APPLICATION OF ECOLOGICAL FOOTPRINT METHODOLOGY TO REGIONAL RESEARCH: CASE STUDY OF REGIONS IN UKRAINE AND HUNGARY

N.V. Gryshchenko, Ph.D. student
V.N. Karazin Kharkiv national university, Ukraine

Environmental impacts of population grow because of high consumption by individuals. This study aims to determine the scale of environmental impact of citizens on the regional level and to find out if the development there is sustainable. The leading innovative regions of Ukraine and Hungary are considered. Ecological footprint assessment method is used to calculate the area needed to provide resources and services for sustaining a current lifestyle of the population. The structure of ecological footprint is composed based on the data available from the statistical agencies of the countries, regional and international agencies.

The results show that Ukrainians have higher ecological footprint than Hungarians at the national level. Leading Ukrainian region has a significantly higher footprint than the average one within the country. A citizen of Northern Great Plain has lower ecological footprint than average Hungarian. However, both regions develop unsustainably, exceeding a bio-capacity level by almost 3 times in case of Kharkiv region and by 1.3 times in case of Northern Great Plain in 2011.

Keywords: ecological footprint, environmental impact, region, sustainable consumption.

Introduction. Hungary is a member of EU since 2004 and Ukraine, sharing European principles, continues its integration to European institutions. Both countries had a period of soviet rule under which the environmental issues were put in the last place. However, today both Hungary and Ukraine harmonize its environmental standards to the European ones. In 1985 European Commission prepared a council Directive on the assessment of the effects of certain public and private projects on the environment for the member states. Consumer choices influence environment heavily and, as some authors argue (Paavola, J. 2001), can alleviate most environmental problems.

The general trend is the growth of consumption of population in both countries and Hungary (see data of State Statistics Service of Ukraine and Hungarian Central Statistical Office). OECD makes forecasts that by 2030 households’ consumption will grow in OECD countries, including residential energy use on average by 1.4 % per year, and will grow even more rapidly in non-OECD countries, particularly in relation to energy consumption, transport, residential water use and waste management (OECD, 2008). The general rule states: the less you consume – the less the environmental impact is. What level of environmental impact of consumption can be considered as sustainable in a certain region? How can we compare indicators at national and regional levels? These are the main questions of this study.

Methodology review. Different environmental impact assessment techniques are used to calculate the environmental impact of a certain citizen. This study is based on Ecological Footprint Assessment (EFA) method which was proposed by William Rees in 1992 in Canada and significantly developed in collaboration of Mathis Wackernagel and Rees in 1996 (Wackernagel, M. and Rees, W. 1996). EF is defined as the total number of ecologically productive area required to sustain consumption of the population calculated on the basis of the yield.

According to some authors (van Vuuren D.P and Smeets E.M.W. 2000), important criteria for evaluating the applicability of the EF as an indicator of sustainable development are: policy relevance and utility for users, analytical validity, measurability (Bakkes, J. and voor Volksgezondheid en Milieuhygiëne, R. 1994), and clarity to the general public.

Two last criteria are important for the current study. Ukraine has not enough practice of EFA, especially on the regional level. Environmental and ecological standards in Ukraine are to be developed more, but local governments need a clear indicator of their environmental activity today.

EF allows estimation of household or per capita consumption within a certain territory, including a region (see studies of (Hopton, M. and White D. 2012) and (Knaus, M. and Löhr, D. et al. 2006). Most agencies and international organizations calculate EFs for countries. Since most significant decisions concerning economic development and environment are made on the regional level, it makes sense to improve EF methodology and to make it applicable for regional research in post-communist countries.

A region is a certain territory with its structure, which changes dynamically while it interacts with other regions, including those from different countries. This leads to one of the weaknesses of the EF concept, namely goods and services can be produced outside the area of consumption. This reduces the accuracy of calculation and the need for consideration of transportation impacts appears. The authors highlight several reasons (Knaus, M. and Löhr, D. et al. 2006), why the territory has become the measurement unit of sustainable development, and is used to calculate the EF: territory is a universal category; it demonstrates the finiteness of natural capital; monetary indicators provide an incomplete assessment, because the price of land may not include variety of biophysical characteristics, such as the biodiversity growth potential. Obviously, significant regional differences occur and this study uses national and local regional yield data where possible in order to get more unbiased results.

Research method – composition of the ecological footprint structure. This study compares Kharkiv region (Ukraine) and Northern Great Plain

1  Environmental Impact Assessment web-page of EC - mode access: http://ec.europa.eu/environment/eia/eia-support.htm
2  http://ukrstat.org/en
3  http://www.ksh.hu/
region (Hungary). This choice of regions is based on the results of the research on their R&D and Innovative potential. They are regions-leaders in respective countries, not counting capital regions.\(^4\)

Calculating EF for a citizen of a region or a country requires lots of diverse data. This study uses data provided by national and regional statistical offices where possible. However, due to the lack of available data some expert evaluations and data from international organisations are used as well. In Ukraine you can easily get access to statistical agencies of the regions. The whole data set for Kharkiv and Northern Great Region includes data from 2003 to 2011. In Hungary statistical data set for Northern Great Plain region is provided by Hungarian central statistical office in the form of Regional statistical yearbooks of Hungary. This study uses yearbooks from 2003 to 2011.


The energy-land is calculated as the area needed for the absorption of CO\(_2\) emitted by transport and as a result of energy use in households. For Hungary energy land is also calculated for energy used for waste-water treatment. EF in terms of CO\(_2\) emissions is the total amount of CO\(_2\) emitted as a result of the population’s consumption - regardless of the territory where these emissions occurred (van Vuuren D.P. and Smeets E.M.W. 2000). Consumed land per person is determined as an average dwelling area per person. Bio-productive land in the study includes area needed to maintain consumption of food of a certain person in a given time period. Limited availability land is calculated as an uncultivated (affected) land.

In case of Ukraine and Hungary to make national and regional data concerning the bio-productive area of the ocean is not considered.


EF should be compared to local bio-capacity to conclude if the country or the region develop sustainably. To evaluate a bio-capacity level the area of bio-productive land per one citizen in the region is determined.

The parameters for Kharkiv region include a productive land (agricultural), forests, built-up area, swampland, open spaces without vegetation, other land and land in the study includes area needed to maintain consumption of food of a certain person in a given time period. Limited availability land is calculated as an uncultivated (affected) land.

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### Table 1.

<table>
<thead>
<tr>
<th>Year</th>
<th>EF energy-land</th>
<th>EF consumed land</th>
<th>EF bio-productive land</th>
<th>EF limited land</th>
<th>Total EF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ukr H</td>
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<td>Ukr H</td>
<td>Ukr H</td>
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</tr>
<tr>
<td>2000</td>
<td>x(^6) 0.097</td>
<td>0.002</td>
<td>0.004</td>
<td>x x 0.155</td>
<td>1.323</td>
</tr>
<tr>
<td>2001</td>
<td>x 0.741</td>
<td>0.002</td>
<td>0.004</td>
<td>x x 0.154</td>
<td>0.093</td>
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<tr>
<td>2002</td>
<td>x 0.745</td>
<td>0.002</td>
<td>0.004</td>
<td>0.088 1.354</td>
<td>x x 0.153</td>
</tr>
<tr>
<td>2003</td>
<td>0.646 0.839</td>
<td>0.002</td>
<td>0.004</td>
<td>0.106 1.327</td>
<td>x x 0.152</td>
</tr>
<tr>
<td>2004</td>
<td>0.857 0.916</td>
<td>0.002</td>
<td>0.004</td>
<td>0.085 1.181</td>
<td>x x 0.150</td>
</tr>
<tr>
<td>2005</td>
<td>0.826 1.011</td>
<td>0.002</td>
<td>0.004</td>
<td>1.345 1.370</td>
<td>x x 0.150</td>
</tr>
<tr>
<td>2006</td>
<td>0.874 0.964</td>
<td>0.002</td>
<td>0.004</td>
<td>1.381 1.224</td>
<td>0.003 0.154</td>
</tr>
<tr>
<td>2007</td>
<td>0.867 0.803</td>
<td>0.002</td>
<td>0.004</td>
<td>1.710 1.600</td>
<td>0.004 0.154</td>
</tr>
<tr>
<td>2008</td>
<td>0.895 0.767</td>
<td>0.002</td>
<td>0.004</td>
<td>1.474 1.188</td>
<td>0.003 0.152</td>
</tr>
<tr>
<td>2009</td>
<td>0.857 0.757</td>
<td>0.002</td>
<td>0.004</td>
<td>1.418 1.111</td>
<td>0.003 0.152</td>
</tr>
<tr>
<td>2010</td>
<td>0.824 0.744</td>
<td>0.002</td>
<td>0.004</td>
<td>1.419 1.101</td>
<td>0.003 0.194</td>
</tr>
</tbody>
</table>

### Table 2.

<table>
<thead>
<tr>
<th>Year</th>
<th>EF energy-land</th>
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<th>Total EF</th>
</tr>
</thead>
<tbody>
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<td>Khr NGP</td>
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<td>0.003</td>
<td>1.368 0.495</td>
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<td>0.003</td>
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<td>0.003</td>
<td>1.679 0.488</td>
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<td>0.003</td>
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<td>0.004</td>
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<td>0.121</td>
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<tr>
<td>2009</td>
<td>0.767 0.698</td>
<td>0.002</td>
<td>0.004</td>
<td>1.937 0.454</td>
<td>0.116</td>
</tr>
<tr>
<td>2010</td>
<td>0.744 0.697</td>
<td>0.002</td>
<td>0.003</td>
<td>1.993 0.423</td>
<td>0.116</td>
</tr>
<tr>
<td>2011</td>
<td>1.065 0.697</td>
<td>0.002</td>
<td>0.005</td>
<td>1.966 0.407</td>
<td>0.122</td>
</tr>
</tbody>
</table>

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4 The methodology of research and the main findings are committed to working paper “Technological parks as basis of intensive development of Kharkiv region and Northern Great Plain in consideration of environmental aspects” (Visegrad Scholarship ID number 51200791)

5 Data source - Ecological passports of Kharkiv region – mode access: http://www.menr.gov.ua/content/article/5993

6 Data is not available for this period.
water surface areas. The parameters for Northern Great Plain include arable land, forests and uncultivated land. Productive/arable land comprises a bio-productive land; forests – an energy-land; built-up area is treated as a consumed land and other territories are limited land. In the case of Northern Great Plain uncultivated land includes both – consumed land and limited land, as there is a lack of regional data on built-up areas.

Main results - empirical analysis
Case of the countries (Ukraine and Hungary). The first stage of calculation includes calculation of EF for citizens of the countries (see the Table 1).
EF of a Ukrainian citizen was growing till 2008. After the global economic crisis the consumption has reduced and EF has also become lower. This is seen clearly for EF of energy-land and bio-productive land. In Hungary the value of EF is fluctuating from year to year but since 2008 it has also been decreasing.

EF energy land keeps a significant part of EF structure of the countries: in Ukraine it makes up to 37 % and in Hungary up to 36% of the whole EF value. According to the calculation results, it may be concluded that residential sector of Hungary is more energy-efficient than the Ukrainian one. Even considering that structure of EF consumed land in Ukraine is more complete than in Hungary, the resulting value is uprising in Hungary with a strong increasing tendency.

The level of products consumption in absolute values in Ukraine is higher than in Hungary, but EF bio-productive land value is lower because of higher productivity of agricultural area in Ukraine. In the EF structure in both countries the part of EF bio-productive land is the highest, namely 63 % in Ukraine and 54 % in Hungary.

The value of EF limited land in the EF structure is relatively low: 0.01% in Ukraine and 9% in Hungary. In both countries the parameter has been growing since 2009.

Case of the regions (Kharkiv and Northern Great Plain regions). Kharkiv region is a major center of production and consumption. The value of general EF there was 26 % higher than average Ukrainian value in 2010. EF bio-productive land and EF energy-land have the main weight in the EF structure. The consumption in the region is high and most residential waste produced is deposited at landfills.

Population of Northern Great Plain region does not consume the same amount of goods as an average Hungarian. EF energy-land per citizen of the region is lower than average Hungarian because the study does not include CO2 emissions during waste-water treatment. The area of consumed land is slowly expanding. EF bio-productive land is significantly lower comparing to Hungarian and to the citizen of Kharkiv region. EF limited land in Northern Great Plain is higher than in Hungary and in Kharkiv region. The calculation results are shown on Table 2.

Next step is to compare EF per capita and bio-productive area per capita in regions. For sustainable development EF should not exceed the bio-capacity of the territory.

The level of consumption of citizens of Kharkiv region is far away from sustainable. From 2003 to 2011 total EF exceeded natural bio-capacity by 1.9 to 2.7 times. The lowest pressure is observed on the consumed land and the highest pressure is on the energy-land. The forest area in Kharkiv region is declining, agricultural area is stable, consumed area is increasing while economic welfare of population is growing.

In Northern Great Plain level of sustainability is higher than in Kharkiv region. Total EF is almost two times lower comparing to Kharkiv region. However, it also exceeds biocapacity of the territory by 1.3 to 1.7 times but with a declining tendency. The highest impact of one citizen of Northern Great Plain region is exerted on energy-land and the lowest impact is experienced by consumed and limited land.

General conclusions. Both regions under the study follow unsustainable path. Kharkiv region has higher impact on energy-land and bio-productive land opposed to Northern Great Plain. Meanwhile, Northern Great Plain has higher limited land and consumed land impact. Total EF is higher than regional bio-capacity. So, the populations of the regions are not able to maintain a current lifestyle without consuming resources of other territories. International trade helps to satisfy consumers but it hardly forces population to change habits and become more efficient.

Level of personal domestic energy consumption and waste production are considered by some authors (Hobson, K. 2001) as “important contributors” to harmful environmental change, and governments should promote sustainable or green consumption in order to decrease environmental impact of a single person and, therefore, of the whole population.

In the scope of environmental economics lack of resources of the territory can be overcome with additional expenditures for the economy (Venkatachalam, L. 2007). It is also important to mention that technological development can contribute to solving environmental problems faced today and prevent further pollution. However, political and institutional situation in Ukraine’s economy is inactive in this respect.

Any governmental initiative, especially in the country like Ukraine with population expressing no-confidence to the government, won’t be successful if there is lack of “informed and accepting public” (Macnaghten, P. and Jacobs, M. 1997:15). According to (Murphy, J. 2001) it is important to recognize environmental problems as those having social dimension and to treat them respectively. People should have enough information about the consequences of choices they make. EF in this case is very representative. It shows the environmental impact of consumption level of each person. Some consumption choices are being made in the scope of maintaining healthy life while others can be referred to overconsumption. This is particularly true talking about EF of bio-productive land.

Populations are facing the ‘Tragedy of Commons’ (Hardin, G. 1968) which implies that people acting individually and expressing their own self-interest, can ultimately deplete common shared resources even if it is obvious that in a long run no one wants it to happen. Population of a country or a region itself cannot decrease environmental impacts caused by the lifestyles, but many individuals together can make right choices and soften their environmental impacts. EF indicator can significantly help them in making their lifestyles more sustainable.
References:


Information about author:

1. Natalya Gryshchenko - Ph.D. student, V.N. Karazin Kharkiv national university; address: Ukraine, Kharkiv city; e-mail: grishchenko.nat@yandex.com