

# ANTHROPOGENIC IMPACT AS A SOURCE OF ENVIRONMENTAL THREATS AND HAZARDS: TENDENCIES AND SPECIFICS OF MANIFESTATION ON THE BORDER TERRITORIES OF WESTERN UKRAINE

## АНТРОПОГЕННИЙ ВПЛИВ ЯК ДЖЕРЕЛО ЕКЗОГЕННИХ ЗАГРОЗ ТА РИЗИКІВ: ТЕНДЕНЦІЇ ТА СПЕЦИФІКА ВИЯВЛЕННЯ НА ПРИКОРДОННИХ ТЕРИТОРІЯХ ЗАХІДНОЇ УКРАЇНИ



**Hanna OBYKHOD,**  
Ph.D. in Economics,  
Public Institution "Institute for  
Environmental Management and  
Sustainable Development of the  
National Academy of Sciences  
of Ukraine", Kyiv

**Ганна ОБИХОД,**  
кандидат економічних наук,  
Державна установа «Інститут  
економіки природокористування  
та сталого розвитку НАН України», Київ

**Inna ILLIASHENKO,**  
Ph.D. in Economics,  
Taras Shevchenko  
National University of Kyiv

**Інна ІЛЛЯШЕНКО,**  
кандидат економічних наук,  
Київський національний університет  
імені Тараса Шевченка



The anthropogenic impact has considerably spread and intensified and therefore, the problem of taking into account the potential of the environment and certain regions in terms of possibilities of its use and sustainability for human economic activity has arisen. Regarding the latter, the development and expansion of cities take the first place by the highest rate of intensity, the mining industry ranks the second, the construction of roads and development of water industry come next.

Public and environment safety in economic activity is a complex socioeconomic problem, the solution of which depends on the nature of the interaction of economic, social, environmental and demographic factors that determine the development of both separate states and civilization in general. On the one hand, the modern society cannot meet its material and nonmaterial needs (i.e. its own security in the socioeconomic area) without increasing the scales of public production accompanied by the strengthening of anthropogenic pressure on the biosphere. On the other hand, the society has to protect the environment (i.e. to ensure its environmental safety), since its state affects both efficiency and comfortability of people's living conditions, their health etc.

There are four forms of negative impact of the anthropogenic impact.

**1. Change of components of the biosphere, the circulation of matters in nature** (mineral production, waste accumulation, emissions and discharges of pollutants into air and water). Environmental pollution is the addition of solid, liquid and gaseous substances or energy (heat, noise, radioactive substances) to the biosphere in the amounts, having a direct or indirect harmful effect on humans, animals and plants. The direct ob-

jects of pollution (acceptors) are main components of the environment – the atmosphere, water, soil, minerals, flora and fauna.

**2. Restructuring of the earth surface** (ploughing-up, deforestation, reclamation work, impoundment, change of the surface water runoff regime, urbanization, and mining).

**3. Change of the energy balance of the planet and buffer properties of the Earth** (due to combustion of solid and liquid fuel, the share

of carbon dioxide in the atmosphere has increased by 25-30%, which may in the future lead to a rise of the average temperature by 1,5-2 ° C. This will cause the so-called phenomenon of the greenhouse effect, when the effective-terrestrial radiation will be less than the planet's absorbing the solar radiation. The increase of carbon dioxide and water vapor in the atmosphere disturbs the heat balance of the Earth. The heating of the atmosphere on a global scale by 2-4°C will lead to the melting of polar ice, resulting in the ocean level rising by about 20 meters and much of the land being drowned).

**4. Destruction of plant and animal diversity, natural habitats of animal and plant breeding, artificial acclimatization and adaptation of animals and plants on new habitats, breeding new plant and animal breeds, etc.** (each year 150 thousand km<sup>2</sup> of forests are cut down in the world. During the last 60 years more than 1 billion hectares of forests were converted to agricultural land, 120 mammal species and 150 bird species disappeared. Up to 2 million living organisms, ranging from 15 to 20% of all plants and animals are now threatened with extinction). The theoretical and methodological base of research of anthropogenic safety and specifics of its manifestation on

*The article considers prerequisites of the spread and specifics of manifestation of anthropogenic influence on the environment by four main forms of negative effects. Determined are reasons for high risks of occurrence of anthropogenic hazards and emergencies of man-made character. Analyzed is a disastrous character of the life activity environment of the Ukraine's population and border western regions by the number of emergencies of man-made character, the death toll and the casualty list as well as material losses during 2000-2014. The role of potentially dangerous facilities in the anthropogenic loading of the border regions is shown and grounded in terms of threats and risks created by them to the environment components. Trends of further cooperation between Ukraine and EU to prevent the spread of environmental threats and hazards on adjacent areas are identified.*

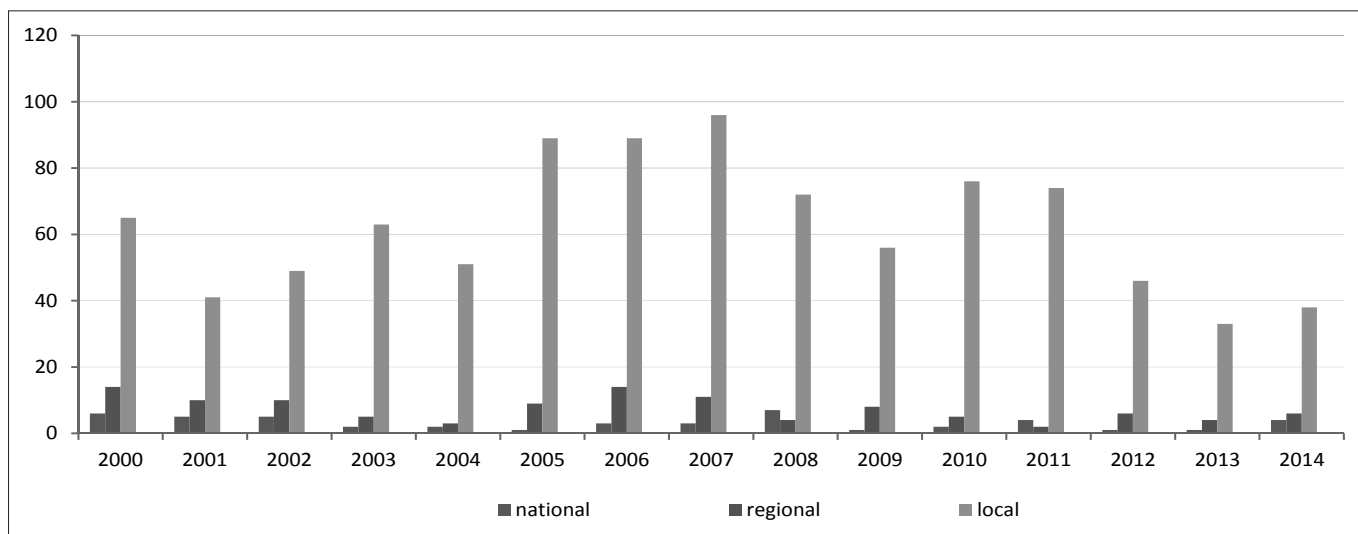
*У статті розглядаються передумови поширення та специфіки виявлення антропогенного впливу на навколишнє середовище по чотирьом основним формам негативних наслідків. Виявлено причини високого рівня антропогенних ризиків та аварійних ситуацій техногенного характеру. Проаналізовано згубний характер середовища життєдіяльності українського населення та прикордонних західних регіонів по кількості техногенних аварій, кількості загинулих та поранених, а також фінансових збитків за період з 2000 по 2014 роки. Показано та доведено роль потенційно небезпечних об'єктів в антропогенному навантаженні прикордонних регіонів в умовах створеними ними загроз та ризиків для компонентів навколишнього середовища. Виявлено тенденції подальшої співпраці між Україною та ЄС з метою запобігання поширення екзогенних загроз та ризиків в прилеглих районах.*

Table 1. Dynamics of human wreck and suffered people and material losses from emergencies of anthropogenic nature, 2000-2014 \*

Indicator	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Всього
The number of emergencies, cases	261	242	208	195	156	212	207	196	165	130	130	134	120	75	74	2505
Human wreck, persons	251	273	356	295	282	344	354	495	413	247	255	277	224	180	239	4485
People suffered in emergencies, persons	318	511	484	290	311	591	284	430	254	330	222	230	383	285	187	5110
Losses from emergencies, mln hrn	117	50	92	44	24	51	97	156	92	189	63	30	64	61	-	1130

\*Source : [9, 10].

Fig. 1. Dynamics and distribution of emergencies of anthropogenic nature in Ukraine by extents, 2000-2014, cases



the territory of Ukraine is revealed and grounded in the work of A. Kachynskiy [1]; B. Danylyshyn and A. Stepanenko's papers [2; 3] highlight regional peculiarities of the manifestations of man-made threats and analyze socioeconomic and environmental consequences of the placement of potentially hazardous industries. The methodological approaches to assessing the environmental hazards in the regional dimension and the forecast of their development are considered in the papers of the researchers of Public Institution «Institute for Environmental Management and Sustainable Development of NAS of Ukraine» [4; 5; 6; 7; 8]. A significant number of scientific reports and materials, including foreign ones [9; 10; 11], is devoted to the problems of anthropogenic threats and risks as well as to the specifics of their manifestation in transboundary areas, and synergistic processes.

According to the results of the research carried out in Ukraine, the increase of the number and scale of the consequences of accidents and disasters in the technosphere is caused by:

- the introduction of new technologies requiring a high concentration of energy, life-threatening substances that have a significant impact on the components of the environment;
- major structural changes in the economy of the country that led to the suspension of many industries, disturbance of economic relations, stoppages in technological chains;
  - high progressive level of wear and tear of fixed assets;
  - the fall of technological and production discipline as well as technical personnel qualification;
  - the accumulation of industrial waste that pose a threat to the environment;
  - the weakening of exactingness and efficiency of the supervisory bodies and government inspections work;
  - a high concentration of the population living near the potentially hazardous facilities associated with the overall urbanization.

It should also be noted that in recent years the sequence of appearance of emergencies of anthropogenic nature is being increased by abnormal changes of the natural factor such as amplitude of temperature oscillations, dry fire hazardous period, hurricanes, landslides, which represents danger to operating potentially hazardous facilities (PHF). The synergistic component is also growing.

During the 2000 to 2014 period, 2505 emergencies of **anthropogenic nature** were registered in Ukraine. Their number considerably varied every year (from 261 in 2000 to 74 in 2014). As a result of these emergencies 4485 people died and 5110 – suffered, material losses reached 1 130 mln hrn (Table 1).

According to State Emergency Service of Ukraine, during 2014 only material losses from fires totaled 7 billion 731 mln hrn (including direct losses - 1 billion 489 mln hrn). Fire destroyed or damaged 27 292 buildings and structures and 4450 equipment units.

The distribution of emergencies in the whole coincides with technogenic load of the territory. The largest number of man-made emergencies is registered in the industrial regions: Donetsk, Luhansk, Kharkiv. By breadth of spreading they come as follows: national – 47, regional – 111, local - 577, object – 938 (Fig. 1).

From the point of view of territories, during 2014 the largest man-made risk was manifested in industrial Donetsk (16 emergencies) and Kharkiv (9 emergencies) regions. In the territories adjacent to EU, namely, Transcarpathian and Ternopil regions the average risks of emergencies remained (3-5 cases) and in Volyn and Lviv regions – 1 case. The main causes were traffic violations, poor technical condition of production facilities, disregard of fire safety and other standards in industry, construction, public utilities, transport and other sectors (Table 2).

In studying the prerequisites of a high level of risk of man-made emergencies, attention should be paid to the placement and operation of PHF in the border regions of Western Ukraine. Analyzing the current spatial orientation of facilities a list of typical problems generated by them for this territory was identified. It should be mentioned that the manifestations of threats from PHF do not virtually differ from the point of view of territories. Some difference is only in the degree of manifestation of harmful impact. Thus, it is known that enterprises of any industry pollute air and chemically hazardous enterprises, moreover, are potential polluters of water bodies (due to inclusion of water resources in the production cycle, penetration of contaminated water into the soil horizons), soil (through unequipped space storages of raw materials or finished products, accumulation of waste) etc.

For a detailed analysis of threats of potentially hazardous industries in the context of regions we have analyzed the semantic content of Ecological passports of the regions and data of the National Report on the State of the

Table 2. Dynamics of anthropogenic emergencies in western regions of Ukraine for the 2000-2014 period \*

Region	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Volyn	8	3	4	1	0	8	3	0	5	1	2	2	1	2	1	41
Transcarpathian	8	7	0	7	7	2	7	4	1	2	1	2	1	4	0	53
Ivano-Frankivsk	5	3	4	2	0	3	3	4	1	3	2	3	1	2	0	36
Lviv	17	27	20	19	10	13	10	6	8	6	2	4	8	3	1	154
Chernivtsi	7	4	7	1	2	2	7	1	0	1	4	0	0	2	1	39

\*Source: data from regional departments of State Emergency Service of Ukraine

Table 3. Most potentially hazardous facilities of border regions and problems caused by them \*

PHF in the context of regions **	Threats of pollution
<p><b>LIVIV REGION</b></p> <ol style="list-style-type: none"> <li>Dobrotvir heat electropower station (Dobrotvir village) – emissions</li> <li>Gas transmittal pipelines administration "Lvivtransgaz" (Lviv) – emissions</li> <li>State Enterprise «Lvivuhillia» (Sokal) – emissions</li> <li>Rozdil state mining and chemical enterprise "Sirka"(Rozdol) – emissions</li> <li>UE "Zbyranka" (Lviv garbage dump, Velyki Hrybovychi village) – emissions, waste products</li> <li>Lviv municipal utility enterprise "Lvivvodokanal" (Lviv) – discharges, waste products</li> </ol>	<p><b>1) air pollution:</b></p> <ul style="list-style-type: none"> <li>industrial emissions belonging to the hundred facilities - the largest environmental pollutants (emissions of Burshtyn HES, evaporation of waste gases from landfills);</li> <li>lack of desulfurization of emissions into the air at most enterprises (Dobrotvir HES, enterprises of petroleum refining industry);</li> <li>blowing radioactive substances from the surface of soil contaminated by the Chernobyl accident;</li> <li>transboundary transfer of air pollutants in the border territories (almost uncontrollable process due to lack of the sufficient number of mobile and stationary observation points);</li> </ul> <p><b>2) water pollution:</b></p> <ul style="list-style-type: none"> <li>contamination of ground waters with liquid products of waste rotting from landfills, there is a high probability of volley of filtrate outside landfills;</li> <li>leakage of contaminated waters from sewage treatment facilities and sludge fields into ground waters;</li> <li>problems associated with discharge and leakage of polluted and mineralized mining waters (stoppage of pumping waters in mines, worsening of drainage capacity of internal drainage network which was on the balance sheet of agricultural enterprises. The situation in town Kalush is especially critical);</li> <li>contamination of surface waters with untreated and insufficiently treated backwaters of the enterprises of the housing and communal services, the share of which in the total discharge of polluted waters is up to 90% (e.g. town Chortkiv, where there is only mechanical treatment of used waters, discharge of backwaters into marine waters UE «Sevmiskvodokanal», etc.);</li> <li>transit contamination of the river Dniester (before Chernivtsi water intake), a significant number of polluted waters from the enterprises of Ivano-Frankivsk, Lviv and Ternopil regions is discharged;</li> <li>a high content of nitrate and high salinity and hardness almost in all water points equipped as quaternary aquifers, that is they are the first to deposit from the surface and are unprotected or vulnerable to human activity;</li> <li>threat of transboundary water pollution from the sewage treatment plants of town Soroky of the Republic of Moldova;</li> <li>violation of hydrological and hydrochemical regime of small rivers in the regions (entry of sewage (thaw) waters without treatment, cluttering river banks and water surface up with waste and household waste, unauthorized construction within coastal protection strips, location of industrial facilities, residential development, plowing plots of land within the water protection zones and coastal protection strips);</li> <li>transboundary problems related to water drainage and supply of industries on the territory of neighboring states.</li> </ul> <p><b>3) soil pollution, change of their structure:</b></p> <ul style="list-style-type: none"> <li>prevalence of unauthorized landfills near medium and small localities of the regions;</li> <li>allocation of large land areas for sludge fields, industrial waste tanks, slag collection points (for wastes of energy, mining, manufacturing industries);</li> <li>absence of land reclamation measures in mining regions;</li> <li>seepage of contaminated waters into deep soil layers;</li> <li>positive dynamics of the daylight surface subsidence over mine fields of dead pits in the zone of influence of mining;</li> <li>activation of karstification over mine fields of dead pits and tailings dams;</li> <li>accumulation of waste of mining, manufacturing and energy industries on the surface;</li> <li>open pit storage of crop protection chemicals;</li> <li>placement of repositories for poisonous substances crop protection chemicals on plots of lands of economic purpose where industrial waste of 5-7 adjacent regions is accumulated;</li> <li>accumulation of waste of mining, engineering, construction, woodworking and agricultural complexes on the lands of industrial facilities (waste fluorescent lamps, batteries, oil products, used oil filters, wood industry waste as well as domestic waste and coal industry waste).</li> </ul>
<p><b>IVANO-FRANKIVSK REGION</b></p> <ol style="list-style-type: none"> <li>Burshtyn HES PC "Zakhidenerho (Burshtyn) – emissions, waste</li> <li>UE "Ivano-Frankivskvodoekotekhprom" (Ivano-Frankivsk) – emissions, discharges</li> <li>PC "Naftokhimik of Prykarpattia" (Nadvirna) - emissions, discharges, waste products</li> <li>Gas transmittal pipelines administration "Prykarpatttransgaz" (Ivano-Frankivsk) – emissions, waste products</li> <li>Oil and gas mining enterprise "Dolynanaftogaz" (Dolyna) – waste products, discharges</li> </ol>	
<p><b>CHERNIVTSI REGION</b></p> <ol style="list-style-type: none"> <li>PC "Chernivtsi oil-fat plant" (Chernivtsi) – emissions, discharges</li> <li>PE "Mamalyha gypsum plant" (Mamalyha village) – emissions, waste products</li> <li>SUE "Chernivtsivodokanal" (Chernivtsi) – discharges</li> </ol>	
<p><b>TRANSCARPATHIAN REGION</b></p> <ol style="list-style-type: none"> <li>Volovets gas compressor station (Volovets village) – emissions</li> <li>Uzhhorod railway transportation administration of Lviv railway (Uzhhorod) – waste products</li> <li>PC "Zakarpattgaz" (Uzhhorod) – emissions (methane)</li> </ol>	

\* The list of problems and their solutions are identified based on the data of Ecological passports of regions and Regional reports on the state of the environment

\*\* Prepared by the authors in accordance with the regulations of the Verkhovna Rada of Ukraine "On informing the public of matters relating to the environment" from 04.11.2004 № 2169-IV and orders of the Ministry of Environmental Protection of Ukraine of 21.03.2005 № 103 "On informing the population of facilities that are the biggest polluters of the environment" and of 01.11.2005 № 397 "On approval of the Regulations on quarterly informing the population through the media of facilities that are the biggest polluters of the environment"

\*\*\* Among the potentially hazardous facilities of border Volyn region there are no industries belonging to the hundred biggest polluters of the environment of Ukraine.

Environment in Ukraine. Spatial location of PHF in the context of regions was determined, the problematic field generated by them and possible ways of the improvement of the situation (Table 3).

Among the effective measures to improve the situation (according to the Environmental passports of regions and Regional reports on the state of the environment), the following ones are offered:

- installation of battery emulsifiers of the second generation on boilers and modern means of oxygen measurement at Dobrotvir HES;
- modernization of technology of purification of dust and gas flow from pollutants at SE "Kovel vetsanzavod";
- implementation of the investment project "Construction of Lutsk regional rubbish recycling complex with the capacity of 450 thousand tons of rubbish per year";
- continuation of works on reconstruction of sewerage and dewatering of massif of individual building at the mines of SE "Volynvuhillia";
- modernization of the technological system of water treatment plant in Lutsk;
- elimination of disparities between capacities of water intake structures and sewage treatment plants, construction of new and reconstruction of existing sewage treatment plants and water networks and sewage systems, increase of the funding for environmental measures from the State budget.

### CONCLUSIONS

So, any economic activity and especially the one that is carried out in adjacent areas may cause emergence and spread of environmental threats and hazards. Therefore, in the border regions, special attention should be paid to adhering to the following principles:

- prevention of transboundary harm from hazardous activities that are associated with a significant risk of transboundary harm to the environment;
- due diligence which is a key element of the obligation to prevent transboundary environmental damage;
- cooperation between states through which warning of transboundary harm and liquidation of its consequences is provided;
- good faith, the regulations of which are turned to future behavior of agents. They are the basis of lawful behavior of states.

In recent decades, there has appeared a new factor of anthropogenic danger associated with the development of informatization, computerization and high technologies. It is caused by transition of the state to a higher level of social and economic development. In today's world, these changes have their own characteristics, among which, from the perspective of human safety, the following ones can be singled out:

- high technologies create goods, the properties of which are unknown or will become known only after a prolonged use on the market;
- these technologies lead to fundamentally new threats. For example, the development of nanotechnology will be accompanied by environmental pollution with nanoparticles;
- high technologies contribute to the creation of new zones of destruction.

With the development and updating of the economic process, the deepening of integration and development of cross-border cooperation Ukraine should conduct studies that will reflect the strategic priorities of the development of its border regions, especially in supporting environmental safety. Due to the emergence of anthropogenic emergencies, Ukraine annually loses 2-2.5% of GDP which restrains the improvement of economic indicators and quality of the population living standards, and the average level of individual risk is 1.5-2 order higher than the allowable one, adopted in developed countries. Therefore we should think of effective ways of preventing man-made disasters caused by a critical state of logistics and technological lag of the leading industries. This is especially relevant for regions adjacent to EU. Thus, the Association Agreement includes several Directives governing the state of the technological safety [12; 13].

However, the safety legislation of Ukraine today only partly meets their requirements. Therefore, in future a strategy of prevention and response to transboundary emergencies of anthropogenic character is to promote international cooperation between Ukraine and neighboring countries before, during and after accidents (including the impact of accidents caused by natural disasters), in order to establish appropriate policies and to strengthen

and coordinate actions at all appropriate levels. In addressing these issues, a significant role will belong to the implementation of European legislation where through effective economic, environmental and legal instruments the technological safety level is greatly reduced.

### REFERENCES

1. Іванюта С.П. Екологічна та природно-техногенна безпека України: регіональний вимір загрози і ризиків : [монографія] / С.П. Іванюта, А.Б. Качинський. – К. : НІСД, 2012. – 308 с.
2. Безпека регіонів України і стратегія її гарантування : [монографія] : у 2 т. / ред. Б.М. Данилишин ; НАН України, РВПС України. – К. : Наукова думка, 2008. – (Проект "Наукова книга").
3. Данилишин Б.М. Наукові основи прогнозування природно-техногенної (екологічної) безпеки [Текст] : монографія / Б.М. Данилишин, В.В. Ковтун, А.В. Степаненко. – К. : Лекс Дім, 2004. – 551 с.
4. Обиход Г.О. Методологічні підходи до комплексної оцінки рівня природно-техногенної небезпеки регіонів України / Г.О. Обиход, В.С. Шуліпенко // Економіка природокористування і охорони довкілля: зб. наук. пр. – К.: ДУ ІЕПСР НАН України, 2013. – С. 107–113.
5. Boiko V. Environmental safety of Ukraine and its regions: economic dimension / Boiko V. // Актуальні проблеми економіки: зб. наук. пр. – К.: ВНЗ «Національна академія управління», 2015. – С. 292–301.
6. Обиход Г.О. Методичні підходи щодо оцінки рівня екологічної небезпеки регіонів України : [Електронний ресурс] / Г.О. Обиход, Т.Л. Омеляненко // Ефективна економіка. – 2012. – № 10. – Режим доступу: <http://www.economy.nayka.com.ua/index.php?operation=1&iid=1429>
7. Ілляшенко І.О. Потенційно небезпечні об'єкти як джерела екологічної небезпеки : [Електронний ресурс] / І.О. Ілляшенко // Ефективна економіка. – 2012. – № 12. – Режим доступу: <http://www.economy.nayka.com.ua>.
8. Дорогунцов С.І. Управління техногенно-екологічною безпекою у парадигмі сталого розвитку: концепція системно-динамічного вирішення [Текст] / С.І. Дорогунцов, О.М. Ральчук; НАН України, Рада по вивченню продуктивних сил України. – К. : Наук. думка, 2001. – 173 с.
9. Національний доповіді про стан техногенної та природної безпеки в Україні за 2004–2013 роки [Електронний ресурс] / Міністерство надзвичайних ситуацій України. – Режим доступу: [http://www.mns.gov.ua/content/national\\_lecture.html](http://www.mns.gov.ua/content/national_lecture.html).
10. Держспори ризику виникнення надзвичайних ситуацій регіонів України [Електронний ресурс] / Державна служба з надзвичайних ситуацій України. – Режим доступу: <http://www.mns.gov.ua/files/2012/2/1/659.pdf>
11. Eurostat: [Електронний ресурс]. – Режим доступу: [http://epp.eurostat.ec.europa.eu/statistics\\_explained/index.php?title=File:Waste\\_generation\\_2010\\_%28kg\\_per\\_inhabitant%29.png&filetimestamp=20121030183609](http://epp.eurostat.ec.europa.eu/statistics_explained/index.php?title=File:Waste_generation_2010_%28kg_per_inhabitant%29.png&filetimestamp=20121030183609)
12. Екологічна і природно-техногенна безпека України в регіональному вимірі : [монографія] / М.А. Хвесик, А.В. Степаненко, Г.О. Обиход та ін. За науковою редакцією д.е.н., проф., академіка НАН України М.А. Хвесика. – К.: ДУ «Інститут економіки природокористування та сталого розвитку НАН України», 2014 р. – 340 с.
13. Бізек В. Політика та право ЄС з питань, що стосуються довкілля: [посібник] / В. Бізек. – Проект Європейського Союзу «Додаткова підтримка Міністерства екології та природних ресурсів України у впровадженні секторальної бюджетної підтримки». – Київ, 2013. – 168 с.

### REFERENCES

1. Ivanyuta S.P., Kachyns'kyi A.B. Ekologichna ta pryrodno-tekhnohenna bezpeka Ukrainy: rehional'nyy vymir rizykov i rizykyv [Environmental and natural-technogenic safety of Ukraine: regional dimension of the threats and risks]. Kyiv, NISD, 2012, 308 p. [in Ukrainian].
2. Danylyshyn V.M. Bezpeka rehioniv Ukrainy i stratehiya yiyi harantuvannya [Regions of Ukraine security and the strategy of its guarantee]. Kyiv, NAN Ukrainy, RVPs Ukrainy, Naukova dumka, 2008 [in Ukrainian].
3. Danylyshyn V.M., Kovtun V.V., Stepanenko A.V. Naukovy osnovy prohnozuvannya pryrodno-tekhnohennoyi (ekologichnoyi) bezpeky [Scientific basis of forecasting natural and man-made (environmental) safety]. Kyiv, Leks Dim, 2004, 551 p. [in Ukrainian].
4. Obikhod H.O., Shchulipenko V.Ye. Metodolohichni pidkhody do kompleksnoyi otsinky rivnya pryrodno-tekhnohennoyi nebezpeky rehioniv Ukrainy [Methodological approaches to comprehensive assessment of natural and technological hazards of Ukrainian regions]. Kyiv, Ekonomika pryrodokorystuvannya i okhorony dovkillia: zb. nauk. pr., DU IEPSSR NAN Ukrainy, 2013, pp. 107–113 [in Ukrainian].
5. Boiko V. Environmental safety of Ukraine and its regions: economic dimension. Kyiv, Aktual'ni problemy ekonomiky: zb. nauk. pr., VNZ "Natsional'na akademiya upravlinnya", 2015, pp. 292–301.
6. Obikhod H.O., Omelyanenko T.L. Metodolohichni pidkhody shchodo otsinky rivnya ekolohichnoyi nebezpeky rehioniv Ukrainy [Methodological approaches to assessing the level of environmental hazard regions of Ukraine]. Efektyvna ekonomika, 2012, no. 10. Available at: <http://www.economy.nayka.com.ua/index.php?operation=1&iid=1429> [in Ukrainian].
7. Ilyashenko I.O. Potentsiyno nebezpechni ob'ekty yak dzherela ekolohichnoyi nebezpeky [Potentially dangerous objects as a source of environmental hazard]. Efektyvna ekonomika, 2012, no. 12. Available at: <http://www.economy.nayka.com.ua> [in Ukrainian].
8. Dorohuntsov S.I., Ral'chuk O.M. Upravlinnya tekhnohennoyi ekolohichnoyi bezpeky u paradyhmi staloho rozvytku: kontseptsiya systemno-dynamichnoho vyrisshennya [Management of technogenic and ecological safety in the paradigm of sustainable development: the concept of system-dynamic solution]. Kyiv, NAN Ukrainy, Rada po vyvchennyu produktivnykh syl Ukrainy, Nauk. dumka, 2001, 173 p. [in Ukrainian].
9. The national report on the state of technogenic and natural safety in Ukraine for 2004–2013. The Ministry of Emergencies of Ukraine. Available at: [http://www.mns.gov.ua/content/national\\_lecture.html](http://www.mns.gov.ua/content/national_lecture.html) [in Ukrainian].
10. The passports of risks of emergencies occurrence of regions of Ukraine. The State Emergency Service of Ukraine. Available at: <http://www.mns.gov.ua/files/2012/2/1/659.pdf> [in Ukrainian].
11. Eurostat. Available at: [http://epp.eurostat.ec.europa.eu/statistics\\_explained/index.php?title=File:Waste\\_generation\\_2010\\_%28kg\\_per\\_inhabitant%29.png&filetimestamp=20121030183609](http://epp.eurostat.ec.europa.eu/statistics_explained/index.php?title=File:Waste_generation_2010_%28kg_per_inhabitant%29.png&filetimestamp=20121030183609).
12. Khvesyk M.A., Stepanenko A.V., Obikhod H.O. Ekologichna i pryrodno-tekhnohenna bezpeka Ukrainy v rehional'nomu vymiri [Environmental and natural and technogenic safety of Ukraine in the regional dimension]. Kyiv, DU "Instytut ekonomiky pryrodokorystuvannya ta staloho rozvytku NAN Ukrainy", 2014, 340 p. [in Ukrainian].
13. Bizek V. Polityka ta pravo YeS z pytan', shcho stosuyut'sya dovkillia [Politics and EU law on matters relating to the environment]. Proekt Yevropeys'koho Soyuzu "Dodatkova pidtrymka Ministerstva ekolohiyi ta pryrodnykh resursiv Ukrainy u vprovadzheni sektoral'noyi byudzhethnoyi pidtrymky", Kyiv, 2013, 168 p. [in Ukrainian].