DIGI EDU HACK 2025

DIGIEDUHACK SOLUTION CANVAS

Title of the solution:	Restoration of natural resources of Kharkiv region
Team name:	EcoUnity - Recovery begins with unity
Challenge addressed:	Restoring Degraded Lands and Water Bodies Using Satellite Analysis
Challenge category:	Sustainability and Environment

Background of the team:

(multiple selections possible in case of mixed teams)

V **Higher Education Students** · **Researchers** · **Professionals**

Teachers · **Primary School Students** · **Secondary School Students**

Others (please specify)

Solution description

What is the final product/service/tool/activity you're proposing? What are its main elements, technologies and objectives? Could you please include a brief implementation plan with some key overall milestones, resources required and eventual barriers foreseen?

How could your solution be used to enhance digital education nowadays? How could its success be measured?

The proposed solution is a GIS-based monitoring and restoration platform designed to assess and recover degraded land and water ecosystems, focusing on the Trav'yanske Reservoir in the Kharkiv region. Using Sentinel-1 and Sentinel-2 satellite data (2021–2025), the system integrates NDWI and NDVI analytical models to automatically classify damaged areas with approximately 90% accuracy.
The platform combines satellite data processing, spatial modeling, and visualization tools to support data-driven decision-making in environmental recovery.
Main components:
-A satellite monitoring module tracking changes in water balance and vegetation;
-Automated analysis and classification of NDWI/NDVI data;
-An interactive GIS portal with recovery maps and recommendations;
-A decision-support panel for communities and environmental agencies.
Implementation plan:Pilot testing at the Trav'yanske Reservoir.
Integration with local land and environmental management systems.
Capacity building for local authorities and students in GIS technologies.
Scaling the solution to other war-affected regions (Sumy and Mykolaiv).Required resources: ESA satellite data, GIS servers, analytical software (QGIS, ArcGIS Pro, Google Earth Engine), and a multidisciplinary team of GIS, ecology, and IT experts.
Potential challenges: Limited access to high-resolution imagery and sustainable funding for long-term operation.

Context

What is the current or future problem you're trying to solve? How does your solution align with DigiEduHack 2025 annual theme?

How does your solution confront the challenge posed by the hackathon organiser and how does it address the challenge category?

The project addresses the urgent post-war degradation of land and water resources in the Kharkiv region, one of the territories severely affected by hostilities. The loss of vegetation cover, disrupted hydrological systems, and soil erosion require modern, data-driven recovery strategies.
By applying GIS technologies and remote sensing data, the solution provides a scientific and scalable approach for evaluating damage, prioritizing restoration zones, and monitoring ecosystem recovery.
The project aligns with the DigiEduHack 2025 theme "Digital solutions for a changing world", as it demonstrates how digital innovation and education can jointly support sustainable reconstruction.
Challenge category: Sustainability and Environment — the project directly contributes to building climate resilience and ecosystem restoration through advanced spatial data tools and community learning initiatives.

Target group

Who is/are the target group/s of your solution and how will they benefit from it? Why is your solution relevant to them? how do you plan to engage these groups so you fully meet their specific needs?

Primary target groups:
-Local communities engaged in post-war land recovery;
-Environmental agencies and authorities responsible for monitoring and restoration;
-University students in geodesy, ecology, and information technology.
Expected benefits:
-Rapid and safe assessment of land degradation without extensive fieldwork;
-Improved decision-making through timely access to spatial data;
-Skill development in GIS-based environmental monitoring.
The project is highly relevant as it integrates digital education, environmental sustainability, and community participation.
Engagement will be achieved through open-access data, educational workshops, and participatory mapping activities involving local stakeholders.

Impact

How will your solution catalyse changes in education and what impacts will it have at social and environmental level? Could you provide examples or scenarios illustrating how such changes and impacts might unfold?

The proposed solution generates environmental, social, and economic impacts, contributing to sustainable land recovery and digital education.
Environmental impact:
Approximately 118 hectares of water and adjacent land areas have been restored, leading to a 20–25% reduction in soil erosion and partial recovery of natural hydrological balance. The application of GIS-based monitoring ensures continuous observation and data-driven decision-making in ecosystem management.
Social impact:The project has engaged local communities in environmental initiatives and created up to 30 jobs in land reclamation and monitoring. It also enhances digital literacy by training students and municipal specialists in GIS technologies and environmental analytics.
Economic impact:Stabilizing soil moisture through ecosystem recovery has increased agricultural productivity by around 15% in surrounding areas.
From an educational perspective, this project catalyzes digital transformation in learning, allowing students to work with real geospatial datasets, develop applied recovery models, and visualize tangible environmental outcomes.
Illustrative outcomes:
Creation of an open-access map of degraded lands in the Kharkiv region;
Use of GIS-based models in environmental education and workshops;
Collaboration with local communities to design regional recovery plans.
Overall, the project transforms satellite data into actionable educational and ecological insights, fostering a new culture of data-driven environmental recovery and sustainable territorial management.

Describe it in a tweet

How would you describe your solution in a short catchy way with maximum 280 characters?

GIS-powered recovery for post-war Ukraine: We transform satellite data into real maps of restoration — accelerating land rehabilitation, empowering education, and reconnecting communities with their environment.

Innovativeness

What makes your solution different and original? Are there similar solutions or approaches currently available or implemented by education sector practitioners? If so, why and to what extent is your solution better?

Our solution uniquely combines GIS analytics, satellite data, and digital education for post-war land recovery. Unlike existing mapping tools, it integrates NDWI/NDVI-based automation with community and student participation, reducing analysis time from weeks to hours and merging science with learning.

Transferability

Can your solution partly or fully be used in other education/learning contexts or disciplines? Could you provide any example?

The model can be adapted for other disciplines and regions: from monitoring forests and wetlands to training students in environmental management, geography, and remote sensing. For example, the same GIS workflow could support climate resilience education in flood-prone areas.

Sustainability

Once you have a prototype, what are your plans for a further development, implementation upscale and replication of the solution? How do you see it working in the mid- and long term?

After prototyping, we plan to validate the model with the Lypetska community, expand it to the Sumy and Mykolaiv regions, and develop an open-source educational GIS module. In the mid- and long term, the platform will evolve into a national digital ecosystem for ecological monitoring.

Team work

Present the members of your team.

Why are you the perfect team to develop this work and what are the competencies you all bring in so the solution is developed successfully? What is your expertise within the thematic field concerned? Are you planning to continue working as a team in the future? If so, why?

Our team of six motivated students integrates expertise in geodesy, cartography, environmental science, and GIS technologies:
① Konshyn Denys – Team Lead & GIS Analyst: "We turn pixels into action plans."
② Shevchenko Sofiia – Spatial Data Specialist: "I know how to transform maps into growth zones."
③ Nechaieva Sofiia – Communication & Visualization Expert: "I ensure clarity in complex data."
④ Taranukha Anastasiia – Remote Sensing Analyst: "I extract meaning from satellite layers."
⑤ Loparieva Daria – Environmental Researcher: "I link data to real ecological outcomes."
⑥ Ryndia Yevhenii – Data Engineer: "I keep our models smart and efficient."
Together, we unite scientific curiosity with a shared goal — to rebuild and re-green Ukrainian landscapes using digital innovation. We plan to continue as a team, expanding our work through academic projects and real-world GIS collaborations.

European Commission

Use of satellite technologies and geographic information systems in the restoration of natural resources in the Kharkiv region.

Solutions for environmental safety and sustainable development

DigiEduHack 2025

Our team

Daria Lopareva,
1st year bachelor's student,
group 103-GZ-D25.

Anastasiia Taranukha,
1st year of master's degree,
group 216-GZ-D25.

Denys Konshyn,
4th year,
group 103-GZ-D22

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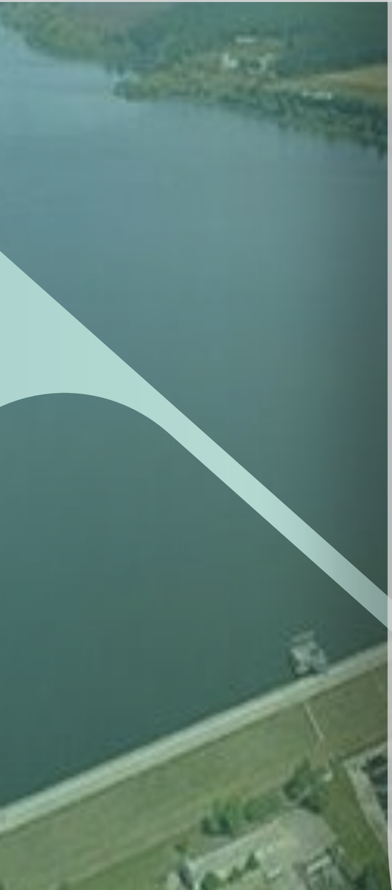
“Recovery begins with unity”

Sofia Shevchenko, 4th year, group 103-GZ-D22

Yevgeniy Rinda, 1st year bachelor's student, group 103-GZ-D25

Sofia Nechaeva, 3rd year, group 103-GZ-D23

Introduction



Subject of research: natural resources (water, land) of the Kharkiv region affected by hostilities.

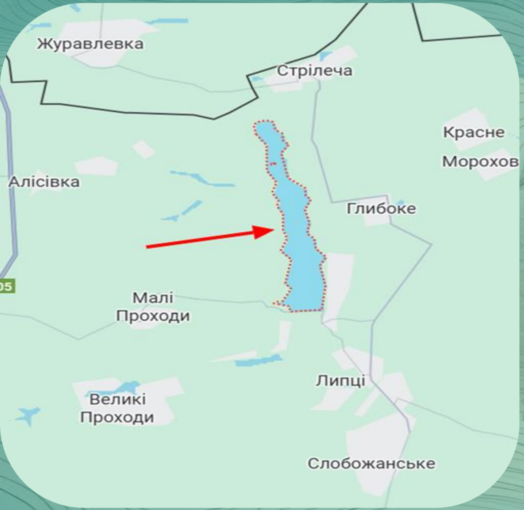
Research objective:

- to assess the ecological condition of the Travyansky Reservoir within the Lipetsk United Territorial Community;
- to develop a map of recommendations and implement practical solutions for the restoration of the Kharkiv region.

Research objectives:

- Determine the extent of water body degradation using Sentinel-1 and Sentinel-2 satellite data.
- Analyze changes in the water surface and vegetation cover (NDWI, NDVI).
- Identify the most damaged areas and develop a plan for priority environmental interventions.
- Prepare a map of recommendations and a prototype GIS solution for further reclamation.

Work methodology



Location of the Travyansky Reservoir

The Travianske and Tymofiivske reservoirs in the Kharkiv region have been almost destroyed due to military operations.

Description of the Travian Reservoir and use of data

- Definition, geographical location, main parameters and characteristics
- Purpose of creating this reservoir
- Fresh water reserve complex for the city of Kharkiv
- The main reason for the decrease in water level in the Travian Reservoir

Data used for the study

The following data are used for the study:

- Satellite remote sensing images
- Cartographic materials
- Ground-based research
- Ground-based hydrophysical, hydrochemical, and hydrobiological indicators

Landsat-1

Regulatory and legal support

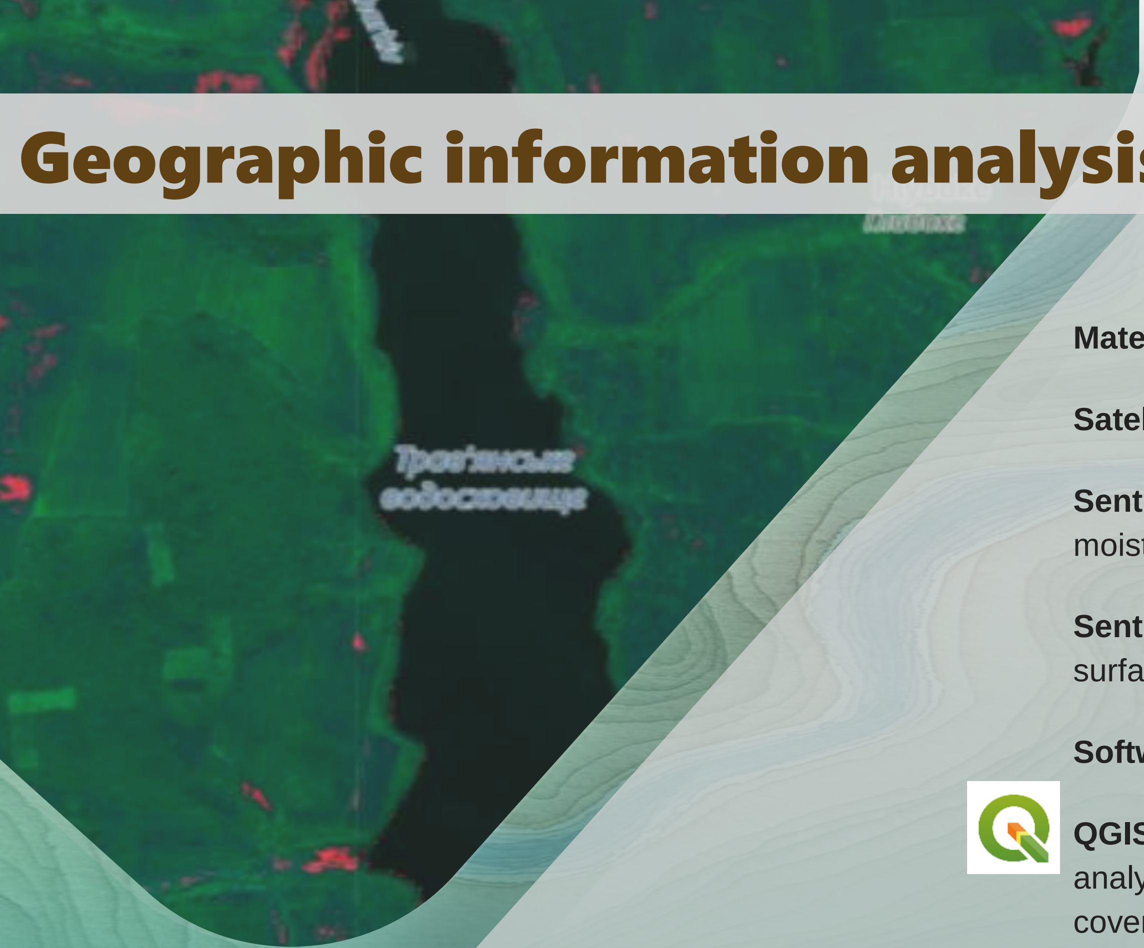
The Water Code of Ukraine regulates the use, protection, and exploitation of water resources and reservoirs.
The Law **“On Environmental Protection”** defines the principles of environmental protection and liability for violations.

CMU Resolution No. 758 establishes the procedure for state monitoring of water resources.
The National Strategy for the Restoration of Ukraine sets the direction for the post-war restoration of natural ecosystems.
The OECD and EU4Environment recommendations define environmental standards for the restoration of the water sector.

Use of cadastral data

1. Ensures the accuracy of boundaries and land status.
2. Integration with GIS showed the structure of land use.
3. Changes were identified based on satellite observations.
4. Allows you to determine the status of plots and responsible land users.

Geographic information analysis



Materials and analysis tools used

Satellite data:

Sentinel-1 — radar images for assessing surface moisture and soil structure.

Sentinel-2 — optical images for determining water surface area and vegetation condition.

Software:

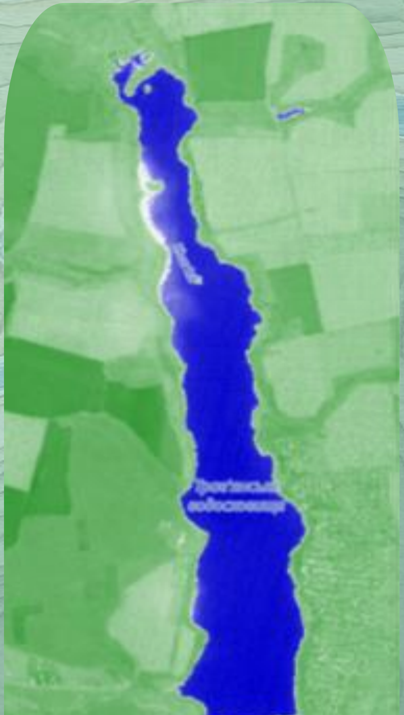
QGIS — creation of NDWI and NDVI index maps, analysis of changes in water regime and vegetation cover between 2021 and 2025.

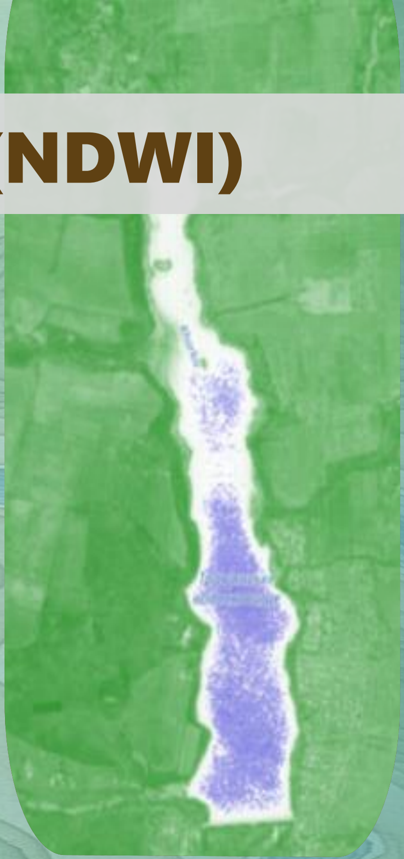
TopoCAD — construction of a digital elevation model (DEM) and analysis of slopes to identify areas of

Normalized Difference Water Index (NDWI)

The normalized difference water index is most suitable for mapping water bodies. Values for water bodies exceed 0.5. Vegetation has lower values. Built-up areas have positive values ranging from zero to 0.2.

November 2021



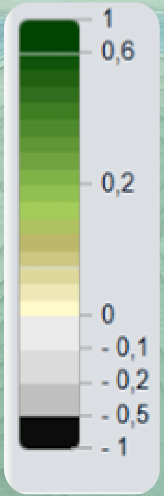


May 2025

Normalized Difference Vegetation Index (NDVI)

November 2021

May 2025



The Normalized Difference Vegetation Index (NDVI) is an indicator of green vegetation cover determined by light reflection in different spectral ranges. NDVI values range from -1 to 1:

- < 0 — water or unproductive surfaces;
- 0–0.2 — low vegetation or lifeless surfaces;
- 0.2–0.4 — shrubs and meadows;
- > 0.4 — dense forests and healthy vegetation.

The closer the NDVI is to 1, the healthier and denser the vegetation.

Priority areas for intervention — ranked using the MCDM method

Zone	E	D	S	T	Integral Score (P)	Priority
Southern (dam, hydrostructure)	2	3	3	3	2.65	I (technical priority)
Northern (dried part)	3	3	2	2	2.55	II (ecological priority)
Central (stabilization zone)	2	2	2	3	2.15	III (monitoring & support)

MCDM criteria

E — Ecological value: assessment of biodiversity and vegetation condition (NDVI).

D — Degree of damage: changes in water surface and ecosystem degradation (NDWI, NDVI).

S — Social significance: impact on the community, proximity to settlements and farmland.

T — Technical feasibility: terrain, road network, possibility of performing work (DEM).

Comprehensive Recovery Program: Three Pillars of Reclamation

Short-term measures (1–3 years):
Cleaning up debris and silt, repairing the dam. Clearing tributary channels, restoring water exchange. Creating coastal protection strips, stocking the reservoir with fish.

Long-term measures (3–10 years):
Ecosystem restoration: planting moisture-loving plants, buffer zones. Modernization of hydraulic structures. Regular monitoring of water quality and ecosystem status.

Social aspect:
Involvement of the community in eco-actions and care for the reservoir. Information campaign on the importance of cleanliness and sustainable use.

Implementation Model: From Risk Zone to Development Zone (Roadmap)

Stage 1 (0-6 months): Assessment.

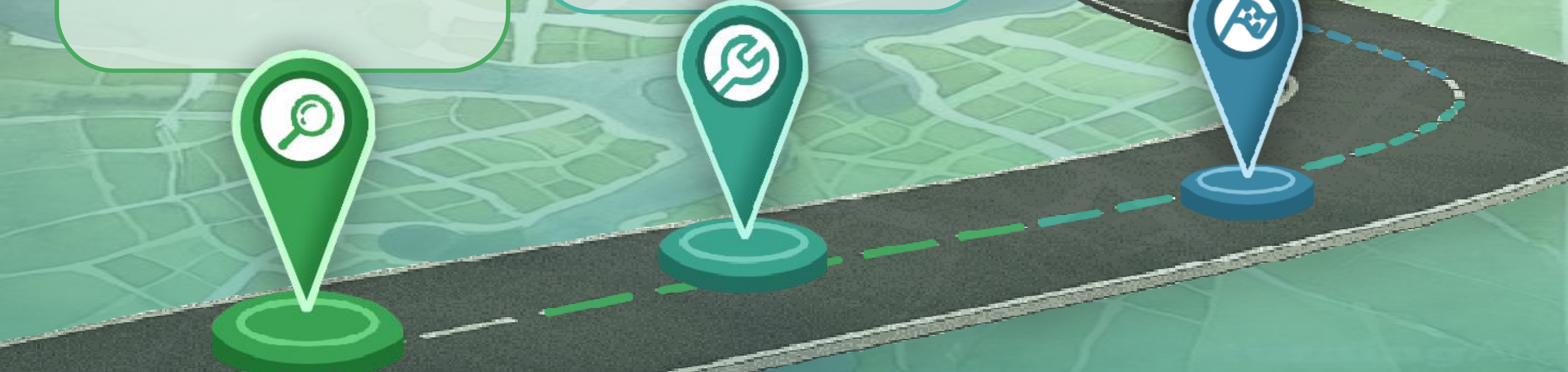
1. Data collection.
2. Analysis and mapping.
3. Field survey.
4. Pilot remediation measures.

Stage 2 (6-18 months): Reclamation.

1. Development of detailed plans.
2. Start of restoration work.
3. Construction of a monitoring system.

Stage 3 (24+ months): Control and scaling.

1. Full recovery and stabilization
2. Expansion to “yellow” zones.
3. Project integration.



Conclusions:

Key findings:

A comparison of Sentinel-1 and Sentinel-2 satellite data (2021–2025) was performed to determine the level of degradation of the Travyansky Reservoir.

A GIS model for assessing NDWI and NDVI changes was developed, which automatically classifies damaged areas with an accuracy of about 90%.

GIS technologies reduced the time for initial environmental assessment from several weeks to several hours, reducing the need for field surveys in hazardous areas.

Project impact:

Environmental: Approximately 118 hectares of water area and coastal areas have been restored. Soil erosion has been reduced by 20–25%.

Social: The community has been involved in eco-initiatives, and up to 30 jobs have been created in the field of recultivation and monitoring.

Digital literacy of the population has been improved through training in GIS tools.

Economic: Yields of adjacent lands have been increased by 15% thanks to soil moisture stabilization and irrigation systems.

Next steps:

Validation: launch of a pilot project together with the Lipetsk united territorial community.

Scaling: Adaptation of the model for other affected regions — Sumy and Mykolaiv Oblasts.

Partnerships: Expansion of cooperation for access to updated satellite data and development of the GIS monitoring ecosystem.

The EcoUnity project proves that modern technologies are not only a tool for analysis, but also a path to the revival of nature, the development of communities, and the formation of a sustainable future for Ukraine.

References used in the project:

Implementation Model: From Risk Zone to Development Zone (Roadmap):

1 -https://mykolaivska.land.gov.ua/рекультивація-порушених-земель/ - State Geocadastre Administration Website.

2 -https://uk.wikipedia.org/wiki/ - Wikipedia.

3 -https://insgeo.com.ua/rekultivacia-rodovysch/- Institute of Geology.

4 -https://19january2017snapshot.epa.gov/sites/production/files/2015-04/documents/a_citizens_guide_to_phytoremediation.pdf - A Citizen's Guide to Phytoremediation.

Methodology:

1 - https://uk.wikipedia.org/wiki/ - Wikipedia

2 - https://www.mao.kiev.ua/biblio/jscans/knit/2014-20/knit-2014-20-5-04-tomchenko.pdf - Use of remote sensing and ground-based observations for a comprehensive assessment of the ecosystem services of the Kyiv Reservoir based on the hierarchy analysis method

3 - https://www.mdpi.com/2072-4292/16/11/1984 - MDPI - Remote Sensing, 2024

4 - https://eprints.zu.edu.ua/41262/1/6.pdf - Eprints Zhytomyr State University, 2023

5 - https://iwaponline.com/jwcc/article/13/2/557/85451/Enhanced-index-for-water-body-delineation-and-area - IWA - Publishing, 2023

Thank you for your attention!

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