Discovering and Assessing the Ecological Risks in the Crimea

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Abstract. This paper gives assessment to the ecological threats and risks in the Crimea. Ecological risks of natural, anthropogenic and social character are investigated in practice and mapped. The Crimea is distinguished by its regional features and it stipulates the peculiarities of ecological risks within the territory. The diversity of landscapes, the contrast of natural conditions and their spatial-temporal variability are the reasons of many dangerous natural and technogenic processes on the territory of the peninsula. The risks are classified according to different principles. There are several types of risks according to the type of environment: natural, technogenic and social. The risks and hazards have been studied and assessed in practice in the Crimea. The natural and anthropogenic risks have been considered and mapped. Key words: natural ecological risks, anthropogenic risks, social ecological risks, Crimea, assessing, mapping.

1. Introduction

Any kind of human activity is known to be linked with certain risk. In fact, every activity has been risky from the time immemorial. Human practice allows us to say that any activity is potentially dangerous. To monitor the risks is one of the most important tasks of modern society. In the course of human development some threats and risks are replaced by others.

The notion “ecological risk” is a variant of the “risk” one. The amount of ecological risk, its probability is calculated for the events and phenomena ecologically significant. It means the risks from natural disasters, industrial accidents, water-borne diseases, air pollution, etc.

The risky situation includes the following components: 1) unfavorable event, which time and place are not known exactly; 2) the subject for which the given event can be unfavorable.

The analysis of nature resource and economic potential of the Crimea, carried out in 2015-2016 allows estimating the ecological risks much more profoundly and in detail. In this case the choice of ecological risk rates is rich in content and gives a chance to create a certain idea about the conditions of the investigated territories. But the main significance of these studies clearly demonstrates in the analysis of the procedures of comparison and assessment of ecological risks.

In spite of the high potential of socio-economic development, in the Crimea there are some essential problems, connected with estimating the development perspectives of the territories, the ecological risks which are sure to be a limiting factor taken into account.
The aim of this paper is to determine the peculiarities of ecological risks manifestation in the Crimea.

The subject of the paper is the territorial peculiarities of distributing the ecological risks on the Crimean territory.

The system of scientific as well as the specific methods of geographical, ecological, socio-economic investigations of the territory has been used in this paper. Besides the statistical, analytical, cartographic and special methods of calculating ecological risks of the territories have been carried out.

The article examines the results of domestic and foreign studies in assessing the ecological risks of the territory, the development of the territorial potential, taking into account the ecological risks.

A wide range of scientific, methodological and virtual data has been analyzed. The data, received at the Administration of Municipal education of the Crimea are used as a statistical database. They show the basic rates of nature-resource and ecological analysis of the territory. The data of the administration of “Krymstat” statistics have been used too.

A great deal of scientific works of domestic and foreign authors is devoted to the study of theory and methodology of ecological risks [see 5, 8, 24]. The bases of calculating methodology of ecological risks are given in works [see 24, 27]. Practical aspects of defining ecological-gene risk factors of certain territories are presented in the works [see 25, 26]. It should be mentioned that a number of works on estimating ecological risks, their spatial distribution and the degree of manifestation have been made for the Crimean territory.

The idea of a given paper is to get the data to characterize the ecological risks of the administrative districts of the region and to consider the integration procedure of different rates in calculating the ecological risks. The administrative-territorial units often turn out to be the territorial units in the studies carried out in the framework of the sciences about the Earth.

2. Methodology and methods
Empirical experience of discovering and assessing the ecological risks made by the authors for the last 10 years [13 – 18] for different Crimean regions helped to determine the basic groups of ecological risks within the territory of the peninsula. First of all two large-scale groups of ecological risks can be defined on the basis of genesis and system–formation processes, they are: natural and anthropogenic risks. Within each group more than 20-25 varieties of the ecological risks can be identified. But only the most significant and clearly manifested ecological risks in the Crimea have been chosen here.

The group of natural risks includes seismic-prone risks; flood, landslides and avalanche hazards, unfavorable hydro-meteorological phenomena, mountain torrent processes, natural nidus diseases. The group of anthropogenic risks is considered to be: domestic wastes, industrial production, municipal economy, agriculture, and traffic communications. Social risks, closely connected with the ecological risks in the Crimea can be referred to as another group.

3. The main part
The ecological risk is supposed to bring about negative changes in the natural habitat or distant negative consequences to the environment. The ecological risk is likely to cause the ecological disaster, catastrophe, breaking down further natural functioning and the existence of ecosystems and objects as a result of anthropogenic activity in natural environment or natural disasters. The notion “risk” (and, accordingly, “ecological risk”) can be explained by danger and uncertainty.

Theoretical and methodological bases of assessing and analyzing the ecological risks are given in the works [see 5, 8, 24].

Let’s consider the peculiarities of assessing and analyzing the ecological risks, the Crimea taken as an example.

The main feature of natural resource management in the Trans-Black sea area is known to have contrasting character registered in dissimilarity of systems. The Crimean peninsula is a part of the Trans-Black sea area with its distinguished regional peculiarities. The variety of landscapes,
contrasting natural conditions and their spatial and temporal genetic variability provoke dangerous processes on the territory of the peninsula. However most part of them is not catastrophic and represents relatively minor risk for the Crimean territory as a whole.

The Crimean mountains due to their low height are, in fact, easy available. But their easy access makes people careless and they underestimate possible dangers. That’s why it is necessary that people should know about the hazards especially while setting up the recreational branch of industry. Safety investigations in tourism in mountainous Crimea were carried out in the 60-70-s of the last century. It was the period of massive development of tourism and outings. According to the data of the rescue service of the Crimea 645 people have suffered on the tourist paths of the peninsula for the last 15 years (2000 – 2015), 96 of them died, more than 200 were badly injured.

Seismic processes of mountainous Crimea are rather weak in comparison with other seismic regions of the adjacent countries. Crimea can be identified as a region of Mediterranean collision belt with low seismic activity and rare destructive earthquakes [see 1]. The peninsula is situated in seismic zone measuring 5-8 on the Richter scale. Catastrophic tremors occur once every 500 years. The periods of repeated earthquakes for Yalta – Alushta region are: 6 - on the Richter scale every 20 years, 7 – every 100 years, 8 – every 500 years [see 1].

Mudflow processes. Mudflows in the Crimea are formed after heavy showers and as a result of the breakdown of the earthy dams blocking the beds of small rivers. Mudflows cause great material damage because mud and stone deposits cover the gardens, destroy roads, bridges and rive rain, buildings. Last years it was the technogenic factor that damaged greatly because the river beds were narrowed while building transport networks, communication tubes, pouring off the ground etc.

Floods in the most dangerous mudflow south-eastern region (Alushta, Sudak) which greatly damaged the area were: the Demerdzhi river 1898, September, 1987, July; 1997 August; the Voron river with tributaries: 1980, 1983, 1987, 1988, 1998; the Suuk-Su river, 1982; the Uskut river, 1988; the Alachuk river, 1997; the Khasta river, 2004; the Kutlak river, 1967, June (20 people died ). It was considered to be one of the most destructive mudflows registered. In other mudflow regions the catastrophic mudflows were: on the Uchan-Su river, 1906, 1949; the Kacha river 1915, 1933 on its tributaries, 1924, 1966; the Alma river: 1955, 1971, 2004 [see 11].

Climatic conditions being unstable don’t make much trouble and in fact there is no practical risk, because the climatic changes can be forecasted and unfavorable consequences can be avoided.

In agricultural activity it is achieved by both agro-technical and land-reclamation measures (the choice of drought-resistant cultures adapted to the climate, planting forest belts, building up water reservoirs, etc.). Even such essentially dangerous climatic phenomena for the Crimea as spring frosts don’t heavily harm in case of perfect production management.

In the warm year period the hail-fall may occur during strong lightning and heavy showers which damage agriculture, i.e. the people risk to lose the results of their year’s work for extremely short period of time. So the anti-hail deference was underway in the Crimea to liquidate this risk.

Floods and high waters.

Crimean rivers in arid climate and with insignificant amount of precipitation are characterized by small waters and don’t threaten with floods as big rivers do. But their flood regime creates almost annual prerequisites for dangerous water level rising, for the risks to people’s life and economic losses. So in August 1847 in Simferopol many houses were destroyed after heavy rains, gardens and kitchen gardens were damaged and some people died. In 1848 high water flooded houses in Yevpatoriya and Feodosiya. This event happens almost every year. One of the last destructive floods occurred on the Bodrak River in August 2004 [see 11].

Flood run-off usually covers relatively small territories. Maximum water consumption from the rivers of 1 % provision (once every 100 years) exceeds many times annual average consumption: for the Zapadny Bulganak river – 400, for the Maly Salgir – 270, for the Zuya – 220 times, but it is once a century!
The risks of floods are increasingly caused by human activity (tree felling, construction of the river banks, creating water reservoirs which in the main regulate the river run-off, but sometimes result in “anthropogenic” floods in accidental water overflow.

Storms. On the Azov and the Black sea storms caused by strong, mainly, north-eastern winds can be observed almost every winter. The strongest winds are in the Kerch strait. On the sea of Azov the average number of stormy days can be 40-60 (in the western part of the sea), waves as high as 4-9 meters may be dangerous to the ships.

One of the large-scale ecological disasters occurred in winter 2010 during the storm in the Kerch strait, when the tanker Volga-Neft – 139 broke up (some 6 miles from the shore). There were neither victims nor injured among the crew, but 1200 tons of oil were spilled into the sea. In the port of Kerch the Vol'nogorsk cargo ship loaded with sulfur (some 2, 1 thousand tons) sank. In the region of the Kapsel harbor near Sudak one ship ran aground, in the region of Tuzla Island the barges loaded with grease ran aground. These accidents will have, by far, sufficiently detrimental ecological consequences: grease pollution will last long and the cargo of sulfur on the ships sunk due to the storms is much more harmful than oil spill.

Natural disease centers. The natural conditions on the peninsula stimulated the spreading of natural centers of some diseases, the number of which has been increasing in the last decades due to violating ecological balance on some territories. Most part of natural disease centers is a group of dangerous infectious diseases resulting in high level of mortality and in some cases – pestilence. Real ecological risk threatens the Crimean residents and holiday makers. The spectrum of these diseases includes: tularemia (rabbit fever); leptospirosis (camisole fever); brucellosis (Cyprus fever); Crimean-Congo hemorrhagic fever; tick-borne encephalitis, epidemic hemorrhagic fever; hydrophobia; nine-mile fever (or Quadrilateral) fever; Marseilles fever, Lyme disease, etc.. In the water reservoirs of the Crimea the strains of cholera vibrio’s are regularly found, their durability being the prerequisite for cholera epidemic spreading.

The end of the XX century saw a lot of processes of extreme character when in a number of Crimean regions the centennial maximum of precipitation and air temperature was exceeded. There were heavy showers and the storms of rare frequency, the cyclonic and stormy activity intensified. So last years can be identified as the years of exogenic activity.

If natural ecological risks are stipulated by the changes in the natural environment, the anthropogenic (techno- ecological risks) are caused by the development of technosphere. In the Crimea the risk of technogenetic accidents and disasters to follow is likely to occur in such regions as: - Perekop zone; it is noted for the dangerous chemical enterprises. Here the residents of the populated areas adjacent to chemical works are threatened with developing of chronic bronchitis, stomach ulcer, heart disease, cancer, etc. So the risk of such diseases is several times as high as the Crimean average; - flat Crimea: huge concentration of transport communications (irrigation channels, gas-tubes, motorcar roads (highways), railroad network), accumulation of chemicals (herbicides, pesticides, mineral fertilizers) in agricultural works; - foothill: the presence of both industry and towns, transport communications, their deployment in inter-ridge depression, which tends to accumulate pollution.

In spite of the fact that the Crimea is not thought to be a highly developed industrial region and the risk of technogenetic accidents is not great, yet there are health hazards to people and the risk of diseases due to municipal and domestic pollution, sewage disposal on the Crimean coastline (main recreational region of the peninsula). The list of ecologically dangerous Crimean objects includes: The site of solid domestic wastes (Gaspra, Yalta), The site of solid domestic wastes (Sudak), Krymsky Titan” plant (Armyansk), “Krymsky soda “ plant (Krasnoperkopsk), Sewerage-purification installations (Simferopol, Sevastopol) (see fig. 1).

In the Crimea in 2015 22.8 thousand tons of pollutants were emitted into the air from stationary sources, it is 2.3 thousand tons more than in 2014. One must take into account that gaseous and liquid pollutants were 93% (21.2 thousand tons) of the total registered emissions from all the stationary
sources. Of all the amount of solid pollutants (36.5 thousand tons) from stationary sources 95.6% of pollutants have been caught and neutralized by purification installations, 30.5% of them being utilized.

Figure 1. Anthropogenic ecological risks on the Crimean territory.

The total volume of emissions from stationary sources was 75.6 thousand tons; 56.0 thousand tons (or 74.1%) were sent to the purification installations [see 12]. On 1 square kilometer of the republic territory 0.9 tons of pollutants is emitted into the atmosphere. It means 12 kg per resident. However in some towns these indices exceeded the average level substantially. In particular in the town of Krasnoperekopsk the amount of emissions on 1km² exceeded the average republican level 346.8-fold, 21.8-fold per dweller, in Armyansk – 26.4-fold and 13.1-fold correspondingly.

The main pollutants of atmospheric air in the region were the enterprises of manufacturing industry. Its share of pollutants is 57 %. Plants producing and distributing gas, water and electric energy, account for 17.1% of pollutants; natural deposits mining enterprises account for 11.4%; agricultural, hunting and forestry plants account for 9.6%.

The largest quantity of pollutant emissions into the air was registered in the town of Krasnoperekopsk (6.9 thousand tons), Armyansk (3.8 thousand tons) and Simferopol (3.6 thousand tons). On the average one enterprise released 102.4 harmful substances into the air. At the same time in Krasnoperekopsk and Armyansk the average emissions have exceeded the republican index 7.5-fold and 18.8-fold correspondingly.

90% of purification installations of the Black Sea are in disastrous conditions: most health resorts of the Crimea dump sewage directly into the sea without any purification (the South coast is already called “cesspit”) Every year the sanitary epidemic station bans bathing in the waters of Bolshaya Alushta – Rybach’e, Malorechenskoye and Solnechnogorsk due to the risk of infection during spa period.

The discharge of polluted run-off has a negative impact on the quality of water resources. 154.3 mln.m³ of sewage, forthcoming and other kinds of water have been poured, including 131.3 mln.m³ of waste water that has been dumped into water reservoirs. The proportion of waste water in total water diversion was 60.9%. Here the discharge of polluted sewage into water reservoirs accounts for 7.2 mln.m³ including 2.5 mln.m³ without any purification [see 12]. 98,3 mln.m³ of standard purified water
has been delivered to the purification installations. Water reservoirs of the republic are still polluted with compounds of heavy metals: chlorides, sulphates, aluminum, iron, phosphates. The basic reasons of sewage water discharge into the surface water reservoirs were: the lack of water diversion in most of the republican territories, poor quality of waste water purification, and unsatisfactory condition of purification installations.

The so-called “postponed disasters” can turn out to be ecologic and technogenic hazards. They can be caused by military industrial complex activity. Near the shores of the Black Sea hundreds of containers with chemical ammunition have been found, sunk here as early as in 1941. They have poisonous substances harmful for people’s health and are considered to be rather a serious ecological risk.

In 2004 in the waters of the Black Sea 500 containers were discovered. There is mustard gas (Iperit) and lewisite in the scuttled barrels. Mustard gas is a militant poisonous substance. In respiratory track affection pneumonia can develop and cause death as a consequence in several days. Antidote against mustard gas doesn’t exist. Lewisite is a persistent poisonous substance. In contrast to mustard gas it doesn’t have a latent period. Immediately after poisoning pain is felt and then eczemas develop. In heavy affections skin ulcers can be seen. The samples of water showed that barrels with chemicals have already begun to decompose.

According to “Voinkonveer 43” scientific laboratory 9 regions with scuttled containers have been found on 1500 square kilometers of the Black Sea coast including 2 regions with scuttled chemical ammunition in 428 containers. In particular near Lastochkino Gnezdo 24 barrels have been discovered, near Chernomorskoje settlement – 49 containers, near the coast of Kerch strait at Eltigen settlement – 11, near Ilya cape in Feodosiya bay -1, in the area of Opasny cape (the coast of Alushta town) – 66, near Sotera cape – (Alushta coast) – 70; Kayabashi cape (Balaklavskaya harbor) – 80, in the regions of Chersoneses and Fiolent capes – 27, at Lukull cape (western part of the Crimean coast) – 65 containers.

Social risks are caused by the mode of life and human activity and differ greatly due to the changeableness of the factors affecting them. Among them there can be defined also ecological and political, economic and ecological, social ecological risks and other risks.

In the Crimea social factors are said to create risks which can be seen in non-stability of socio-economic life, first of all.

So, agricultural lands structure changes rather frequently and it affects the increasing dynamics of many negative processes. If we carefully consider the dynamics of agro-climatic phenomena we can make sure that many agro-climatic factors such as frosts are influenced by the cultures which are not suitable for the climatic conditions of the region. These cultures may be thought of as the risky ones. Consequently it is necessary that the analysis of economic and social profitability of such cultures should be carried out and also more detailed investigations of different frosts in various places should be made.

The largest forest fires have been registered in Yalta mountain-forest sanctuary. In 1993 the area under fire was 459 hectares including 44.3 hectares of crown fire, in 1998 –107 hectares (including 4.5 hectares of crown fire).To put out the fire forestry authorities called the Black Sea Navy servicemen, marines, cadets of military schools, 5500 volunteers, modern fire technology, airplanes and helicopters being used too. The fight with impending fire disaster was being waged for 10 days. New risks for people’s health appear in towns where most Crimean’s live. But unfortunately the researchers are slow to perceive and study this process and the statistical data to assess the level of risk and its consequences haven’t been collected yet. However even now it is possible to identify ever increasing danger and risks nowadays.

4. Conclusions
The Crimea is distinguished by its regional features and it stipulates the peculiarities of ecological risks within the territory. The diversity of landscapes, the contrast of natural conditions and their spatial-temporal variability are the reasons of many dangerous natural and technogenic processes on
the territory of the peninsula. The risks are classified according to different principles. There are several types of risks according to the type of environment: natural, technogenic and social.

The risks and hazards have been studied and assessed in practice in the Crimea. The natural and anthropogenic risks have been considered and mapped.

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