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## ECOLOGICAL RISK ASSESSMENT MODELS

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### ABSTRACT

The interconnection between ecological risk assessment value and economic development partially increases. Especially, to prevent the pollution according to the national and international law the improvement of the taken measures, the definition of sanctions in accordance with the existing laws, and value of the possible future pollution risks assessment by the scientific methodology and methods grows day by day. In every country either the methodological approach or point of views and priorities in ecological risks assessment are different. The article covers the different models of ecological risks assessment, their merits and demerits.

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### INTRODUCTION

In the developed nations the increase of environmental (ecological) pollution because of the rapid industrialization shows that the works on environmental management and expenses for environmental pollution control are several-fold lower than the environmental damage[1].

Based on this fact, since the end of 1980-ies the ecological risk assessment is used as a tool in the environmental management. In other words this tool is used for understanding and assessment of the interrelation between human agency and the negative ecological effect caused by this agency. The assessment of ecological risk by this way is the main issue in ecological management and receiving the current information in this field and its assessment. Ecological risk assessment is based on ecological method of the risk degree assessment.

### METHODOLOGICAL APPROACH

Environmental deterioration, notable increase of natural and human-induced disasters cause the clear understanding of the lack of the financial, technical and human resources available for safety issue resolution, and in other words cause the intelligent search of the effective approach for the organization of safety[2]. At the present day there are too many resources of environmental pollution. Thus, at the end of the year 1980 there were collected many scientific facts showing the acceleration of the global climate change, and confirming the interrelation between man-made emissions of the greenhouse gas and global climate change. At the result of natural and human interventions the analysis and forecasting of the negative changes of the environmental quality became the most actual problem. Thus, the assessment of the damage caused by environmental risk factors is one of the most important elements of the environment conservancy measures management. In the developed nations the environmental damage assessment and ecological systems disorders while the environmental damage are connected directly[3]. In the world experience the following four different approaches of the ecological risk assessment exist: engineering approach, model approach, expert approach, sociological approach. In accordance with the definition given by Academy of Sciences of the US risk assessment is the use of available scientific information and forecasts based on science for hazard assessment of the harmful factors influence on the environment and health. The risk assessment process is divided into four staged main elements: detecting and identification of the hazard, influence dose assessment (exposure), dose-response assessment and risk characteristics. The ecological risk assessment is realized in the framework of the offered approach[4]. It is worth mentioning that the ecological-toxicological aspect of the risk analysis is not meant for different types and population of sea or fresh water organisms which constantly dwell in aquatic habitat but serves to hazard assessment of the hydro ecological system[5].

Since 80-ies of the XX century in the US the fair number methods have been developed for determination of different risk types and reasons which stipulate the necessity of risk assessment. Today this methodology is widely used in various developed nations and is recommended by the International Health Organization as the leading tool for definition of the damage amount which undesirable factors of the environment cause to health. Prior to 1986 approximately 30 documentations dedicated to risk analysis and risk assessment were developed and published in the US. In 1980 the



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largest international society on risk analysis in the world 'The Society for Risk Analysis' was organised and the first designated journal on risk analysis named 'Risk Analysis' began to be published. It is worth to particularly note that the most of the situations that may occur in the environment in the near 30 years have been already defined by the past and future [6]

### MATERIALS AND METHODS

There are definite operational phases related to all models of the ecological risk assessment. They include: identification of the problem, definition of damages, expansion assessment, influence assessment, results assessment, and risk assessment. In different countries in accordance with their characteristics there were developed many models of ecological risk assessment. Researching these models we can show two main classifications which have different characteristics from the methodological point of view: the modes of ecological risk assessment concentrated in the chemical analysis and the models of ecological risk assessment in social economic terms influence. To determine the damage risks on people health caused by chemical constitution of the industrial facilities the National Academy of Scientists (NAS) in the US forcedly accepted the research of the ecological risk assessment and developed the appropriate model in 1983. This method took as a basis the existent and new legislation on Chemical Substances of the European Union, enhanced its quality and improved it by different additions and corrections. It is also the improved version of risk assessment methodology for some definite fields and many operations carried out [7].

#### 2.1 United States Environmental Protection Agency

United States Environmental Protection Agency (EPA) focuses its activity on chemical analysis in ecological risk assessment. The methodology of EPA focusing especially on researches of pollution risk assessment gives assessment to the risks caused by the agrochemicals to the organism. At the same time in accordance with the Water Quality Standards Instructions (Regulations) and law of Clear Water under the ecological legislation of the US the risk assessment is again focused on the chemical analysis. Generally EPA gives the ecological risk assessment methodology as follows. The ecological risk assessment is a process which assesses possibility and ability to show the one or several negative ecological impact [8]. Focused on chemical analysis the US EPA alongside with the changes in the water quality determines the risks in the ground, sea, transition ecosystems and ecosystem functions, and influence of these risks on fish stock population in its researches which use the Ecological Risk Assessment methodology. The received information improves the risk management process with the aim of pollution decrease and is included into the plan. In the researches the ecological risk is assessed by the ecological risk assessment methods, the conceptual models of risk management and control were developed. Despite the ecology risk assessment methodology developed by the US EPA is focused on the chemical analysis it became the basis for the future developed similar methodologies. Many different ecological methodologies of the risk assessment were developed by the accomplishment of the incomplete aspects and addition of the new points of view.

#### 2.2 World Health Organization

World Health Organization redeveloped the EPA from the point of view of human health and ecology risk assessment. This structure differs from EPA with the following the subsequent risk occurs in parallel with the risk assessment process by managers and contribution of stakeholders. Each process accomplishes its function within the framework of its inner dynamics, but at the same time there can be connections between interactions, relations and two processes in any point. On the stage of ecological risk assessment the Organization for Economic Cooperation and Development created the structure similar to the ecological risk assessment model of World Health Organization.

#### 2.3 The European Union

There are two approaches in sequence in the countries of the European Union. Despite the ecological risk assessment in the EU legislation focuses on the chemical analysis of the new and current agrochemicals assessment, the DPSIR structure focused on the accepted later Water Framework Directive (WFD) in the scale of the river basins includes the other natural conditions and social economic structure in its risk assessment. Because of agrochemicals hazard the The European Commission developed the 'New agrochemicals policy' for environment and human health safety [9]. This system has been serving as main since 1981, and differs from the current chemical legislations for the 'current' and 'new' agrochemicals. 100 of the 'existent' till the year 1981 and known as 'new' the 106 agrochemicals were announced as 'existent' ones. The preparations included after 1981 were determined as 'new' ones. According to the current laws this is necessary for

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implementation of the very valuable tests to the new agrochemicals. But at the same time no dimensions were implemented to the current agrochemicals. The legislation on environment started to be developed in the European Union in 1973. Since this date the structure of the risk assessment has been determined by many regulation laws and instructions of the European Union. At the same time in 1995 the pollution assessment criteria were determined by Technical Guidance Documents (TGD) and was accepted by all countries of the European Union. The US National Research Council uses the risk assessment structure of the European Union as a basis for the 'Federal Government Risk Assessment: Process Management'. This report is also known as Red List [10]. Despite this structure was first prepared for the human health assessment afterwards it was adjusted to the ecological risk assessment [11]. The Technical Documentation of the Management defines the scientific, political and social characteristics as the important parts of the general assessment process. The subsection status can change in different countries in accordance with topography, climatology and etc. [12]. In this paragraph the standards were developed for the EU countries considering the average ecological characteristics and possible subsections. In accordance with these standards the measurable information and area can be re-reviewed for the certain emission values and research fields. The main principles in these directions were determined by European Environment Agency [13]. At the present time and at this stage majority of the countries had to consider the general methodology of the ecological risk assessment. The risk management approach of Holland (The Ecological Management Program of the Holland Government) first began to be developed by the use of German Ecological Management Program in the period of 1986-1990. In accordance with this concept and notion the value of the impact basis (ecological quality and impact standards) of the approach was emphasized in addition to the source-based approach in the risk management (emission standards). But the first risk assessments were based only on the chemical analysis [14].

### 2.4 The other countries

The Great Britain and Canada formed their own ecological risk assessment models [15]. The ecological risk assessment model of the Great Britain alongside with the legislation is also based on the assessment of the territories (areas) which are under the potential pollution risk [16]. The American risk assessment model approach as well as the Canadian model shows the opposite approach. This model is based on the following idea of the NRC committee: 'despite the risk assessment and risk management process are analytically independent of one another, practically they have to interact. If they progress independently it will be hard to adopt the right decisions by the due date for the risk managers [17].

### 2.5 Azerbaijan Republic

In accordance with the articles 2, 3, 6, and 7 of the 'Regulations of recognition and implementation of the international (regional) and interstate standards, norms, rules and recommendations on the territory of Azerbaijan Republic' and the articles 8.12 and 8.45 of the 'Regulation on State Committee for Standardization, Metrology and Patent of the Republic of Azerbaijan' on the basis of international standards the following government standards were developed and submitted: 'Water quality', 'Environment Management Systems. Instruction requirements for use', 'Environment management systems. General instruction regulations on principles, systems and activity methods'. This standard includes the instructions on information gathering which is necessary for preparation of the risk assessment or additional measurements plans. But it gives instructions only on generally requested formation. It highlights the necessity of additional information for the typical measurement methods. Determination of contaminated land volume and especially the environment which causes the pollution, human risk assessment can be hard. In conjunction with this complexity with the aim of acquiring of the amount of information necessary for characterizing of the potential risks, methods and receptors, the process of determination of the contaminated lands and their assessment must be the process occurring repeatedly together with the different stages of the research. The aims have to be re-reviewed at each stage and the requirements relating to the next research have to be prepared.

## DISCUSSIONS

The ecological risk assessment process of the US EPA works out the process of risk management process and technical assessment process separately. Ecological risk assessment offers additional opportunities on ecological risk management discussions to the majority of interested organizations and also non-governmental organizations and social agencies. Also the other structures such as the reconsidered NRC structure, the structure of assessment of the new and current agrochemicals risk of the EU, food additives risk assessment and management WHO structure (C.I.S. committee on food and agriculture), related parties queries and risk managers play the larger and more valuable role in the risk assessment [18]. The paradigm of risk management and all other risks except the level of interaction between the related parties follows the same logic. There is a

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terminological difference between the ground of the human health and ecological risk assessment processes. There is a noticeable difference in the process of hazard identification [19]. There is noticeable improvement in the risk assessment of protection of the environment which is the source of pollution. It is important to control different pollution sources for the ecological improvement. To solve the pollution and human environment deterioration problems the basin approach have to be accepted instead of assessment of water sources or foulants in sequence. The structure of the watershed divide approach builds the interaction between the natural resources and private sector activity. The majority of states in the US develop the strategy in accordance with the Clear Water Action Plan and annexes their basins. In this basin approach not only the environment (water, air and etc.) is assessed but also the interactions between these environments. Similarly the Water Structure directives which are the basis for water management in the EU countries changes from the local scale to the basin scale by means of implementation of the juridical legislation. Different tensions (pollution, climate changes, regional and global economic structure and etc.) influence different ecosystems in various manners. From this point of view the availability of different ecological risk analysis clears the way for innovations implementation to these fields and gives an opportunity of rational use of the ecosystems with the complex structures.

### OUTCOME

As per some authors with critical approach to the ecological risk assessment there are too many disbeliefs in the ecological risk assessment because of incomplete understanding of ecosystem operations, inability to build regular connections and relations between the parameters of the mechanisms. These disbeliefs will be of higher priority in the assessment according to juridical, technical or social economic context [20].

Also in other research with the aim of possessing the scientific approach to the Canadian structure which is based on the chemical analysis and puts the risk management into the ground of the risk assessment process, the authors discussed the differences of Ecological Risk Assessment of the US Environmental Protection Agency which values the risk management as the second process. As per other author, the risk assessment was developed as a part of risk management by the risk experts to overcome the ecological disaster in the environmental actions. The environmentalists suppose that the risk assessment cannot be enough for the full development of characteristics of people, and ecological hazard and harm of the ecosystems [21]. Per environmentalists the risk assessment instead of being a risk removal is an effort just to determine the amount of risks and classify them by types. It is also supposed that it is not easy to eliminate the mistakes in ecological assessment, and the optimized assessment of such kind of risks gives an opportunity for ecological risk management. In spite of this the author adds that some groups of environmentalists put aside this approach and accept the risk assessment approach. Despite environmentalists' negative point of view about the risk assessment, the ecological risk assessment was accepted and successfully implemented by many countries, in spite of the approach and priority differences in the methodology. There are methodological differences between the US EPA structure based on chemical analysis, Canadian structure based on risk management and the EU WDF structure which includes the natural state and social economic structures. The approach have to be chosen due to the research on ecological risk assessment.

The critical notes about the assessment listed above: the inability of full understanding of the ecosystems mechanisms do not mention the inability of causal relationships between the sub-components forming this mechanism. Despite the complex of the interrelation group between the sub-components it is possible to determine and assess the impact level and amount of these interrelations. Solution of these problems with more certainty requires the definite time period, more rational economic ecological methods, technologies and etc.

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