

# “Agricultural education in times of war: Strategic visions, leadership practices and post-war reconstruction”

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## SPECIAL ISSUE: ACADEMIC MANAGEMENT IN THE CONDITIONS OF WAR

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# AGRICULTURAL EDUCATION IN TIMES OF WAR: STRATEGIC VISIONS, LEADERSHIP PRACTICES AND POST-WAR RECONSTRUCTION

## Abstract

In the post-war reconstruction of Ukraine, agricultural universities will provide the state with specialists capable of implementing the seamless integration of "green" benchmarks. The full-scale war has not only threatened the sustainable operation of all spheres of higher education institutions but also forced them to look for new ways of adaptation and development. This study aims to assess the readiness of higher education institutions in the agrarian sector to meet the personnel needs of the state in the medium-term of post-war reconstruction. The paper used a group of parameters with specific indicators: education (change in the number of graduates at the Bachelor's and Master's educational levels, the ratio of publicly-funded and fee-based education seekers, changes in the average entrance score), science (change in the number of articles published in Scopus and the corresponding h-index, the number of Erasmus grants received, the amount of budget funding for science), recognition (academic ranking of higher education institutions by the Webometrics and Top-200 Ratings), and financing (estimated amounts of funding from the general and special fund, and their ratio). The study offers a unique approach to calculating the Integrated Sustainability Index of higher education institutions. This index clearly illustrates how efficiently 15 agricultural higher education institutions have adapted to wartime transformations. For example, Sumy National Agrarian University and Lviv National Natural Resource Management University have this index exceeding 30%. The study draws attention to the problematic areas of university activity during the war and suggests extending the valuable experience of Sumy National Agrarian University.

## Keywords

agrarian university, University Integrated Sustainability Index, international activity, sustainable agriculture

## JEL Classification

I23, J43, H56

## INTRODUCTION

Academic management became critical during martial law and within the confines of the post-war reconstruction of Ukraine. The full-scale war on the territory of Ukraine forced higher education institutions to adapt their activities (educational, scientific, international, social) and management policies (infrastructure, personnel, financial, information, and communication). Strategic guidelines for the post-war reconstruction of Ukraine have formed vector tasks for higher education institutions to meet the needs of the state in the context of providing a skilled labor force for the restoration of territories and restructuring of priority economic activities.

According to the proposals for changes in the directions and volumes of training in the war and post-war period (Melnyk, 2022), agriculture is indicated as a priority area that requires expansion and restructuring of types and subtypes of the agricultural sector toward a "green"

economy and the introduction of efficient agricultural production. It is now becoming apparent that higher education institutions in the agrarian sector are entrusted with a responsible mission of supporting the state in the field of human capacity building by forming a new generation of specialists for the sustainable development of Ukrainian agriculture, capable of repositioning Ukraine in global food security, which is currently under threat. This is confirmed by Lin et al. (2023) and de Gourcuff et al. (2023).

Moreover, the prospects for EU membership confirm the need for seamless integration of “green” benchmarks in the development of agriculture (The Verkhovna Rada of Ukraine, 2022), which, as a result, requires a new approach to the training of agricultural specialists. Thus, this study aims to assess the readiness of higher education institutions in the agrarian sector to meet the state’s recruitment needs in the medium-term period of post-war recovery. The paper focuses on specific activities of higher educational institutions, the problematical character and imperfection of which have worsened in wartime conditions. There is a strange paradox when temporarily occupied universities show better performance than those located far from the combat zone. In particular, the example of Sumy National Agrarian University, located in the temporarily occupied territory from the first days of the war, is striking (Gaid et al., 2022).

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## 1. RESULTS

### 1.1. Agrarian education: Significance in the post-war reconstruction of Ukraine and the experience of EU countries

Military operations on the territory of Ukraine have caused many negative consequences, which have already affected and will continue to affect the productivity and sustainability of agriculture in the long term. Moreover, a robust food security system is currently under threat on the domestic market and outside Ukraine.

For example, among the Russian-occupied Ukrainian territories and territories where combat operations are carried out, Kherson, Kharkiv, and Zaporizhzhia regions are the most productive organic areas (Organic Info, 2022). According to estimates of the State Environmental Inspectorate of Ukraine (2022), the soil and groundwater pollution level exceeds regulatory values, especially in regions close to the front line. At the beginning of September 2022, the direct damage caused to Ukraine’s land resources and agro-industrial complex amounted to UAH 6.6 billion (Kyiv School of Economics et al., 2022). These have created problems for Ukraine’s agriculture that will take years to overcome.

Ukrainian agriculture should strategically produce more food on less accessible soil. This means that it is crucial to improve agriculture’s efficien-

cy and meet the population’s domestic and export needs for healthy and safe nutrition in the next decade (Kömíves et al., 2019). Agricultural universities turn out to be significant contributors in this context. The training of specialists who can tackle top-priority problems in agriculture in a rational, innovative, and effective way allows for overcoming the food crisis and eliminating the risks associated with food danger. In these challenging times for Ukraine, agricultural education at each level (Bachelor’s or Master’s) should equip students with skills to identify the relationship between various information on agriculture.

Moreover, further European integration requires a new generation of Ukrainian agricultural specialists to form stable value orientations based on European values in agricultural production. These competencies contain knowledge of EU legislation and readiness to use this information in their future professional activities. The EU educational policy aims to spread the paradigm of lifelong learning, and this trend significantly impacts the educational systems of member states (Think Tank, 2017).

The EU Common Agricultural Policy (CAP) considers lifelong learning as an unconditioned opportunity to harmonize the needs of modern society with the modern agricultural system, making it an essential element of contemporary educational policy. Furthermore, the new CAP Strategic Plan for 2023–2027 supports the involvement of young professionals (farmers) as a factor in promoting sustainable development of agricultural

business in rural areas (European Commission, n.d.c), which once again underlines the significance of agricultural education in the EU.

European agricultural education is an example of a territorial transformation of rural areas based on creating regional clusters centered at agricultural universities. The structure of agricultural education varies depending on different national education systems. It may be centralized or partially transferred to regions (as in Germany). In France, agricultural education is considered an agricultural policy instrument and a driving force for agricultural modernization and rural transformation. Agricultural higher education institutions in France can establish independent learning centers. Students here can complete special training and receive an additional diploma of intensive training in agriculture (Mulder, 2015).

Considering the specifics of agricultural education, in which theoretical and practical knowledge are very closely intertwined, the diploma of a qualified specialist from the EU countries provides sufficient practical knowledge. Based on this, agricultural education institutions in the EU countries are equipped with an appropriate training base, namely modern farms, where students can master the basic principles of farming and processing agricultural products. Furthermore, this approach declares the importance of an infrastructure base at the university for implementing practical training of a future specialist in the agrarian sector, which could reasonably improve agricultural education in Ukraine in the context of post-war reconstruction.

## 1.2. Assessment of the readiness of higher education institutions in the agrarian sector to meet the personnel needs of the state in the medium term of post-war reconstruction

Agrarian education has now acquired a new meaning in the context of the post-war restoration and repositioning of Ukraine in global food security. Furthermore, prospects of EU membership and European integration require new adaptive academic management solutions from agricultural

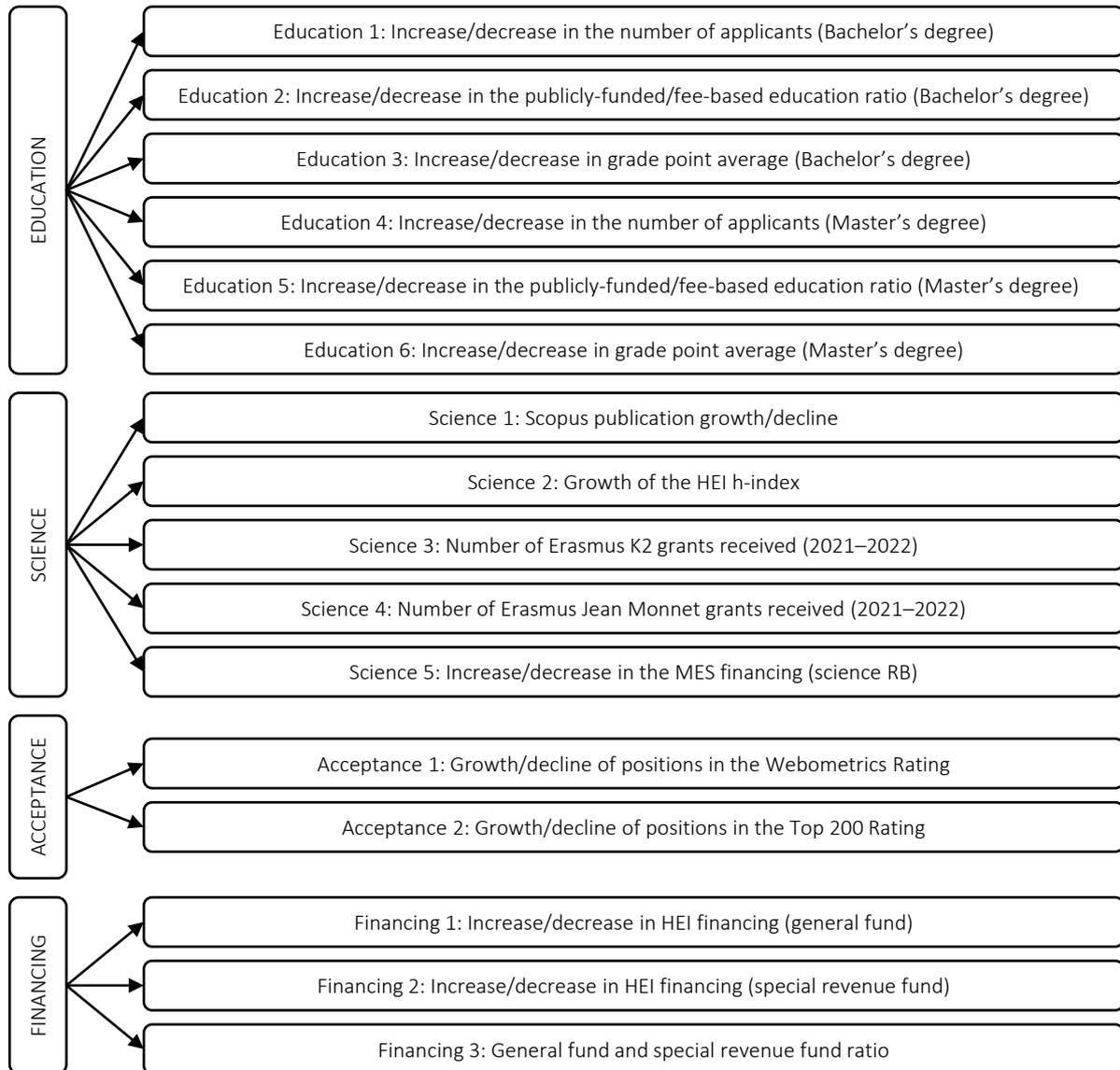
universities related to appropriate steps toward the transition to sustainable agriculture and food systems. Such measures should contribute to improving teaching and research activities in sustainable agriculture, viewing the new EU Organic Action Plan (European Commission, n.d.a) and the national CAP Strategic Plans for the European Union (European Commission, n.d.b).

The study seeks to assess the readiness of higher education institutions in the agrarian sector to meet the personnel needs of the state in the medium term of the post-war reconstruction by calculating the University Integrated Sustainability Index. A system of indicators (education, science, acceptance, and financing parameters) is used to achieve this goal. Each indicator is formed based on evaluating the indicator subsystem (Figure 1).

The list of required specialties was used following Melnyk (2022) to form an analytical sample. These specialties include agronomy, livestock production manufacture and processing technology, agriculture engineering, veterinary medicine, and food technology. In addition, the educational programs of these specialties form the main professional competencies of the agricultural education.

The objects of this study are 15 agricultural universities in Ukraine, which train specialists in at least three of the above specialties. It should be noted that these universities were in different conditions during the period of martial law. Thus, the territories being the location of Sumy National Agrarian University, Dmytro Motornyi Tavria State Agrotechnological University, and Kherson State Agrarian and Economic University, have been occupied since the beginning of armed hostilities. As a result, the last two universities were moved to other cities in Ukraine. In contrast, Sumy region was de-occupied in April 2022.

The study analyzed the dynamics of the ratio of indicator values in 2022 and 2021 (Unified State Electronic Database on Education, 2023). This ratio reflects trends in the agricultural education of Ukraine during the war period. The “education” indicator is a quantitative and qualitative human potential for forming a new generation of specialists in the agrarian sector. The “science” indicator reflects the development of the scientific potential



**Figure 1.** System of indicators for determining the University Integrated Sustainability Index

of higher educational institutions. The effectiveness of the Erasmus K2 and Erasmus Jean Monnet Projects (National Erasmus+ Office in Ukraine, n.d.) is an element of scientific consolidation and unification of the operation of agricultural higher educational institutions. The dynamics of this indicator characterizes student mobility, which contributes to implementing the best European practices and strengthening the practical training of future specialists (Bryła, 2019). This analysis focuses on strengthening the openness of the European educational and scientific space for Ukraine after the commencement of a full-scale russian invasion. The “acceptance” indicator considers an HEI image representation identifying

the position of higher education institutions in the educational and research area. Finally, the “financing” indicator is a characteristic of the financial stability of higher educational institutions during the war period.

The mathematical tools used to calculate the University Integral Sustainability Index include the taxonomy analysis method (Lipsey & Wilson, 2009). The taxonomy coefficients are calculated by sequentially performing the following procedures:

- 1) forming a standard vector  $z_{0j}=(z_{01},z_{02},\dots,z_{0n})$ , which determines the conditional HEI, which is assigned the best value of parameters from a

standardized matrix in terms of the analyzed indicators;

- 2) determining the multidimensional Euclidean distance of each HEI to the standard one;
- 3) calculating the average value of the Euclidean distance for all HEIs;
- 4) calculating the root-mean-square deviation of multidimensional distances;
- 5) calculating the taxonomy coefficient that reflects the level of development of each HEI.

All analyzed indicators were divided into two groups. Those indicators whose growth leads to an increase in the University Integral Sustainability Index are classified as incentives (the criterion for maximizing the reference (standard) value is applied to them). Conversely, indicators whose growth leads to a decrease in the University Integral Sustainability Index are classified as disincentives (the criterion for minimizing the reference (standard) value is applied to them). Table A1 (Appendix A) shows the input data matrix to bring it to the same units of measurement.

According to the “education” indicator, the higher educational institution “Podillia State University” has 2 out of 5 reference values. It is the leader in increasing the number of applicants for a Bachelor’s Degree Program and the publicly-funded/fee-based education ratio indicator. This situation is predictable since its territorial location has contributed to the increase in these indicators. However, the grade point average of its applicants has significantly reduced compared, for example, to the State Biotechnological University, in which the quality of applicants has significantly increased compared to 2021. The most significant increase in applicants for the Master’s Degree Program is seen at Lviv National Natural Resource Management University, which its location can also explain – far from the territories where military operations are being conducted. Sumy National Agrarian University has a reference value of the publicly-funded/fee-based education ratio indicator for the Master’s Degree Program. The number of applicants on a contract basis increased significantly in 2022. This trend is typical for the 2022

university admission process, partly due to the liberalization of admission conditions, particularly for those from territories where military operations are conducted and, in some cases, the desire of the male population to avoid military conscription. As for the quality of the recruited contingent for the Master’s Degree Program, applicants to Uman National University of Horticulture have the highest average score.

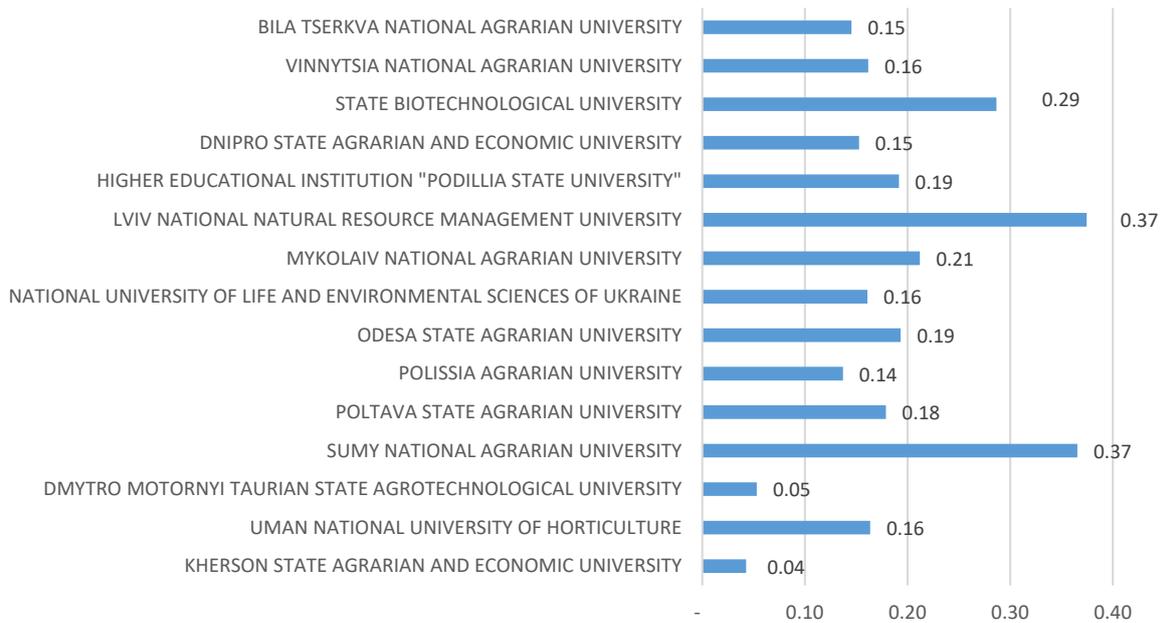
The “science” indicator showed the most incredible values at Sumy National Agrarian University. The number of Erasmus K2 and Erasmus Jean Monnet grants received has reference values. Lviv National Natural Resource Management University is the leader in Scopus publication growth, and the largest increase in the h-index belongs to the higher educational institution “Podillia State University.” Vinnytsia National Agrarian University had the highest financing rate by the Ministry of Education and Science in scientific areas in 2022.

The higher educational institution “Podillia State University” significantly increased its position in the Webometrics Rating and Top-200 Rating lists comparing 2021 and 2022. Thus, this HEI showed reference values according to the “acceptance” indicator. However, most agricultural educational institutions are outside the first hundred by these indicators.

A reference increase in the estimated financing of HEIs for both the general and special funds (“financing” indicator) was observed for State Biotechnological University. Despite this growth, this HEI could not maintain the standard proportion by ratio. By the publicly-funded/fee-based education ratio indicator, Poltava State Agrarian University, the most considerable amount of raised funds accounts for each hryvnia of budget funds, according to the estimate, was the reference.

This analysis demonstrates the unique advantages of each agricultural HEI, which does not provide an opportunity to assess a particular HEI’s complete picture and competitive position. To solve this problem, the study calculated the University Integral Sustainability Index (Figure 2).

Figure 2 shows that the closer the index is to 1 (reference value), the closer the indicators of the



Note: The index is calculated as a taxonomy coefficient based on indicators.

**Figure 2.** University Integral Sustainability Index

object of research (the HEI) are to the reference value. Thus, according to the calculation results, Lviv National Natural Resource Management University and Sumy National Agrarian University were as close to the standard as possible. On the other hand, Dmytro Motornyi Tavria State Agrotechnological University and Kherson State Agrarian and Economic University were the most distant from the reference values. As expected, the positions of the latter are caused by the movement of these universities, military operations in the regions where they are located, and infrastructure damage. This has negatively affected the admission campaign and other indicators forming the Integral Sustainability Index.

### 1.3. Experience of Sumy National Agrarian University in overcoming problematic areas of activity of higher educational institutions during the war

According to the results of calculating the Integral Sustainability Index, Sumy National Agrarian University has the value closest to the reference one compared to other universities. Despite its territorial location in the high-risk zone, it managed not only to adapt to the military conditions of carrying out all its activities but also to achieve

an increase in indicators that have formed a sufficient level of the University Integral Sustainability Index. The practice of academic management at Sumy National Agrarian University is not exceptional. However, certain mechanisms and managerial decisions became decisive in the new military conditions, making it possible to adapt and develop.

The first decision was to strictly follow the Sumy National Agrarian University Strategy for 2021–2025 (Sumy National Agrarian University, 2020). The specialists invited from other higher educational institutions joined the development of this base document, which allowed an unbiased assessment of the university. The document defined the university mission, vision, and principles and contained a list of strategic development goals with specific indicators. To date, an analysis of this document indicates that it has been adapted to the drastic transformations in the educational environment caused by both the COVID-19 pandemic and the war period. Strict adherence to the principles and implementation of the goals to be sought has made it possible to maintain positions and increase the number of key indicators, including in international activities. Unfortunately, many domestic higher education institutions have only theoretical shallow strategies.

In the city's occupation and blockade, the central managerial decisions of the university's administration were focused on solving urgent and forced tasks. The urgent ones included evacuating students, including international ones, providing food and access to drinking water, preserving the material and technical (scientific and laboratory) base, preserving biological items, and protecting the territory. The forced tasks consisted of eliminating the consequences of the direct impact of military operations, particularly the consequences of shelling, preserving damaged premises and protecting them from possible looters, and evacuating the affected population. At the same time, implementing urgent and forced tasks did not hinder the university in fulfilling its strategic indicators. Following the principles of European education in the context of the sustainable development of Ukrainian agriculture was the impetus for introducing such new educational programs as Sustainable Agriculture and Food Security and Agriculture Engineering in 2022. This step is a response to the state's need for personnel support for agriculture in the post-war reconstruction of Ukraine. Training a new generation of specialists in the agrarian sphere will contribute to the strategic repositioning of Ukraine in global food security.

Analyzing the "education" indicator in terms of the experience of Sumy National Agrarian University, the 2022 admission campaign was held in difficult conditions. Sumy National Agrarian University is one of the higher educational institutions in Sumy region that was significantly affected by military operations during this period:

- 1) a rocket hit a house near the Law College of Sumy National Agrarian University, destroying all windows, doors, and sometimes inter-story ceilings in the administrative building and dormitory of the college;
- 2) the occupation forces seized the Malovystoropskyi College of SNAU, setting up a headquarters there. During the retreat, the entire material and technical base of this structural unit was stolen or destroyed;
- 3) the blast wave from the air strike damaged the university's greenhouse complex and boiler room.

As expected, the damaged infrastructure jeopardized the success of the admission campaign. In this regard, the next significant decision of the academic management was the rapid restoration of damaged facilities through financial support from the Ukrainian agricultural business and foreign partners. The created system of interaction with the agricultural business, which is represented, in particular, by graduates of the university of different years, allowed the university to promptly ensure the supply of products, repair materials, seeds, and protective equipment for sowing operations. Furthermore, international partners provided funds for prompt restorations and charitable assistance and generators. This decision has significantly increased the number of applicants for both Bachelor's and Master's Degree Programs. In addition, the need to quickly respond to the students' needs during the distance learning process has led to the creation of the E-SNAU mobile application. This app is adapted to modern gadgets and contains all the required educational and financial information, access to the university's library resources, etc.

The university's personnel policy was the main lever for maintaining the proper level of the "science" indicator. The decision of academic management in this context was to preserve the scientific potential of the university. At the first stage of the war, about 40 research and academic staff left the university to go abroad. The pre-established and massively tested distance education system during the pandemic made it possible not to suspend the educational process. The academic staff being abroad could fully perform their employment duties. Most displaced academic staff used a system of grant support from the countries' governments where they were evacuated. Since the beginning of 2023, 18 persons of the university academic staff have been working as Visiting Professors at the Paris-Saclay University (France), University of Barcelona (Spain), Swiss Federal Institute of Technology (Switzerland), Weihenstephan-Triesdorf University of Applied Science (Germany), Royal Agricultural University (Great Britain), and others.

Unlike many HEIs, Sumy National Agrarian University has chosen the path of fruitful use of internship opportunities for its staff. It strategically focuses on implementing European experience and applying knowledge and skills acquired by personnel

as knowledge from “agents of change” for the university. The international service of Sumy National Agrarian University has managed to adapt the SNAU internationalization strategy to wartime conditions, which has led to an increase in the number of grant revenues, in particular under Erasmus programs. In 2022, SNAU won four Jean Monnet Projects and two K2 higher education potential development projects. In addition, the university received a license from the government of the People’s Republic of China to establish Sumy College of the Henan Institute of Science and Technology with an annual recruitment of 300 students.

Educational programs of agricultural universities should consider the state’s needs in the post-war reconstruction and contribute to the harmonious integration of the Ukrainian agrarian sector into the European agricultural segment within the prospects of joining the EU. In 2022–2023, two new double degree programs were launched with the Czech University of Applied Sciences (Czech Republic) and the Royal Agricultural University (Great Britain). Moreover, publication activity was intensified through joint research with foreign partners.

The “acceptance” indicator characterizes the image component of the university. According to various ratings in the pre-war period, Sumy National Agrarian University was consistently in the top three institutions of agrarian education in Ukraine (Euro Osvita, 2021; Osvita.ua, 2021). Furthermore, after the introduction of the updated model of additional financing of higher education institutions, based on the results of modeling the cost distribution formula for the item “Training of HEI personnel and ensuring the operation of their practice bases,” Sumy National Agrarian University received additional state funding for more than UAH 30 million (Ministry of Education and Science of Ukraine, 2021). Therefore, improving the university’s position in the rating system is proof of proper academic management.

Finally, the critical decision of academic management on the “financing” indicator was to rethink the potential of funding sources. Understanding the priority of military support and the limited state opportunities to finance education, the university has chosen the path of developing its entrepreneurial potential. An entrepreneurial university today is a strategic opportunity to survive and continue its development, meeting the state’s and the population’s needs for high-quality education and forming scientific and innovation centers. The established system of interaction with stakeholders has ensured the full-fledged operation of the university even during the occupation period. In particular, international students who were evacuated and those who had previously left the country paid their tuition on time. Sumy National Agrarian University had no problems paying wages and salaries. Raising funds from international partners has become an essential source of restoring the university’s material and technical base. In 2022, the university received UAH 4,519.1 thousand from the Swiss Agency for Development and Cooperation of the Federal Department of Foreign Affairs of the Confederation. As part of the DAAD Project for implementing the German-language Agricultural Management Master’s Program Agricultural Management of the Weihenstephan-Triesdorf University of Applied Science the university received UAH 1,111.3 thousand to purchase modern laptops.

An agreement was signed with Rotary Club – the German International Voluntary Club – to support Sumy National Agrarian University students from war zones in Ukraine in paying for agricultural education. As a result, sixty-six university students were given the opportunity to pay for their studies with the Club’s funds in the equivalent of EUR 515 per year for two years.

Thus, the growth of the ratio of the special and general funds has demonstrated the readiness of Sumy National Agrarian University for the strategy of an entrepreneurial university.

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## CONCLUSION

This study assessed the readiness of higher education institutions in the agrarian sector to meet the personnel needs of the state in the medium term of post-war reconstruction. The results showed that the Integral Sustainability Index of most HEIs is far from the reference values, which characterizes their adaptability to new wartime conditions as low. According to the “education” indicator, the vast majority

of agricultural universities have achieved an increase in indicators (an increase in the number of applicants). But this trend is rather due to the influence of external factors.

As expected, the post-war period will have other trends in recruiting students for agricultural specialties. Therefore, strategic decisions should be declared today to increase the number of applicants in the post-war period at the expense of international students and increase the prestige of agricultural education. The problems of developing the scientific component in agricultural universities are mainly related to the outflow of scientific potential. The response to this challenge can be competent administrative management regarding personnel policy – maximum support and preservation of contacts with scientific and academic staff forced to go abroad and work under internship programs at universities in other countries. Furthermore, reduced funding from the state fund should accelerate universities' understanding of the need to switch to an entrepreneurial university strategy. The only way to success and prosperity is grant activities, cooperation with businesses, and international projects.

In wartime, everyone works on their own front. Agrarian universities should prepare a springboard for the post-war restoration of Ukraine by forming a new generation of specialists for the sustainable development of Ukrainian agriculture capable of repositioning Ukraine in global food security.

## AUTHOR CONTRIBUTIONS

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Formal analysis: Olena Nifatova.

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Methodology: Olena Nifatova.

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Writing – review & editing: Olena Nifatova, Volodymyr Ladyka, Yuliia Hryshyna, Yuriy Danko.

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# APPENDIX A

**Table A1.** Standardized input data matrix for evaluating the University Integral Sustainability Index

Source: Authors' elaboration of input data based on Unified State Electronic Database on Education (2023) and data from National Erasmus+ Office in Ukraine, Osvita.ua, and Scopus.

HEI	Education						Science					Acceptance		Financing		
	E1s	E2d	E3s	E4s	E5d	E6s	S1s	S2s	S3s	S4s	S5s	A1s	A2s	F1s	F2s	F3d
BILA TSEKVA NATIONAL AGRARIAN UNIVERSITY	0.03	-0.55	-1.01	-0.40	-0.58	0.89	0.48	-1.13	-0.58	-0.61	-0.68	-0.4	0.40	-0.39	-0.15	-0.32
VINNYTSIA NATIONAL AGRARIAN UNIVERSITY	-0.29	0.83	-0.15	1.04	-0.61	0.19	-0.78	0.32	-0.58	-0.61	2.04	-0.5	-0.71	-1.23	-0.08	-0.44
STATE BIOTECHNOLOGICAL UNIVERSITY	-0.66	0.19	2.70	-0.38	-0.08	0.21	-0.63	-1.27	-0.58	0.15	1.73	-0.2	-0.62	3.11	3.32	-0.05
DNIPRO STATE AGRARIAN AND ECONOMIC UNIVERSITY	-0.20	-0.54	0.07	-0.54	-0.34	0.54	0.11	0.14	-0.58	-0.61	-1.08	-0.6	0.40	-0.35	-0.58	-0.35
HIGHER EDUCATIONAL INSTITUTION "PODILLIA STATE UNIVERSITY"	3.41	-1.29	-1.48	-0.45	-0.61	0.32	-2.55	1.62	-0.58	-0.61	-0.24	2.35	2.16	-0.29	-0.25	0.18
NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE	-0.58	0.50	-0.47	-0.62	0.35	0.33	-0.02	-0.41	0.51	0.15	-1.16	-0.1	0.12	-0.73	0.21	-0.13
LVIV NATIONAL NATURAL RESOURCE MANAGEMENT UNIVERSITY	0.26	-0.82	-0.27	3.05	-0.76	0.62	1.51	1.26	1.6	0.15	0.04	0.92	0.59	-0.26	-0.07	-0.44
MYKOLAIV NATIONAL AGRARIAN UNIVERSITY	-0.67	-0.48	-0.08	-0.59	-0.68	-0.46	0.88	0.00	-0.58	0.15	0.79	-0.4	-0.25	1.19	-0.41	0.35
ODESA STATE AGRARIAN UNIVERSITY	-0.02	-0.52	0.25	-0.32	0.40	0.47	1.44	-1.63	-0.58	-0.61	-0.24	0.44	-0.53	0.21	0.16	-0.60
POLTAVA STATE AGRARIAN UNIVERSITY	-0.04	0.33	0.20	-0.86	-0.43	0.59	0.45	1.26	0.51	0.15	-0.72	-0.8	-1.64	-0.12	-0.04	-0.62
POLISSIA AGRARIAN UNIVERSITY	-0.26	-0.03	-0.20	-0.36	-0.76	0.11	-0.66	-0.45	-0.58	0.91	-0.51	-1.6	-0.90	-0.05	-0.35	-0.21
SUMY NATIONAL AGRARIAN UNIVERSITY	0.18	-0.84	-0.20	0.81	-0.77	-0.25	0.45	-0.33	2.69	3.18	-0.35	1.66	1.24	-0.43	-0.23	-0.35
DMYTRO MOTORNYI TAVRIA STATE AGROTECHNOLOGICAL UNIVERSITY	-0.71	1.26	1.18	0.05	0.64	-2.17	-0.23	0.54	-0.58	-0.61	1.04	0.12	-0.53	-0.19	-1.46	3.49
UMAN NATIONAL UNIVERSITY OF HORTICULTURE	0.15	-0.64	-1.12	0.23	1.48	0.99	0.03	-0.91	0.51	-0.61	0.33	-0.5	-0.90	-0.17	-0.08	-0.18
KHERSON STATE AGRARIAN AND ECONOMIC UNIVERSITY	-0.59	2.61	0.60	-0.66	2.74	-2.39	-0.48	0.97	-0.58	-0.61	-0.99	-0.4	1.14	-0.28	0.02	-0.33
P <sub>0</sub> reference (max;min)	3.41	-1.29	2.70	3.05	-0.77	0.99	1.51	1.62	2.69	3.18	2.04	2.35	2.16	3.11	3.32	-0.62