

Education
in Crisis Ecological Management:
Ukrainian Perspective

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神戸学院経済学論集

第56巻 第1・2号 抜刷

令和6年9月発行

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The development of a new educational course on crisis ecological management is proposed as an essential step toward addressing complex environmental challenges in Ukraine. The course aims to equip professionals with the expertise needed to navigate non-conventional ecological scenarios, fostering a specialized mindset and innovative capabilities for crafting eco-friendly solutions. By adopting a multidisciplinary approach, the course intends to integrate aspects of ecological prerequisites for sustainable development, methodology for assessing various ecological catastrophes, and responses to global climate shifts within the context of local and regional dynamics. This initiative is particularly critical for Ukraine, as it seeks to harness the country's extensive experience in responding to diverse ecological incidents of varying scales and origins. The envisaged course holds the potential to establish a foundation for a comprehensive roadmap aimed at refining the nation's environmental education system and aligning it with contemporary international ecological paradigms. Moreover, the course could serve as a model for driving strategic decision-making in the realm of ecological management, thereby contributing not only to the scholarly discourse but also to practical environmental conservation efforts.

Keywords : *crisis ecological management, environmental disaster, complex ecological crisis, Ukraine.*

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Ecologically oriented issues, whether of one nature or another, have been, are, and will continue to be inherent to specific territories, with their quantity, quality, and intensity contingent upon both objective natural factors and anthropogenic activities. Typically, distinct ecological challenges manifest for specific regions, which are protracted and accumulative. However, as technology advances and human consumptive activities intensify, these issues progressively amplify in magnitude and unpredictability. For instance, within the region of Ukrainian Polissia, ecologically typical challenges throughout one and a half centuries have encompassed enforced land reclamation, soil erosion, periodic flooding, and forest fires, among others. Subsequently, anthropogenically generated challenges have emerged, such as landscape disruption due to amber extraction, deforestation, contamination by radionuclides and pesticides, and imbalanced application of mineral fertilizers. In the past decade, this region has markedly experienced the repercussions of global climate alterations, which introduce substantial and occasionally unforeseen modifications to the manifestation of all aforementioned ecological predicaments. All of these aspects are closely interwoven with economic and societal processes. Even when scrutinizing a purely radiological issue such as the determination of doses for internal radiation exposure in the population, a series of unanticipated factors have been identified that influence the formulation of the investigated parameter [1]. Thus, we have confronted the imperative of a comprehensive resolution to ecological issues and those closely linked to them. This trajectory has been adopted by all international organizations, from the European Union (as evidenced by the array of initiatives within the European Green Deal, which Ukraine has also aligned with) to the United Nations (for instance, the recently endorsed ministerial declaration of the Ninth UN Conference on Environment and Europe). These and other documents, a majority of which have been ratified by Ukraine and incorporated into the national environmental

policy until at least 2050, guide the global community toward sustainable development. This entails the holistic addressing of ecological concerns to achieve an equilibrium between satisfying contemporary human needs and safeguarding the ecological interests of future generations.

In 2022, however, a new artificial ecological threat emerged in Ukraine - the war, which gave rise to novel global challenges and significantly complicated the resolution of other environmental problems. As of October 7, 2022, the damages inflicted on Ukraine's ecology by Russia's full-scale invasion were estimated at \$35.3 billion. One-fifth of Ukraine's protected areas are at risk of destruction, with approximately 2,000 cases of environmental damage recorded by October 2022. Preliminary assessments indicate that the costs of air pollution caused by the war amount to around €25 billion, and an additional €11.4 billion is required to mitigate the harm inflicted on the soil. Within just seven months of conflict, 31 million tons of carbon were released into the atmosphere, approximately equivalent to the yearly emissions of New Zealand. Moreover, the restoration of the ruined infrastructure could result in an additional 79 million tons of greenhouse gas emissions. These estimations do not account for the extensive consequences of the Russian-induced breach of the Kakhovka Reservoir dam, which will fundamentally alter the region's ecosystems.

In total, Ukraine hosts more than 1500 major hazardous facilities. Foremost among them is the Zaporizhzhia NPP, which, along with several other nuclear installations in Ukraine, has become a target of Russian nuclear terrorism. The impact of projectiles and bombs on these production sites leads to emergencies that can result in the release of hazardous chemicals, explosive substances, as well as radionuclides, into the atmosphere and surrounding areas.

The resolution of the aforementioned issues is complicated by active combat operations and their consequences, including landscape disruption and territorial

mine contamination. However, the war not only results in an ecological catastrophe but also triggers humanitarian crises and food shortages of both local and global magnitudes, with indefinite durations. To address these matters, highly qualified experts in sustainable development, particularly ecologists, are urgently needed. Currently, such professionals are scarce within the country. Sectoral task forces dealing with issues of wartime and post-war periods have been composed of highly specialized experts, each well-versed in a specific aspect, yet lacking a holistic perspective on the problem. The outcomes of these groups' efforts have produced fragmented and sometimes contradictory proposals, which are challenging to consolidate into a unified overarching plan. Moreover, specialists at the primary levels face difficulties in making swift decisions when confronted with non-standard environmental incidents. Surveys of practicing ecologists reveal that the country lacks a standardized algorithm for responding to crisis-level environmental situations.

The main reason for the lack of integration between ecological and related knowledge, and the inability to adopt a top-down view and perform the role of an ecological crisis manager, lies in the characteristics of ecological education in Ukraine. Despite the abundance of available environmental courses, a substantial portion of the content is redundant and outdated. Simultaneously, instruction tends to be confined to narrow topics or overloaded with excessive calculations. The absence of targeted information presentation makes it challenging to determine the appropriate course of study for those seeking knowledge to meet educational needs. As a result, an ecologist specialist may struggle to comprehensively and swiftly assess a situation and make critically vital decisions within short timeframes, whereas time can be a pivotal criterion for decision effectiveness. Increasingly, scientific publications emphasize the significance of professionalizing personnel to address the consequences of critical environmental problems. Contem-

porary and well-structured education and training play a crucial role in preparing professionals to mitigate the aftermath of catastrophes [3, 6]. An analysis of educational provisions in the United States and Europe revealed that the preparation of specialists to address ecological disasters adheres to distinct standards [4]. These standards are contingent upon the specific demands and educational levels of the audience, thematic focus, content, and instructional methods [5]. Currently, across the world, notably in the United States, specific strides have been taken towards the development and enhancement of educational programs for ecologists aspiring to engage in research or professional endeavors related to crisis ecological situations and disasters, including crisis ecological management [2]. However, in Ukraine, insufficient attention has been historically directed toward this issue. Ukraine critically requires proficient experts capable of generating rapid and innovative ecological solutions amidst complex environmental threats. These experts are essential for achieving sustainable development goals, particularly in light of Ukraine's commitment to various international environmental agreements. Consequently, there exists an objective necessity for the development of innovative interdisciplinary educational courses aimed at preparing ecologists for working in non-standard crisis situations. Notably, these educational programs should encompass locally-oriented instruction to provide ecologists with an understanding of regional and locally-specific matters. This understanding should be complemented by a broad set of applicable competencies [2]. In light of these considerations, Ukraine is uniquely positioned to furnish the practical component of such a program, given its extensive spectrum of domestic experience in mitigating the consequences of ecological incidents of diverse scales and origins.

Hence, the objective of this article is to substantiate the development of a new educational course titled 'Crisis Ecological Management.' This course aims to

equip professionals with the capacity to operate effectively within non-standard, complex crisis ecological situations, fostering an appropriate mindset and action pattern. Furthermore, it seeks to enhance the existing research potential in the realm of crisis ecological management.

Addressing the points mentioned, the course should cover ecological sustainability prerequisites, catastrophe ecology understanding, crisis ecological management nuances, and novel methodologies for evaluating diverse-origin ecological catastrophes. Emphasis should be placed on adapting crisis management theory beyond conventional practices, accounting for audience qualifications and future roles. The course should also explore ecosystem responses to global climate changes and local anthropogenic stressors.

Developing the crisis ecological management course can be seen as the inaugural stride in a long-term project for shaping a new ecological policy across various implementation levels in Ukraine. It could be seamlessly integrated into educational programs, providing a foundation for comprehensive managerial decision-making and broadening the horizons of scientific inquiry. This course should serve as the cornerstone for drafting a roadmap to enhance Ukraine's ecological education system, attuned to contemporary trends and narratives. The roadmap should address the challenges confronting ecological education and professionals in light of escalating environmental threats and evolving perceptions of the essence and role of ecology as a science and a determinant of human survival. It must encompass foundational principles for fostering systemic ecological awareness and serve as the groundwork for designing and directing the functions and developmental trajectories of a new state ecological policy. State policy needs to encompass not just operational management but also strategic development in line with contemporary challenges and international standards, drawing from global expertise and the latest advancements in environmental conservation.

Initiating the development of the crisis ecological management course as a cornerstone for the corresponding roadmap involves commencing with the following fundamental steps:

- Analyze the ecological component of education for significant deficiencies, barriers to improvement, and tentative methods to overcome them, and identify key needs of practicing ecologists and managers across various levels.
- Conduct a comparative analysis of American, European, Asian, and Ukrainian models of ecological education (recent trends, incorporation of new elements, barriers, etc.).
- Develop and justify novel methodological approaches for researching and teaching ecological management theory under crisis conditions, extending beyond conventional practices.
- Define the essential components for inclusion in the ‘Crisis Ecological Management’ course.
- Examine contemporary global research and regulatory frameworks within the field of crisis ecological management.
- Define the role of socio-ecological emergent systems in effective crisis ecological management.
- Study assessment methods for ecological challenges’ consequences and prediction of measures’ effectiveness in Europe, Asia, and the USA. Develop indicative action models for crisis ecological managers at different levels.
- Explore and master innovative techniques, tools, and research approaches in environmental conservation and crisis ecological management in Europe, Asia, and the USA, to implement them into education and practice in Ukraine.
- Develop materials for crafting appropriate educational and reference literature to train crisis ecological managers.
- Develop materials for creating a roadmap to enhance the environmental

education system in Ukraine.

The implementation of the above-mentioned initiatives will catalyze a deeper understanding of ecology among students and practicing ecologists, fostering professionalism and highlighting its significance within the global context of sustainable development. Simultaneously, the developed course could be beneficial to international colleagues : Ukraine is currently forging a unique model of achieving sustainable development amidst artificially induced environmental catastrophes, and elevated levels of industrial pollution, notably the Chornobyl disaster and the destruction of the Kakhovka reservoir dam. For foreign experts, obtaining “on-the-ground” insights would prove valuable. Hence, this project stands as an essential initial stride for contemporary management of Ukraine’s balanced development and a contribution to the global ecological scientific community.

Approaches to environmental education and crisis ecological management vary significantly among countries. As a result, diverse patterns emerge regarding acquiring and disseminating knowledge within professional ecological education across different national scientific and educational contexts. To better comprehend these nuances, it is essential to analyze the following global developmental trends. The investigation of global experiences in crisis ecological management and ecological catastrophes will enable a comparative analysis of Ukrainian and international teaching systems. This study aims to uncover the place of Ukrainian ecological education within the global context and dissect the formation, organization, incorporation, and transmission of knowledge in the ecological education systems of Europe, Asia, and the USA. It seeks to explore educational trends and thematic preferences, as well as consider how to integrate academic global experiences into Ukraine’s educational landscape to foster highly qualified ecologists capable of assuming the role of crisis ecological managers amid the complexities

of modern Ukraine. This research is interdisciplinary, encompassing not only crisis ecological management but also aspects of social dynamics, psychology, and state governance. As a result, its outcomes could spark discussions not only among educational and scientific communities but also among managers and practicing ecologists.

The development of an educational course in this direction is exceedingly crucial, given the escalating negative consequences arising from the synergy of familiar ecological challenges and recent environmental threats. Major accidents and technological catastrophes have occurred, are ongoing, and unfortunately, are projected to continue, especially in the context of the 20th and 21st centuries, characterized by episodes of accidents and catastrophes. We are witnessing a growing intensity of environmental challenges of various scales, primarily attributed to global climate changes accelerated by anthropogenic activities. Regrettably, the situation has been further complicated by the Russian military aggression against Ukraine, resulting not only in a global food and energy crisis but also in extensive ecological repercussions. These consequences are not confined solely to Ukraine's territory. They encompass contamination of the environment by various pollutants, disruptions to natural and semi-natural ecosystems, and threats to rare and endangered species. These effects extend beyond Ukraine's borders to other countries as well. This is primarily linked to disruptions in land use patterns and the intensification of activities by climate-vulnerable enterprises in the energy sector. Ukraine is currently not only asserting its right to existence but is also putting forth all efforts to integrate into ecologically oriented global programs for humanity's sustainable development. Therefore, for Ukraine, the training of highly qualified professionals to address ecological crises and the formulation of innovative environmental policies hold exceptional importance. Ecologists must possess not only multidisciplinary expertise but also the ability for systemic eco-

logical thinking and a profound understanding of the issue. This is particularly crucial in times when insufficient environmental awareness, coupled with economic recovery delays and the risks of global climate change, ushering in a new nuclear era and an energy crisis with their inherent threats.

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