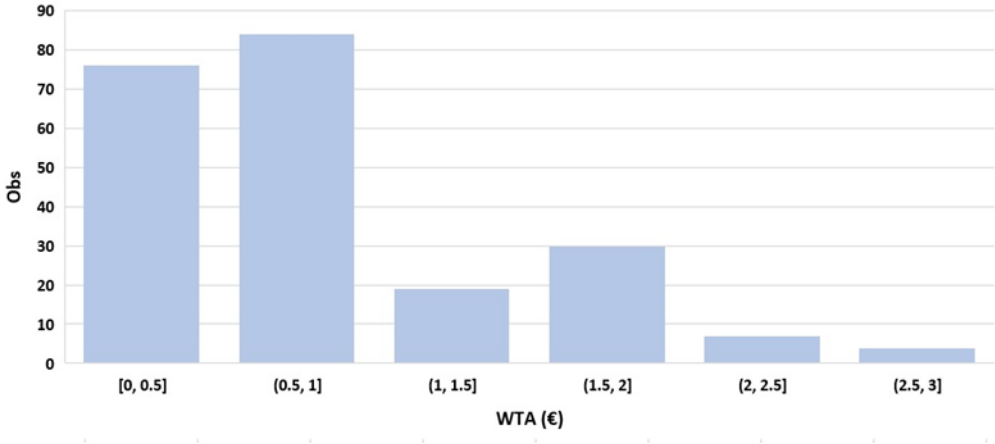

Figure 1. WTA for 1 kg of fruit with a higher CF. Source: own elaboration on survey data

Table 3.
Variables and descriptive statistics. Source: own elaboration on survey data

Variable	Description	Obs	Freq%
Fruit consumption habits - Frequency	1 if 'Everyday'; 0 otherwise	163	0.41
	1 if 'Nearly every day'; 0 otherwise	37	0.50
	1 if 'Less than twice a week'; 0 otherwise	19	0.09
Socio-economic factors - Job situation	1 if 'Stable or retired'; 0 otherwise	183	0.84
	1 if 'Occasional work'; 0 otherwise	16	0.07
	1 if 'Unemployed'; 0 otherwise	21	0.10
Socio-economic factors - Food expenditure	'No financial problems'	75	0.06
	'Moderate care'	131	0.60
	'Very careful'	14	0.34
Demographics – Male	1 if subject is male; 0 otherwise	0.39	-
Demographics – Age	Age, in years	47.7	15.84
Demographics – Education	Number of years of schooling	15.4	3.23
Demographics - Household composition	Partner	0.55	-
	Parents in the household	0.07	0.34
	Children in the household	0.48	0.85
	Number of household members	2.37	1.17

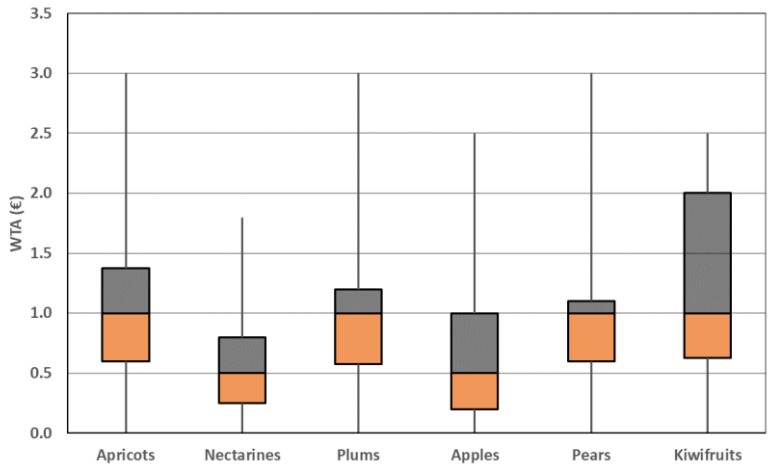

Figure 2. Distribution of the stated WTA by fruit species

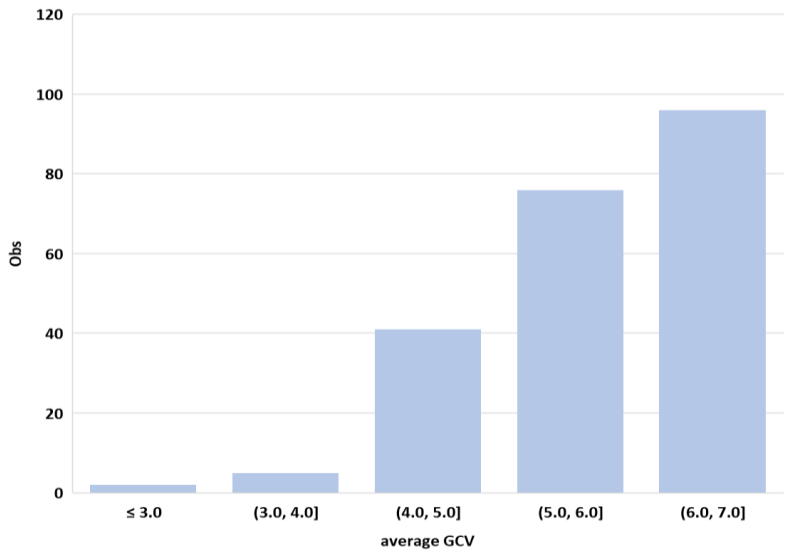

Figure 3. GCV distribution. Source: own elaboration on surveyed data

Table 4.
GCV results. Source: own elaboration on surveyed data

GCVs' scale	mean	Std dev
Mean of 1-6 GCV items	**5.78**	**1.27**
GCV/1. It is important to me that the products I use do not harm the environment.	**6.13**	**1.09**
GCV/2. I consider the potential environmental impact of my actions when making many of my decisions.	**5.41**	**1.38**
GCV/3. My purchase habits are affected by my concern for our environment.	**5.25**	**1.40**
GCV/4. I am concerned about wasting the resources of our planet.	**6.37**	**1.10**
GCV/5. I would describe myself as environmentally responsible	**5.78**	**1.03**
GCV/6. I am willing to be inconvenienced in order to take actions that are more environmentally friendly	**5.77**	**1.23**

A linear regression model was first applied to investigate determinants of consumers' WTA conventional fruit in place of fruit with a lower CF:

$$y_i = \boldsymbol{x}\boldsymbol{\beta} + \varepsilon_i \quad (1)$$

where y_i represents subject *i*-th compensation for trading the lower CF fruit with the higher CF fruit, $\boldsymbol{x}$ is the vector of independent variables, $\boldsymbol{\beta}$ is the vector of regression parameters, and ε_i is the linear regression error, with zero mean and constant variance.

Then, considered that the distribution of WTA is highly skewed (Figure 1), two tests were performed to assess the effectiveness of the statistical analysis. The first one consisted of assessing the (heteroskedasticity) robust standard errors known as White-Huber standard errors. Secondly, the Cook's distance method was used to determine possible significant outliers that might exist in the dataset.

Last, the initial regression results were adjusted applying a robust method. The bisquare weighting scheme was used to calibrate weights to be assigned to each observation. The final model consisted of the variables listed in Table 3 and the increased CF characterising the higher CF fruit compared to the low CF fruit, as reported in Table 1. It was expected that frequent fruit consumers with higher levels of GCV requested a higher compensation to accept high CF fruit, while those less concerned with environmental issues would request less. The same goes for the higher frequency of fruit consumption, stable work position, and unconstrained food expenditure, based on past studies and intuition.

5 Results

Results of the robust linear regression are reported in Table 4. The multiple adjusted R^2 was calculated as 0.13, indicating a weak predicting power but a significant fit. All significant variables were below the 5% significance level. The residual standard error was 0.5528.

Fruit consumption habit was found to be significant. As expected, the more frequent was fruit consumption, the more they requested to be willing to accept switching to a higher CF, and vice versa. That is, consumers who are more familiar with fruit care more about fruit attributes.

Turning to consumers' attitude towards environmental protection, subjects showing higher GCV asked for more compensation, representing an additional validation of GCV proposed by Haws et al. (2014).

In terms of demographics, subject age was negatively correlated with the WTA fruit with a higher CF. Elder consumers seemed to pay less attention to fruit/food attributes, while younger consumers showed higher compensation to accept the higher CF fruit.

Table 4.
Robust linear regression results of WTA the higher CF fruit with CF increase as fruit attribute.
Source: own elaboration on survey data - adjusted R^2 = 0.126

Parameter	Estimate	p-Value	T value	Significance
Intercept	**0.8646**	**<2e-16**	**15.3499**	***
Fruit consumption - Not Everyday	**0.3043**	**0.0218**	**-2.6622**	**
Environmental protection - GCV	**0.1862**	**0.0368**	**-2.2543**	**
Demographics – Age	**-0.0075**	**0.0128**	**3.0470**	**
Demographics – No. of Children in the Household	**-0.1185**	**0.0233**	**3.8183**	**
Fruit attributes – CF increase	**-0.6225**	**0.0114**	**-2.4238**	**

Surprisingly, subjects who lived with children were more accepting of the higher CF fruit, indicating that they do not necessarily want their children to be trying environmentally friendly food.

The remaining demographics, *Male, Education, Partner in family, Parents in family, and Number of family members,* and the employment situation and the attitude toward food expenditure were not significant.

Lastly, the CF increase associated with lower CF fruit trade with the higher CF was significant. As expected, consumers declared a relatively high compensation to accept the exchange with fruit with a higher CF. This result suggests that consumers pay attention to a certain attribute concerning the respect of the environment in food purchase decisions. Nevertheless, the relationship between the monetary value measured with the WTA and the CF levels' difference between the lower CF fruit and the higher CF fruit shows intrinsic limitation. Indeed, this association may not be only due to the increased CO_2 value since it may also be influenced by fruit species and price displayed to participants. In particular, it was found that the size of the CF increment (in percentage from the measure of the low-impact fruit) and the price showed for the higher CF fruit were highly correlated (-0.79).

Table 5.
Robust linear regression results of WTA a compensation to give up the CF fruit, with the price of the high-CF fruit as a fruit attribute.
Source: own elaboration on survey data – adjusted R^2 = 0.134

Parameter	Estimate	p-Value	T value	Significance
Intercept	**0.8659**	**<2e-16**	**15.7878**	***
Fruit consumption - Not Everyday	**0.2422**	**0.0924**	**-2.7282**	*
Environmental protection – GCV	**0.1772**	**0.0599**	**-2.1992**	**
Demographics – Age	**-0.0075**	**0.0094**	**2.4667**	***
Demographics – No. of Children in the Household	**-0.1124**	**0.0373**	**3.7496**	**
Fruit attributes – Price of High CF fruit	**0.1157**	**0.0037**	**3.3443**	***

Anyhow, the linear regression analysis with the variable price instead of CF increase (Table 5) indicated rather low but significant goodness of fit as well (R^2 = 0.134), with a residual standard error equal to 0.5144. The same variables were significant compared to the former regression results, with a slight difference in significance for three variables: Age and Price - High CF fruit.

6 Discussion

The results suggest interesting aspects of the food industry, marketers, and future research.

Consumers seem to be somehow sensible to reducing CF compared to the conventional product, even if this attitude would require additional research to consider possible confounding effect with the product's price. The presence of the attribute CF has demonstrated to be significant, and its presence of food labels is strongly recommended to support the market differentiation strategy. Clearly, not all consumers are willing to buy products characterised by mitigated environmental impact, with multiple reasons, and the increased costs may be the cause (Dale, 2008).

Fruit species, price and CF increase are strongly associated because each fruit species was characterised by unique attributes (price for the high CF fruit and CF increase). Certainly, it is possible to argue that the low CF fruit had on average a relevant value as expressed by the intercept, but there is not sufficient evidence about how much carbon emissions saved affected this value. On the other hand, a useful finding was that the GCV scale could predict consumer preference even for food characterised by lower CF as part of environmentally friendly products. This aspect highlights that positive attitudes towards the environment tend to increase the perceived value of the product characterised by a lower CF, and it is in line with other studies that have recently investigated WTP products with lower CF (Chen et al., 2018; Drichoutis et al., 2016; Vecchio & Annunziata, 2015). In general, in all these studies, consumers tend to be more willing to pay for products (including fruit) with a lower CF label than conventional ones.

These results highlight that there is an environmental impact mitigation potential pulled from the food demand side. This finding may have interesting policy implications, embracing consumers and producers.

As Canavari & Coderoni (2019, 2020) suggested, the diffusion of CF labels can inform consumers about the environmental impact associated with food production and the environmental label's potential in reducing it while helping food producers to reduce carbon emissions cost-effectively.

In addition, this study is partially in agreement with (Boccaletti & Nardella, 2000). While their results indicated that WTP was positively related to income and risk concern and negatively related to education, this study outcomes suggest that income and education are not significant per se. In contrast, risk concerns framed by GCVs, are confirmed to be significant in purchase decisions.

Food producers can use CF values to strengthen their corporate brand and product differentiation (Carbon Trust, 2008). In this regard, the higher compensation requested by consumers to trade low CF fruit with high CF fruit may enter cost-benefit analysis in the form of additional revenues gained thanks to the low CF food attribute, and this may favour the adoption of practices and technologies aimed to reduce the environmental impact (Medici et al. 2020).

Another contribution of this study was in having provided participants with a comparison with the same fruit varieties. Products appeared to be fully interchangeable from a functional point of view, and with a similar nutrient content, without the need to consider additional features like energy or protein, instead of food mass, as suggested by (Schau & Fet, 2008). This circumstance allowed to bypass additional product analysis that could have complicated experimental design resulting in less consumer participation.

Moreover, providing consumer guidance about the production methods used to grow fruit is another plus of this study. In this way, the CF attribute was strengthened, and participants became more aware of the differentiated attribute concerning environmental sustainability.

However, this study has several limitations. Methodologically, the contingent valuation approach adopted is based on stated preference in a hypothetical setting. The perceived value measure may likely be affected by hypothetical bias due to non-actual purchase decisions. A hypothetical bias means that people tend to request a monetary amount significantly different from what they actually would do in a real transaction. Hypothetical bias can also lead to a larger WTA variability, reflecting on the overall model performance. However, this bias was intrinsically limited by the relatively low value of the product compared to participants' income. In addition, supermarkets' choice as the survey location was also performed to limit participants' strategic behaviour and response bias. Personal interviews too limited the shortcomings of surveying through a simple questionnaire, providing detailed information on the product attributes and the farming method used to grow it, i.e. PA. Also, the use of WTA instead of WTP may have limited participants' bias, even though it may have created some misunderstanding since it is a less intuitive measure of perceived value. Results suggested a good relationship between the monetary value attributed to the lower CF fruit and the level of CF itself. However, it was impossible to limit possible bias associated with the other product attributes of fruit species and price because of the particular survey settings.

7 Conclusions

This study's results have described consumers' behaviour and attitudes for products characterised by a reduced environmental impact in terms of CF and contribute to the literature in consumer science and sustainable supply chain management. Value perception was measured using a contingent valuation method with a stated preference approach, asking consumers to state their WTA monetary compensation in an exchange offer for a 1-kg fruit punnet characterised by a higher CF (conventional fruit) in place of fruit characterised by a lower CF (sustainable fruit).

Fruit consumption habits were found to be significant in consumers' purchase decisions. As expected, consumers who are more familiar with fruit care more about fruit attributes, and the more frequently subjects consumed fruit, the more willing they requested to accept the higher CF fruit, and vice versa.

Concerning consumers' attitude towards environmental protection, subjects showing higher GCV asked for more compensation, representing an additional validation of GCV proposed by Haws et al. (2014).

In terms of demographics, elder consumers seemed to pay less attention to food attributes, while younger consumers showed higher compensation to accept the higher CF fruit. Subjects who lived with children were more accepting of the higher CF fruit, indicating that they do not necessarily want their children to be trying environmentally friendly food.

The CF increase associated with lower CF fruit trade with the higher CF one was significant: consumers declared a relatively high compensation to accept the exchange with fruit with a higher CF.

This result suggests that consumers pay attention to a certain attribute concerning the respect of the environment in food purchase decisions. However, the relationship between the WTA higher CF fruit and the CF increment shows limitations, as the preference towards fruit with increased CF value can also be influenced by fruit price. This evidence is supported by the high correlation between CF increase and price (-0.79).

In conclusion, findings support the use of CF labels for fruit, as they are potentially helping to orient consumers towards buying products less harming the environment, thus addressing the agriculture and food sector need to limit its contribution to global warming and the leading role that agriculture can play in reducing GHG emissions (Adenaeuer et al., 2020).

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