The Economics of the XXI Century:

Current State and Development Prospects

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INTERNATIONAL DIMENSION OF NATIONAL ECONOMIC SUSTAINABLE DEVELOPMENT[1]

Introduction. The development of any economic indicators and indicators of sustainable development particularly must consider the principles of formation and the criteria for the use of each individual indicator. Thus, the selection of indicators should be scientifically sound, which implies the use of certain criteria of the principles. One of the possible variants of sustainable development indicators criteria is the following: data evaluation (quality, availability, reliability); characteristic of the indicator (representativeness, content, sensitivity, concreteness); utility for research (design clarity, retrospective and predictability); formation of the integrity of the picture; cost of developing the indicator; performance of the indicator; determining the effectiveness of specific programs and activities; study of trends, monitoring of the environment of a particular region (territory); raise awareness of the population; setting goals, managing strategic investment decisions.

The following indicators can be distinguished: economic development (GDP per capita, investment levels, competitiveness, employment); poverty and social indexes (poverty risk, financial poverty, access to the labor market, other aspects of social exclusion); aging of the population (the share of the elderly population, the correspondence of pensions, demographic changes, financial stability of citizens); health (period of life without illness, health care, state and quality of food products, chemical industry management, environmental impact on health); changes in the Earth's climate and energy (emissions of greenhouse gases, climate change, energy); production and consumption (material consumption, eco-efficiency, general consumption, agriculture, corporate social responsibility); management of natural resources (wild birds, fish stocks, marine ecosystems, clean water resources, use of

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land resources); transport (energy consumption in transport, increase in the number of transport, social and environmental dimensions of transport); global governance (citizens' trust, policy coherence, public participation); global partnership (official development assistance and support, sustainable development financing, trade globalization, resource management).

The countries of the European Union are moving towards a sustainable development linked with integration policies in the economic, social, environmental and institutional spheres.

The last allows a comprehensive solution of economic problems by intensifying the growth of the gross domestic product; environmental - by reducing the volume of gross output; social - by increasing employment and providing guarantees for social security. The current strategy for the transition to sustainable development of the European Union is based on the following priority tasks: maintaining a stable production and a high level of consumption; observance of guarantees of social equality; reduction of environmental pollution; organization of landscapes and protection of non-renewable natural resources; preservation of species diversity

Ecological footprint as an important indicator of sustainable development **measuring.** The ecological footprint indicator is estimated as a degree of human consumption of natural resources. In a context of sustainable development, the problem of effective natural resources usage still remains rather relevant one in order to meet the needs of present and future generations. The concept of an ecological footprint was firstly introduced in 1992 by the Canadian ecologist W. Rees and his postgraduate M Wackernagel. In the narrow sense the ecological footprint measures human demand for natural resources under conditions of sustainable development.

The ecological footprint is calculated through the area of biologically productive territory or water area, which are necessary to provide humans with resources and utilization of industrial waste. Important components that determine the size of the environmental footprint are population size, volume of consumption, volume of consumable goods and services.

The first high values of the ecological footprint were recorded in the 80's of the twentieth century, when humanity ecological pressure began to exceed biological capacity. Since those times the scale of environmental deficit has been increasing from year to year. Thus, according to [6], the consumption of natural resources exceeded the corresponding reserves by 25% in 2003. At the begging of 2018 the mankind uses the equivalent of 1.7 Earths for economic production and industrial waste utilization. In general, it is needed up to one and a half year for the planet to recover what the humanity uses in a year [1]. Material sector of national economies uses excessively the ecological resources and services than biologically the planet can regenerate through overfishing, overharvesting forests, and emitting more carbon dioxide into the atmosphere than forests can sequester. Such intensive consumption of natural goods leads to limited resources in the future, as well as increases the timing of their recovery.

The purpose of an environmental footprint calculation is to assess the consumption of natural resources within the unique indicator and to analyze the biological capabilities of the environment. The ecological footprint is measured in units of area, one unit of specific land equates to the average hectare of biologically productive space of average world productivity. Therefore, for ecological footprint calculating the index of land productivity within a specific country is taken into account and the factor accounting the equivalence of land worldwide is included [5, 7].

According to the Global Footprint Network information, the Earth Overshoot Day campaign is starting to be reached earlier and earlier every year and has moved from the end September in early 2000s to beginning of August in 2017. Earth Overshoot Day is the day on the calendar when humanity has used the resources that it takes the planet the full year to regenerate. If the humanity would precede the usual business path, it is expected that the economic pressure on the Earth's ecosystems would exceed the biological potential on 75 percent by the end of 2020s (fig. 1.).

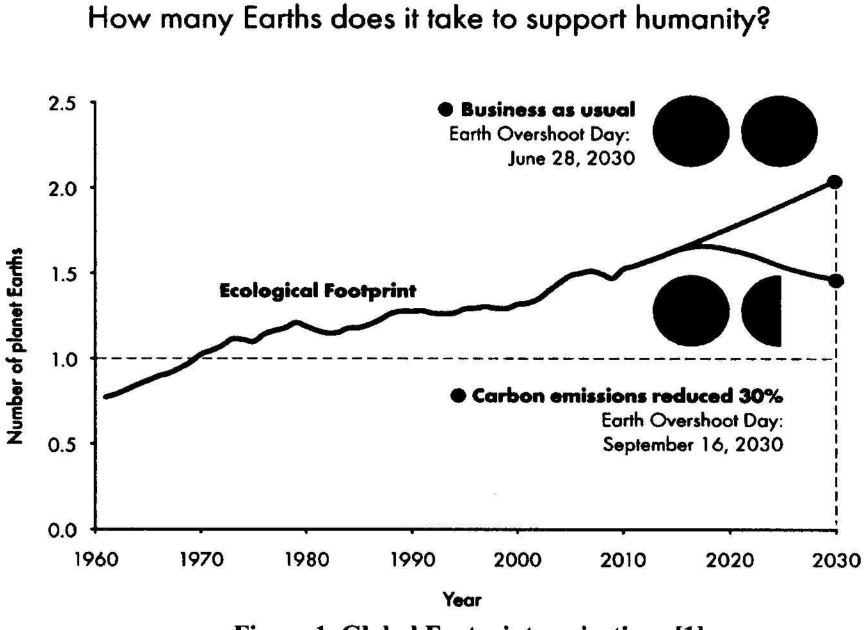

Figure 1. Global Footprint projections [1]

The Global Footprint Network underlines the necessity to live within a biologically constrained world through investing in technology and infrastructure.

Special efforts of business, government and individual are needed to reach the goal The country's ecological footprint in practical calculations is presented in the form of arable land, pastures, forests, industrial zones, which are necessary for production of food consumed by the population. In addition, the environmental footprint should include areas for utilization of waste arising from generation of energy, as well as for the placement of infrastructure. People consume natural goods and environmental services, and therefore they should represent the sum of areas concerned, regardless of the location of the person. Considering the diversity of economic activity the ecological footprint is calculated as the sum of six environmental footprints:

1. The Crops footprint is an area that is necessary for the production of all consumed agricultural crop products, including cereals, fruits, vegetables, roots, nuts, tea, coffee, sugar, margarine, butter, tobacco, as well as feed necessary for the production of poultry, pigs, etc. which in the future become meat and is consumed by humans.
2. The Grazing footprint is the area needed for grazing and keeping farm animals, whose products are further consumed by humans. It means meat and dairy products of cattle, sheep, goats.
3. Forest footprint is an area that is necessary for the production and consumption of wood. Forest footprint includes wood, wood charcoal, business wood (including boards, plywood), paper, cardboard.
4. The Fish footprint is an area that is needed for the production and consumption of sea fish and seafood. The composition of fish footprint includes all types of sea fish, crustaceans, as well as fish meal and oils used for animal feed.
5. The energy footprint is the area that is needed for energy production, including the provision of energy resources, waste management of energy production There are regional differences for energy footprint estimations between trace values for developed and developing countries.
6. Build-up land footprint is the area of the territory necessary for placing the infrastructure including objects for housing, transport, and production facilities.

The dynamics of world ecological footprint by components is presented in the figure 2.

A combination of the ecological footprint within six separate components makes it possible to separately assess the contribution of each of these footprints in the human consumption of natural resources.

The calculation of the ecological footprint is limited to determining the flows of resources and waste. Having indicated all resources and waste flows the ecological pressure is translated into units of global hectares, which the final measure for ecological footprint expression. The separate ecological footprints are summed up, which gives information about general demand for the required area of land. In the context of sustainable development, the ecological footprint is considered as an ecological and economic indicator for the use of natural resources without compromising the environment.

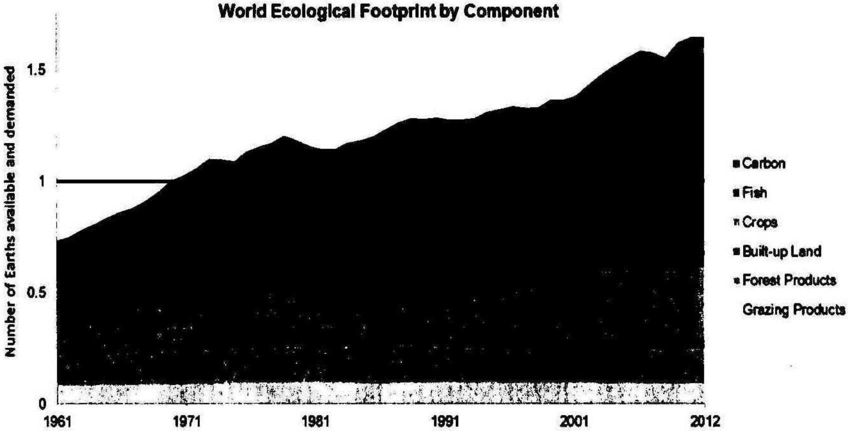

Figure 2. Dynamics of world ecological footprint by components in 1961-2012 [1]

Along with the ecological footprint the considerable attention in research is paid to the index of human development, which is an indicator to measure socio-economic results of human activity and appropriate for coordination of human interests within ecological systems constraints. The ecological footprint and human development index are depending on each other, as depicted in Fig. 3.

The fig. 3 shows the dependence between the human development index and the ecological footprint. According to the figure, the country's achievement in human development indicates a high level of human potential and brings it closer to sustainable development. In general the transition to sustainable development is expressed through improvements in quality of life of the population and through the control of natural resources consumption that is limited by environmentally friendly energy. In particular, the countries that passed the thresholds of "*very high human development*" are close to sustainable development. North America and most European countries possess very high human development. The countries of the Pacific region have an HDI that is relevant to lower, middle and higher levels of development. The countries of the Middle East and Central Asia have an index of human development that corresponds to the average and advanced levels of development. The countries of Latin America are shifting from the value of HDI, which corresponds to the lower level of human development to the value of HDI, which corresponds to the average level of human development.

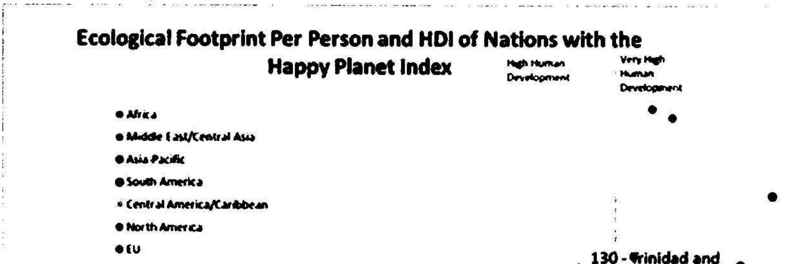

Figure 3. Human Development Index (HDI) and Ecological Footprint [1]

According to the United Nations (UN), the value of the human development index above 0.8 is an indicator of high achievements, and the value of environmental footprint, which is less than 1.8 global hectares per capita indicates that the country's natural resources must be renewed at least at the current pace. Only renewable resources can be produced within a stable path for a long period of time limiting that their production does not exceed the rates of their recovery.

The average world ecological footprint per capita is 2.7 global hectares, while there are only 2.1 global hectares of biologically productive areas per capita are available on the planet. In other words the bio capacity is a measure of the amount of biologically productive land and sea area available to provide the ecosystem services that humanity consumes – our ecological budget or nature's regenerative capacity. The problem of resource conservation is multidirectional and includes the rational use of resources related with resources saving campaign. The resources saving programs are reducing the specific consumption of natural substances per unit of final product, and it reduces the environmental burden.

This "deficit" is called a deviation or excess of an ecological footprint over the biological capabilities of the natural environment. Such a deviation leads to the exhaustion of natural resources which is a key element of economic system functioning. The solution to this problem by leading scientists is seen in reducing consumption, and / or increasing the productivity of a natural ecosystem.

Within this study the analysis of the ecological footprint at a regional level is carried out. The generally accepted calculation of the environmental footprint is carried out as follows:

$$EF = \frac{P}{Y_N} \cdot YF \cdot EQF, \quad (1)$$

where P – level of regional gross product, fixed prices;

YF – country-specific yield factor for the production of each product;

EQF – equivalence factor for the land use type producing products;

Y_N – annual national average yield for the production of commodity:

$$Y_N = \frac{P_C}{A_G}, \quad (2)$$

where P_C – GDP of a specific country;

A_G – a total territory of a country in thousands ha.

The biological capacity is calculated with the following formula:

$$BC = A \cdot YF \cdot EQF, \quad (3)$$

where A – bio productive area that is available for the production of each product, thousands ha.

YF – country-specific yield factor for the land producing products;

EQF – equivalence factor for the land use type producing products.

Each country has its own values of "yield of land" indicator, which are determined in an expert way. For example, for Hungary the value of this coefficient is 2, for New Zealand is 2.25, and for Ukraine is 2.7. In this way, in order to calculate the environmental footprint in the regions of Ukraine, we take into account that the yield of land is equal to 1/2,7. A factor indicating the equivalence of types of land around the world is taken at 2.64.

The biological potential among countries is also unevenly distributed within countries, for example the United States of America, Brazil, the Russian Federation, China, India, Canada, Argentina, and Australia possess more than half the entire biological potential of the Earth. The World Wildlife Fund proposed to divide all countries into the categories of «environmental debtors" and "environmental lenders" ("donors"). Environmental debtors are countries such as the United States, China, India, because their ecological footprint is greater than the biological potential of these countries.

Thus, in the USA the ecological footprint per capita is 2.25 times more than biopotential, China has ecological deficit, which 4 times overpass the biological potential, and India has ecological deficit, which 2.75 times overpass the biological potential. Such "scarcity" of natural resources can have further severe consequences. Among the "lenders" are countries such as Canada, South America, Australia with New Zealand, most of the African continent and Russia. The listed countries have certain ecological reserves, but the presence of significant natural components in the country does not guarantee rapid economic growth, since the country can choose a model of economic development through the export of natural potential. However, with current trends in natural resources spending the countries that are "ecological creditors" would eventually have significant "ecological deficit" in natural goods.

The humanity will use the amount of natural resources that is equal to biological potential of two planets by 2050, unless severe reductions in intense consumption of natural resources would happen or sharp technological changes that would improve the efficiency of resource using. If the situation becomes unchanged the ecological footprint will exceed biological capacity twice.

Intensive and inappropriate use of natural resources creates a risk not only for loss of biodiversity, but also for damage to ecosystems and their ability to provide society with the necessary resources.

The modern type of economic development is characterized by intensive use of natural resources, energy, emissions of harmful substances, including carbon monoxide (CO_2). Therefore, the energy footprint, which refers to the area of the territory necessary for energy production, including the supply of energy resources, utilization of waste energy production, as well as the area intended for the absorption of CO_2 is of particular interest.

The need to consider the energy footprint is due to the objective precondition for the emergence of economic losses due to climate change. According to experts estimations it is about 9.795 gigatonnes (Gt) (or 35.9 $GtCO_2$ of carbon dioxide) is released into the atmosphere in 2014, which has already led to a disturbance of the ecological balance on a global scale. Fossil fuel emissions were 0.6% above emissions in 2013 and 60% above emissions in 1990 (the reference year in the Kyoto Protocol) [2]. The climate change is caused by greenhouse gas emissions, which can include direct gas (CO_2 - carbon dioxide) and indirect action (CO - carbon monoxide). Particularly the CO_2 is one of the harmful components of exhaust gases within incomplete combustion of gasoline and plays a decisive role in the occurrence of ischemic heart disease and cancer [3].

High emissions of harmful substances were observed in Ukraine in early 90s of the last century. Since 2000 the emission of air pollution has been decreasing, which is associated with a decrease in the production of energy dependent sectors and the transition to the development of service economy (financial and credit institutions, insurance companies, investment funds, etc.). The reduction of carbon dioxide emissions is a key point for preventing climate change and eliminating harmful effects on humans.

There are two ways for carbon monoxide absorption from the atmosphere. The first one is related to the natural capture of CO_2 by ecosystems (for example, absorption by the forest), however, natural ecosystems do not have sufficient "capacity" to cope with current emissions of carbon monoxide. The second method involves human intervention, as a result of the application of appropriate technologies. However, absorption technologies are still poorly developed and require significant capital investments for their implementation.

One hectare of forests could absorb carbon dioxide emitted during the burning of about 1,450 liters of gasoline [6, 7], so an increase in forest plantations will be an effective measure against the current emissions of carbon monoxide.

However, the growing requirements of society for the quality of the environment and the processes of using natural resources creates potential for existing system of forest plantations modernization. The influence of the forest on the components of nature, economy and social sphere, depends on the nature of its location, productivity, ecological status, reproduction efficiency.

The proposed method for reducing concentrations of CO_2 in the atmosphere consists in determining the area of land in the regions of the country, which must be additionally planted with forest. The following procedure can be used to determine the area of land that is necessary for planting with forest, in order to reduce the concentration of CO_2:

$$S_p = E_m \cdot \frac{(1-0,33)}{R_n}, \quad (4)$$

where S_p – the area of green plantings, necessary for capturing CO_2, created in the process of production of gross product by regions, in thousand hectares;

E_m – annual CO_2 emissions, in thousand tons;

R_n – the norm of absorption of CO_2 by plants, for each country takes its values, which is established by analyzing all possible conditions (for example, for Ukraine this value is 59.40 tons / ha);

0,33 – the average absorption coefficient of CO_2 by water sources.

The following formula can be used to determine the percentage of territories allocated for "green" plantings:

$$T_{\%} = \frac{S_p}{S_r} \cdot 100\%, \quad (5)$$

where $T_{\%}$ – percentage of areas allocated for forest plantations, in%;

S_r – area of the region analyzed in thousand hectares.

Green plantations have a vivid health effect on the population well-being According to Korostelev N. the health effect of forests is related to the favorable conditions, namely "... the green color for our eyes, the aroma of flowers and pine needles ... People who are in the zone of green planting could have a decrease on 20 beats per minute, the temperature of the skin decreases." [3].

Due to high bactericidal forest activity the forest plantations can disinfect the natural environment. However, with the forest aging the absorption possibilities are approaching zero, therefore, the procedures for "greening" the territories should be carried out annually to achieve maximum results in the fight against carbon monoxide

Ecological footprint and biological capacity of the Ukrainian regions. The territory of Ukraine is characterized by a diversity of climate conditions and natural resources availability. The most valuable natural resources are land and mineral resources. The mineral resources base includes about 20 thousand deposits of 113 different kinds of resources. Mineral resources complex is considered to be as one of the most important components of the national economy. The mineral-raw material base in Ukraine has considerable economic potential to meet the needs of the national economy. For the proper functioning of mineral-raw material base it is also needed to reduce the share of shadow economy sector. It is not enough to know the biological potential of a certain territory, it is also important to know the economic value of available ecological goods and services. Thus, for to proper estimation of natural resources there exist certain restrictions, such as market demand and competitive conditions. Moreover sometimes it is impossible to use market approaches to estimate the value of natural resources, because they are not traded on the market or there is no demand side to pay the money [4]. Actually the economic estimation of natural goods and services is calculated for the development of relevant economic mechanisms of sustainable development fostering. When there are proper economic conditions and consumer's well-being there is little place for shadow economy and environmental estimations are properly conducted. Sustainable planning and national economic development requires the comparison of natural resource potential and needs of society with the capabilities of the natural ecosystem. At the present stage of economic development the human impact on the environment is so global that the natural environment is on the limit of its biological capabilities. The human impact increases with such rate that natural systems do not have time to recover, and lagging in terms of providing healthier conditions for human life.

Implementation of sustainable development ideas is sound only after the formation of the institutional balance at the macro level. The last should include international cooperation of the countries, which prompts the general unification in achieving the goals (for example, the transition to a sustainable development model). It is worth noting that the institutional systems of any country has its own specific advantages and disadvantages. The apparent lack of completeness and insufficiency of institutional systems forms the rules of human relations and the environment. The elimination of institutional drawbacks would reduce the negative impact on the environment, and would be expressed in building new relations of society and the natural ecosystem. The result institutional system improvement should be the creation of an ecologically oriented institutional system, the main task of which is to take into account the environmental effects of all social processes.

Considering the above mentioned arguments the research on estimation the assimilation capacity of natural systems and environmental load is relevant. The variety of environmental pressure and biological capacity indicators is large; however, ecological footprint and the energy footprint are considered to be the most popular indicators. We took the economic achievements for Ukraine in fixed local process, so the results are not comparable on international level, except the difference between ecological footprint and biological capacity.

The practical significance of the analysis related to estimations of the ecological and energy footprint indicators is to assess region sustainability level in order to stimulate sustainable development.

The methodology and the appropriate theoretical basis for calculation the ecological footprint were given in the formulas above. In particular, it was shown how the ecological footprint and assimilation potential of the regions are calculated for the regions in order to identify the regions of environmental debtors and regions of environmental donors (table 1).

The obtained values of the ecological footprint show how much of global hectare is required for the production of gross domestic product by regions, and how many on average of global hectares per person is needed to create gross regional product. For the analysis of the approaches of the ecological footprint in dynamics we took the corresponding values for such years as 2000, 2006, 2009 and 2016.

According to calculations Chernivtsi region has the lowest ecological footprint in 2000 (EF = 0.488 global hectares per capita). Given the fact that the population of the Chernivtsi region is the smallest among all other regions, the anthropogenic impact on the environment is also small. However, it should be noted that the level of real GRP, which is created in the region is much smaller than in other regions. The maximum value of the ecological footprint in 2000 is calculated for Zaporizhia region (EF = 1.33 global hectares per capita), the last is explained by the fact that the region has strong industrial sector. The industrial production in Zaporizhia region is produced in black and nonferrous metallurgy, mechanical engineering and metal processing. In addition Zaporizhia region produces a quarter of the country's total electricity. As a result of the presence of a powerful industrial sector in the Zaporizhia region, there is a significant load on the natural environment.

Table 1. Ecological footprint of the Ukrainian regions in 2000, 2006 and 2016 (authors calculations)

Regions	2000 year			2006 year			2016 year		
	Population, thousands	Real GRP, mln UAH	Ecological footprint per capita	Population, thousands	Real GRP, mln UAH	Ecological footprint per capita	Population thousands	Real GRP, mln UAH	Ecological footprint per capita
Crimea	2012.0	3247.2	0.7017	1983.8	8085.1	0.8771			
Vinnytsia	1811.0	3022.3	0.7285	1694.5	6255.8	0.7945	1606.4	8589.7	1.0309
Volyn	1067.7	1744.8	0.7134	1037.7	3873.7	0.8034	1042.8	4724.0	0.8802
Dnipropetrovsk	3662.6	10463.4	**1.2471**	3443.9	26379.3	**1.6485**	3265.8	29286.2	**1.7424**
Donetsk	4894.0	13734.5	**1.2250**	4422.9	36464.9	**1.7743**	4281.3	16013.1	0.7267
Zhytomyr	1422.3	2253.6	0.6916	1330.8	4426.5	0.7158	1251.7	5491.8	0.8529
Zakarpattia	1263.9	1709.9	0.5905	1245.5	4124.7	0.7127	1259.4	3805.3	0.5871
Zaporizhia	1970.2	6015.9	**1.3329**	1860.2	12490.9	**1.4451**	1759.8	11949.3	1.3193
Ivano-Frankivsk	1430.1	2477.7	0.7563	1386.2	5702.5	0.8853	1382.4	6346.6	0.8920
Kiev	2615.3	4710.7	0.7863	2693.2	9669.4	0.7727	1730.7	14484.1	1.6261
Kirovohrad	1164.5	1716.2	0.6433	1067.2	4125.7	0.8320	976.9	5715.8	1.1368
Luhansk	2628.6	5089.8	0.8452	2409.1	12174.5	1.0876	2212.7	4090.3	**0.3502**
Lviv	2617.0	4650.2	0.7757	2558.8	10827.5	0.9107	2536.0	12859.9	0.9851
Mykolaiv	1269.5	2634.3	0.9058	1218.9	5984.7	1.0566	1161.3	6855.2	1.1470
Odessa	2510.4	5621.6	0.9775	2391.2	12546.9	1.1292	2393.4	14490.1	1.1763
Poltava	1673.5	4540.5	**1.1844**	1547.0	11176.7	**1.5548**	1444.0	13150.9	**1.7698**
Rivne	1183.3	1997.6	0.7369	1155.4	4497.1	0.8376	1161.5	4749.0	0.7944
Sumy	1336.9	2778.2	0.9071	1226.3	4820.6	0.8460	1118.3	5520.2	0.9591
Ternopil	1156.9	1473.0	0.5558	1108.9	3251.4	0.6310	1067.8	3540.0	0.6441
Kharkiv	2887.9	6574.7	0.9938	2813.4	16137.4	1.2344	2724.9	17706.3	1.2626
Kherson	1205.6	1866.5	0.6758	1125.0	3812.3	0.7293	1065.1	4419.2	0.8062
Khmelnytskyi	1419.7	2344.2	0.7208	1370.3	4839.2	0.7600	1297.8	5692.6	0.8521
Cherkasy	1438.0	2527.0	0.7671	1341.5	5521.6	0.8858	1247.4	7204.0	1.1221
Chernivtsi	932.3	1043.7	**0.4887**	908.2	2583.1	**0.6121**	909.9	2538.6	0.5421
Chernihiv	1228.9	2442.8	0.8677	1159.9	4510.2	0.8368	1050.3	5207.4	0.9633

High values of the ecological footprint in 2000 are observed in Poltava, Donetsk and Dnipropetrovsk regions. These regions are economically developed in comparison with others. Thus, in the Donetsk region, the level of real gross domestic product in 2000 accounted for 13734.5 million UAH, which is almost 13 times more than in

Chernivtsi region. Dnipropetrovsk region has 0.02 global hectares higher indicators of Ecological footprint in comparison with Donetsk region. The rest of regions have insignificant indicators of the environmental footprint (to one), which in the present conditions is permissible.

The calculations carried out according to the data for 2006, 2009 and 2016 show the growing tendencies of the ecological footprint, in comparison with the results obtained in 2000. This indicates extensive ways of industrial development, anthropogenic impact on the environment. In 2006 and 2009, the Chernivtsi region has the smallest ecological footprint (EF = 0.612 and 0.629 hectares per capita per capita, respectively), but there was a slight increase in this indicator compared to 2000.

An integral part of the analysis of the environmental footprint is the assessment of the biological potential of the regions. The last is needed to identify and analyse their positioning by the categories of "environmental lenders" ("donors") or "environmental debtors". The obtained results show that high value of biological potential is observed in the Chernihiv region (BC = 2.53 hectares per capita) (as of 2000). This region has a favourable geographical location, since it is located in the Polissya and forest-steppe zones. Forest plantations make up 20% of the total territory of the region, which creates favourable conditions for the absorption of harmful substances in the atmosphere. Population size is also influence the size of the biological potential and fewer inhabitants are associated with a smaller impact on the natural environment. The lowest values of biological potential are observed in the Donetsk region (BC = 0.529 hectares per capita). High population increases anthropogenic impact on the environment. However due to the military activities in 2014-2017 and decrees in economic activity in a region the size of biological potential in Donetsk has increased and the region came to the territory with positive environmental balance. The empirical paper [8] proves that there is a strong correlation between economic development and morbidity rates in Ukraine. That is economic growth in Ukrainian regions is achieved through sacrifice of environmental quality and deterioration of health indicators.

According to the results of the 2006 and 2009 years the maximum value of biological potential belongs to the Chernihiv region. Based on two indicators of the ecological footprint and biological potential, it is possible to draw conclusions about the regions that belong to ecological "debtors" and ecological "lenders". The situation when the biological capacity exceeds the ecological footprint characterizes the region as an "ecological donor". Some of ecological donor regions are characterized by moderate use of natural resources, as well as effective reduction or prevention of negative environmental impacts. However, some regions of "eco-donors" category received the position due to geographically favorable conditions and ecological reserves.

Table 2. Biological capacity of the Ukrainian regions in 2000, 2006, 2016 (authors calculations)

Regions	Area of the region, th. ha	2000 year		2006 year		2016 year	
		Popula-tion, thousands	Biological capacity per capita, ha	Popula-tion, thousands	Biological capacity per capita, ha	Popula-tion, thousands	Biological capacity per capita, ha
Crimea	2610	2012.0	1.26	1983.8	1.29		
Vinnytsia	2650	1811.0	1.43	1694.5	1.53	1606.4	1.60
Volyn	2010	1067.7	**1.84**	1037.7	**1.89**	1042.8	1.84
Dnipropetrovsk	3190	3662.6	0.85	3443.9	0.91	3265.8	0.90
Donetsk	2650	4894.0	**0.53**	4422.9	**0.59**	4281.3	**0.60**
Zhytomyr	2980	1422.3	**2.05**	1330.8	**2.19**	1251.7	**2.30**
Zakarpattia	1280	1263.9	0.99	1245.5	1.00	1259.4	0.99
Zaporizhia	2720	1970.2	1.35	1860.2	1.43	1759.8	1.51
Ivano-Frankivsk	1390	1430.1	0.95	1386.2	0.98	1382.4	0.98
Kiev	2810	2615.3	1.05	2693.2	1.02	1730.7	1.58
Kirovohrad	2460	1164.5	**2.07**	1067.2	**2.25**	976.9	**2.46**
Luhansk	2670	2628.6	0.99	2409.1	1.08	2212.7	1.18
Lviv	2180	2617.0	0.81	2558.8	0.83	2536.0	0.84
Mykolaiv	2460	1269.5	**1.89**	1218.9	**1.97**	1161.3	2.07
Odessa	3330	2510.4	1.30	2391.2	1.36	2393.4	1.36
Poltava	2880	1673.5	1.68	1547.0	1.82	1444.0	1.95
Rivne	2010	1183.3	1.66	1155.4	1.70	1161.5	1.69
Sumy	2380	1336.9	1.74	1226.3	**1.90**	1118.3	2.08
Ternopil	1380	1156.9	1.17	1108.9	1.22	1067.8	1.26
Kharkiv	3140	2887.9	1.06	2813.4	1.09	2724.9	1.12
Kherson	2850	1205.6	**2.31**	1125.0	**2.48**	1065.1	**2.61**
Khmelnytskyi	2060	1419.7	1.42	1370.3	1.47	1297.8	1.55
Cherkasy	2090	1438.0	1.42	1341.5	1.52	1247.4	1.63
Chernivtsi	810	932.3	0.85	908.2	0.87	909.9	0.87
Chernihiv	3190	1228.9	**2.53**	1159.9	**2.69**	1050.3	**2.96**

Based on our calculations, the following regions of Ukraine can be classified as "eco-donors": Vinnytsia, Volyn, Zhytomyr, Zakarpattia, Ivano-Frankivsk, Kiev, Kirovograd, Mykolaiv, Odesa, Poltava, Rivne, Sumy, Ternopil, Kherson, Khmelnytsky, Cherkasy, Chernivtsi and Chernihiv oblasts. The "eco-donors" regions have available biological potential to develop economic activities based on available resources. The environmentally friendly economic directions which are recommended for the "eco-donors" regions include the green tourism, organic agriculture and social economy sectors development.

The situation when biological potential is smaller than the ecological footprint characterize the region as an "environmental debtor". Most of "environmental debtors" regions in Ukraine are developed regions, where economic growth prevails and the environmental protection activities are implemented. In addition, the focus on economic growth and increasing welfare of the regions promotes intensive use of natural resources, which in the future will result in their exhaustion and degradation of the natural ecosystem. According to our calculations, the following regions of Ukraine are in the category of "environmental debtors": Dnipropetrovsk, Zaporozhye, Lugansk, Lviv, Kharkiv regions. It is needed to develop a special economic policy for "environmental debtor" regions, the last have to be oriented at increase of environmental efficiency through the achieved economic potential. Moreover the research results of [9] on relations between energy efficiency and economic growth for transition countries show that economic achievements are the most crucial factor for energy efficiency increase. The continuous oil price increase stimulates economic incentives for energy saving and implementation of renewable energy sourness. Economically developed regions have to consider the factor of innovation and implementation of high technologies to improve environmental sustainability.

According to [10] partial indicators of the sustainable development have a number of problems: firstly, from the large number of available indicators one needs to choose the "best" ones, which are suitable for a particular kind of task; and secondly, even with the study of the same problem by different scientists, different results can be obtained. This is due to the presence of different criteria on the basis of the selection of indicators, and therefore difficult to understand whether we are moving to sustainable development or not. Third, the use of indicators set is difficult in the mathematical modeling of sustainable development, since there is a problem multicollinearity among the set of indicators. In this regards the further direction if research would be devoted the justification of other indicators which are suitable for the decision making process on the way to sustainable development.

CONCLUSION

To conclude, the ecological footprint estimations can be considered as a relevant indicator for bringing country closer to sustainable development. Sustainable development could be achieved when the economic impact on environment does not exceed the biological capacity of the natural ecosystem. It is necessary to balance the functioning of economic and ecological systems on the path to sustainable development. One of the policy implications of our research is to formulate the economic strategies for each region separately depending on the state of economic and environmental situation. The regions with higher biological potential have to develop stimulating economic policies to achieve the economic indicators of sustainability goals. The regions with lower biological potential have to develop restrictive economic policies to achieve the environmental indicators of sustainability goals. The research proves that all Ukrainian regions are on the same track of development and environmental situation have to be improved not only through the economic restriction measures, but the mechanisms of positive motivation are also suitable policy instruments. The stimulation economic policy have to be aimed at development of resource saving technologies, with special emphasize to CO_2 emissions, since Ukrainian economy is one of the most inefficient in terms of nonrenewable energy use

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