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REGIONAL ENVIRONMENTAL CHALLENGES AND PRIORITIES FOR SUSTAINABLE RECOVERY IN UKRAINE

The period of 2022–2025 has become a time of profound trials for Ukraine. The war has not only destroyed cities and infrastructure but also created unprecedented environmental risks that will determine the country's resilience for decades to come. Damaged industrial facilities, polluted water bodies, burned forests and fields, destroyed irrigation systems, and the accumulation of waste – all of these form a new ecological reality.

Environmental security has ceased to be a secondary field and has turned into a strategic element of national security. Food security depends on soil and water quality; public health and social resilience depend on air and ecosystem conditions; the ability to adapt to climate change defines economic development and integration into European structures.

The purpose of this study is to examine Ukraine's regional environmental challenges in 2022–2025, identify priority measures for adaptation and recovery, and analyse how national reforms and international cooperation can serve as the foundation for the country's ecological transformation [1].

1. Regional Environmental Challenges. Eastern and Southern Regions. These regions suffered the greatest destruction. Intense fighting was accompanied by explosions of industrial facilities and oil depots, leading to chemical leaks and oil spills. For example, in 2022, in Mykolaiv Oblast, damaged storage tanks caused petroleum products to seep into soil and groundwater. Residents of nearby villages had to rely on delivered water for several months. Another example is the destruction of irrigation systems in Kherson Oblast. Before the war, they ensured the stable production of vegetables and fruits, including for export. Today, thousands of hectares have turned into arid, degraded lands. This not only undermined local agriculture but also put regional food security at risk.

Of particular concern is the pollution of the Black and Azov Seas. Wastewater discharge and toxic substances entering rivers increase the risk of marine ecosystem collapse. Fish population decline and deteriorating water quality negatively affect fisheries and tourism, further aggravating the socio-economic situation.

Central and Western Regions. Although they were not subject to large-scale destruction, they face persistent environmental problems. In the Dnipro and Dniester basins, nitrate and phosphate levels are rising due to excessive fertilizer use. Water from these rivers serves as drinking water for millions of people, including in neighbouring countries, making this a transboundary issue. In Vinnytsia and Khmelnytskyi Oblasts, widespread monocultures (corn, sunflower) have led to soil degradation. According to JRC (2025), in some areas, soil fertility has declined by 20–30% over the past decade. In Zhytomyr Oblast, groundwater levels are falling, threatening both agriculture and water supply.

Thus, the ecological risk here is hidden but long-term: soil depletion and water shortages could eventually become as threatening as the direct consequences of war.

Western Borders and the Carpathians. The Carpathians face dual pressure. On the one hand, the war triggered a rise in illegal logging: wood became a substitute for heating amid gas supply disruptions. On the other hand, the region has seen a surge of internally displaced persons, increasing strain on ecosystems. In Ivano-Frankivsk Oblast, landslides were recorded on recently logged slopes, posing threats to rural settlements. At the same time, tourist influx has grown, with mountain trails and riverbanks suffering erosion from overuse. All of this reduces ecosystem resilience, increases flood risks, and leads to biodiversity loss.

Industrial Centers. Kryvyi Rih, Zaporizhzhia, and Dnipro have traditionally been hubs of metallurgy and heavy industry. Their plants were among the largest air polluters in Europe even before the war. The situation worsened after hostilities began: filtration and waste management systems were damaged, while surging construction and household waste created illegal dumps. In Kryvyi Rih, sulphur dioxide levels in 2023 were recorded at 5-6 times above permissible norms. In Dnipro, high concentrations of heavy metals were found in soils near unauthorized construction waste landfills. These conditions directly affect public health: respiratory diseases are on the rise, and child health indicators are deteriorating.

2. Recovery and Adaptation Efforts. Ukraine has taken steps toward ecological adaptation, though the scale of destruction and financial constraints slow progress. In the east, water supply systems are being restored. In Mykolaiv Oblast, new pipelines have been equipped with membrane filters, improving drinking water quality. In Kharkiv Oblast, local solar-powered stations are being tested to energize wastewater treatment plants, reducing vulnerability to power outages.

In western Ukraine, agroforestry practices are expanding. Shelterbelts are planted along fields, protecting soil from erosion, improving microclimates, and fostering biodiversity.

These projects, supported by international donors, are also integrated into farmer education programs.

In the industry, cooperation with the EBRD provides positive examples. In Zaporizhzhia, a metallurgical plant was modernized with state-of-the-art filters, reducing dust emissions by 30% and improving air quality. However, such projects remain isolated and insufficient to bring systemic change.

3. Policy Instruments and International Cooperation. Sustainable recovery is impossible without integrating Ukraine into European and international initiatives. The European Green Deal opens opportunities for legislative harmonization and access to financing. The case of Lviv illustrates this: cooperation with Poland introduced a waste separation system, now gradually spreading to other cities.

International climate funds already support Ukrainian initiatives. The Global Environment Facility funded a floodplain restoration project in Policia, returning natural functions to ecosystems and lowering flood risks. The Paris Agreement offers Ukraine access to carbon trading. For metallurgy, this is a chance to attract investment and modernize production. For example, if Ukrainian plants adopt CO_2 capture technologies, they could sell quotas while remaining competitive on the European market [2].

Civil society plays a vital role. Organizations like Ecoaction run air monitoring systems in industrial cities. Their publicly available data creates pressure on authorities and businesses. As a result, negotiations on modernizing treatment facilities have begun in Dnipro.

4. Forecasts and Scenarios for Environmental Recovery to 2030. Analysis of current trends suggests that Ukraine’s environmental trajectory will depend on political choices, international support, and internal resilience. Three main scenarios are possible:

Inertia Scenario. If recovery proceeds slowly and focuses only on local damage, many environmental problems will persist by 2030. Land degradation in the east and south will continue without systematic reclamation. Water bodies will remain vulnerable, and industry will operate on outdated facilities.

Health risks will rise, especially respiratory illnesses. In Dnipro and Kryvyi Rih, childhood respiratory diseases could increase by 15–20 % if emissions remain high. In the Carpathians, deforestation could exacerbate floods and biodiversity loss.

Accelerated European Transition. A more optimistic scenario involves Ukraine’s active integration into the European Green Deal and the broad use of climate funds. By

2030, major industries could be modernized, emissions reduced by 25–30 %, and waste separation introduced in all major cities.

Agriculture would transition to sustainable practices: organic fertilizers, agroforestry, and drip irrigation. Soil fertility would recover, and water pollution would decrease. The Dnipro and Dniester water systems could undergo partial rehabilitation, improving drinking water for millions. The Carpathians could become a model of sustainable development, with minimized illegal logging and eco-friendly tourism. Ukraine would integrate into cross-border European ecological projects, strengthening its role in EU climate policy [3].

Fragmented Recovery. This scenario assumes uneven progress. Some regions would gain access to aid and modernization, while others would lag behind. For example, western regions could develop agroecology and sustainable tourism, while eastern territories remain ecological risk zones. In the industry, only select enterprises would be modernized, leaving older industrial hubs polluted. Water system improvements would be local and piecemeal, without a comprehensive strategy. This would deepen regional inequalities, potentially fuelling long-term instability.

Key Projections to 2030:

• East and south require long-term ecological rehabilitation programs; otherwise, land degradation will become irreversible.

• Central and western regions must adopt sustainable land management or face water shortages and soil productivity decline.

• Industrial centres will remain high-risk zones without systemic modernization of metallurgy and chemical industries.

• The Carpathians could either become a model of sustainability or suffer catastrophic floods and biodiversity loss, depending on forest governance.

Thus, by 2030, Ukraine will have the chance to join Europe’s ecological transformation and turn destruction into a foundation for sustainable development. But this requires strategic planning, coordinated state action, international partnerships, and active civil society engagement.

The environmental situation in Ukraine in 2022–2025 reflects both the destructive consequences of war and the opportunity for deep transformation. The east and south require ecosystem and water system restoration; the center and west need sustainable land use; industrial hubs must modernize production; and the Carpathians demand forest and biodiversity protection.

Examples of successful initiatives – from restoring water supply with modern technologies to EBRD-backed metallurgy upgrades – prove that sustainable development is possible. But it requires three components: national political will and reform, international partner support, and active civil society participation.

Ukraine has been given a unique chance: to turn the environmental crisis into the foundation for a new development model. If efforts are strategically united, the country can not only recover but also become part of Europe's Green Transition, where ecology underpins economic growth, social resilience, and international cooperation.

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