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Legal principles of forest fire protection on radiation hazardous lands of Ukraine in modern conditions

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Abstract

The legal framework for protecting forests from wildfires on radiation-hazardous lands in Ukraine, especially in the current environment, considering the new challenges and threats posed by both martial law and accelerated climate change, requires a thorough analysis of the current legislation in this area, clarification of legal gaps, and identification of the most priority areas for its improvement. The purpose of this study was to analyse the system of current legislation aimed at regulating the protection and defence of forests from fires, including on radiation-hazardous lands of Ukraine, and to assess the level of efficiency of legal regulation of these social relations and to evaluate them. The methodological principles in the context of the study were general and special methods of scientific cognition, including formal logical, comparative legal, formal legal, statistical, analysis and synthesis, and dialectical methods. The study substantiated the complex

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nature of the system of forest protection against fires on radiation-hazardous lands. The study analysed the risks and threats of forest fires on radiation-hazardous lands in Ukraine. It is stated that the state of fire safety on the lands of the forest fund that have been affected by radiation is the most threatening at the present stage. Generalisations were made containing a set of necessary measures aimed primarily at strengthening the due level of interaction between the relevant services in organising forest protection from fires on radiation-hazardous lands of Ukraine in modern conditions. The practical value of this study lies in the fact that, considering the scientific theory and a set of methods of scientific cognition, it provides a thorough analysis of Ukrainian legislation and clarifies the peculiarities of legal support for the protection of Ukrainian forests from fires on radiation-hazardous lands at the present stage, which helped to determine the real state of legal regulation of the relevant area and gaps in the organisation of its application, which should actualise the improvement of law-making and law enforcement practice in the area under study. The findings of this study can be used to update the legal support for the activities of public institutions implementing the state policy in the field of forest protection on lands subjected to radioactive contamination

Keywords: legal support; wildfire; forest; radiation safety; fire safety; Chornobyl nuclear power plant; risks and threats of martial law

Introduction

During 2014-2024, Ukraine witnessed a trend of increasing number and scale of wildfires in landscapes that are difficult to extinguish. The greatest risks and threats of such fires relate primarily to radiation-hazardous lands in the northern part of Zhytomyr and Kyiv administrative regions. The full-scale armed aggression of the Russian Federation (RF) and the constant bombardment of Ukraine's territory have significantly increased the risks, spreading them throughout the country.

Since the beginning of Russian aggression in 2014 and the full-scale invasion in 2022, the causes of fires in ecosystems have been compounded by military operations and explosive ordnance contamination. Specifically, in 2020 alone, fires spread across 31.7 thousand ha of Ukrainian land (Regional Eastern European Fire Monitoring Centre, 2020). The territory of the Chornobyl Exclusion Zone (CHZ) was occupied by Russian troops from the first day of their invasion of Ukraine on 24 February 2022 and was factually de-occupied on 28 March 2022. In such a brief time, the invaders caused considerable environmental damage and left behind mined areas (Halushchenko, 2023).

The problem of forest protection from wildfires in the territory contaminated by radioactive fallout in Ukraine has become a subject of study for many scientists in various fields of knowledge. O. Soshenskyi *et al*. (2023) investigated the problem of reducing the risk of forest fires for settlements in Ukraine. V. Kashparov *et al*. (2024) carried out a comprehensive assessment of firefighters' exposure due to forest fires on radiation-hazardous lands of Ukraine; N. Beresford *et al*. (2021) assessed the risks and consequences of forest fires in the CHZ in the international dimension; many other researchers who established/confirmed that radioactive forests have a series of specific hazards caused by the presence of high

levels of ionising radiation, which should be considered when fighting fires, including those that should be reflected at the legislative level (Baró *et al*, 2020). Some other researchers have come to analogous conclusions in their studies, having investigated the environmental consequences of the forest fires that occurred in April 2020 in the CHZ (Igarashi *et al*., 2020; Talerko *et al*., 2021; Kovalets *et al*., 2022).

The legal regulation of forest protection from wildfires on radiation-hazardous lands in Ukraine has not received proper scientific analysis. Scientific developments in this aspect can only provide additional arguments for analysing the level of legal regulation of forest fire protection on these lands and forming a new approach to its optimisation by identifying shortcomings and legal conflicts. The studies of researchers who focused on the shortcomings of legal regulation were not comprehensive, did not provide a full assessment of the regulatory framework and did not analyse new regulations in the field under study (Usenya *et al*., 2018). This raises the issue of identifying shortcomings in the regulatory framework for fire safety in Ukraine's forests, considering progressive changes to the current legislation.

O. Gulac *et al*. (2022a) conducted a study on overcoming the environmental crisis in the forestry sector of Ukraine in the context of The European Green Deal (2019). In another study, O. Gulac *et al*. (2022b) analysed public administration reforms in the forestry sector of Ukraine. D. Holiaka *et al*. (2020) analysed experimental biogenic fluxes of ^{137}Cs and ^{90}Sr in forest ecosystems. The researchers substantiate the need for a systematic and comprehensive approach to management in the forestry sector, which should receive an suitable level of legal support, including the development and adoption of a long-term strategy for managing Ukrainian forests, minimising forest fire risks, and improving approaches to public sector and public interaction in preventing and extinguishing fires in ecosystems, considering the specific features of the areas affected by radiation damage.

Considering the problematic of the study and the aforementioned trends in the scientific literature, the purpose of this study was to investigate the legal framework for preserving forests from fires on lands contaminated by radioactive fallout in Ukraine in the current conditions.

Materials and Methods

The methodological framework of this study included a set of general and special methods and approaches of scientific cognition, including dialectical, formal logical, analysis and synthesis, comparative legal, and formal legal methods. The application of the dialectical approach helped to investigate social relations regarding the formation and implementation of the legal framework for the protection of forests from fires on radiation-hazardous lands in their unity and interconnection, to identify patterns of development, and to outline the dynamics of the relevant protective legislation. Using the formal logical method, the study analysed the regulations aimed at regulating forest wildfire protection and identified the specifics of ensuring forest wildfire protection on radiation-hazardous lands. The methods of analysis and synthesis helped to identify trends in the current state of forest fire protection on radiation-hazardous lands and focused on special risks and threats during martial law. Using the comparative legal method, the study performed a comparative analysis of the current legal provisions in the field of forest protection from fires on radiation-hazardous lands, which have a series of legal conflicts. Thus, the formal legal method was used to analyse the systematic, effective,

and mutually consistent nature of the current legislation in the area under study. It was important to apply the scientific theory of "human place in life safety", which substantiated the complex and multi-level nature of the system of forest protection from fires on radiation-hazardous lands. In modern conditions, this system should include not only the potential of relevant state bodies but also involve the capabilities of the public and civil society sector as a whole, to ensure a safe environment for citizens and preserve Ukraine's natural resources.

The material basis for the study included statistical data on the number and scale of forest fires that occurred on radiation-hazardous lands in Ukraine since 2015 (Nuclear and Radiation Safety in the Exclusion Zone, 2017; Regional Eastern European Fire Monitoring Centre, 2020; Goldammer *et al*., 2023). Strategic documents, draft laws, and current laws of Ukraine were analysed, including the following: "Fire Safety Rules in the Forests of Ukraine" (2004), "Regulations on Forest Fire Stations" (2005), "Strategy for the Development of the Territories of the Exclusion Zone and the Zone of Unconditional (Mandatory) Resettlement Affected by Radioactive Contamination as a Result of the Chornobyl Disaster for 2021-2030" (2020). A separate part of the source base comprised the system of sub-legislative acts, including joint orders of various central executive authorities (Order of the Ministry of Environmental Protection and Natural Resources of Ukraine No. 382, 2020; Resolution of the Cabinet of Ministers of Ukraine No. 612, 2022). The analysis of a set of statistical, regulatory, and administrative sources allowed the study to fulfil its purpose.

Results and Discussion

Risks and threats of forest fires on radiation-hazardous lands. The forests of the CHZ perform a vital protective function in limiting the spread of radioactive contamination. In fact, the safety of the local population depends on the level of reliability of the Exclusion Zone's protective capabilities. As a result of the Chornobyl accident, over 3 million hectares of forest areas were affected by radiation damage. Environmental monitoring data on radiation-hazardous lands indicate contamination of almost all environmental components, as ^{137}Cs and ^{90}Sr activity concentration levels are still high within forest resources. At the same time, the migration of radionuclides as a result of the Chornobyl accident leads to secondary accumulation of such radioisotopes outside the radiation hazardous areas, which determines their potential hazard (Malimon, 2009).

The results of monitoring the radiation dose rates obtained from the radiation monitoring posts on the territory of the CHZ in 2020 indicate that the equivalent gamma radiation dose rate levels during the period of forest fires (April-August), specifically in the areas of their spread, did not change significantly; and ^{137}Cs activity in the atmospheric air did not reach values exceeding the permissible concentration for the population, but was 1.4-44 times higher than the reference levels, depending on the measurement location (Kashparov *et al*., 2024). Although the concentration of Chornobyl radioisotopes did not exceed the permissible levels for radionuclides in surface air even in most areas immediately adjacent to the Chornobyl NPP (nuclear power plant) during the fires of 2020 and 2022, due to the large size of the areas covered by the fire during this period, the activity of radionuclides of anthropogenic origin was "raised" to the terabecquerel level in the air in the form of aerosols and condensates (Beresford *et al*., 2021; Kashparov *et al*., 2024), which were recorded at a considerable distance from the wildfire epicentres (Fig. 1).

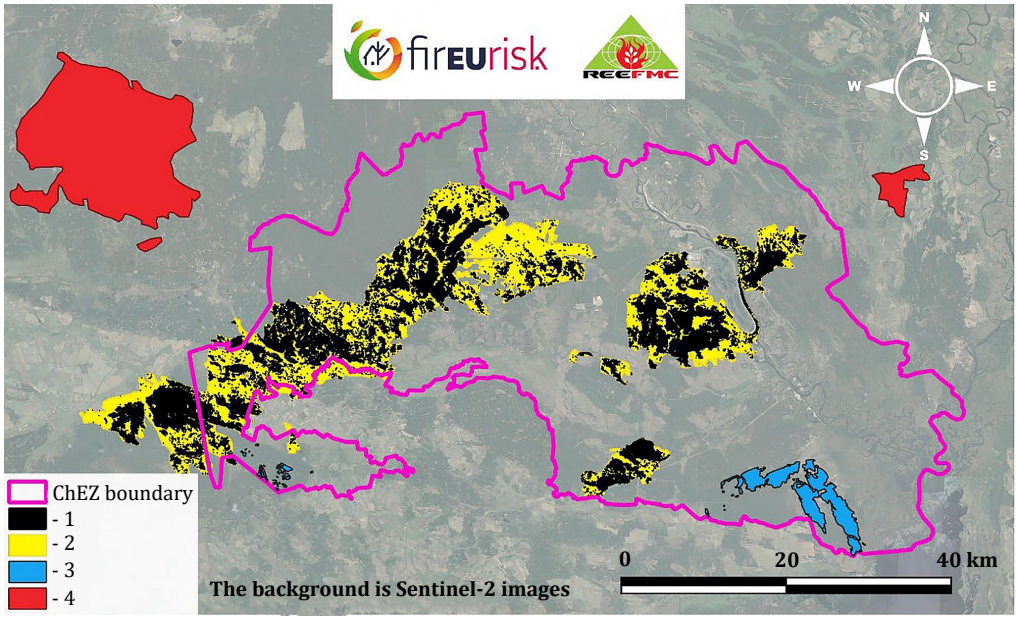

Figure 1. Spatial distribution of areas affected by wildfire in the Exclusion Zone and adjacent territories

Notes: 1 – where woody vegetation died, 2 – other areas affected by landscape fires in April 2020, 3 – areas with dead trees as a result of fires in 2022, 4 – areas of burned areas traversed by fire in April 2020, which are mostly not classified as radiation hazardous land

Source: compiled by the authors of this study

Apart from the release of radionuclides outside the CHZ and the direct physical threat to radioactive substance management facilities, wildfires in the Exclusion Zone can lead to a considerable deterioration of the radiological situation at the local level due to an increase in the volume concentrations of radionuclides in the surface layer of the atmosphere, which can cause an additional risk of exposure to personnel involved in the firefighting process (Kashparov *et al*., 2024). Internal exposure of firefighters can be caused by radionuclides entering the respiratory system. During wildfires, not only hot evaporation of radionuclides occurs, but also formation of fine radioactive aerosols due to ash formation and condensation of radionuclides, which is accompanied by an increase in radionuclide concentrations in the surface air (Yoschenko *et al*., 2006).

Furthermore, according to empirical data from the last decade, pine forests contain up to 40% of gross ^{137}Cs activity on the forest floor (up to 10% in wood and about 5% in bark). Together with the high content of radiocaesium in the litter, which is characterised by low shielding of gamma radiation, this can substantially affect the formation of the equivalent dose rate of external exposure to humans (Kashparov *et al*., 2024). Resolution of the Cabinet of Ministers of Ukraine No. 612 (2022) defines the permissible period for a forest firefighter to stay in the fire zone mediated by the concentration of radionuclides according to certain standards approved by

Resolution of the Chief State Sanitary Doctor of Ukraine No. 62 (1997).

The issue of forest wildfires in the Exclusion Zone is one of the most pressing environmental problems in Ukraine that can transform into social ones (Anisimova *et al*., 2023). A.A. Dvornik *et al*. (2017) and V.A. Kashparov *et al*. (2024) indicate that even small grassland wildfires across radiation-hazardous lands have significant environmental consequences, specifically due to the accumulation of up to 40% of the total stock of biologically mobile radionuclides in forest ecosystems in the combustible materials. N. Evangeliou and S. Eckhardt (2020) found that large-scale forest fires in 2015 and 2020 in the Exclusion Zone contributed to the spread of radioactive aerosols with smoke and confirm the above. Specifically, two of them in 2015 had an extremely negative social response in Europe for Ukraine's reputation. According to O. Soshenskyi *et al*. (2023), the fires of 2020 had even more extensive negative consequences and scope for the state as a whole, including human casualties, significant destruction, environmental damage (over UAH 10 bn), and the loss of forests – over 157,000 ha (Zhytomyr, Kyiv, and Luhansk oblasts).

At the same time, a series of factors, including active hostilities, rapid climate change, species structure of tree stands in the Exclusion Zone with a predominance of conifers (which generate significant amounts of combustible materials), considerable accumulation of debris and woody debris, low density of firefighting roads, insufficient funding and restricted access to certain forest areas due to mine danger altogether contribute to the occurrence of forest fires, the development of which will be conditioned by the ongoing military operations in Ukraine. The situation is only getting more complicated considering that military actions are causing environmental crises in other regions of Ukraine (Pyrikov *et al*., 2022), which poses systemic threats to the environment (Khrushch *et al*., 2023) and national security of Ukraine (Rzhevska & Melnyk, 2023).

Therefore, at the present stage, the risks and threats of forest fires on radiation-hazardous lands of Ukraine are becoming more urgent and acute, considering the rapid climate change that leads to an increase in the number and intensity of fires in ecosystems in general, active hostilities and shelling throughout Ukraine, lack of adequate financial support for their prevention, and, clearly, the threat of radiation contamination to neighbouring territories.

Statutory regulation of protection of Ukrainian forests from wildfires on radiation hazardous lands. The strategic goal of forest management in the Exclusion Zone is to preserve its ecosystems, which are the main source of radionuclides, and prevent their uncontrolled movement, i.e., to maximise the barrier function to prevent radionuclide leakage. Therewith, this purpose does not differ from the usual management at the level of state forestry enterprises, nor from the activities of other agencies in protected areas in Ukraine, but it requires restrictions on the production of commercial products/timber, and therefore on the main use of the forest. Compared to other protected areas in Ukraine, the conditions are characterised by the presence of forests contaminated with radionuclides, which are unstable to fire and disease, and 30% of which have already been damaged by fires (Strategy for the Development of the Territories..., 2020).

The Exclusion Zone is a part of the land with significant management features that has been subjected to the most significant radioactive contamination due to the Chornobyl accident (Order of the Cabinet of Ministers of Ukraine No. 535, 2012). The total area of the Exclusion

Zone covered by forest vegetation is about 140.6 thousand ha (Loginova, 2015). The protection of forests located on radiation hazardous lands is carried out following the Law of Ukraine No. 791a-XII dated 27 February 1991, which defines the procedure for the functioning of this territory (Law of Ukraine No. 791a, 1991).

The regulatory framework for the protection of Ukrainian forests from wildfires in general and the forests of the Exclusion Zone specifically is based on a series of regulations at the highest state, departmental, local, and facility levels. Considering the current legal developments, it is worth noting the most important ones. Among them are resolutions adopted by the Cabinet of Ministers of Ukraine: on the rules for the formation of fire and rescue units within the framework of voluntary fire protection (Resolution of the Cabinet of Ministers of Ukraine No. 314, 2023), on the establishment of rules for forest protection in general (Resolution of the Cabinet of Ministers of Ukraine No. 612, 2022), on the establishment of norms for the functioning of forest protection at any level (Resolution of the Cabinet of Ministers of Ukraine No. 976, 2009). Resolution of the Cabinet of Ministers of Ukraine No. 1127 (2000) establishes the norms of functioning of the service of protection of the nature reserve fund of Ukraine.

At the departmental level (a separate central executive body), it is worth noting the Order of the Ministry of Environmental Protection and Natural Resources of Ukraine No. 382 (2020) on establishing the requirements for the functioning of the fire protection of the State Forestry Agency of Ukraine; Order of the State Committee of Forestry of Ukraine "On the commissioning of the automated system "Fire" (2021). Orders of the State Committee of Forestry of Ukraine are important: Order of the State Committee of Forestry of Ukraine No. 526 (2005) – on establishing requirements for the functioning of forest fire stations; Order of the State Committee of Forestry of Ukraine No. 278 (2004) – on establishing requirements for fire safety in the forests of Ukraine. At the interagency level, it is worth noting the joint Order of the Ministry of Ecology and Natural Resources of Ukraine and the Ministry of Internal Affairs of Ukraine No. 01/01 (2018) on establishing an algorithm of actions for joint firefighting by units of the operational and rescue service of civil protection, protection of the nature reserve fund, and other forest users within the Chornobyl Radiation and Ecological Biosphere Reserve, etc.

The system of bodies that perform the state function of firefighting in the forests of Ukraine is generally characterised by a conservative and archaic approach to ensuring fire safety in forests (with the dominance of measures to protect forests from wildfires), which does not include the fundamentally new approach of developed countries aimed at "fire management", which is clearly reflected in the regulations. Therefore, with this in mind, most of the requirements of the already quite outdated regulations, such as the "Fire Safety Rules in the Forests of Ukraine" (2004) and "Regulations on Forest Fire Stations" (2005), are not met in the Exclusion Zone due to a series of objective and subjective factors (Zibtsev *et al*., 2023). These include a lack of funds, low level of technical equipment, inadequate forest roads and communications, frequent changes in institutional support at the highest state level, and a lack of a strategic vision of the role of institutions that are supposed to protect forests from wildfires on radiation-hazardous lands in Ukraine, etc.

At the same time, the adoption of Resolution of the Cabinet of Ministers of Ukraine No. 612 (2022) – on the regulation of forest protection and conservation processes and the corresponding amendments to the regulation of the

same level, the Resolution of the Cabinet of Ministers of Ukraine No. 976 (2009) – on the regulation of state forest protection and protection of other forest users, where the significant legal construction "forest protection of other forest users and forest owners" was added to the title itself (since only about 73% of forests are under the jurisdiction of the State Agency of Forest Resources, while the remaining 27% are distributed among other forest users and owners), made fundamental changes to the state's function of implementing fire safety in Ukrainian forests, without considering the complexity of the system itself, which is authorised to perform this function.

Thus, substantial shortcomings in the regulatory framework for fire safety in Ukraine's forests are as follows:

- the validity of legally and technologically outdated regulations in the context of the issues under study (Order of the State Committee of Forestry of Ukraine No. 278, 2004; Order of the State Committee of Forestry of Ukraine No. 526, 2005);
- substantial contradictions and discrepancies of a legal and substantive nature between the existing regulations in the area under study. The most delicate of these are between Resolution of the Cabinet of Ministers of Ukraine No. 612 (2022) – regarding the regulation of forest protection and conservation and Order of the State Committee of Forestry of Ukraine No. 278 (2004) – regarding the approval of fire safety requirements in the forests of Ukraine, which, in essence, regulate relations in one area of public activity and set requirements for the protection of forests from fires);
- the title of the Resolution of the Cabinet of Ministers of Ukraine No. 612 (2022) "On Approval of the Procedure for Organising the Protection and Protection of Forests" is "somewhat misleading", since its content relates mainly to firefighting activities and relevant regulations; and secondly, the development and adoption of this regulation according solely to the norms of the Forest Code of Ukraine, without considering the basic law – the Civil Protection Code of Ukraine, Article 4 of which defines "civil protection" as a set of measures implemented both in peacetime and during a special period (which is martial law) to protect the population, territories, and the environment as a whole and is aimed at exercising state control over compliance with fire and industrial safety requirements;
- despite the adoption of the resolution of the Cabinet of Ministers of Ukraine concerning the regulation of requirements for the organisation of forest protection and conservation at the highest state level, rather than at the departmental level, it does not consider the complexity of the relevant state function and is not coordinated with the civil protection system and relevant regulations, whose bodies are involved in extinguishing a forest fire if there is a risk of its spreading over more than 5 ha, but have a significant factor in conjunction with other actors (conscious public, territorial community, military administrations, other agencies and organisations), specifically in preventive and other activities.

Even though the Resolution of the Cabinet of Ministers of Ukraine No. 612 (2022) refers to some no longer valid regulations (specifically, in Items 61 and 62), its innovative and progressive nature is undeniable according to modern approaches, technological innovations, and modern world standards for the development of strategic regulations with a detailed presentation of the terminology. However, the structure of "Organising the Protection and Protection of Forests", even though this regulation outlines the procedure for implementing a system of measures to preserve forests from wildfires, illegal logging and other

harmful impacts, contains exclusively fire protection components of its content, namely: 1) types of forest fires; 2) standards of protection and defence of forests against fires; 3) organisation of forest protection against fires; 4) management of forces and means of extinguishing fires; 5) formation of fire and rescue units; 6) functioning of a forest fire station; 7) accounting of forest fires; 8) information on forest fires; 9) formation of fire and rescue units.

Prevention of forest wildfires and fire safety in ecosystems overall is achieved through the annual implementation of pre-planned fire prevention measures, maintaining an appropriate level of readiness of fire and rescue units according to the level of fire danger, considering weather conditions, as well as rapid detection and elimination of forest fires. The State Agency of Forestry, local state/military administrations, local governments, permanent forest users and forest owners are responsible for compliance with regulatory requirements on fire safety in the forest sector. The direct implementation of measures to prevent and extinguish fires and keep records of such fires is the responsibility of permanent forest users and owners of forest plots. The State Agency of Forestry (hereinafter referred to as the SAR), in turn, constantly publishes information on the level of fire danger using the automated system "Pozhezhi".

Specific features of legal support for the protection of Ukrainian forests from wildfires on radiation hazardous lands. Within the boundaries of the nature reserve fund, which is the Chornobyl Radiation and Ecological Biosphere Reserve on the radiation-affected lands, the State Protection Service of the Nature Reserve Fund of Ukraine, whose activities are regulated by Resolution of the Cabinet of Ministers of Ukraine No. 1127 (2000), is responsible for preventing forest wildfires. However, the professional community is increasingly focusing on the need to create a departmental fire protection service under the State Agency of Ukraine on Exclusion Zone Management, considering the substantial features of implementing such a function in the territory that has suffered significant radioactive damage.

Fire safety requirements in Ukrainian forests stipulate that forest plantations with a radioactive contamination density of 1 to 14 Ci/km^2, regardless of their type and age, should have one fire hazard class higher (Order of the State Forestry Committee of Ukraine No. 278, 2004). According to official data, 66% of the radiation-affected land is classified as the highest natural fire hazard class (I), of which 38% is land with contamination exceeding 555 kBqm^2, and 13% is classified as Class II. In highly fire-prone pine forests, the accumulation of combustible substances, which potentially determines the level of burning intensity, varies from 110 t/ha at age 22 to 220-280 t/ha at ages 44-64. According to the data published by S. Zibtsev *et al*. (2023), about 1.4 mn cubic metres of dead wood and fallen trees have accumulated on the radiation-affected lands; observation tower systems allow detecting wildfires only on 27% of the territory of the radiation-affected zone; many fire roads are cluttered and cannot be effectively used to extinguish wildfires.

Extinguishing forest wildfires on highly contaminated land, even where there are roads and water bodies, is complicated by the fact that it is impossible to send ground firefighting units to the fire, and requires the use of only aviation, which is difficult and risky in the current realities for Ukraine, mediated by active military operations. Resolution of the Cabinet of Ministers of Ukraine No. 612 (2022) also defines the specifics of fire-fighting forestry measures in the Exclusion Zone. Sub-item 13 of Item 27 stipulates that a set of necessary measures must be taken on the lands

affected by radioactive contamination to prevent and spread forest fires, including beyond the contamination zone, and in extinguishing the fire, forest firefighters must ensure compliance with radiation safety standards and proper provision of personal protective equipment, including respiratory or gas masks.

The "Strategy for the Development of the Territories of the Exclusion Zone and the Zone of Unconditional (Mandatory) Resettlement Affected by Radioactive Contamination as a Result of the Chornobyl Disaster for 2021-2030" (2020), developed and presented at the level of the Cabinet of Ministers of Ukraine, as a separate structural element within Section 5 "Areas of Strategic Development of the Exclusion Zone/Unconditional Resettlement" includes subsection 5.6.2 – regarding the development of fire management measures and an integrated decision-making system for prevention, rapid response, and safe extinguishing (in compliance with radiation requirements) of forest fires in the Exclusion Zone. In the context of substantial underfunding of budgets allocated for the protection of forests from wildfires, the use of modern advanced technologies, including information technologies, is a priority in the context of fire safety. In fact, this should allow for more precise adjustment of forest wildfire protection systems, processing of incoming information, and making relevant management decisions.

To improve fire management in the Exclusion Zone, prevent the spread of radioactive substances beyond its borders and enhance the barrier function of ecosystems, the Strategy envisages the following activities: collecting and analysing information on the state of forests; scaling up the number and quality of fire barriers (including roads and water bodies); preparing cartographic materials, including maps of fire danger, fire management, fire sensitivity of ecosystems, and analysing them; development of fire management plans for the exclusion zones (fire detection systems (towers, cameras fire detection systems (towers, cameras, unmanned aerial vehicles, patrols), fire network (mineralised strips, fire zones, water bodies and their location), firefighting procedures (firefighting strategy and tactics, interaction of involved units), scope of planned firefighting measures, provision of firefighting equipment and relevant equipment; development of modern information systems for proper decision-making on forest wildfire prevention, immediate response and fire extinguishing in compliance with radiation requirements in the Exclusion Zone (Strategy for the Development of the Territories..., 2020).

At the same time, section 5.4 on the requirements for the non-proliferation of radioactive contamination includes forestry and fire prevention measures aimed at limiting the spread of radionuclides outside the relevant zone, since forest wildfires are identified as the primary threat of radioactive contamination. Among a range of ways to achieve positive results, specifically, in the context of fire safety in forests, the following are highlighted: the need to create departmental fire protection; construction and appropriate equipment of forest fire stations; development of a system for early detection of forest wildfires based on modern technologies; artificial reforestation of non-forested areas with forest-forming species resistant to fire and disease; ensuring proper condition of the protection zones of road rights-of-way and linear facilities; cleaning of burned areas; implementation of a system of fire prevention and restrictive fire measures in ecosystems in general.

For a long time, no special legislation was adopted to regulate fire safety and firefighting on lands affected by radionuclides. The Regional Eastern European Forest Fire Monitoring Centre at the National University of Life and Environmental

Sciences of Ukraine, together with the Ministry of Internal Affairs of Ukraine, the State Agency of Ukraine on Exclusion Zone Management, the United States Forest Service and other bodies, within the framework of a research project, developed and discussed in detail a joint regulation of the Ministry of Internal Affairs and the Ministry of Environmental Protection and Natural Resources of Ukraine on the approval of a separate Instruction regarding the specifics of firefighting by the joint security units of the nature reserve fund, civil protection and forest users on the territory of the Chornobyl Biosphere Reserve (Table of comments, 2018), and in 2018 this regulation was approved and registered with the Ministry of Justice of Ukraine (Order of the Ministry of Ecology and Natural Resources of Ukraine and Ministry of Internal Affairs of Ukraine No. 01/01, 2018).

Therewith, a series of regulations have been adopted that govern certain requirements for radiation safety. These include the Order of the Ministry of Emergency Situations defining the procedure for ensuring individual dosimetric monitoring in the structures of the Emergency Service (Order of the Ministry of Emergency Situations No. 85, 2007); the Order of the Ministry of Healthcare of Ukraine and the State Emergency Service on radiation safety requirements during work in the exclusion zone (Order of the Ministry of Healthcare of Ukraine, Ministry of Emergencies and Affairs of Protection of the Population from the Consequences of the Chornobyl Disaster No. z0754-08, 2008). Important, considering the subject of the study, are the departmental orders of the State Agency for the Management of the Exclusion Zone: regarding the algorithm of actions in emergency situations on lands that have suffered radiation damage; the formation and operation of the headquarters in the event of an emergency within this territory; numerous mobilization plans for extinguishing forest wildfires, etc. (Usenya *et al*., 2018).

The protection of land affected by radiation, including forests, is mediated by the specific features of their protective statutes. Thus, Part 1 of Article 14 of the relevant Law of Ukraine, which factually regulates the regime of land that is radioactively affected by the Chornobyl accident, determines the need to follow a special environmental protection regime in this territory. Part 2 of Article 14 of the same regulation delineates the functionality of law enforcement agencies in this territory: 1) public order – within the competence of the National Police; 2) fire and technogenic safety – among the powers of the currently functioning State Emergency Service (Law of Ukraine No. 791a, 1991).

Even though the Exclusion Zone already has a protected status that also applies to forest lands, the professional community has long emphasised the need to create a special protected zone regime in this area. Consequently, in 2016, the President of Ukraine signed a corresponding Decree. The Chornobyl Biosphere Reserve is located in two areas within the Ukrainian part of CHZ – namely, within 30 km of the Exclusion Zone and covers 2/3 of its land area (about 225 thousand ha), except for 10 km of the Chornobyl NPP's specially protected zone, the Radioactive Waste Management Zone. The purpose of its creation was to preserve the Ukrainian natural fund, conduct scientific research, coordinate joint activities of various agencies, and restrict visits to radiation-affected lands (Decree of the President of Ukraine No. 174/2016, 2016).

The specific features of forest protection within the nature reserve fund are defined by the relevant Law of Ukraine (Law of Ukraine No. 2456, 1992). A separate Decree of the President of Ukraine No. 381 dated 21 November 2017

argues for additional measures to strengthen the protection of the nature reserve fund, specifically by improving the provision of state protection units of the nature reserve fund of Ukraine (Decree of the President of Ukraine No. 381, 2017). And on 14 July 2000, the Cabinet of Ministers of Ukraine adopted Resolution No. 1127 (2000), which approved the activities of such a service "On the Service of State Protection of the Nature Reserve Fund of Ukraine" – in compliance with Article 60 of the relevant Law of Ukraine on the Nature Reserve Fund (Law of Ukraine No. 2456, 1992).

In due course, the Regulation on the State Protection Units of the Nature Reserve Fund of Ukraine was improved by adopting Resolution of the Cabinet of Ministers of Ukraine No. 283 (2012) and introducing a series of important changes, where the Annex to the list of positions of this Service added a number of firefighters, including "station chief" and "fire observer" (Resolution of the Cabinet of Ministers of Ukraine No. 1127, 2000).

Thus, firstly, the Exclusion Zone lacks sufficient human, financial, and technical resources to implement a set of necessary fire prevention measures on a large territory of forests. Secondly, the significantly increased risks of new-type forest wildfires due to climate change, the gradual accumulation of a critical mass of combustible materials and mine danger necessitate balanced strategic management decisions, considering international best practices, technological developments, and scientific research, which should be systematically reflected in regulations that would be comprehensive/intersectoral, not just local. Examples include the Strategy for the Development of the Territories of the Exclusion Zone and the Zone of Unconditional (Mandatory) Resettlement Affected by Radioactive Contamination as a Result of the Chornobyl Disaster for 2021-2030 (2020) and the joint Order of the Ministry of Ecology and Natural Resources of Ukraine and the Ministry of Internal Affairs of Ukraine No. 01/01 (2018) on the approval of the Instruction on joint firefighting by the units of the state protection of the nature reserve fund, civil protection service, and permanent forest users on the territory of the Chornobyl Radiation and Ecological Biosphere Reserve. At the same time, it is not so much the development as the implementation of such norms/intentions that is more important, considering the basic principle of radiation safety and radiation protection, which means that the number of exposed persons and the absorbed dose of ionising radiation should be minimised as much as possible, according to the economic and social capabilities of a particular entity.

Conclusions

The state of fire safety on the forest lands affected by radiation damage is the most threatening at the present stage. The contamination of the Chornobyl forests, which have been under occupation since the first days of Russia's full-scale aggression, with explosive objects creates new additional risks. The system of fire protection on the lands of the forest fund that have been affected by radiation does not meet the specifics of this territory, as it cannot ensure fire safety in a large area of tens of thousands of hectares, primarily due to the lack of an adequate level of legal regulation of the relevant state function, appropriate firefighting equipment, and a sufficient number of trained specialists. And in the absence of adequate state funding, martial law with the corresponding risks and threats, the real capacity of enterprises and institutions to update firefighting equipment and fire extinguishing equipment is substantially limited. At the same time, the specifics of the activities of those affected by radioactive

contamination are substantially limited in terms of the commercial component.

In the context of the above, it is important, first of all, to ensure proper interaction between the relevant services. Therefore, there is a need to improve the current Mobilisation Plan for extinguishing wildfires in the Exclusion Zone, accommodate the new fire hazard assessment system; create a departmental fire protection service under the State Agency of Ukraine on Exclusion Zone Management, whose activities would consider the specifics of the territory ; improve the implementation of the system of preventive fire protection measures; upgrade the skills of forest firefighters, considering the latest approaches and practices of fire prevention and extinguishing in ecosystems; improve the interaction of various services and agencies in firefighting based on clear legal regulation; strengthen the inclusion of voluntary firefighting groups, territorial communities, and public activists, specifically, in educational and informational activities and the implementation of preventive fire measures in forests.

Thus, fire safety in Ukrainian forests as an integral part of national security can only be effectively ensured if environmental, economic, legal, engineering, and technical measures are applied in a comprehensive manner. However, the algorithm of interaction and coordination of actions of bodies regulating relations between state bodies, NGOs, legal entities, and individuals in the context of the above, regardless of their type of activity and form of ownership, is crucial, since the state is cannot fully fund all necessary measures in the current conditions. Therefore, the prospects for future research in this area include the development of optimisation mechanisms within the framework of legal support and relevant adoption of interagency regulations on the interaction of forces and means in the activities of forest protection from fires on radiation-hazardous lands of Ukraine. Additionally, it is important to consider technological innovations that could replace human labour, with corresponding reflection in regulations in the implementation of such activities; development of mechanisms for attracting international funds, etc.

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Conflict of Interest

The authors of this study declare no conflict of interest.

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Організаційно-правові засади охорони лісів від пожеж на радіаційно небезпечних землях України в сучасних умовах

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Анотація

Організаційно-правові засади охорони лісів від пожеж на радіаційно небезпечних землях України, особливо в сучасних умовах, зважаючи на нові виклики та загрози, пов'язані як з воєнним станом, так і прискореними кліматичними змінами, вимагають ретельного аналізу чинного законодавства у відповідній сфері, з'ясування юридичних прогалин та визначення найбільш пріоритетних напрямків його удосконалення. Мета статті полягала у аналізі системи чинного законодавства, спрямованого на врегулювання охорони й захисту лісів від пожеж, у тому числі і на радіаційно небезпечних землях України, та оцінки стану рівня ефективності правового регулювання означених суспільних відносин та оцінки їх. Методологічними засадами у контексті проведення дослідження послугували загальні і спеціальні методи наукового пошуку, серед яких: формально-логічний, порівняльно-правовий, формально-юридичний, статистичний, аналізу й синтезу та діалектичний. У межах дослідження обґрунтовано комплексний характер системи охорони лісів від пожеж на радіаційно небезпечних землях. В роботі проаналізовано ризики та загрози виникнення лісових пожеж на радіаційно небезпечних землях України. Констатовано, що стан забезпечення пожежної безпеки саме на землях лісового фонду, що зазнали радіаційного ураження, постає найбільш загрозливим на сучасному етапі. Сформовано узагальнення, що містять комплекс необхідних заходів, спрямованих насамперед на посилення належного рівня взаємодії профільних служб в організації охорони лісів від пожеж на радіаційно небезпечних землях України в сучасних умовах. Практична цінність статті полягає у тому, що в ній, з урахуванням наукової теорії та комплексу методів наукового пізнання, здійснено ретельний аналіз українського законодавства та з'ясовано особливості організаційно-правового забезпечення охорони українських лісів від пожеж на радіаційно небезпечних землях на сучасному етапі, що дозволило визначити реальний стан правового регулювання відповідної сфери та прогалини в організації його застосування, що має актуалізувати удосконалення нормотворчої та правозастосовної практики у досліджуваній сфері. Результати дослідження

можуть бути використані для актуалізації правового забезпечення діяльності публічних інституцій, що реалізують державну політику в сфері охорони лісів на землях що зазнали радіоактивного забруднення

Ключові слова: справове забезпечення; лісова пожежа; радіаційна безпека; пожежна безпека; Чорнобильська атомна електростанція; ризики та загрози воєнного стану