



A cross-section from the consumer perspective on sustainable nutrition: consumer awareness and motivation status

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Abstract

Sustainable diets and food production systems are important for healthy life and future generations. This goal should be reachable by consumer motivations. The study aim is the evaluation of awareness and knowledge of sustainability and logo/claims related with sustainability.

Participants' knowledge about sustainability definition and logos/claims related to sustainability were assessed by an online-questionnaire. The questionnaire involved the calculation of annual dietary carbon emissions (kg), nitrogen waste (g), and water consumption (L).

Four hundred-two volunteers participated in the study (male: 24.9%; female: 75.1). Only 44 participants (10.9%) explained what sustainable nutrition definition, correctly. The rates of knowledge about logos were quite low; 29.4% for organic product logo; 26.6% for Good farming practice logo; 86.1% for Recycle logo; and 8.0% for Eco-label logo, respectively. The education status of participants affected to knowledge of logo/claim ratio ($p < 0.05$). Ethic production and environmental impact statement information were care of participants' ratio of 33.6% and 34.1%, respectively. The mean dietary carbon emission of participants was 551.0 ± 343.6 kg/year, which was 81% of the upper limit (680 kg/year). The mean nitrogen waste was 3238.8 ± 4620.9 g/year and mean water consumption was $91,538.7 \pm 157,537.9$ L/year. Mediterranean diet model carbon emission and nitrogen waste were higher than other diet models, omnivore diet models had more water consumption than other diet models. But these differences were not found statistically significant ($p > 0.05$).

Sustainable nutrition can be achieved via consumers' awareness. Food industry and government should encourage the people about promotion of sustainable food preferences.

Keywords Dietary carbon emission · Diet preferences · Food labels · Sustainable nutrition

Introduction

Sustainability is a social concept that has a close relationship to global warming, climate change, and the sustainability of the world. The main goal is to use the limited resources in the world more effectively and to leave a better world for the next generations to meet their nutritional needs. Nutrition has an effect on the environment via food production, processing, transport, and consumption stages (Smetana et al. 2019). Global food production systems are not sustainable at

the present time, with the present food production systems; are the cause of 30% of global carbon emission, use of 40% of farming area, use of 70% of water, effect to be under the threat of extinction species, eutrophication of the coastal area, and effect to fish farming (EC 2013). In addition to climate change, the COVID-19 pandemic's economic crisis affected food supply and food security, deeply (Grunert et al. 2014; Van Loo et al. 2021; Futtrup et al. 2021). So, sustainable food systems are urgently needed, which has the lowest environmental effects (Springmann et al. 2020).

The FAO defined sustainable diets as “diets with low environmental impacts which contribute to food and nutrition security and healthy life for present and future generations” (FAO, 2022). Sustainable diets suggest more healthy foods such as; legumes, nuts, fruits, and vegetables, reduction of added sugars, and red meat according to some guidelines (Willett et al. 2019, Harvard T.H 2022). Scientific data

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is needed for the possible change in nutrition guidelines in the near future. This is the first study that calculated annual dietary carbon emission, nitrogen waste, and water consumption according to the diet preferences of adults.

The most important problem of sustainable nutrition is insufficient encouragement of social behavior. The food logos/claims seem like a very important mediator for communication with consumers (EFAD 2020). The food logos/claims help consumers to make food choices that produce more environmental and ethical products. In practice, carbon emissions and nitrogen waste, and water consumption will be decreased (Willett et al. 2019). Effective development should be achieved by a sustainability system including the food production system and the food logos/claims industry. Because food producers and suppliers can need a feedback mechanism that explains the understandability of their products. We thought that this study is important both for an economic return such as sales and for promoting the production of more reliable products. On the other hand, study results are important in terms of discovering sustainability knowledge and awareness of consumers.

Methods

This study has a cross-sectional design, involving all areas of Turkey that has seven different regions (TUIK 2021). The data of the study was collected from December 2021 to March 2022. The online survey was used for data collection via social media announcements. The sample size was calculated with the G-power program as 316 and the study was finished with 402 adult participants (18–65 years old). All participants accepted to be a participant in the study and they approved the voluntary consent form. Non-interventional Clinical Researches Ethics Committee approval was get by Non-Interventional Ethics Committee of Hacettepe University (no: GO 21/1191, Decision No: 2022/02-52).

Questionnaire design

The questionnaire was designed by the researcher appropriate to the online application based on literature. The questionnaire involved 3 important titles;

- socio-demographic information (age, gender, education),
- sustainable nutrition awareness,
- food consumption calculation.

Socio-demographic information was examined, which is related to sustainable nutrition behavior, such as; the age, gender, and education status of participants. Primary school, secondary school and high school education levels were very low, so they were evaluated as a basic education level. *Sustainable nutrition awareness* and some logos knowledge associated with sustainability were evaluated, which were used mostly by food producers in Turkey (Fig. 1). Logos means; Organic product logo, Good farming practice logo, Recycle logo, Eco-label logo. *Food consumption calculation*; The questionnaire involved the calculation of annual dietary carbon emissions (kg), nitrogen waste (g), and water consumption (L). Annual dietary carbon emissions, nitrogen waste, and water consumption were calculated with a food frequency questionnaire and the Harvard University calculator (<https://harvard-foodprint-calculator.github.io/>) (Harvard 2022). When the participants' annual dietary carbon emission was evaluated, the upper limit of annual dietary carbon emission was accepted as 680 kg, (Harvard 2022).

Statistical analysis

The study data was evaluated by SPSS 23.0 (Statistical Package for Social Science, USA) software. The data was stated as mean (\bar{x}), standard deviation (SD), number (n), and percentage (%) values. Chi-square tests were used in categorical qualitative data, and determination of differences with data was made by post hoc test. Kruskal Wallis Test was used to determine statistical differences of Annual carbon emissions, nitrogen waste, and water consumption according to dietary preferences. Statistical significance was determined as $p < 0.05$ value.

Results

Four hundred-two volunteers participated in the study (male: 24.9%; female: 75.1%). The mean age of participants was 30.4 ± 13.6 years. Most of the participants had undergraduate and postgraduate education (85.8%).

Fig. 1 Logos were evaluated in this study, which are related to sustainable nutrition



Table 1 Sustainable nutrition means and logo knowledge of participants according to education status

		Basic education		Undergraduate		Postgraduate		Total		p
		n	%	n	%	n	%	n	%	
Sustainable nutrition mean	Knows	13 ^a	22,8	65 ^a	20,4	12 ^b	46,2	90	22,4	0.010*
	Does not know	44 ^a	77,2	254 ^a	79,6	14 ^b	53,8	312	77,6	
Organic product logo	Knows	18	31,6	88	27,6	12	46,2	118	29,4	0.125
	Does not know	39	68,4	231	72,4	14	53,8	284	70,6	
Good farming practice logo	Knows	15	26,3	81	25,4	11	42,3	107	26,6	0.172
	Does not know	42	73,7	238	74,6	15	57,7	295	73,4	
Recycle logo	Knows	42 ^a	73,7	280 ^b	87,8	24 ^{a,b}	92,3	346	86,1	0.012*
	Does not know	15 ^a	26,3	39 ^b	12,2	2 ^{a,b}	7,7	56	13,9	
Eco-label logo	Knows	4	7,0	24	7,5	4	15,4	32	8,0	0.777
	Does not know	53	93,0	295	92,5	22	84,6	370	92,0	
Total		57	100,0	319	100,0	26	100,0	402	100,0	

• Categorical qualitative data were determined by Chi-square tests and Post hoc tests

There are 4 logos/claims in Turkey, related to sustainable nutrition. The participants declared that 22.4% of participants know what sustainable nutrition means. However, only 44 participants (10.9%) explained what sustainable nutrition means, correctly. Most of the participants explained sustainable nutrition, as healthy eating behavior for a lifetime. The rates of knowledge about logos were quite low; 29.4% for organic product logo; 26.6% for Good farming practice logo; 86.1% for Recycle logo; and 8.0% for Eco-label logo, respectively (Table 1).

Sustainable nutrition means and logos knowledge of participants were commonly low, not including recycled logo. The education status of participants affected to knowledge of logo/claim ratio, undergraduate and postgraduate participants were more informed. The knowledge ratio of the eco-label logo was very low among all participants.

The participants declared that they always pay attention to the price of food when they are buying food. Most of them rarely pay attention to energy and nutrients ingredients (44.3%). Ethic production and environmental impact

statement information were notice of participants' ratio of 33.6% and 34.1%, respectively (Table 2).

69.4 percent of participants declared that they can pay more money for the food that is produced with less environmental impact and promote animal welfare. They mostly agree to 5% and 10% pay more than now food price (Table 3).

The first 3 diets most preferred by the participants were omnivore (69.7%), halal (18.7%), and the Mediterranean diet (8.7%), respectively. Participants' dietary mean annual environmental impact (carbon emissions, nitrogen waste, and water consumption) were presented in Table 4. The mean dietary carbon emission of participants was 551.0 ± 343.6 kg/year, which was 81% of the upper limit (680 kg/year). The mean nitrogen waste was 3238.8 ± 4620.9 g/year and mean water consumption was $91,538.7 \pm 157,537.9$ L/year. Mediterranean diet model carbon emission and nitrogen waste were higher than other diet models, omnivore diet models had more water consumption than other diet models. But these differences were not found statistically significant ($p > 0.05$).

Table 2 Which of the following do you pay attention to in the food label/packaging while purchasing food?

	Never		Always		Rarely		Often		Total	
	n	%	n	%	n	%	n	%	n	%
Price	0	0	292	72.6	15	3.7	95	23.6	402	100.0
Energy and nutrients ingredients	34	8.5	56	13.9	178	44.3	134	33.3	402	100.0
Ethic production statement	135	33.6	70	17.4	135	33.6	62	15.4	402	100.0
Environmental impact statement	137	34.1	45	11.2	167	41.5	53	13.2	402	100.0

Table 3 Perspectives of participants on overpaying for environmental production and animal welfare

Would you pay more for products that have a less environmental impact and promote animal welfare?	n	%
No	123	30.6
Yes	279	69.4
What is the rate you will pay for this?		
%2	61	15.2
%5	85	21.1
%7	37	9.2
%10	75	18.7
%15	21	5.2
Total	402	100.0

Discussion

Nutrition education and health awareness are important factors that develop healthy life behavior. Food labeling helps to consumers for healthier foods choice such as; reduces some nutrient intake like sodium and trans-fat (Shang-guan et al. 2019). The sustainability characteristics of food labels should provide consumers with opportunities for food choices that have fewer environmental, social, and ethical impacts (Annunziataa et al. 2019).

Consumer awareness and motivation are important to the development of standards, although sustainability labels are not always fully understood, and their impact sometimes is not strongly effective (Annunziataa et al. 2019). Lack of food label/claim understanding can be related to low consumption frequencies of sustainable food, so understanding might be crucial to foster consumption among individuals that are less motivated (Grunert et al. 2014). Sustainable nutrition means were questioned for the evaluation of sustainable nutrition awareness of adults in this study. 22.4% of participants declared that they know what sustainable nutrition means. But, only 44 participants (10.9%) explained what sustainable nutrition means, correctly. Most of the participants explained sustainable nutrition, as healthy eating behavior for a lifetime that is not true. This is the quite

low ratio for awareness for sustainability. A similar situation exists for logos related to sustainability. Sustainable nutrition means and logos knowledge of participants were commonly low, without recycled logo. The rates of knowledge about logos were quite low; 29.4% for organic product logo; 26.6% for Good farming practice logo; 86.1% for Recycle logo; and 8.0% for Eco-label logo. The education status of participants affected to knowledge of logo/claim ratio, undergraduate and postgraduate participants were more informed ($p < 0.05$). Eco-label logo is “goods and services should meet high environmental standards throughout their entire life cycle: from raw material extraction through production and distribution to disposal” which is voluntary for industry (EC 2022). Although, Eco-label is developed for encouraging produce and consume environmentally friendly products, the knowledge ratio of the eco-label logo was very low among all participants (8%).

The education level of consumers can affect the selection of food, therefore consumers with lower education levels were shown as a developable strategy for sales (Hersey et al. 2013). Gundala and Singh (2021) studied buying behavior of consumers and shown that education level, consumer knowledge, and availability of foods were influencing factor for buying behavior. Their study suggested to the companies can craft marketing strategies to increase consumers’ awareness of the benefits of organic food consumption. Furthermore, policymakers should encourage to companies and consumers for sustainability knowledge development.

Sustainable food production and labeling has extra cost for manufacturers and consumers (Annunziataa et al. 2019). Food price is the important determinant for food choices (van Bussel et al. 2022). For this reason, it should be questioned whether the producer and the consumer are suitable for the extra cost. The participants declared that they always pay attention to the price of food when they are buying food. Most of them rarely pay attention to energy and nutrients ingredients (44.3%). Ethic production and environmental impact statement information were notice of participants’ ratio of 33.6% and 34.1%, respectively. 69.4 percent of participants declared that they can pay more money for the food that is produced with less environmental impact and promote animal welfare.

Table 4 Annual carbon emissions, nitrogen waste, and water consumption of participants’ dietary preferences

Diet models	n		Carbon emissions (kg)	Nitrogen waste (g)	Water consumption (L)
	n	%	$\bar{x} \pm SD$	$\bar{x} \pm SD$	$\bar{x} \pm SD$
Omnivore	280	69.7	564.9 ± 364.8	3625.0 ± 5068.2	101,558.7 ± 169,746.7
Halal	75	18.7	491.9 ± 247.9	1890.8 ± 2954.9	66,928.5 ± 112,327.3
Mediterranean Diet	35	8.7	636.6 ± 338.2	3640.5 ± 3798.5	75,604.8 ± 153,009.4
Vegetarian Diets	12	2.9	347.8 ± 256.0	1482.1 ± 1866.5	58,024.9 ± 89,142.0
Total	402	100	551.0 ± 343.6	3238.8 ± 4620.9	91,538.7 ± 157,537.9

Kruskal Wallis Test was used to determine statistical differences ($P > 0.05$)

They mostly agree to 5% and 10% pay more than now food price. Public health educators, policy makers, and the food industry may also consider this positive information for promote sustainable diets and products.

Carbon emissions according to food consumption/preferences

Food industry used 48% of fertile land and 70% of clean water for global food production. The limited natural resources and greenhouse gas emissions (responsible for 20–35%) as a result of food production increase the need for a sustainable food system (Alsaffar 2015; FAO and WHO 2019). Individual food preferences play key role in the sustainable diets. Especially, healthy diet style has minimal red meat, processed meat, with less added sugar or refined grain, which can be less use of natural sources such as water, energy and emissions of greenhouse gases have an environmental sustainability (Rippin et al. 2021). In general, the studies focus on vegan and omnivore diet environmental results. In this study, different diet preference evaluated in terms of annual carbon emission, nitrogen waste and water consumption. The first 3 diets most preferred by the participants were omnivore (69.7%), halal (18.7%), and the Mediterranean diet (8.7%), respectively. The mean dietary annual carbon emission of all participants was 551.0 ± 343.6 kg/year, which was 81% of the upper limit (680 kg/year). Although, livestock prize is expensive in Turkey, especially; red meat and products, carbon emission of all type diets should be less than the upper limit. Omnivore diet's carbon emission was 564.9 ± 364.8 kg/year; Halal diet's was 491.9 ± 247.9 kg/year; Mediterranean Diet's was 636.6 ± 338.2 kg/year; Vegetarian Diets' were 347.8 ± 256.0 kg/year. Vegetarian Diets are limited in terms of animal products, so it is an expected result to cause low carbon emissions. Halal diet is protected by certain Islamic principles, most notably the avoidance of pork (and products), alcohol and meat/meat products don't slaughtered according to Islamic dietary law (Lever 2020). There is not any rules about food preferences but this principles should cause less consumption animal foods. The Halal consumption preferences may limit animal sources consumption amount because of the necessity to choose of halal slaughtered animal sources. The mean nitrogen waste was 3238.8 ± 4620.9 g/year and water consumption was $91,538.7 \pm 157,537.9$ L/year. Mediterranean diet model carbon emission and nitrogen waste were higher than other diet models, omnivore diet model had more water consumption than other diet models. But these differences were not found statistically significant ($p > 0.05$).

Using limited global sources is the most critical challenge of the last century. Food production and consumption systems play a crucial role in reducing the environmental burden of food choices. Consumers need directions that help to make simply choosing. There are many logos and claims on the food packet about sustainability but consumers don't know these meanings. Education about sustainability definition and logo/claims are important and are most important strategy for development of sustainability awareness. Private voluntary labeling should be promoted in terms of the sustainability aspects of food. There is a need to more study with food and food products related to sustainability including different populations. Next study can evaluated the food preferences according to energy and nutrient sufficiency.

Author contribution All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by [Nesli Ersoy]. The first draft of the manuscript was written by [Nesli Ersoy] and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Data availability The datasets generated during and analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval All participants accepted to be a participant in the study and they approved the voluntary consent form. Non-interventional Clinical Researches Ethics Committee approval was get by Non-Interventional Ethics Committee of Hacettepe University (no: GO 21/1191, Decision No: 2022/02–52).

Consent to participate Not applicable.

Consent for publication All authors have approved the manuscript and agree with its submission to the Environmental Science and Pollution Research.

Competing interests The author declares no competing interests.

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