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RUSSIA'S MILITARY AGGRESSION: ANALYSIS OF SOCIO-ECONOMIC CONSEQUENCES OF THE DESTRUCTION OF THE ECOSYSTEM OF UKRAINE

ABSTRACT

The war waged by the Russian Federation against Ukraine has threatened the existence of the country's ecosystem, encompassing the Ukrainian nation, the environment, and the economy. For Ukraine, one of the most pressing issues today is the ecological catastrophe, which negatively impacts the country's socio-economic stability. Therefore, the purpose of this article is to examine and systematize the socio-economic consequences of the destruction of Ukraine's ecosystem as a result of Russian aggression.

The article explores the state of the ecosystem under the influence of military aggression, analyzing the ecological, social, financial, and economic consequences of its destruction. The authors identify crimes aimed at the destruction of the ecosystem and assess the damage inflicted on both the environment and the economy.

The study highlights the socio-economic consequences of military aggression, including a decline in the quality of life and the deterioration of public health; an intensification of the demographic crisis; worsening psychological conditions; job losses and rising unemployment; a decline in the standard of living; and an increase in the number of individuals with disabilities, injuries, and chronic diseases caused by military operations. These factors create additional social, financial, and medical challenges, necessitating measures to ensure inclusivity and accessibility. The authors propose well-founded strategies for the restoration of affected ecosystems.

Keywords: ecosystem, financial assessment, analysis, economic catastrophe, state economy, losses, enterprise, social consequences, diseases

JEL Classification: I31, H56, O13

INTRODUCTION

Russia's military aggression caused a real ecocide and genocide in Ukraine. With its actions, the Russian Federation caused the mass destruction of the flora and fauna, poisoning of the atmosphere, Ukrainian fertile lands, and water resources. The Russian-Ukrainian war led to catastrophic changes in the ecology, economy, and finances of the country; the consequences that the country receives as a result of military events affect the security of the domestic ecosystem.

Pollution of the atmosphere, water basin, and soil causes changes in their qualitative state. In turn, polluted elements of the natural environment affect living organisms: humans, flora, and fauna, giving rise to negative changes in them. These environmental disruptions lead to severe social, ecological, financial, and economic consequences, threatening the future existence, preservation, and development of the country.

For Ukraine, one of the main problems today is the ecological disaster caused by the war in Ukraine, which negatively affects the economy of our country. According to the estimates of the working group under the State Ecological Inspectorate, as of January 2024, the losses to the ecology of Ukraine are already over UAH 2.2 trillion, and these are only approximate calculations, since part of the Ukrainian territories remain occupied. To this amount, we can add the cost of hundreds of thousands of square kilometers of damaged land, damage from forest fires and emissions of toxic substances into

the atmosphere, the destruction of flora and fauna, etc. The five regions of Ukraine most economically affected include: Dnipropetrovsk, Kharkiv, Mykolaiv, Donetsk, and Zaporizhia regions (Kuzmenko et al., 2024). The amount of damage caused includes UAH 12,3 billion of damage from land contamination and soil pollution, UAH 1107 billion of damage from air pollution, including burning of petroleum products, forest fires, fires of other objects, as well as UAH 82.2 billion of damage from contamination of water resources and sea waters (Rzheuska, 2024). The damage to 600 species of animals, 750 species of plants and fungi, including species listed in the Red Book, has been done.

Since the beginning of the full-scale Russian military invasion, the total amount of direct damage to residential and non-residential real estate, other infrastructure, vehicles, and inventories has exceeded USD 157 billion. Residential buildings accounted for the largest share of the total direct losses, namely 37.5% or USD 58.9 billion, and infrastructure - 23.4% or USD 36.8 billion. Losses of assets of enterprises and industry amount to at least USD 13.1 billion and continue to grow. As a result of the war, direct losses in the agricultural sector and land resources amount to USD 10.3 billion. Meanwhile, losses in the energy sector are rapidly increasing and have now reached USD 9.0 billion (Kyiv School of Economics, 2024).

LITERATURE REVIEW

Recently, more and more scientists have begun to study the issues of losses and harm caused by the Russian Federation to the ecology and economy of Ukraine. The proven (Francis, 2014) relationship between armed conflicts and the ecosystem services system allows us to assess the ecological cost of war and build a conceptual framework that integrates ecosystem services into the analysis of the consequences of military actions.

At present, only the initial signs of environmental degradation are recorded, while the long-term effects on the economy and society remain unknown, but are predicted to be devastating and irreversible (Rawtani et al., 2022; Vakhovych et al., 2024).

Researchers (Prins, 2022) pay particular attention to the transboundary nature of environmental threats. War can affect not only the ecosystems of Ukraine but also neighboring countries through shared water resources, forests, and biodiversity.

War creates not only a humanitarian, but also a deep ecological crisis, which can have long-term consequences for the health of the population (Shumilova, 2023), increasing poverty, inequality, and lack of food security (Mottaleb et al., 2022).

Since the beginning of the full-scale war, a number of researchers (Shoib et al., 2022; Miller KE, 2024; Roitblat Y et al., 2025) have drawn attention to the health of the population affected by the war, in particular, mental health, and emphasize the high probability of serious psycho-emotional disorders and a decrease in the level of well-being among the Ukrainian population.

In particular, researchers (Kuzmenko et al., 2024) studied the consequences of the enemy's use of missiles and shells on the territory of Ukraine, determined the radius of the destruction zone, the formation of craters and funnels, and the volume of uprooted soil, which causes harm to the country's ecosystem.

Authors (Marenich et al., 2022) in their article examined the essence of military ecocide caused by Russian aggression and its impact on the economic security of the state. The team of authors (Rudenko et al., 2024) in their work provides an in-depth analysis of the results of the destruction of agricultural lands, water, and forest resources during the war on the financial and economic condition of domestic agricultural enterprises.

Scientist (Angurets, 2022) conducted a study at the beginning of the war on the extent of damage and its consequences for the environment as a result of Russia's armed aggression. Researchers (Grinchuk, 2024; Rzheuska, 2024) attempted to determine the amount of financial damage to the environment and ecosystem as a result of the war.

A deep analysis of ecosystem damage from the destruction of Russia's military aggression against Ukraine is constantly carried out by specialists from the Kyiv School of Economics (Kyiv School of Economics, 2024). They assess direct and indirect damage and develop scenarios for the recovery of Ukraine's economy after the war.

Researcher Varnalii Z. (2023) examined the key components of human social security in war conditions and identified threats to human life, health, and mental well-being.

Unfortunately, the war continues, losses and harm from the destruction of the ecosystem are increasing, and therefore, in our opinion, it is necessary to continue research on the analysis of the socio-economic and environmental consequences of the destruction of the ecosystem.

AIMS AND OBJECTIVES

This study aims to investigate and systematize the socio-economic consequences of the destruction of Ukraine's ecosystem due to Russian aggression and to substantiate practical recommendations for its restoration.

To achieve this goal, the following research objectives have been formulated:

1. To systematize crimes related to the destruction of Ukraine's ecosystem.
2. To financially assess the consequences of ecosystem destruction.
3. To determine the socio-economic consequences of military aggression.
4. To form well-founded measures for the restoration of affected ecosystems.
5. To assess the role of international donor assistance in the restoration of Ukraine's ecosystem.

METHODS

This study employs both general scientific and specific methods: analysis, deduction, induction, and structuring – for reviewing and analyzing scientific literature; synthesis – for classifying crimes related to the destruction of the ecosystem; systemic approach – for examining the interrelationships between various elements of the ecosystem; economic and statistical analysis – for assessing and financial evaluation direct and indirect losses resulting from ecosystem destruction and their impact on socio-economic development; comparative analysis – for evaluating morbidity levels during wartime and peacetime.

RESULTS

The war launched by Russia against Ukraine poses a daily threat to the ecological, economic, and social security of the country. During Russia's military aggression against Ukraine, the territory of our country has suffered and continues to suffer enormous losses, primarily the destruction of the national ecosystem. In order to determine the extent of damage caused to the Ukrainian economy, society and environment as a result of Russian aggression, the Government of Ukraine developed and approved on March 20, 2022 a special Procedure for Determining Damage and Losses Caused to Ukraine as a Result of Armed Aggression (Cabinet of Ministers of Ukraine, 2022), which includes assessing damage in 22 areas, including economic and human losses; damage caused to land, water and forest resources; subsoil, atmospheric air, infrastructure and agriculture. As of December 31, 2024, specialists have calculated the approximate scale of the costs caused to the environment, which is more than USD 108 billion in damage and almost 6,500 cases of ecosystem destruction. However, the real damage caused to the environment as a result of military operations is much greater (Grinchuk, 2024).

Since the beginning of the full-scale armed aggression, 9,590 missiles and 13,997 drones have been fired by Russian occupation forces at facilities on the territory of Ukraine, which has led to damage to the ecosystem. Of these, 2,429 missiles and 5,972 drones have been intercepted. In total, 11,879 objects were hit, of which 6,203 were civilian objects and 5,676 were military (2024).

The authors attempted to systematize war crimes that led to the destruction of the ecosystem and classify them according to a number of features, revealing the content of each of them and determining the financial and economic consequences (Table 1).

Missiles launched over Ukrainian territory contain hundreds and thousands of kilograms of chemicals that, when fully burned and when their remains enter the environment, cause significant pollution and are toxic to all living things (Kuzmenko et al., 2024).

Since the beginning of the war, oil depots in Ukraine have become targets for destruction by Russian missiles. Such attacks led to the destruction of the bases themselves and large-scale fires, which resulted in harmful combustion products being released into the atmosphere (Angurets, 2022).

Table 1. Classification of crimes aimed at destroying the ecosystem of Ukraine. (Source: compiled by the author based on 3; Dzyuba et al., 2025. 6; 29)

Classification feature	Characteristics	Financial and economic consequences
Air pollution	<ul style="list-style-type: none"> emissions into the atmosphere due to the burning of pollutants, oil, fuels, and lubricants; threat of nuclear attack; emissions into the atmosphere as a result of industrial destruction. 	<ul style="list-style-type: none"> losses resulting from the destruction of industrial facilities; additional costs for firefighting. <p>The amount of losses is USD 27 billion</p>
Soil pollution	<ul style="list-style-type: none"> soil contamination with the remains of military equipment and missiles; soil contamination with chemicals and compounds; damage to the upper layer of agricultural land; land mining. 	<ul style="list-style-type: none"> additional costs for demining and land restoration; losses of agricultural enterprises from lost income. <p>The amount of losses for soil contamination is estimated at USD 0.3 billion, and additional costs for demining are USD 35.6 billion</p>
Destruction of the plant world	<ul style="list-style-type: none"> burning out of forests and perennial plantings as a result of fires; mining of forests; destruction of reserves and nurseries. 	<ul style="list-style-type: none"> costs for demining territories; additional costs for the restoration of forests and forest belts. <p>The amount of losses is estimated at USD 26.5 billion, with additional USD 23 billion costs for waste disposal</p>
Destruction of the animal world	<ul style="list-style-type: none"> death of animals and birds as a result of shelling, fires, and mining; fish poisoning; migration of animals and birds; death of livestock due to lack of electricity supply. 	<ul style="list-style-type: none"> losses of agricultural enterprises and private households due to the death of livestock. <p>The amount of losses is estimated at USD 14.56 billion</p>
Water pollution	<ul style="list-style-type: none"> pollution of surface water due to burning of pollutants, oil, fuels, and lubricants; pollution of groundwater due to penetration of pollutants through the soil together with groundwater; water pollution by remnants of military equipment; 	<ul style="list-style-type: none"> additional costs for water purification; unforeseen costs for the delivery of drinking water to contaminated regions. <p>Losses amount to USD 1.6 billion</p>
Unauthorized use of subsoil	<ul style="list-style-type: none"> flooding of mines; unauthorized extraction of subsoil; unauthorized use of fresh water. 	<ul style="list-style-type: none"> losses of extractive enterprises from lost income from subsoil extraction. <p>The total losses in the extractive sector are estimated at USD 10.6 trillion.</p>
Landscape change	<ul style="list-style-type: none"> trampling of soils, floods, excessive precipitation; population disturbance; undermining of the Kakhovka reservoir; flooding of territories; introduction of invasive species. 	<ul style="list-style-type: none"> costs of restoring soil and water resources; additional costs of avoiding natural disasters. <p>Damages to hydraulic infrastructure amount to USD 11 billion</p>
Destruction of the infrastructure of cities and towns	<ul style="list-style-type: none"> destruction of industrial enterprises; transport enterprises; energy, trade, healthcare institutions, education, and financial institutions. 	<ul style="list-style-type: none"> costs of restoring enterprises. <p>The total losses are estimated at USD 176 billion</p>
Loss of human capital	<ul style="list-style-type: none"> demographic losses (population loss, declining birth rate, mass emigration); economic losses (increasing unemployment, shortage of qualified personnel due to mobilization and migration); psychosocial losses (deterioration of the psycho-emotional state of adults and children, rupture of social ties) 	<ul style="list-style-type: none"> costs for the return of Ukrainians from abroad accounting to UAH 150.03 million in 2025; loss of 30% of GDP; slowdown in GDP growth rates; Increase in social payments (payments to IDPs, UAH 14 billion per month)

One of the problems is the destruction of industry and attacks on it, from explosions and burning of explosive products, toxic substances enter the air and soil, through the air, poisonous compounds enter human bodies, causing various diseases, and it also affects animals, birds, and fish.

A major problem is soil contamination with chemicals, which leads to a decrease in its fertility; in addition, it harms people and animals living in contaminated areas. In large areas of Ukraine, significant destruction of the surface layer of soils occurs due to the combustion of ammunition. The detonation of missiles, artillery shells, and high-explosive. Currently, the content of mercury, zinc, and cadmium in the soil is eight times higher than normal, and a high content of copper, nickel, lead, phosphorus, and barium is also recorded (Angurets, 2022). Soil pollution is estimated at USD 0.3 billion. Such soil pollution primarily harms agricultural enterprises, as it reduces the quality and volume of finished products obtained, which leads to losses in the agrarian sector.

According to estimates by the Kyiv School of Economics and the Zoi Environment Network, around 186,000 square kilometers of land — nearly 31% of Ukraine's territory — face risks of damage and contamination. More than 20,000 square kilometers of this land are reported to be over 75% damaged, with the Donetsk, Kharkiv, and Zaporizhia regions experiencing the most severe destruction (Kyiv School of Economics, 2024).

Ukrainian land has become a terrible testing ground for various types of weapons, including long-range howitzers, multiple launch rocket systems, phosphorus bombs, and cruise missiles. Satellite images of the Izyum district of the Kharkiv region revealed 480 craters from 82 mm shells, 547 craters from 120 mm shells, and 1,025 craters from 152 mm shells over an

area of 1 km². Explosions in this section of the front displaced about 90,000 tons of soil. It was found that the cost of disposing of waste from missiles, equipment, and construction debris is USD 23 billion (Kuzmenko et al., 2024).

At the same time, tanks with fuel, lubricants, remnants of equipment, missiles, and drones remain on the surface of the soil. Chemical elements and compounds formed from their combustion and decay seep into the soil, which slows down the moistening of the upper layer of soil, pollutes groundwater, and studies prove that 2,365,129 m² of land is littered with the remains of destroyed objects and ammunition.

Another threatening problem is the mining of territories; demining requires approximately 200 thousand square kilometers. Currently, around 0.5 million hectares of forests in areas under Ukrainian control are in need of demining. The mined territory loses its purpose and cannot be used for a long time; in addition, demining such an area of territory requires significant costs. According to estimates by the Kyiv School of Economics (KSE) and the World Bank, the price of a non-technical survey of a mined territory can fluctuate around USD 6 per hectare, a technical survey - USD 3,050 per hectare, and clearance - USD 29,400 per hectare (Kyiv School of Economics, 2024).

Complete demining requires significant financial costs; the cost of demining can be approximately USD 1781 per hectare, including the weighted costs of non-technical survey, technical survey, and demining. Of course, an individual agricultural enterprise is not able to independently carry out demining activities; this requires the involvement of foreign experts and international financial assistance.

The destruction of landscapes and ecosystems is also a consequence of war. Ecologists note that huge craters, uprooted soil, digging trenches, construction of fortifications, and movement of heavy equipment led to terrible changes in the landscape. As a result, vegetation is destroyed, and wind and water erosion increase (Kuzmenko et al., 2024). Landscape change also leads to significant losses for private households and agricultural enterprises.

Hostilities are currently taking place in the eastern and southern regions of Ukraine. These regions are characterized by low forest cover; in these areas, forests and forest belts perform protective functions. Their destruction and damage will affect the climate of these regions and can lead to significant erosion processes. In particular, in the south of Ukraine, the consequences may be wind erosion and desertification, which will negatively affect the quality of the soil and animal life (Kuzmenko et al., 2024).

It has been established that fires resulting from the explosion of shells and missiles are the main cause of the destruction of Ukrainian forests. As of today, 30% of Ukraine's forest fund has been affected by forest fires. In 2022, there was the longest fire in the history of independent Ukraine. The Chernobyl territory burned for about a month. As a result of the fires in Ukraine, the following areas were affected: forests - 1,227 thousand hectares; natural landscapes - 645 thousand hectares; agricultural lands - 1,340 thousand hectares; built-up areas - 129 thousand hectares. The fires covered 425 thousand hectares of nature reserves, of which 292 thousand hectares are in occupied territories and territories where hostilities are taking place (Kyiv School of Economics, 2024).

In modern scientific research, increasing attention is being paid to the analysis of the socio-economic consequences of Russia's war against Ukraine, particularly its impact on natural resources and industries dependent on an export-oriented model (Mottaleb et al. 2022, Prins 2022). Forestry is one of the sectors that has undergone significant transformations as a result of the armed conflict. The growing demand for wood as a source of energy in times of crisis threatens environmental degradation (Prins, 2022) due to the excessive use of forest resources; the cessation of exports of Ukrainian forest products leads to economic losses and the rupture of international trade relations, and the sanctions policy on Russian and Belarusian wood leads to the transformation of global markets, causing their reorientation towards Asian countries.

Another act of ecocide is the destruction of wildlife. Crimes against animals during the war can be divided into three groups: crimes against domestic animals, crimes against farm animals (destruction of farms, shooting of animals), and crimes against wild animals, in particular those kept in captivity (zoos, shelters, etc.). All of them create a significant public danger and generate negative consequences both during the war and after its end. A major problem remains the mass death of animals and their migration to other areas of the country that are not intended for their life. Detonation of mines, rocket explosions, and fires led to a widespread migration of animals from the eastern and northern regions of Ukraine to the central regions.

During the first year of the war, more than 200 agricultural enterprises were destroyed and damaged, most of them in Donetsk, Luhansk, Kyiv, Chernihiv, Mykolaiv, Zaporizhia, Kharkiv, Kherson, and Sumy regions. Today, it is known that 6 thousand cows, 100 thousand pigs, and 4.5 million domestic birds have died. Despite this, there are constant attacks by Russian missiles on energy facilities in Ukraine, which result in the power outage of farms and poultry farms, leading to the death of animals and birds. In the village of Chornobayvka, Kherson region, 4 million chickens died at a poultry farm.

This happened as a result of the destruction by the Russian occupiers of the power plant that supplied electricity to the farm, which made it impossible to carry out automated bird feeding (Grinchuk, 2024).

The next problem is water pollution. Rivers and lakes suffer from pollution by the remains of military equipment, shells, and weapons, which are too toxic. Oil products that enter the water form a film on the water surface, which disrupts the exchange of energy, gases, heat, and moisture between water and the atmosphere, which worsens the living conditions of the inhabitants of the sea, rivers, and lakes, leading to the death of microorganisms, fish, and birds.

In addition, climate change and landscape change are taking place, so large rivers and lakes are becoming shallower, and small ones are on the verge of disappearing. It is essential to take measures such as using modern technologies for water purification, reducing the siltation of water bodies, and preserving groundwater. But groundwater is currently at risk, which is associated with the flooding of mines and mine waters (Kuzmenko et al., 2024).

The explosion of the dam at the Kakhovka hydroelectric power station effectively left 94% of irrigation systems in Kherson, 74% in Zaporizhia, and 30% in Dnipropetrovsk regions without a water source (Rudenko, 2024). The explosion of the Kakhovka reservoir affected not only farmers and water users, but also fisheries, whose losses amounted to about UAH 4 billion. In total, according to preliminary calculations, the losses from the loss of all biological resources amounted to UAH 10.5 billion (Kyiv School of Economics, 2024). The destruction of industry and energy facilities led to the shutdown of equipment that pumps water out of mines; mine sites were flooded, water was not pumped out, but seeped into groundwater and wells, polluting them. Thus, residents of Donetsk, Luhansk, and Zaporizhia regions faced the problem of contamination of drinking water in wells (Marenich et al., 2022).

An equally serious crime is the theft of Ukrainian resources and their export to Russia for sale. Well-documented cases include the theft of agricultural products and illegal deforestation in occupied territories. The losses from the appropriation of Ukrainian grain alone amount to more than UAH 30 billion. The Russian occupiers did not limit themselves to the theft of agricultural and forest products; the invaders appropriated, in large quantities, metal products, goods from stores, food, machinery, machines, equipment, etc.

Thus, the Russian invasion and occupation pose a mortal threat to people, animals, plants, harm the ecology, destroy soils, reservoirs, forests, destroy residential infrastructure, industry, change natural landscapes, and cause their devastation. The scale of the destruction of the ecosystem carried out by the occupiers is significant, but their reliable assessment requires further research and recording of facts after the deoccupation of the territories.

The restoration of the ecosystem after the war will be a complex and prolonged process. Ecosystem regeneration may take decades, and in some cases, even centuries. The destruction of the ecosystem is a complex process that affects the entire ecological system, disrupts biodiversity, changes the climate, landscape, and water balance, and has serious economic and social consequences. The restoration of such ecosystems will be a long-term and difficult process that will require significant efforts and resources.

If, at present, it is possible to determine the volume of economic losses from Russian military aggression, then the social consequences are our future, which the government, state, and public organizations, as well as the population of Ukraine, are already facing today. Within the scope of the topic stated in the title of the article, we will outline the social consequences of the destruction of the ecosystem of Ukraine caused by the military aggression of the Russian Federation for the social security of a person, understanding it as the level of protection of vital socio-economic interests of a person, his rights, freedoms and values from real and potential, endogenous and exogenous threats (Varnaliy, 2023).

According to the Office for the Coordination of Humanitarian Affairs (OCHA), 40 percent of the country's total population is in need of humanitarian assistance, of which 56 percent are women and girls, 23 percent are children, and 15 percent are people with disabilities.

Ukraine, especially its eastern and southeastern regions, is a highly industrialized country. The energy and manufacturing sectors, the banking sector, education, and culture have been significantly impacted, leading to job losses and rising unemployment. However, those employed in the agricultural and processing sectors have been hit hardest, as agricultural land is the most affected, making it difficult to continue using it for agriculture (Nagaichuk et al., 2020). Thus, due to active hostilities and the occupation of some territories, farmers are unable to cultivate their fields, leading to reduced yields and crop losses. The logistics chains of product sales were disrupted, and Ukraine's export capabilities decreased, which affected global agricultural markets and provoked an increase in food prices within the country.

Job losses and unemployment negatively affect the socio-economic stability of the population, leading to a decrease in living standards and an increase in internal and external migration flows, which in turn requires the state to organize social security for people affected by the ecocide caused by the war. A large number of buildings – residential buildings, office

buildings, medical facilities, educational and cultural institutions, etc. – were destroyed, leaving people without housing, jobs, and the opportunity to receive education, medical care, public services, etc. And, as a result of Russia's military aggression, a new category of people in need of protection appeared in Ukraine – internally displaced persons (IDPs). As of January 2023, more than 19 million remained affected by various forms of displacement, including 5.4 million internally displaced persons (IDPs) – 58 percent of whom were displaced for six months or more – and 5.5 million returnees, 20% of whom returned from abroad (Ukraine – Internal Displacement Report, 2023).

The widespread pollution of the ecosystem and the depletion of natural resources also contribute to a decline in the quality of life and a deterioration in public health. The following diseases are the biggest public health problems during war (Nelson, 2022):

1. Malnutrition, which leads to cognitive disorders and abnormal development, especially in children.
2. Infectious diseases, especially those that spread freely in crowded places, include respiratory diseases such as COVID-19, measles, and tuberculosis, as well as diarrheal diseases, which can spread easily where there is no safe drinking water, a lack of sanitation, and hygiene.
3. Mental disorders, including post-traumatic stress disorder, depression, substance abuse, and suicide.
4. Diseases of the reproductive system, including complications during pregnancy and childbirth, prematurity, low birth weight, and death during the first month of life.
5. Non-communicable diseases, the most common of which are hypertension, coronary heart disease, chronic lung disease, and cancer. People suffering from these diseases are deprived of the opportunity to get their medicines due to the destruction of medical facilities, lack of medical workers, etc. The use of certain types of weapons can result in radiation exposure that causes respiratory, neurological, and heart diseases, as well as many types of cancer.

The war has caused significant damage to the medical infrastructure, making access to medical services difficult for many citizens. The destruction of hospitals, the shortage of medical supplies and equipment, and the lack of qualified medical personnel have significantly affected the ability of the health care system to provide the appropriate level of medical care (Figure 1).

Separately, it should be noted that the increase in the number of people with disabilities, injuries, and chronic diseases acquired during military operations. According to the State Statistics Service of Ukraine, as of January 1, 2023, there were more than 2.7 million people with disabilities living in the country, which constituted 6.6% of the total population (41). During 2023, more than 230 thousand people in Ukraine acquired the status of persons with disabilities (43). These statistics reflect the significant social and medical challenges faced by Ukrainian society, in particular due to military operations, which cause numerous injuries and disabilities. In addition, people with these types of disabilities need inclusive services, which will require additional financial investments from the country to create inclusiveness and accessibility.

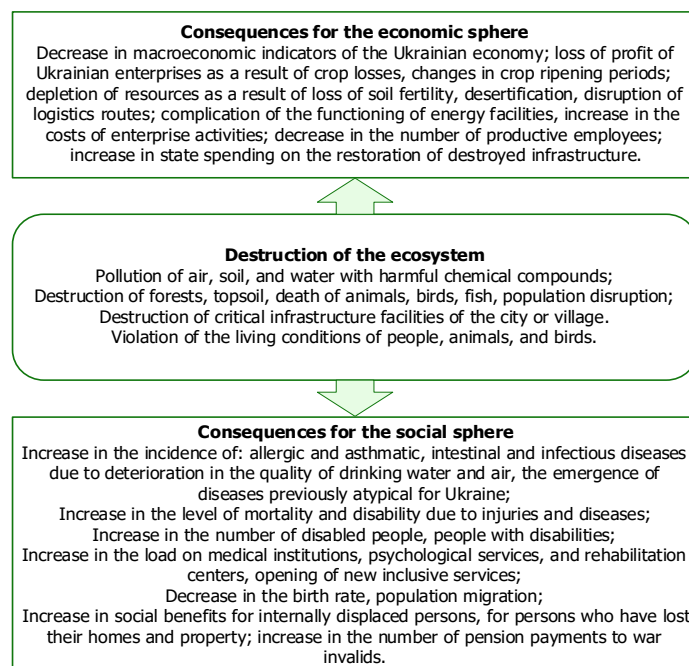


Figure 1. Consequences of the destruction of Ukraine's ecosystem for the socio-economic sphere.

The consequence of ecocide and genocide, which generates socio-economic problems, is a decrease in the birth rate, which leads to a demographic crisis. The current Russian-Ukrainian war has exacerbated the demographic crisis in Ukraine, causing increased migration processes and a decrease in the birth rate. According to official statistics, at the beginning of 2022, 41.2 million people lived in Ukraine (excluding Crimea, Sevastopol, and the ORDLO) (41). In November 2024, more than 6,225,700 Ukrainians were in Europe, and another 560,200 Ukrainian citizens were outside Europe (18). Approximately 5 million of them applied for temporary protection in EU countries. In total, since February 24, 2022, 19.5 million movements from Ukraine abroad have been recorded, and more than 11 million to Ukraine (Cabinet of Ministers of Ukraine, 2022). According to official data, in 2023, 187 thousand children were born in Ukraine, and 496 thousand people died. This gives grounds to state that the population of Ukraine has significantly decreased and continues to decrease (Slonchak, 2024). According to forecasts, after the end of hostilities or the termination or abolition of martial law in Ukraine, the population of Ukraine, according to the assessment of the Institute of Demography and Quality of Life Problems of the National Academy of Sciences, by 2041 may decrease to 28.9 million people, by 2051, to 25.2 million people (Nazarova, 2012).

DISCUSSION

The destruction of Ukraine's ecosystem as a result of the military aggression of the Russian Federation has not only an ecological but also a profound socio-economic dimension. Destruction of natural resources, land degradation, water and air pollution, loss of biodiversity — all this leads to long-term consequences that affect the health of the population, food security, economic stability and climate resilience of the country.

The lack of a unified methodology for quantitative and qualitative analysis of environmental losses complicates the formation of a well-founded environmental policy, international legal position and recovery strategy.

Domestic methods for assessing damage to the ecosystem are mainly based on calculating the state's lost revenue from environmental fees, taxes, and regulatory payments that were not received due to pollution caused by the war, adjusted by coefficients that take into account the scale of military destruction and their impact on the environment (Stakhiv, 2023). This approach differs from generally accepted international standards, which are usually based on assessing the real impact on ecosystems, restoration costs, and long-term environmental risks. Assessments of damage to the Ukrainian ecosystem are currently carried out fragmentarily — through individual cases, expert opinions, or journalistic investigations. This approach does not allow for the complex nature of environmental damage to be taken into account. In addition, individual socio-economic consequences of environmental destruction remain outside the scope of formalized calculations. In this context, there is an urgent need to develop a national methodology for assessing environmental damage that:

- integrates environmental, economic, and social parameters;
- takes into account international standards (e.g., RDNA2, IVS 2022 methodologies);
- allows for the formation of an evidence base for reparations and compensation;
- contributes to the strategic planning of the restoration of territories.

The development of such a methodology should become a priority for interdisciplinary scientific groups, state institutions, and civil society. It will not only ensure transparency and justification of environmental policy, but will also become a tool for protecting the national interests of Ukraine at the international level.

At the same time, there is an urgent need to develop a comprehensive strategy for ecological restoration, which should become an integral part of the overall strategy for post-war reconstruction. Such a strategy should take into account:

- ecosystem services as the basis of social well-being;
- integration of ecological principles into the processes of infrastructure reconstruction;
- use of modern technologies (in particular satellite monitoring) for damage assessment and recovery planning;
- attraction of international assistance and partnership.

Currently, Ukraine has already adopted a number of documents that can serve as the basis for the formation of such a strategy (Cabinet of Ministers of Ukraine, 2024).

These documents require alignment with international standards for environmental damage assessment (CERCLA, Directive 2004/35/EC, DPSIR model), as well as integration of the principles of the ecosystem approach to recovery. Without this, there is a risk of a fragmented approach to reconstruction, which will not ensure long-term stability.

Thus, the development of a national ecological recovery strategy is critically important for overcoming the consequences of the war, ensuring sustainable development, and integration of Ukraine into the European ecological space. It should be based on an intersectoral approach, scientifically sound methods for assessing the socio-economic consequences of damage caused to the ecosystem as a result of Russia's military aggression against Ukraine.

CONCLUSIONS

The study of the Russian Federation's crimes against the ecosystem enables their classification based on the following factors: air pollution, soil pollution, destruction of the flora, destruction of the fauna, water pollution, unauthorized use of subsoil, destruction of landscapes, urban and rural infrastructure, and loss of human capital. The volumes and amounts of such crimes have been determined, and they continue to grow as military operations continue and the amounts of damage increase.

The list of damage caused and the amount of losses that the Russian Federation caused us during the war is extremely large. It will be very difficult for Ukraine to overcome the consequences of the destruction of the ecosystem on its own. We hope that the world community will help assess the losses and contribute to their compensation. To date, preliminary calculations have been made of Ukraine's needs for reconstruction and restoration, which are estimated at an unprecedented USD 411 billion for the world. Today, there are three types of sources of financing for Ukrainian reconstruction that Ukraine is currently working on with international partners, in particular: international financial organizations (IFOs), private funds, and frozen assets of the Russian Federation. In 2025, the Government of Ukraine, with the support of international donors, allocated USD 7.37 billion towards the recovery of priority sectors, including education, social protection, demining, energy, healthcare, and transport. Nevertheless, the overall financial gap for Ukraine's economic recovery is estimated at USD 9.96 billion.

Given the seriousness and danger of the situation in Ukraine, experts are looking for ways to restore the ecosystem. They are developing tools and mechanisms, the implementation of which will minimize the consequences of military actions in the coming years. To date, the Ukraine Recovery Plan has been developed, which includes 850 projects with a total cost of USD 750 billion, including projects to restore a clean and protected environment with a planned cost of USD 20 billion.

The manifestation of the social consequences of the destruction of the ecosystem of Ukraine is the negative impact on the social security of the individual, the level of protection of vital socio-economic interests of the person, rights, freedoms, and values. Military actions lead to large-scale destruction of infrastructure, destruction of agricultural lands, natural resources, and environmental pollution, which have long-term consequences for the economy and the population.

Understanding the scale and modeling of the socio-economic consequences of Russia's military aggression against Ukraine, particularly in the context of ecocide and genocide, is crucial for developing preventive and compensatory measures. This knowledge is essential for planning effective recovery strategies, including the implementation of social support programs. Leading experts are currently exploring options for the recovery of affected territories, striving to integrate the expertise and capabilities of scientists, educators, farmers, agribusiness and eco-business representatives, and public organizations. Addressing the critical challenges of Ukraine's post-war future requires collaborative efforts to develop effective solutions.

ADDITIONAL INFORMATION

AUTHOR CONTRIBUTIONS

All authors have contributed equally.

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The Authors declare that there is no conflict of interest.

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ВОЄННА АГРЕСІЯ РОСІЇ: АНАЛІЗ СОЦІАЛЬНО-ЕКОНОМІЧНИХ НАСЛІДКІВ РУЙНУВАННЯ ЕКОСИСТЕМИ УКРАЇНИ

Війна, яку веде російська федерація проти України, поставила під загрозу існування екосистеми країни, до складу якої входить українська нація, навколишнє природне середовище та економіка країни. Для України однією з головних проблем на сьогодні є екологічна катастрофа, що негативно впливає на соціально-економічний стан нашої держави. Саме тому метою дослідження є вивчення й систематизація соціально-економічних та екологічних наслідків знищення екосистеми України в результаті російської агресії. Досліджено стан екосистеми під впливом воєнної агресії, проведено аналіз екологічних, соціальних, фінансових та економічних наслідків у результаті руйнування

екосистеми України. Автори здійснили конкретизацію злочинів, спрямованих на руйнування екосистеми, оцінили фінансову шкоду, яка заподіяна екології та економіці.

У ході дослідження визначені соціально-економічні наслідки воєнної агресії, зокрема зниження якості життя та погіршення здоров'я населення; збільшення демографічної кризи; погіршення психологічного стану; втрата робочих місць і зростання безробіття; зниження рівня життя; зростання кількості людей з інвалідністю, каліцтвами та хронічними захворюваннями як наслідками воєнних дій, що генерує додаткові соціальні, фінансові та медичні виклики, реагування на які потребує забезпечення інклюзивності й безбар'єрності. Автори запропонували обґрунтовані заходи щодо відновлення постраждалих екосистем.

Ключові слова: екосистема, фінансова оцінка, аналіз, економічна катастрофа, економіка держави, збитки, підприємство, соціальні наслідки, захворювання

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