"Public Impact on Environmental Protection and Recovery in Wartime: Strategies and Solutions"

1. Definition of the concept of Ecosystem in legislation and science

In science, ecosystem is a geographic area where plants, animals and other organisms, as well as weather and landscape, work together to form a bubble of life. Ecosystems contain biotic (living) factors, as well as abiotic (nonliving) factors. Biotic factors include plants, animals and other organisms. Abiotic factors include rocks, temperature and humidity.

Every part of an ecosystem depends on every other part, directly or indirectly. A change in the temperature of an ecosystem often affects what plants grow there, for instance. Animals that depend on plants for food and shelter have to adapt to the changes, move to another ecosystem or perish.[1]

Ecosystem is a natural complex created by living organisms, with conditions of their existence interconnected by the exchange of substances and energy, which form a system of interrelated biotic and abiotic phenomena and processes. (Verkhovna Rada of Ukraine, Law 'On Approval of the National Programme for the Protection and Restoration of the Environment of the Azov and Black Seas' of 22.03.2001) [2]

"Ecosystem" means a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit. (Convention on Biological Diversity (CBD): Article2)[3]

The Convention on Biological Diversity is an international agreement on the conservation of biological diversity, the sustainable use of its components and the equitable sharing of benefits arising from the utilisation of genetic resources.

2. The impact of war on ecosystems in Ukraine

Russia's full-scale invasion of Ukraine has caused significant damage to our country's natural ecosystems. The negative impact of the war on nature has been ongoing throughout the 9 years of Russian aggression against Ukraine. However, since February 2022, the geography and scale of this impact has increased significantly. Despite the inaccessibility of a significant amount of data on the impact of a full-scale war on nature, it is already possible to draw preliminary conclusions about the damage caused to various ecosystems based on open sources of information.

When we lose natural ecosystems, whether due to war or short-sighted investment projects, we also lose all the services we used to receive for free from these ecosystems. And then we have to pay dearly for the technologies needed to

[1] https://education.nationalgeographic.org/resource/ecosystem/
[2] https://zakon.rada.gov.ua/laws/show/2333-14#Text
[3] https://www.cbd.int/doc/legal/cbd-en.pdf

compensate for the lost services, or even more dearly for the loss of health due to environmental degradation.

Sustainable development is impossible without preserving a significant share of natural areas. And since Ukraine has already lost most of its natural ecosystems during the historical periods of occupation, when our lands and all their resources were a raw material appendage of the Russian Empire (whatever it called itself then), and continues to lose them now due to war and the greed of individual enterprises, the rejection of the practice of destroying nature should be one of the cornerstones of breaking Ukraine's ties with its colonial past.

That is why it is so important to make natural ecosystems a priority in the planning and implementation of post-war recovery projects.

If we focus on restoring ecosystems affected by war, in most cases all we need to do is let nature repair the damage - again, completely free of charge. At the same time, many ecosystems have suffered irreversible damage and will require active restoration measures.

It is impractical to talk about the exact timeframe for the recovery of natural ecosystems, as it depends on the types of affected ecosystems and the nature of their damage. In addition, the natural processes of ecosystem recovery (the so-called 'secondary succession') are quite variable and do not 'pay attention' to forecasts of the timeframe. On average, however, it will take tens (sometimes more than a hundred) years to restore ecosystems to their pre-war state.[4]

3. The role of the public in environmental monitoring and data collection

The Law of Ukraine 'On Environmental Protection' (Articles 20 and 22) provides for the establishment of a state environmental monitoring system (hereinafter referred to as the 'SEMS') and monitoring of the state of the environment and the level of its pollution. These functions are vested in the Ministry of Ecology and other central executive authorities that are subjects of the state environmental monitoring system, as well as enterprises, institutions and organisations whose activities lead or may lead to environmental degradation.

According to the DeepState online map , we can track the situation on the frontline, which will help us understand which territories have been de-occupied and where environmental research can be conducted. Before doing so, it is important to analyse the situation and assess the level of security for the research at the preparatory stage

In times of war, the role of the public in environmental monitoring and data collection becomes critical, as official structures may be restricted in their access to the affected areas. Civil society organisations, activists and volunteers can:

[4] https://ecoaction.org.ua/iak-vijna-vplyvaie-na-pryrodu.html?amp

1. Collect and record data on pollution, ecosystem destruction and violations of environmental standards through mobile applications, social media and other platforms.

2. Use technology (drones, satellite images, IoT sensors) to monitor the environment, especially in war zones.

3. Involve the public in educational campaigns and actions to raise awareness of environmental issues.

4. Cooperate with government agencies and international institutions by sharing collected data for response and recovery.

Preparation of appeals and petitions: based on the collected data, the public can initiate petitions and appeals to the authorities to take measures to protect the environment and restore the ecosystem.

It is important to collect evidence to bring the aggressor to justice, to compensate for damage, to finance restoration, etc.

4. How the civic society can influence the collection of information on environmental issues

Ukrainians are asked to record environmental crimes and send evidence to state authorities

The Ukrainian Parliament Commissioner for Human Rights has published instructions on where to report environmental crimes.

The Ombudsman said that the materials received by state authorities will serve as evidence to determine the degree of environmental pollution, qualify the crime, calculate the damage of environmental crimes, identify and prosecute perpetrators, and recover reparations from Russia.

How to record the consequences and why should you do so?

1. In writing, photos and video. In addition to the crime itself, film the environment for a complete context.

2. Show your face and state your name, surname, and patronymic.

3. Indicate the date, time and exact location of the shooting (otherwise, the evidence will not be admissible in court).

4. Record (if possible) the personal data of witnesses affected by the crime (name, date of birth, phone number, address).

Where to submit evidence?

Ukraine has already created a number of digital platforms and applications that greatly simplify the collection of evidence of Russian war crimes

There are also a number of convenient online resources that record crimes against the environment:

- SaveEcoVot chatbot, you need to add it to Telegram or Viber first;

- EcoHarm chatbot;

- EcoThreat app;

- the Ecoinspector2 app, which automatically generates appeals and reports environmental crimes to the State Environmental Inspectorate.

- The WarCrimes platform is supported by the Office of the Prosecutor General of Ukraine;

- WarCrime chatbot of the Ministry of Justice of Ukraine;

- The State Environmental Inspectorate's chatbot for documenting environmental crimes;

We'll talk about apps in more detail later

5. Technologies already used to collect data

Monitoring by satellite

- The use of satellite imagery to analyse the state of the earth's surface, forests, water bodies and detect changes in the environment. Example: The Sentinel system (Copernicus software) allows you to monitor pollution, deforestation and water resources.

«The Copernicus MOOC» is an online training course aimed at enabling people to understand how to use Sentinel Earth observation data to meet societal and governmental needs, as well as to create business opportunities. The EU's Copernicus programme is a comprehensive Earth observation programme using a system of satellites and ground-based systems, as well as a range of derived software products and services for applying data in everyday life - from environmental and agricultural issues to security and emergency response.[5]

Follow this link to register for this free course
https://www.copernicus.eu/en/opportunities/education/copernicus-mooc

Drones (UAVs)

- Unmanned aerial vehicles are used for detailed inspection of hard-to-reach or large areas.

[5] https://ukraine-eu.mfa.gov.ua/news/shcho-take-programa-yes-copernicus-ta-yak-mozhna-vikoristati-yiyi-mozhlivosti-bezkoshtovnij-onlajn-kurs-yevropejskoyi-komisiyi

Monitoring (reconnaissance) aerial photography is a type of specialised survey carried out from aircraft - planes, helicopters, UAVs. The altitude ceiling is determined from hundreds of metres to tens of kilometres. The features of reconnaissance UAV photography are as follows:

- photographs of military equipment, including destroyed enemy vehicles, are taken in flight with automated documentary television online filming;

- the images usually have a slight deviation from the nadir, which is due to the constant mechanism of intelligent avoidance of enemy air defence shells;

- the imagery covers a large area of terrain without 'dead zones' by overlaying images on top of each other for further photo montage without preserving the longitudinal and transverse overlap used in civilian engineering and photogrammetric surveys.

Geographic information systems (GIS) in the form of mobile applications

- Interactive maps allow you to display environmental data in layers that can be analysed for decision-making.

For example, the EcoThreat map from the Ministry of Environmental Protection and Natural Resources of Ukraine.

EcoThreat is the official web resource and mobile application of the Ministry of Environment, which allows everyone to find out reliable information about the state of air, water, soil and other environmental data. For example, if telegram channels scare you with radiation pollution, you can check whether the radiation is now normal. If the forests nearby are burning, you can see the latest air quality data.

Also apps and web resources:

- SaveEcoBot: Informs citizens about environmental issues, combines data on pollution, polluters and environmental protection tools.
- EcoHike: Allows you to record polluted areas of nature and coordinate actions to eliminate them.

Regarding applications:

In the context of war and limited resources in Ukraine, it is more appropriate to focus on improving existing mobile applications for monitoring and collecting environmental information rather than creating new ones. This approach will reduce the dispersion of resources, maintain data consistency and increase the effectiveness of existing tools.

Existing applications already have an established user base, basic infrastructure, and a certain level of public trust. Integrating additional features, such as analysis of new types of pollution, improved data visualisation, access to recommendations, and interaction with volunteer initiatives, can significantly enhance their potential. For example, expanding the environmental data collection and

processing functions in already popular apps will allow for faster response to environmental issues and engagement with a wider audience.

Thus, instead of creating new apps that will require time to adapt and implement, modernising and optimising existing platforms will help create a more holistic, efficient environmental monitoring system that will be useful for citizens, environmental services and volunteer organisations.

Social media and crowdsourcing

- Using platforms such as Facebook or Telegram to collect information from citizens. Activist groups often organise monitoring and collect data on environmental issues.

Given all of the above, the Ukrainian space is saturated with technologies that collect data on environmental issues.

Can we talk about one single state database with complete structured information on environmental issues during the war?

It is advisable to create an operational unified toolkit of an open database of the consequences of hostilities in Ukraine and *of damaged and destroyed natural resource objects* (to the extent that it does not contradict the requirements of the law). The respective geoportal accumulates and posts the results of collecting information on all these environmental issues by thematic categories. The infrastructure of geospatial data on environmental challenges will reduce the time for making management decisions as a result of GIS analysis and environmental audits, and will also allow for a significant detailing of some sections of draft measures for environmental revitalisation and post-war environment. It will also *create a legal framework for the payment of compensation and reparations for environmental crimes.*

A specialised database can be created only with active state support in the adoption of regulations for its creation.

The practical value of the relevant geo-data portal will facilitate the use of data in the effective assessment of accumulated damage during active hostilities and after their completion.

Data storage: Data should be stored on secure server platforms with limited access to prevent unauthorised access or manipulation.

Minimising data storage time: Some platforms may automatically delete personal data after a certain period of time after collection to reduce the risk of data breaches.

In order to ensure anonymity and confidentiality when collecting environmental data, it is necessary to combine technological, legal and organisational approaches. It is important to consider not only the technical aspect, but also outreach to citizens to raise their awareness of the possible risks and benefits of participating in such initiatives.

6. Conclusion andsuggestions

In the context of war, when environmental threats become an integral part of reality, the public plays a critical role in protecting and restoring the environment. Through active participation, mobilization of volunteers, and sharing information with the international community, public organizations and individuals can significantly impact the preservation of natural resources and the restoration of affected ecosystems.

Key strategies in this process include the development of public monitoring and control over environmental crimes. Thanks to modern technologies such as geographic information systems, drones, and mobile applications, it has become possible to quickly collect and analyze environmental data. These tools provide activists with new opportunities to document environmental violations and further communicate with government and international bodies.

Equally important is the integration of the public into legislative processes concerning environmental protection. The introduction of specific legal mechanisms for access to information about environmental damage and the ability to influence government decisions will strengthen the public's role in environmental recovery efforts.

Involving the public in environmental decision-making processes through the creation of advisory councils at government institutions will allow the expertise of public organizations to be combined with official environmental protection measures and ensure the inclusion of community interests in the restoration of affected ecosystems.

Overall, active public involvement and improved monitoring tools will form the basis for more effective environmental restoration after the war, ensuring a healthy and safe environment for future generations.