

Електронний журнал «Ефективна економіка» включено до переліку наукових фахових видань України з питань економіки (Категорія «Б», Наказ Міністерства освіти і науки України № 975 від 11.07.2019). Спеціальності – 051, 071, 072, 073, 075, 076, 292.
Ефективна економіка. 2023. № 12.

DOI: <http://doi.org/10.32702/2307-2105.2023.12.52>

УДК 502.7:502.171.2(477.83) (043.2)

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IMPROVEMENT OF ENVIRONMENTAL POLICY AT THE UNIVERSITIES (LVIV POLYTECHNIC NATIONAL UNIVERSITY CASE STUDY)

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ВДОСКОНАЛЕННЯ ЕКОЛОГІЧНОЇ ПОЛІТИКИ В УНІВЕРСИТЕТАХ (НА ПРИКЛАДІ НУ «ЛЬВІВСЬКА ПОЛІТЕХНІКА»)

The article examines the essence of the category environmental policy of universities, possibilities and methods of its implementation and improvement. Environmental policy is the commitment of an organization to the laws, regulations, and other policy mechanisms concerning environmental issues. Thus, environmental policy tends to focus on problems arising from human impact on the environment,

which is important to human society by having a (negative) impact on human values. Such human values are often labeled as good health or the “clean and green” environment. In practice, policy analysts provide a wide variety of types of information to the public decision-making process.

The main publications in scientific researches we can describe in following areas: *Perception of Universities as Key Players in Ecology; Green Initiatives and Sustainability; The Role of Education in Environmental Awareness; International Collaboration in Environmental Science; Assessment of Impact and Policy Effectiveness.*

In 2024, LPNU was ranked globally among the top 1000 universities according to Times Higher Education. As of 2024, there are about 25,000 students at the University. The information about the environmental aspects of LPNU activities was summarized for participation in The Times Higher Education Impact Rankings, and UI GreenMetric World University Rankings

For improvement of the Environmental Policy at the Universities, we propose to use casual loop modeling. A causal loop diagram comprises four fundamental components: variables, the connections linking them, the signs indicating their interrelationships, and the sign of the loop determining the system's behavior.

The goal of article is to investigate the Environmental Policy at the universities possibilities and methods of its implementation. The research object is approaches to environmental policy at the universities improvement. The research subject is theoretical, methodological, and applied principles of Environmental Policy at the modern educational institutions.

Development of the researched problem should relate to the development of specific steps of action in each of the described in our research directions. It should be taken into account that University's Environmental Policy influence brings not just environmental benefits, but is also an effective way to improve the position in the world market of educational services which leads to an increased number of students and profit.

У статті досліджено процес створення та вдосконалення екологічної політики університетів, можливості та методи її реалізації та вдосконалення. Екологічна політика – це відповідність організації законам, нормативним актам та іншим політичним механізмам, що стосуються екологічних питань. Екологічна політика, як правило, зосереджується на проблемах, що виникають внаслідок впливу діяльності підприємств та організацій на довкілля, що є важливим для людського суспільства, оскільки має (негативний) вплив на людські цінності. Такі людські цінності часто називають міцним здоров'ям або «чистим і зеленим» навколишнім середовищем. На практиці аналітики надають широкий спектр видів інформації для процесу прийняття рішень щодо екологічної політики.

Основні напрями сучасних наукових досліджень сьогодні характеризують такі напрями: сприйняття університетів як ключових гравців в екології; зелені ініціативи та сталий розвиток; роль освіти в екологічній свідомості; міжнародне співробітництво в галузі екологічної науки; оцінка впливу та ефективності політики.

У 2024 році Національний університет «Львівська політехніка» (НУЛП) увійшов до світового рейтингу серед 1000 найкращих університетів за версією Times Higher Education. Станом на 2024 рік в університеті навчається близько 25 000 студентів. Інформація про екологічні аспекти діяльності НУЛП була узагальнена для участі в рейтингах The Times Higher Education Impact Rankings та UI GreenMetric World University Rankings.

Запропонована у статті модель причинно-наслідкового циклу складається з чотирьох основних компонентів: змінних, зв'язків, що їх пов'язують, ознак, що вказують на їх взаємозв'язки, і знаків петлі, що визначає поведінку системи.

Метою статті є дослідження екологічної політики в університетів, можливостей та методів її реалізації. Об'єктом дослідження є підходи до вдосконалення екологічної політики університетів. Предметом дослідження є теоретичні, методологічні та прикладні засади екологічної політики НУЛП.

Висновки та практичні рекомендації щодо процесів удосконалення екологічної політики в НУЛП можуть бути впроваджені в господарську діяльність сучасних закладів освіти.

Keywords: *environmental policy, decision making, university management, simulation, casual loop diagram.*

Ключові слова: *екологічна політика, прийняття рішень, управління університетом, імітаційне моделювання, модель причинно-наслідкового циклу.*

Statement of the problem in general and its connection with important scientific or practical tasks. In our research activities, we are faced with insufficient information and interest in the Environmental Policy improvement in non-production organizations, namely in educational institutions. We consider the reasons for this to be the limited number of relevant specialists, as well as the lack of adapted methods. The theoretical-methodical and applied significance of the solution of the identified directions of research determines the relevance of the chosen topic and determines the goal, task, and logical-structural structure of the master's qualification thesis.

Analysis of recent research and publications. The main publications in scientific researches we can describe in following areas:

- Perception of Universities as Key Players in Ecology (many publications identify universities as crucial participants in implementing environmental policies. They may engage in research, adopt sustainable practices, and contribute to raising environmental awareness among students);
- Green Initiatives and Sustainability (some publications may highlight specific environmental initiatives that universities undertake to reduce their impact on the environment. This could include energy conservation, the use of renewable energy sources, waste management practices, and more);
- The Role of Education in Environmental Awareness (publications may also address the role of universities in shaping environmental consciousness among students. This might involve integrating ecological topics into curricula and

fostering research on environmental issues);

- International Collaboration in Environmental Science (since many environmental issues are global, some research may focus on international collaboration between universities to address common challenges collectively);
- Assessment of Impact and Policy Effectiveness (analysis of publications might involve evaluating the effectiveness of university environmental policies and their impact on the environment).

Formulation of article goals (setting the task). The main tasks of work: explore the essence of the concept of "environmental policy" in universities; create and simulate the process of casual loop diagram of Environmental Policy improvement at LPNU.

Presentation of the main research material. Environmental policy is the commitment of an organization to the laws, regulations, and other policy mechanisms concerning environmental issues. These issues generally include air and water pollution, waste management, ecosystem management, maintenance of biodiversity, and the management of natural resources, wildlife, and endangered species [1]. For example, concerning environmental policy, the implementation of an eco-energy-oriented policy at a global level to address the issues of global warming and climate change could be addressed [2]. Policies concerning energy or regulation of toxic substances including pesticides and many types of industrial waste are part of the topic of environmental policy. This policy can be deliberately taken to influence human activities and thereby prevent undesirable effects on the biophysical environment and natural resources, as well as to make sure that changes in the environment do not have unacceptable effects on humans [3].

One way to describe environmental policy is that it comprises two major terms (Fig. 1):

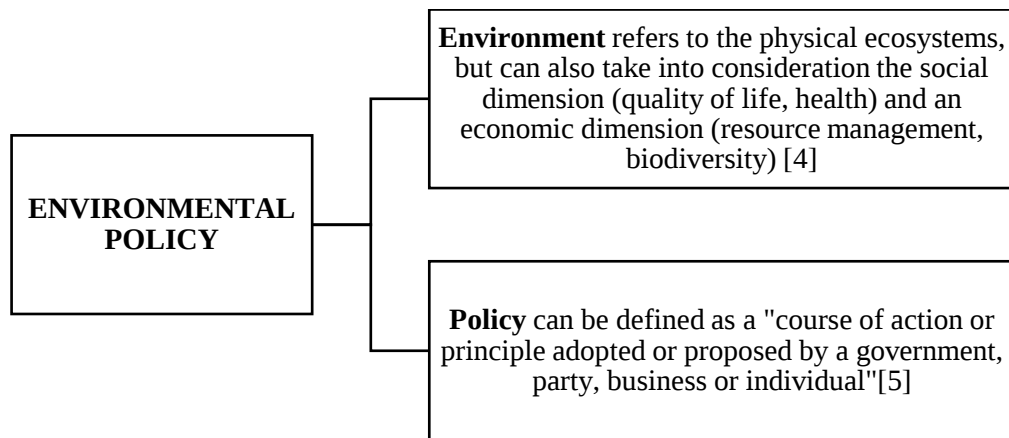


Fig. 1. Components of environmental policy

Source: Systematized, summarized and grouped according to data [4-5].

Thus, environmental policy tends to focus on problems arising from human impact on the environment, which is important to human society by having a (negative) impact on human values. Such human values are often labeled as good health or the “clean and green” environment. In practice, policy analysts provide a wide variety of types of information to the public decision-making process [6].

The war started by the Russian Federation has caused significant damage to all the areas of the life of Ukrainians – material (in the form of destruction of buildings, enterprises, and infrastructure), financial (the loss of tax and customs revenues to the state budget), human (deaths of military and civilians, injuries, the deterioration of mental health of the population, population migration to other countries), cultural (the destruction of cultural institutions and monuments, the deterioration of relations between Ukrainians and the residents of the country-aggressor), etc. The confrontation between the West and Russia will have a long-term, large-scale negative impact on the economy of most European companies [7].

Lviv Polytechnic National University (LPNU) is the largest scientific university in Lviv. Since its foundation, it has been one of the most important centers of science and technological development in Central Europe.

Environmental Policy ensures that Lviv Polytechnic National University (hereinafter referred to as the University) is determined by the principles of environmental sustainability in its activities. It has been recognized that the University

activities may have a significant impact on the local and global environment, and therefore strives to mitigate the negative impact on the environment through education, research, and other activities and to contribute to the improvement of the environment [9].

The purpose of the University's environmental policy is to develop and implement effective mechanisms and tools to prevent negative environmental impact and foster the environment. The objectives of the University's Environmental Policy are (Fig. 2):

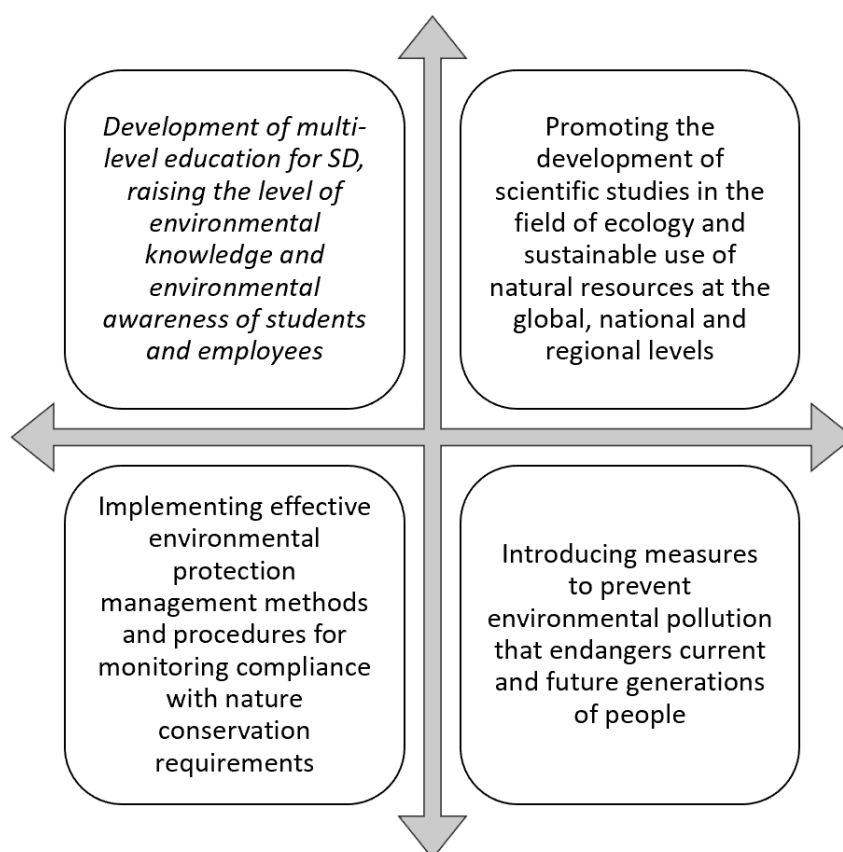


Fig. 2. The objectives of the LPNU's Environmental Policy

Source: Systematized, summarized and grouped according to data [9].

The organization of key principles of existing LPNU's Environmental Policy is shown in Fig. 3.

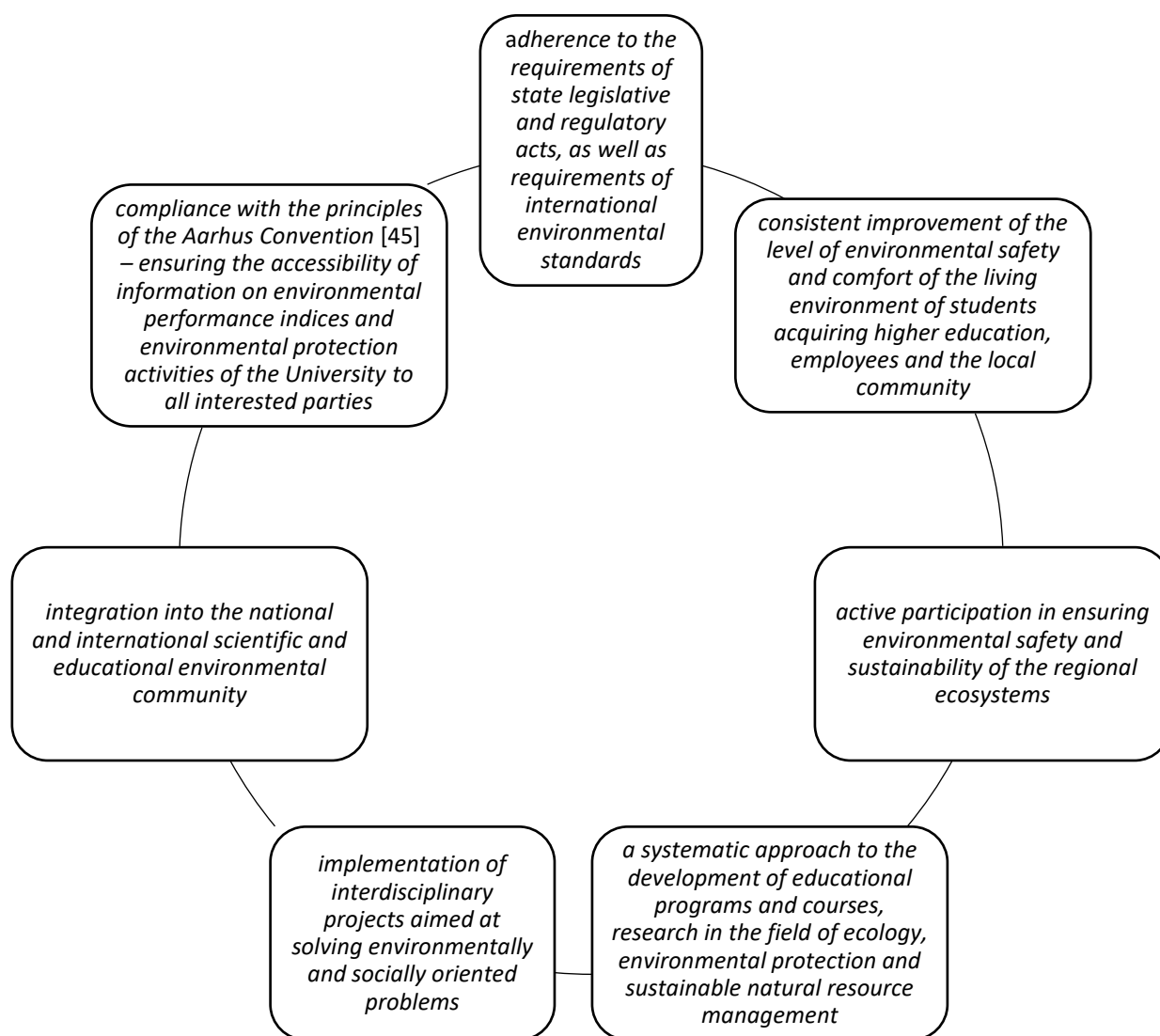


Fig. 3. Key principles of LPNU's Environmental Policy

Source: Systematized, summarized and grouped according to data [9].

LPNU's commitment is to ensure compliance of all aspects of the University's functioning with the requirements of current environmental legislation as well as national and international environmental standards.

The environmental policy is communicated to all employees of the University.

The University employees are guided in their activities, in particular, by the environmental policy.

The goal of the LPNUs in the field of environmental protection is to contribute to the achievement of the goals of sustainable development in the university and beyond through concrete steps. The LPNU decided to improve all the university's activities regarding the status and progress in achieving the Sustainable Development

Goals. This kind of activity will help the LPNU to increase its position in THE rankings.

Since 2004, THE (Times Higher Education) has been furnishing reliable performance data about universities for students and their families, academics, university leaders, governments, and industry. They develop university rankings to evaluate global university performance, serving as a valuable resource for readers to comprehend the diverse missions and accomplishments of higher education institutions [10].

THE Impact Rankings stand as the sole global performance assessment that evaluates universities based on the United Nations' Sustainable Development Goals (SDGs). Employing meticulously calibrated indicators, THE offers a thorough and equitable comparison across four overarching domains: research, stewardship, outreach, and teaching.

The 2023 Impact Rankings is the fifth edition, and the overall ranking includes 1,705 universities from 115 countries and regions.

The most obvious and traditional way that a University might help to deliver the SDGs is by creating research on relevant topics.

Ecological Mission: To align university policies with the rigorous standards of sustainability, it became necessary to formalize the concept [49]. This institutionalization process unfolded as follows: initially, members of the Green Development Committee (GDC) crafted an ecological mission for the university. Subsequently, to foster widespread support, particularly among faculty and leadership, the GDC extended invitations to 150 university leaders, including all top administrators, to evaluate the proposed mission. Reviewers were tasked with expressing their stance on each mission element (i.e., support, do not support, undecided) and were encouraged to provide specific feedback on any or all components. Through this approach, university leaders actively engaged in taking ownership of the concepts and ideas encapsulated in the proposed mission. The GDC then refined the mission's language to address reviewers' concerns, encapsulating the modifications in an internal report circulated to the reviewers [10].

For this kind of improvement, we propose to use casual loop modeling. A causal loop diagram consists of four essential elements: variables, the connections that join them, signs that denote their relationships, and the loop's sign that dictates the system's behavior. Representing a problem or issue using a causal perspective allows for a deeper understanding of the underlying forces that produce complex behavior.

So, let's build the causal loop model with the following connections (see Figure 4). For this purpose, we use Vensim software (developed by Ventana Systems). It primarily supports continuous simulation (system dynamics), with some discrete event and agent-based modeling capabilities.

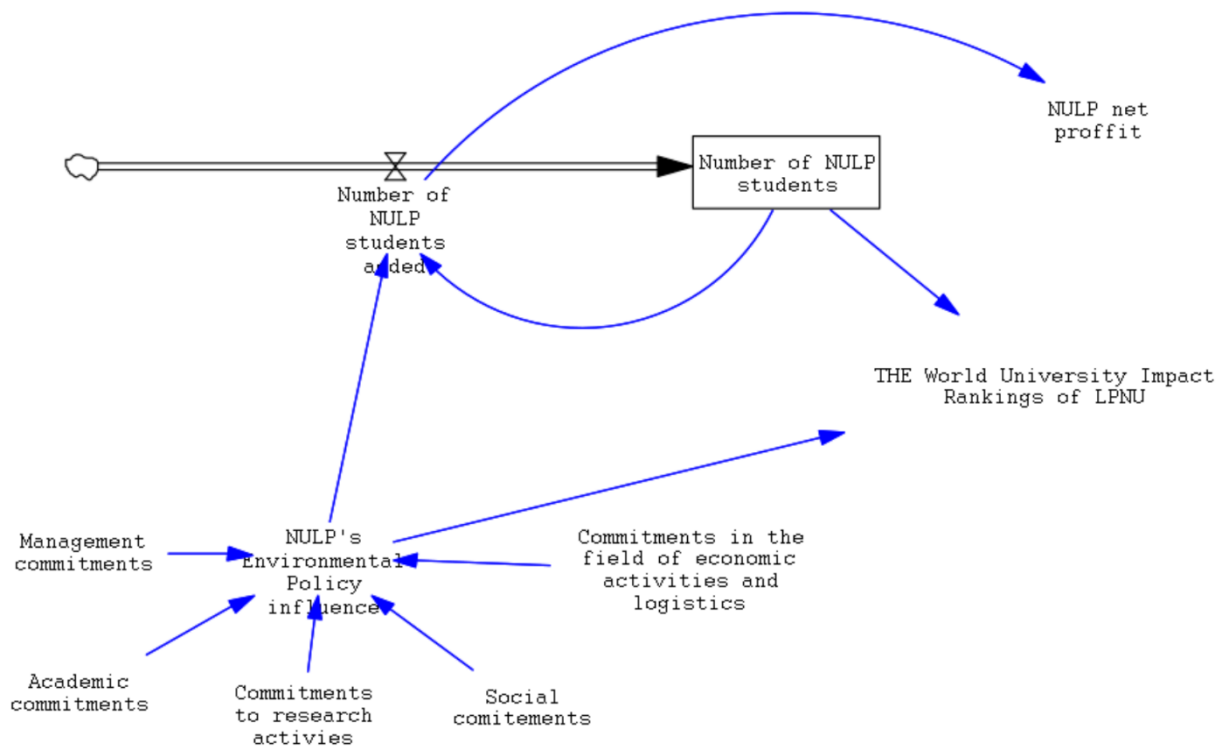


Fig. 4. Casual loop diagram of the NULP's Environmental Policy improvement efficiency

Source: Created by author.

Our model has the following flow: the Number of NULP students starting from today's number 22 580 [9]. We suppose, that the number of students added (NSA) increases according to the following equation (1):

$$NSA = \text{Number of NULP students} * \text{NULP's Environmental Policy influence} \quad (1)$$

in other words – improving NULP's Environmental policy increases the number of students.

NULP's Environmental Policy influence consists of the improvement of five main components (according to our analysis made in subsection 1) (2-3).

$$\begin{aligned}
 \text{NULP's Environmental Policy Influence} = & \\
 = K_1 * \text{Management commitments} + & \\
 + K_2 * \text{Academic commitments} + & \\
 + K_3 * \text{Commitments to research activities} + & \quad (2) \\
 + K_4 * \text{Social commitments} + & \\
 + K_5 * \text{Commitments in the field of economic activities and logistics} & \\
 \sum_{i=1}^5 K_i = 1 & \quad (3)
 \end{aligned}$$

where K_1, K_2, K_3, K_4, K_5 – weighting factor of each main components.

In our model we assume that every component influence is proportionally the same, in other words, we can write (4):

$$K_1 = K_2 = K_3 = K_4 = K_5 = 0.2 \quad (4)$$

Later, with the help of experts, we can change the value and proportion of every weighting factor (from 0 to 1).

In the next step of our casual loop model, we use NULP's Environmental Policy influence as an increasing factor in the future number of students. Increasing the future number of NULP students will let us increase our position in THE World University Impact Rankings and NULP net profit.

To make strategic goals work, in our opinion, we need to make at least 10 years of simulation of previously described input data on our casual loop model outputs.

Finally, we will have three outputs:

1. THE World University Impact Rankings of LPNU (Rank will change in 10 years on 3 points).
2. The Number of NULP students. Environmental Policy improvement will increase the number of students.
3. NULP net profit. Increasing number of NULP students will increase the profit every year. Additionally, we need to discount our annual profit.

So, our research proved the necessity of university's Environmental Policy improvement and efficiency. The started work will undoubtedly lead to social, environmental, and economic results both for the students and employees of any university.

All-round support of the university and state management will allow to continue and annually improve the Environmental Policy, involving the achievement of an increasing number of sustainable development goals and, accordingly, raising the awareness of employees and students

Development of the researched problem should relate to the development of specific steps of action in each of the described in our research directions. It should be taken into account that NULP's Environmental Policy influence brings not just environmental benefits, but is also an effective way to improve the LPNU position in the world market of educational services which leads to an increased number of students and profit.

Conclusions and prospects for further investigations in this area. Environmental policy refers to an organization's dedication to adhering to laws, regulations, and various policy mechanisms related to environmental concerns. These concerns typically encompass aspects such as air and water pollution, waste management, ecosystem oversight, the preservation of biodiversity, the sustainable management of natural resources, as well as the protection of wildlife and endangered species.

Sustainability is built on three pillars: Economic, Environmental, and Social. Striking a harmonious balance among these three pillars is essential for meeting our current needs while safeguarding a vibrant and healthy world for future generations.

Environmental Policy ensures that university is determined by the principles of environmental sustainability in its activities. It has been recognized that the university activities may have a significant impact on the local and global environment, and therefore strives to mitigate the negative impact on the environment through education, research, and other activities and to contribute to the improvement of the environment.

The development of the researched issue should align with the formulation of concrete action steps outlined in each of the research directions we have described. It's important to consider that the impact of NULP's Environmental Policy extends beyond environmental advantages; it also serves as a strategic means to enhance LPNU's standing in the global educational services market, resulting in an augmented student enrollment and increased profitability.

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Стаття надійшла до редакції 03.12.2023 р.