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ASSESSMENT OF THE NEGATIVE EFFECTS OF MILITARY OPERATIONS ON THE TERRITORY OF VYSHGOROD DISTRICT OF KYIV REGION

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Abstract. *The article identifies the negative factors that have arisen as a result of military operations on the territory of Ukraine. The article presents the values of environmental damage in terms of quantitative indicators of the impact of military operations on the natural environment and the country's economy based on open data of the State Environmental Inspectorate of Ukraine. The destruction, which includes the loss of biodiversity, production facilities, air pollution, land, open water bodies, forests and the entire ecosystem, is considered.*

The article analyses the impact of negative factors that arose after the full-scale invasion on 24.02.2022 and affected land use (using the example of Kyiv region). The area of land plots by land category that was under occupation from 24 February 2022 to 02 April 2022 was calculated. Based on the proposed method of analysis, it will be possible to calculate the area of land, taking into account its designated purpose, ownership and type of use. The number of territorial communities affected by the negative consequences of hostilities is given.

The assessment of the negative effects of hostilities is carried out in the long term, as it requires the collection and analysis of a large amount of data. However,

this is an extremely important process for determining the necessary resources and strategies for restoring the territory and infrastructure. In the future, the data on monitoring the state of the environment from the negative impact of hostilities will become the basis for making informed decisions on the restoration and development of territories, ensuring a balanced approach to the conservation of natural resources and economic recovery of the affected regions of our country.

Keywords: *assessment of the negative consequences of military operations, impact assessment, economic development of the territory, territorial communities, land and soil protection, monitoring, land management*

Statement of the problem. The problem of assessing the negative consequences of hostilities in territorial communities is that military conflicts and hostilities significantly worsen the state of the environment and the economy, both in the conflict zone and in the country as a whole. The negative impact on the environmental situation can occur due to air, soil and water pollution, loss of natural resources, destruction of infrastructure, which leads to economic instability and, as a result, unemployment.

Assessing the negative impact of hostilities in territorial communities is a complex task, as military conflict can have long-term and unpredictable consequences.

To solve this problem, it is necessary to develop a comprehensive and effective methodology for assessing the negative effects of hostilities based on the use of various tools and approaches in the context of territorial communities. It may include the following criteria:

- collection and analysis of information on the state of the environment and economic development in the conflict zone;
- development of forecasts on the possible consequences of hostilities, taking into account various scenarios and their impact on territorial communities;

– development of strategies and measures to reduce risks and minimise the negative effects of the war, including measures for environmental restoration, socio-economic recovery and support for vulnerable groups.

Analysis of recent research and publications. The following scientists have studied the ecological and economic assessment of land use, its rational use and the impact of military operations on land resources: Dorosh Y. M., Butenko E. V., Dorosh A. Y., Bavrovska N. M., Kharytonenko R. A., Boretska N. P., Stadnytskyi V. A., Pavlovych-Seneta J. P., Hutsulyak H. D., Hutsulyak Y. H. and others. Their research provides a comprehensive analysis of issues related to the assessment of the negative consequences of hostilities in territorial communities and makes a significant contribution to the development of scientific knowledge in this area.

Dorosh Y. M., Dorosh A. Y. and Kharytonenko R. A. note that the methodology for developing a programme for the rational use and protection of community resources has all the prerequisites to become an important science-based document that will determine the methods for developing such programmes, shape their structure and content. This document will enable communities to develop effective programmes for managing their own resources, which will contribute to their economic development, increase the level of human potential and improve the environmental situation in the community [1].

Butenko E. V., Kharitonenko R. A. and Petrychenko S. V. emphasize that there is a need to study the consequences of military actions on the productive potential of lands and their plots and identify the following tasks for their further solution: to carry out a general analysis of lands affected by the negative impact of military actions; to assess the loss of productive potential of lands of territorial communities affected by military actions; to propose new restrictions on the use of lands and their plots affected by military actions; to develop measures to restore the productive potential of lands and their plots.

In turn, V. Stadnytskyi notes that "the formation of a system of rational agricultural land use should ensure the harmonisation of both environmental, economic and social factors of balanced rural development. In the ecological sense,

this system should include, at least, optimisation of the structure of land and sown areas, soil protection reclamation of the territory of agricultural enterprises, and introduction of soil protection technologies for growing crops" [3].

Kharytonenko R. A. and Butenko E. V. argue that the removal of erosion-prone arable plots from cultivation, the creation of filtration strips on them and grass on waterways will help reduce water erosion and increase the area under perennial grasses, which will have a positive impact on the environmental situation. According to estimates, the implementation of such measures will lead to an increase in gross revenue from the sale of agricultural products, which will have an economic effect. [4].

According to Butenko E. V. and Bavrovska N. M. "the method of land management in improving the land management system is one of the priorities in the implementation of land policy, which will allow the development of the necessary land management and urban planning documentation, land inventory, topographic and geodetic works, land valuation, development of land management schemes and feasibility studies for the use and protection of lands of administrative-territorial entities, development of working land management projects for the reclamation of disturbed lands, protection of lands from erosion, flooding and other dangerous geological processes" [5].

Boretska N. P. assures that "one of the effective ways to attract investment to solve priority problems of territorial development is the further expansion of public-private partnerships. The essence of relations within the framework of public-private partnership is that such partnership is a form of joint participation in projects to obtain socio-economic effect, on the one hand, and focused on the redistribution of tasks, responsibilities, risks and profits between participants, on the other" [6].

Kireytseva O. V. and Zhylin O. V. note that the ecological and economic approach meets the requirements of the basic economic principle of management in a market environment, which is to achieve the highest production efficiency with minimal expenditure of resources and funds. It also complies with the ecological

principle, which provides for the rational use and economic use of natural resources and minimisation of damage to the environment [7].

Given the significance of all the above developments, the issue of environmental and economic assessment of the negative impact of military operations on land resources, including in the context of community territories, remains open. These issues require additional analysis, reflection and further research.

The purpose of the study is to assess the negative environmental impact of military operations in the context of post-war reconstruction and to identify ways to overcome the negative effects of the war.

Materials and methods of the research. The following research methods were used: monographic - in the processing of scientific work on assessing the impact of hostilities on territorial communities; abstract and logical - to substantiate the purpose, objectives and formulation of research conclusions; comparative and statistical analysis - to describe the object of research (territorial communities) according to statistical reporting; graphical - to visualise the impact of hostilities on community lands and in the process of restoring these lands. The method of analysis was based on the analysis of relevant governmental guidelines and regulations on assessing land losses due to emergencies and hostilities, which affected land use.

Using the QGIS software [8], a map of the liberated territories of the Vyshhorod district of Kyiv region was created by interpolating data from the open database Kadastr.live and the boundaries of the occupied territory (Fig. 2) [9]. Based on the map, the area of the liberated territories of Kyiv region was calculated in hectares by land category using the built-in QGIS function "Field Calculator" using the formula S = Area / 10,000 (Table 2).

Research results and discussion. Assessment of the negative effects of hostilities in territorial communities is an important tool for analysing the consequences of conflict. This process includes assessing the impact of hostilities on the environment, human health and the economy, as well as assessing possible ways to reduce the negative impact on the lands of territorial communities. One of the legal acts that controls assessment activities in Ukraine is the Law of Ukraine "On

Environmental Impact Assessment" [10]. The law establishes requirements for environmental impact assessment and provides for public participation in the decision-making process. In addition, there is a law of Ukraine that approves the Methodology for Determining the Damage and Losses Caused to the Land Fund of Ukraine as a Result of the Armed Aggression of the Russian Federation [11].

Assessment of the environmental impacts of hostilities may include an assessment of air, water and soil pollution, as well as the impact on biodiversity and ecosystems. This can help set priorities for environmental restoration and public health protection.

"The assessment of economic consequences includes an estimate of the damage caused by the destruction of infrastructure and loss of jobs. It is also possible to determine the costs of restoring infrastructure and economic development of the territory. The Order of the Ministry of Reintegration of 17 November 2022 No. 273 approved an updated list of territorial communities located in the areas of military (hostilities) or those under temporary occupation, encirclement (blockade)" [12]. Based on this document, payments will be made to internally displaced persons. We remind you that the list is not fixed - it is regularly updated. The list includes 331 communities from 9 regions: Donetsk (66), Kharkiv (56), Dnipro (10), Luhansk (37), Zaporizhzhia (64), Kherson (49), Mykolaiv (26), Sumy (19), Chernihiv (4).

All internally displaced persons from these settlements will receive financial assistance from the state. The list of recipients is formed in agreement with the Ministry of Defence of Ukraine based on proposals from the relevant regional and Kyiv city military administrations.

Sustainable development tools such as environmental and social impact assessment, life cycle analysis, risk and vulnerability assessment can be used for effective environmental and economic assessment of the effects of military operations. It is also advisable to take into account local specificities and context in order to properly adapt and implement recommendations.

Environmental impact assessments help to identify changes in the state of the natural environment as a result of military operations. This approach includes the

study of ecosystem destruction, loss of biodiversity, environmental pollution and other environmental impacts.

The method used to assess environmental damages is the "cost of loss of ecosystem services", which is based on the idea that ecosystems provide a variety of useful services, such as air and water purification, plant pollinators, climate regulation, etc. These services are an important resource for society, and their loss can have serious environmental and economic consequences. Thus, the method is to estimate the value of these ecosystem services in monetary terms. This method allows for the conversion of environmental aspects into economic terms, which facilitates comparisons between different options or projects. It can be applied in a wide range of areas, from assessing the environmental impact of new infrastructure projects to estimating the cost of biodiversity loss due to land use change.

Economic impact assessment is also used to determine the economic damage and losses caused by military operations. This approach includes an analysis of the loss of production capacity, reduced tourist flow, reduced community income and other economic impacts.

For a comprehensive impact assessment, life-cycle analysis methods are used to understand the consequences of hostilities at all stages of the life cycle of facilities, including production, operation and disposal. To assess risks and vulnerability, special techniques are used to help understand the possible consequences of hostilities and their impact on vulnerable components of the environmental and economic environment.

Three main criteria are taken into account in determining such zones: temporarily occupied territories, territories under encirclement or blockade, and territories where active hostilities are ongoing.

The Order of the Ministry of Reintegration of 25 April 2023 No. 125 amended the List of territories where military operations are (were) conducted or temporarily occupied by the Russian Federation [12]. This list was adopted in December 2022 and is updated periodically. Changes to it are made in agreement with the Ministry of

Defence based on proposals from the relevant regional and Kyiv city military administrations (Fig. 1).

Figure 1. Infographics of the number of territorial communities affected by the negative consequences of hostilities [12].

When assessing the impact of a conflict, it is important to consider not only the negative but also the potentially positive effects. For example, more environmentally friendly technologies and more sustainable infrastructure can be used during the reconstruction process. In addition, it is possible to involve the local population in the reconstruction process, which will facilitate their active involvement in the development of the territory. Ukraine has 4,857,200 officially registered internally displaced persons, for whom more than one million places of residence have been created. Of these places, 144,000 are located in the regions of Ukraine, including 31,000 intended for long-term residence. The largest number of internally displaced persons is registered in Donetsk, Dnipro, Kharkiv regions and the city of Kyiv.

According to information from the Office of the President of Ukraine, since 2 December 2022, more than one million places have been created for internally displaced persons, of which 144,000 are located in different regions of Ukraine, including 31,000 for long-term residence. However, at the same time, between 70% and 95% of internally displaced persons consider the lack of housing and work to be

their main problems, with work not always being appropriate for their place of residence. These data are confirmed by the report of the International Organisation for Migration, which indicates that among the most important problems for internally displaced persons are housing conditions (27%), payment for rented housing (23%), payment for utilities (20%) and unemployment (13%).

Another important aspect is the damage to the country's ecosystem. According to the State Ecological Inspectorate, since the beginning of the military aggression of the Russian Federation, as of 14 July 2023, the damage caused to the environment of Ukraine amounts to about UAH 2 trillion (Table 1) [13].

1. Environmental damage as a result of Russia's armed aggression [13]

Type of damage	Cost	Area
Soil contamination	**12,8** billion UAH	**422,4** thousand m^2
Land contamination with "war" waste	**930,9** billion UAH	**16,7** million m^2
Air pollution by burning oil products	**50,9** billion UAH	**707,9** thousand tonnes
Air pollution from forest fires	**1011,2** billion UAH	**62,8** thousand hectares
Air pollution from other fires	**5,7** billion UAH	**1,4** million m^2
Pollution of water bodies	**40,2** billion UAH	**1,7** thousand tonnes
Pollution of water bodies	**4,5** billion UAH	**20,7** million kg
Unauthorised use of water resources	**15,5** billion UAH	**410,2** million m^3

One of the important factors in agriculture is soil contamination. Areas affected by shelling, the burning of military equipment, mined and covered with craters become unsuitable for safe agricultural use due to the large amount of chemicals contained in munitions. After the explosion, these substances remain in the soil and migrate, i.e., get into groundwater and crops. Food grown on war-affected land can be dangerous to consume. One of the possible ways to avoid this danger is to assign degrees of danger to these areas. This will allow for the most objective decision-making regarding these areas for their restoration.

At the beginning of the large-scale invasion of the Russian army, Kyiv region was one of the first territories to suffer from aggression. The occupation of the Kyiv region began on 24 February 2022, when enemy troops entered the area through the border with the Republic of Belarus. The hostile actions resulted in the seizure of 15 communities that were part of the Vyshgorod, Bucha and Brovary districts, covering 270 settlements. During the military operations in 2022, significant destruction was

recorded in 46 of the 69 territorial communities in the region. The communities of Bucha, Irpin, Vyshhorod, Gostomel, Borodyan, Makariv, Dmytriv and Velykyi Dymer districts were the most affected [9]. On 2 April 2022, the occupied territory of Kyiv region was completely liberated from the Russian invaders (Fig. 2).

Almost 33,000 hectares were occupied on the right bank of the Vyshhorod district of Kyiv region. Most of this land is forestry land (Table 2). A large number of residential and public buildings were also affected, and buildings, bridges, and enterprises were destroyed.

2. The area of land liberated from occupation in the right-bank part of Vyshhorod district of Kyiv region by land category

Land category	Area, ha
Lands of the water fund	784,30
Lands of residential and public buildings	1037,18
Lands of historical and cultural purpose	0
Land for forestry purposes	25722,69
Lands of recreational purpose	0,06
Lands of nature reserve and other environmental protection purposes	0,38
Lands of industry, transport, communications, energy, defence and other purposes	75,81
Lands of recreational purpose	48,57
Agricultural land	4859,54
Total	**32528,53**

One of the negative factors that affected the environmental situation in the Kyiv region after the full-scale invasion on 24.02.2022 was the undermining of the dam on 26 February near the village of Kozarovychi, which separated the Irpin River from the Kyiv Reservoir. After the river spilled, some agricultural land turned into a shallow swamp and could no longer be used for its intended purpose. In addition, the result is the flooding of chaotic landfills, which has a serious environmental impact on water resources and poses a threat of spreading infectious diseases to the population [14].

By the end of 2022, 27,000 infrastructure facilities, including approximately 24,000 residential buildings, had been damaged. The affected facilities also included educational, healthcare and administrative institutions.

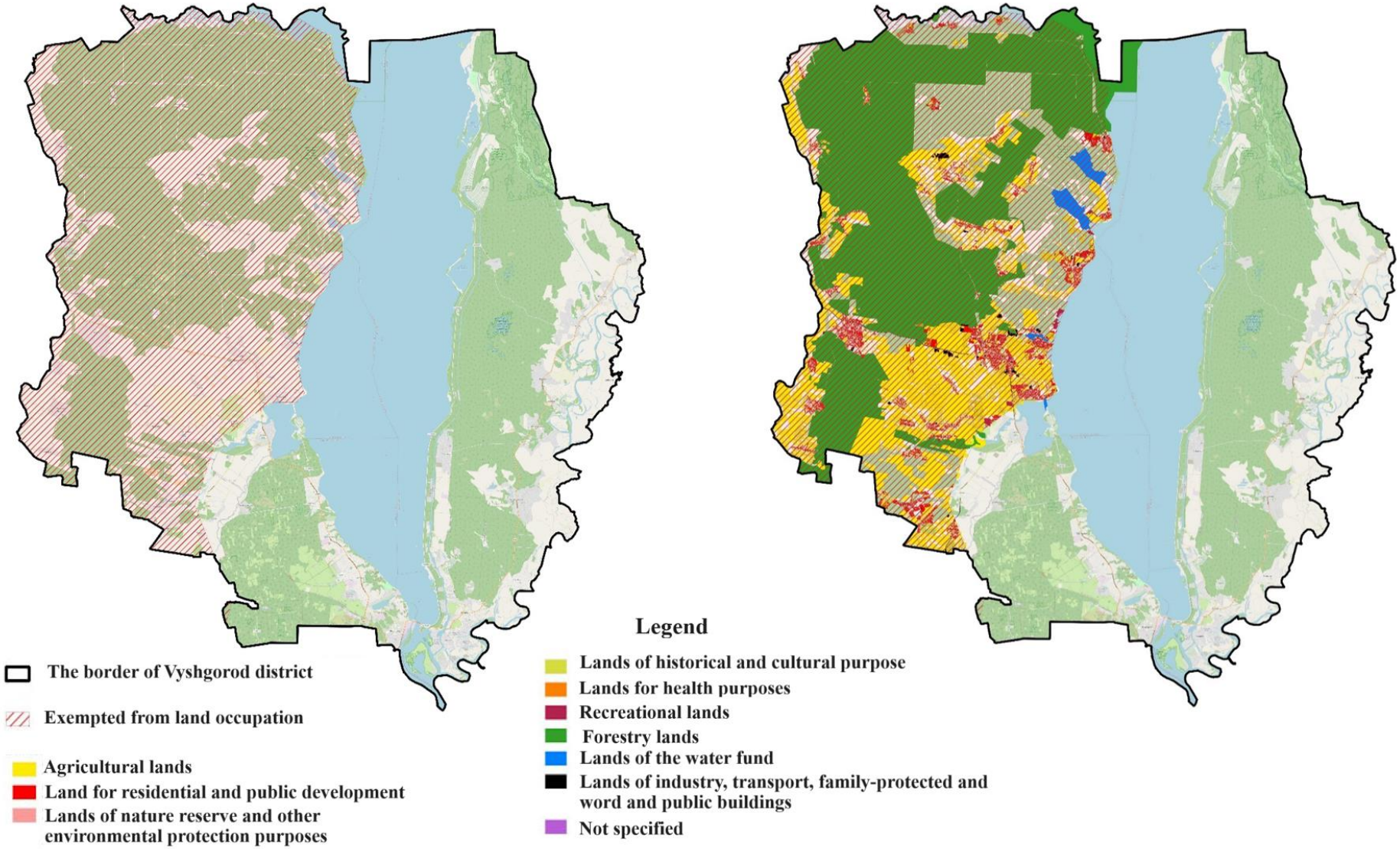

Figure 2. Map of the liberated territories of Vyshhorod district of Kyiv region as of 02.04.2022

**developed by the author based on sources [9, 15]*

At the same time, according to information provided by Oleksiy Kuleba, by the end of 2022, 5,551 facilities were restored, and another 3,460 facilities were partially restored. In particular, 4,632 residential buildings, 153 educational institutions, 78 healthcare facilities, 41 administrative buildings and the Administrative Service Centre (ASC) were fully restored.

After the liberation of Kyiv region, demining work began in the region. As of the end of 2022, the State Emergency Service (SES) had cleared 21,670 hectares of land of mines. The sappers found and neutralised approximately 76,000 dangerous explosive devices.

So, summing up the above, we can conclude that ecocide is currently underway - a form of warfare aimed at causing irreparable damage to the ecosystem of the state against which the aggression is being carried out, its flora, fauna and land resources. The aggressor who commits ecocide aims to nullify the potential for recovery of the country in which the hostilities are taking place. This definition was introduced in the 1970s in response to the actions of the US Army in Vietnam. Last year, a group of international lawyers drafted a law that would recognise ecocide as a war crime. The initiators filed a corresponding application with the International Criminal Court on 22 June 2021.

The occupier's military actions in Ukraine have serious consequences for the 900 protected areas that are currently in danger. The main consequences of such actions include:

1. *Loss of biodiversity. Armed conflicts can lead to the destruction and damage of unique ecosystems that harbour rare species of plants and animals. This leads to the loss of biodiversity and disruption of the ecological balance in these regions.*

2. *Environmental pollution. Military operations can cause air, water and soil pollution through toxic emissions, incineration, explosions, etc. This leads to environmental problems and threats to human and animal health.*

3. *Destruction of infrastructure. War can lead to the destruction of the infrastructure of protected areas, including buildings, roads, communication systems,*

security structures, etc. This leads to a loss of control over these areas and can alter natural processes and worsen conditions for animals and plants.

4. Lack of security supervision. Military conflict can lead to the absence or restriction of access to protected areas by security services. This can create opportunities for illegal activities, such as illegal logging, illegal fishing, poaching, etc., which negatively impacts nature.

5. Loss of cultural heritage. Protected areas are also important as cultural heritage. Military actions can cause destruction or damage to historical and cultural monuments located in these areas. This is a loss of unique cultural heritage and can have long-term consequences for the local community and the cultural development of the region.

6. Impact on people's lives. Military conflicts have a negative impact on the local population, forcing people to leave their homes and settlements. This leads to a breakdown of the socio-economic and ecological connection between people and nature, as well as a humanitarian crisis.

The overall impact of these consequences is a threat to nature, biodiversity, cultural heritage and the lives of the local population. This requires immediate measures to stop the hostilities, restore the areas and restore the normal functioning of the protected areas in the future.

Conclusions and recommendations. The study analyses and provides examples of the negative consequences of hostilities in territorial communities, which are expressed in environmental and economic indicators based on open data from the State Environmental Inspectorate of Ukraine. It is established that hostilities have a significant impact on the state of the natural environment and economic sustainability of communities.

Information from the open platform Kadastr.live was collected and analysed, and on this basis, the area of land affected by hostilities between 24 February and 02 April 2022 was calculated by land category in Kyiv region. Based on this methodology, it is possible to further analyse the area in terms of the designated

purpose of land plots, land ownership and type of use, which will become the basis for assessing the damage caused by hostilities.

In order to minimise this negative impact and ensure the sustainable development of territorial communities, it is recommended to use the assessment of the negative effects of hostilities as a useful tool.

Assessing the negative effects of war also allows us to find the best solutions to restore the environment and economy in areas that have suffered damage from war. It can take a long time, as it requires data collection and analysis of a large amount of information. In the future, the data from monitoring the state of the environment from the negative impact of hostilities will become the basis for making informed decisions on the restoration and development of territories, ensuring a balanced approach to the preservation of natural resources and economic recovery of the affected regions of our country.

To achieve effective management of the consequences of military operations, it is necessary to ensure proper coordination between different authorities and other stakeholders. It is also important to ensure access to reliable and accurate information on the state of the environmental and economic environment for informed and scientifically sound decision-making. Thus, assessing the negative impacts of military operations is an integral part of efforts to ensure sustainable development of territorial communities and preservation of the natural environment.

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ОЦІНЮВАННЯ НЕГАТИВНИХ НАСЛІДКІВ ВОЄННИХ ДІЙ НА ТЕРИТОРІЇ ВИШГОРОДСЬКОГО РАЙОНУ КИЇВСЬКОЇ ОБЛАСТІ

Анотація. *В статті було здійснено ідентифікацію негативних факторів, що виникли внаслідок воєнних дій на території України. Приведені значення збитків довкіллю в кількісних показниках впливу воєнних дій на природне середовище та економіку країни на основі відкритих даних Державної екологічної інспекції України. Розглянуто руйнування, які налічують в собі втрату біорізноманіття, виробничих потужностей, забруднення атмосферного повітря, земель, відкритих водоймищ, лісів та в цілому екосистеми.*

Проаналізовано вплив негативних факторів, які виникли після повномасштабного вторгнення 24.02.2022 року та відобразилися на землекористуваннях (на прикладі Київської області). Розрахована площа земельних ділянок в розрізі категорій земель, яка була під окупацією з 24 лютого 2022 року до 02 квітня 2022 року. На основі запропонованого методу аналізу можна буде розрахувати площі земель з урахуванням їх цільового призначення, форм власності та виду використання. Наведена кількість територіальних громад, що зазнали впливу негативних наслідків під час воєнних дій.

Оцінка негативних наслідків воєнних дій здійснюється в довгостроковій перспективі, оскільки вимагає збору та аналізу великої кількості даних. Проте це надзвичайно важливий процес для визначення необхідних ресурсів та стратегій відновлення території та інфраструктури. В подальшому, дані моніторингу стану довкілля від негативного впливу воєнних дій стануть основою для прийняття обґрунтованих рішень щодо відновлення та розвитку

територій, забезпечуючи збалансований підхід до збереження природних ресурсів та економічного піднесення уражених регіонів нашої країни.

Ключові слова*: оцінювання негативних наслідків воєнних дій, оцінка впливу, економічний розвиток території, територіальні громади, охорона земель і ґрунтів, моніторинг, управління земельними ресурсами*