

Ecological and Economic Security Assessment in the System of Regional Environmental Management: A Case Study of Ukraine

L. F. Sokolenko¹ and I. V. Tiutiunyk² and D. V. Leus³

¹Department of Finance, Sumy National Agrarian University,
160, G. Kondratieva St., 40021 Sumy (Ukraine)
Email: sokol1207@ukr.net

²Department of Finance and Credit, Sumy State University,
2, Rymskogo-Korsakova St., 40007 Sumy (Ukraine)
Email: i.karpenko@finance.sumdu.edu.ua

³Department of Finance and Credit, Sumy State University,
2, Rymskogo-Korsakova St., 40007 Sumy (Ukraine)
Email: d.leus@sumdu.edu.ua

ABSTRACT

In the article the analysis of methodical approaches to the assessment of the level of ecological and economic security of regions is done. The authors proposed to assess ecological and economic security as integrated index which takes into account the interrelation of financial and ecological components and the influence of natural and artificial risks. It is identified the main indicators of integrated index of ecological and economic security. The scale of regions' grading (depressed, satisfactory secure, acceptably secure regions), depending on the value of the integrated index is worked out. In the manuscript the authors estimated the level of ecological and economic security of regions of Ukraine. According to the results the majority of regions of Ukraine have the low (in average not higher than 0,2) level of security. The authors highlighted that given approach, will allow to improve the quality of regional management by means of strategy development which is the most favorable for the financial possibilities and ecological situation in region. It is proposed to develop measures for effective distribution of budget funds, depending on the level of developed index.

Keywords: Level of ecological and economic security, regional natural management, financial security, regional strategy development.

Mathematics Subject Classification: 90B50, 91B76, 91B82

Journal of Economic Literature (JEL) Classification : C13; O44; Q01, Q57, R11

1. INTRODUCTION

Modern functioning of Ukraine's economy requires search of new ways of interaction of the society with the environment. Trends of ecological and economic development witness about essential disproportions in the ecological development of certain regions and inequality of their financial

provision. The main macroeconomic indicators that characterize the level of ecological development of the country in general and its position among other countries, in particular, will be stated in the article. According to the Environmental Performance Index (Environmental Performance Index, 2010-2015), Ukraine, during recent 5 years improved its position only for one point and now occupies the 95th place among 179 possible. According to the Index of Economic Freedom (Index Economic Freedom, 2010-2015), which takes into account such ecological characteristics as: air pollution, CO₂ emission, greenhouse gases emission, quality of water, biodiversity and living environment, climate change, Ukraine occupies the 162th place. According to the Global Competitiveness Index (World Economic Forum, 2010-2015) it occupied the 79th place among the 140 possible in 2015, though in 2010 it occupied the 89th place.

The analysis confirms preconditions for the growth of ecological insecurity of regions and the country in general. It creates prerequisites to the determination of the key directions of ecological security management on the macro-, meso-, and micro levels by effective and rational environmental management and its providing in short- and especially long-term periods.

2. GENERATION OF THE DATA

Problems of environment and society interaction were investigated by such scientists: V. Anuchin, I. Blekhtsin, T. Galushkina, Yu. Kurazhkovskiy, N. Narezhniy, V. Mineev, V. Preobrazhenskiy, V. Rudenko, V. Stepanov, N. Cui, C. Feng, G. Gan, G. Li, J. Tian, and others. Taking into account the significant contribution of the scientists to assessment of ecological security and its' separate components, the question of methodical providing of the assessment of financial and ecological security level as the integrated economic indicator remains unsolved. It characterizes financial and ecological relations among entities of regional environmental management system concerning the formation of conditions for the resource-saving use and reproduction of natural resources.

2.1. Basic material statement

The purpose of this work is to development of theoretical and methodical approach to regional financial and ecological security assessment by developing system of indicator based on coordination of ecological and economical indexes. It allows to determine influence of ecological factors on the level of financial provision of region and to make effective decisions on the financial instruments usage in the system of environmentally-oriented regional development.

Ecological security assessment identifies the integrity of ecosystem and the ability to maintain its health under various risks. Ecological security assessment is a quantitative description of the quality of ecological system security.

Definition of quantitative indexes of financial-ecological security of the region, based on the coordination of financial and ecological components will permit to analyze the level of security in dynamics, to define and take into account factors causing the decrease of its level and to define the directions of the further regional management.

According to C. Feng, N. Cui, G. Li, L. Gan:

- the indicator system must be able to reflect every aspect of the urban eco-security;
- the data for the indicators must be able to be collected from the reliable sources and be consistent;
- the indicator system must be able to accommodate the relationship between the evaluation indicators and the evaluation criteria, especially to generate corresponding evaluation indicators based on evaluators' criteria (C.Feng, N.Cui, G. Li and L.Gan, 2015).

There are a lot of approaches to determination of the main components of ecological security. M. Averkina allocates: natural and ecological (level of erosion and tilling of agricultural lands; contents of humus; the proportion of lands, polluted with radiation; growth rates of reforestation; the proportion of water, lost during the transportation; water intensity of gross value added (GVA); technogenic and ecological (emissions of the poisonous substances emissions into the atmosphere by the immovable and movable objects; proportion of water, consumed for the industrial purposes; proportion of contaminated waters in the general water drainage; creation of the wastes of the I-III class of hazards) and social-ecological security (growth rates of incomes and average salary of the population; level of the official unemployment; employment of the population; quantity of beds in the hospitals per 10 thousand of people; population growth per 1000 residents; rate of crimes; availability of residential stock per 1 person in average) (M. F.Averkina, 2010).

V. H. Potapenko and D. S. Biryukoviy distinguish 4 groups of indicators of the assessment of ecological security:

- waste regulation (volume of created, disposed, recycled and volume of waste removed to the special places and objects);
- usage and protection of water resources (volume of consumed water, polluted, cleaned and allocated natural water objects);
- usage and protection of forests, animal resources and conservation areas (volume of logging, wood restoration, quantity and areas of wildlife reserves, national nature parks, etc);
- emissions of sulfur dioxide and nitrogen oxide into the atmosphere (V. G. Potapenko, 2012).

2.2. Methods of regional ecological and economic security assessment

To sum up, the most productive is distinguishing of the natural-ecological and anthropogenic-ecological danger with detalisation within each of them indexes according to the kinds of natural resources.

To the indexes of natural and ecological security we can refer:

- level of erosion of arable lands;
- forests reproduction on lands of common usage;
- rate of increase of forests reproduction on lands of common usage;
- water intensity of gross value added (GVA).

Anthropogenic-ecological security is a characteristics of the risk level, based on the performing of manufacturing activities by the economic entities (excessive emissions and leakage of contaminators into the environment; excessive usage of natural resources while the manufacturing process).

The indexes of assessment of the level of anthropogenic-ecological security of the region are:

- volume of emissions of contaminators into the atmosphere by immovable and movable sources;
- volume of created and neutralized wastes of the I–III classes of hazards;
- ratio of the volume of leakage of contaminated waters and capacities of purification plants.

Not less important components of financial and ecological security of the region is the financial component. It defines the level of financial protection of subjects of system of regional environmental management and their ability for independent financing of ecologically oriented measures.

Today there are a great number of scientific and methodical approaches to the assessment of the level of financial security. Based on the conducted research of the existing analytical base of the determination of quantitative indexes of the assessment of financial security we have distinguished their key indicators. They will be taken into account while the development of methodical approach to the assessment of financial and ecological security of the region in terms of its components (budget, taxation, investment).

Indexes that characterize the level of budget security of the region are:

- rates of increase (decrease) of the Gross Regional Product (GRP);
- amount of the external public debt to GRP;
- amount of the internal public debt to GRP;
- ratio of transfers to GRP;
- expenditures for the realization of the ecologically-oriented measures, % to GRP.

Level of protection of the interests of subjects of system of regional environmental management, economical stability and independence of the functioning system of taxation and ability to coordinate interests of economic entities with the interests of public authorities are reflected in the indexes of taxation security, which include:

- ratio of tax to the GRP, %;
- level of the governmental grants for the region;
- coefficient of the tax burden.

Realization of the ecologically-oriented measures on the regional level requires essential capital investments. One of subjects of system of regional environmental management are investors. The amount of investment, as a rule, depends on the level of attractiveness and financial reliability of the region. Indicators that reflect investment climate in the region are indicators of investment security, main of which are:

- amount of the direct foreign investments per capita;
- ratio of the amounts of the investments into fixed capital to the GDP;
- ratio of the amounts of the investments to the value of fixed assets;
- ratio of net increase of direct foreign investments to the GDP;
- proportion of direct foreign investments in the general amount of investments;
- level of depreciation of fixed assets.

To provide the comparability of the indexes of ecological and financial security it is necessary to carry out rationing of indicators.

According to the Methodical recommendations forevaluation of the level of economic security [Ministry of Economic Development and Trade of Ukraine, 2013] rationing of indicators it is carry out by means of linear function. All indexes are divided into stimulators and destimulator. Bringing of indicators to the unique comparable form is carried out by their comparison with the maximum/minimum values, depending on what is more desirable for us – growth or reduction of an indicator.

Table 1:Formula for calculating the level of financial and environmental security in the region

Indicator	Formula	Meaning
Integrated index of financial and ecological security of the region in terms of ecological component (I_E)	$I_E = \sqrt[5]{I_R \times I_A \times I_{WR} \times I_{Wast} \times I_W}$	I_R – state of land resources; I_A – state of air; I_{WR} – state of wood resources; I_{Wast} – handling with wastes; I_W – state of water resources.
Integrated index of financial and ecological security of the region in terms of financial component (I_F)	$I_F = \sqrt[3]{I_B \times I_T \times I_I}$	I_B – integrated index of financial component in terms of budget policy of the region; I_T – integrated index of financial component in terms of indexes of taxation policy of the region; I_I – integrated index of financial component in terms of indexes of investment policy of the region.
The level of financial and ecological security of the region	$P_{FESR} = 1 - (\beta + \alpha \cdot \sigma \cdot (I_F - I_E))$	β – natural risks; α – artificial risks (influence of the human); σ – correlation coefficient of financial and ecological indexes of security .

Depending on the obtained value of the level of financial and ecological security of the region it is offered to group regions in levels:

- a) depressed regions – region with the low level of FESR ($0 < FESR \leq 0,33$);
- b) satisfactory secure regions – region with the satisfactory level of FESR ($0,34 < FESR \leq 0,66$);
- b) acceptably secure regions - region with the high level of FESR ($0,67 < LFESR \leq 1$).

3. RESULTS

Based on the given approach assessment of the financial and ecological security of the regions in terms of main subjects of system of the regional environmental management will be conducted.

In general, the majority of the regions have low level of investment security (0,3 – 0,4), consequently, they are quite susceptible in terms of their ability to attract new investments to the regions under internal and external dangers. Analysis of the level of the taxation security allowed making conclusion about the sufficient stability of the taxation income in the region. The proportion of the taxation income in the structure of GRP in the last 5 years was in average 2% (Table 2).

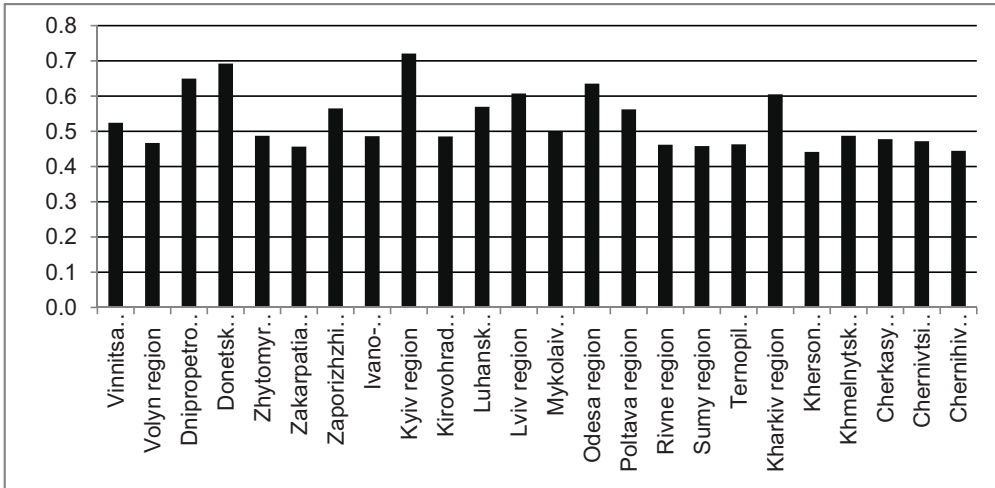
Table 2: Level of investment, taxation and budget security*

Region	Investment security	Taxation security	Budget Security	Region	Investment security	Taxation security	Budget security
Vinnitsa region	0,27	0,83	0,60	Mykolaiv region	0,32	0,88	0,62
Volyn region	0,19	0,75	0,60	Odesa region	0,26	0,66	0,64
Dnipropetrovsk region	0,43	0,83	0,68	Poltava region	0,47	0,88	0,64
Donetsk region	0,22	0,92	0,66	Rivne region	0,33	0,92	0,61
Zhytomyr region	0,35	0,87	0,61	Sumy region	0,43	0,80	0,61
Zakarpattia region	0,45	0,96	0,60	Ternopil region	0,46	0,85	0,59
Zaporizhzhia region	0,41	0,70	0,65	Kharkiv region	0,35	0,90	0,63
Ivano-Frankivsk region	0,29	0,73	0,60	Kherson region	0,42	0,87	0,60
Kyiv region	0,88	0,83	0,65	Khmelnyskyi region	0,20	0,84	0,61
Kirovohrad region	0,67	0,83	0,61	Cherkasy region	0,23	0,95	0,61
Luhansk region	0,29	0,89	0,62	Chernivtsi region	0,36	0,88	0,60
Lviv region	0,46	0,83	0,61	Chernihiv region	0,25	0,86	0,60

*Calculated by the authors

The budget security is characterized by the low values of the mentioned index, and in average its rate is 0.4. Annual increase of the amount of external and internal state debt of Ukraine, considerable level of power concentration and dependence of the local authorities on the transfers caused low values of this index and so, consequently, great dependence of the state and local authorities on the internal and external environment.

In general the level of financial security of the regions (fig.1) has an average value. Except for Dnipropetrovsk, Kyiv, Odesa, Kharkiv regions, which have the value higher than 0,5. The lowest values have Kherson and Zaporizhzhya regions.

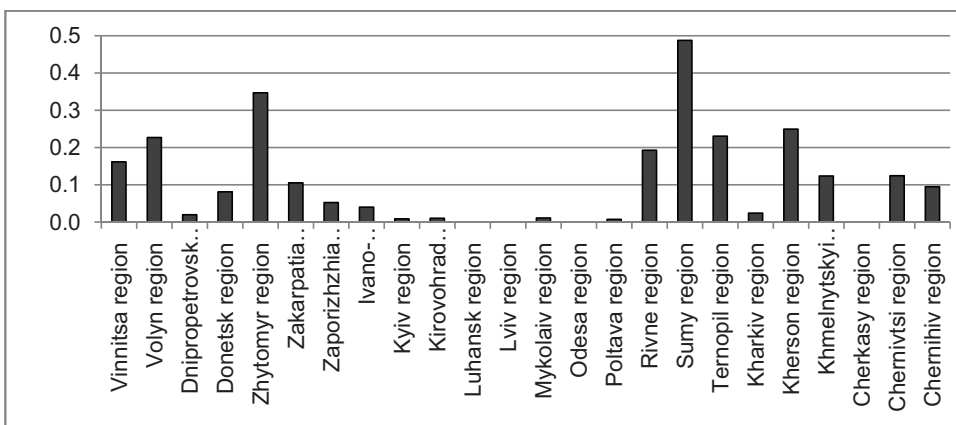


*Calculated by the authors

Figure 1. Level of financial security of the regions of Ukraine in 2015*

Ecological component reflects the influence of the economic activity on the environment, effectiveness of the use of natural resources and the level of innovation development of the country. According to the offered approach to the assessment of the level of the regions ecological security, evaluation of its level in terms of regions of Ukraine is to be done (fig. 2).

According to the obtained results, the majority of the regions have low level of ecological security. Except for Volyn', Zhytomyr, Sumy, Ternopil, Kherson regions, which level of security is higher than 0,2. Thus, the given values of the variable of the ecological security characterize complicated ecological situation in the majority of the regions in general and the necessity of realization of the measures to the improvement of ecological situation in particular.



*Calculated by the authors

Figure 2. Level of ecological security of the regions of Ukraine, 2016*

Results of the calculation of the integrated index of financial and ecological security are presented in the table 3.

Table 3: Level of financial and economic security in terms of regions of Ukraine*

Region	2013	2014	2015	Region	2013	2014	2015
Vinnitsa region	0,65	0,64	0,59	Mykolaiv region	0,42	0,43	0,36
Volyn region	0,48	0,46	0,33	Odesa region	0,28	0,26	0,42
Dnipropetrovsk region	0,48	0,47	0,29	Poltava region	0,53	0,56	0,48
Donetsk region	0,64	0,67	0,69	Rivne region	0,51	0,53	0,37
Zhytomyr region	0,55	0,57	0,34	Sumy region	0,58	0,61	0,56
Zakarpattia region	0,44	0,44	0,37	Ternopil region	0,39	0,43	0,31
Zaporizhzhia region	0,48	0,46	0,38	Kharkiv region	0,43	0,43	0,58
Ivano-Frankivsk region	0,53	0,55	0,43	Kherson region	0,56	0,57	0,43
Kyiv region	0,46	0,44	0,37	Khmelnitskyi region	0,33	0,4	0,13
Kirovohrad region	0,51	0,52	0,4	Cherkasy region	0,6	0,62	0,18
Luhansk region	0,52	0,54	0,48	Chernivtsi region	0,55	0,57	0,22
Lviv region	0,51	0,51	0,52	Chernihiv region	0,57	0,6	0,5

*Calculated by the authors

The highest level of financial and ecological security have Vinnitsa, Kharkiv and Sumy regions. Almost half of the regions of Ukraine can be characterized as satisfactory secure (level of financial and ecological security is 0,33-0,66) and less than half of the regions are depressed (from 0 till 0,33).

4. DISCUSSION AND CONCLUSION

Several authors researched approaches that assess the level of financial and ecological security. They are based on the different number of groups of indexes. During this research has been proposed the integrated index of financial and ecological security of region that allowed revealing low level of ecological development of most regions of Ukraine. It is noted that this entails disproportions in the ecological development of certain regions and inequality of their financial provision.

In the present study, we proposed to consider the influence of natural and artificial risks on financial and ecological security that often encountered in practice. This approach makes it possible to receive more precise estimates.

In our opinion, suggested scientific and methodical approach to assessment of the level of financial and ecological security of the region allows:

- 1) taking into account interconnection between financial and ecological indicators of security;
- 2) assessing the magnitude of natural and artificial risks and defining their influence on the indexes of financial and ecological components;
- 3) performing organization of the regions according to the level of integrated index for the further development and implementation of the corresponding strategy of ecologically secure regional development;
- 4) improving the efficiency of the process of financial support of the region and thus remove the imbalance of their financial and ecological development.

5. REFERENCES

EnvironmentalPerformanceIndex<http://epi.yale.edu/> [2014]

IndexEconomicFreedom<http://www.heritage.org/index/visualize> [2015]

Averkina, M. F., 2010, Methodical bases of assessing the level of economic and environmental security of the region. *Scientific Proceedings of Ostroh Academy National University, series "Economics"* **14**, 414–420.

Guidelines for calculation of Ukraine's level economic security. Order of the Ministry of Economic Development and Trade of Ukraine of 29.10.2013 № 1277 [Internet]. Available from: http://cct.com.ua/2013/29.10.2013_1277.htm

World Economic Forum [Internet]. Available from <http://www.weforum.org/>.

Official Ukrainian database [Internet]. Available from: <http://www.ukrstat.gov.ua/>

Potapenko, V. G., 2012. Strategic priorities for safe development of Ukraine based on "green economy". Kyiv: NISD.

Sokolenko, L. F., & Mikhailova, L. I., 2015. The algorithm of assessment of financial and environmental safety of the region. Visnyk Chernihiv State Technological University. "Section Economics", **2**, 229–234.

Shemaeva, L. G., Onofriychuk, V. P., 2012. Technique of assessment of level of financial security of sector of public finances in Ukraine. *Problems of science*, **3**, 38–43.

Tian, J., & Gang, G., 2012. Research on Regional Ecological Security Assessment. *Energy Procedia*, Vol. 16, Part B, 1180-1186.

Feng, C., Cui, N., Li, G., Gan, L., 2015. Regional Ecological Security Assessment: A Case Study of Tongling City, Anhui Province. *Forest Research* **4**, [Internet]. Available from: <https://www.omicsgroup.org/journals/regional-ecological-security-assessment-a-case-study-of-tongling-city-anhui-province-2168-9776.1000132.php?aid=36774>.

Kozulia T.V., Sharonova N.V., Kozulia M.M., 2010. Ecological Corporative System Concept in Solving Problems of Ecological Estimation and Ecological Hygienic Normalization, *R&I*, **4**, 51-57.

Rozenbaum, A. N., Klimchenko, V. V., 2016, Estimation of the Level of Ecological Safety in the Small City. *International Journal of Ecology & Development* **31**, 49-55.

Lutafali, S., Khoja, F., 2011, Economic and Ecological Partnership Revitalizing Urban Slums: A Case Study of Cairo. *International Journal of Ecology & Development* **18**, 29-45.