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ASSESSMENT OF GEOECOLOGICAL VULNERABILITY AS A TOOL FOR COPING CAPACITY DEVELOPMENT TO EMERGENCIES

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Abstract. The analysis of prerequisites of development and introduction in Ukraine of modern approach to a problem of the ensuring preventive safety based on methodology of an assessment of geoecological vulnerability to emergency situations is studied in the article. Comparative analysis of characteristics of "emergency situation" and "geosystem" in terms of vulnerability conception allowing conclude that adaptation of the conception in Ukraine can effectively be solved by use of research tools of constructive geography and geoecology. SWOT analysis of an assessment of geoecological vulnerability methodology introduction in Ukrainian regulation system of the prevention and liquidation of emergency situations is studied.

Keywords: emergency situations, geosystem, geoecological vulnerability, assessment, coping capacity, prevention, landscape approach, impact, environment

Introduction

Now the increasing quantity and cross-border scale of consequences of the emergency situations (ES), against permanent degradation of environment, is that indicator which testifies to need of improvement of the scientific and methodological approaches existing in Ukraine in the field of ensuring geoecological safety.

In final documents of the World Conference on Disaster Reduction (on January 18-22, 2005, Coba, Hiogo, Japan) the international community at the highest level as a strategic task testified need of creation and strengthening of institutes, mechanisms which can systematically promote capacity-building of counteraction to dangers.

In this context "The Hyogo Framework for Action 2005-2015: Building the resilience of nations and communities to disasters" as one of priority actions defined creation of potential of counteraction of disaster at the level of the states and communities: "Identification, assessment and monitoring of risk factors of disasters and improvement of the early prevention. A basic point for activities for reduction of risk of emergency situations and education of culture of counteraction to disasters is the knowledge of dangers and physical, social, economic and ecological factors of vulnerability to disasters which communities, as well as models of change of dangers and factors of vulnerability in a short-term and long-term outlook on the basis of which the appropriate measures are taken face".

In December, 2013 the European Commission published the document rather new acts which strengthen the all-European policy in the sphere of management of emergency situations. The revised legislation reflects actions which will be taken concerning disaster risk reduction and formation of culture of the prevention of emergency situations, including on vulnerability assessment bases. Respectively, identification and estimation of vulnerability becomes an actual task for development of the society steady against natural and technogenic catastrophes.

Ukraine joined a number of the international agreements and conventions which are connected with the solution of problems of transition to a preventive security system (The State Emergency Service of Ukraine, 2014). This step means carrying out active actions in the field of harmonization and the subsequent implementation of the normative legal acts, methodological approaches and separate standards aimed at the development and strengthening of potential of counteraction of emergency situations at the expense of measures of the early prevention.

Formation of "vulnerability" as scientific concept originates in the 1970th in social sciences where vulnerability was perceived as the response to perception of risk of emergency situations of mainly natural character focused on technological solutions. Since 1980th, the dominating position is taken by the alternative concept – definitions and estimates of vulnerability as starting point for an assessment of consequences and decrease in risks of emergence of emergency situations (Schneiderbauer and Ehrlich, 2004; Cardona, 2004).

Specifics of the international theoretic-methodological approaches concerning a vulnerability assessment to emergency situations is their orientation to decision-making, development of programs and the plans of action, increase of awareness of the population.

Within the last decades in the European Union countries and the USA to influences of emergency situations numerous scientific works are devoted to a problem of the analysis and an assessment of vulnerability (Adger, 2006; Birkmann, 2006; Birkmann, 2014; O'Brien, 2013), leaving their comprehensive review beyond the scope of this work, we will stop on consideration of the concept "vulnerabilities" in the context of geoecological approach.

In the presence of certain positive movements in the field of improvement of standard and legal base of management of emergency situations, in Ukraine still there is no scientific and methodological basis of estimation of vulnerability. Experience of realization of an assessment of vulnerability to emergency situations is limited to researches in the field of the social and economic analysis of emergency situations of natural and technogenic character, and also methodical approaches to an assessment of consequences of emergency situations in the international and Ukrainian practice (Voloshyn, 2010) for today and completely is absent in relation to an assessment of geoecological vulnerability to emergency situations.

Practical realization of approaches to an assessment of impact of emergency situations on environment which is in Ukraine for today, is mainly limited to ascertaining and an economic assessment of deterioration of components of environment, that is identification of threat and damage which arise under the influence of factors of emergency situations. It doesn't correspond to world practice of providing system of preventive safety within which it is required applications of the approaches based on identification, an assessment and monitoring of risk factors of disasters and improvements of an early warning system.

We consider that the success of realization of an objective in Ukraine will depend on that, how modern applied direction will fit into an outline of basic scientific researches and development within "new" geography (Bagrov et al., 2012). Constructive and geographical approach is backbone for integration of information, analytical processes and decision-making processes at a uniform methodological basis. As a powerful impulse for development of this direction development and deployment of private methodology of estimation of geoecological vulnerability to emergency situations can serve.

The purpose of this work is the analysis of prerequisites of development and introduction in Ukraine of modern approach to a problem of the ensuring preventive safety based on methodology of an assessment of geoecological vulnerability to emergency situations.

Method

The theoretic and methodological fundamentals of the paper are based on modern scientific provisions on geoecology, constructive geography with use of the latest achievements in the field of the prevention of disasters and risk management of emergency situations.

The problem and prospects of application of methodology of an assessment of geoecological vulnerability to emergency situations is considered on the basis of application of an analytical method as material for which the international normative legal acts, standard and methodical documents, and also literary data on problems of ensuring ecological safety served in system of the prevention and elimination of consequences of emergency situations.

Results

It is obvious that identification and the subsequent assessment of geoecological vulnerability to emergency situations demands, first of all, a clear understanding that such "vulnerability" and in what distinctive features of "geoecological vulnerability".

The term vulnerability ("vulnerare" from Latin – a wound) is used in English for 400 years. It has various interpretation in several fields of knowledge. Sociological, economic, computer, medical sciences, sciences about Earth equally use this term. The existing references cover more than 25 various definitions, concepts and methods for vulnerability systematization (Bohle, 2001; Cardona, 2004; Chambers, 1989; Green, 2004;

Luers, 2005; Pelling, 2003; Schneiderbauer and Ehrlich, 2004; Turner et al., 2003; Un-Habitat, 2003; UN/ISDR, 2004; Wisner et al., 2004).

In each area of scientific knowledge vulnerability is treated differently, however all definitions have a number of the general aspects connected by that this property defines nature (type) of response to external influence.

For today there is no uniform definition of concept of vulnerability, the definition formulated in the UN International Strategy for Disaster Reduction) is the most widely used. Vulnerability is conditions which are created under the influence of physical, social, cultural and natural factors and processes which in total raise a susceptibility of society to emergency situations.

It is possible to say that the conceptual base for this term already in general is created (Birkmann, 2013; Green, 2004; Luers, 2005), however the methodological basis as the uniform developed structure with the developed conventional approaches to applied aspects of use of this concept, still needs scientific development.

The leading scientists published a number of works on application of geoecological approaches in the prevention and elimination of consequences of the natural technogenic catastrophes based as on world, and national experience (Bokov, 2005; Chervanev, 2000; Mamaev, 1996; Mjagkov, 1995; Puzachenko et al., 1991). Without repeating the key standard principles stated in these works, we will stop on the specifics of application of geoecological approach which are insufficiently lit, in our opinion, in a vulnerability assessment to emergency situations.

Researchers Vogel, C and O'Brein, K (2004) allocate the following basic characteristics of vulnerability:

- multidimensionality and differentiation, that is change in physical space, round and in social groups;
- dependence on a measurement scale (considering time, a place, analysis units – individuals, farms, territories, systems);
- dynamism – its characteristics and driving forces change in time;
- complexity – is defined by numerous interrelations of social, political, economic and natural character.

In spite of the fact that conceptual classifications of "vulnerability" differ in judgments about them different scientists and experts, we will pay attention that in overwhelming number of cases it is considered as reaction or set of reactions to external influence, i.e. as object - the object relation. From this as if has to follow that there is an opportunity unambiguously to estimate such relation in objective criteria and is determined. But if so was, then we would have opportunity to make a certain deterministic model "influence reaction" or "donor recipient" (as it was accepted in ecological and medical and sanitary assessments). But in works of Adger, 2006; Alexander et al., 2014; Bankoff et al., 2004; Cardona, 2011 it is repeatedly noted that such unambiguity of reactions isn't observed: vulnerability is various in dependence not only on type and force of external influence, but also on a condition of system which resists to it, or it doesn't perceive, or, on the contrary, independently to strengthen. Because of such richness of the possible relations between influence and result we consider it expedient to give other, subject - subject interpretation of concept of vulnerability that will explain, on our belief, a variety of the relations between donor system and system recipient if we accept variety and system complexity of each of them- vulnerability is an estimation of a wide range of direct and indirect manifestations of external influence through the internal geoecological and social and economic manifestations giving the chance to people and communities to counteract influence of emergency situations, or on the contrary, limiting their ability to interfere with negative impact of emergency situations.

Thus, vulnerability is a type and level of response of natural and social system (geosystem in the broadest sense) which has subject - subject character.

The last is important in several relations: a) explains why between the level of influence and reaction of system to it there shouldn't be an unambiguous compliance; b) denies possibility of an unambiguous assessment of influence and reaction to it; c) doesn't give the chance steadily to predict vulnerability of that the subject relations can't be determined are estimated.

Discussion

Comparison of key features of "emergency situation" and "geosystem" (table 1) in terms of vulnerability conception allows to assume that adaptation of the concept of an assessment of vulnerability in Ukraine can effectively be solved by use of research tools of constructive geography and geoecology.

Table 1

Comparative analysis of main features of "emergency situations" and "geosystem" in terms of vulnerability conception

Features	EMERGENCY SITUATION (Subject 1)	GEOSYSTEM (Subject 2)
Territoriality/ spatiality	Emergency situations arise within territorial units, having a certain spatial localization. There is a geographical division of the territory which was affected by emergency situations: blow zone; the zone "filtrations" located round a blow zone; zone of rendering a public aid.	The geosystem represents set of territorial units in which borders of geocomponents are genetically interconnected with human activity. The geosystem is a content of space; properties which depend on their spatial localization, the sizes and a form; functioning as ability to maintain autonomy in environment.
Dynamism	In dynamics of emergency situations allocate 4 characteristic stages: 1. A stage of accumulation of deviations from a normal state or process; 2. Initiation of the extraordinary event which is the cornerstone of emergency situations; 3. Process of an extraordinary event during which there is a release of the risk factors (energy or substance) making an adverse effect on the population, objects and environment; 4. An attenuation stage which chronologically covers the period from overlapping of localization of an emergency situation, to a complete elimination of its straight lines and indirect consequences.	Is the characteristic of geosystem (for example, a stage of succession or seasonal and daily dynamics) which cover all its states and their changes in time, irrespective of time scale and duration – suddenness of changes. Allocate 4 large-scale levels of dynamic changes of a landscape – daily dynamics, seasonal, long-term dynamics and evolution.
Complexity	The emergency situation is defined by result of complex interaction between potentially dangerous physical impacts (for example, floods, the fires) and vulnerability of natural and social and economic environment.	Complexity of geosystem determined, on the one hand, by interaction of the components composing it, and on another - the morphological units (natural territorial complexes of the lowest ranks) forming the interfaced ranks within a landscape entering it.
	Depending on scale of the consequences caused by an emergency situation, capacity of the technical and material resources necessary for their elimination, the following levels of emergency situations are defined: the global; national; the regional; the local; the object.	Allocate three main geosystem levels of the organization of landscape systems: planetary (landscape sphere; geographical belts; continents, oceans; subcontinents); regional (landscape countries; landscape (zone) areas; landscape provinces; landscapes); local (districts; natural boundaries; subnatural boundaries; facies).

At emergency situations object of control and monitoring of an ecological state are only certain components of a landscape (atmospheric air, surface and underground water, a biota), but not structure of a landscape in general. Thus ecological parameters in zone emergency are estimated mainly on the basis of measurements of concentration of the polluting substances, and for an assessment of impact on a plant and animal life structurally functional indicators of populations and biocenoses are used. As such researches demand in the majority of long time, for estimates of current state of natural components ecological ranging of the territory, based on methods of expert estimation is often used.

For the last 20 years many approaches, methods of an assessment and mapping of vulnerability of landscapes to anthropogenic influence were offered, however modern threats to security define need of development of methodology of an assessment of the geoecological vulnerability to emergency situations based on landscape approach as Vladimir Preobrazhensky defined (1988): "Take for truth that the nature is arranged as it is seen by a studying of landscapes".

Identification of relationships of cause and effect between influence of factors of emergency situations and possible structurally functional changes of a landscape is one of problems of an assessment of geoecological vulnerability. And if a key postulate of the techniques based on approaches of ecological rationing is the statement "has to correspond", at the heart of the analysis and an assessment of geoecological vulnerability search of the answer to a question lies: "What landscape complex is least capable to keep structural and functional integrity under the influence of factors of emergency situations?"

Applying landscape approach in an assessment of geoecological vulnerability to emergency situations, it is supposed that influence of emergency situations has some kind of "curtailed" character. In this case we don't see all thin elements of interaction at the level of atoms, living tissues, concrete live organisms, and we operate the generalized image, object – a landscape (Harvej, 1974).

The assessment of vulnerability is made through a prism of comparison of conditions of a landscape which change happens as a result of external influences of factors of emergency situations, and during processes of its self-development, revealing cause and effect indicators.

The degree of susceptibility of landscape complexes to influence to emergency situations expressed through the concept "vulnerability" can be a investigated on own vulnerability, as internal property of a landscape which characterizes its own susceptibility to anthropogenic and/or natural influences which isn't depending on type of emergency situations and specific vulnerability to concrete type of emergency situations.

There are various techniques of an assessment of vulnerability of the natural complexes differing in object of research and a set of the estimated criteria which in the majority are reduced to calculation of an integrated ball and index indicator (Opekunova, 2000; Vasiliev et al., 2000). The analysis and generalization of various techniques and approaches to an assessment of vulnerability show expediency of development of the generalized integrated methodology.

Obligatory elements of an assessment of geoecological vulnerability are: landscape maps as basis of spatial localization; a set of estimated criteria and indicators in total the landscapes defining degree of vulnerability to emergency situations; analysis of the structurally functional organization of landscape complexes; estimation and classification of landscape complexes by vulnerability degree to emergency situations; development of geoecological recommendation on strengthening of coping capacity to vulnerability.

For identification of the major promoting factors and restrictions for development and introduction of methodology of an assessment of geoecological vulnerability in a regulation system of the prevention of emergency situations presented in table 2 the scheme of SWOT analysis is used.

The conducted analysis shows that, despite of substantial positive influence from outside, by basic factors, qualificatory introduction of methodology of estimation of geoecological vulnerability, there are internal is both insufficient worked out of theoretical bases actually methodologies and on the whole absence of the proper normatively-legal and organizational providing of ecological safety in the field of the state system of prevention and reacting on the emergencies of natural and technogenic character.

Therefore practical recommendations about the necessity of introduction of methodology carry the some fragmentary character not taken to the level of practical introduction, that on the whole complicates the decision of strategic task is creation of the system of geoecological research and information support of administrative decisions in area of warning and minimization of consequences of emergencies.

For today this direction is in the initial stage of forming and critically important and fundamental is a necessity of development of corresponding methodological basis.

Introduction of methodology of an assessment of geoecological vulnerability will provide transition to qualitatively new level of management of the prevention of emergency situations, mitigation of risks and consequences for the account: transition from the model based on collecting, documenting and synthesis of data on emergency situations to the analysis of geoecological prerequisites of their emergence, identification of natural mechanisms of self-control, development of preventive measures; transition from preparation and

Table 2

SWOT analysis of an assessment of geoecological vulnerability methodology introduction in Ukrainian regulation system of the prevention of emergency situations

Strengths	Weaknesses
Promotion at the international level of the necessity and first priority of development and deployment of strategy of reduction of vulnerability to emergency situations on the basis of system approach (The Hyogo Framework for Action 2005-2015: Building the resilience of nations and communities to disasters);	Inadequacy of public preventive policy in the field of providing of safety at emergencies to the level of the real risks of the dangerous natural phenomena and degree of complication of modern productively-technological complexes on territory of Ukraine;
Presence of research and practice experience in area of geosituationanalysis and assessment of impacts on environment;	Modern approaches and principles of protection of population and territories to emergencies are introduced in a "post-Soviet" form and by slow rates;
Strengthening of collaboration of Ukraine with international organizations in area of strengthening of potential of counteraction to the emergencies;	Low level of accumulation of material and financial resources for prevention and liquidation of emergencies;
Presence in international practice of the modern approved methodical approaches of management technogenic and natural risks on the basis of assessment of vulnerability;	Weakening of state control and ineffectiveness of mechanisms of government control of technogenic and natural safety;
Presence of the database on the state of technogenic and natural safety in Ukraine;	Absence of regulatory base and instructional-methodical documents, regulating the assessment of vulnerability to the emergencies;
Adoption of obligations for implementation of the The Hyogo Framework for Action 2005-2015 aimed at the development and strengthening of potential of counteraction to emergency situations;	Use of mainly “intuitional”, but not systematical methods of management during realization of strategic and tactical tasks of prevention and liquidation of consequences of emergencies;
Presence of classifier of emergencies, the list of emergencies, certain in corresponding normatively-legal acts and grouped on the signs of belonging to the corresponding types of emergencies (detected and potential) that can arise up on separate territory of Ukraine or object in different industries of national economy, is fixed in basis of that;	Low level of introduction of GIS technologies in practice of prevention of emergencies, that give wide possibilities for integration of geoecological information, its analytical treatment and visual presentation of spatial differentiation to vulnerability of landscape complexes;
Elaboration of the Atlas of natural, technogenic, social dangers and risks of origin of emergencies is in Ukraine;	Absence of single vertical line of management in area of providing of geoecological safety at emergencies;
International experience of the use of conception of assessment of vulnerability in a management risks of emergencies;	Lack of awareness of a decision-making persons on advantages of assessment of vulnerability in the decline of risk of emergencies;
Development of the project of Conception on risks management of emergencies of technogenic and natural character;	Absence of complex approach in methodologies of assessment of impact of emergencies on environment;
Functioning and development of the governmental research and information system on questions of emergencies, preparation acceptance and control of administrative decisions concerning emergencies intended for support of processes.	Lack of practical experience in the field of vulnerability assessment to emergencies

Table 2 *(continue)*

Opportunities	Threats
Creation of new databases of geoecological information and mechanisms of their actualization is in the context of coping capacity development to emergencies;	Absence of system large-scale geoecological researches;
Development of geoecological recommendations on the reducing of degree of vulnerability to the emergencies;	Absence of generalizeddata on environmental impact on the different stages of life cycle of emergencies;
Development of framework methodology on assessment of the geoecological vulnerability to the emergencies, based on quantitative and quality indexes, oriented to the process of making decision in area of prevention of emergencies;	Absence of the system of indicators and criteria for assessment of vulnerability to emergencies
Consolidation of interdisciplinary and multy-field approaches in the system of prevention and liquidation of consequences of emergencies;	Absence of methodologies allowing to set the degree of vulnerability to the emergencies depending on structural-functional organization of landscape;
Development of modern methodical base by estimation and prognostication of emergencies for the successful functioning of control system of emergencies;	Underdeveloped conceptual and terminological apparatus.
Possibility of diagnostics and typology of landscape complexes on the degree of vulnerability to the emergencies of natural and technogenic character;	
Transition from the quantitative indexes of emergencies to the quality estimation assisting preparation of variants of administrative decisions for development and strengthening of the system of preventive safety.	

submission of information for decision-making to preparation of versions of preventive administrative decisions on the basis of typology of landscape complexes on degree of natural and technogenic danger of emergence of emergency situations.

For the purpose of improvement of system of preventive safety, it is expedient to realize a number of the pilot projects directed on development and approbation of methodology of an assessment of geoecological vulnerability to emergency situations, for example, studying of current state and tendencies of development of an assessment of vulnerability at the national, regional and local levels; studying of the aspects and problems connected with application of methodology of an assessment of geoecological vulnerability in the existing uniform state system of the prevention and emergency response; approbation of an assessment of geoecological vulnerability at the level of certain landscape complexes.

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