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Determination of Ecological Footprint of Instructors and Biocapacity Deficit in Turkey: A Case Study of Hatay-Iskenderun Region

Omer Eren (Corresponding author)
Department of Biosystems Engineering, Faculty of Agriculture, Mustafa Kemal University, Antakya/Hatay, Turkey
E-mail: dromereren@gmail.com

Selcuk Ugurluay
Department of Biosystems Engineering, Faculty of Agriculture, Mustafa Kemal University, Antakya/Hatay, Turkey
E-mail: selcuk.ugurluay@gmail.com

Oktay Soyler
Iskenderun Vocational School, Iskenderun Technical University, Iskenderun/Hatay, Turkey
E-mail: oktay.soyler@iste.edu.tr

Mustafa Cakir
Iskenderun Vocational School, Iskenderun Technical University, Iskenderun/Hatay, Turkey
E-mail: mustafa.cakir@ iste.edu.tr

Hakan Kalpakcioglu
Iskenderun Vocational School, Iskenderun Technical University, Iskenderun/Hatay, Turkey
E-mail: hakan.kalpakcioglu@ iste.edu.tr

Abstract
Humans have always benefited from natural sources to satisfy their needs. Today, with the increase in population, the natural resources on our earth are decreasing and assumed to be consumed in the near future because of the consciousness of the individuals and the consciousness of consumption away from sustainability. It is important to determine how many planets the world will need in the future if the individual continues to live that way with his current consumption habits. The concept of ecological footprint emerges in determining this need. In this study, ecological footprints were calculated and evaluated depending on the consciousness and consumption habits of the Iskenderun Vocational School of Higher Education affiliated to a newly established university, Iskenderun Technical University. Web-based "Ecological Footprint Calculation Survey" was used as data collection tool in the research. Descriptive statistics such as mean, standard deviation were used in the analysis of the data. As a result of the calculations, the average ecological footprint of Instructors was determined as 2.84 gha person^{-1}, the average carbon footprint was 12.44 tons person^{-1} and the biocapacity deficit caused by instructors was -1.37 gha person^{-1}. According to these results, at least 2.84 worlds are needed for Iskenderun Vocational School of Higher Educations Instructors for a sustainable life.

Keywords: Biocapacity, carbon footprint, ecological footprint, instructor, Hatay, Turkey

1. Introduction

People have always benefited from natural resources as much as the day-to-day to meet their needs. Along with population growth, the natural resources on the earth are also decreasing. How many planets like the world are needed in the future if they continue to live in the context of existing consumption

habits? The determination of the answer to this question is important for a habitable world to be left to future generations. The "ecological footprint" in this context is one of the methods used.
Ecological footprint is the biologically fertile soil and water area needed to produce the resources consumed by an individual, community, or activity through current technology and resource management, and to dispose of the resulting waste. It is expressed in "global hectare (gha)". This includes the infrastructure and necessary areas for plant cover to absorb waste carbon dioxide (Lin et al., 2016).
The ecological footprint is one of the most effective means of giving an idea of the impact of a person on nature. Everyone has an influence on the earth because people consume the products and services of nature. The first study on ecological footprint was made by William E. Rees in 1992. The concept and related calculation methods were first performed by Dr. Mathis Wackernagel in his doctoral dissertation. The measure obtained in the study was also called Ecological Footprint. Wackernagel and Rees, in their book published in 1995, detailed the concept of ecological footprint and the relationship between sustainable development and the methods of calculation. Ecological footprint in this direction; to give clues for sustainable life and as an important indicator at the point of putting the burden that human beings have on this planet (Akyüz et al., 2016).
According to WWF's global footprint network, the global ecological footprint of the world and Turkey in 2013 was 20.60 and 0.24 billion gha respectively. The ecological footprint per capita was calculated as 2.87 gha and 3.19 gha, respectively (Figure 1).

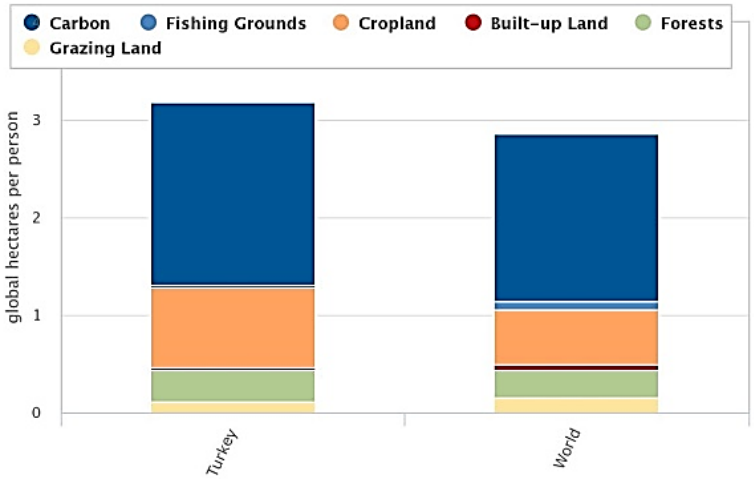

Figure 1. Ecological footprint per person for Turkey and World (GFN, 2017)

The capacity of ecosystems to regenerate what people demand from those surfaces. Life, including human life, competes for space. The biocapacity of a particular surface represents its ability to renew what people demand. Biocapacity is therefore the ecosystems' capacity to produce biological materials used by people and to absorb waste material generated by humans, under current management schemes and extraction technologies. Biocapacity can change from year to year due to climate, management, and also what portions are considered useful inputs to the human economy. In the National Footprint Accounts, the biocapacity of an area is calculated by multiplying the actual physical area by the yield factor and the appropriate equivalence factor. Biocapacity is usually expressed in global hectares (gha) (Lin et al., 2016).

Each year, the Global Footprint Network (GFN) measures the biological capacity of more than 150 countries worldwide and publishes the National Footprint Accounts (NFA). The biocapacity per capita of the world and Turkey in 2013 was calculated as 1.71 gha and 1.47 gha, respectively (Figure 2).

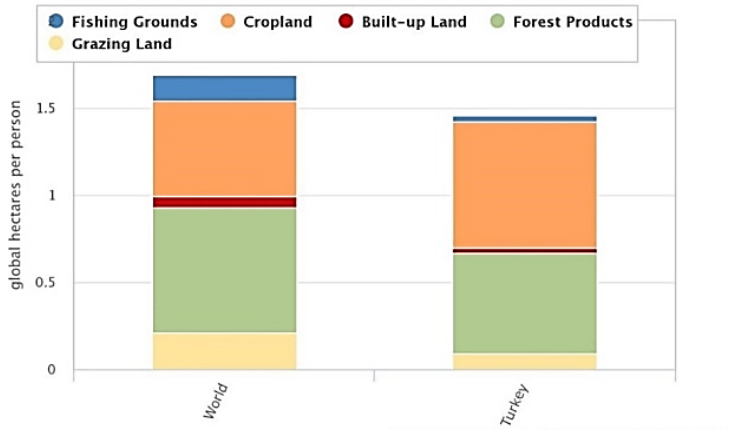

Figure 2. Biocapacity per person for World and Turkey (GFN, 2017)

There are many studies in the international literature using ecological footprint calculation methods that show that ecological footprints are an effective tool for individuals to perceive the effects of consumption habits on nature (Schaller, 1999; Dawe et al, 2004; Ryu and Brody, 2006; Janis, 2007; Wada et al., 2007; Niccolucci et al., 2012).

When the national literature studies are examined, the global importance of the ecological footprint in Turkey is explained and emphasized (Dinç, 2015). Ecological footprints have been proposed as a means of environmental education without changing the awareness, attitudes and behaviors of primary school students, prospective teachers and engineering students towards sustainable life (Keleş, 2007; Keleş et al., 2008; Erdoğan and Tuncer, 2009; Keleş, 2011; Coşkun, 2013; Çetin, 2015; Eren et al., 2016). There are researches that include ecological footprint calculations depending on consciousness and consumption habits of the university staff (Akıllı et al., 2008; Akyüz et al., 2016; Eren et al., 2017).

As a result of literature surveys, ecological footprint studies conducted for university lecturers in Turkey were found to be very low. In particular, university faculty members who are thought to have high levels of awareness should be informed about the ecological footprint and be aware of the effects on nature. For this purpose, ecological footprints were calculated and evaluated according to the consumption habits of Iskenderun Technical University Iskenderun Vocational School.

2. Material and Method

2.1 Material

The main material of the study is the data obtained with the questionnaire applied to the instructors who are currently working at Iskenderun Technical University Iskenderun Vocational School. In addition to this, related articles, theses, reports and notifications were also used.

2.2 Method used to collect data

Academic staff working in 16 departments of Iskenderun Vocational School were accepted as the target group. The data were collected on April 2017 through a questionnaire interviewed with the target audience. The first part of the questionnaire was prepared to determine the demographic characteristics of the participants. In the second part of the questionnaire, questions were asked about food, travel, home and other life habits to determine ecological footprints. In the preparation of these questionnaire questions, the ecological footprint calculation engine "Ecological Footprint Calculation Survey" was used.

As the main group, 38 teaching staff working at Iskenderun Vocational School were taken into consideration. However, because of the fact that two teaching staff are abroad, no questionnaire could be done with them. A total of 36 (1 Assistant Professor, 7 Instructor Dr. and 28 Instructor) instructors were interviewed.

2.3 Method of analysis of data

In order to calculate the ecological footprint of the teaching staff, ecological footprint calculation engine developed by the World Wildlife Fund (WWF) was used (Figure 3).

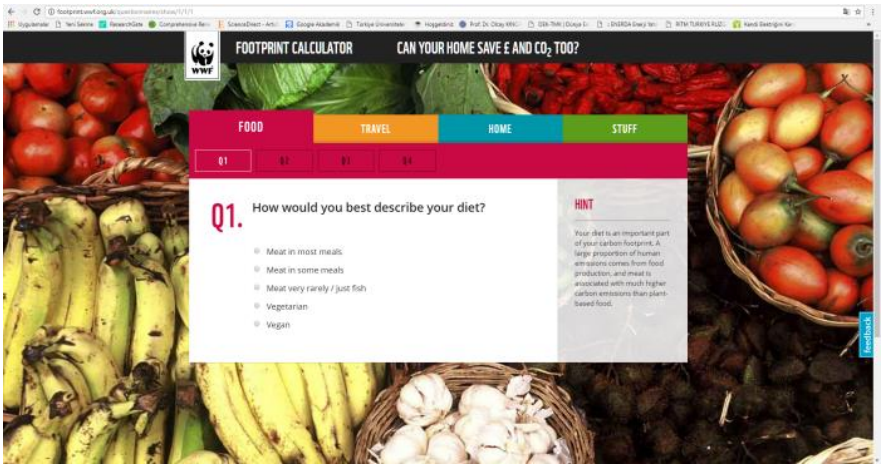

Figure 3. Ecological footprint calculation engine (WWF, 2017)

The data obtained as a result of the surveys are processed for the calculation engine and the ecological footprints of the instructors of Iskenderun Vocational School are calculated. The obtained findings are summarized by the frequency table. The Kolmogorov-Smirnov test was used to investigate whether the ecological and carbon footprint data were normally distributed. It has been determined that they do not show normal distribution. For this reason, the significance between the variables was questioned by the Kruskal-Wallis test.

Biocapacity (BC) deficit calculated by the following equations (Lin et al., 2016):

$$\text{BC deficit} = \text{BC-EF}_c$$

Here EFc was ecological footprint of consumption. BC deficit is always negative values.

3. Results and Discussion

3.1 Demographic characteristics

The average age of the instructors participating in the survey is approximately 43 and the number of individuals in the family is approximately 4 persons. In addition, the duration of the teaching staff is approximately 20 years. 11% of the teaching staff members were female and 89% were male (Table 1). In addition, 2.78% of the faculty members were Assistant Professors, 19.44% were Instructors Dr. and 77.78% were Instructors.

Table 1. Demographic characteristics of instructors participating in the survey

Demographic Characteristics	Min.	Max.	Average	Stan. Dev.
Age (Year)	23	62	43.03	10.13
[1] Number of individuals in the family (Person)	1	10	3.87	1.43
[2] Duration of work (Year)	1	40	19.64	7.88

3.2 Assessments

The average ecological footprint of the instructors surveyed was 2.84 gha person^{-1}. The calculated ecological footprints were found to be composed of 20.39% of food sourced, 22.17% of travel sources, 24.67% of domestic sources and 32.77% of other sources. The averages carbon footprint of the instructors surveyed was calculated as 12.44 tons person^{-1} (Table 2).

Akyüz et al (2016) calculated the ecological footprint of the academicians of Ege University Faculty of Agriculture as 3.17 gha person^{-1}. Eren et al (2017) calculated the ecological footprint of the academicians of Mustafa Kemal University Faculty of Agriculture as 3.08 gha person^{-1}. That is, it can be said that the ecologic footprints of Iskenderun Technical University, Iskenderun Vocational School of Higher Education instructors pollute the world less.

Table 2. Ecological and carbon footprint averages and distribution of ecological footprint components

Calculated Value		Instructor
Ecological Footprint (gha person^{-1})		2.84
Distribution of Ecological Footprint Components (%)	Food	20.39
	Travel	22.17
	Residential	24.67
	Other	32.77
Carbon Footprint (ton person^{-1})		12.44

Akyüz et al (2016) calculated the carbon footprint of the academicians of Ege University Faculty of Agriculture as 15.32 tons person^{-1}. Eren et al (2017) calculated the carbon footprint of the academicians of Mustafa Kemal University Faculty of Agriculture as 14.31 tons person^{-1}. In other words, the carbon footprint of the Iskenderun Technical University Iskenderun Vocational School instructors is low.

When the instructors were compared ecological footprints according to the titles (Table 3), the lowest ecological footprint belonged to Dr. lecturers with 2.73 gha person^{-1}. Dr. instructors followed the Instructors with 2.87 gha person^{-1} ecological footprint. The highest ecological footprints were found to belong to Assistant Professors with 3.26 gha person^{-1}. The ecological footprint varies according to academic titles, but this difference is not statistically significant ($p > 0.10$).

Table 3. Ecological and carbon footprint averages and distribution of components of ecological footprints according to the titles

Calculated Value		Inst.	Inst. Dr.	Asst. Prof. Dr.
Ecological Footprint (gha person^{-1})		2.87	2.73	3.26
Distribution of Ecological Footprint Components (%)	Food	19.79	21.86	20.00
	Travel	22.54	21.93	18.00
	Residential	24.54	24.14	30.00
	Other	33.14	32.07	32.00
Carbon Footprint (ton person^{-1})		12.66	11.59	14.23

The lowest carbon footprint was 11.59 tons person-1 for Dr. Lecturers (Table 3) when evaluated the instructors' carbon footprint according to the titles. Dr. Instructors followed the Instructors with 12.66 tons person^{-1} of carbon footprint. It was determined that the highest carbon footprint belongs to Assistant Professor with 14.23 tons person^{-1}. The carbon footprint of instructors varies according to the titles, but this difference is not statistically significant ($p > 0.10$).

When ecological footprints were analyzed according to the age groups and sex of the instructors, it was determined that the ecological footprints of female participants were higher than male participants (Table 4). It can be said that the expenditure of jewelry and personal care which are included in the other sources components of the female participants is influential in the formation of this difference. According to age groups, it was determined that the age group of 35 or less is the most environmentally friendly group in terms of ecological footprint, followed by the group of 36-50 age respectively, and finally the personnel of 51 and older age are in the last place. The ecological footprint of the academicians varied according to age groups and sex but it was determined that this difference was not statistically significant ($p > 0.10$).

When carbon footprint analysis was conducted according to the age groups and sex of the instructors, the carbon footprint of female participants was found to be higher than male participants (Table 4). According to age groups, the age group of 51 years and over was the most environmentally friendly group in terms of carbon footprint, followed by the group of 36-50 age group respectively, and finally the personnel of 35 years old and younger were in the last place. The carbon footprint varies according to age groups and sex but this difference is not statistically significant ($p > 0.10$).

Table 4. Ecological and carbon footprint averages by gender and age groups

Calculated Value	Gender		Age Groups		
	Female	Male	≤35	36-50	≥51
Ecological Footprint (gha person^{-1})	3.35	2.78	2.83	2.86	2.89
Carbon Footprint (tons person^{-1})	16.97	11.87	12.74	12.59	12.10

Lastly, biocapacity deficit caused by instructors calculated as -1.37 gha person$_{-1}$ according to Turkey's biocapacity value (1.47 gha person^{-1}).

4. Conclusion

In this study, the ecological and carbon footprints of the surveyed faculty members were calculated with face to face interviews with 36 participants from Iskenderun Vocational School in Turkey. According to the results obtained; the ecological footprint of the instructors is below the average of 2.87 gha person^{-1} in the world average and 3.19 gha person^{-1} in Turkey.

Calculated footprint value; Travel-based, food-sourced, domestic and other sourced life habits. It has emerged that people are generally able to travel by private means and not travel by public transport due to their life habits, so that the level of awareness of the damage caused by carbon emissions is low. Regarding food consumption, it is generally understood that people are predominantly fed with meat and fish, organic production and consumption are less reliable. According to habits of domestic living, it has been seen that insulation is not enough in the houses where people live, and that they sustain their lives without regard to ecological balance in terms of fuel and energy saving. According to other living habits, it has been concluded that people's private life needs (electronic, household goods, jewelry and personal care) do not have a balanced attitude in terms of ecological footprint, expenditure items are unnecessary and they are inadequate to recycle waste.

It can be said that the Dr. Lecturers are more environmentally friendly than the lecturers with other titles because of their low ecological and carbon footprints and need an average of 2.73 worlds for a sustainable life.

Suggestions can be made to change the life habits of Iskenderun Vocational School faculty members in order to draw even lower ecological and carbon footprints, leave a more environmentally friendly nature for future generations, and prevent the depletion of biological diversity. These;

- Wherever possible, the use of public transport should be encouraged, measures must be taken to save energy in homes and offices, and household waste should be separated to enable recycling.
- Natural resources should be used in ways that do not exceed ecological boundaries and should increase protected areas.
- Environment friendly, recyclable and reusable products should be preferred rather than the production, distribution, transfer and use of synthetic, chemical, toxic substances, heavy metals, polluting gases that nature cannot convert.
- Excessive water waste should be avoided.
- Meat and meat products should be consumed without overdoing and local products should be preferred especially for food consumption.

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