# “Environmental Performance Index: relation between social and economic welfare of the countries”


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# ENVIRONMENTAL PERFORMANCE INDEX: RELATION BETWEEN SOCIAL AND ECONOMIC WELFARE OF THE COUNTRIES

## Abstract

The paper deals with the analysis of methodology of Environmental Performance Index. The authors analyzed and systematized the main existing integrated indices, which were used for evaluation of environmental, social and economic situation in the countries. The authors allocated the environmental performance index as a basis for analyzing the environmental policy of the country. In this direction, the authors analysed the main features, structure and indicators of environmental performance index. The authors allocated the world-leader countries with huge level of CO2 emissions. According to the results, the authors aproved that these countries should improve their environmental policy. Accordingly, they occupied less position in environmental performance index. For the purpose to analyze the relation between ecological, social and economic welfare, the authors analyzed score of sustainable development goal index, social progress index and gross domestic product per capita. The comparison analysis of findings showed that countries with good position on environmental performance index have the strong position on sustainable development goal index and social progress index. The authors suggested that Ukraine should orient to the EU countries with purpose to improve the environmental policy.

**Keywords** damage, index, ecology, environment, health, policy, pollution, social, sustainable development

**JEL Classification** Q01, Q05, R11

## INTRODUCTION

Current rapid growth in all economic spheres provoked the range of negative consequences in the environment. Thus, the world community and scientists have already directed all the forces to minimize the negative ecological consequences and achieve a balance between all the spheres: economic, social, political and environmental. As a traditional point of view, this balance could be achieved through the implementation of the main principles of the sustainable development. It should be underlined that a lot of actions have already been done by the world communities.

In this case, a lot of target documents and concepts were signed and accepted by the countries. The results of the analysis showed that this process also has its own history. The first conference "Declaration of the United Nations Conference on the Human Environment" on sustainable development was in Stockholm in 1972. It was the first step to make the concept of sustainable development. This Declaration consisted of the 26 principles to save the environment. The next conference was organized in Rio de Janeiro in 1997, during which General Assembly "Program for the Further Implementation of Agenda 21"

was accepted. During that period, a lot of documents were accepted and implemented, which were connected with sustainable development (Kyoto Protocol, Earth Charter, etc.).

After that, in 2000, "Millennium Declaration" was signed by 189 countries. The general concept of this document was to achieve the balance in the world community through three main directions: peace and security, peace and development. The main idea of this document is to achieve the 8 goals during the period 2000–2015 for the purpose to guarantee the equal life for everyone in any country; access to the clean environment, water and air; access to good education; decreasing the poverty over the world, etc. Then, after the long period of discussions and consultation, in 2015, the final action plan for 2016–2030 "Transforming our world: the 2030 Agenda for Sustainable Development" was accepted. This document consists of the 17 goals and 169 tasks and was the logical extension of Millennium Declaration.

The results of the analysis showed that the world community tries to save the nature for future generations, to provide the equal economic development for everyone, human rights, etc. In this case, a lot of problems and investigations are c lose to connect with methods to estimate all the main indicators of Sustainable Development Goals 2030 (SDGs 2030). In addition, using SDGs 2030, a lot of scientists are trying to develop one integrated index and rating, which could estimate and indicate the place of country in the world in terms of economic, social and ecological development.

## 1. LITERATURE REVIEW

According to the mentioned above, the huge number of scientists try to improve the existing indexes and use the key factor in making decisions in different spheres. It should be underlined that the scientists (Hsu et al., 2012) proposed to use the Environmental performance Index (EPI) and pilot trend Environmental performance index for the purpose to understand what world achieve of after 1992. It is noted, that in 1992, Rio Earth Summit was held.

Thus, Färe R. Grosskopf S. and Hernandez-Sancho F. in their work (Färe et al., 2004) use the Data Envelopment Analysis (DEA) and proposed own Environmental Performance Index. The main features of this index are that it is constructed as ratios of distance functions. They approved that it was a perfect aggregator of functions, which provides a natural and elegant basis for constructing quantity indexes. They took advantage of these properties to construct a quantity index of good outputs and a quantity index of bad outputs. They indicated, that their ratio is their Environmental Performance Index (Färe et al., 2004).

Ismail and Abdullah in their work (Ismail et al., 2012) described new vision of EPI for Association of Southeast Asian Nations (ASEAN) countries. They proved that method of EPI had a weak side in arithmetics, as a consequence, it eliminated some extreme values in data. Accordingly, the bullet point of their concept was using the decision-making tool of Analytic Hierarchy Process (AHP).

Kortelainen in his work (Kortelainen, 2008) used the Malmquist index approach trying to analyze the dynamics of Environmental Performance Index and how the main index components have developed during the sample period in general, identify the major factors in each country's performance.

Zhou, Ang, and Poh, used the slack-based efficiency measures to model environmental performance on the basis of the Environmental Performance Index (Zhou et al., 2006). It is noted that Rogge in his work (Rogge, 2012) used the Environmental Performance Index, method which was proposed in the paper (Zhou et al., 2007), and DEA trying to allocate the negative tendency in separate spheres, which should be reoriented.

On the other hand, the scientists in the work (Munksgaard et al., 2007) highlighted that all indexes don't involve the environmental damage costs. In this case, they proposed to improve method to estimate Environmental Performance Index through taking to account the environmental damage costs.


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The results of analysis showed that estimation of environmental performance is conducted not only among countries, but also in the corporate sector. Mostly, during the decision making by the stakeholders whether or not to invest in the company. Thus, the scientists Zaim (2004), Azad et al. (2010), Wagner (2009), Chigrin (2014), Galdeano-Gómez (2010) proposed to include different types of ecological indexes during the estimation of companies' performance. Besides, in that works, the authors proved that company's environmental performance and welfare are correlated. On the other hand, the range of authors proved that EPI is also correlated with countries' welfare. Thus, the main idea of the paper is to analyze the EPI and others indexes, and how they correlate with countries prosperities.

## 2. METHODS

In this research, the general methods of scientific knowledge are used by the authors. In order to analyze and summarize the main world ecological, social and environmental indexes, the authors used analysis and synthesis. Using the compilation and comparison, the authors identify the main features of Global Competitiveness Index; World Competitiveness Yearbook; Ease of Doing Business; Human Development Index; Global Hunger Index; The IT Industry Competitiveness Index; International Property Rights Index; Corruption Perceptions Index; Environmental Performance Index, etc. Moreover, the authors allocated the world leaders on GDP per capita and CO2 emission as the object of investigation. The statistical and mathematical methods where used to identify the tendency of the main environmental, ecological and social indexes. In addition, using that methods, the authors analyzed the place of economic developed countries on the EPI, SDGI and Social Progress Index. Using the scientific approach, the authors made conclusions on the correlation between EPI and countries' welfare. The abovementioned approaches allow to allocate the weaknesses of Ukrainian policy on a way to achieve the Sustainable Development Goals 2030. Furthermore, it gives opportunities to highlight the leaders among world under EPI, SDGI and Social Progress Index for the purpose to take into account the best practice to achieve SDG for Ukraine.

Thus, the main goal of this article is to analyze of the Environmental Performance Index and how it correlates with countries' welfare (including economic and social development) for the purpose to understand the part of way for achieving the Sustainable Development Goals 2030 in Ukraine.

## 3. RESULTS

The results of analysis showed that the huge range of indexes and ratings was already developed by the scientists and the world organizations: Global Competitiveness Index; World Competitiveness Yearbook; Ease of Doing Business; Human Development Index; Global Hunger Index; The IT Industry Competitiveness Index; International Property Rights Index; Corruption Perceptions Index; Environmental Performance Index and etc. The dynamic of Global Competitiveness Index, Ease of Doing Business, Corruption Perceptions Index, Sustainable Development Goals Index and Social Progress Index presented in Table 1.

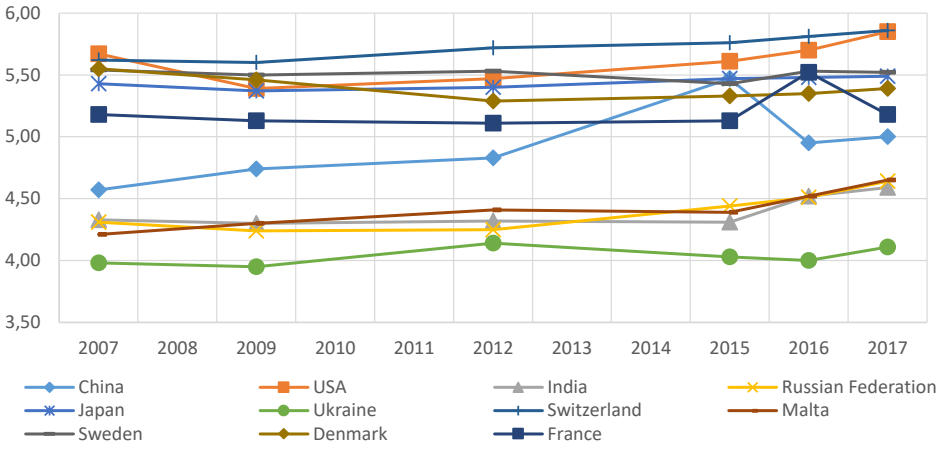
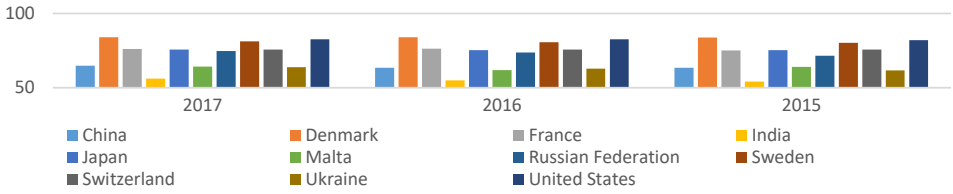
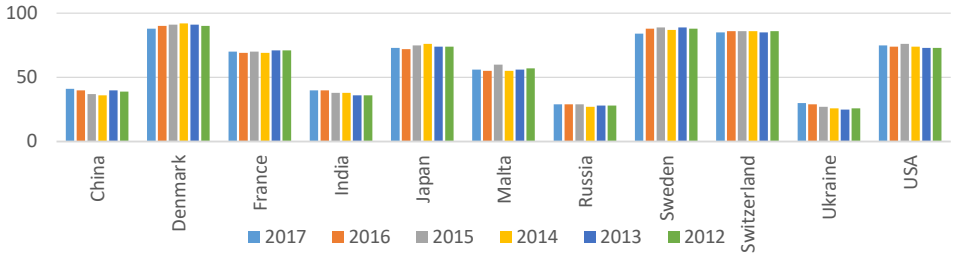
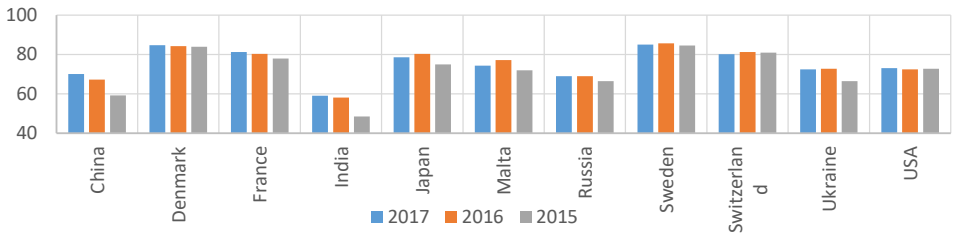
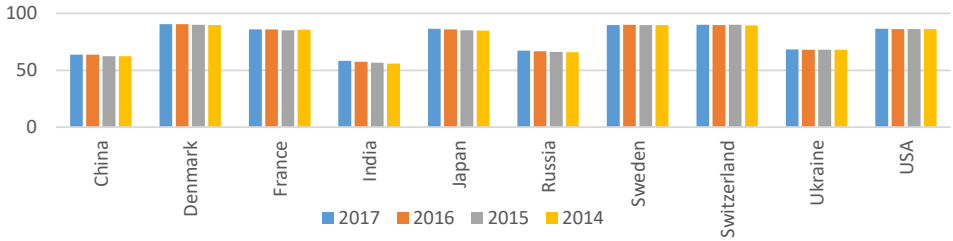
It should be underlined that most of indexes, which were presented in Table 1 analyze the same indicators but with different combinations. Furthermore, the range of authors proposed new indexes or to modify the existent ones. Taking into account the current Sustainable Development Goals 2030 under this article, the authors analyzed the Environmental Performance Index.

Environmental Performance Index was developed by the team of researchers and policy experts at the Yale Centre for Environmental Law and Policy (Yale University) and Columbia University's Centre for International Earth Science Information Network (CIESIN) in collaboration with the World Economic Forum (Esty et al., 2006). From 2006, the methodology of Index has been improving according to the new trends and Sustainable Development Goals. According to the official methodology of Environmental Performance Index (Environmental, 2018), it estimates two main parts:

- environmental health, which rises with economic growth and prosperity;

**Table 1.** The main world economic, ecological and social indexes

Source: Compiled by the authors on the basis of Global (2018), Ease (2018), Corruption (2018), SDG (2018), Social (2018).

| Index | Dynamic |
|---|---|
| Global Competitiveness Index (Global, 2018) |   |
| Ease of Doing Business (Ease, 2018) |   |
| Corruption Perceptions Index (Corruption, 2018) |   |
| Sustainable Development Goals (SDG, 2018) |   |
| Social Progress Index (Social, 2018) |   |



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Source: Compiled by the authors on the basis of Environmental (2018).

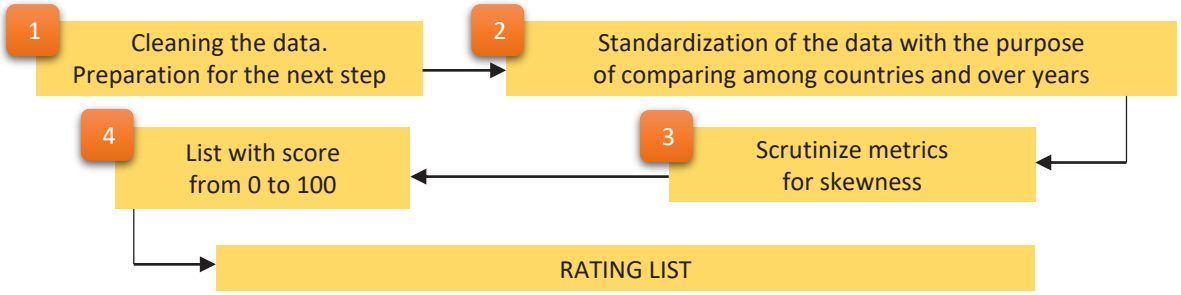


**Figure 1.** The algorithm of calculation the Environmental Performance Index

- ecosystem vitality, which comes under strain from industrialization and urbanization.

It should be underlined that experts of this Index supposed that good governance emerges as the critical factor required to balance these distinct dimensions of sustainability (Environmental, 2018).

**Table 2.** Environmental Performance Index: the main indicators of policy objective – environmental health

Source: Compiled by the authors on the basis of Environmental (2018).

| Group | Indicator | Weight | |
|---|---|---|---|
| Air quality | Household solid fuels | 0.4 | 0.65 |
| | $PM_{2.5}$ exposure | 0.3 | |
| | $PM_{2.5}$ exceedance | 0.3 | |
| Water and sanitation | Sanitation | 0.5 | 0.3 |
| | Drinking water | 0.5 | |
| Heavy metals | Lead exposure | 1 | 0.05 |

It should be underlined that all information about the process of calculation and approaches, which are used, are open access with all details at the official website of Environmental Performance Index (Environmental, 2018).

Thus, the process of calculation consists of the four steps: data preparation; data standardization; scrutinizing metrics for skewness; rescaling the data into 0-100 score. The algorithm of calculation is presented in Figure 1.

During of the rescaling all indicators are consolidated into one list in order to compare and to aggregate into the integrated index. The Environmental Performance Index uses the distance-to-target technique for indicator construction, which situates each country relative to targets for worst and best performance, discussed in more detail below, corresponding to scores of 0 and 100, respectively.

**Table 3.** Environmental Performance Index: the main indicators of policy objective – ecosystem vitality

Source: Compiled by the authors on the basis of Environmental (2018).

| Group | Indicator | Weight | |
|---|---|---|---|
| Biodiversity and habitat | Marine protected area | 0.2 | 0.25 |
| | Terrestrial biome protection – national weights | 0.2 | |
| | Terrestrial biome protection – global weights | 0.2 | |
| | Species protection index | 0.2 | |
| | Protected area representativeness index | 0.1 | |
| | Species habitat index | 0.1 | |
| Forests | Tree cover loss | 1.0 | 0.1 |
| Fisheries | Fish stock status | 0.5 | 0.1 |
| | RMTI | 0.5 | |
| Climate and energy | Carbon Dioxide – total | 0.5 | 0.3 |
| | Carbon Dioxide – power sector | 0.2 | |
| | Methane | 0.2 | |
| | Nitrous oxide | 0.05 | |
| | Black carbon | 0.05 | |
| Air pollution | Sulfur oxide | 0.5 | 0.1 |
| | Nitrogen oxide | 0.5 | |
| Water resources | Wastewater treatment | 1.0 | 0.1 |
| Agriculture | Sustainable nitrogen management index (SNMI) | 1.0 | 0.05 |

According to the methodology, the Index score is calculated by the formula (1).

$$IS = \frac{x - \underline{x}}{\bar{x} - \underline{x}} \cdot 100, \quad (1)$$

where $IS$ – indicator score, $x$ – a country's value, $\bar{x}$ – the target for best performance, $\underline{x}$ – the target for worst performance.

Moreover, if $x$ is greater than $\bar{x}$, the corresponding indicator score is 100. Likewise, if a x is less than $\underline{x}$, the corresponding $IS$ is 0.

Under this research, the authors analyzed the results of Environmental Performance Index for Ukraine and countries, which have the huge volume of CO2 emissions and generate the biggest share of GDP in the world.

Thus, according to the databases, the following countries such as China, the USA, India, Russian Federation and Japan occupied the first five places in CO2 emissions in the world (Table 4). In such direction, Ukraine occupied the 26th place in terms of CO2 emissions in the world.

Thus, China generates only 14.84% of the world GDP, but it produces 29.51% of CO2 emissions in the world. The same situation is in India and Russian Federation. Their CO2 emissions in percentage are twice higher than their share of GDP in the world. Unfortunately, we can see the same situation in Ukraine.

Still, the situation in Lithuania is different. Their CO2 emissions are twice less than share of GDP in the world. It is necessary to underline that in the USA and in the most EU countries, the share in the GDP of world is higher than share of the world CO2 emissions (Figure 2).

According to the official data of EPI (2018), Switzerland, France, Denmark, Malta and Sweden round out the top five countries (Environmental, 2018). The leader in the world was Switzerland with a score of EPI (2018) 87.42 in overall environmental performance. On

**Table 4.** CO2 emissions and share of the world GDP by the country

Source: Created by the authors on the basis of World Development (2017), CO2 time (2017).

| Countries | GDP, bln $ | % GDP in the world | CO2, kton (Gg) per year | % CO2 in the world | CO2 per 1$ of GDP |
|---|---|---|---|---|---|
| China | 11007.72 | 14.84% | 10641788.99 | 29.51% | 1034.39 |
| USA | 18036.65 | 24.32% | 5172337.73 | 14.34% | 3487.14 |
| India | 2095.40 | 2.83% | 2454968.12 | 6.81% | 853.53 |
| Russian Federation | 1331.21 | 1.80% | 1760895.31 | 4.88% | 755.98 |
| Japan | 4383.08 | 5.91% | 1252889.87 | 3.47% | 3498.37 |
| Germany | 3363.45 | 4.54% | 777905.50 | 2.16% | 4323.72 |
| Iran | – | – | 633749.58 | 1.76% | – |
| Republic of Korea | 1377.87 | 1.86% | 617284.88 | 1.71% | 2232.15 |
| Canada | 1550.54 | 2.09% | 555400.90 | 1.54% | 2791.74 |
| Saudi Arabia | 646.00 | 0.87% | 505565.10 | 1.40% | 1277.78 |
| Indonesia | 861.93 | 1.16% | 502961.30 | 1.39% | 1713.72 |
| Brazil | 1774.72 | 2.39% | 486229.08 | 1.35% | 3649.98 |
| Mexico | 1143.79 | 1.54% | 472017.79 | 1.31% | 2423.20 |
| Australia | 1339.14 | 1.81% | 446348.29 | 1.24% | 3000.21 |
| South Africa | 314.57 | 0.42% | 417160.99 | 1.16% | 754.08 |
| United Kingdom | 2858.00 | 3.85% | 398524.37 | 1.11% | 7171.46 |
| Turkey | 717.88 | 0.97% | 357157.41 | 0.99% | 2009.98 |
| Italy | 1821.50 | 2.46% | 352885.93 | 0.98% | 5161.72 |
| France | 2418.84 | 3.26% | 327787.26 | 0.91% | 7379.28 |
| Poland | 477.07 | 0.64% | 294879.37 | 0.82% | 1617.84 |
| Ukraine | 90.62 | 0.12% | 228688.17 | 0.63% | 396.24 |
| Lithuania | 41.17 | 0.06% | 12478.11 | 0.03% | 3299.44 |
| World | 74152.48 | – | 36061709.91 | – | 2056.27 |


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Source: Created by the authors on the basis of World Development (2017), CO2 time (2017).

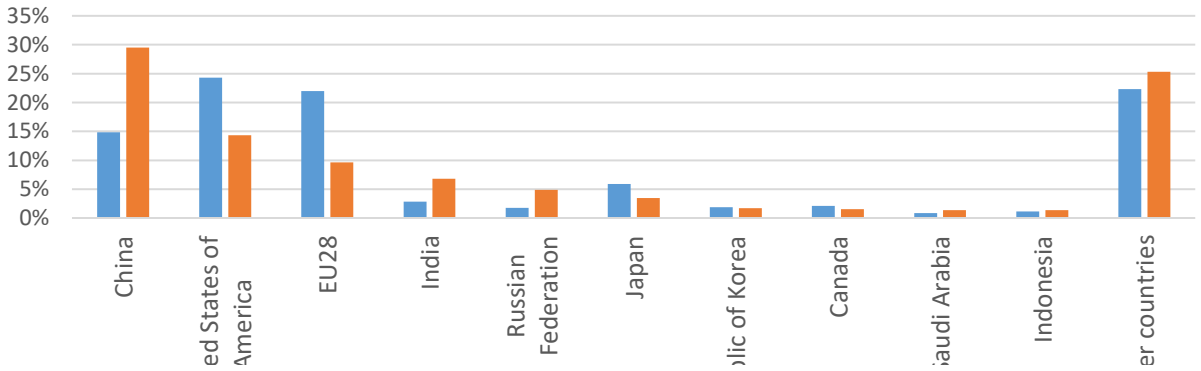


**Figure 2.** Comparison of the share of CO2 and GDP in the world by countries

the other side, Switzerland has the weak hand on sustainable nitrogen management, terrestrial biome protection – national and global weights (Figure 3). Accordingly, France – 83.95, Denmark – 81.60, Malta – 80.9 and Sweden –80.51 (Environmental, 2018). It is noted, that first places were occupied by the EU countries. Ukraine occupied 109th place with score of 52.87. The dynamics of EPI for Chine, USA, India, Russian Federation, Japan and Ukraine is presented in Table 5.

**Table 5.** The dynamics of EPI

Source: Created by the authors on the basis of Environmental (2018), Global (2016), EPI (2014).

| Countries | EPI 2018 | | EPI 2016 | | EPI 2014 | |
|---|---|---|---|---|---|---|
| | Rank | Score | Rank | Score | Rank | Score |
| China | 120 | 50,74 | 109 | 65,1 | 118 | 43 |
| USA | 27 | 71,19 | 26 | 84,72 | 33 | 67,52 |
| India | 177 | 30,57 | 141 | 53,58 | 155 | 31,23 |
| Russian Federation | 52 | 63,79 | 32 | 83,52 | 73 | 53,45 |
| Japan | 20 | 74,69 | 39 | 80,59 | 26 | 72,35 |
| Ukraine | 109 | 52,87 | 44 | 79,69 | 95 | 49,01 |

Source: Created by the authors on the basis of Environmental (2018).

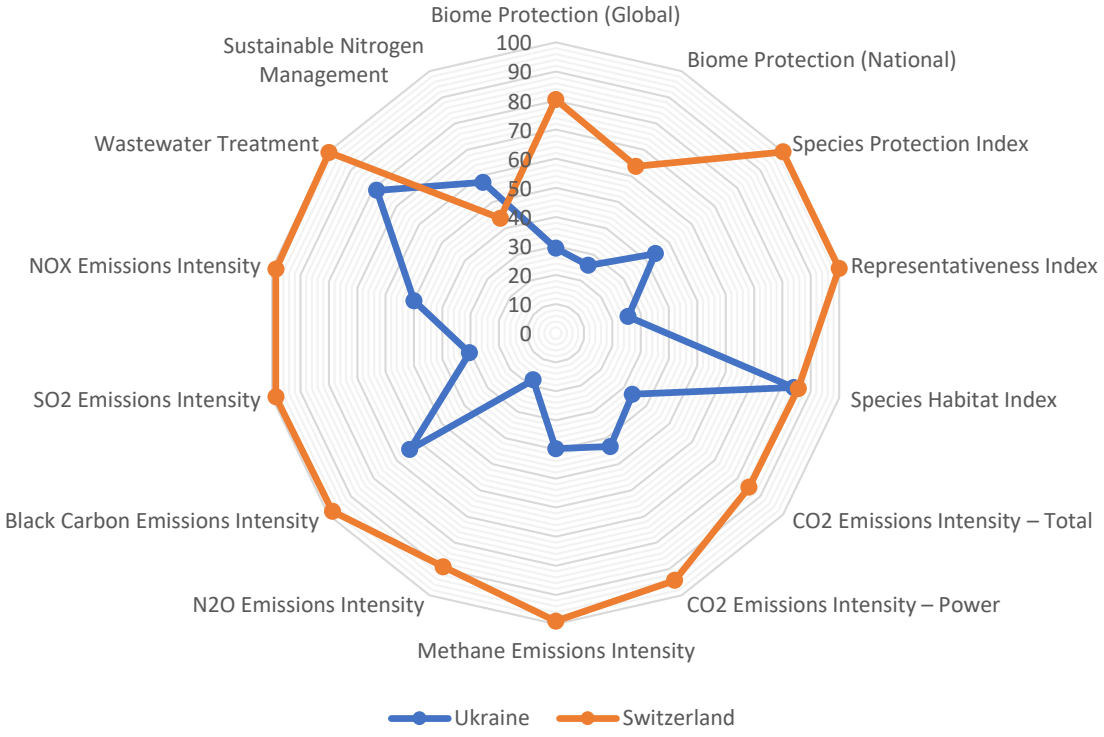


**Figure 3.** Comparative analysis of ecosystem vitality between Switzerland and Ukraine

**Table 6.** Comparison analysis of EPI, SDG index and GDP per capita

Source: Created by the authors on the basis of Environmental (2018), SDG (2018).

| | Countries | EPI score | GDP per capita, $/person | SDG Index score |
|---|---|---|---|---|
| Top CO2 emissions | China | 50,74 | 14399,0 | 67,1 |
| | USA | 71,19 | 53341,8 | 72,4 |
| | India | 30,57 | 6092,65 | 58,1 |
| | Russia | 63,79 | 24811,1 | 69,9 |
| | Japan | 74,69 | 38252,3 | 80,2 |
| | Ukraine | 52,87 | 7270,69 | 72,7 |
| Top five leader on EPI | Switzerland | 87,42 | 57430,0 | 81,2 |
| | France | 83,95 | 38058,90 | 80,3 |
| | Malta | 80,90 | 35743,4 | 77,0 |
| | Sweden | 80,51 | 46662,1 | 85,6 |
| | Denmark | 81,60 | 45966,2 | 84,2 |

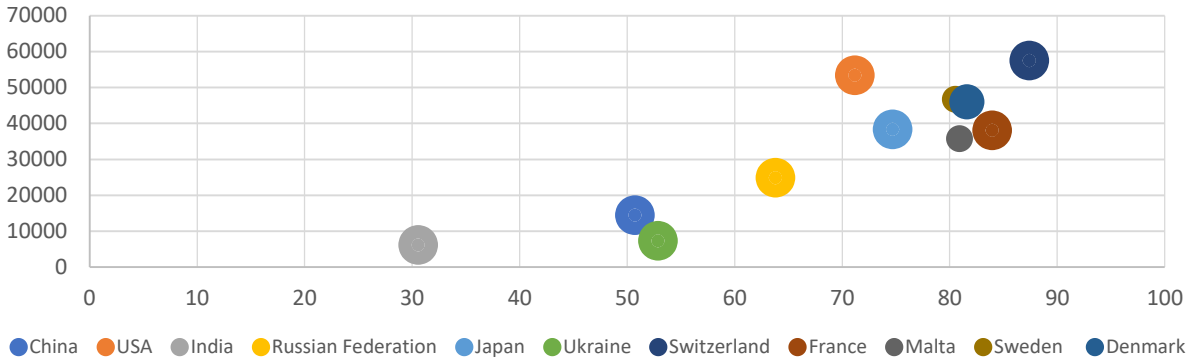


**Figure 4.** Comparison analysis of GDP per capita and EPI score by countries

Source: Created by the authors on the basis of Environmental (2018), SDG (2018).

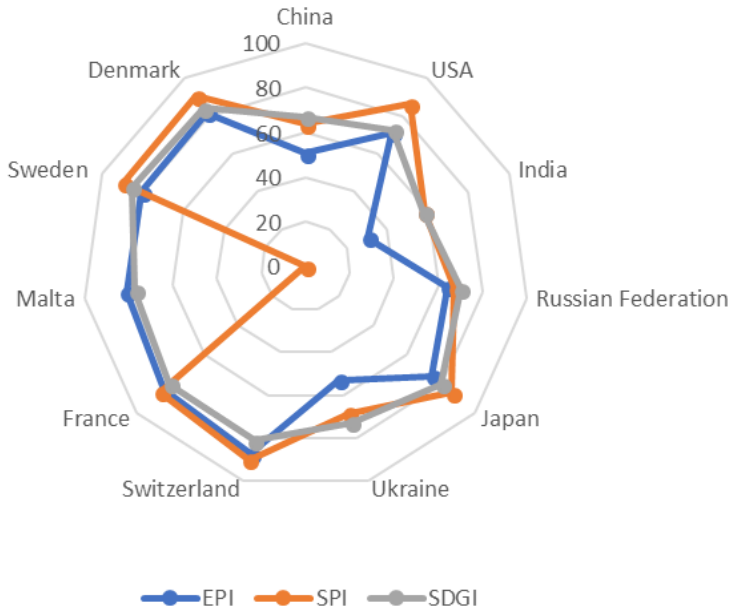


**Figure 5.** Comparison analysis of EPI, social progress index and SDG Index score by countries



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The findings showed that from year to year, the EPI in China, India and Ukraine has been increasing and, corresponding by they are going down in the rating (Table 3). In this case, Ukraine should take to account experience of top five EU countries on EPI. It is noted, that among the block of indicators, ecosystem vitality of Ukraine has not bad results on Wastewater Treatment; Sustainable Nitrogen Management and Species Habitat Index (Figure 3).

The results of the analysis showed that EPI results are close to the SDG Index calculation. Moreover, Ukraine has better position on EPI than the countries, which are world CO2 polluters (Table 6).

It should be underlined that the countries with the highest GDP occupied better position in EPI (Figure 4).

Thus, comparing the EPI with social progress index, the results showed that the best countries on EPI have good position on social progress index and SDG Index (Figure 5). It is noted, that social progress index was not calculated for Malta yet.

## CONCLUSION

Thus, the findings showed that the Environmental Performance Index estimated countries from the ecological point of view. Noticed, that world-leader countries (China, USA, India, Russian Federation, Japan) excluding USA don't demonstrate the good position among all indexes (EPI, SDGI and social progress index).

The countries with good results of EPI also have the good position on SDG Index and social progress index. Moreover, the findings showed that GDP per capita and Environmental Performance Index are corelated. The countries with highest GDP per capita have thebetter position on EPI. Comparative analysis showed that Ukrain should orient to EU countries for improving theenvironmental performance for the purpose to achieve the Sustainable Development Goals 2030 in Ukraine. In this case, the experience of countries (Switzerland, France and Denmark), which occupied the first places on environmental policy, will be interesting for further investigations for the purpose to implement and adopt that experience in Ukraine. In addition, according to the results, Ukraine should orient to Denmark in social policy.

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