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THE USE OF UNIVERSITY BIOSYSTEM ENVIRONMENTAL PROTECTION PLATFORM TO PREVENT A NEW OUTBREAK OF THE COVID-19 PANDEMIC

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The purpose of this study was to determine the possibility of practical use of the Hackathon Platform for ecological protection of the university biosystem to prevent a new outbreak of the COVID-19 pandemic. The COVID-19 pandemic significantly affects companies and population's behaviour. The most significant change occurred in the attitude of companies to the environment from technical and technological points of view. To increase their production sustainability, these companies are looking at the possibilities of waste recovery through sustainable recycling, or recovery of waste as a source of secondary raw material. One of the simplest ways is to use agricultural waste for energy purposes, bringing bioenergy to the forefront as a new area of Industry 4.0. The ALARA model was used to assess the quality of six biosystem components (atmospheric air, water resources, soil layer, the level of land pollution with chemicals and littering by the unauthorized dumps; sufficient volume of green planting on the territory). This allowed the development of management decisions and environmental protection measures based on the system of calculated indicators of potential environmental damage for each of six biosystem components. The forecast of plan implementation: the quality of four from among six biosystem components (atmospheric air, water resources, soil layer, sufficient volume of green planting on the territory) will increase on average by 30–40%. A minor improvement in the quality of the other biosystem components (approx. by 10%) raises concerns about the high probability of a new outbreak of the COVID-19 pandemic.

Keywords: Hackaton-platform; biosystem components; ALARA; waste

In most countries of the world, the 2020 COVID-19 pandemic and subsequent total quarantine led to the mixed results for the biosystem (McKibbin and Fernando, 2021; McVittie and Faccioli, 2020; Gu and Zhou, 2020). The negative results include: the emergence of new species and an increase in the volume of existing environmental pollutants (used medical masks, gloves, wipes, sanitizers), an increase in plastic waste (disposable dishes, disposable bags); funding reductions for the production of solar, wind and other alternative energies (Hou et al., 2020; Gwada et al., 2019). Specialists take an active part in searching for effective methods and ways to limit the spread of the coronavirus (Obi et al., 2020; Shcherbak et al., 2021) and to restore and protect the biosystem from its negative effects (Perrings and Espinoza, 2021; Tamang et al., 2020). One of such methods is the use of the Hackathon-platform as a youth environmental activist movement (Chit, 2020). These aspects were also addressed at the Glasgow Climate Summit (1–12 November 2021), which accepted conclusions on environmental protection and stronger measures, to combat climate change. The project of biosystem environmental protection created using the Hackathon-platform must meet the following criteria (Rodrigues et al., 2021): it must be environmentally friendly – it must offer an ecological approach to the use of resources (Ghazi et al., 2021); it must be implementable – it must have concise solutions using a minimum amount of resources (Willemen, 2020); it must be implemented by means of a digital/technological component (websites, social networks, crowd sourcing, crowd funding, creating a digital application) (Pogačar and Žižek, 2016); it must have a progress – it is necessary to make provision for the possibility of expanding the results both in the geography of implementation, and in the time of using the obtained results (Sanz, 2019). The main goal of this research is to create the Hackathon-platform for the environmental protection of the university biosystem in order to prevent a new outbreak of the COVID-19 pandemic. The article presented analyses the changes in the biosystem due to the COVID-19 pandemic from the point of view of its comprehensive evaluation. The ALARA model was used for the overall analysis, followed by statistical evaluation. The COVID-19 pandemic significantly affected the view of environmental issues and influenced the use of agricultural waste, biosystems, urban environment and the socio-ecological behaviour of population. These assessments use different evaluation criteria to determine the pandemic's environmental impact.

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Material and methods

It is suggested to use the Harrington-Menchergoal desirability function on the principles of ALARA (an acronym for „as low as risk acceptable") in order to develop the measures for the environmental protection of biosystem. The ALARA model assumes that environmental safety is achieved based on economic and social feasibility while striving for technically achievable risks to zero. In order to construct the multifactorial geo-ecological quality assessment of biosystem, it is offered to use the adapted system of the indicators characterizing the biosystem geo-ecological condition from a holistic perspective. The generalized function of desirability is the quantitative expression characterizing biosystem comprehensively as a whole as the set of values of individual indicators with their weight coefficients corresponding to values of the generalized function (Costanza, 2020). The methods and techniques used in this research are explained below.

Study area

The study object is the biosystem of the sports and health camp "Youth" of Kyiv National University of Technology and Design (hereinafter SHC "Youth" KNUTD), located near the village of Plyuty in Kyiv region of Ukraine (Fig. 1).

SHC "Youth" KNUTD is located near the village of Plyuty in Kyiv region, occupies 0.058 km^2, 400 m from the Kozynka River (a tributary of the Dnipro River), surrounded by the woodlands. The camp is used as a place for summer holidays and recreation of students and staff of KNUTD and other universities in Ukraine, making it very important for the recreation of young people and teachers. Therefore, all the natural resources of this biosphere must be in good condition. This issue becomes especially important with the threat of a new outbreak of the COVID-19 pandemic.

Sampling

The field studies were conducted in July – August 2020. They involved 35 students and faculty members who were taking a vacation at SHC "Youth" KNUTD during this period. The data obtained from the online Google table survey were discussed on the Hackathon-platform in January – February 2021. Sixty students and faculty members participated in the Hackathon-platform. The total number of students in KNUTD makes 9000, faculty members – 365. Calculation of the sample representativeness confirmed that all the results obtained after data processing can be prolonged to the universe general population (9365 people) at 95% probability and error of 15%.

ALARA model

Comprehensive quality assessment of the biosystem components of SHC "Youth" KNUTD on the basis of the generalized desirability function (Costanza, 2020) can be calculated as follows:

$$D = \sqrt[\sum_{i=1}^{6} w_i]{d_1^{w_1} \cdot d_2^{w_2} \cdot d_3^{w_3} \cdot d_4^{w_4} \cdot d_5^{w_5} \cdot d_6^{w_6}} \quad (1)$$

where:
the geometric weighted average of the estimates $d_i\left(i=\overline{1.6}\right)$ reflects the state of various factors affecting the quality of the biosystem: d_1 – atmospheric air quality assessment; d_2 – water resources quality assessment; d_3 – soil layer quality assessment; d_4 – assessment of the level of land pollution by chemical substances; d_5 – assessment of the level of land littering by the unauthorized dumps; d_6 – assessment of provision of the territory with green spaces; w_i – value of weights of particular assessments, $i=\overline{1.6}$

The main general concept of using a comprehensive assessment of biosystem quality was the transformation of natural values of private parameters of different ecological essence and dimensionality into a single dimensionless scale of desirability (preference). As a scale of desirability, there was used the table of correspondence between the relations of preference in the empirical and numerical systems developed by UNESCO (Olson et al., 2001). The connection between the quantitative indicators of the area biosystem geo-ecological assessment (five-point scale) and the level of biosystem geo-ecological quality is shown in Table 1.

In order to calculate the complex index of environmental quality, mathematical models were found for private estimates $d_i\left(i=\overline{1.6}\right)$ in the form of logistic curves. Initially, the intervals of acceptable values for all parameters were

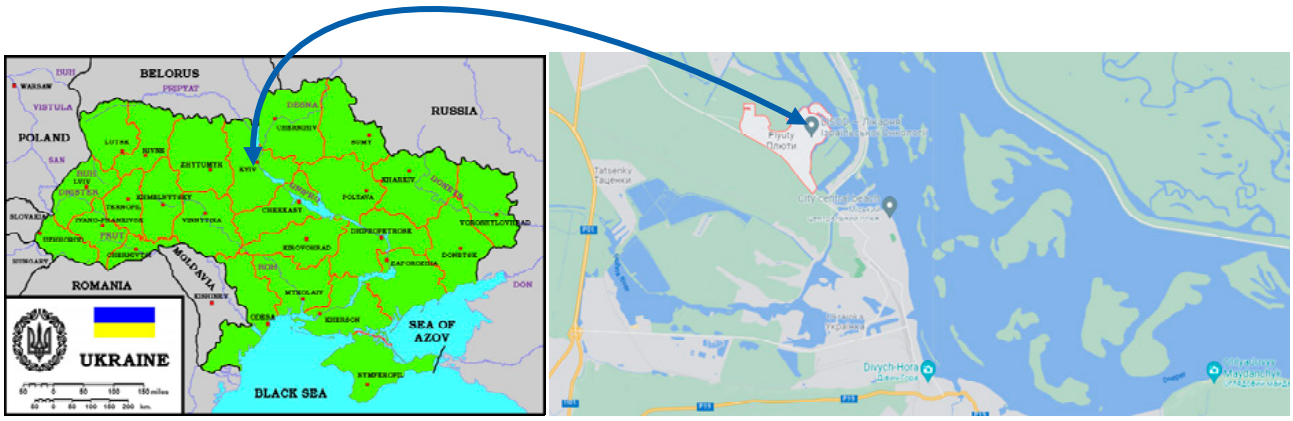


Fig. 1 Location of the sports and health camp "Youth"

Table 1 Assessment of the biosystem geo-ecological quality

Comprehensive geo-ecological situation	Indicator level (five-point evaluation)	Geo-ecological quality (desirability)	UNESCO assessment
Favourable	1	very high	0.88–1.00
Conditionally favourable	2	high	0.71–0.87
Satisfactory	3	satisfactory	0.51–0.70
Intense	4	low	0.37–0.50
Critical	5	very low	0.00–0.36

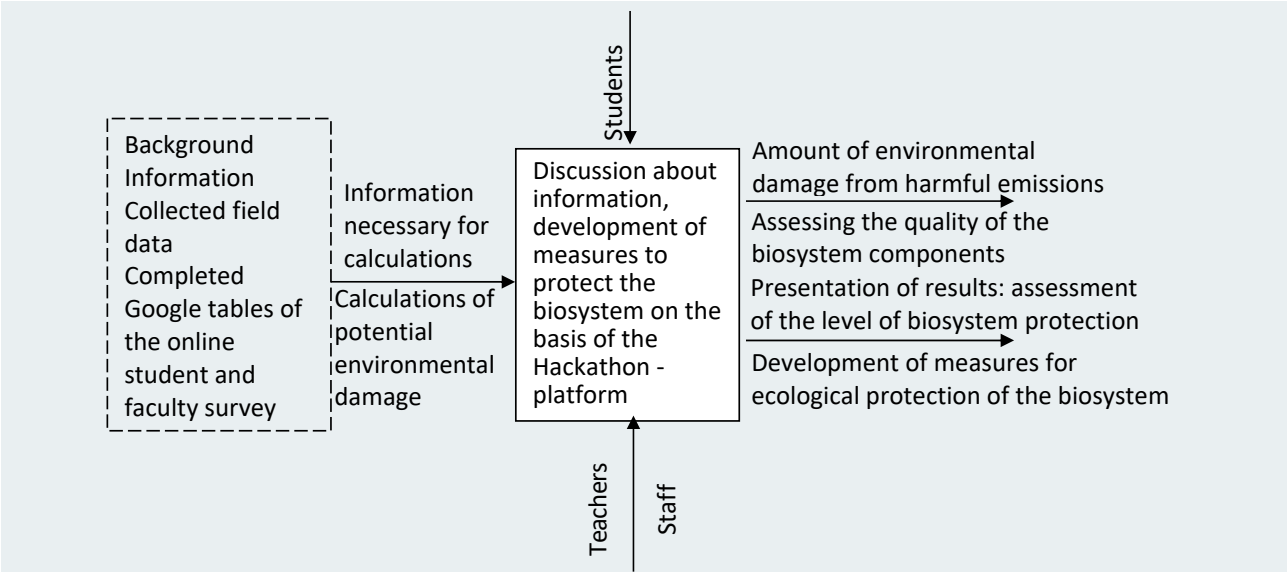


Fig. 2 Scheme of using the Hackathon-platform for the development of measures to protect the university biosystem

specified (the upper and lower limits of possible values of the biosystem indicators).

Statistics analysis

All statistical analyses, including the statistical description of the processed field samples were performed using the STATISTICA 13 software package. The sequence of information processing is presented in Fig. 2.

Results and discussion

Analysis of survey results for consistency of judgments

In order to determine the degree of importance of various influencing factors on the university biosystem, they were assessed according to a points system taking into account the analysis of expert opinions on the basis of the Hackathon-platform (Rutkin, 2015). In order to apply the methodology for assessing the components quality of the biosystem SHC "Youth" KNUTD, 60 experts took part in the survey and filled in online Google tables. The expert group consisted of students, teaching staff and faculty members of the university. The matrix of pair correlation coefficients and Kendell's concordance coefficient were used to check the consistency of expert judgments, as the expert evaluation was conducted by ranking of factors (Stoltzfus et al., 2017).

Biosystem quality assessment by means of a comprehensive index

The mathematical model for calculation of the complex index of quality assessment of the biosystem SHC "Youth" KNUTD had the following form:

$$I_l = \sum_{i=1}^{n} W_l \cdot f_l \qquad (2)$$

where:

$I = \overline{1, n}$ –number of biosystem component (in the expert survey); W_l – weight coefficient of the biosystem component; f_l – value of the score in the comprehensive assessment of geo-ecological situation of the biosystem component

The coefficients W_l were normalized, obeying the following expression: $\sum_{i=1}^{n} W_l = 1$. As a result of the model assessment, all components of the biosystem SHC "Youth" KNUTD were identified in 12 different states by the value of the complex index (Table 2).

According to the value of Kendell's concordance coefficient on the UNESCO scale, the degree of consistency in the expert survey scores turned out to be "low" (Olson et al., 2001). Three subsets were identified based on the evaluation results and, subsequently, three subgroups of experts with concordant opinions were singled out. Based on the results of opinion generalization of three groups

Table 2 Geo-environmental quality of the biosystem components for recreation

Value of the complex index of the component biosystem	Geo-environmental quality of the biosystem component for rest and recreation
(0; 1.10]	optimal
[1.11; 1.50]	relatively optimal
[1.51; 1.90]	conditionally favourable
[1.91; 2.10]	favourable
[2.11; 2.50]	relatively favourable
[2.51; 2.90]	conditionally satisfactory
[2.91; 3.10]	satisfactory
[3.11; 3.50]	relatively satisfactory
[3.51; 3.90]	conditionally dangerous
[3.91; 4.10]	dangerous
[4.11; 4.50]	relatively dangerous
[4.51; 5]	crisis

of interviewed experts, average weighting coefficients of the quality importance of biosystem components were calculated. The most significant included: the level of land pollution by chemicals and the unauthorized dumps (25.9%), the quality of air and water resources (24.6%), the provision of area with green spaces (18.7%). Additional gradations ("conditional" and "relative") were included in the assessment of the geo-ecological quality of biosystem components, and a fractional division of the integer scale was made in accordance with Pareto's law (20/80 principle). This allowed taking into account the differences in the manifestation of anthropogenic impacts on the biosystem components.

Development of environmental measures to improve the quality of biosystem components of SHC "Youth" KNUTD

Measures to improve the quality of biosystem components of SHC "Youth" KNUTD according to the mathematical model presented were taken systematically on the basis of the Hackathon-platform (Nolte et al., 2020), taking into account the adverse states of all its components. The forecast of improving the geo-ecological state, improving the quality of biosystem components for rest and recreation, and reducing the indices of potential environmental damage to

Table 3 Action plan taking into account the priorities of quality indicators of recreational biosystem components and the possibility of preventing a new COVID-19 outbreak

No	Content of the environmental protection measure	Environmental effect of the event	Expert group	Integrated index	Component quality
M1	Reducing unauthorized waste disposal sites of various hazard classes; various chemicals: – disposal of disposable masks, gloves, napkins, sanitizers – use of disposable biodegradable masks, bags and utensils – use of reusable masks with antimicrobial properties	1. elimination of detected debris 2. reducing the area of waste disposal facilities	1	0.51	satisfactory
			2	0.50	low
			3	0.55	satisfactory
			average value	0.52	satisfactory
			standard deviation	0.026	
M2	Reducing the environmental damage to green areas as a result of the allocation of areas for deposit development: – reconstruction of green protective (buffer) area of the sand mining pit – planting of plants (trees, shrubs) – remediation of the soil layer after the mining works	1. restoration of the water level in the Kozinka River 2. elimination of the threat of swamping of the surrounding area	1	0.77	high
			2	0.85	high
			3	0.81	high
			average value	0.81	high
			standard deviation	0.02	
M3	Reducing environmental damage from the pollution of water resources: – a ban on the discharge of sewage by the population of the village of Plyuty and storm water into the river – cleaning the reservoir from bottom sediments and vegetation, household garbage, deepening the bottom, clearing and strengthening the banks	1. reducing pollution of water, soil, bottom sediments, and natural waters 2. Stimulation of self--purification of the river by means of biological preparations	1	0.65	high
			2	0.70	high
			3	0.75	high
			average value	0.70	high
			standard deviation	0.025	
M4	Reducing environmental damage from emissions of hazardous substances into the atmosphere during mining operations: – conducting excavation and overburden operations, internal and external dumping operations, re-excavation of rock piles, and closed crushing of raw materials – control of unloading height in order to prevent rock collapse and reduce dustiness of the atmosphere	1. reduction of silica dust in the air by 20% 2. reduction of dust concentration during excavation and loading operations by up to 15%	1	0.73	high
			2	0.73	high
			3	0.74	high
			average value	0.73	high
			standard deviation	0.006	

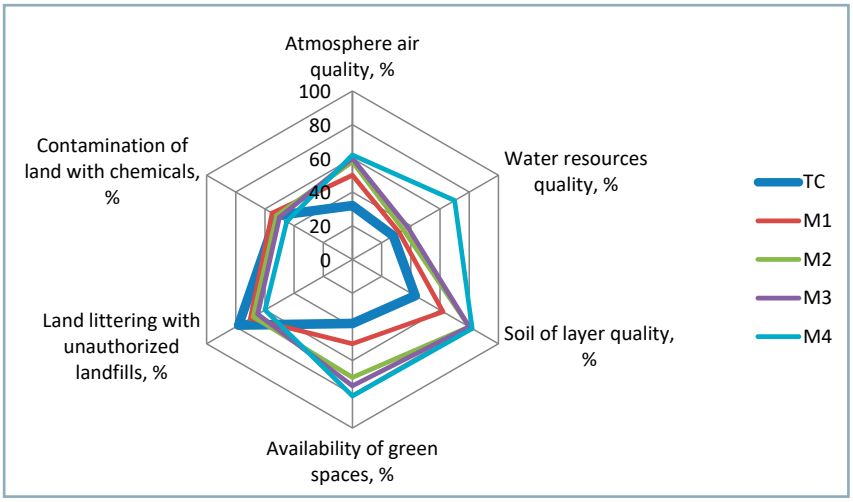


Fig. 3 Multifactor graph-analytical scheme for quality improvement of the components of SHC "Youth" KNUTD

the area is presented in the form of an action plan, taking into consideration the priority of all indicators (Table 3).

The plan of measures was developed based on the Hackathon-platform by discussing the problems and ranking the priority of activities and the possibility of preventing a new outbreak of COVID-19 (Caraka et al., 2020).

Quality assessment of the biosystem SHC "Youth" KNUTD after enforcement of environmental protection measures

Based on Table 3, improvement of a geo-ecological condition of the biosystem SHC "Youth" KNUTD as a result of implementation of developed plan of measures is predicted. The multifactor graph-analytical scheme of change in a geo-ecological biosystem state of SHC "Youth" KNUTD taking into account values of private functions of desirability (in %) for all six components is presented in Fig. 3.

Sequence of the biosystem quality improvement of SHC "Youth" KNUTD

Improvement of the geo-ecological quality of the biosystem for recreation of students and university teaching staff, reduction of the threat of a new outbreak of COVID-19 is provided by the sequence of measures implementation «TC → M1 → M2 → M3 → M4» (Fig. 4).

The value of a complex indicator of biosystem quality of SHC "Youth" KNUTD after implementation of measures will be compliant to a "high" level of geo-ecological comfort of rest and recreation of students and teaching staff of the university (Shcherbak et al., 2020). While comparing a sequence of states in the measures implementation process, it is possible to reveal and prevent dangerous deviations from a normal condition, to increase geo-ecological biosystem quality taking into account preferences and needs of people in the given area, and to implement preventive measures against a new outbreak of COVID-19 (Shcherbak et al., 2021).

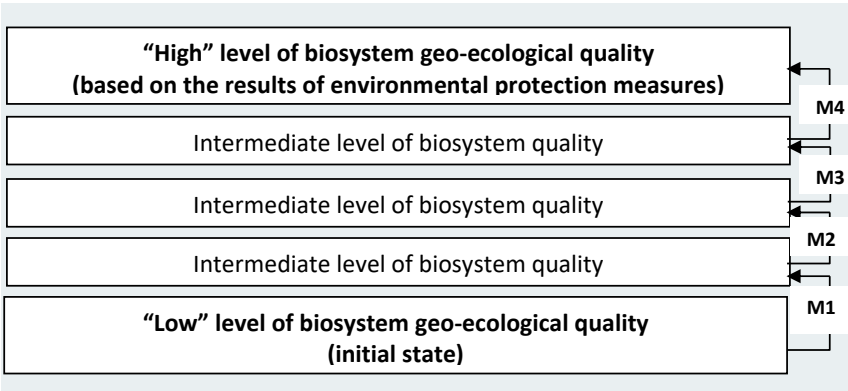


Fig. 4 Multistep scheme to improve the biosystem quality of the SHC "Youth" KNUTD

Conclusion

The various components of biosystems affecting sustainability in industry and agriculture have different importance regarding to their qualitative and quantitative aspects. In several aspects, qualitative indicators are more important for the production sustainability in industry. Quality assessment of the biosystem components and the development of action plan for its improvement was carried out by expert method on the basis of the Hackathon-platform. The ecological damage from the negative anthropogenic impact under the threat of a new outbreak of COVID-19 pandemic was determined by the results of field work and relevant calculations. Kendell's concordance coefficient was used to check the consistency of expert judgments. The ALARA model was used to assess the geo-ecological quality of the biosystem components. This model assumes that environmental safety is achieved on the basis of economic and social feasibility while reaching technically achievable risks equal to zero. The current state of the biosystem components of the sports and health camp "Youth" Kiev National University of Technology and Design (Plyuty village, Kiev region, Ukraine) was assessed in 2 stages: summer 2020 (35 participants) – field collection of information; winter 2021 (60 participants) – processing of information, development of environmental action plan based on the Hackathon-platform. The quality of atmospheric air increased by 30%, the quality of water resources by 42%, the quality of the soil layer by 39%, the amount of green planting provided to the area by 43%. The level of land pollution by chemical substances decreased by 7%, the level of land littering by the unauthorized dumps by 18%. Ultimately, the geo-ecological quality of four from the six biosystem components of sports and recreation

camp "Youth" KNUTD changed from the category "low" to "high" as a result of the consistent implementation of environmental measures. Biosystem components level of land pollution by chemical agents and level of littering by the unauthorized dumps still remain at a low level. In the context of a possible new outbreak of COVID-19, the situation that has been emerged requires finding new solutions to protect the biosystem. The multifactor model of assessing the quality of the biosystem components makes it possible to predict the changes under the influence of anthropogenic and environmental protection measures to ensure sustainable balanced development of the university area.

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