Environmental Friendly Food. Choice Experiment to Assess Consumer's Attitude Toward "Climate Neutral" Milk: The Role of Information

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Abstract

The livestock sector has a high impact in terms of carbon footprint. Lowering GHG emission from the livestock sector deals with implementing climate neutral production techniques in a cost effectiveness way and with developing market communication to make carbon free milk competitive with alternative products. This study aimed at analyzing how information and communications could impact on the consumer's attitude toward climate neutral fresh milk. The research focused on a case study carried out in Tuscany among a sample of supermarket customers, to assess consumer attitude toward fresh climate neutral milk using choice experiments methods. The participants were asked to attend a focus group meeting made of four different sessions. During the first session participants were asked to fill a background questionnaire and to watch a short documentary video showing the climate change risks. A second session consisted in a choice experiment in which participants were presented with 12 choices, each describing a scenario in which the milk key attributes were planned at different levels (price, organic labeling and carbon footprint labeling). During a third session the focus group discussions was developed following a semi-structured debate about environmental labeling, climate neutral labeling and the environmental impact of individual's purchasing behavior. In the last fourth session participants were asked to express their preferences on the choice-sets with the same scenarios presented in the second session, in order to assess variation in individual WTP toward climate neutral and organic milk. Results show that information could play a role in changing consumer attitude toward carbon free products.

Keywords: *carbon footprint, choice experiments, food, consumer behaviour. Multinomial discrete choice models*

1. Introduction

Climate change and global warming are having growing interest in the scientific debate and in the policy agenda at global level. The concern about greenhouse gas (GHG) emissions from production activities have produced multilateral effort to address actions in order to mitigate the global warming impacts. Human activities are the main responsible for GHG emission: every economic activity contributes to climate change. Reducing GHG emission asks for raising public awareness about climate change risks, for improving production technologies, for implementing market communication and changing consumer's behavior.

According to the United Nations Framework Convention on Climate Change (UNFCCC), agricultural GHG emissions account for almost 14% of global GHG emissions. In the EU zone the agricultural sectors is responsible for 9.2% of total EU GHG emissions. At farm level, the GHG emission is mainly due to the livestock rearing (manure, urine and ruminant digestion). Livestock represent around the 50% of total agricultural emission, with methane and nitrous oxide accounting for around 5% and 4.3% of total European GHG emissions (Fellmann, 2012). This assessment dismisses agricultural emissions due to fuel consumption, fertilizers and pesticides production and land use change (Smith et al., 2007). Furthermore, the food chain produces emission in all its stages from the farms through industry and distribution up to the waste disposal. Actually, the food accounts for 31% of the total GHG production in Europe (Environmental Impact of Products, 2006). Food consumption is responsible for GHG emission in an accountable proportion; changing individuals' food consumption patterns can have a deep effect in mitigating GHG emission. In other words influencing consumer's behavior toward a more sustainable and climate neutral purchasing pattern could represent an effective option to substantially reduce global GHG emission. Public opinions and attitudes regarding climate change must be enhanced; information and communication are key issues to empower consumers to adopt the needed changes in purchasing decision. At the same time the economic system must adopt climate neutral production techniques providing the market with carbon free products. The "carbon" characteristics of these products must be properly included in the labelling schemes to allow consumer to make more climate conscious decisions. The consumers' response toward carbon labeling schemes is crucial to allow suppliers to obtain a competitive advantage in disclosing "GHG contents" of their products.

This study aimed at analyzing how information and communications could impact on the consumer's attitude toward climate neutral fresh milk. The livestock sector has a high impact in terms of carbon footprint (Guerci et al., 2014). Lowering GHG emission from the livestock sector deals with implementing climate neutral production techniques in a cost effectiveness way and to develop market communication to make carbon free milk competitive with alternative products. The research focused on a case study carried out in Tuscany among a sample of supermarket customers, to assess consumer attitude toward fresh climate neutral milk using choice experiments methods. The participants were asked to attend a focus group meeting made of four different sessions. During the first session participants were asked to fill a background questionnaire and to watch a short documentary video about the climate change risks. In the second session, choice-sets are were administered to participants; the 12 choice-sets were built through the planning of a choice experiment, where each choice-set describes a scenario in which the milk key attributes were presented at different levels (price, organic labeling and carbon footprint labeling). During a third session the focus group discussions was developed following a semi-structured debate about environmental labeling, climate neutral labeling and the environmental impact of individual's purchasing behavior. In the last fourth session participants were asked to express again their preferences on the same scenarios presented in the second session to assess variation in individual WTP toward climate neutral and organic milk. Multinomial discrete choice models were applied in order to evaluate attitudes and WTP variations; the model results show that information could play a role in changing consumer attitude toward carbon free products.

2. Methodology, questionnaires and data collection.

Research focused on a dairy product since agricultural GHG emission contribution is largely due to the livestock sector. Lowering GHG emission for this sector asks for cost effectiveness production techniques and market communication to make the carbon neutral milk competitive with other alternative milk. Since there is no foot print label scheme for food products in the Italian market, we selected milk, among other dairy products, given that milk is a habitual purchased product. Thus it is conceivable that consumers are familiar with milk standard attributes and price and they are able to

make their choice between product's well-known attribute (i.e. price) and the new attribute (carbon free). In this way individuals could focus more on the perceived value of the carbon label, making a more conscious decision. The survey was conducted in a sample of 39 voluntarily recruited supermarket customers in rural and urban areas of Tuscany; at the end of the meeting to each participant was given an attendance token. The participants were asked to attend four different sessions of the focus group meeting. During the first session participants were asked to fill a background questionnaire. The background questionnaire was composed of three main parts. In the first part the participants were asked to fill answers regarding their perceived economic condition; the second part of the questionnaire was about respondent's environmental sensitiveness, purchasing habits (organic, food miles, conventional buyers etc..) and milk consumption (price, frequency, quantity and quality of purchased milk). The third part was dedicated to questions on socio-demographic aspects (age, educational level, family size. etc). In this session a five-minute long documentary about the potential impact of consumers' choices on climate change risks was screened. A second session consisted in a choice experiments in which participants were presented with a number of 12 choice-sets (scenarios), each describing a series of a systematically and independently varied key attributes (price, organic labeling and carbon footprint labeling, no eco labeling). Each choice-set consists of two alternatives describing different milk attributes and different attribute levels. Participants were asked to select one option in each choice-set. After a short "warming-up" break (10 minutes) the main section of the session followed to increase participants' exposure to information on climate change issues. The focus group discussions followed a semi-structured track, lasted between 60 and 80 min and were assisted by a moderator. The session included a deep discussion about individual climate change awareness, about their environmental sensitiveness and their perceptions and attitude toward sustainable environmental food. In this section respondents were invited to discuss on a set of real labels related to "environmental" characteristics of food and on their interests and attitudes towards a hypothetical new label accounting GHG emissions of fresh milk. This session had the objective to enhance consumer information about climate change issues, to improve the people's understanding about climate change risks and to share individual's views and perceptions about different food product labels and about the impact of purchasing behavior on GHG global emission. The focus group discussions were completely recorded and a full transcript was produced. In the last fourth session participants expressed their preferences on the same scenarios already presented in the second session.

2.1 Models and experimental design. Multinomial discrete choice models

In order to illustrate the case study, the class of Random Utility models (RUM) is defined. In general, every alternative is indicated by *j* (*j=1,...,J*), while *i* denotes the consumer/user (*i=1,...,I*); the respondent is asked to give his/her preference within each choice-set, formed several alternatives, in what follows we consider to have binary choice-sets. Thus, the following expression is characterized by a stochastic utility index U_{ij}, which may be expressed, for each unit *i* as:

$$U_{ij}=V_{ij}+e_{ij} \qquad (1)$$

where V_{ij} is the deterministic part of utility, while e_{ij} is the random component, independent and Gumbel distributed. The class of RUM, which aims to achieve the utility maximization for the respondent, enlarges the characteristics of Logit and Nested Logit (NL) models where the Independence of Irrelevant Alternatives (IIA) is hypothesized. The relaxation of this assumption is undoubtedly a very substantial improvement because the IIA means that the choosing probability in one choice-set is independent of the presence of other attribute values or any other alternative; on the other hand, we may say that IIA derives from the hypothesis of independence and homoscedasticity of the error terms. In addition, this can also be interpreted by considering the cross-elasticity term. In fact, IIA implies an equal proportional substitution between alternatives. Furthermore, these models cannot take account of a different behaviour of the consumer; i.e. each respondent, with different baseline characteristics, is treated in a similar way (the same estimate values of attributes) according

only to their judgment, exclusively. In the literature, a first contribution to improving these issues is in Train (1998), where a Random Parameter Logit (RPL) model is introduced. At present, this model is more precisely called Mixed Multinomial Logit (MMNL), McFadden and Train (2000). In fact, this RUM model allows to evaluate the respondents' heterogeneity or, better, the consumer/user's variability is estimated by considering the attributes as random variables and not fixed variables, i.e. as random variables across respondents; in addition, just because more choice-sets are supplied to the respondents, the repeated choices (during time) imply a correlation which is confounded with the consumer/user's variability (unobserved utility). A further issue is related to the presence of the heteroscedasticity, e.g. variability across alternatives, which may be taking into account through the following Heteroschedastic Extreme Value (HEV) model, which makes it possible to highlight the real impact of each attribute on the respondent's preference. The Heteroschedastic Extreme Value (HEV) model (Bhat, 1995; Hensher, 1999) also belongs to the RUM class, formula (1). The main feature of this model concerns the modified assumptions on the random component, which is supposedly distributed as a type I extreme value distribution, independently but not identically distributed. It must be noted that this different hypothesis on the random component makes it possible to treat the relaxation on the IIA differently with respect to the MMNL model. This relaxation is fundamental and strengthens improvement with respect to the basic MNL logit model. Furthermore, in the HEV model, different scale parameters between alternatives are estimated. Moreover, the presence of large variances for the error terms influences the effects of changing the systematic utility for the generic alternative *j.*

When considering the consumer's choice modelling, experimental designs and statistical models are closely connected and the properties of one design affect the corresponding model. When these properties do not exist in the design, this must be taken into account in the model. This is the case of an improvement in the design optimality specifically defined for a MMNL; on the other hand, when considering the respondents' heterogeneity, a specific design matrix for each respondent is planned (Sandor and Wedel, 2005), by including the heterogeneity evaluation directly in the design step instead of the model step. Within the choice experiment step, optimality criteria, above all D-optimality, ad-hoc algorithms and specified information matrices for the experimental design involved were entirely defined in 1990's. Further developments are related to the construction of optimal or near optimal designs with two-level attributes for binary choices in the presence of the first order interactions, or when optimal designs are defined with mixed-level attributes. In Bliemer et al. (2008) several algorithms are compared (in draws within the Pseudo Monte-Carlo simulation method) to select efficient Bayesian designs.

2.2 The Heteroscedastic extreme value model

The main feature of the HEV model concerns the modified assumptions on the random component, which is supposedly distributed as a type I extreme value distribution, as mentioned previously. This different hypothesis on the random component makes it possible to relax the IIA property differently. In the HEV model, different scale parameters between alternatives are estimated. The main evident advantage is that the scale parameters may be defined as the weights in order to measure the uncertainty relating to the alternatives and the attributes involved. Therefore, the probability that a respondent *i* chooses the alternative *j* from a choice-set C_i is:

$$\boldsymbol{P}_{ij}=\int_{e}\ \prod_{k\in Ci;k\neq j}\Lambda\left\{\frac{x_{ij}\beta-x_{ik}\beta+e_{ik}}{\vartheta_k}\right\}+\frac{1}{\vartheta_j}\lambda\left(\frac{e_{ij}}{\vartheta_j}\right)de_{ij} \qquad (2)$$

In (2), θ_j is the scale parameter for the *j* alternative and $\lambda(\bullet)$ is the probability density function of the Gumbel distribution, while $\Lambda(\bullet)$ is the corresponding cumulative distribution function evaluated by considering two distinct choices for the *i* respondent; in fact, the term $x_{ij}\beta$ denotes the deterministic part of utility of formula (1) related to alternative *j* and alternative *k*, respectively. Note that the integral function is defined on the domain [-∞,+∞] of the random component *e*, related to the unit *i* and the alternative *j*. In this case, preferences of respondent *i* are evaluated by considering a scaling term (scale parameter) θ_j for the alternative *j* in the choice-set C_i i.e., the heteroscedasticity of the error term. In the case-study, two alternatives are included in each choice-set and therefore only one scale-parameter is estimated.

With respect to the conditional logit model, the HEV model and the Mixed MNL logit model could be considered as competitive models for identifying and measuring the presence of an over-dispersion when modelling the respondent preferences.

3. Results

The background questionnaire results allow us to gather information on respondents socioeconomic characteristic as well as on their environmental sensitiveness and purchasing behavior. Respondents demographic in terms of age and location of the focus group are provided in table 1. The respondents were 13 men and 26 women, a balance reflecting the recruitment rule to prefer persons in charge of the current expenditure within the family.

Table 1

Focus group description by age and location

Location	Age		
	18-|50	>50	Total
Rural	10	9	19
Urban	8	12	20
Total	18	21	39

In the background questionnaire, the respondents were asked to answer a question about their perceived economic well-being. The question was stated with regard to the respondent judgments of his/her own economic situation. The largest part of respondents defined themselves in a modest or well-off economic status. The age of respondent is positively correlated with the level of perceived economic status: the respondents perceiving themselves in a well-off or affluent economic status were on average 57 years old while the average age of respondents perceiving themselves in a worst economic status was around 45.

In relation to respondents purchasing habits result shows that "local" is the most frequently immaterial characteristics associated to food purchased by consumers: 82% of respondents purchases local food "almost always" or "often". The sample includes consumers purchasing with regularity food with some form of certification of immaterial characteristics such as denomination of origin or fair trade. The participants answered to purchase organic certified food "very rarely" only in the 28% of the cases and "never" in the 8%; the 64% of the sample purchases "sometimes" or "almost" organic food. The 31% of the sample is not informed about integrated farming certified products but about 40% purchases these products "sometimes" or "often". The 28% of respondents declares to purchase "almost always" food with denomination of origin certification (table2).

Table 2

Purchasing habits for different types of food (% of respondents)

	organic food	integrated farming	denomination of origin	local food	fair trade	ready meals
Never	8	13	10	0	3	18
Very rarely	28	15	36	0	23	38
Sometimes	46	21	38	18	41	31
Often	18	18	3	54	23	10

Almost always	0	3	13	28	5	0
I don't know	0	31	0	0	5	3
Total	100	100	100	100	100	100

As expected the Conditional Logit Model and the HEV model (formula(2)) results show that the respondents' WTP is generally highly determined by price and weakly determined by environmental signals of fresh fluid milk (CO2 =carbon footprint and BIO =organic labels; the coefficients have the expected sign given the adopted coding of answers, implying a WTP for reducing environmental impacts). However if we compare the two different choice experiments carried out before (t_0) and after (t_1) the exposure to information during focus group sessions, some interesting differences arose. In fact through the first choice-sets administering, choice modelling results (Table 3) show that the price has a major role in determining the respondents preference and that the utility toward environmental characteristics of the product is higher for organic milk than for carbon free milk (BIO coefficients equal to -0.99 vs. coefficient CO2 equal to 0.79). A completely different situation is described by results of the choice experiment at time t_1 (Table 5): the coefficient for price increase from -1.11 to -0.17; furthermore the carbon-free characteristic of milk becomes relatively more important than the organic certification in determining the purchase of fresh milk.

Tab 3- Conditional logit model results -1st choice-sets administering

Parameter	DF	Estimate	Std.Error	t-Value	Pr > |t|
CONST	1	1.2130	0.2613	4.64	0.0001
PRICE	1	-1.1167	0.3291	-3.39	0.0007
CO2	1	-0.7983	0.1241	-6.43	0.0001
BIO	1	-0.9921	0.1303	-7.61	0.0001

Tab 4- Conditional logit model results -2nd choice-sets administering

Parameter	DF	Estimate	Std.Error	t-Value	Pr > |t|
CONST	1	1.3953	0.2623	5.32	0.0001
PRICE	1	-0.1797	0.3179	-0.57	0.5719
CO2	1	-0.9228	0.1265	-7.29	0.0001
BIO	1	-0.7550	0.1226	-6.16	0.0001

When considering the second administering of choice-sets (t_1) both the HEV and the logit models confirmed that the price was less important than in the first t_0 choice (Tab.3 and 4). After the exposure to the information the respondents' utility was less determined by price and more determined by carbon foot print; the organic milk parameter value was lower than in the first administering session. It must be noted that the ranking of perceived values of the environmental attribute are inverted from the first to the second administering of choice set. While, in the first experiment, the organic milk utility is higher than the carbon free milk one, in the second experiment the carbon free milk utility values is higher than the organic one. This shows a competitive interaction between organic and carbon food certification.

Respondents show a willingness to pay for a price premium for both carbon labeling and organic certification (Table 6). The average price paid for products with carbon labeling (CO2) at time t_0 is 0.55€ higher than the basic price of the experiment design (0.86€/l); the price premium for organic labeling (BIO) is slightly lower but still positive (0.51). Interestingly, the exposure to information increases the average price premium paid for both products but in a larger extent for products with organic certification (0.56€/l, +10%). This effect seems caused by the shift of at least one part of the

choices from organic (-7% of expressed choices) to carbon labeling (+10.3% of expressed choices). In presence of a carbon labeling scheme only consumers with a higher willingness to pay maintain their choice for organic certification.

Tab. 5 - Number of choices and average price premium paid for products with carbon footprint and organic certification-1st and 2nd choice sets administering

	CO2		BIO	
time	n. of choices	av.price premium (€/l)	n. of choices	av.price premium (€/l)
t_0	272	0.55	272	0.51
t_1	300	0.57	253	0.56
% variation t_0 - t_1	10.3	2.2	-7.0	10.0

We also investigated the effect of background questionnaire variables by including the interactions between choice and socioeconomic and environmental variables. Various combinations, were tested, and only the statistical significant effects are included in the results. The two HEV models include also some interaction terms accounting for respondent heterogeneity within the sample. Overall, the impact of price is lower with the increase of respondents' age (positive sign of the coefficient for PRETA). This results is coherent with the better perceived economic status of older respondents. At t_0 the male respondents were more likely to prefer organic products (Negative coefficient for BIO*GENDER, table 6) but this attitude seems no longer present after the exposure to information (reduced value and significance of the coefficient in table 7).

The interaction term linking CO2 labels and regular purchase of food miles labeled products show not significant coefficients both at time t_0 and t_1, probably due to the low number of observations. However, it is interesting notice that the sign of the estimated coefficient reverses moving from t_o to t_1: while in the first choice experiment the habitual purchase of foo-miles labelled products decreases the probability to choice carbon free milk, after the exposure to information the same respondents showed a higher probability to purchase it.

Tab 6- HEV model results – 1st administering session

Parameter	DF	Estimate	Error	t-Value	Pr > |t|
PRICE	1	-1.0457	0.3061	-3.42	0.0006
CO2	1	-0.5304	0.1222	-4.34	0.0001
BIO	1	-0.7224	0.2205	-3.28	0.0011
PRICE*AGE	1	1.1537	0.4476	2.58	0.0099
BIO*GENDER	1	-1.0059	0.4611	-2.18	0.0291
CO2*KM0	1	0.0222	0.2540	0.03	0.9304
SCALE1	1	0.8394	0.5387	1.56	0.1192

In the first administering session this consumer group show no utility toward carbon labels: parameter value is equal to 0.02 (Table 5). In the second choice experiments the utility toward carbon free milk arose and the parameter values was equal to -0.29.

Tab 7- HEV model results – 2nd administering session

Parameter	DF	Estimate	Std.Error	t-Value	Pr > |t|
PRICE	1	-0.4902	0.3368	-1.46	0.1456
CO2	1	-0.6277	0.0972	-6.46	0.0001
BIO	1	-0.3957	0.0883	-4.48	0.0001
PRICE*AGE	1	1.1255	0.3088	3.65	0.0003
BIO*GENDER	1	-0.3893	0.2446	-1.59	0.1114
CO2*KM0	1	-0.2952	0.2234	-1.32	0.1865
SCALE1	1	1.2374	0.6458	1.92	0.0554

The male seems to be less oriented toward price attribute and to have no attitude toward carbon labeled milk and a slight attitude toward organic milk. Nevertheless this participants group in the second session (Table 7) shows less utility for price, slightly increasing utility toward organic milk and carbon labelled milk.

4.Conclusion

In this study, a choice experiment is planned and choice-sets together with a background questionnaire are administered to a set of respondents at focusing on the consumers' attitude toward climate neutral milk. The collected data are analyzed through the application of RUM models, in particular conditional logit and HEV models in order to evaluate the heteroscedasticity across alternatives (scenarios).

This preliminary study confirms that the consumer attitude toward carbon labeling is generally low and that it is generally lower than the attitude toward organic labels. At the same time the study shows that the role of information is crucial is determining consumer behavior changes toward climate change issues. If we analyses the respondents attitude toward the key attributes in the two administered sessions of choice-sets, we can observe that the importance of the price in the selection process is declining after the respondents' were informed on the potential impact of consumers' choices on climate change risks. While their attitude toward climate neutral milk have generally been increased in the second choice experiments, since the carbon footprint attribute is increasing its importance in the respondents choices criteria in the second choice experiments. Regarding the relationship between organic labels and the hypothetical carbon free labeling the results showed that there were substitution effects between the two environmental labeling schemes. The increased utility toward carbon free milk caused the decrease attitude toward organic milk. The interaction between the two labels develops a competitive effect with potential impact on market share.

References

Bellarby, J., Foereid, B., Hastings, A., Smith, P., 2008. Cool Farming: Climate Impacts of Agriculture and Mitigation Potential. Greenpeace, Amsterdam.

Bhat, C.R. 1995. A heteroschedstic extreme value model of intercity travel mode choice. Transportation Research Part B-Methodological. 29, 471-483.

Bliemer, M., Rose J., Hess., S. 2008. Approximation of Bayesian efficiency in experimental choice designs. Journal of Choice Modelling. 1, 98-127.

Carlsson-Kanyama, A. and Gonzalez, A.D. 2009. "Potential contributions of food consumption patterns to climate change", American Journal of Clinical Nutrition, Vol. 89 No. 5, pp. 1704-9.

Cohen M.A. Vandenbergh M. P. 2012. "The Potential Role of Carbon Labeling in a Green Economy," 34 Energy Economics S53-S63

Echeverrıa R., Moreira V. H., Sepulveda C., Wittwer C.2014 "Willingness to pay for carbon footprint on foods" ,British Food Journal, Vol. 116 Iss 2 pp. 186 – 196

Environmental Impact of Products (EIPRO). 2006. "Analysis of the Life Cycle Environmental Impacts Related to the Total Final Consumption of the EU 25". European Commission Technical Report EUR 22284 EN.

Felleman T. 2012. "Agricultural GHG emissions in the EU: an exploratory economic assessment of mitigation policy options". Joint Research Centre. Scientific and Policy Reports: European Commission.

Gadema, Z. and Oglethorpe, D. (2011), "The use and usefulness of carbon labelling food: a policy perspective from a survey of UK supermarket shoppers", Food Policy, Vol. 36 No. 6,pp. 815-822.

Garnett, T. 2011. "Where are the best opportunities for reducing greenhouse gas emissions in the food system (including the food chain)?" Food Policy 36 S23–S32.

Guerci M., Bava L., Zucali M., Tamburini A., Sandrucci A. 2014 "Effect of summer grazing on carbon footprint of milk in Italian Alps: a sensitivity approach" Journal of Cleaner Production 73 236-244

Hensher, D. A. 1999. HEV choice models as a search engine for the specification of nested logit tree structures. Marketing Letters. 10, 339-349.

McFadden, D., Train, K. 2000. Mixed MNL for discrete response. Journal of Applied Econometrics. 15, 447-450.

Sandor, Z., Wedel, M. 2005. Heterogeneous conjoint choice designs. Journal of Marketing Research. 42, 210-218.

Röös E., Tjärnemo H. 2011."Challenges of carbon labelling of food products: a consumer research perspective", British Food Journal, Vol. 113 Iss 8 pp. 982 – 996

Tan M.Q.B., Tan R.B.H., Khoo H.H. 2014. "Prospects of carbon labeling-a life cycle point of view" Journal of Cleaner Production 72, 76-88.

Train, K.E. 1998. Recreation demand models with taste differences over people. Land Economics. 74, 230-239.

Vanclay, J.K., Shortiss, J., Aulsebrook, S., Gillespie, A.M., Howell, B.C., Johanni, R., Maher, M.J.,Mitchell, K.M., Stewart, M.D. and Yates, J. 2011. "Customer response to carbon labelling of groceries", Journal of Consumer Policy, Vol. 34 No. 1, pp. 153-160.

Upham P., Dendler L., Bleda M. 2011."Carbon labelling of grocery products: public perceptions and potential emissions reductions" Journal of Cleaner Production 19 (4) 348-355.

Virtanen Y., Kurppa S., Saarinen M., Katajajuuri J.M., Usva K., Mäenpää I., Mäkelä J., Grönroos J., Nissinen A. 2011. "Carbon footprint of food-approaches from national input-output statistics and a LCA of a food portion" Journal of Cleaner Production, 19 1849-1856.