

UDC 504.062

Nataliia Antoniuk,
Dr. Habil., Dr. of Economics,
Professor of the Department of Economics, Marketing,
Management and Administration, National Academy of Management,
Kyiv, Ukraine
antoniuknata2811@gmail.com

**ENVIRONMENTAL AND ECONOMIC ASPECTS OF SOIL
POLLUTION AS A RESULT OF MILITARY ACTIONS***

*within the scope of the Ernst Mach grant

The research conducted within this study has revealed significant changes in the soil condition in the affected areas due to military conflicts. The soil condition assessment was based on analyzing its physical, chemical, and biological properties. The main findings of the research indicate the following changes:

1. Physical properties of the soil: Increased soil erosion is observed due to hostilities. Constant explosions and movements of heavy military equipment lead to damage to the soil cover and a reduction in its stability, causing large masses of soil to be washed away by water during rainfall, resulting in the emergence of debris, fragmentation, and destruction of the soil layer.

2. Chemical properties of the soil: Soil analysis from samples have shown soil contamination with heavy metals and other harmful substances. Due to various types of weaponry, toxic substances enter the ground, harming vegetation, microorganisms, and water resources. All this can lead to a decrease in soil fertility and pose a risk of groundwater pollution.

3. Biological properties of the soil: The research has revealed a decrease in the biological activity of the soil in the affected areas. Microorganisms responsible for organic matter decomposition and cyclic processes in the ground may be damaged or destroyed due to hostilities. It disrupts natural environmental processes that sustain soil fertility. The

reduction in the number of microorganisms can also affect the availability of nutrients for plants, leading to decreased productivity and loss of agricultural potential in the affected areas.

The research findings underline the significant impact of hostilities on the environmental state of the soil. The disturbances in soil stability and changes in its physical, chemical, and biological properties have significant consequences for natural ecosystems, agriculture, and the economy as a whole.

These results indicate the necessity of taking measures to restore the damaged soil and reduce the negative impact on the environment and the economy. For instance, rehabilitation and soil restoration programs can be developed using environmentally friendly methods such as bioremediation and organic fertilizers. It is also crucial to establish monitoring systems for soil quality and water resources to detect pollution and take measures to mitigate it promptly.

Additionally, it is essential to implement legislative norms and environmental standards that promote soil conservation and restoration while holding individuals accountable for its degradation and pollution.

Detailed analysis of the environmental consequences of soil destabilization due to hostilities reveals a significant impact of this process on the natural environment. The research findings indicate the following environmental consequences:

Loss of biodiversity: Soil damage caused by hostilities leads to a loss of biological diversity. Soil is a habitat for numerous microorganisms, insects, worms, and plants that play vital roles in maintaining ecosystem functions. The damage to the soil layer and contamination with substances result in the loss of these organisms and decreased biodiversity in the conflict-affected area.

1. Contamination of groundwater: Soil instability can cause contamination of groundwater. Toxic and harmful substances that enter the soil can seep through it and reach water sources, such as groundwater. It can lead to the pollution of water resources and harm aquatic ecosystems and human health.

2. Air quality reduction: Hostilities can also contribute to decreased air quality. Explosions and fires can release toxic gases, smoke, and other pollutants into the atmosphere. It can have harmful effects on human health, vegetation, and ecosystems. Air pollution can also have long-term consequences, such as accumulating harmful substances in the atmosphere, contributing to climate change and global warming.

3. Loss of natural habitats: Soil damage and its negative impact on ecosystems can result in the loss of natural habitats. Many diverse plant and animal species depend on healthy soil for their existence and reproduction. Soil damage can lead to the destruction of their habitats and loss of living conditions.

4. Impact on human health: The environmental consequences of soil degradation can directly affect human health. Soil contamination with toxic substances can lead to polluting agricultural crops, food products, and water sources, causing poisoning, respiratory diseases, and other chronic illnesses.

All these consequences underscore the need for a conscious approach to nature conservation and natural resource management. It is necessary to develop and implement strategies for the reclamation and restoration of damaged soils, reduce the use of harmful substances, and promote sustainable agriculture and environmentally friendly technologies. It is also essential to monitor and control air quality, groundwater, and soil to detect pollution and take necessary measures to reduce it promptly. The effective management of water and natural resources, the development of sustainable agricultural practices, and adopting of environmentally friendly extraction and production methods are also essential steps toward preserving environmental balance.

Furthermore, international cooperation in environmental protection is crucial for addressing environmental problems, including the consequences of military conflicts. Governments and international organizations can collaborate on developing and implementing global standards and norms for soil conservation, water resources, and air protection and facilitate the exchange of experiences and technologies.

Another economic consequence is dependence on external aid. Due to disrupted stability and decreased production, the regions may face significant economic difficulties and instability. It can force them to rely on external assistance to recover and develop their economy and infrastructure. Dependence on external aid can lead to a loss of self-sufficiency and independence and the accumulation of external debt that will need to be repaid in the future.

Additionally, the economic consequences of disrupted stability can also affect other sectors of the economy. For example, a decrease in agricultural production can have a negative impact on the food industry, trade, and other related sectors. It can create additional economic pressure and result in an overall decline in economic activity in the region. Overall, studies have shown that the disruption of stability due to military conflicts has serious economic consequences. Some of them are agricultural losses, decreased tax revenues, and dependence on external aid. These consequences pose challenges to economic recovery, development, and stabilization of the regions and require effective strategies for managing and restoring soil resources to ensure sustainable development and improve the quality of life for the local population.

Studying soil instability's environmental and economic aspects due to hostilities and its legal implications significantly impacts scientific discourse development and management strategies in post-conflict recovery. The research results described in previous sections indicate severe consequences of such conflict on the regions' environmental, agricultural, and economic conditions.

The understanding that soil stability disruption leads to changes in its physical, chemical, and biological properties presents significant tasks for scientists and practitioners. The study has shown that consequences such as increased erosion, decreased fertility, and contamination with harmful substances require adequate soil protection and restoration measures.

Violations of soil stability also have serious environmental consequences. The loss of biodiversity, groundwater contamination, and worsening air quality reflect on the region's ecosystem. These can have

long-term implications for natural resources, climate, and environmental balance.

Significant consequences of soil degradation have also been identified in agriculture. Reduced food production, decreased crop quality, increased pest control, and land restoration costs negatively impact food security, economic stability, and rural farm incomes. It jeopardizes the stability of the agricultural sector and may lead to increased dependence on food imports.

Regarding the legal implications of soil stability violations, it is important to consider relevant international norms and conventions governing environmental protection and conduct during hostilities. For instance, the Hague Convention regime concerning the environment's safety during armed conflicts and the Geneva Conventions on protecting war victims contain provisions related to the prohibition of releasing hazardous substances into the environment and safeguarding civilian populations from the environmental consequences of war.

However, implementing such legal norms and control mechanisms is challenging, particularly in conflict situations where chaos and illicit actions often accompany warfare. The international community needs enhanced efforts to ensure compliance with legal norms and accountability for destabilizing soil due to hostilities. It is crucial to develop effective monitoring, documentation, and reporting mechanisms for environmental violations and crimes and ensure proper investigation and prosecution of individuals responsible for such actions.

References:

1. Antoniuk, N., Litvak, O., Litvak, S., Kovalenko, S., & Shtyk, Y. (2023). Aspectos ecológicos y económicos de la inestabilidad del suelo como resultado de las hostilidades y sus consecuencias jurídicas. *REICE: Revista Electrónica De Investigación En Ciencias Económicas*, 11(21), 164–185.
2. Gomiero, T., Pimentel, D., Paoletti, M. G. (2011). Environmental impact of different agricultural management practices: Conventional vs. organic agriculture. *Critical Reviews in Plant Sciences*, 30(1-2), 95-124.
3. Panagos, P., Borrelli, P., Meusburger, K., Yu, B., Klik, A., Lim, K. J., Yang, J. E., Ni, J., Miao, C., Chattopadhyay, N., et al. (2017). Global rainfall erosivity assessment based on high-temporal resolution rainfall records. *Scientific Reports*, 7(1), 4175.