WELL-EDUCATED CARBON FOOTPRINT: SAMPLE OF A UNIVERSITY STAFF IN TURKEY

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ABSTRACT

This paper aims to calculate the carbon footprint of a Turkish university staff and find out relations between demographical specification and the associated carbon footprint. The term personal carbon footprint is used to describe the total amount of carbon dioxide and another greenhouse gas emission for which each individual is responsible. 139 staff participated in the survey. According to the results; the carbon footprint of the participants was calculated at 12.069 tons per person. Lifestyle constitutes 35%, food constitutes 23%, housing constitutes 18%, and travel constitutes 24% of total calculated carbon footprint. The carbon footprint of the participants is higher than the average of Turkish people and the world. It has resulted in that gender, age and tenure did not affect housing, travel, food, lifestyle and total carbon footprint significantly. On the contrary, marital status had a significant impact on housing, travel, food, lifestyle and total carbon footprint. Regarding to income, it had a partial affect on total carbon footprint. It is seen that income is positively related to travel and total carbon footprint.

Key Words: Carbon footprint, University staff, Turkey.

INTRODUCTION

The term, ecological footprint, was introduced by Wackernagel and Rees (1996) and was designed to assess societies' pressure on the environment (York et al. 2009). An alternative definition for ecological footprint is a measure of how much area of biologically productive land and water an individual, population or activity requires producing all the resources it consumes and to absorb the corresponding waste (WWF 2012). Ecological footprint composes of carbon, agriculture, forestry, other land use, buildings and fishing footprints. According to the report of WWF (2012), the most important component of the ecological footprint is carbon footprint that is nearly half of the ecological footprint of the world and Turkey (Özsoy Erden 2015).

The term carbon footprint is commonly used to describe the total amount of carbon dioxide and other greenhouse gas emissions for which an individual or organization is responsible (Carbon Trust 2007). Carbon footprint stands for a certain amount of gaseous emissions that are relevant to climate change and associated with human production or consumption activities (Wiedmann & Minx 2008). Personal carbon footprint is the measure of the greenhouse gases produced by a person and has units of kilograms (kg) or tons of carbon dioxide equivalent and it has two main dimensions; primary footprint and secondary footprint. Primary footprint is the direct emission of carbon dioxide from the burning of fossil fuels, domestic energy consumption, and transportation. Secondary footprint is the indirect emission of carbon dioxide from the whole lifecycle of products, which is related to person lifestyle (Bright Green 2015). Personal carbon footprint calculation is important due to managing the footprint, its components and reducing emissions over time (Carbon Trust 2007; Carbon Trust 2012).

Personal carbon footprint consists of 4 dimensions: housing, travel, food and lifestyle. Housing is described as carbon footprint that the individuals cause in order to meet their need for accommodation. The items affecting accommodation are the size of the dwelling, the way of heating (electricity, natural gas, coal, etc.) and how much water is used. The second dimension is travel, which shows the carbon footprint that the individuals cause due to their travels. The items affecting travel are the number of cars per house, the size of the engine, the type of fuel (diesel, natural gas, petrol, hybrid, and electricity) and the number of journeys (by plane, train, personal car, bicycle, etc.) per year. The third dimension is food. This shows the carbon footprint that the individuals cause due to their food habits. To measure this dimension, the amount of consumed local food, organic food and meat and how much of these food waste is recycled is taken into consideration. The fourth and the last dimension is the lifestyle. This dimension shows the amount of carbon footprint that the individuals cause due to their lifestyle choices. To measure this dimension, the bought goods (e.g. furniture, clothes, etc.), the usage of second-hand shops, the usage of telecommunication systems and the recycling of goods are considered.

According to the report of EDGAR (2013), the average carbon footprint of the world is 4.93 tons per person and it is 4.40 tons per person in Turkey (Table 1). Detailed carbon footprint analysis shows that components of the carbon footprint of the world and Turkey have similarities. For instance, 26% of carbon

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footprint comes from housing, 24% of travel, 28% of food, 23% of lifestyle in the world; in Turkey, 24% of carbon footprint comes from housing, 23% comes from travel, 27% food and lastly 26% from lifestyle (Hertwich & Peters 2009).

Table 1: List of countries for carbon footprint per person

Rank	Country	Carbon Footprint per Person
1	Qatar	39,01
2	Trinidad and Tobago	29,75
3	Curacao	29,21
4	Kuwait	28,13
5	Bahrain	25,39
…		
77	Portugal	4,60
78	Argentina	4,48
79	*Turkey*	*4,40*
80	French Guiana	4,19
81	Aruba	4,01
…		
205	Afghanistan	0,02
206	Puerto Rico	0,01
207	Chad	0,01
208	Virgin Island	0,01
209	Timor-Leste	0,001

Source: EDGAR (2013) CO2 time series 1990-2013 per capita for world countries

EFFECTS OF CARBON FOOTPRINT

The most important greenhouse gas, arising from human activity, is carbon dioxide. Virtually all human activities cause carbon dioxide emissions which leads to climate change. By using electricity generated from fossil fuel power stations, burning gas for heating or driving petrol or diesel car, every person is responsible for carbon dioxide emissions. Furthermore, every product or service that humans consume indirectly creates carbon dioxide emissions; energy is required for their production, transport, and disposal. These products and services may also cause emissions of other greenhouse gases. Understanding and addressing the full range of people's impact is crucial to minimizing the effects of climate change (Carbon Trust 2007).

Table 2: What to do for smaller carbon footprint

Use smaller engine car
Take public transport instead of the car
Walk or cycle instead of short car journeys
Car share to minimize fuel consumption
Buy products with less packaging
Consider organic products
Eat seasonal and local food
Switch off equipment that is not in use
Buy energy efficient household appliance
Purchase green energy
Install loft or cavity wall insulation
Fit double glazing
Buy a home energy monitor
Use solar water heating
Install a dual flush toilet
Get a garden water butt

Source: Bright Green 2015

Table 2 shows suggestions for smaller carbon footprint activities, such as buying small engine car, eating seasonal and local food and using solar water heating. These activities may minimize carbon footprint.

Nowadays, there are a lot of research on carbon footprint and its effects (Cohen & Vanderbergh 2008). A very important study, done by Greenstein et al. (2008) shows that carbon footprint causes climate change which affects people's happiness level severely (Greenstein et al. 2008). Along the same thought, Knight et al. (2012) carried out research on work hours and carbon footprint relation and results show that reducing 10% in work hours reduce 14.6% carbon footprint and reducing 25% in work hours reduce 36.6% carbon footprint (Rosnic & Weisbrot 2006). According to Happy Planet Index (HPI) report, high HPI score is only possible with high life expectancy, high life satisfaction and low ecological footprint (Wisser, 2011). Improving green consumer society and environmental citizenship society can minimize the carbon footprint in any country (Emelianoff et al. 2012). Research of Knight and Rosa (2011: 943) also shows that there is a positive linear correlation between economic development and environmental well-being (Knight & Rosa 2011).

In the literature, researches show that carbon footprint is an important and relevant topic. In Turkey, it is possible to say that only a few papers carried out carbon footprint research and all these studies are dealing with the concept of environmental policy and environmental peace. In addition to that, there is no research on measuring the public carbon footprint in Turkey. The most relevant paper to this research was aimed to measure pre-service teachers' ecological footprint (Keleş, Uzun & Özsoy 2008). From this point of view, the present research is the first one aiming to measure the carbon footprint of a public university staff in Turkey. Regarding the sampling of the research, random sampling method was used and the sample was selected from this public university staff. Working with this group brought some hypothetical problems such as some papers put forward negative relation between educational status and carbon footprint (Buchs & Schenpf 2013), and some others put forward positive relation between educational status and carbon footprint (Egas & York 2012). Therefore, no hypothesis has been proposed within the research but research questions have been proposed such as:

RQ1: Does carbon footprint of Turkish university staff differ from the world carbon footprint average?

RQ2: Does carbon footprint of Turkish university staff differ from Turkey's carbon footprint average?

RQ3: Do demographic specifications of Turkish university staff affect carbon footprint?

METHOD

Concerning the method of the research, the questionary method was used. Survey form included 2 parts. The first part of the survey form questioned demographical specification of the participants (gender, marital status, age, tenure, and income) and the second part questioned personal carbon footprint of the participants. The carbon footprint of the participants was calculated on the criteria of carbon footprint calculator (*http://www.carbonindependent.org)* which includes the most up to date calculation numeric of carbon footprint.

There is 680 staff working at the selected public university. According to 95% confidence level and 5% confidence interval, 246 participants represent the research universe. Survey sent to 246 participants and 191 of them volunteered for the research (%78 of the sample) and out of 191 questionnaires, 52 of them were eliminated due to incomplete answers (21% of the sample). At the end, 139 successful questionnaires (57% of the sample) show results in the research.

RESULTS

Kolmogorov-Smirnov normal distribution analysis was used to decide distribution of carbon footprint components. Results show that; housing (K-S: 1,97; p: 0,00), travel (K-S: 2,73; p: 0,00), food (K-S: 1,87; p: 0,02), lifestyle (K-S: 3,16; p: 0,00) and total carbon footprint (K-S: 1,46; p: 0,02) variables have a non-normal distribution.

Research results show that, 84 male (%60,4) and 55 (%36,4) female; 86 married (%61,9) and 53 single (%38,1) participated in the survey. The average age of the participants were 34; they have been working for 10 years and their average monthly net income was reported as 3.908 Turkish Liras ($1.350 = €1.210).

Table 3: Information for components of carbon footprint

Components of Carbon Footprint	Mean	SD	% of Total Carbon Footprint
Housing	2,102	1,43	18
Travel	2,941	1,79	24
Food	2,811	0,39	23
Lifestyle	4,214	0,72	35
Total Carbon Footprint	**12,069**	**3,32**	**100**

According to Table 3, the sample of the research was in 21st position in the world with 12.069 tons per person and results show that; 65% of carbon footprint is primary (housing, travel, and food) and 35% of carbon footprint is secondary (lifestyle) for the research sample. According to analysis which can be seen in Table 3, the carbon footprint average of housing is 2.10 tons (18%), of travel is 2.94 tons (24%), of food is 2.81 tons (23%) and lastly lifestyle average is 4.21 tons (35%).

Table 4: Comparison of carbon footprint

Components	World	Turkey	Turkish University Sample
Housing	26	24	18
Travel	24	23	24
Food	28	27	23
Lifestyle	23	26	35
Total	**100**	**100**	**100**

Source: Herwitch, Peters, 2009 and designed by authors

The most important comparison in the research is the components of carbon footprint. When the percentages of the world, Turkey and Turkish university sample comparison were examined; travel and food carbon footprint did not differ between them radically. But when it came to housing and lifestyle, the percentage comparisons were drastically different. In the case of housing, in Turkish university sample, it is much smaller than the world and Turkey; and in the case of lifestyle, in Turkish university sample, it is much higher than the world and Turkey (Table 4).

Table 5: Comparison of the world average carbon footprint with Turkish university sample

Components	World	Turkish University Sample	t	p
Housing	1,282	2,102	6,757	*0,000*
Travel	1,183	2,941	7,835	*0,000*
Food	1,380	2,811	42,438	*0,000*
Lifestyle	1,134	4,214	49,858	*0,000*
Total	4,930	12,069	25,298	*0,000*

Table 5 was designed to show the analysis results of the RQ1 (Does carbon footprint of Turkish university staff differ from the world carbon footprint average?). According to the results, the average carbon footprint of Turkish university staff is higher than the world average. When the results are examined in a detailed way, housing (t: 6.757, p: 0.000), travel (t: 7.835, p: 0.000), food (t: 42.438, p: 0.000), lifestyle (49.858, p:0.000) and total carbon footprint (t: 25.298, p: 0.00) of Turkish university staff are significantly higher compared to the world average.

Table 6: Comparison of Turkey average carbon footprint with Turkish university sample

Components	Turkey	Turkish University Sample	t	p
Housing	1,058	2,102	8,602	*0,000*
Travel	1,014	2,941	8,588	*0,000*
Food	1,190	2,811	48,072	*0,000*
Lifestyle	1,146	4,214	49,664	*0,000*
Total	4,408	12,069	27,147	*0,000*

Table 6 was designed to show the analysis results of the RQ2 (Does carbon footprint of Turkish university staff differ from Turkey's carbon footprint average?). According to the results, the average carbon footprint of Turkish university staff is higher than Turkey's average. When the results are examined in a detailed way, housing (t: 8.602, p: 0.000), travel (t: 8.588, p: 0.000), food (t: 48.072, p: 0.000), lifestyle (t: 49.664, p: 0.000) and total carbon footprint (t: 27.147, p: 0.000) of Turkish university staff are significantly higher compared to Turkey's average.

Table 7: Gender effect of carbon footprint

Components	Gender	Mean	SD	Test	Test Value	p
Housing	Female	2,30	1,79	MW-U*	1435,5	0,171
	Male	2,10	0,94			
Travel	Female	2,86	1,93	MW-U*	2141,5	0,459
	Male	2,97	1,97			
Food	Female	2,72	0,44	MW-U*	1958,0	0,129
	Male	2,86	0,35			
Lifestyle	Female	4,33	0,71	MW-U*	2013,0	0,186
	Male	4,13	0,72			
Total	Female	12,64	3,83	MW-U*	2084,5	0,331
	Male	11,69	2,91			

*: Mann-Whitney U Test

Table 7 shows a part of RQ3 (Do demographic specifications of Turkish university staff affect carbon footprint?). In the first part of RQ3, gender effect of the carbon footprint was analyzed. Results show that gender is not significant on housing (MW-U: 1435.5, p: 0.171), travel (MW-U: 2141.5, p: 0.459), food (MW-U: 1958.0, p: 0.129), lifestyle (MW-U: 2013.0, p: 0.186) and total carbon footprint (MW-U: 2084.5, p: 0.331) of Turkish university staff. In the light of the findings, the components and the total of carbon footprint level of female and male staff are statistically similar.

Table 8: Marital status effect of carbon footprint

Components	Marital Status	Mean	SD	Test	Test Value	p
Housing	Single	2,45	1,62	MW-U*	1808,0	*0,041*
	Married	1,88	1,25			
Travel	Single	3,18	2,56	MW-U*	2164,0	*0,048*
	Married	2,79	1,81			
Food	Single	2,89	0,40	MW-U*	1748,5	*0,021*
	Married	2,76	0,38			
Lifestyle	Single	4,50	0,76	MW-U*	1404,5	*0,000*
	Married	4,03	0,64			
Total	Single	13,08	3,91	MW-U*	1674,5	*0,009*
	Married	11,47	2,76			

*: Mann-Whitney U Test

Table 8 shows the second part of RQ3 (Do demographic specifications of Turkish university staff affect carbon footprint?). In the second part of RQ3, the marital status effect of the carbon footprint was analyzed. Results show that, marital status of Turkish university staff is affecting housing (MW-U: 1808.0, p: 0.041), travel (MW-U: 2164.0, p: 0.048), food (MW-U: 1748.5, p: 0.021), lifestyle (MW-U: 1404.5, p: 0.000) and total carbon footprint (MW-U: 1674.5, p: 0.009) significantly. According to the results of research; single staff have bigger carbon footprint in the components and the total of carbon footprint compare to the married staff.

Table 9: Correlations results

Items	1	2	3	4	5	6	7
1. Housing	-						
2. Travel	-0,02	-					
3. Food	-0,06	0,01	-				
4. Lifestyle	0,14	0,06	*0,26***	-			
5. Total CF	*0,45***	*0,77***	*0,17**	*0,38***	-		
6. Age	-0,06	-0,04	-0,17	-0,18	-0,15	-	
7. Tenure	-0,04	-0,03	-0.17	-0,24	-0,18	*0,88***	-
8. Income	-0,13	*0,46***	-0,04	-0,03	*0,25***	*0,36***	*0,36***

Spearman's rho test results. **p<0,01 *p<0,05

Table 9 shows correlation results. Analyses show that age has no significant relations among housing, travel, food, lifestyle and total carbon footprint. Same results were retrieved for the tenure. It was seen that tenure is not significantly related to housing, travel, food, lifestyle and total carbon footprint. For income, it is positively related to travel and total carbon footprint and not related to housing and food.

Regarding the findings of RQ3, demographic specifications partially affects carbon footprint of the participants. It was calculated that gender, age and tenure do not affect housing, travel, food, lifestyle and total carbon footprint significantly. On the contrary that, the marital status significantly affects housing, travel, food, lifestyle and total carbon footprint and it is determined that the carbon footprint of married staff is significantly lower than the single staff. Concerning the income, it affected the carbon footprint partially. It is seen that income is positively related to travel and total carbon footprint; whereas, it is not statistically related to housing, food, and lifestyle.

CONCLUSION

The carbon footprint of the participants in the research (12.069 tons per person) is significantly higher than Turkey's carbon footprint average (4.408 tons per person) and also the world's carbon footprint average (4.930 tons per person). When the components of the carbon footprint were examined, the highest portion belonged to lifestyle (35%), and the rest portions are respectively as follows: travel (24%), food (23%) and housing (18%). It was resulted that gender, age and tenure did not affect the carbon footprint significantly. On the contrary that, the marital status significantly affected the carbon footprint. And lastly, income is positively related to travel and total carbon footprint.

The average carbon footprint of the study participants was calculated as 12,069 tons per person, which is very high. The cause of such a large carbon footprint could be due to the location of the university, which is far from the city center and mostly study participants preferred drive to campus by personal car. In addition to that, the participants' preference of transportation (especially plane) to the national and international conferences also could have increased the travel carbon footprint. In order to decrease the travel carbon footprint, it can be suggested to the participants to use public transportation during their commute to work and to participate in conferences online.

One of the reasons why the lifestyle carbon footprint could be so high is due to perception that exported goods have better quality than the local Turkish goods, where the international trade has begun in last three decades. Another factor is due to the participants' preference of convenience food and nonlocal food which increases the carbon footprint. And lastly, the aversion of Turkish public towards use of second-hand shops (furniture, clothes, shoes, etc.) can increase the carbon footprint as well. The suggestions to help to decrease the lifestyle carbon footprint can be to promote the use of local foods and second-hand goods, and the increase the number of second-hand shops. Of course, the local foods and the goods in second-hand shops should be proper to the quality standards in order to be preferred.

LIMITATIONS AND FUTURE RESEARCH

In the research, there are some limitations. First of all, the surveys are self-reported information. Additionally, the sample size was not statistically sufficient to represent the universe. Another limitation of the research is, as the chosen sample (University staff) has not been examined in the national or international literature before, the comparison of the results of the research with the country and world average can pretend to show that the university staff have bigger carbon footprint than the other jobs.

For the further research, the sample size should be proper and sufficient in order to enhance the results. Also, the calculation of the specific jobs' carbon footprint (e.g. doctors, nurses, pilots, teachers, accountants, engineers, etc.) can contribute to the literature.

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