# Ecological Footprint as Indicator of Students Environmental Awareness Level at Faculties of Organizational Sciences, University of Belgrade and University of Maribor

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*The Ecological Footprint is a complex sustainability indicator that answers a simple question: How much of the Earth's resources is demanded to support humankind lifestyle and activities? Ecological Footprint translates consumption and waste flow data into a measurement of the biologically productive area required to sustain that flow. We used Ecological Footprint as input feature that provides an effective heuristic and pedagogic tool for capturing current human resource use. The key aspect of this paper will be focused on the measuring of environmental awareness level among the students of the Faculty of Organizational Science, University of Belgrade and University of Maribor. For the determining student's environmental awareness level and their Ecological Footprint, we used a closed form questionnaire with 15 questions. Statistical analysis has been performed in SPSS software package.*

## 1. Introduction

Human economy depends on the planet's natural capital that provides all ecological services and natural resources. As a result of population increase and economic development, humans have exerted a considerable impact on the earth and are facing a series of incompatibilities among the natural resources, environment, and economy, such as the dichotomy of population growth and depression of resources and environment deterioration. It is required a new concept of development – one which is sustainable and which takes into account the satisfaction of the needs and wants of every citizen of the earth, of the pluralism of societies and of the balance and harmony between humanity and the environment. The implication of this ecological situation is obvious: to be sustainable, human beings must live within nature's carrying capacity; and they must measure where they are now and how much further they can go, [32].

Significant changes must occur in the entire world to assure the kind of rational development – changes which will be directed towards an equitable distribution of the world's resources and more fairly satisfy the needs of all peoples. This kind of development will also require the maximum reduction in harmful effects on the environment, the utilization of waste materials for productive purposes, and the design of technologies which will enable such objectives to be achieved, [25].

The reform of educational processes and systems is central to the building of this new development ethic and world economic order. Recommendation 96 of the Stockholm conference on the Human Environment called for the development of environmental education as one of the most critical elements of an all-out attack on the world's environmental crisis, [33].

The goal of environmental education is to develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones. Environmental education means a brand-new style of life, new ethical and cultural values and responsible persons. Environmental education can be defined as "learning to protect and improve environment in a systematic, planned and knowledge-based way during the whole human lifecycle in order to spread awareness about basic characteristics of environment, its structures and relationships that tends to make a human protect and improve environment in a way that will ensure humans' existences now as well as in the future", [16, 17. 18, 24].

The one of key characteristic of environmental education is action because environmental education has to promote civic responsibility, encouraging learners to use their knowledge, personal skills, and assessments of environmental problems and issues as a basis for environmental problem solving and action. Because of these, occurs a need for an adequate measurement of these environmentally sounded actions, and as a good tool for this measurement it can be taken environmental indicator – Ecological Footprint.

Ecological Footprint (EF) is used to translate consumption and waste flow data into a measurement of the bio-

logically productive area required to sustain that flow. In this research Ecological Footprint was used as input feature that provides an effective heuristic and pedagogic tool, at courses of Environmental Management and Technological Systems and Principles of Ecology, for capturing current resource use of students of the Faculties of Organizational Science, University of Belgrade and University of Maribor.

## 2. Importance of environmental education

The Belgrade Charter was adopted by a United Nations conference in 1976 and provides a widely accepted goal statement for environmental education: "The goal of environmental education is to develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations, and commitment to work individually and collectively toward the solutions of current problems and the prevention of new ones."[25]. A few years later, the world's first intergovernmental conference on environmental education adopted the Tbilisi Declaration. This declaration is built on the Belgrade Charter and established three broad objectives for environmental education. These objectives provide the foundation for much of what has been done in the field since 1978:

- To foster clear awareness of and concern about economic, social, political, and ecological interdependence in urban and rural areas;
- To provide every person with opportunities to acquire the knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment;
- To create new patterns of behavior of individuals, groups, and society as a whole towards the environment, [26].

Environmental education's essence is in its role in the education for a sustainable future. That's the reason why environmental education uses content from the environment, economy and society to organize learning processes that help understanding the evolution of human interaction with the environment through development, to analyze present realities, and to plan and participate in coherent processes of change toward a more sustainable future. This set of knowledge, skills and values, endorsed by representatives of all sectors of every society, is the framework for education for sustainability and the basis for much of the new curriculum planning taking place across the world. This kind of education (for sustainable development) is learner-centered, providing learners with opportunities to construct their own understandings through hands-on, minds on investigations. Learners are engaged in direct experiences and are challenged to use higher-order thinking skills. Education for sustainable development supports the development of an active learning community where learners share ideas and expertise, and prompt continued inquiry. Also, this education provides real-world contexts and issues from which concepts and skills can be learned. It recognizes the importance of viewing the environment within the context of human influences, incorporating an examination of economics, culture, political structure, and social equity as well as natural processes and systems.

Through comprehensive, cohesive programs, learners explore how feelings, experiences, attitudes, and perceptions influence environmental issues. They become knowledgeable about natural processes and systems and gain an understanding of human processes and systems. They develop a sense of their rights and responsibilities as citizens, are able to understand the ideals, principles, and practices of citizenship in democratic societies, and they gain the skills necessary for citizenship, [17]. The awareness, knowledge, and skills needed for these local connections, and understandings provide a basis for moving out into larger systems, broader issues, and a more sophisticated comprehension of causes, connections, and consequences. Education for sustainable development fosters skills and habits that people can use throughout their lives to understand and act on environmental issues. It emphasizes critical and creative thinking skills along with other higher level thinking processes that are key to identifying, investigating, and analyzing issues, and formulating and evaluating alternative solutions. The aim of good higher environmental education is to enable students to work in or lead interdisciplinary teams to find solutions, using environmental sciences and management methods, so that they'll be skilled to devise integrative environmental knowledge and management solutions for complex environmental issues on a regional, national and international level, for the private as well as for the public sector. What has to be offered in the program of good higher environmental education is interconnected with the wide range of requirements in professional life; therefore the program of higher environmental education is designed to meet these new sustainability challenges, by integrating inputs from the social and human sciences into the study of environmental planning and engineering, [17, 18]. The focus is on how firms, governments, and other organisations can support sustainable development in an economically efficient and socially acceptable manner. Logical, the mode of teaching modes varies throughout the higher environmental education program and includes formal lectures as well as project-based individual and team studies, during witch students are asked to

get actively involved in organisational and contents related aspects of the teaching program, giving feedback for a continuous advanced evolution of higher education for sustainable development and future, [15].

## 3. Ecological footprint

From this point of view, struggle for ecological services and goods will play a most important function in the 21st century. All human activities require the use same property of earth - primarily biologically productive land, but also includes land used for buildings and roads, food production, the production of energy and material resources and land required for waste-disposal and the absorption of emissions. In the early 1990's the Ecological Footprint concept was created by Mathis Wackernagel and William Rees at the University of British Columbia [20, 28, 29], and nowadays Ecological Footprint become established as important environmental indicator.

The Ecological Footprint tracks the area of biologically productive land and water required to provide the renewable resources people use, and includes the space needed for infrastructure and vegetation to absorb waste carbon dioxide ($CO_2$). The Ecological Footprint is an accounting framework that tracks humanity's competing demands on the biosphere by comparing human demand against the regenerative capacity of the planet. In order to determine whether human demand for renewable resources and $CO_2$ uptake can be maintained, the Ecological Footprint is compared to the regenerative capacity (or 'biocapacity') of the planet. Biocapacity is the total regenerative capacity available to serve the demand represented by the Footprint. Both the Ecological Footprint (which represents demand for resources) and biocapacity (which represents the availability of resources) are expressed in units called global hectares (gha), with 1gha representing the productive capacity of 1ha of land at world average productivity. The collective impact of this land consumption determines the limits for our local functions. The following [9]:

- Biodiversity land,
- Bioproductive land (Arable land, Pasture land and Forested land),
- Bioproductive sea space,
- Built land,
- Energy land.

Relying on *Oslo Methodology*, Ecological Footprint can be defined as, [1]:

- a *method* for calculating and evaluating the environmental impact of the consumption of goods and services;
- an *indicator* that provides a simplified demonstration of significant environmental impacts from various types of consumption;
- a *tool* for environmental impact assessment when considering different alternatives in a political/administrative decision-making process, or for reporting on the state of the environment in a regions.

The Ecological Footprint is a resource accounting tool that measures how much biologically productive land and sea is available on Earth, and how much of this area is appropriated for human use. The Ecological Footprint clarifies the relationship of resource use to equity by explicitly tying individuals' and groups' activities to ecological demands, [30]. The Ecological Footprint analysis attempts to measure human demand on nature. It compares human consumption of natural resources with planet Earth's ecological capacity to regenerate them.

Calculating Ecological Footprint we make effort to measure how much biologically productive area is required to produce the yearly resource flows consumed by the residents of a region (a city, a country, or the world), to absorb wastes or emissions (especially $CO_2$), and to host the built infrastructure in that region, [4].

In future, the Ecological Footprint can be used in process of identifying and planning strategies, which can help us to succeed in a world of limited resources, and ensure their rational use. The world average of Ecological Footprint last year was 2.7 global hectares per person, while the Ecological Footprint of Europe was 4.7 hectares. The situation in Balkan is a little bit better, the lowest footprint is in Serbia (2.4 ghp), than it comes Bosnia and Herzegovina (2.7 ghp) and Croatia (3.7 ghp), and with highest Ecological Footprint in region has Slovenia with 5.3 global hectares per person, [9].

## 4. Results of statistical analysis

### *4.1. Results of statistical analysis for students of Faculty of Organizational Sciences, University of Belgrade*

Environmental Management course is taught at the third year of undergraduate studies at the Faculty of Organizational Sciences, University of Belgrade. Survey was conducted on 44 students (more than 40% of total number of students which is by all means a characteristic of a representative sample). Students answered on 15 closed-type questions and according to their responses, the EF value was calculated for each of them. Creation and evaluation of survey was based on the Global Footprint Network standard. After attending course of Environmental Management, students filled the survey

papers once again. Our aim in this research was to determine whether there are or not significant improvements of achievement levels in action-oriented higher environmental education occurred. These improvements include the creation of new patterns of student behavior in their relationship with environment.

In order to evaluate results of survey, we used statistical software package SPSS 17. In the sample of 44 students, 24 of them were female students and 20 were male students. We first wanted to examine if female students are more ecologically aware then male students. Thus, we focused on the variable EcoFootPrintBefore. Using Kolmogorov-Smirnov test, we determined that variable is normally distributed ($Z = 0.790$, $p>0.05$). In respect to these results, we used parametric t-test for independent samples. Mean value for female students was $1.216 \pm 0.128$, while mean value for male students was $1.21 \pm 0.148$. Results showed no significant difference between genders, $t_{(42)} = -0.160$, $p>0.05$.

Very important issue that we wanted to raise is possible difference between genders in answering on each of the 15 questions. Chi-square test of categorized data was performed and results showed that there is no statistically significant difference between male students and female students. This result is at least unexpected, so we will emphasize couple of interesting observations. We used Chi-square statistics in order to examine whether male students and female students differ in the number of new clothing items they buy. Results showed no statistically significant difference between male students and female students, ($\chi^2=1.381$, *df*=3, N=44, *p>0.05*). Same conclusion was made comparing variables "What is the percent of food you throw away and what percentage of food you buy is locally grown or seasonal". Results implied no statistically significant difference between genders ($\chi^2=2.151$, *df*=2, N=44, *p>0.05*; respectively, $\chi^2=2.631$, *df*=3, N=44, *p>0.05)*. Observing, how much meat and meat products students buy, we conclude that there are no significant differences between males and females. Unfortunately, both male and female students are not dedicated to the trend of healthy and organically grown food, which is in Serbia still not widespread, but it is expensive. Their diet is mostly based on meat products, and the result show that 72% of students in their daily diet consume meat products, and that implies low level of ecological perception in food consumption of students and their families.

As a next step, we wanted to examine possible correlation between GPA (Grade Point Average) and the EF value of students. Knowing the fact that both of the variables are normally distributed, Pearson correlation was used. Result indicated that there is no significant correlation between these two variables, $r=0.264$, *p>0.05.* This result implies that environmental education (with consequential environmental actions) does not depend on formal educational system in Serbia, because (based on educational curriculum and programs), it is evident lack of formal and permanent environmental education at all levels of formal education in Serbia, [21].

Further on, we wanted to explore potential association between number of rooms (space of apartment) and number of rooms that are being heated during winter and cooled during summer months. Knowing that we are examining nominal types of variables, Spearman's rho correlation coefficient was calculated, $r_s=0.486$, *p<0.05*. Positive direction of correlation indicates that bigger apartments (flat) imply higher number of heated rooms. On the other hand, there is no statistically significant correlation between space of apartments and number of cooled rooms, $r_s=-0.031$, *p>0.05.*

### *4.2. Results of statistical analysis for students of Faculty of Organizational Sciences, University of Maribor*

Survey was conducted on the sample of 43 freshmen students at Faculty of organizational sciences, University of Maribor. In the sample of 43 students, 28 of them were male students and 15 were female students. We first wanted to examine if female students are more ecologically aware then male students. Using Kolmogorov-Smirnov test, we determined that variable is normally distributed ($p > 0.05$). In respect to these results, we used parametric t-test for independent samples. Mean value for female students was $1.777 \pm 0.257$, while mean value for male students was $1.919 \pm 0.226$. Results showed no significant difference between genders, $p>0.05$.

The issue that we wanted to search is potential difference between genders in answering on each of the 15 questions. Chi-square test of categorized data was performed and results showed that there is statistically significant difference between male students and female students on couple of questions. For instance, males and females significantly differ on frequency of car using ($LI = 6.286$, $df = 2$, $p<.05$). Same finding applies for question "What is the fuel consumption of the car you travel in most often", statistically significant difference was noted ($LI = 12.440$, $df = 3$, $p<.01$). Our results implied that male students use car far more frequently then female stu-

dents. In addition, they more often use car with high fuel consumption.

Further on, we used chi-square statistics in order to examine whether males and females differ on how much pieces of new clothes are bought by students. Results showed no statistically significant difference between male students and female students, ($\chi^2$ = 5.807, df=3, p>0.05). Same conclusion was made comparing variables "How much percent of food you throw away and how much percent of food that you buy is locally grown or season food". Results implied no statistically significant difference between genders ($\chi^2$=1.273, df=2, p>0.05; respectively, $\chi^2$=2.927, df=4, p>0.05).

Afterwards, we wanted to examine is students environmental awareness influenced by their parents educational level. Nonetheless, results implied that there is no significant difference between students [F (2, 39) = 0.506, p>0.05]. In addition, we wanted to examine if students coming from smaller towns are more ecologically aware than their colleagues from Ljubljana, capital of Slovenia. In our sample, 18 of them were from Ljubljana and 24 were from other cities (one student didn't answer the question). Using Kolmogorov-Smirnov test, we determined that variable is normally distributed (p>0.05). In respect to these results, we used parametric t-test for independent samples. Mean value for Ljubljana students was 1.954 ± 0.249, while mean value for students coming from smaller towns was 1.825 ± 0.215. Results showed no statistically significant difference between students of different hometown, p>0.05. Only difference between students coming from Ljubljana and other cities was in the question "How far do you travel by car each week", (LI = 17.093, df = 4, p<.01).

## 5. Conclusion

Comparing the Serbia (2.3ghp) and EU (4.7ghp) results, value of students EF is 1.21 ghp, which represents an impressive achievement pointing to a high level of environmental awareness amongst Serbian students at Faculty of Organizational Sciences - University of Belgrade. Although results didn't reach a significant statistical difference between genders, it is obvious that male students are more dedicated to environmental issues and protection. High level of environmental awareness amongst students does not depended on formal educational system in Serbia (it lays in adequate good higher environmental education, and knowledge absorbed from Environmental Management course), because it is evident lack of formal and permanent environmental education at all levels of formal education in Serbia. We can conclude that environmental subjects must be included as a basic one at all level of Serbian formal education. Further on, must be emphasized that both male students and female students are not dedicated to the trend of healthy and organically grown food, which is in Serbia still not widespread, but it is expensive. Their diet is mostly based on meat products, and that implies low level of ecological perception in food consumption of students and their families.

Course of Technological Systems and Principles of Ecology, taught at the first year of undergraduate studies at Faculty of Organizational Sciences - University of Maribor, enrolls a little bit more than 100 students. Our research is based on the sample of 43 students, which is by all means a characteristic of a representative sample. Average value for the EF of students is 1.869 ghp. Comparing to Slovenian (5.3ghp) and EU (4.7ghp) results, this represents remarkable achievement which proves high level of environmental awareness amongst Slovenian students. In the core of these impressive results, lays adequate and permanent environmental education, and knowledge absorbed from above mentioned course. In recent papers, it is often cited that level of parental education is significantly correlated with children's environmental awareness. However, in our research no significant difference between students with different parental education background was noted. This finding clearly shows that Slovenia has excellent educational system concerning environmental issues, especially in elementary and high school. Also, results showed that female students are ecologically more aware than male students. Although, results didn't reached statistically significance, trend that female students are far more dedicated to environmental protection is obvious. In particular we have to mention results concerning issues of car using. As the matter of fact, results implied that male students use car far more frequently then female student. Further on, they more often use car with high fuel consumption. In addition, our analysis points out that both male students and female students are dedicated to the trend of healthy and organically grown food. Also, their diet is mostly based on locally grown food, which implies high level of ecological perception and healthy life trend in Slovenia.

The results of both studies and analysis emphasize the importance of environmental education. In order to this, we can conclude that higher education institutions have to contribute to further development of environmental awareness and formal environmental education, by achieving following goals:

- Acquire skills, assess and apply complex management concepts in order to solve today's and tomorrows environmental challenges.

- Gain knowledge in environmental sciences and their practical application.
- Train soft skills by working in international and interdisciplinary teams.
- Combine a theoretical orientation with practical project work.
- Give a range of practical techniques in such areas as environmental planning, environmental policy, environmental management systems (EMS), modeling, geographic information systems (GIS) and data management.
- Corporate social responsibility, logical framework analysis, life cycle assessment (LCA), and energy analysis and planning.
- Use different tools for project design, environmental monitoring, quality control and evaluation as well as planning.
- Train in using cost-benefit and cost-effectiveness methods.

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