Formation of the Environmental Insurance System to Improve the Environmental Safety of the State: the Case of Ukraine

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ABSTRACT

The methodological approaches to the insurance against environmental risks are analyzed in the article. The methodology of environmental risk assessment, the methodical bases of the insurance of quality of land resources of agricultural producers to improve environmental safety at the regional level are justified. The paper provides for the assessment of environmental risks by means of the integral indicator of environmental hazard W_j, taking into account the indicators characterizing the quantitative parameters of the risk of violation of standard conditions of the ecosystem operation. The key indicators of hazard of the region are defined, and the environmental risk in the territory of Ukraine is analyzed. It has been proven that the application of the methodology of environmental risk assessment and analysis enables to determine the top-priority goals of the regional development strategy, to justify a risk level acceptable for the regions, to optimize the strategy of ensuring natural and technogenic safety of the regions, to conduct the territory zoning according to the degree of internal threat to life. The insurance reserve fund for the conservation and recovery of soil fertility is calculated on the example of Sumy Region (Ukraine) in order to improve the environmental safety of agricultural production. The need for environmental insurance as an effective way to minimize possible losses of the insured associated with the consequences of adverse accidental and catastrophic events to improve the regional environmental safety is proved.

Keywords: environmental safety, insurance, environmental risk, integral indicator, insurance of land resource quality.

Mathematics Subject Classification: 62J12, 62G99
Computing Classification System: I.4
JEL Classification: G22, Q56, Q58

1. INTRODUCTION

Considering environmental insurance as one of the economic and legal levers to ensure the environmental safety of Ukraine (other essential measures include tax policy changes, a significant increase in penalties for environmental violations, the creation of funds by enterprises to pay out compensation and reimburse any expenses for cleaning up the environment polluted by these enterprises, the creation of a system of regional and industry-wide environmental funds as the condition for ensuring the environmental safety of facilities and the population in the event of major accidents and disasters), it is essential to clearly define its place. The environment pollution caused by enterprises can be associated with constant and single emissions due to technical and technological reasons or random phenomena, and occurs on a local or global scale.

It is important to identify the ways to reduce losses from emergencies. An emergency is understood as any change in the conditions and circumstances of human and societal life, which leads to human and material losses and environmental damage. This event as a consequence of a natural or man-made disaster leads to significant negative environmental, social and economic losses (Taraniuk, 2012). The specificity of emergency situations due to their probabilistic nature is such that the work towards their prevention requires significant costs, and the quantitative assessment of the work performance is difficult. The forces and resources in reserve for emergencies remain largely untapped. The improvement of the state of industrial safety requires the development of professionally executed scenarios of the possible development of actions at the potentially hazardous facilities in the event of emergencies (see the works of Ali 2018 and Brammer, 2014).

The determination of the degree of environmental hazards of production is one of the main issues in the environmental insurance system. We propose to consider the function of ecological state as a relationship between the volume of output and the amount of financial resources aimed at carrying out environmental activities:

$$E_t = f(q_t, v_t), \qquad (1)$$

where E_t – function of ecological state;
q_t – volume of output;
v_t – costs of ecological activities.

At the same time, the environmental safety of any facility involves not only the probability of accidents, the severity of impact factors, but also the recipients that fall within the area affected by an accident. This factor is determined by the facility location, climatic conditions, the initial (pre-emergency) state of the environment. In this case, the environmental hazard of any emergency situation in the region should be defined as the following function:

$$N = f(P, P_t), \quad (2)$$

where N – environmental hazard of an accident at an enterprise in the region;
P – probability of an accident at the facilities of the region;
P_t – factor of the severity of accident consequences.

The probability of an accident is determined by the dependence:

$$P = 1 - \sum [1 - P_i (Q_i , V_i)], \quad (3)$$

where P_i – probability of an accident at the i enterprise;
Q_i, V_i – volume of output and costs of environmental measures, respectively;
i = 1, 2, 3…. n – environmentally hazardous facilities in the region.

The analysis of the latest major emergencies at the enterprises shows that almost all of them have been caused for the organizational and technological reasons, erroneous or improper actions of personnel (Kutsenko, et al., 2016). Therefore, the problem of environmental safety should be addressed by improving industrial technologies in the process of their design, construction and operation.

The goal of the research is to develop scientifically based proposals for the development of an environmental insurance system to improve environmental safety through the formation of theoretical, methodological and organizational provisions and improvement of existing ones.

2. RESEARCH DESIGN AND METHOD

2.1. Research design

To finance the measures aimed at ensuring the population safety in emergency situations and to compensate for costs of eliminating the consequences of accidents and catastrophes, it is expedient to create the system of potentially hazardous facility insurance and the insurance of the citizen's life and property from catastrophic destruction. The elements of this system should be taken into account at the stage of the technical project development and the selection of the facility location (Sokolenko, et al., 2017).

The financial basis of environmental insurance is the system of environmental insurance funds, which includes the enterprise insurance fund, the mutual enterprise insurance fund and the environmental risk insurance fund. Such system of funds makes an enterprise analyze the efficiency of its operation, choose the optimal ratio of funds allocated for reserve and usage, at its own descretion, and most importantly, the principle of free choice of the method of reserving financial resources in case of an accident is implemented (Dudchyk, 2015).

The business insurance fund is intended for the implementation of liability for compensation of part of the damage, the responsibility for which has not been imposed on the insurer. The mutual insurance fund provides for the accumulation of financial resources for the same purposes as that of the insurer,

but with the corresponding refusal of the services of the insurance company. The insurance fund of hazardous enterprises and the mutual insurance fund, created by industry and regional associations of such enterprises, are established using the same procedure. They are created for the purpose of compensation of environmental damages, the need for which arises only as a result of judicial or other claims of the injured party in the case of an event, that is, an accident, which is accompanied by a sudden peak emission of pollutants into the environment. The amount of contributions and compensation of losses from these funds are determined either by the enterprise itself or by a joint decision of the members in each individual case (Ivaniuta, 2013).

In the unified environmental insurance system, these two funds play a supporting role in relation to the third fund – the insurer's environmental risk insurance fund. This fund accumulates financial resources from the insurer and ensures the property liability of hazardous enterprises for causing damage to third parties and their own production through sudden accidental pollution (Law of Ukraine "On Insurance", 1996). It is expedient to pay attention to the fact that the creation of the system of insurance environmental funds in the region should be multifaceted and take into account the features of the accumulated production capacity, the location of productive forces and the state of natural potential. This system should focus on the real possibilities of indemnifying for environmental losses in order to ensure the sustainable socio-economic development of regions, enterprises and industry-specific complexes. It is not only about the extent of compensation for environmental losses. The primary goal is to ensure the possibility of compensation for damage, the inevitability of economic responsibility for a sudden peak emission of pollutants into the environment.

Given that the organization of environmental insurance provides for the existence of mandatory and voluntary forms of insurance, a contract in the first case should provide for the amount of compensation for each type of damage. This is extremely important for large environmentally hazardous enterprises with a high probability of accidents due to the high degree of equipment wear, the level of danger of technologies, raw materials and materials, the potential danger of the composition of possible pollutants, the location of production and an enterprise as a whole.

The list of enterprises for compulsory insurance is developed by joint efforts of the involved services, and shall be approved at least at the level of the regional administration. The voluntary insurance of environmental risk, unlike mandatory insurance, introduces restrictions neither for the insurer nor for the insured. Therefore, an insurance contract is concluded without any mandatory requirements and has a wide range of contractual terms and conditions. However, the higher the risk of accidental pollution is, the higher the insurance premium rates should be.

The functional structure of a key insurance party – the insurer – includes the following elements (Taraniuk, 2012):

- main activity;
- organization of financing of preventive and environmental measures, incentive concessional financing of the most active insured persons at the expense of profits from insurance and other activities;
- environmental audit of the enterprises that have concluded environmental insurance contracts, potential users of the insurer's services;
- collection, accumulation, processing and analysis of data to improve the insurance system and the insurer performance.

The main activity is the accumulation of premiums, the payment of compensation in case of accidental pollution, other work with the insured persons. It is carried out by the special environmental insurance department. The finance department of the insurer is responsible for prompt transfer of funds of insurance premiums. The environmental audit service as a separate structure of the insurer performs all the works related to the assessment of the environmental condition of insurers. The data collection, accumulation, processing and analysis are carried out by a special group, which is responsible for the formation of an information database for the efficient operation of the company (Doroguntsov, Fedoryshcheva, 2012).

The financial and economic support of catastrophic and environmental risk insurance is shown in Fig. 1. The determination of an accidental pollution risk for all types of environmental insurance should be performed by the environmental audit service, which provides information on the degree of environmental hazard of one or another facility and the amount of potential environmental damage.

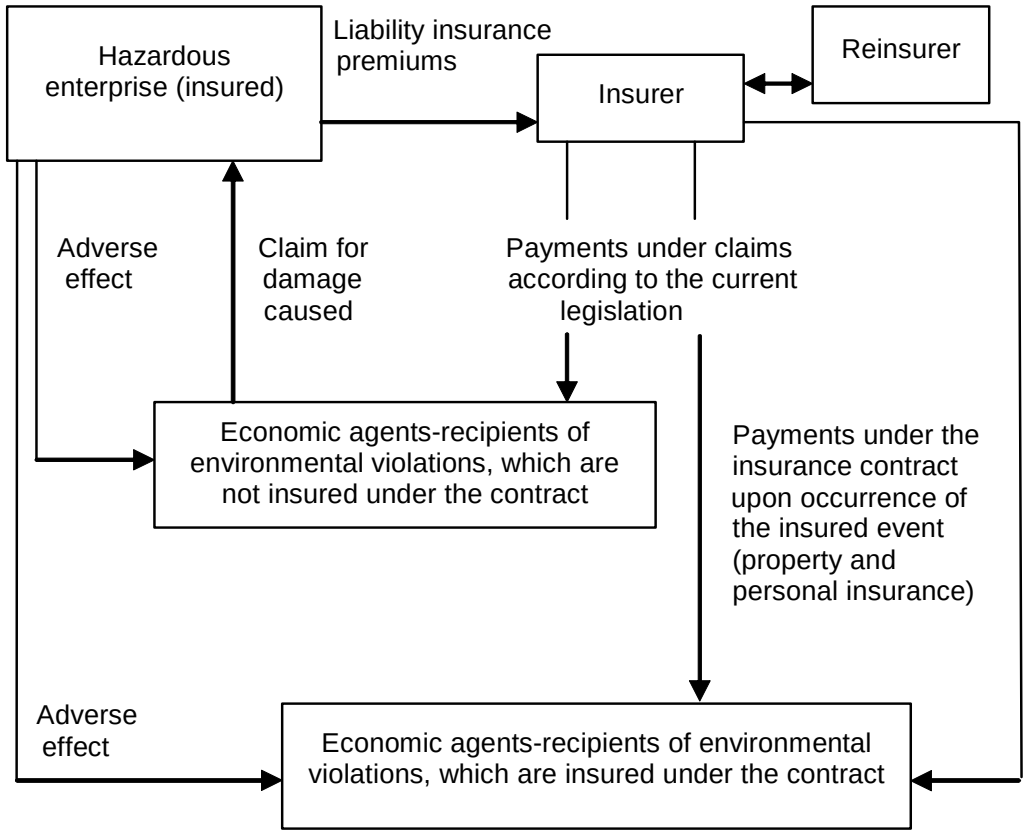

Figure 1. Financial and economic support of catastrophic and environmental risk insurance

Source: Authors' presentation

The formation of the market of environmental insurance services is not a guarantee of compensation for losses incurred by the society. On the basis of environmental services and other sources of financing, it is essential to develop various forms of entrepreneurship focused on environmental protection, restoration of natural resource potential; to create a system to eliminate the consequences of various disasters designed for carrying out effective actions in any crisis situation (Angelovaac, et

al., 2018). One of the new directions of the development of insurance of the resource potential of the agrarian sector is the mechanism of compulsory insurance of land resource quality (paragraphs 2.3, 3.3) for the purpose of further greening of agricultural production.

Therefore, insurance is an effective way to minimize possible losses of the insured associated with the consequences of adverse accidental events.

2.2. Methodology of environmental risk assessment

Environmental risk is an important sign of environmental harzard as it reflects its objective nature – the probability of this phenomenon occurrence. Environmental risk is understood as the probability of occurrence of negative consequences from a set of adverse effects on the environment that cause the ecosystem irreversible degradation. There are different methodological approaches to the environmental risk assessment. We propose to identify the most serious threats and rank them (Pirozhkov, Khvesyk, 2015,), then to assess the environmental risk taking into account economic loss, mortality, etc., resulting from natural and man-made emergencies. At the same time, the integrated characteristics of environmental hazards are of particular importance. When determining the level of environmental risk, it is important to consider in the effective integral indicator all components that may create an environmental threat, according to which the information and statistical base can actually be formed in the form of specific indicators characterizing the quantitative parameters of the risk of violation of standard conditions of the ecosystem operation, namely:
- value of damage caused by environmental problems,
- volume of emissions of pollutants;
- population mortality;
- volume of waste generation, etc.

A single indicator can not be the basis for ranking the regions, so the ranking is based on the total integral indicator of environmental hazard W_j, calculated by the formula:

$$W_j = \sum_k \beta_k w_{kj}, k = 1,2,3,4,5,6; j = 1,...,24 \quad (4)$$

where w_{kj} – k hazard index of the j region, β_k –weight coefficient ($\sum \beta_k = 1$);

w_1 – standardized values of individual risk of death in the population during the year as a result of emergency situations;
w_2 – risk of loss of property as a result of emergencies for the year;
w_3 – volume of emissions of pollutants into the atmospheric air per capita per year;
w_4 – volume of waste generation per capita per year;
w_5 –forest regeneration index per capita per year;
w_6 – mortality per 100,000 people per year.

These integral indicators are the methodological basis for the scientific substantiation of the level of required technogenic and environmental safety and functional and spatial natural and economic zones, decision-making on the placement of new potentially hazardous industrial facilities and the

expansion of existing ones.

2.3. Methodical bases of the insurance of quality of land resources of agricultural producers

The existing regulatory and legislative framework of Ukraine on land issues creates the possibility of developing economic incentives for improving the agro-ecological assessment of land that will provide the recovery of soil fertility on a large scale (Law of Ukraine “On the Basic Principles (Strategy) of the State Environmental Policy for the Period up to 2020”, 2010). An integrated approach provides for the state control over the agro-ecological state of the soil, the level of fertility and economic motivation of investments in the conservation and recovery of soil fertility. Such drastic measures will foster the prevention of an environmental crisis in land use (Lupenko, 2015).

According to the Land Code of Ukraine (Land Code of Ukraine, 2002), Ukraine shall indemnify land owners and users losses caused by the deterioration of soil quality and other useful properties of agricultural land, but the loss indemnity mechanism has not been tried and tested yet. One of the ways of the corresponding mechanism can be the compulsory insurance of land resource quality. In this case, insurers are the enterprises-users of agricultural land resources of all forms of ownership. The object of insurance is land resources owned or leased by agricultural enterprises. Insurance risk involves a reduction in soil fertility in accordance with the standards specified in a land plot certificate, for which relevant authorities should examine the quality of land resources within their certification. An insured event is the deterioration of the key certificate indicators of land resource quality through geo-climatic processes, natural phenomena, accidents, illegal actions of third parties, etc. The fact of occurrence of an insured event is determined by the annual comparison of existing indicators with the certificate ones.

Insurance should be carried out for the enterprises-land users, which have more than 1 hectare of land. The quality of land should influence the amount of insurance premium: agricultural enterprises with land of better quality should pay a larger amount of insurance premium as they can gain more profit and should pay for the opportunity to use better land plots. For enterprises-land users which will invest their own funds in the reproduction of land resources, it is necessary to provide discounts to insurance premiums, as they contribute to improving the quality of land resources. In the case of degraded land quality, the amount of insurance payment increases. Insurance liability is limited to the amount of costs for the reproduction of land quality, and is not more than 70% of the total amount of damage. It is possible to use a franchise as well. The mandatory nature of such insurance will make it possible to cover large and environmentally hazardous facilities as a matter of priority. It is also advisable to use the insurance policy with 3-4 degrees of protection as a mortgage (security) in long-term lending for improving the quality of land resources.

The size of insurance fund for the conservation and recovery of soil fertility for agricultural purposes can be calculated by the formula:

$$F = S \cdot Q \cdot T/100\%, \qquad (5)$$

where F – value of insurance fund; S – area of agricultural land resources; Q – monetary value of 1 ha of agricultural land resources; T – insurance tariff (%).

With proper organization of environmental insurance, the risk of insured is reduced: the greater the number of insured is included in the insurance field, the higher the financial stability of environmental insurance operations and the lower the insurance premium rates are. For organizational and methodological support of the environmental insurance system it is essential to identify the regions where the organization of the environmental insurance system is most appropriate; to conduct an inventory of environmental hazard facilities, to determine the level of environmental risk for each of them; to develop a list of specific insurance events subject to mandatory and voluntary environmental insurance. At the same time, it is expedient to develop an organizational and economic mechanism for implementing the environmental insurance system in the region; to determine the rate of insurance premiums and amounts to be paid to the insured in case of an insured event; to develop basic regulatory documents; to test models of the regional environmental insurance system.

3. EMPIRICAL RESULTS ANALYSIS

3.1. Assessment and analysis of environmental risk in Ukraine

The development of the system of environmental and catastrophic risk insurance enables to reduce the costs of enterprises to satisfy any claims of third parties in connection with damage caused by the environment pollution; to give affected parties a guarantee in obtaining the amount of compensation due to them by law regardless of the financial condition of a contaminating enterprise; to perform the functions of monitoring the implementation of security measures by enterprises; to be one of the sources of their financing, etc. (Semenda, 2018).

The general integral indicator of environmental hazard *Wj* enables to rank the regions of Ukraine for the purpose of their classification on the level of environmental safety. The quantitative values of integral threat assessments characterizing the environmental safety of Ukraine in the regional dimension according to the formula 4 are given in Table 1.

Table 1. Characteristics of the regions of Ukraine by the integral indicator of environmental hazard (W_j)*

Regions of Ukraine	w_{1j}	w_{2j}	w_{3j}	w_{4j}	w_{5j}	w_{6j}	*Wj*
Vinnytsia	0.329	0.036	0.315	0.013	0.365	0.542	0.282
Volyn	0.000	0.000	0.155	0.007	0.775	0.914	0.292
Dnipropetrovsk	0.986	0.011	0.955	1.000	0.120	0.302	0.563
Donetsk	0.528	0.002	1.000	0.150	0.090	0.216	0.373
Zhytomyr	0.564	0.000	0.191	0.005	1.000	0.766	0.405
Zakarpattia	0.000	1.000	0.196	0.002	0.355	0.789	0.433
Zaporizhzhia	0.475	0.001	0.506	0.036	0.222	0.530	0.328
Ivano-Frankivsk	0.000	0.604	0.457	0.009	0.349	0.6111	0.370
Kyiv	0.526	0.000	0.439	0.020	0.350	0.592	0.348
Kirovohrad	0.445	0.002	0.199	0.340	0.454	1.000	0.409
Luhansk	1.000	0.092	0.728	0.081	0.539	0.433	0.513
Lviv	0.053	0.027	0.271	0.012	0.260	0.329	0.163
Mykolaiv	0.419	0.063	0.196	0.031	0.456	0.869	0.358
Odesa	0.284	0.016	0.213	0.003	0.286	0.429	0.217
Poltava	0.121	0.001	0.324	0.035	0.295	0.654	0.253

Regions of Ukraine	w_{1j}	w_{2j}	w_{3j}	w_{4j}	w_{5j}	w_{6j}	*Wj*
Rivne	0.000	0.000	0.137	0.007	0.907	0.819	0.283
Sumy	0.271	0.003	0.213	0.009	0.412	0.821	0.304
Ternopil	0.000	0.010	0.165	0.012	0.166	0.777	0.208
Kharkiv	0.360	0.168	0.285	0.011	0.087	0.337	0.240
Kherson	0.580	0.148	0.191	0.005	0.367	0.927	0.406
Khmelnytskyi	0.136	0.122	0.176	0.011	0.361	0.663	0.257
Cherkasy	0.140	0.014	0.301	0.014	0.264	0.715	0.262
Chernivtsi	0.150	0.203	0.138	0.002	0.511	0.945	0.338
Chernihiv	0.286	0.027	0.245	0.004	0.616	0.890	0.352

* Calculated by the authors according to the data of the State Statistics Service of Ukraine: http://www.ukrstat.gov.ua/

Since the first six main relevant components account for 75.4% of dispersion in the structure of a set of primary data, they form the basis for calculating the integral indicators of the regions, using formula 4. Applying this ratio to each object of the statistical data set (in our case, 24 objects), we can obtain the value of the integral indicator of environmental hazard *Wj* for each of these regions (Table. 1).

When calculating the integral indicator of environmental hazard *Wj* by the expert evaluation method, we determined the corresponding weight coefficients for each w_{kj} (Table 2).

Table 2. Determination of weight coefficients β_k

wkj	w_{1j}	w_{2j}	w_{3j}	w_{4j}	w_{5j}	w_{6j}
β_k	0.2	0.2	0.2	0.1	0.1	0.2

Source: Authors' presentation

The ranking of the regions of Ukraine (Figure 2) is based on the results of the assessment of the integral indicator of environmental hazard that enables to classify them regarding a hazard level. It should be noted that the highest value of this indicator testifies to a low level of environmental safety of the region.

After the quantitative assessment of environmental risk, the implementation of qualitative interpretation of the calculated values becomes relevant. To do this, we identify the obtained quantitative values of risk (the degree of risk). We suggest that a numerical interval of the environmental risk value, taking the possible values from zero to one, be evenly divided into four intervals. In other words we propose to determine such intervals and their qualitative interpretation:

1) **(**0.00–0.25) – low environmental risk;
2) **(**0.25–0.50) – moderate environmental risk;
3) **(**0.50–0.75) – average environmental risk;
4) **(**0.75–1.00) – high environmental risk.

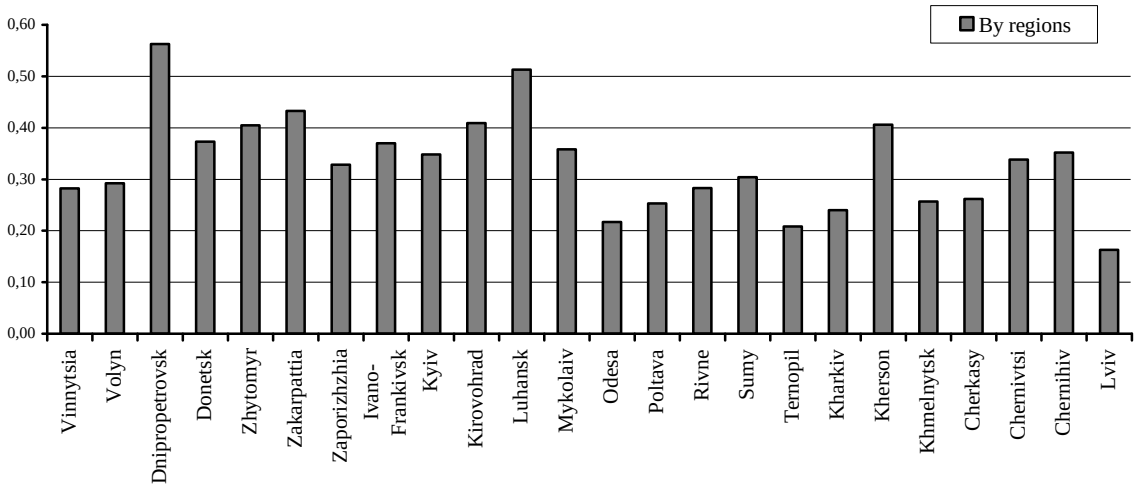

Figure 2. Ranking of the regions of Ukraine based on the assessment of the integral indicator of environmental hazard*

* Calculated by the authors according to the data of the State Statistics Service of Ukraine: http://www.ukrstat.gov.ua/

According to the risk assessment indicators obtained, the regions of Ukraine can be divided into three classes: increased hazard (level of environmental risk in the range of (0.5–0.75)), moderate hazard (level of environmental risk in the range of (0.25–0.50)) and relative hazard (level of environmental risk is less than 0.25).

The results obtained indicate the heterogeneity of the regions of Ukraine with respect to the integral indicator of environmental hazard. The highest level of hazard is observed in Dnipropetrovsk and Luhansk regions. Since they have a high modulus of technogenic pressure: the highest level of environmental pollution among all regions, the greatest load on the territory of technogenic hazardous industries, the largest number of people living in the area of possible damage caused by highly toxic substances, inefficient use of natural resource potential (Kutsenko, et al., 2016).

The regions with moderate danger are considered to be Zhytomyr, Zakarpattia, Kirovohrad, Kherson, Donetsk, Zaporizhzhia, Ivano-Frankivsk, Vinnytsa, Volyn, Kyiv, Mykolaiv, Cherkasy, Rivne, Sumy, Chernihiv, Poltava, Khmelnytskyi and Chernihiv regions. This situation is explained by the dominance of mining, processing, chemical and other industries of harmful production on the territory of these regions, while using outdated waste and energy-intensive technologies, production and environmental equipment, the performance life of which has already expired.

In recent years, Lviv, Odesa, Ternopil and Kharkiv regions have been referred to the class of relative hazard that is a positive factor, given the recreational potential of these regions.

The empirical data obtained are quite consistent with the current situation in Ukraine and the existing natural and climatic conditions. The territory of Ukraine does not belong to any seismically dangerous zones or zones with the high probability of occurrence of other kind of natural disasters, therefore, the level of environmental risk is mainly assessed as low and moderate. At the same time, a significant industrial complex, the lack of effective environmental legislation and preventive measures are

increasing the likelihood and consequences of environmental disasters of all kinds year by year.

3.2. Formation of the insurance reserve fund for the conservation and recovery of soil fertility on the example of Sumy Region, Ukraine

Environmental risk insurance is carried out both on a voluntary basis and in a mandatory manner. The source of formation of insurance funds are insurance premiums of enterprises with environmentally hazardous production facilities. The seed capital of the insurer may be created at the expense of regional environmental funds, financial resources of state and commercial insurance systems, contributions of the founders. The payment of insurance indemnities will first depend on the number of insured persons, the amount of seed capital and the relevant payments, the possibility of reinsurance.

The results of the calculations carried out according to the statistical reporting (Website of the State Statistics Service of Ukraine and Zagórda, Walczykova, 2018) on the formation of the insurance fund for the conservation and recovery of soil fertility for agricultural purposes, where the main types of crop production are grown in accordance with formula 5 on the example of the Sumy Region in 2017, are shown in Table 3.

Table 3. Formation of the insurance fund for the conservation and recovery of soil fertility in Sumy Region in the cultivation of grain and industrial crops*

Name of districts	Grain crops				Industrial crops			
	Area, thousand hectares	Monetary value of 1 ha of land, thousand US dollars	Insurance payment amount from 1 ha, US dollars	Size of insurance fund, thousand US dollars	Area, thousand hectares	Monetary value of 1 ha of land, thousand US dollars	Insurance payment amount from 1 ha, US dollars	Size of insurance fund, thousand US dollars
Total for region	594.5	38.5	192.5	114,441	94.2	36.0	180.0	16,956
Sumy	1.5	40.0	200.0	300	0.1	41.0	205.0	21
Bilopilskyi	51.9	39.5	197.5	10,250	8.2	35.5	177.5	1,456
Burynskyi	38.8	39.0	195.0	7,566	7.0	35.0	175.0	1,225
Velykopysarivskyi	24.8	40.0	200.0	4,960	5.7	6.8	170.0	969
Hlukhivskyi	35.5	38.5	192.5	6,835	5.1	36.0	180.0	918
Konotopskyi	49.4	39.0	195.0	9,635	8.2	36.0	180.0	1,476
Krasnopilskyi	32.5	39.5	197.5	6,420	5.7	35.5	177.5	1,012
Krolevetskyi	20.4	30.0	150.0	3,060	1.6	33.0	165.0	264
Lebedynskyi	44.7	40.0	200.0	8,940	7.1	36.5	182.5	1,296
Lypovodolynskyi	31.5	39.5	197.5	6,220	5.4	35.5	177.5	959
Nedryhailivskyi	33.0	40.0	200.0	6,600	3.9	36.0	180.0	702
Okhtyrskyi	37.8	40.0	200.0	7,560	7.9	35.5	177.5	1,402
Putyvlskyi	17.0	38.5	192.5	3,275	2.2	34.0	170.0	374
Romenskyi	58.1	39.0	195.0	11,330	9.5	35.0	175.0	1,663
Seredyno-Budskyi	12.1	29.5	149.5	1,785	0.8	31.5	157.5	126
Sumskyi	51.4	40.5	202.5	10,410	10.0	40.5	202.5	2,025
Trostianetskyi	22.9	40.5	202.5	4,635	4.0	36.0	180.0	720
Shostkynskyi	19.0	29.5	149.5	2,805	1.0	30.5	152.5	153
Yampilskyi	12.2	29.0	145.0	1,770	0.8	26.0	130.0	104

Continued Table 3. Formation of the insurance fund for the conservation and recovery of soil fertility in Sumy region in the cultivation of potatoes and vegetables*

Name of districts	Potato and vegetables			
	Area, thousand hectares	Monetary value of 1 ha of land, thousand US dollars	Insurance payment amount from 1 ha, US dollars	Size of insurance fund, thousand US dollars
Total for region	87.4	35.5	177.5	15,514
Sumy	1.1	40.0	200.0	220
Bilopilskyi	6.1	38.0	190.0	1,159
Burynskyi	3.0	37.0	185.0	555
Velykopysarivskyi	3.0	28.0	140.0	420
Hlukhivskyi	6.5	38.0	190.0	1,235
Konotopskyi	8.7	37.0	185.0	1,610
Krasnopilskyi	3.5	29.0	145.0	508
Krolevetskyi	5.0	32.0	160.0	800
Lebedynskyi	6.2	37.5	187.5	1,163
Lypovodolynskyi	1.6	30.5	152.5	244
Nedryhailivskyi	3.6	31.0	155.0	558
Okhtyrskyi	6.0	36.0	180.0	1,080
Putyvlskyi	3.6	35.5	177.5	639
Romenskyi	6.7	37.5	187.5	1,256
Seredyno-Budskyi	2.5	34.0	170.0	425
Sumskyi	9.3	39.0	195.0	1,814
Trostianetskyi	3.2	29.5	147.5	472
Shostkynskyi	4.3	37.0	185.0	796
Yampilskyi	3.5	30.5	152.5	534

* Calculated by the authors according to the data of the State Statistics Service of Ukraine: http://www.ukrstat.gov.ua/

In the calculations made, the amount of insurance rate is equal to 1% of the monetary value of agricultural land resources, but it varies for each farm depending on the quality of land resources in accordance with the certificate indicators in connection with the use of increasing (from 1.0 to 2.5) and decreasing (from 0.9 to 0.2) coefficients.

The insurance reserve fund should be used to recover the quality of land resources, paying insurance compensation to their owners upon occurrence of an insured event subject to their compliance with the agrotechnical requirements for growing crops; to reproduce land resources unsuitable for agricultural use; to prevent the deterioration of the ecological state of agricultural land; to carry out measures to reproduce degraded and contaminated soil, to increase fertility, etc. The relations between the insurer and the insured are based on the principles of mutual benefit and economic interest of the insured in improving the level of its own environmental safety.

4. DISCUSSION AND CONCLUSION

The studies have shown that serious damage to the national economy and population is caused by accidental pollution of the environment as a result of accidental circumstances. In this regard, to reduce the risk of economic damage as a result of accidental pollution is one of the pressing issues.

At the same time, the environmental insurance, aimed at forming insurance environmental funds to indemnify third parties and the insured for loss or damage incurred as a result of accidental environmental pollution, fostering the implementation of measures to prevent accidents among the insurers and to reduce the risk at environmentally hazardous enterprises in the region, is of vital importance.

To reduce environmental risks, it is proposed to create the environmental insurance system, the main prerequisite of which is the principle of its cross-border operation, that is, the achievement of standards of environmental risk at the regional level for all its participants. The interregional nature of this system is that the spread of harmful substances “does not recognize” national or state borders. In this regard, the creation of an interregional system is a condition for ensuring environmental safety of facilities and the population.

The assessment and analysis of environmental risk, general trends and variations of natural and man-made emergencies, the obtained quantitative values of integral hazard assessments characterizing the environmental safety for each of the regions of Ukraine, have shown that in general the ecosystem of Ukraine is on the verge of exceeding the permissible impact, especially in Donetsk-Dnipropetrovsk region, a number of the western, central regions of Ukraine and certain districts of other regions.

Therefore, the application of the methodology of environmental risk assessment and analysis enables to determine the top-priority goals of the regional development strategy, to justify a risk level acceptable for the regions, to optimize the strategy of ensuring natural and technogenic safety of the regions, to conduct the territory zoning according to the degree of internal threat to life.

The means of subsistence and products of agricultural labour “imply” the natural-environmental and socio-economic patterns. Only such understanding of agricultural production challenges, awareness of the need for environmental insurance can overcome the current, purely technological and economic approach to the interaction, relationship of man, production and nature. The task of science is to ensure an integrated social and natural approach, the integrated understanding of the processes and changes taking place in the environment under the influence of economic activities, the demographic and socio-economic development of society.

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