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# ASSESSING ENVIRONMENTAL SECURITY OF DIFFERENTIATED TERRITORIES

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**Abstract.** The scientific work illustrates the newly developed methodical approach to complex statistical research of environmental security of differentiated territories. It is based on the method of integrated assessment of the level of environmental security as the result of the mutual influence of industrial and economic, nature-protective activities of environmental innovations. On its basis, the analysis of environmental situation has been carried out both of the countries of the world and separate territories. The directions of improvement of statistical observation have been justified in the field of environmental security, which include modernization of the forms of manifestation of international observation practice. This provides a combination of statistical indicators and the correct conduct of interterritorial comparisons.

## 1. Introduction

As a result of aggravation of environmental problems (atmospheric pollution, reduction of minerals, destruction of plant and animal species), there is a growing need for effective environmental policy based on the analysis of statistical data on the state of the environmental security of territories. This necessitates the development of the concept of environmental security, especially regarding the improvement of statistical observation and the formation of a system of indicators of environmental security of countries and territories.

Under present conditions of growing demand for statistical information characterizing the environmental situation of differentiated territories (countries, regions, municipalities), the solution of the task of assessing their level of environmental security is becoming even more relevant, since
– there is no adequate and comparable system of indicators that would make it possible to conduct international and regional comparisons;
– the current analytical tools used, macro- and mezo-economic indicators do not give a chance to obtain comparable results, since they are aimed at solving narrow problems and their application cannot be extended to other territories;
– the problem of developing a generalized indicator for the characterization of environmental security remains unresolved;

Environmental security is a multidimensional complex phenomenon, which, of course, complicates the process of its integrated assessment. Such tasks are solved by various methods and techniques that are presented in the numerous works (Aradau, 2014; Baker, et al. 2015; Harrington and Clifford, 2017; Zemlickiene Razminienė, Tvaronavičienė, 2018; Mcdonald, 2018; Von et al. 2014; Watts, 2013; Yusoff, 2013; Drobyazko et al., 2019; Olaniyi, et al. 2019; Areiqat et al., 2019; Cherchyk et al. 2019; Dalevska et al. 2019; Eddelani et al. 2019; Smaliukienė, Monni, 2019). We can state that scientific publications do not adequately cover issues of typology of differentiated territories of the world in terms of environmental security, which forms an informational basis for the adoption of effective management decisions in this area, forecasting and development of measures in order to prove environmental security.

## 2. Methodology of research

The statistical study of the ecological security of differentiated territories is multidimensional, since it depends on many factors. On the basis of the studied material, the approach to the integrated study of environmental security is presented, shown in Figure 1.
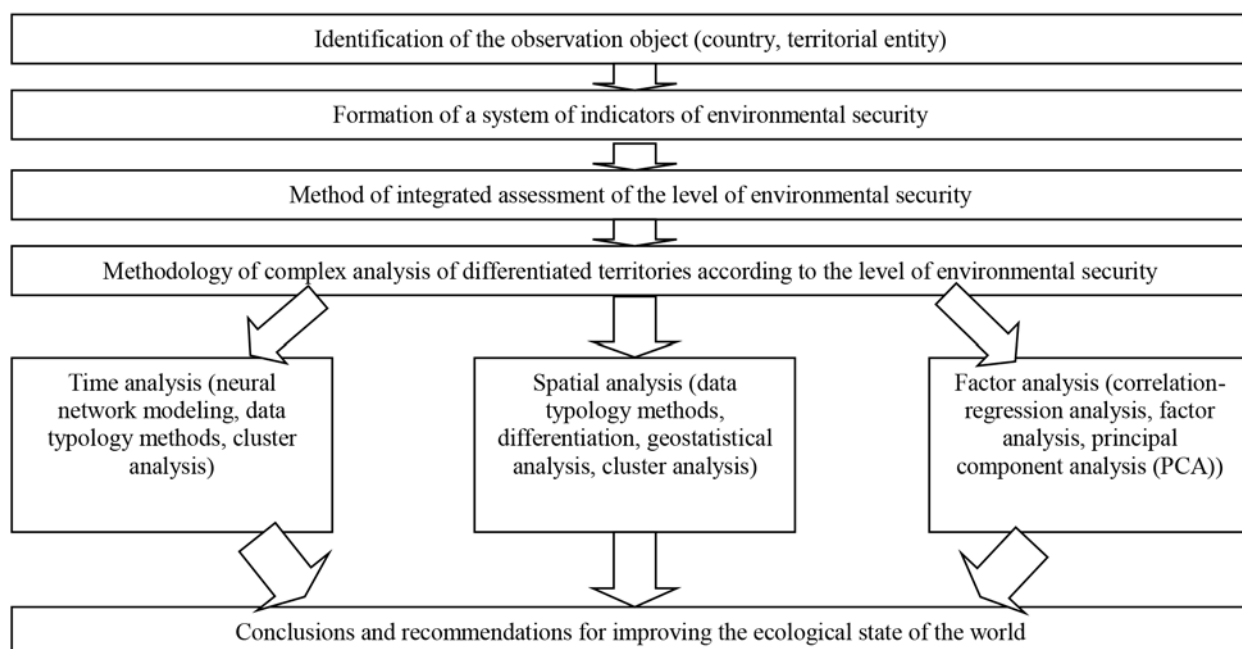


**Fig. 1.** Methodical approach to complex statistical research of environmental security of differentiated territories

*Source:* Designed by the authors.

At the first stage, the object of observation is identified: country, territory, municipal entity. Artificially formed territories can also be considered as objects of observation. The analysis of ecological security at the world level is complicated due to the lack of a generally recognized system of indicators that characterize the ecological security of countries and provide the possibility of interstate comparisons (Schmidt-Bleek, 2009; Olaniyi, O.E.; Prause, G.; Bakkar, Y., 2019).

The study of environmental security of differentiated territories also has problems due to two aspects: the first aspect is the lack of information (nomenclature of indicators, methodology for obtaining them); the second aspect is historically driven heterogeneity of the economic space. In conducting comparisons between differentiated territories in the world, one has to take into account their differentiation, and also to understand that their heterogeneity can change in time (Corry, 2017). This is manifested in all spheres of life: economic, social, institutional, environmental, natural and climatic, and other spheres.

The important aspect that does not contribute to increasing the reliability of data at the level of differentiated territories is its size. It is obvious that, in other equal conditions, the smaller the value of the studied general population, the more significant are the errors of measurement, namely, errors, inaccuracies, registrations of a separate unit of the population (Stevens, et al. 2012; Masood, O.; Tvaronavičienė, M.; Javaria, K. 2019).

At the second stage, a system of indicators is created taking into account the features of the selected observation object. Note that the formation of the system of indicators is complicated by a number of reasons:
– there is no single methodological approach to the definition of a system of indicators at the international and national levels;
– lack of published information; for example, in the statistics database of territorial entities, there are only two sections describing environmental security: production and consumption wastes, atmospheric air protection.

Thus, in order to overcome the problems discussed above, the selection of indicators in order to assess the level of environmental security should be based on the following assumptions
– open access and availability of statistical information necessary for the calculation of the integrated assessment of the level of environmental security, which will ensure the practical use of the developed methodology;
– the possibility of obtaining information for a number of years, which will make it possible to study the development of the phenomenon in the dynamics.

The third stage is the development of a methodology for assessing the level of environmental security, which is based on the construction of an integrated assessment across the population of indicators (Mudgal, 2012) and on individual units of assessments of environmental security factors.

The fourth stage is the development of a methodology for a comprehensive analysis of the state of differentiated territories according to the level of their environmental security on the basis of a combination of methods of temporal, spatial and factor analysis.

## 3. Spatial grouping of differentiated territories

The application of various methods of multidimensional statistical analysis gives a chance to implement the typology of differentiated territories, to construct matrices of strategic management, to identify factors that shape the ecological security of studied observation objects, to assess the level of differentiation of territories according to the level of environmental security and to determine the trends and patterns of its development. The spatial analysis is performed on the joint use of geostatistical methods, analysis of differentiation and methods of portfolio analysis (McDonald, 2012). The spatial grouping makes it possible to group objects based on object attributes and additional spatial/temporal constraints, as shown in Table 1.

**Table 1.** Types of spatial constraints for the spatial grouping of differentiated territories

| Types of spatial constraints | Working principle |
|---|---|
| Correlated to the common edge | Groups with continuous polygon objects. Only polygons with a common edge may belong to the same group. |
| Correlated to a common vertex | Groups with continuous polygon objects. Only polygons with a common edge or a common vertex may belong to the same group. |
| Delaunay triangulation | Objects of the same group will have, at least, one common natural neighbor with another object of this group. Correlations of the natural combination are based on the Delaunay triangulation. Conceptually, the Delaunay triangulation method creates a network of non-overlapping triangles, based on centroids of objects. Each object is a node of a triangle, and nodes with common edges are considered to be neighbors. |
| $k$-nearest neighbors algorithm | Objects of the same group will be located next to each other. Each object will be a neighbor, at least for one other object in the group. Neighborly correlations are built on the nearest $k$-objects, with an integer $K$ for the Number of Neighbors parameter. |
| File of spatial weights | Spatial and, if necessary, temporary correlations are determined by the file of spatial weights. A spatial weights matrix or a spatial weights matrix for a network is created. |
| No spatial constraints | Objects are grouped only with the use of proximity in the data space. Objects do not have to be located adjacent to each other in space or time in order to get into the same group. |

*Source:* Hardt, 2017; Sustainable development and environment. UNECE

When spatial grouping is made, a spatial constraint and a distance determination method are specified. With its implementation, one can use Euclidean distance and the $k$-nearest neighbors algorithm as a spatial constraint, in which the number of neighbors should be indicated. The number of neighbors by default is 8 and cannot be less than 2 for the "$k$-nearest neighbor". This value reflects the exact number of candidates for the nearest neighbors, which is considered when constructing groups. An object will not be included in the group if one of the other objects in this group is not the nearest "$k$-neighbor" (Hardt, 2017).

The results of the spatial grouping of differentiated territories should be used in order to construct index maps that reflect their environmental security. The use of typology methods of differentiated territories is based on the aggregate concept (Chalecki, 2016) using artificial and natural breaks. According to this concept, it is possible to make a preliminary indication of the types of territories (countries, territorial and municipal entities) on the level of environmental security. We can distinguish five types: 1) crisis; 2) low; 3) average; 4) favorable; 5) high.

In order to implement the typological grouping for the determined types, an integral level of environmental security is used, calculated on all indicators. The level of environmental security of differentiated territories may be in the range (0.00 - 1.00). By performing an artificial breakdown by intervals, we obtain: 1) the crisis level (0,00; 0,20); 2) low - (0,20; 0,40); 3) average - (0.40; 0.60); 4) favorable - (0,60; 0,80); 5) high - (0.80; 1.00).

In order to perform temporal analysis, the methods of periodization, analysis of trends in the development of environmental security on the basis of neural network modeling are used. The essence of the latter's application is that it allows the classification of territories based on the given reference representatives of certain classes in dynamics (Chapin, et al. 2010). The algorithm for classification of observation objects on the level of environmental security on the basis of neural network modeling includes the following:

1. Formation of a system of indicators characterizing ecological security carried out taking into account the specifics of the selected observation object;

2. Bringing the initial array of data to a single dimension based on normalization procedures. This procedure gives a chance to bring the data to a single scale (Fagan, 2017);

3. Determination of reference representatives of classes of territories according to the level of environmental

security on the basis of cluster analysis. The application of this method (in order to split the initial population of objects into the same number of classes) makes it possible in a few years to identify the stable representatives of the groups received. These representatives will serve as benchmarks (samples) of highlighted classes;

4. The solution of the classification problem is performed using networks of the following types: the probabilistic neural network and the linear network, the multilayer perceptron, the Kohonen network, the radial basis function. The architecture of the fuzzy neural network in this case has three layers of neurons: the input, the hidden and the output. The input layer is represented by a system of indicators characterizing the ecological security of territories. By means of synopsis, the connection of the input layer with a hidden layer of neurons is provided, in which the activity of the neuron is determined as the Euclidean distance. The output layer is presented by neurons, which calculates the Gaussian functions activity of belonging to the class. Using the Gaussian function provides the elimination of "noise" (unnecessary information) available in the input data (Floyd, 2015; *Drobyazko S., 2017)*;

5. Control over the quality of the result, based on cross-checking, which involves splitting the observations into research and control populations.

Within these guidelines, an error function is formed which requires minimization in the process of controlled neural network training. This function is intended to evaluate the quality of the neural network during training. The neural network's capability to solve the tasks set before it depends on the quality of its training. In order to improve the results, it is possible to use re-learning of a network that has such a disadvantage as the loss of capability to generalize the phenomena under study. In order to ensure the reliability of the final model, one can use the test set of observations, when the amount of instructive data allows. The final model must be tested on the data from the reserve set. This ensures the reliability of the results and indicates that the results achieved are real (Cook, J. et al. 2016).

6. Getting an able-bodied neural network that makes it possible to classify the territory by the level of environmental security and can be used for objects of different levels of aggregation.

The parallel application of several methods of the data typology enables not only to identify the stable place of the studied population of objects in the space of indicators, but also to identify the type of studying territory in terms of environmental security. This gives a chance to verify the results obtained and to study the patterns of development of the studied phenomenon.

Within the allocation of spatial factors of environmental security, it is expedient to use geostatistical analysis, in particular, the calculation of research regression. The dependent variable is the integral assessment - the level of environmental security; the independent variables are parameters reflecting the economic and industrial development of differentiated territories, the state of environmental activities and the implementation of environmental innovations. As a result, a model is being developed that can identify indicators that have the greatest influence on the level of environmental security.

At the fifth stage, conclusions are drawn on the state and dynamics of ecological security of the territories, recommendations and proposals for the adoption of managerial decisions in the development of programs in order to ensure environmental security.

## 4. Methodology for assessing the level of environmental security of differentiated territories

The development of a methodology for assessing the level of environmental security is a key element in conducting this study. The methodology for assessing the level of environmental security consists of the following steps: formation of the information base of the study, reduction and data restoration, normalization, breakdown into blocks, calculation of integral indicators by blocks, calculation of the level of environmental security (Fig. 2).
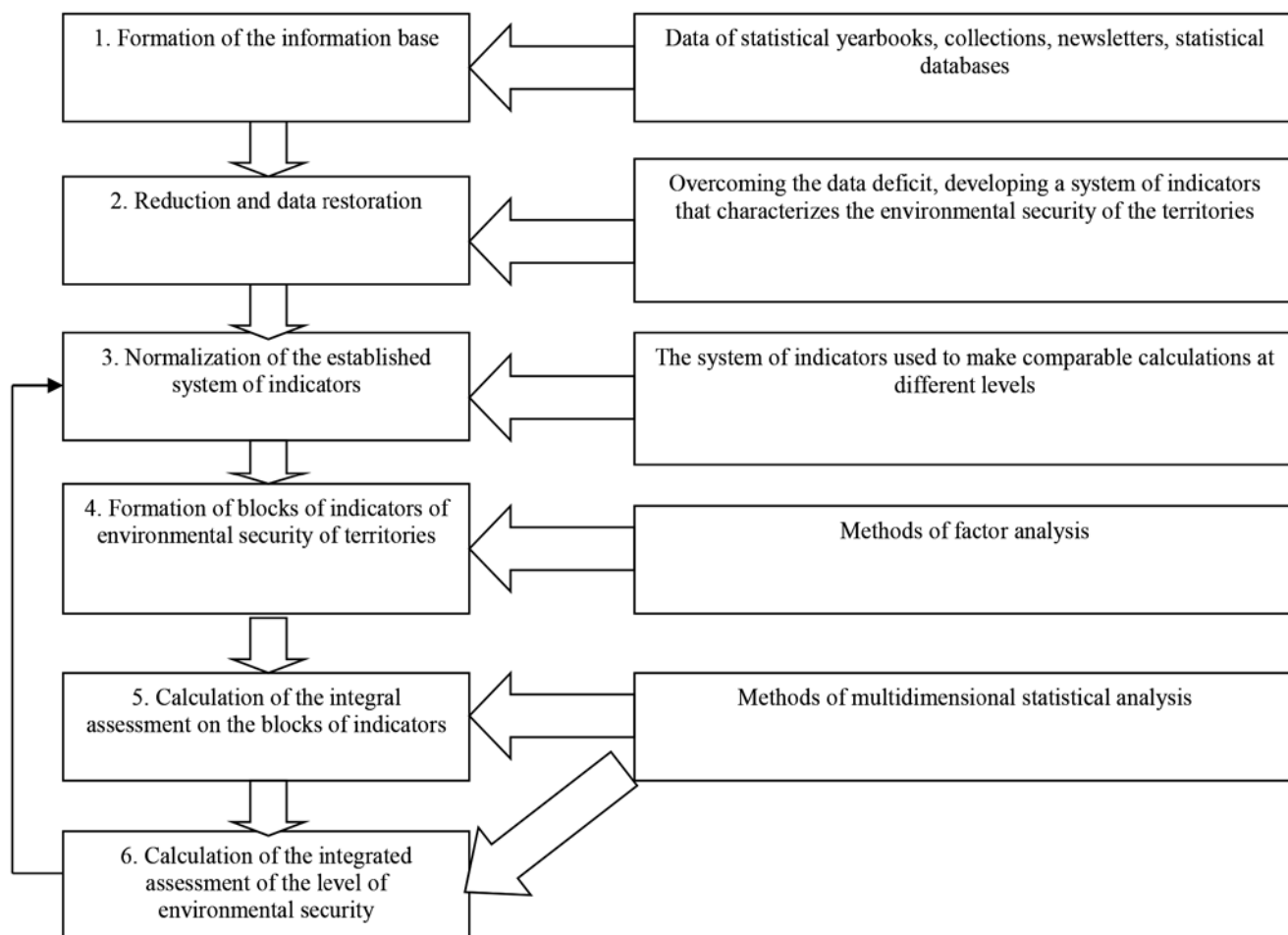
**Fig. 2.** Methodology for assessing the level of environmental security of differentiated territories

*Source:* Designed by the authors

At the first stage, the information base of the research is formed on the basis of these official sources according to the chosen observation object. As a result, the following information arrays of data are created depending on the object of observation.

1. For the world as a whole:
– production and economic activity: renewable energy sources (renewable electricity generation, as a percentage of total electricity production, renewable energy consumption, as a percentage of total final energy consumption), rent payments and adjusted savings (share of natural resources lease, as a percentage of GDP, adjusted savings on the cost of consumption of fixed capital, as a percentage of GDP, corrected savings on the value of the loss from emissions, as a percentage of GDP);
– environmental activities: water resources (renewable internal sources of fresh water per capita, cubic meters), atmospheric air protection (emissions to the atmosphere of pollutants, thousand tons by species: greenhouse gases, nitrous oxide, methane), natural territories (terrestrial and marine areas, protected as a percentage of the total area of the territory), which are especially protected, the climate (annual precipitation level, mm per year) (Environment. The World Bank, 2017);
– environmental innovations (this block is not considered due to its not developed at the world level).

2. Separate inland areas:
– production and economic activity is considered through a set of indicators: production indices by type of economic activity «Processing production», as a percentage of the previous year; production indices by type of economic activity «Production and distribution of electricity, gas and water», as a percentage of the previous

year; Indices of production by type of economic activity «Extraction of minerals», as a percentage of the previous year; indices of industrial production, as a percentage of the previous year; volume of work performed on the type of economic activity (Karpenko, et al. 2018);

– environmental activities include the following blocks of indicators: atmospheric air protection, water status, production and consumption wastes, specially protected natural areas, forestry, climate, environmental costs (Clark, 2014). It should be noted that the indicator characterizing the costs of environmental protection is expedient to be converted into a relative indicator, calculating it to GDP at the level of the country and separate territories, and at the level of municipal formations - to the volume of shipped goods of own production, performed works and services on its own.

– environmental innovations are considered through a group of indicators that characterize the share of organizations that implemented innovations that increase environmental security, both in the production process of goods, works and services, and as a result of consumer use of innovative products, as well as special costs associated with with environmental innovations (Hardt, 2017).

Despite the fact that municipalities are relatively independent from the external environment, the parameters that characterize the country as a whole remain intrinsic to it, but they have their own specifics. Therefore, for the analysis of environmental security of the territories of this level of aggregation, it is proposed to expand the actual list of indicators that characterize the protection of atmospheric air and waste from production and consumption, the indicators of the national and regional level, the functioning of the municipal entity that characterizes the specifics (Rajapaksa, et al. 2018). As a result, a comprehensive study on the environmental security of municipalities is proposed to be conducted in three constituent parts:

1. Indicators characterizing the ecological state and reflecting two components of environmental security: environmental activities, ecological innovations: air protection, waste products, water resources, environmental costs, environmental innovations. It should be noted that due to the data deficit at the level of municipalities, the regional and national components are taken into account:

a) environmental costs (investments in fixed capital, directed on environmental protection and rational use of natural resources per capita; the share of current (operational) costs for environmental protection, including the payment for environmental protection services at the cost of goods shipped from own production, performed works and services on their own (without small business entities), percents; costs of biodiversity conservation and protection of natural territories, dol. US per capita; expenses for protection and rehabilitation of land, surface and underground waters, dol. US per capita; expenses on protection of atmospheric air and prevention of climate change, dol. US per capita);

b) water resources (volume of reversible and consistently used water, thousand cubic meters per capita; use of fresh water, thousand cubic meters per capita; volume of reversible and consistently used water, thousand cubic meters per capita; discharge of contaminated sewage in surface water objects, thousand cubic meters per capita);

c) environmental innovations (the share of organizations that carry out environmental innovations, which ensure the increase of environmental security in the production of goods, works and services, as a percentage of the total number of organizations that carry out environmental innovations: reduction of energy expenditures by organizations for the production of units of goods, works, services; reduction by organizations of material costs for the production of units of goods, works, services; reduction of carbon dioxide ($CO_2$) emissions into the atmosphere; decrease by organizations of pollution of the environment (atmospheric air, land, water resources, noise reduction); replacement of raw material and materials organizations with safe or less dangerous ones; organization of recycling (recycling) waste production) (Stevens, et al. 2012);

2. Indicators characterizing socio-economic development and reflecting industrial and economic activity: the number of medical and preventive institutions (units); number of organizations that carry out educational activities in educational programs of preschool education, supervision and care for children (units); number of sports facilities - total (units); number of organizations of cultural-recreational type (unit); number of children's and youth sports schools (units); investment in fixed assets at the expense of the municipal budget, dol. US; investments in fixed assets, carried out by organizations located on the territory of the municipal education

(without small business entities), dol. US; the percentage of unprofitable organizations in the total number of organizations, percent; percentage of profitable organizations, percent; accounts payable, dol. US; receivable, dol. US; commissioning of residential houses on the territory of the municipality - sq. m. of total area; number of municipal bodies for the protection of public order (units) (Rob, et al. 2004);

3. Indicators characterizing the development of human potential: the percentage of children aged 1-6 who receive a preschool educational service and/or service from its contents in municipal educational institutions, the total number of children aged 1-6 years, the percentage; the number of those engaged in youth sports schools, people; the number of those studying in general educational institutions, taking into account the separate units (branches), people; total fertility rate, millet; total mortality rate, millet) Gandini, et al. 2017).

The formed data array has a heterogeneity of indicators and there may be no data for individual territories, therefore, at the second stage, if necessary, a recovery and reduction of data is carried out in order to increase the reliability of the results of the analysis.
The system of indicators with reconstructed data is subject to correlation analysis for testing for multicollinearity. The main criterion for the exclusion of the indicator from the system is the high value of the pair correlation coefficient.

Comparison of matrices of pair correlations over several years made it possible to determine indicators that strongly correlate with other indicators. These include: "Indices of industrial production, as a percentage of the previous year; the share of organizations that carried out innovations, which provide reduction of material costs for the production of goods, works and services, as a percentage; the share of organizations that carried out innovations that provide reduction of energy consumption per unit of goods, works, services, as a percentage; the share of organizations that carried out innovations that reduce the emission of carbon dioxide ($CO_2$) into the atmosphere, as a percentage" (Zhaoxue and Linyu, 2010).

The controversial point is the consideration of indicators: the share of organizations that implemented innovations that reduce the pollution of the environment, and the turnover of road transport organizations of all types of activities. Since the relatively high correlation coefficients were fixed not for each year under study, it was decided to leave them in the system of indicators. As a result, the system of initial indicators has the value of correlation coefficients with other indicators not exceeding 0.55 (Schoer, et al. 2012).

At the third stage, the normalization procedure is carried out, since "the feature of the initial data set is the incomparability of the units of measurement and the multi-directionality of their influence on the level of environmental security. These disadvantages can be eliminated in different ways. In order to move away from different units of measurement, the procedure of standardization or normalization of indicators is carried out".

In this study, the following formulas are used in order to eliminate the multi-directional effects of indicators on the level of environmental security:

$$x_{norm\_ij} = \frac{x_{ij}}{x_{max\_ij}} \qquad (1)$$

$$x_{norm\_ij} = 1 - \frac{x_{ij}}{x_{max\_ij}} \qquad (2)$$

where:
   $x_{norm\,ij}$ is the normalized value of the $i$-indicator for $j$-territory;
   $x_i$ is the actual value of the $i$-indicator for $j$-territory;
   $x_{max\,ij}$ is the maximum value of the $i$-indicator for $j$-territory.

Formula (1) is used if the parameter has a positive influence on the formation of the integral assessment, and formula (2) is used in the case of negative influence.

At the fourth stage, the allocation of the main indicator blocks is based on factor analysis. When interpreting its results, it is necessary that the number of factors is small, and in the sum they should explain the main part of the overall dispersion of the system of primary indicators (Table 2).

**Table 2.** Blocks of indicators characterizing environmental security of differentiated territories

| № | Block name | Indicators |
|---|------------|------------|
| 1 | Indicators reflecting the negative influence of human activities on the state of the environment | – "Emissions of pollutants into the air from stationary sources, as a percentage of the previous year; <br> – discharge of contaminated wastewater into surface water bodies, thousands cubic meters per capita; <br> – use fresh water, thousands cubic meters per capita. |
| 2 | Indicators reflecting the beneficial influence of human activities on the state of the environment | – volume of reversible and consistently used water, thousands cubic meters per capita; <br> – the share of restored forest lands to the area of forest lands damaged by fires, in percentages; <br> – absorption of substances polluting the atmosphere away from stationary sources, as a percentage of the previous year |
| 3 | Indicators reflecting the implementation of environmental innovations by organization | – the share of organizations that reduce pollution of the environment (atmospheric air, land, water resources, noise reduction), as a percentage; <br> – the share of organizations that carry out the replacement of raw materials and materials or use safe or less dangerous, as a percentage; <br> – the share of organizations that perform recycling (recycling) of waste from production, water or materials, as a percentage. |
| 4 | Indicators characterizing production activity that affects environmental security | – production indices - "Extraction of minerals", as a percentage of the previous year; <br> – production indices - "Production and distribution of electricity, gas and water", as a percentage of the previous year; <br> – production indices - "Processing production", as a percentage of the previous year; <br> – transportation of goods by road transport organizations of all types of activity, mln tons. |

*Source:* Marzec, 2015; UNDP. Human Development Report, 2018

At the fifth stage, the construction of integrated indicators is carried out according to the blocks of indicators, which are used both for groupings of differentiated territories, and for a detailed consideration of their position on the value of the integral integrated assessment of the level of environmental security (formula 3).

$$I_k = \frac{\sum_{i=1}^{m} x_{norm\_ij}}{m_k} \tag{3}$$

where:

$I_k$ – is the private index of environmental security in the $k$-th block of indicators;

$m_k$ is the number of indicators studied, in $k$-th block of indicators.

At the sixth stage, a consolidated assessment of the environmental security of differentiated territories is calculated based on the application of a multidimensional mean. The level of environmental security is based on two variants: as in the whole system of indicators (Formula 4), and on the blocks of indicators (Formula 5).

$$\bar{I}_j = \frac{\sum_{i=1}^{n} x_{norm\_ij}}{n} \tag{4}$$

$$\bar{I}_{kj} = \frac{\sum_{k=1}^{k} I_k}{k} \tag{5}$$

$I_j$, $I_{kj}$ is the level of environmental security for each $j$-territory;
$n$ is the number of indicators being studied for each $j$-territory;
$k$ is the number of indicator blocks for each $j$-territory.

The normalized integral assessment, calculated by the formula (5), makes it possible to obtain, in addition to a generalized idea about the state of the phenomenon under study, an assessment of the level of environmental security of the studied differentiated territories in the context of the individual factors forming it.

## 5. Comparative analysis of countries on the level of environmental security

Data collection for conducting international comparisons has been carried out on the following information sources: the Eurostat database, the OECD, the World Bank and the national statistics of the countries. It has been established that the comparability of research results at the international level can be achieved only with the use of the World Bank database, which publishes statistical information of countries.

The selection of indicators has been carried out on a comparative system of indicators for conducting interstate calculations for assessing the level of environmental security (Table 4).

**Table 4.** Blocks of indicators for cross-country comparisons on the level of environmental security

| № | Block name | Indicators |
|---|---|---|
| 1 | Water resources | – renewable domestic freshwater resources per capita, cubic meters; |
| 2 | Protection of atmospheric air | – total volume of greenhouse gas emissions, thousand tons; <br> – $CO_2$ emissions, thousand tons; <br> – nitrous oxide emissions, thousand tons; <br> – methane emissions, thousand tons; |
| 3 | Natural protected areas | – land and marine protected areas, percentage of the total area of the territory; |
| 4 | Renewable energy resources | – renewable sources of electricity generation, as a percentage of total electricity production; <br> – renewable energy consumption, as a percentage of total final energy consumption |
| 5 | Climate | – annual precipitation, mm per year; |
| 6 | Lease payments and adjusted savings for the use of natural resources | – the share of lease of natural resources, as a percentage of GDP; <br> – adjusted savings on the cost of capital consumption, as a percentage of GDP; <br> – adjusted savings on the cost of losses from solids emissions, as a percentage of GDP. |

*Source:* Marzec, 2015; StatCounter, 2018

The qualitative analysis of the established system of indicators revealed the possibility of studying environmental security at the international level for 1998, 2008 and 2018, as only during this period information was collected on most indicators characterizing the state of the environment. The statistical survey is performed with the following assumptions:
    – if the value of the indicator in the studied period is absent, then the value of this indicator for the previous period is taken;
    – in the case of considering the indicator "protected land and marine areas, as a percentage of the total area of the territory", the data for 1998, 2008, 2018 are equal to the corresponding data for 1994, 2004 and 2014.

The analysis of data within each year made it possible to establish that some indicators are not measured in all countries. In order to improve the quality of comparisons from the list of countries excluded countries with more than 2/3 passes throughout the system of indicators. As a result, 92 countries have been selected. On the basis of the proposed methodology for constructing the level of environmental security, the normalization of data has been performed and on their basis an integral assessment of the sample of countries of the world has been calculated (Table 5).

**Table 5.** Level of environmental security of countries for 1998, 2008 and 2018

| № | Country | Level of environmental security | | | № | Country | Level of environmental security | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1998 | 2008 | 2018 | | | 1998 | 2008 | 2018 |
| 1 | Argentina | 0,44 | 0,51 | 0,51 | 47 | Jordan | 0,41 | 0,45 | 0,45 |
| 2 | Australia | 0,41 | 0,41 | 0,41 | 48 | Japan | 0,43 | 0,47 | 0,47 |
| 3 | Austria | 0,51 | 0,56 | 0,56 | 49 | Kenya | 0,50 | 0,52 | 0,52 |
| 4 | Burundi | 0,56 | 0,62 | 0,62 | 50 | Republic of Korea | 0,43 | 0,46 | 0,46 |
| 5 | Belgium | 0,42 | 0,48 | 0,48 | 51 | Laos | 0,51 | 0,59 | 0,59 |
| 6 | Burkina Faso | 0,46 | 0,50 | 0,50 | 52 | Sri Lanka | 0,47 | 0,48 | 0,48 |
| 7 | Bangladesh | 0,43 | 0,48 | 0,48 | 53 | Luxembourg | 0,41 | 0,48 | 0,48 |
| 8 | Bulgaria | 0,43 | 0,47 | 0,47 | 54 | Morocco | 0,42 | 0,46 | 0,46 |
| 9 | Belarus | 0,42 | 0,47 | 0,47 | 55 | Madagascar | 0,46 | 0,50 | 0,50 |
| 10 | Bolivia | 0,49 | 0,53 | 0,53 | 56 | Mexico | 0,42 | 0,45 | 0,45 |
| 11 | Brazil | 0,49 | 0,49 | 0,49 | 57 | Mali | 0,48 | 0,50 | 0,50 |
| 12 | Kingdom of Bhutan | 0,63 | 0,68 | 0,68 | 58 | Mozambique | 0,52 | 0,56 | 0,56 |
| 13 | Central African Republic | 0,50 | 0,55 | 0,55 | 59 | Malaysia | 0,54 | 0,56 | 0,56 |
| 14 | Canada | 0,48 | 0,47 | 0,47 | 60 | Namibia | 0,51 | 0,57 | 0,57 |
| 15 | Switzerland | 0,49 | 0,54 | 0,54 | 61 | Nigeria | 0,52 | 0,52 | 0,52 |
| 16 | Chile | 0,52 | 0,54 | 0,54 | 62 | Nicaragua | 0,48 | 0,52 | 0,52 |
| 17 | China | 0,27 | 0,26 | 0,26 | 63 | Netherlands | 0,42 | 0,47 | 0,47 |
| 18 | Republic of Côte d'Ivoire | 0,52 | 0,53 | 0,53 | 64 | Norway | 0,52 | 0,56 | 0,56 |
| 19 | Republic of Cameroon | 0,54 | 0,56 | 0,56 | 65 | Nepal | 0,47 | 0,54 | 0,54 |
| 20 | Republic of the Congo | 0,62 | 0,72 | 0,72 | 66 | New Zealand | 0,53 | 0,54 | 0,54 |
| 21 | Colombia | 0,57 | 0,62 | 0,62 | 67 | Pakistan | 0,45 | 0,48 | 0,48 |
| 22 | Comoros | 0,43 | 0,47 | 0,47 | 68 | Panama | 0,51 | 0,56 | 0,56 |
| 23 | Costa Rica | 0,52 | 0,58 | 0,58 | 69 | Peru | 0,52 | 0,56 | 0,56 |
| 24 | Germany | 0,42 | 0,49 | 0,49 | 70 | Philippines | 0,47 | 0,51 | 0,51 |
| 25 | Denmark | 0,43 | 0,49 | 0,49 | 71 | Papua New Guinea | 0,57 | 0,62 | 0,62 |
| 26 | Dominican Republic | 0,43 | 0,49 | 0,49 | 72 | Poland | 0,47 | 0,48 | 0,48 |
| 27 | Algeria | 0,42 | 0,47 | 0,47 | 73 | Portugal | 0,43 | 0,47 | 0,47 |
| 28 | Ecuador | 0,56 | 0,61 | 0,61 | 74 | Romania | 0,48 | 0,52 | 0,52 |
| 29 | Egypt | 0,44 | 0,46 | 0,46 | 75 | Russia | 0,42 | 0,41 | 0,41 |
| 30 | Spain | 0,42 | 0,46 | 0,46 | 76 | Rwanda | 0,54 | 0,55 | 0,55 |
| 31 | Finland | 0,45 | 0,47 | 0,47 | 77 | Senegal | 0,44 | 0,50 | 0,50 |
| 32 | Fiji | 0,57 | 0,59 | 0,59 | 78 | El Salvador | 0,46 | 0,49 | 0,49 |
| 33 | France | 0,42 | 0,48 | 0,48 | 79 | Suriname | 0,63 | 0,67 | 0,67 |
| 34 | Gabon | 0,59 | 0,61 | 0,61 | 80 | Sweden | 0,45 | 0,50 | 0,50 |
| 35 | UK | 0,42 | 0,46 | 0,46 | 81 | Togo | 0,53 | 0,55 | 0,55 |
| 36 | Ghana | 0,49 | 0,52 | 0,52 | 82 | Thailand | 0,44 | 0,51 | 0,51 |
| 37 | Guinea | 0,50 | 0,53 | 0,53 | 83 | Tunisia | 0,43 | 0,46 | 0,46 |
| 38 | Greece | 0,41 | 0,46 | 0,46 | 84 | Turkey | 0,42 | 0,45 | 0,45 |
| 39 | Guatemala | 0,49 | 0,53 | 0,53 | 85 | Tanzania | 0,51 | 0,55 | 0,55 |
| 40 | Honduras | 0,50 | 0,51 | 0,51 | 86 | Uganda | 0,53 | 0,54 | 0,54 |
| 41 | Indonesia | 0,41 | 0,44 | 0,44 | 87 | Uruguay | 0,48 | 0,53 | 0,53 |
| 42 | India | 0,37 | 0,38 | 0,38 | 88 | USA | 0,25 | 0,25 | 0,25 |
| 43 | Ireland | 0,42 | 0,45 | 0,45 | 89 | Venezuela | 0,57 | 0,62 | 0,62 |
| 44 | Israel | 0,41 | 0,45 | 0,45 | 90 | Vietnam | 0,46 | 0,49 | 0,49 |
| 45 | Italy | 0,43 | 0,47 | 0,47 | 91 | Zambia | 0,58 | 0,61 | 0,61 |
| 46 | Jamaica | 0,47 | 0,48 | 0,48 | 92 | Zimbabwe | 0,45 | 0,48 | 0,48 |

*Source:* Regions in the European Union Nomenclature of territorial units for statistics NUTS 2018/EU-28, 2018; UNESCO Institute for Statistics. Sustainable Development Goal; United Nations General Assembly (UNGA), 2009; calculation authors

Based on the calculated level of environmental security in selected countries of the world, their typology has been fulfilled. In advance five types of environmental security were identified at equal intervals: crisis, low, medium, high, favorable. The results of the grouping are presented in Table 6.

**Table 6.** Typology of countries according to the level of environmental security for 1998, 2008 and 2018

| Level | Distribution of the world countries by years | | |
|---|---|---|---|
| of environmental security / the interval of measurement of the integral indicator | 1998 | 2008 | 2018 |
| Crisis / [0,00; 0,20] | – | – | – |
| Low / [0,20; 0,40] | India, China, USA | India, China, USA | India, China, USA |
| Medium / [0,40; 0,60] | Australia, Luxembourg, Israel, Jordan, Indonesia, Greece, United Kingdom, Spain, Germany, Morocco, Netherlands, France, Turkey, Ireland, Algeria, Mexico, Belorussia, Russia, Belgium, Portugal, Italy, Bangladesh, Japan, Republic of Korea, Dominican Republic, Comoros, Tunisia, Denmark, Bulgaria, Argentina, Thailand, Senegal, Pakistan, Finland, Sweden, Zimbabwe, Madagascar, Burkina-Faso, Japan, Vietnam, Jamaica, Sri Lanka, Nepal, Philippines, Poland, Canada, Uruguay, Romania, Mali, Nicaragua, Ghana, Switzerland, Bolivia, Brazil, Guatemala, Kenya, Greece, the Central African Republic, Honduras, Austria, Namibia, Tanzania, Laos, Panama, Mozambique, Peru, Norway, Côte d'Ivoire, Nigeria, Costa Rica, Chile, New Zealand, Togo, Uganda, Malaysia, Rwanda, Cameroon, Burundi, Ecuador , Colombia, Papua New Guinea, Fiji, Venezuela, Zambia, Gabon | Australia, Luxembourg, Israel, Jordan, Indonesia, Greece, United Kingdom, Spain, Germany, Morocco, Netherlands, France, Turkey, Ireland, Algeria, Mexico, Belarus, Russia, Belgium, Portugal, Italy, Bangladesh, Japan, Republic of Korea, Dominican Republic, Comoros, Tunisia, Denmark, Bulgaria, Argentina, Thailand, Egypt, Senegal, Pakistan, Finland, Sweden, Zimbabwe, Madagascar, Burkina Faso, Vietnam, El Salvador, Jamaica, Sri Lanka, Nepal, Philippines, Poland, Canada, Uruguay, Romania, Mali, Nicaragua, Ghana, Switzerland, Bolivia, Brazil, Guatemala, Kenya, Greece, Central African Republic, Honduras, Austria, Namibia, Tanzania, Lao, Panama, Mozambique, Peru, Norway, the Republic of Côte d'Ivoire, Nigeria, Costa Rica, Chile, New Zealand, Togo, Uganda, Malaysia, Rwanda, Cameroon, Fiji | Australia, Luxembourg, Israel, Jordan, Indonesia, United Kingdom, Spain, Germany, Morocco, Netherlands, France, Turkey, Ireland, Algeria, Mexico, Belorussia, Russia, Belgium, Portugal, Italy, Bangladesh, Japan, Republic of Korea, Dominican Republic, Comoros, Tunisia, Denmark, Bulgaria, Argentina, Senegal, Thailand, Egypt, Senegal, Pakistan, Senegal, Pakistan, Finland, Sweden, Zimbabwe, Madagascar, Burkina Faso, Philippines, Viet Nam, Viet Nam, Yemen, Sri Lanka, Nepal, Philippines, Philippines, Poland, Uruguay, Rwanda, Mali, Nicaragua, Ghana, Switzerland, Bolivia, Brazil, Guatemala, Kenya, Greece, Central African Republic, Honduras, Austria, Namibia, Tanzania, Panama, Mozambique, Peru, Norway, the Republic of Côte d'Ivoire, Nigeria, Costa Rica, Chile, New Zealand, Uganda, Malaysia, Rwanda, Cameroon, Burundi, Ecuador, Colombia, Fiji, Venezuela |
| Favorable / [0,60; 0,80] | Republic of the Congo, Kingdom of Bhutan, Suriname | Ecuador, Zambia, Gabon, Burundi, Venezuela, Papua New Guinea, Colombia, Suriname, The Kingdom of Bhutan, the Republic of the Congo | Lao, Zambia, Greece, Togo, Papua New Guinea, Gabon, the Kingdom of Bhutan, Suriname, Republic of the Congo |
| High / [0,80; 1,00] | – | – | – |

*Source:* UNESCO Institute for Statistics. Sustainable Development Goal; United Nations Statistics Division; calculation authors

As a result of constructing a typological grouping of countries in terms of environmental security, it was found that 2 out of 5 groups are not filled with observation objects, namely crisis and high level of environmental security.

The countries under study were divided into three groups with low, medium and favorable levels. The trends are as follows:

– India (0.38), China (0.26) and the United States (0.25) have a consistently low level of environmental security;

– Suriname (0.67), the Kingdom of Bhutan (0.68) and the Republic of the Congo (0.72) have a very favorable level of environmental security;

– most countries are characterized by a stable medium level of environmental security.

Thus, the typology of different methods does not contradict each other and makes it possible to make effective managerial decisions. It should be noted that in order to develop monitoring of environmental security in the countries under study, it is necessary to implement recommendations for the improvement of statistical observation, allowing a comprehensive assessment of the environmental state of the studied areas, as well as the harmonization of national systems of indicators with international ones.

## Conclusions

On the basis of critical analysis, the system of statistical indicators of environmental security has been generalized and improved by harmonizing the systems used by domestic and international databases in order to assess the state of the environment and the environmental situation of differentiated territories in order to conduct interterritorial comparisons. The solution to this problem was based on the analysis by means of statistical observation. As a result, it has been proposed for intergovernmental organizations to perform ensuring the environmental security on the basis of three components:

– production and economic activity, which is found indirectly in the following blocks: renewable energy resources, lease payments and adjusted savings;

– environmental activities characterized by five blocks of indicators: water resources, atmospheric air protection, specially protected natural areas, climate, biodiversity;

– environmental innovations that are considered through a set of indicators characterizing innovations that provide increased environmental security both in the process of producing goods, works and services, and as a result of consumer use of innovative products, as well as special costs associated with environmental innovations;

– environmental activities based on the following blocks of indicators: atmospheric air protection, water resources status, production and consumption wastes, specially protected natural areas, forestry, climate, environmental costs;

– environmental innovations that are considered through a set of indicators, organizations characterizing a specific weight, made innovations that provide increased environmental security, both in the process of producing goods, works and services, and as a result of consumer use of innovative products, as well as special costs, associated with environmental innovations.

## References

Aradau, Claudia. (2014). The Promise of Security. Resilience, 2(2):73–87. https://doi.org/10.1080/21693293.2014.914765

Areiqat, A.Y.; Al-Ali, A.H.: Al-Yaseen, H.M. (2019). Entrepreneurship in palm fronds recycling: a Jordanian case. Entrepreneurship and Sustainability Issues, 6(4): 1694-1703. http://doi.org/10.9770/jesi.2019.6.4(10)

Baker, Aryn; Richard, A. Matthew and Karen, O'Brien. (2015). How Climate Change is behind the Surge of Migrants to Europe. Time Magazine, September 7. Accessed November 13. Available on the Internet: http://time.com/4024210/climate-change-migrants/

Chalecki, Elizabeth L. (2016). Environmental security: a guide to the issues. Available on the Internet: https://books.google.ru/books?id=GPk-Oc_7mzsC&printsec=frontcover&dq=

Chapin, F.S.; Carpenter, S.R.; Kofinas, G.P. et al. (2010). Ecosystem stewardship: sustainability strategies for a rapidly changing planet. Trends in Ecology & Evolution, 25 (4): 241-249. https://doi.org/10.1016/j.tree.2009.10.008

Cherchyk, L.; Shershun, M.; Khumarova, N.; Mykytyn, T.; Cherchyk, A. (2019). Assessment of forest enterprises' performance: integrating economic security and ecological impact. Entrepreneurship and Sustainability Issues, 6(4): 1784-1797. http://doi.org/10.9770/jesi.2019.6.4(17)

Clark, Nigel. (2014). Geo-Politics and the Disaster of the Anthropocene. The Sociological Review, 62(S1): 19-37. https://doi.org/10.1111/1467-954X.12122

Cook, J.; Oreskes, N.; Doran, P. T.; Anderegg, W. R. L.; Verheggen, B.; Maibach, E. W.; Carlton, J. S.; Lewandowsky, S.; Skuce, A. G.; Green, S. A. (2016). Consensus on consensus: a synthesis of consensus estimates on human-caused global warming, Environmental Research Letters, 11(44). https://doi.org/10.1088/1748-9326/11/4/048002048002

Corry, Olaf. (2017). The International Politics of Geoengineering: The Feasibility of Plan B for Tackling Climate Change. Security Dialogue, 48(4): 297-315. https://doi.org/10.1177%2F0967010617704142

Dalevska, N.; Khobta, V.; Kwilinski, A.; Kravchenko, S. (2019). A model for estimating social and economic indicators of sustainable development. Entrepreneurship and Sustainability Issues, 6(4): 1839-1860. http://doi.org/10.9770/jesi.2019.6.4(21)

*Drobyazko S. (2017). Formation of competitive positions as providing of economic security of insurance companies // International scientific journal "Internauka". Series: "Economic Sciences", №2.* URL: https://doi.org/10.25313/2520-2294-2017-2-4784

Drobyazko S., Hryhoruk I., Pavlova H., Volchanska V., Sergiychuk S. (2019). Entrepreneurship innovation model for telecommunications enterprises. Journal of Entrepreneurship Education, Volume 22, Issue 2, 2019. URL: https://www.abacademies.org/articles/entrepreneurship-innovation-model-for-telecommunications-enterprises-8097.html

Eddelani, O.; El Idrissi, N. E.; Monni, S. (2019). Territorialized forms of production in Morocco: provisional assessment for an own model in gestation. Insights into Regional Development, 1(1): 6-18. https://doi.org/10.9770/ird.2019.1.1(1)

Environment. The World Bank (2017). Available on the Internet: http://data.worldbank.org/topic/environment

Fagan, Madeleine. (2017). Security in the Anthropocene. European Journal of International Relations, 23(2): 292-314. https://doi.org/10.1177%2F1354066116639738

Floyd, Rita. (2015). Global Climate Security Governance: A Case of Institutional and Ideational Fragmentation." Conflict, Security and Development 15(2):119–146. https://doi.org/10.1080/14678802.2015.1034452

Gandini, A.; Garmendia, L.; San Mateos, R. (2017). Towards sustainable historic cities: mitigation climate change risks, Entrepreneurship and Sustainability Issues 4(3): 319-327. https://doi.org/10.9770/jesi.2017.4.3S(7)

Hardt, Judith Nora. (2017). Environmental Security in the Anthropocene. London: Routledge. URL: https://www.routledge.com/Environmental-Security-in-the-Anthropocene-Assessing-Theory-and-Practice/Hardt/p/book/9781138704893

Harrington, Cameron, and Clifford Shearing. (2017). Security in the Anthropocene. Bielefeld: Transcript. URL: https://www.transcript-verlag.de/978-3-8376-3337-5/security-in-the-anthropocene/

Karpenko, L.; Serbov, M.; Kwilinski, A.; Makedon, V. & Drobyazko, S. (2018). Methodological platform of the control mechanism with the energy saving technologies, Academy of Strategic Management Journal, Volume 17, Issue 5, 2018: URL: https://www.abacademies.org/articles/Methodological-platform-of-the-control-mechanism-1939-6104-17-5-271.pdf

Marzec, Robert P. (2015). Militarizing the Environment. Minneapolis, MN: University of Minnesota Press. http://dx.doi.org/10.1007/s13412-017-0450-9

Masood, O.; Tvaronavičienė, M.; Javaria, K. (2019). Impact of oil prices on stock return: evidence from G7 countries, Insights into Regional Development 1(2): 129-137. https://doi.org/10.9770/ird.2019.1.2(4)

Mcdonald, M. (2018). Climate change and security: towards ecological security? International Theory, 10:2: 153-180. https://doi:10.1017/S1752971918000039

McDonald, Matt. (2012). Security, the Environment and Emancipation: Contestation Over Environmental Change. London: Routledge. https://doi.org/10.4324/9780203805138

Mudgal, S. (2012). Assessment of resource efficiency indicators and targets. Final report for the European Commission. Paris: BIO Intelligence Service, Institute for Social Ecology and Sustainable Europe Research Institute and Sustainable Europe Research Institute (SERI). URL: http://ec.europa.eu/environment/enveco/resource_efficiency/pdf/report.pdf

Olaniyi, O.E.; Prause, G.; Bakkar, Y. (2019). Entrepreneurial compliance opportunities for maritime fuel producers, Entrepreneurship and Sustainability Issues 6(4): 1550-1565. https://doi.org/10.9770/jesi.2019.6.4(1)

Olaniyi, O.E.; Prause, G.; Bakkar, Y. (2019). Entrepreneurial compliance opportunities for maritime fuel producers. Entrepreneurship and Sustainability Issues, 6(4): 1550-1565. https://doi.org/10.9770/jesi.2019.6.4(1)

Rajapaksa, D.; Islam, M., Managi, S. (2018). Pro-Environmental Behavior: The Role of Public Perception in Infrastructure and the Social Factors for Sustainable Development. Sustainability, 10(4): 937. https://doi.org/10.3390/su10040937

Razminienė, K.; Tvaronavičienė, M. (2018). Detecting the linkages between clusters and circular economy. Terra Economicus, 16(4): 50-65. http://dx.doi.org/10.23683/2073-6606-2018-16-4-50-65

Regions in the European Union Nomenclature of territorial units for statistics NUTS 2018/EU-28 (2018). Available on the Internet: http://ec.europa.eu/eurostat/documents/3859598/6948381/KS-GQ-14-006-EN-N.pdf/b9ba3339-b121-4775-9991-d88e807628e3

Rob, H.; Jongmana, G.; Mart, K. et al. (2004). European ecological networks and greenways. Landscape and Urban Planning, 68: 305-319. URL: http://assets.cambridge.org/97805218/27768/frontmatter/9780521827768_frontmatter.pdf

Schmidt-Bleek, F. (2009). The Earth: Natural Resources and Human Intervention (Sustainability Project). London: Haus publishing

Schoer, K., et al., (2012). Conversion of European Product Flows into raw material equivalents. Heidelberg: Institut fur Energie- und Umweltforschung URL: https://www.ifeu.org/nachhaltigkeit/pdf/RME_EU27-Report-20120618.pdf

Smaliukienė, R.; Monni, S. (2019). A step-by-step approach to social marketing in energy transition. Insights into Regional Development, 1(1): 19-32. https://doi.org/10.9770/ird.2019.1.1(2)

StatCounter. (2018). Search Engine Market Share Worldwide - January 2018. StatCounter GlobalStats. Available on the Internet: http://gs.statcounter.com/search-engine-market-share>

Stevens, Paul A.; Batty, William J.; Longhurst, Phil J.; Drew. Gillian H. (2012). A critical review of classification of organisations in relation to the voluntary implementation of environmental management systems. Journal of Environmental Management, 113: 206-212. http://dx.doi.org/10.1016/j.jenvman.2012.08.037

Sustainable development and environment. UNECE. Available on the Internet: http://www.unece.org/stats/sde.html

UNDP. Human Development Report (2018). Available on the Internet: http://hdr.undp.org/en/2018-update

UNESCO Institute for Statistics. Sustainable Development Goal. Available on the Internet: http://uis.unesco.org/en/topic/sustainable-development-goal-4

United Nations General Assembly (UNGA). (2009). Climate Change and Its Possible Security Implications. Report of the Secretary-General. A/64/350. United Nations, New York. Available on the Internet: http://www.un.org/esa/dsd/resources/res_pdfs/ga-64/SGReport_on_climate_change_and_security.pdf

United Nations Statistics Division. Available on the Internet: http://unstats.un.org/unsd/demographic/sconcerns/disability/disab2.asp

Von, Lucke; Franziskus, Zehra; Wellmann, and Thomas Diez. (2014). What's at Stake in Securitizing Climate Change?. Geopolitics, 19(4): 857-864. http://dx.doi.org/10.1017/S1752971918000039

Watts, Michael. (2013). A Political Ecology of Environmental Security. In Environmental Security: Approaches and Issues, edited by Rita Floyd and Richard A. Matthew, 82-101. London: Routledge. https://doi.org/10.1017/S1752971918000039

Yusoff, Kathryn. (2013). Geologic Life: Prehistory, Climate, Futures in the Anthropocene. Environment and Planning, D 31: 779–95. URL: http://disaster-sts-net.ss.uci.edu/content/geologic-life-prehistory-climate-futures-anthropocene

Zemlickiene, V.; Mačiulis, A.; Tvaronavičienė, M. (2017). Factors impacting the commercial potential of technologies: expert approach. Technological and Economic Development of Economy, 23(2): 410-427 http://dx.doi.org/10.3846/20294913.2016.1271061

Zhaoxue, L.I.; Linyu, X. (2010). Evaluation indicators for urban ecological security based on ecological network analysis. Procedia Environmental Sciences, 2: 1393–1399.

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