The relationship between environmental awareness, environmental behaviors, and carbon footprint in Turkish households

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Abstract

Having knowledge about household environmental behaviors is important for planning and conducting efforts to reduce carbon footprint. In this study, the relationship between environmental awareness, purchasing, household practices, and carbon footprint was investigated, and the impact of demographics on these variables was determined. The analysis shows that sensitivity dimension of environmental awareness is related to few environmental behavior variables (purchasing and efficiency) whereas willingness dimension was related to all variables (except gas). While improvements in demographic factors (income, education, and female employment status) positively affect environmental sensitivity, they increase carbon footprint from automobile. Only increase in income has an effect on willingness. It is determined that income positively affects environmental purchasing. Furthermore, it is revealed that environmental household practices did not differ in terms of demographic characteristics, except the effect of education on pollution.

Keywords Carbon footprint · Environmental awareness · Environmental behavior · Environmental purchasing · Household · Turkey

Introduction

The amount of carbon in the atmosphere has increased exponentially in recent years due to the rapid increase in population, industrialization, and decrease in forest lands. As a result of the carbon increase, global warming has become one of the popular topics discussed and emphasized worldwide. Global warming and climate change which have been seen with meteorological events such as precipitation changes, radical temperature changes, rising sea levels, and rising droughts, floods, and storms are considered by many to be the greatest problem the world has faced (Broer and Titheridge 2010). Many studies have been done about the risks and impacts of global warming. These show the direct and indirect impacts of climate change associated with global warming on the environment and human health (Huang et al. 2011; Nicholas and Breakey 2017; Perera 2016; Watts et al. 2015).

The negative impacts of environmental pollution and global warming affect all living species. Humans have significant responsibility in reducing carbon emissions as people being the main reason in terms of carbon emissions and being the only species who can develop awareness. The Intergovernmental Panel on Climate Change states that the most important cause of global warming is of human activity with 95% precise (IPCC 2014). Carbon emissions are one of the largest contributors to the global warming phenomenon (Liu et al. 2017). The carbon footprint is a concept used to estimate climate change-related

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impacts. It is basically a measure to understand the environmental damage of carbon emissions such as global warming and climate change in numbers.

Turkey is considered among high-risk countries in terms of the negative effects of climate change due to being located in the Mediterranean Basin. It is estimated that at the end of the twenty-first century, it will be the third country in Europe and Central Asia Region that is most exposed to extreme climatic events (Silkin 2014). Turkey published "National Climate Change Strategy" by aiming to reduce the effects of climate change in 2010 (MEU 2010). It set a national vision within this plan to confront climate change, to be a country that integrates climate change policies with development policies, expands energy efficiency, increases the use of clean and renewable energy sources, actively participates into the efforts for climate change, and can offer high quality of life and well-being to all its citizens with low carbon intensity. Scaling up Climate Action Turkey report by Climate Action Tracker (CAT) stated that there is a potential in reducing the share of households' energy consumption by around 50% and consequently carbon emissions by 2030 with decarbonization efforts such as awareness and ensuring efficient energy use (CAT 2019). Turkey has started to strengthen standards for new buildings to be built as close to zero energy consuming and apply measures to upgrade existing buildings according to new building efficiency standards with the National Energy Efficiency Action Plan (NEEAP) 2017–2023 (MENR 2017). Also, it has a tax advantage for small engine, fuel cell, electric, and hybrid vehicles which have high energy efficiency, low emission levels within this plan.

On the global scale, there are important responsibilities for the households especially in climate change and energy use. In the EU and China, energy consumption and carbon dioxide emissions of households have already surpassed those of industry (Li et al. 2015). Households' pro-environmental behaviors such as heating, cooking, recycling, water use, product purchase, usage and disposal, and household management have significant effects on emissions. Hertwich and Peters (2009) found that on the global level, 72% of carbon emissions are related to household consumption, 10% to government consumption, and 18% to investments. In other words, one of the most important factors that increase natural resource consumption, environmental pollution, and carbon emissions is the environmental behavior of the households. The importance of families around the world in enhancing their conscious, environmentally friendly purchasing, and consumption behaviors to levels that are sustainable is recognized by everyone (Şener and Hazer 2008). Some researchers report that household energy consumption can be reduced significantly with behavioral change (Dursun et al. 2019). Therefore, environmental behaviors of households are critical for environment and it is important to understand the factors affecting them.

Figure 1 shows the share of sectors' direct carbon emissions in Turkey (IEA 2019). While households directly consume about one-fifth of the total energy produced, they also contribute to the emissions of other sectors with their consumption and behavior habits. More importantly, population and urbanization are growing rapidly in Turkey which also increases energy demand and consequently emissions. According to Turkey Statistics Institute data, the annual population growth rate in 2018 is 14.7 per thousand compared with the previous year, and the annual average population growth rate is estimated as 12.1 per thousand between 2017 and 2023. While the rural population is 7.7%, urban population is 92.3% in 2018 (http://www.turkstat.gov.tr/). Depending on the economic growth and urbanization, per capita CO_2 emissions in Turkey have increased from 4 to 6.6 t in the last 20 years (http://www.turkstat.gov.tr/; Akbostancı et al. 2018). All these points to the difficult path for reducing carbon emissions in Turkey and refers to the responsibility of the households. For this reason, analyzing the impacts of households' demographic characteristics on awareness, environmental behaviors and carbon emissions are important.

Many studies have been conducted on the effect of demographic factors. However, these studies have produced conflicting results. While some studies present full or partial impact of demographic characteristics on environmental awareness, behavior, and carbon footprint (Roper Organization 1990; Laroche et al. 2001; Jain and Kaur 2006; ICOM 2008; Csutora 2012), others state a weak or lack of impact and suggest that personality characteristics such as awareness are more significant (Kinnear et al. 1974; Fisher et al. 2012).

In societies with high environmental awareness, policies for preventing environmental problems can be planned and implemented more easily. Environmental awareness and attitudes are of great importance in developing environmental behaviors and reducing carbon emissions (Conrad and Hilchey 2011; Erkal et al. 2011; Giudici et al. 2019). Understanding the knowledge people have about environment or determining the awareness gained by people about environment is important in dealing with environmental problems and building a sustainable society (Ramsey et al. 1992; Sudarmadi et al. 2001). It has been found by some studies that environmental awareness may have an impact on changing people lifestyles in favor of environment (Chen 2009; Szerényi et al. 2011; von Borgstede et al. 2013).

Environmental awareness is accepted as a significant factor for adopting pro-environmental behavior (Fu et al. 2020). However, awareness does not directly result in environmental behavior (Wang et al. 2011). Hadlock and Beckwith (2002) showed that people will not willingly behave in favor of environment until they experience adverse impacts of environmental problems. Thus, there is no consensus on the environmental awareness—behavior relationship (Fu et al. 2020).
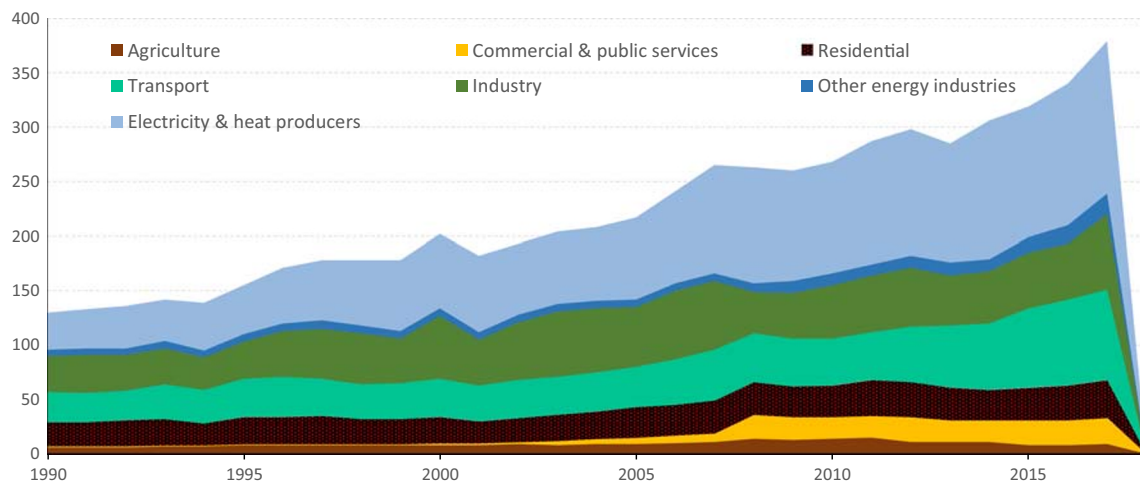
Fig. 1 Carbon emissions of sectors in Turkey (IEA 2019)

Peattie (2010) reports that environmental values reflect cultural traditions significantly, and individuals' environmental concerns may differ between countries and cultures. Environmental awareness, attitudes, and behaviors differ according to cultures (Laroche et al. 1996). Thus, the findings that arise from the studies examining only a few environmental variables in the households, or collecting data from the single respondent in the household will not apply to every culture and economy.

Although there are several studies conducted in Turkey about environmental issues (Adaman et al. 2011; Büyükkeklik et al. 2010; Çabuk et al. 2008; Dursun et al. 2019; Koçoğlu and Koçoğlu 2017; Şener and Hazer 2008; Tumbaz and Moğulkoç 2018; Yaraş et al. 2011), they are limited in number and mostly focusing on individuals and firms. Studies on energy consumption and carbon emissions are mostly at macro-level (Demirbaş et al. 2004; Karakaya et al. 2019, Katırcıoğlu and Katırcıoğlu 2018) or forecasting (Ari and Koksal 2011; Toksarı 2016). Considering the issue only in this way may result in ignoring or overlooking policies regarding carbon emissions and environmental behavior of households who are end-consumers (Santillán Vera and de la Vega Navarro 2019).

In this study, which aims to investigate the relationship between household characteristics, environmental awareness, environmental behavior, and carbon footprint, the following questions were addressed.

- Is there any impact of household characteristics (household income, couple education level, and female employment status) on environmental awareness, environmental behaviors (environmental purchasing and environmental household practices), and carbon footprint of households?
- Is there any impact of environmental awareness on environmental behaviors of households?

- Is there any impact of environmental awareness on direct emissions (electricity/gas consumption and automobile use) of households?

It is expected that the findings of this research which examine households' environmental behaviors, direct emissions, environmental awareness, and demographic factors together and collect data from families (couples/parents together responded to the survey) in an economy with a high demand for consumption will contribute significantly to the literature.

Another contribution of this study is that it is one of the first studies examining the impact of female's employment on dependent variables. In the literature, there is no study examining the impact of female employment on environmental behavior and carbon footprint in a household, whereas Wilhite et al. (1996) point at culture specific habits such as women's participation in the work force, which can play an important role on energy use and environment. As the employment rate is still low in Turkey compared with developed countries (World Bank 2019), female employment status may be a differentiator factor for environmental behaviors and carbon footprint. Thus, it has been added into demographic factors in this study.

The findings will be helpful for understanding the drivers behind environmental behavior of households and how carbon footprint is affected. Knowing the approaches of the households to environmental problems will provide important information to the regulators in order to plan and carry out efforts to improve environmental awareness and reduce carbon footprint. It will also provide important information to the firms in terms of managing their activities. In addition, studying on a different culture like Turkey will contribute to the enrichment of literature. It will provide implications for public policy makers and practitioners. This study is organized as following; literature review, methodology, analysis, and results. In the last section, conclusion and suggestions are presented.

Literature review

Environmental behaviors have been studied in the literature widely from a theoretical perspective (Ajzen 1991; Blake 1999; Hines et al. 1987; Kollmuss and Agyeman 2002; Stern et al. 1999). According to the comprehensive review done by Frederiks et al. (2015), it was found that environmental behavior is more complex than expected; thus, it is difficult to examine environmental behaviors based on a single theory. For this reason, they developed a model including individual and situational predictors, and their impacts on household behaviors. Based on Frederiks et al. (2015), the impacts of sociodemographic (income, education, and female employment) and psychological (awareness) factors on environmental behaviors and carbon emissions were reviewed in the literature.

The relationships between "environmental awareness and carbon footprint", "demographic factors and carbon footprint", or "demographic factors and environmental practices" have been widely examined in the literature (Awasthi and Li 2018; Afroz et al. 2017; Bai and Liu 2013; Hammami et al. 2017; Kulözü 2016; Pandebesie et al. 2019; Qu et al. 2016; Ramzan et al. 2019; Tabi 2013). However, none of these studies considered all these variables together in the analyses.

Awareness and demographic characteristics

Environmental awareness has been defined by Madsen and Ulhøi (2001) and Coertjens et al. (2010) as being sensitive to environment by gaining knowledge about environmental problems and showing attitude to protect the environment. Environmental awareness has been explained in or along with different terms such as sensitivity, attitude, or willingness in the literature. Chawla (1998) stated that sensitivity is an important variable for environmental awareness, and it shows the predisposition of people for environmental behavior.

In some studies (O'Connor et al. 1999; Dupraz et al. 2003; Mandell and Wilhelmsson 2011; Wang et al. 2016; Shao et al. 2018), willingness of people for environmental acts such as paying higher prices for environmental friendly products was examined. It was deduced that being knowledgeable or sensitive about environment does not directly reflect on environmental behavior. People may not show environmental friendly behaviors although they know environmental problems due to the various reasons such as cost or comfort. They tend to show environmental behaviors in case they are willing to compromise from their standards or comfort.

The studies about environmentally aware consumers can be traced back to the 1970s. Earlier studies such as Berkowitz and Lutterman (1968) and Anderson and Cunningham (1972) examined the demographic characteristics of consumers who are socially responsible. They found that people who are female and pre-middle aged, with a high level of education (high school at that time) and high-income or socioeconomic status are more

conscious about social issues. Mainieri et al. (1997) determined that the women who are middle class, living in the cities, and having families are more environmental conscious consumers. According to Straughan and Roberts (1999), environmental awareness of young people and women is higher; environmental attitudes and behaviors increase as the level of education rises, and the people living in cities are environmentally more aware. Soonthonsmai (2001) found that young, well-educated, and high-income consumers have high environmental awareness. On the other hand, there are studies that find negative relationship between income and environmental concerns (Roberts 1996; Samdahl and Robertson 1989). Also, Van Liere and Dunlap (1981) have revealed that demographic features do not make a significant difference on environmental trends. Abdul-Wahab and Abdo (2010) examined the relationship between demographic characteristics (gender, age, and education level) of people in Oman and found that males, younger, and more educated people have more environmental awareness about environmental problems. Golley and Meng (2012) found that highly educated households have higher awareness about energy consumption, environment, and health.

Awareness and environmental behaviors

The presence of environmental awareness among consumers has an impact on environmental purchasing (Alsmadi 2007; Arabacıoğlu and Tatlıdil 2009). According to Schlegelmilch et al. (1996), environmental awareness accounts for 20% of environmental purchasing behavior. It has been shown that consumers with high environmental awareness make more environmental friendly purchases than with low ones. The consumers with higher awareness are more willing to buy eco-friendly products with higher prices (Chitra 2007). Al Mamun et al. (2019) studied environmental behavior of Malaysian low-income households in specific to green vehicles and found that environmental concern and self-efficacy have a positive impact on environmental purchasing in low-income households.

Although consumers are aware of environmental problems, they can continue to harm the environment with their consumption habits (Tantawi et al. 2009). Schäfer et al. (2012) examined the relationship between life events (childbirth and relocation) and sustainable consumption by conducting sustainable consumption campaigns with information mailing and personal consultation. Although it was found that the campaign affected behaviors regarding to sustainable significantly, it did not have a considerable impact on the sustainable consumption behaviors of people during life events. Koçoğlu and Koçoğlu (2017) stated that even though environmental awareness is high in students, environmental purchasing tendencies are moderate thus not fully compatible with awareness level. Similarly, Autio and Heinonen (2004) showed that young consumers do not show environmental behaviors as much as their environmental awareness.

Environmental sensitive consumers not only take environmental factors into account when purchasing products but are also more likely to carry out environmental household practices such as turning off lights and recycling (Barr and Gilg 2006). While it was found in some studies that there is a positive relationship between environmental awareness and environmental behavior, there are also others stating that there is no relationship. Simmons and Widmar (1990) and Ek and Söderholm (2010) stated that costs and environmental awareness are effective in energy consumption. On the other hand, Vining and Ebreo (1990) and Wang et al. (2011) found that environment awareness has no considerable impact on electricity-saving behavior.

Awareness and carbon footprint

It is often defined as the amount of carbon dioxide created by human activities and lifestyles by direct emissions (e.g., energy used by households at home and transport) and/or indirect emissions (e.g., energy used in the production of goods and services which were consumed later by households) (Wright et al. 2011). The carbon footprint is a useful measure to show impacts and to understand the damage of carbon emissions on environment. Carbon emissions increased tremendously for over the past years (Dogan and Ozturk 2017). For this reason, many studies emerged in the literature. Tabi (2013) investigated the relationship between environmental awareness and carbon footprint associated with heating, electricity, and transportation activities in the housing sector of Hungary. It was found that there is no significant difference between the carbon footprints of individuals with high and low environmental awareness and that both groups have similar energy consumption and therefore similar carbon footprints. Boucher (2016) examined the relationship between climate change awareness and carbon footprint (transport and food-related carbon footprints only). It was found that there is a relationship between awareness and carbon footprint only in a small proportion of the people who have quite high awareness (about 18%). Tam and Chan (2018) argue that individuals with high environmental awareness think they will be abused because of this awareness in a society with low environmental awareness, and therefore, they do not reflect this awareness to behaviors. Thus, they stated increasing the generalized confidence in the society could alleviate this idea of abuse.

It has been shown in several studies that being aware alone is not sufficient to show environmental behavior (Autio and Heinonen 2004; Tantawi et al. 2009; Wang et al. 2011; Koçoğlu and Koçoğlu 2017). Csutora (2012) stated that, even if environmental awareness of individuals is high, the transformation of this awareness into environmental behavior at high-income level is limited due to high consumption. Even if people are highly aware, they do not act in favor of environment if there is a need for a compromise such as paying higher prices or decreasing the comfort by energy saving acts (Wang et al. 2011).

Environmental behaviors and demographic characteristics

As the consumers have become more aware about decreasing resources and environmental pollution, they began to re-evaluate their consumption behaviors (Kinnear et al. 1974). Environmental friendly products started to be produced in response to consumers' environmental concerns (Kohl 1990). As a result, green consumer, eco-conscious consumer, and sustainable consumption concepts have emerged in the literature. All these concepts are covered under environmental purchasing in this study.

Environmental consumer behaviors are not only limited to the purchase of environmental friendly products but also includes environmental household practices such as the use of each product to be consumed in a cost-effective manner and the participation in recycling or the disposal of waste (Minton and Rose 1997; Pagiaslis and Krontalis 2014). Therefore, sustainable consumption of households (Salo et al. 2016); household wastes (Nguyen et al. 2015; Xu et al. 2017), household water use, and conservation habits (Fan et al. 2013) and energy use habits (Huang et al. 2011) were emerged in environmental behavior studies.

There are several studies explaining the characteristics affecting environmental purchasing behavior in the context of individual, economic, geographical, and socio-demographic categories (Bodur and Sarigöllü 2005; Çabuk et al. 2008; Kinnear et al. 1974; Leonidou and Leonidou 2011; McDonagh and Prothero 2014). The studies about consumers and consumption behaviors revealed that consumers decide to buy environmental products, and even afford to pay more to purchase environmental friendly products according to their demographic characteristics (Dunlap and Scarce 1991; Afroz et al. 2015; Rahnama and Rajabpour 2017). Çabuk et al. (2008) examined the relationship between the socio-demographic characteristics of individual consumers and environmental purchasing; it was observed that individuals who are married, young, educated, and high household income showed more environmental purchasing behavior. Samdahl and Robertson (1989) mentioned a negative relationship between income and environmental purchasing. Concerning socio-demographic characteristics, Roper Organization (1990) stated that environmental purchasing behavior occurs at higher levels in women with high-income, education, and social status. Similarly, Roberts (1996) concluded that middle-aged and highly educated individual were more environmental friendly, and there was a negative relationship between income and environmental purchasing. ICOM (2008) found that there is a positive relationship between age and environmental purchasing. The older

consumers who are over 55 years are more involved in environmental purchasing in the USA. Abdul-Wahab and Abdo (2010) found that males, younger, and more educated people act more in environmental behaviors. Csutora (2012) found that education has a slightly higher impact on environmental behavior compared with income. Fisher et al. (2012) stated gender and income have an impact on environmental purchasing. Females and people with higher income are more prone to use green products.

Bandara et al. (2007) found that high-income households are more likely to reduce and segregate waste than low-income households. Vassileva et al. (2012) found that electricity consumption of Swedish households increased by household income. Fisher et al. (2012) claimed that there is no relationship between gender and environmental household practices except recyclable bags; however, higher income is related to waste recycling. It can be said that people who are prone to recycling are well educated, have higher income, have their own homes, and are knowledgeable about recycling (Zen et al. 2014). Babaei et al. (2015) showed that awareness, attitudes, and practices about recycling among environmental household practices are affected by demographic characteristics such as age, education level, gender, and occupation. Jonkute (2015) stated that women living in the city, childless, single, and high education level show more environmental consumption behavior in Lithuania. Xu et al. (2017) stated that demographic characteristics affect the amount of waste production, but there is limited information about waste separation or recycling efforts.

It is usual to find different results between environmental friendly purchasing, practices and demographic characteristics because consumption is an economic, physical, and social process influenced by the nature, circumstances, psychology of individuals, and the geography, culture, laws, politics, infrastructure of the society in which they live (Peattie 2010).

Carbon footprint and demographic characteristics

As household income increases, expenditures on education, recreation, transportation, and technology rise, and this increases the carbon footprint due to consumption (Peters et al. 2007). Baiocchi et al. (2010) who investigates the relationship between socio-demographic characteristics and consumer behavior and carbon footprint in the UK found that as the income level of households increased, carbon footprint also increased. Golley and Meng (2012), examining the relationship between income and carbon footprint from urban households in China, found that higher income households generate more emissions per capita compared with lower income households. Lyons et al. (2012) investigated the carbon footprint by household characteristics in Ireland, such as the region, income level, the marital status, and having children, the number of people in the household, and the number

of disabled people in the household. According to the results of this study, high-income households have higher carbon footprint than low-income households. Boucher (2016) examined the relationship between carbon footprint and socio-economic and welfare variables and found that income level was the most dominant variable in individuals' carbon footprints. Zang et al. (2017) found that the households with high-income, urban-settled, and higher number of people create higher carbon footprint than others. Sarwar (2019) showed that higher income in urban settlements decreases the carbon footprint resulted from urbanization. Although a strong relationship between household income level and carbon footprint is seen in the literature, some studies indicate that as household income increases, consumption expenditures are shifting from carbon intensive consumption such as food and housing to less carbon-intensive consumption such as recreation and culture (Büchs and Schnepf 2013; Chitnis et al. 2014; Jones and Kammen 2011; Druckman and Jackson 2016).

Baiocchi et al. (2010) found that carbon footprint was reduced by education, and therefore, there is an evidence of the benefit of environmental education. Golley and Meng (2012) reported that highly educated households pay more attention to energy consumption and prefer low carbon footprint practices. Büchs and Schnepf (2013) found that education level has a significant impact on the carbon footprint of households. Boucher (2016) concluded that individuals with higher levels of education (undergraduate and more) have higher airway carbon footprint than others, but highway carbon footprint was lower. Balaguer and Cantavella (2018) argue that the rise in education compensates for the increase in per capita carbon footprint with higher income, and therefore, encouraging education is important to balance carbon emissions in a developing economy. Sovacool and Brown (2010) stated that individuals with a high level of education have a higher environmental awareness, but because their income levels are high, their consumption is high and this increases carbon footprint.

Methodology

Sample

Our empirical study was conducted on households living in the city center of Nigde province, Turkey. The households in city centers of Turkey are mostly using natural gas for heating and cooking; the rest is gradually passing to natural gas (Gazbir, 2016). In order to reflect the overall picture or to predict the future, only natural gas has been taken into account for heating. It is targeted to reach 1,000 family households from 40,000 located in the city. The couple/parents answered the survey together to collect more accurate data for the whole household. The households were visited by researchers

between December 2017 and January 2018, and 403 households voluntarily participated in the survey. Data was entered in SPSS, where examination of missing and erroneous data was conducted, and 68 cases were removed because of majority missing data. Data from 335 surveys were coded for further analysis, and effective response rate of the survey was 33.5%. Demographic characteristics of households are presented in Table 1.

Male participants were between 25 and 70 years old, and female participants were between 19 and 66 years old, and mean age was around 40. While 42.4% of male participants were university graduates, 30.7% were high school graduates and 26% were primary school graduates; 33.1% of the female participants were university graduates, 29.3% were high school graduates, and 34.6% were primary school graduates. Between 2 and 10 people were living in these households, and the mean for the number of people living in a household was approximately 4. About 40% of female in the households had a profession. When the total income of the households was analyzed, 41.5% of them had 3000 and below, 37% of them had between 3001 and 5000 , and 21.5% of them had 5001 and above income.

Data collection

The data were collected by means of a standard survey in face-to-face interviews from households. The survey instrument consisted of several sections. The first section contained

Table 1 Demographic characteristics of households

Demographics	Min.	Max.	Mean	Std. dev.
Age (female)	19	66	39.8	8.75
Age (male)	25	70	43.2	9.30
No. of people	2	10	3.85	1.30
Income (monthly)			Frequency	Percentage
3000 and under			139	41.5
3001–5000			124	37.0
5001 and over			72	21.5
Education (male)				
University			142	42.4
High school			103	30.7
Primary school			87	26.0
No education			3	0.09
Education (female)				
University			111	33.1
High school			98	29.3
Primary school			116	34.6
No education			10	3.00
Female employment status				
Unemployed			203	60.6
Employed			132	39.4
Total			335	100

questions for determining households' characteristics. Since the analysis unit is households, individual characteristics were not included in this study. Demographic characteristics that guide household behaviors such as household income, education of parents, and working status of women were used.

The scales for measuring the levels for environmental awareness, purchasing, and household practices are in the second section. We developed questionnaire to measure the variables which were taken from previous studies (e.g., Bai and Liu 2013; Balderjahn 1988; Oreg and Katz-Gerro 2006; De Leeuw et al. 2015; Fan et al. 2013; Hines et al. 1987; Huang et al. 2011; Lin et al. 2012; Markowitz et al. 2012; Peattie 2010; Wang et al. 2019). Environmental purchasing and household practices items were scored on a five-point frequency scale (always = 5, …, never = 1), and awareness items were scored on a five-point agreement scale (absolutely agree = 5, …, absolutely disagree = 1).

As mostly households are not knowledgeable about their carbon footprints, the questions related to energy use (electricity and gas consumption) and transportation (number of automobiles, engine volume, fuel type) are presented in the third part in order to measure the primary (direct) carbon footprint of households.

The environmental awareness, purchasing, and household practices scales used in the research were specifically designed according to Turkish households' consumption and lifestyle patterns. For this reason, Churchill's (1979) research paradigm was used to create these scales. This process includes: (i) specifying the domain of the construct; (ii) generating items; (iii) collecting data and purifying measures; and (iv) assessing reliability and validity. The draft survey was reviewed by five academicians and two experts to comment on understandability and appropriateness. We adjusted them for the pilot study which was conducted to ensure the reliability based on their suggestions. After preliminary tests of reliability and an examination of item-to-total correlations, the measures were purified; some items were dropped from the scales.

Exploratory factor analysis (EFA) was conducted on the three scales to assess dimensionality of the constructs as Hair et al. (2008) recommended. The first requirement of EFA involved the KMO (Kaiser Meyer Olkin) test for distribution value. Extraction was made analyzing the principal components with Varimax rotation. All KMO values are greater than 0.60, which is adequate for conducting factor analysis, and Bartlett's test of sphericity is significant at p value < 0.05 (Table 2).

For validity and reliability, a minimum of 1.0 for eigenvalue, greater than 0.50 for loadings and 0.60 for Cronbach Alpha (α), was required in analyses (Hair et al. 2008, Nunnally 1978). EFA indicated two factors with eigenvalues greater than 1, accounting for 70% of the variance in the environmental awareness (Table 2). All item loadings were

greater than 0.5. Environmental awareness consists of two dimensions. The first dimension was named "sensitivity" because it consists of items measuring how much sensitive people are about environment. The second dimension was named "willingness" because it is made up of items showing compromise households can make on their standards or the costs they can bear for the environment.

Table 2 shows EFA results of environmental purchasing and household practices scales. Six items on the

environmental purchasing were collected under one dimension which explains about 59% of environmental purchasing behavior. Environmental household practices have three dimensions. Eigenvalues were greater than 1. The behaviors of households regarding wastes such as oils and chemicals were named as pollution. The behaviors such as caring about energy and water use and preferring to use public transportation were named as saving. Efficient use of water and energy resources by households

Table 2 Exploratory factor analysis, reliability, and t test: environmental awareness, purchasing, and household practice scales

Scale, dimensions, and items	KMO (Bs)	EV	λ	%	α	$\bar{x}$	σ	t
Environmental awareness	0.77***							
Sensitivity		3.24		46.33	0.79			
Environmental problems are not considered enough			0.86			4.11	1.16	17.8***
More serious legal measures must be introduced for environmental problems			0.82			4.25	1.20	18.9***
Should be given more attention to the news, events, etc. related to environmental problems			0.84			4.00	1.23	14.7***
Should be given more attention to environmental problems regardless of their economic impacts			0.55			3.37	1.33	5.01***
Willingness		1.65		25.59	0.86			
We are willing to pay more taxes to protect environment			0.90			2.79	1.38	− 2.79**
We are willing to compromise on our living standards to protect environment			0.84			3.07	1.35	0.99
We are willing to pay a price to protect environment			0.85			2.80	1.44	− 2.50*
Environmental purchasing	0.89***							
Purchasing		3.52		58.75	0.86			
We prefer to use environmental friendly packaging (glass, etc.) in our house			0.76			3.66	1.16	10.5***
We do not prefer to use products from firms that we know are not environment friendly			0.78			3.59	1.18	9.93***
As a household, we are a loyal customer of environmental friendly firm			0.78			3.54	1.19	9.44***
We prefer to use products that do not harm the environment in our house, although a little expensive			0.77			3.53	1.23	8.93***
We read the label/contents of the products we will use in our house to learn their environmental impacts			0.74			3.51	1.30	8.08***
We warn family friends/relatives about non-environmental friendly firm/products			0.75			3.50	1.22	7.59***
Environmental household practices	0.66***							
Pollution		2.20		31.46	0.63			
We do not pour used/waste oil down the sink			0.66			3.40	1.40	5.18***
We try to reduce the use of chemicals in our house as much as possible			0.62			3.17	1.33	2.28*
We do not prefer to use environmentally harmful/polluting products (such as sprays) in our house			0.79			3.05	1.37	0.63
Saving		1.16		16.58	0.66			
We prefer energy/water saving products in our house			0.83			3.96	1.33	13.1***
As a household, we often prefer to use public transport for saving			0.78			3.47	1.53	5.58***
Efficiency								
We pay attention to energy use in our house (e.g., unplugging the TV, computer when not in-use, etc.)		1.07	0.83	15.32	0.64	4.39	0.93	27.1***
We pay attention to water use in our house (e.g., turning off the water while brushing teeth, etc.)			0.79			3.83	1.09	13.8***

KMO (Bs) Bartlett's sphericity test p value, *EV* Eigenvalue, λ factor loading, *%* explained variance, α Cronbach's alpha, $\bar{x}$ mean, σ standard deviation, $\alpha = 0.05$, and test value is 3 in one sample t test

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

was named as efficiency. The pollution, saving, and efficiency explained environmental household practices at the rate of 32%, 17%, and 15%, respectively.

Results

Descriptive statistics

Table 2 presents the level of the households' environmental awareness and environmental behaviors. When the means of awareness items presented in Table 2 are examined, it can be seen that the values are distributed over a wide range (from 2.79 to 4.25). It is noteworthy that the means of the items in sensitivity were relatively high, whereas the means in willingness remained at a relatively moderate level. In addition, the means of the items in sensitivity were higher than test value, while the means of willingness (except one) were lower than the test value.

The means of the items in the one-dimensional environmental purchasing scale were collected in a narrow range between 3.50 and 3.66, and all values were statistically higher than the test value at $p < 0.001$ (Table 2). Although t test results indicate that the households in the survey tend to do environmental friendly consumption in general, it can be said that the means all clustered around 3.60 indicate that there is still more efforts required in this respect.

The means in three-dimensional environmental household practices were above the test value (Table 2) and all but one item (we do not prefer to use environmentally harmful/polluting products (such as ozone depleting sprays) in our house) were statistically significant. However, it is noteworthy that the means of the items in the saving and efficiency were higher than those in the pollution.

Demographics and environmental behaviors

Female employment status

Approximately, 40% of the females in the households who participated in the survey stated that they have a profession and have a job. An independent sample t test was conducted to see the impact of employment of female on environmental behaviors and carbon footprint size, and the results are presented in Table 3. It has been found that there is a statistically significant difference in sensitivity, purchasing, and carbon footprint from automobiles, and the means for employed female are higher. On the other hand, no difference has been observed in willingness dimension of environmental awareness, in all dimensions of environmental household practices, and in the carbon footprint caused by electricity and natural gas. Having a second car, being aware of environmental issues is expected in case of employed female because of being in a

wider network as a working person and making environmental purchases with increasing income.

Income

ANOVA was conducted to see the impact of household total income on environmental behaviors. The impact of household income was analyzed in three levels (Table 4). The results show that there is a difference between household income and environmental purchasing and environmental awareness, whereas there is no difference between income groups in terms of environmental household practices. This means that as household income increases, environmental purchasing behavior increases, and households may be willing to bear costs for environmental problems.

It has been seen that the carbon footprint from natural gas and automobile differs according to income groups, whereas the footprint from electricity does not differ much. Although the income group of 5000 and over has a high mean in carbon footprint from electricity, there is no considerable difference between different income groups. This also can be seen in other characteristics as electricity consumption has become a standard expenditure due to the use of similar electrical appliances, lighting, and so on. The carbon footprint from automobile in households with an income of 5000 and over is quite different from other income groups. This difference can be explained by owning more than one automobile and/or using automobile more in high-income households. On the other hand, it was found that natural gas consumption does not differ according to female's employment and education but decreases as income increased. This finding can be explained that as the income of households increases, they insulate their houses and/or live in new houses with insulation.

Education

As there is diversity, the education levels of the both parents were taken into account together, and the environmental behaviors of the households were examined according to their education levels (Table 5). The sample includes households where only one or both parents have university diplomas or both do not have. The results revealed that sensitivity varies according to the education level of the parents, whereas willingness does not differ. Although the statistical difference in sensitivity arises from the difference between two education level groups, both parents have university diplomas and both do not have university diplomas; means indicate that the level of sensitivity increases as the education level of the parents increases. On the other hand, there is no impact of education on willingness. In other words, although education increases sensitivity, it did not provide a considerable difference in willingness.

Table 3 Female employment and environmental behaviors

Environmental behaviors	Unemployed ($n = 203$)	Employed ($n = 132$)	t
Environmental awareness			
Sensitivity			
Mean	3.83	4.08	2.36[*]
Std. deviation	0.99	0.91	
Willingness			
Mean	3.72	3.70	0.15
Std. deviation	1.17	1.24	
Environmental purchasing			
Mean	3.54	3.68	1.31[*]
Std. deviation	0.96	0.87	
Environmental household practices			
Pollution			
Mean	3.28	3.08	1.85
Std. deviation	1.00	0.94	
Saving			
Mean	3.65	3.76	0.85
Std. deviation	1.21	1.18	
Efficiency			
Mean	4.11	4.08	0.33
Std. deviation	0.86	0.82	
Carbon footprint			
Electricity			
Mean	1.46	1.41	0.81
Std. deviation	0.55	0.49	
Natural gas			
Mean	2.89	2.60	1.15
Std. deviation	2.23	2.17	
Automobile			
Mean	1.36	1.74	-2.96[**]
Std. deviation	0.89	1.49	

[*] $p < 0.05$; [**] $p < 0.01$

Similarly, no statistical difference was found between these groups in terms of environmental purchasing. In fact, these findings and the findings obtained from the efficiency and saving dimensions of environmental household practices support each other. Environmental behaviors that will reduce the costs in a household are preferred in households regardless of the education level instead of environmental purchasing which requires partial willingness from households and can only be tolerated by willingness.

On the other hand, it was found in pollution dimension that the means decreased as the level of education increased. Partly, a similar result has been found in carbon footprint from automobile because automobiles are used more as the level of education increases. This finding supports our previous findings regarding the female employment status and household income, as both parents will have the opportunity to work, and their income will increase as their education levels increase.

The impact of education on the footprint from electricity and natural gas was not observed. These findings support our interpretation that these are fixed (standardized) expenses.

The relationship among environmental awareness, environmental purchasing, and environmental household practices

In this section, the relationship between environmental awareness, purchasing, and household practices was investigated by multiple regression analysis. Two dimensions (sensitivity and willingness) of environmental awareness are independent variables. Environmental purchasing and three dimensions of environmental household practices (pollution, saving, and efficiency) are dependent variables.

The impact of environmental awareness on environmental purchasing is examined and results were shown in Table 6.

Table 4 Income and environmental behaviors

Environmental behaviors	[1] ≤ 3000 (n = 139)	[2] 3001–5000 (n = 124)	[3] ≥ 5001 (n = 72)	F
Environmental awareness				
Sensitivity				
Mean	3.77 [3][a]	3.94	4.21 [1]	5.01[**]
Std. deviation	0.96	1.04	0.77	
Willingness				
Mean	3.51 [3]	3.77	3.97 [1]	3.85[*]
Std. deviation	1.29	1.16	0.99	
Environmental purchasing				
Mean	3.47 [3]	3.60	3.83 [1]	5.38[*]
Std. deviation	1.03	0.85	0.77	
Environmental household practices				
Pollution				
Mean	3.20	3.21	3.17	0.38
Std. deviation	1.08	0.91	0.90	
Saving				
Mean	3.54	3.79	3.80	1.82
Std. deviation	1.27	1.19	1.05	
Efficiency				
Mean	4.07	4.09	4.19	0.52
Std. deviation	0.92	0.78	0.76	
Carbon footprint				
Electricity				
Mean	1.47	1.35	1.52	2.68
Std. deviation	0.53	0.55	0.48	
Natural gas				
Mean	3.14 [3]	2.69	2.42 [1]	3.63[*]
Std. deviation	2.46	1.98	1.98	
Automobile				
Mean	1.47 [3]	1.29 [3]	1.95 [1, 2]	7.57[**]
Std. deviation	1.08	0.77	1.70	

[a] The numbers in brackets show statistically different groups

[*] $p < 0.05$; [**] $p < 0.01$

According to the results, a statistically significant but relatively low percentage (about 7%) of the variance in environmental purchasing is explained by awareness. Sensitivity and willingness have a similar impact on environmental purchasing. It was partly surprising that sensitivity has the same impact as willingness. This finding indicates a significant potential for the firms interested in environmental production and marketing.

The results of repeated regression analyses for environmental awareness and environmental household practices are shown in Table 7. There is a statistical association between awareness and pollution, and approximately, 8% of the variance is explained by independent variables. However, while sensitivity is not related to pollution, willingness has a strong and positive ($p < 0.001$) impact. There is a statistically

significant relationship between efficiency and environmental awareness. Approximately, 6% of the variance in the efficiency is explained by environmental awareness. Unlike in the pollution, sensitivity also has an impact on efficiency in addition to willingness. The relationship between environmental awareness and saving is much stronger than others. About one-fourth of the variance in saving is explained by environmental awareness. However, only willingness has a strong and positive relationship while sensitivity has not.

The relationship between environmental awareness and carbon footprint

The relationship between the primary (direct) footprint of households and environmental awareness was examined by

Table 5 Education and environmental behaviors

Environmental behaviors	[1] None of them has a university degree ($n = 179$)	[2] One has a university degree ($n = 59$)	[3] Both has a university degree ($n = 97$)	F
Environmental awareness				
Sensitivity				
Mean	3.79 [3]	3.99	4.15 [1]	4.76[**]
Std. deviation	0.99	1.01	0.84	
Willingness				
Mean	3.67	3.55	3.87	1.47
Std. deviation	1.24	1.21	1.09	
Environmental purchasing				
Mean	3.59	3.47	3.67	0.86
Std. deviation	0.95	0.93	0.86	
Environmental household practices				
Pollution				
Mean	3.36 [3]	3.09	2.97 [1]	5.57[**]
Std. deviation	0.97	0.96	0.96	
Saving				
Mean	3.65	3.74	3.73	0.84
Std. deviation	1.22	1.22	1.16	
Efficiency				
Mean	4.12	4.07	4.08	0.89
Std. deviation	0.88	0.75	0.81	
Carbon footprint				
Electricity				
Mean	1.43	1.38	1.48	0.72
Std. deviation	0.56	0.44	0.53	
Natural gas				
Mean	2.96	2.47	2.62	1.45
Std. deviation	2.45	1.87	1.88	
Automobile				
Mean	1.34 [3]	1.42 [3]	1.87 [1, 2]	6.84[**]
Std. deviation	0.82	1.13	1.61	

[a] The numbers in brackets show statistically different groups

[**] $p < 0.01$

regression analysis (Table 8). There is a linear and negative relationship between carbon footprint from electricity and environmental awareness. However, this relationship is very weak and a small part of the variance is explained by independent variables. Also, sensitivity has no impact on carbon footprint. There is a negative relationship between willingness and carbon footprint from electricity.

No relationship was found between carbon footprint from natural gas and environmental awareness as natural gas has a standard use in households for heating and cooking purposes.

Table 6 The relationship between environmental awareness and environmental purchasing

Dependent variable: environmental purchasing	Independent variable: environmental awareness	R^2	ΔR^2	β	t	F
Environmental purchasing	Sensitivity	0.07	0.06	0.17	3.22[**]	12.9[***]
	Willingness			0.16	3.01[**]	

[**] $p < 0.01$; [***] $p < 0.001$

Table 7 The relationship between environmental awareness and environmental household practices

Dependent variable: environmental household practices	Independent variable: environmental awareness	R^2	ΔR^2	β	t	F
Pollution	Sensitivity	0.09	0.08	0.04	0.86	16.6[***]
	Willingness			0.28	5.31[***]	
Saving	Sensitivity	0.28	0.28	0.07	1.56	67.5[***]
	Willingness			0.51	10.7[***]	
Efficiency	Sensitivity	0.07	0.06	0.15	2.89[**]	12.8[***]
	Willingness			0.18	3.32[**]	

[**] $p < 0.01$; [***] $p < 0.001$

In other words, households mostly are not being able to intervene in natural gas consumption, especially in central heating systems.

The results of the regression analysis between carbon footprint from automobile and environmental awareness showed that there is a relationship between two variables. Although there is no relationship between carbon footprint from automobile and sensitivity, there is a strong negative relationship with willingness. It shows that environmental awareness that has reached to willingness level is going to be effective in case households have a choice to consume more or less such as in electricity and automobile.

Discussions

The analysis began with examining the validity and reliability of the scales. Environmental awareness has two (sensitivity and willingness) dimensions; environmental purchasing has one, and environmental household practices have three dimensions (pollution, saving, and efficiency). All have sufficient validity and reliability.

It is an important finding that the items in willingness remain at a relatively low level in spite of high means in sensitivity. These values were interpreted as the unwillingness of households to compromise their living standards for dealing with environmental problems.

The analysis indicated that households in the survey tend to buy environmental friendly products in general. However, the means did not reach higher levels; thus, environmental purchasing was not considered satisfactory and that there is a long way for the households to take in terms of environmental purchasing. While the means for the items in sensitivity were statistically higher than the test value, the means for willingness (except for one item) were statistically lower than the test value. While this finding supports the interpretation made for environmental purchasing, it has been seen that households are not willing to bear any financial costs when these findings are considered together.

When the means were examined for the items in the environmental household practices, it was found that all of them were above the test value. However, means of items in the saving and efficiency are higher than those in the pollution. It shows that households are more willing when it comes to saving and efficiency, but less willing when it comes to pollution.

It was seen that the willingness in the awareness is quite low compared with the others. The means for awareness, saving, and efficiency are high, but they decrease when a willingness for the environment is required from the household. In fact, these descriptive scores are not surprising, Blake (1999) and Hadlock and Beckwith (2002) partially supported. Although the knowledge of environmental issues and pro-environmental attitudes is high, it indicates

Table 8 The relationship between environmental awareness and carbon footprint

Dependent variable: carbon footprint	Independent variable: environmental awareness	R^2	ΔR^2	β	t	F
Electricity	Sensitivity	0.031	0.025	− 0.084	− 1.507	5.228[**]
	Willingness			− 0.134	− 2.396[*]	
Natural gas	Sensitivity	0.010	0.004	− 0.076	− 1.340	1.634
	Willingness			− 0.047	− 0.842	
Automobile	Sensitivity	0.024	0.018	0.003	0.060	4.054[*]
	Willingness			− 0.155	− 2.772[**]	

[*] $p < 0.05$; [**] $p < 0.01$

that households may be reluctant to give up or pay extra for the environment, and different motivations and factors may play a role in environmental purchasing and household practices. This may be due to an incomplete or incorrect understanding that environmental problems are caused only by producers and that households have no impact on the occurrence and/or growth of environmental problems.

All demographic characteristics have impact on sensitivity. This finding is consistent with the literature (Abdul-Wahab and Abdo 2010; Anderson and Cunningham 1972; Berkowitz and Lutterman 1968; Golley and Meng 2012; Mainieri et al. 1997; Roberts 1996; Soonthonsmai 2001). On the other hand, only the household income has an impact on willingness. This finding shows that although it is possible to raise environmental sensitivity through education and socialization, these will not be sufficient for willingness and that income is an important factor for environmental behaviors requiring willingness. The fact that the impact of household income was found on environmental purchasing but education level was not also supports this idea. This finding is consistent with Balderjahn (1988) and Csutora (2012) who stated that environmentally concerned consumers are mainly from higher income societies.

The impact of demographic characteristics on environmental household practices (pollution, saving, and efficiency) could not be determined. Only it has been found that education has negative impact on pollution. This suggests that problems such as reducing the use of chemicals at home and disposal of waste oils can only be solved with sensitivity and willingness together. This finding contradicts with Bandara et al. (2007) and Xu et al. (2017) who stated that there is a negative relationship between income and waste separation. Again, unlike environmental awareness, even income does not have an impact on saving and efficiency. This can be explained by the fact that every rational individual behaves in a way that reduces his/her expenses. These findings contradict with Vassileva et al. (2012) who stated that higher income households consume more electricity. Babaei et al. (2015) found that education is strong predictor for waste disposal.

None of the demographic characteristics examined in the study showed differences in carbon footprint from electricity. This finding contradicts with several studies in terms of income and education (Baiocchi et al. 2010; Balaguer and Cantavella 2018; Büchs and Schnepf 2013; Golley and Meng 2012; Lyons et al. 2012; Sarwar 2019). Peters et al. (2007) stated that the largest portion in household carbon footprint belongs to electricity consumption due to the service sector reforms and increased income. Boucher (2016) claimed that income and education have positive relationships with carbon footprint. Zang et al. (2017) showed that income and education levels have positive relationships with footprint from electricity. The difference may be due to carrying out the study in only family households. Most

of the electrical appliances in Turkish families are present even in newly established households as dowry, regardless of demographic factors. Considering that most of the electricity is consumed by these appliances (Enerji Dünyası 2019), the results can be understandable.

In terms of natural gas-induced carbon footprint, it was found that there was only a difference with income, and interestingly, the higher income group has lower carbon values. Electricity and natural gas-induced carbon footprints do not differ with demographic characteristics (excluding the impact of income on natural gas use) because both of them have become fixed (standard) expenses for households up to a certain level. Again, the impact of income on natural gas can be explained by the fact that individuals live in more insulated houses as their income increases. Both findings support our assessment about the impact of income on saving and efficiency. However, these findings contradict with Büchs and Schnepf (2013) who stated that income and education increase home energy emissions (including natural gas and electricity). On the other hand, Baiocchi et al. (2010) found that higher income increases emissions at the beginning of economic growth, but it will decrease as the growth continues.

On the other hand, it was found that carbon footprint from automobile use increased in terms of all the characteristics (female employment status, higher education levels, and income) are considered together. This result is likely because the number of automobiles in the household may increase as both parents work, and the possibility of finding better paid jobs and household income increases with higher education levels. It is consistent with Zang et al. (2017) who stated that income and education have a considerable impact on automobile use-related footprint. Büchs and Schnepf (2013) found that there is a positive relationship between income, education, and automobile use-related footprint. Baiocchi et al. (2010) showed that there is a relationship between income and transport emissions.

Wilhite et al. (1996) stated that employed female may cause a differentiation in energy use. Our findings regarding the impact of female employment, which was examined for the first time in the literature, support this prediction for automobile use but not for electricity and gas. The absence of a difference in electricity and gas emissions may have resulted from the fact that both of them became a standard consumption for almost all households in Turkey. Even in case of working female, heating in a central system continues to heat whole day; cooking is still an activity held in Turkish households for breakfast and dinner, and electrical appliances are working in a specific time frame but more intensely. These may have affected our findings. Sener and Hazer's (2008) results also showed that women do not show some behaviors related to sustainable consumption enough in Turkey. It would be desirable to have higher means for environmental awareness, purchasing, and practices for both groups (employed and unemployed female).

It was seen that environmental awareness explained a low percentage of the variance in environmental purchasing. However, both dimensions of awareness have similar impacts on environmental purchasing. It is surprising that willingness, which is expected to have a higher level of impact, found to be similar to sensitivity. This finding contradicts with Mainieri et al. (1997) indicating that general environmental sensitivity is not effective at predicting environmental purchasing.

A relatively low proportion (8%) of the variance in pollution has been explained by awareness. It was found that willingness has a strong relationship with pollution while sensitivity has no relationship. This finding supports the claim that sensitivity alone is not sufficient to realize environmental household practices; thus, the environmental problems can only be deal with environmental awareness at willingness level. This result agrees with Balderjahn (1988) who stated "the predictive power of the attitude toward pollution is disappointingly poor." Another finding of this study is that a high percentage (about one quarter) of the variance in saving was explained by environmental awareness, and while sensitivity did not have an impact, willingness has a high impact. It is consistent again with Balderjahn (1988) who found "consumers with an internal control ideology save more energy than others." The analysis also showed that both awareness dimensions have an impact on efficiency. Therefore, when it comes to reducing energy and water use in households, in other words reducing costs, sensitivity alone can be sufficient in realizing environmental household practices.

Conclusion and implications

Human activities are the most important cause of global warming as much of the carbon footprint is related with household consumption. Therefore, it is important to know the approaches and practices of households on environmental problems in order to plan and carry out efforts to reduce carbon footprint. This study examined the relationships between environmental behaviors, carbon footprint, environmental awareness, and demographic characteristics only in the households where families live.

Efforts for environmental problems in Turkey are still at the early stages, and studies about the role of Turkish households in environmental issues are limited. Even, the finding that that one-third of the respondents never heard carbon footprint shows that there is a need for public awareness campaigns about carbon footprint through the media. Thus, this study's findings may be beneficial for understanding the situation of environmental behaviors and carbon footprint in households for developing environmental strategies.

Environmental awareness explained a relatively low percentage of the variance in environmental purchasing, and sensitivity is as important as willingness. This finding is useful for

firms as it shows that even environmental sensitivity has an impact on environmental purchasing. This means that environmental sensitivity may increase the sales of environmental friendly firms. For this reason, it is suggested that firms should take a role in raising environmental sensitivity.

It was found that households are more willing to saving and efficiency in environmental practices. It points out that it can be a useful practice for practitioners to emphasize the aspects of environmental behaviors improving saving and efficiency in campaigns. Also, providing government incentives for energy efficient appliances will be beneficial.

If there is a willingness needed for environment, the means of awareness, saving, and efficiency are all decreasing. It happens because of either unwillingness of households to compromise their living standards or incomplete/incorrect understanding of environmental problems. We observed during the survey that households believe firms are the main culprit for environmental issues. Thus, it is important to continuously enlighten people about that their household behaviors have a strong impact on environment through media channels. Also, education will be helpful as it was found that education has no impact on variables except awareness and pollution. The reason for this may be due to the lack of subjects related to environment in Turkish education system. Thus, enriching the K-12 and university level education by adding energy, environment subjects will be beneficial.

It was observed that the independent variables in the study did not affect the electricity and gas emissions of the households. Most of the carbon footprint from electricity and natural gas in households are stable, and the efforts of the households do not lead to any prominent reduction in these emissions. There is only a negative relationship between income and gas emissions. It is thought that this is due to the insulation in new buildings (higher priced) required by regulation. For countries using a central system for heating and using electricity only in lighting and appliances such as Turkey, it is recommended that policy makers implement regulations that will ensure the implementation and inspection of measures (infrastructure maintenance, insulation for older buildings, education of building management staff, using energy efficient appliances) to decrease energy use and emissions in households. A good example to this is the use of plastic bags in Turkey that has been reduced by approximately 75% in a short period of time (BIK 2019; Anadolu Agency 2019).

Female employment status, higher education levels, and higher income increase carbon footprint due to the increased number of automobiles in households. There are several alternatives to use instead of automobiles such as shuttles, public transportation, and bikes, but due to the comfort or time, people are not willing to use these alternatives. Emphasizing the benefits of these sustainable alternatives and improving the availability and quality of public transport will be useful for

reducing automobile related footprint. It can also be suggested to apply incremental carbon tax depending on kilometers.

The variance of environmental purchasing is explained by environmental awareness with a relatively low percentage. Also, sensitivity is as important as willingness. This finding is useful for firms as it shows that even environmental sensitivity has an impact on environmental purchasing. Thus, it is an opportunity for firms to differentiate themselves in the market by inclining to environmental friendly production and marketing.

It was revealed that only willingness has an impact on decreasing emissions and only income has an impact on willingness. Households are more open to practices related to saving and efficiency. For this reason, emphasizing the cost minimizing aspect of environmental behaviors and emission decreasing measures in public and private campaigns to increase willingness are suggested.

As a sum, it is extremely important to understand that having knowledge or being sensitive about environment is not enough for showing environmental behaviors. It is necessary to be willing to compromise for environment. The scope, content, and frequency of current public campaigns and programs need to be enriched in terms of household impacts on environment.

Limitations and future studies

This study was carried out in an area where the winter season is relatively harsh. Considering that the regions in Turkey have different climatic conditions, it will be possible to generalize the findings of this study in case it will be repeated in different regions. Also, the emission related with heating and cooking is only from natural gas. Future studies can include households that use alternative fuels (electricity, coal, biomass, and renewables) for their heating and cooking. Furthermore, the fact that research data was collected from households living in multi-storey buildings may have had an impact on the results. Therefore, it is recommended to include detached households in future studies. Because electric vehicles are not widespread in Turkish market, only gasoline, diesel, and LPG were considered fuel for automobiles. Electric vehicles could be included in the study in the future.

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