IMPLEMENTATION OF THE EU DIRECTIVE 2002/49 IN UKRAINIAN LEGISLATION: EXPERIENCE IN THE CIVIL AVIATION SECTOR

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Abstract. *The prospective of the EU Directive 2002/49 implementation in Ukrainian legislation has been considered. The paper demonstrates the practical aspects of implementing specific provisions of the Directive 2002/49 using the example of civil aviation in Ukraine and analyses the gaps and inconsistencies in current legislative and regulatory acts. The main areas of Directive application and its advantages have been analysed. At this stage of Eurointegration in Ukraine, there is a need to implement a national-level legislative act that aligns with EU Directive 2002/49. Such a legislative act should create the political preconditions for managing major noise sources and harmonizing EU requirements in the field of noise management with those of Ukrainian legislation. The use of a unified methodology and harmonized criteria for noise assessment will allow stakeholders to gain correct information for objective analysis of different noise sources and their impact on human health. This approach facilitates the effective comparison of various modes of transportation and the identification of priority measures to reduce noise and its negative effects on the population. Furthermore, the development of noise action plans enables the implementation of specific measures for noise regulation and the promotion of policies aimed at improving the quality of life for citizens by reducing noise pollution.*

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Introduction. The European Environment Agency (EEA) reports (EEA, 2020) that over 100 million European residents suffer from the negative impact of noise, which has harmful consequences for health. It is found that 20% of the EU population resides in areas where noise levels are deemed detrimental to health. This includes over 22 million individuals who fall into the high-annoyance group, 6.5 million people experiencing significant sleep disturbance, more than 48,000 people afflicted with heart disease, and over 12,000 cases of premature mortality. Additionally, it is estimated that there could be more than 12,500 cases of cognitive impairment in children as a potential consequence of noise exposure each year. Thus, noise has become one of Europe's major environmental problems, and in order to improve overall health and protect the environment, EU Directive 2002/49 relating to the assessment and management of environmental noise was introduced to manage noise from the main sources: road traffic noise, railway noise, industrial noise, and aircraft noise (EP&CEU, 2002). The document proposes a unified methodology and harmonized assessment criteria are introduced for these noise sources.

Since Directive 2002/49 includes recommendations for assessing the effectiveness of noise reduction measures every 5 years, many EU countries have already gone through several cycles of implementing the Directive (EP&CEU, 2002). Therefore, at this stage, it is possible to evaluate its achievements and shortcomings, as well as examine how associated EU member countries have adapted to the requirements of this document. In 2021, the Agreement on the Common Aviation Area was ratified in Ukraine, marking the first time among international Eurointegration commitments that the implementation of Directive 2002/49 was included. Indeed, noise management issues should not

be limited to the aviation industry alone. However, considering that the aviation sector is often at the forefront of innovation, it is logical to use the implementation of noise reduction measures as a case study for other industries.

Materials and methods. To identify gaps in Ukrainian and European legislation in the field of aviation noise management, an analysis was conducted on key documents from the EU and Ukraine of various levels and subordination, which describe the processes of identification, assessment (modeling, measurement, prediction), and the development of measures to reduce aviation noise. In particular, the main functions of noise management, as defined by EU Directive 49/2002, have been studied. Additionally, Ukrainian legislative and regulatory acts were analyzed, taking into account the context of the current stage of civil aviation development and the influence of current crisis phenomena in society on the perception of aviation noise.

The functions of the EU Directive 2002/49. The EU Directive 2002/49 serves as a framework for the assessment and management of environmental noise in European Union member states. The directive has two main objectives [2]: development of entire approach to prevent the deterioration of the population's health and to provide a basis for the development of measures to reduce noise from major noise sources (EP&CEU, 2002). One of the specific tasks of EU Directive 2002/49 is to collect high-quality data on noise levels from major anthropogenic sources by implementing a unified methodology and harmonized noise assessment criteria. This data is further analyzed to apply best practices for noise reduction, compare different noise sources, their operating conditions, and the effectiveness of implemented measures. The directive covers various sources of noise, including road traffic, railway, industrial, and aviation noise. Other types of noise such as agricultural, military, biogenic, and domestic noise are either considered negligible due to insignificant exposure or included in one of the four specified categories (EP&CEU, 2002). The main sources have been defined as those that 1) affect the largest number of people and 2) generate the highest sound levels.

The implementation results of the Directive should be presented in the following stages (EP&CEU, 2002):

1. Determination of Noise Exposure: This involves conducting noise mapping to assess noise exposure levels. It helps identify areas where noise levels exceed the established thresholds and determine the population affected by noise pollution.
2. Dissemination of Information: The collected information and results of noise mapping should be effectively communicated to the public and stakeholders. This ensures transparency and awareness regarding noise levels and their potential impact on health and the environment.
3. Adoption and Implementation of Action Plans: Based on the findings of noise mapping, action plans should be developed and implemented. These plans should be grounded in the results of noise mapping and aim to reduce the harmful effects of noise on human health and the environment. They may include measures such as noise mitigation strategies, infrastructure modifications, and land-use planning adjustments.

Overall, the Directive aims to establish a framework for developing a comprehensive approach among communities to reduce noise from major sources. It emphasizes the importance of data-driven decision-making, effective communication, and the implementation of action plans to mitigate the adverse effects of noise on human well-being and the surroundings.

Main sources	Noise mapping (requirements of Directive 2002/49)	Basic mapping unit	Results on the portal "The NOISE Observation & Information Service for Europe"
Noise of agglomerations/ industrial noise	-/+	Agglomeration (urbanized territory with a population > 100,000 and high population density)	-/+
Noise from road traffic	+	Main road (>3 million vehicles annually)	+
Railway noise	+	Main railway (>30,000 trains per year)	+
Aviation noise	+	Main airport (> 50,000 operations per year)	+
Main sources	Noise mapping (requirements of Directive 2002/49)	Main sources	Noise mapping (requirements of Directive 2002/49)
Noise from military activities (like training flights)	-	*Biogenic noise*	-
Residential noise	-	*Agricultural noise*	-

Fig. 1. The main sources of environmental noise are coverage EU Directive 2002/49

The key stages for the successful implementation of Directive 2002/42 provisions are as follows (fig. 2) (EP&CEU, 2002):

1. Determining noise exposure boundaries (mapping): This involves identifying and defining the areas affected by noise pollution.
2. Informing and involving the public in the consultation process: This stage aims to engage the community and gather their input and feedback on the noise-related issues.
3. Developing and implementing noise action plans: Based on the findings from the mapping and public consultation, noise action plans are formulated and implemented to address and mitigate the identified noise issues.

An important feature of this algorithm is the ability to review the achieved results every five years (Fig. 2) based on the following criteria: the area covered by noise contours, the number of affected populations, and the cost of implemented measures. The effectiveness of the proposed approach in the European region, combined with the balanced approach of ICAO to aviation noise management, demonstrates the progress that has been achieved, albeit against the backdrop of the COVID-19 pandemic, in reducing aviation noise exposure according to the EASA Report (EASA, 2020). In particular, it is forecasted that the pollution levels of 2019 will not be reached in the next few decades (fig. 3)

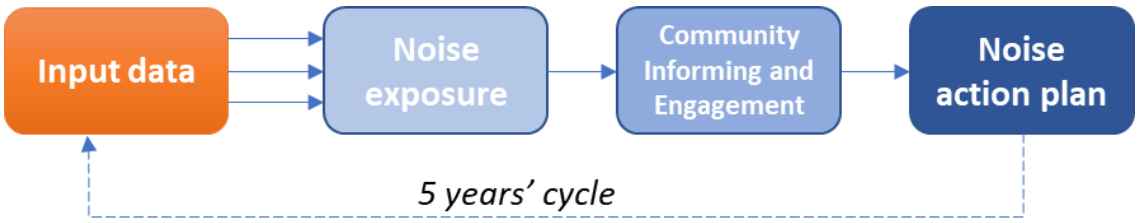

Fig. 2. The Directive 2002/49 cycle and key stages

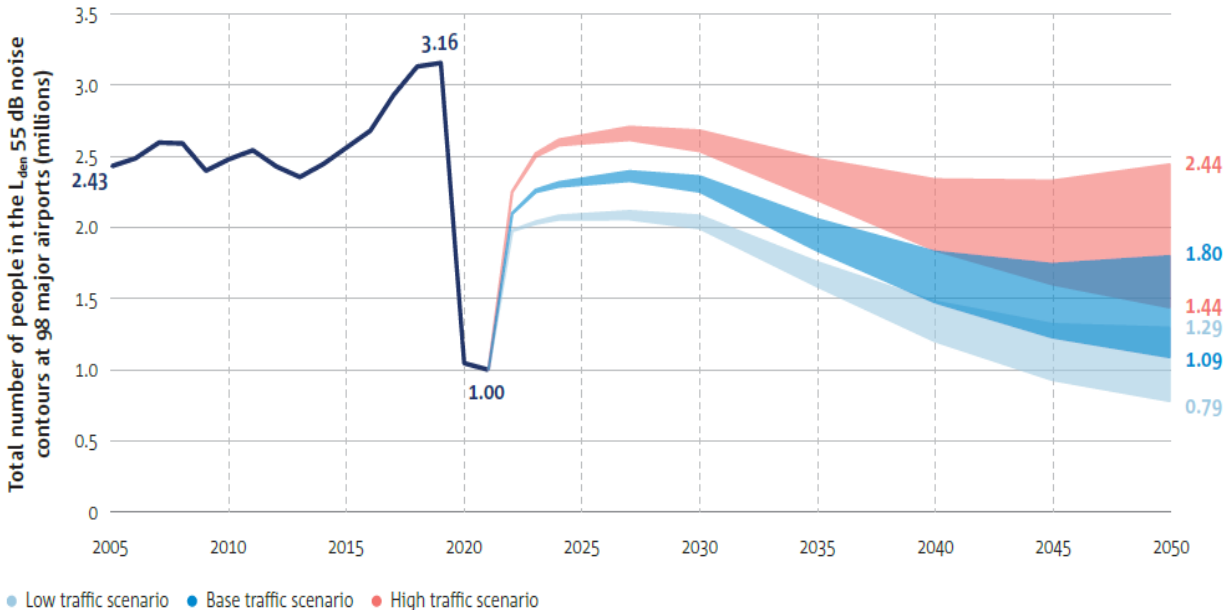

Fig. 3. Aviation noise exposure: forecast after COVID-19 outbreak (EASA, 2020)

On the other hand, the problem of annoyance caused by environmental noise will not decrease proportionally to the reduction in noise exposure due to a number of non-acoustic factors that can significantly influence the level of local population annoyance. Such factors include: characteristics of the sound event, level of engagement of the local population in understanding the issue of acoustic pollution and existing management mechanisms, daily migration processes, and the presence of other environmental stressors, urban planning and design, socio-economic factors, and individual sensitivities to noise. All these factors contribute to the overall annoyance and impact of noise pollution on the local population. In particular, the results of observations on the number of complaints during the pandemic restrictions revealed cases of increased annoyance among the population due to urban noise, including aviation noise, despite a significant reduction in the number of take-off and landing operations. These observations emphasize the need for a comprehensive understanding of noise management strategies that go beyond mere reduction in exposure levels.

For example, during the COVID-19 lockdown in Spring 2020, many cities, including Greater London in the UK, experienced significant changes in daily routines and behaviors due to restrictions on movement and social distancing measures (Tong, H at al., 2021). These changes likely had an impact on noise complaints and patterns (Fig. 4). The results (Tong, H at al., 2021) show that during the COVID-19 lockdown the number of noise complaints increased by 48%, compared with the same

period during Spring 2019. In this way, such studies only confirm non-acoustic factors and the necessity to consider not only noise exposure but also the importance of involving the local population in the development of noise action plans.

Implementation of Aviation Rules of Ukraine № 381 and the initial results. In Ukraine, the issue of environmental pollution from airports was not regulated at the state level until 2019. This included the absence of any approved guidelines or aviation rules that would regulate the assessment of the noise impact from airports on the population residing in adjacent areas, as well as practical recommendations regarding the mutual development of airports and local communities. On the other hand, due to significant gaps in national environmental legislation, the information provided to the public about the environmental problems of airports was also at a relatively low level. Airport websites or official aviation authority websites did not contain the results of zoning the areas surrounding airports based on noise impact, emissions, electromagnetic radiation, and third-party risk, which had been carried out by experts from the Airport Environmental Problems Center/ National Aviation University since 2009.

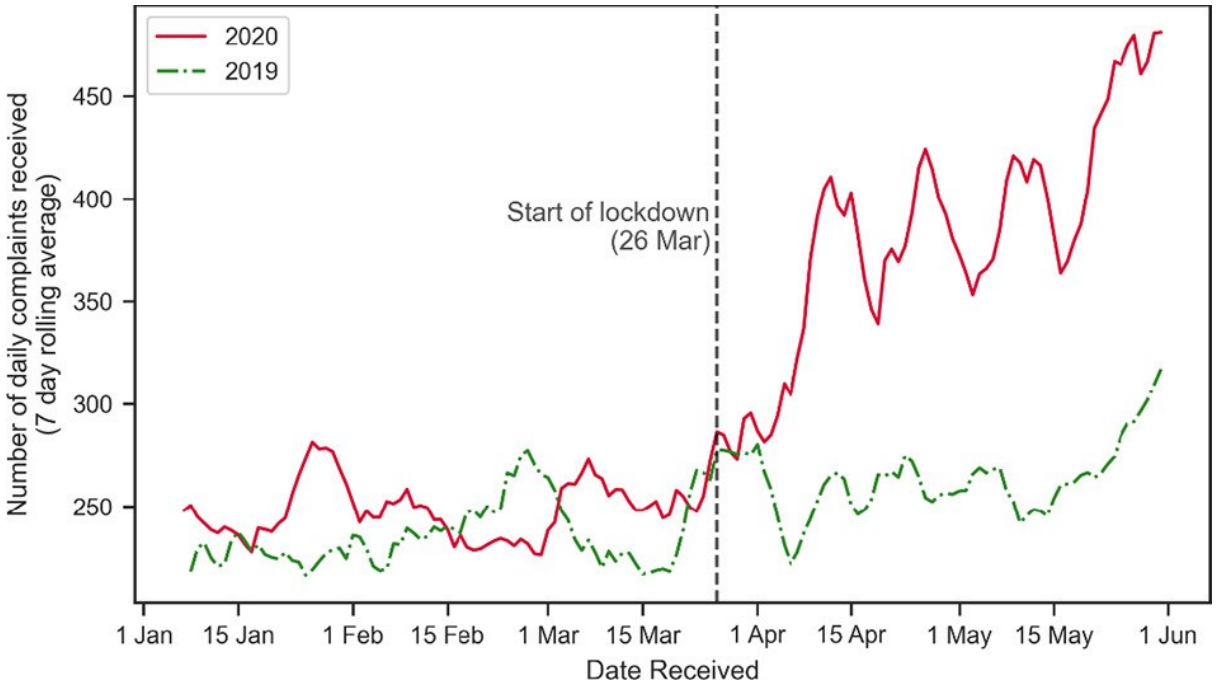

Fig. 4. Results of research in London on changes in noise perception during pandemic restrictions (Tong, H et al., 2021)

Against the backdrop of Eurointegration processes, the State Aviation Service of Ukraine introduced the Aviation Rules of Ukraine № 381 (ARU № 381) in 2019 (ДАСУ, 2019). The implementation of these rules aimed to establish clear requirements for airport operators regarding the conditions and zoning regulations of aerodrome areas based on the impact of aviation noise. It also includes requirements for the quality of input data, the necessity of conducting field measurements, and the publication of data on restricted residential development zones around airports. The publication of ARU No. 381 raised several clarifying questions among airport operators. In order to strengthen and clarify specific provisions, Guidelines for Spatial Zoning of the Area Surrounding the Airport based on the Impact of Aviation Noise (Order of the State Aviation Service

of Ukraine № 585, dated April 23, 2020) were developed (ДАСУ, 2020). Therefore, these two documents, despite their different levels, are desirable to be considered together as a comprehensive approach. The new ARU № 381 and MR № 585 establish requirements for creating noise maps in the vicinity of airports. Similar types of regulatory and legislative acts in the field of protecting the population from the harmful effects of noise from other sources (such as road traffic noise, railway noise, industrial noise) are currently absent in Ukraine. However, the existence of restricted development zones (sanitary protection zones) is required by state sanitary and building norms, including State Sanitary Rules № 173.

In 2021, the State Aviation Service of Ukraine (SASU), with the support of the "Consultative Fund to Support the Ukraine-EU Association" and GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit), launched the NOMOS project (Noise Monitoring System, https://nomos.avia.gov.ua/) – Fig.3.

This project essentially serves as an equivalent to the European resource called The NOISE Observation & Information Service for Europe (https://noise.eea.europa.eu). However, a detailed analysis of ARU № 381 and MR № 585 revealed significant fundamental differences from the European approach defined within Directive 2002/49.

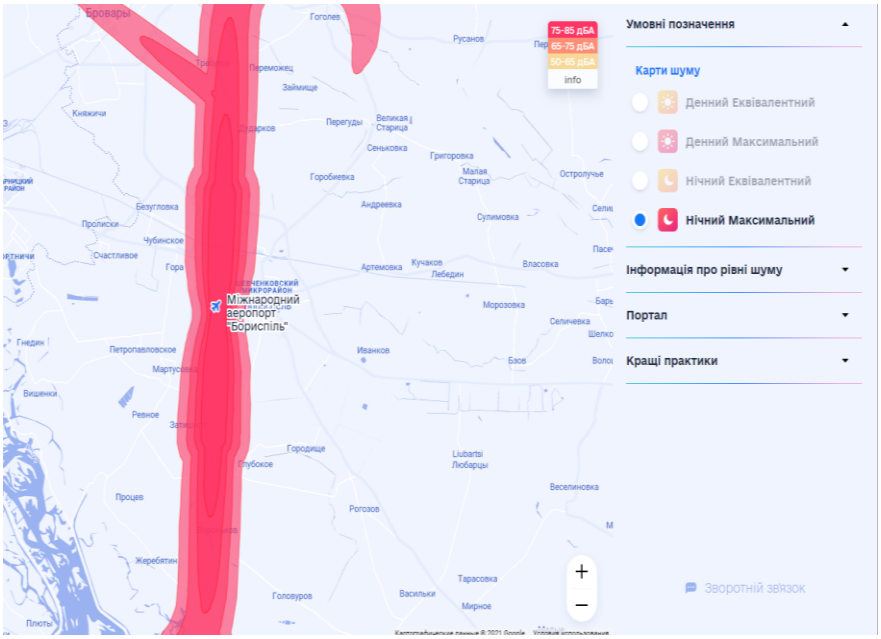

Fig. 5. Example of noise data from NOMOS portal: noise zones and major airport vicinity

Results and Discussion. Although ARU № 381 was developed and approved with the aim of implementing EU Directive 2002/49/EC of the European Parliament and the Council dated June 25, 2002, ARU №. 381 and MR № 585, which complement it, are neither a translation of the Directive nor an improved version of it.

Ukrainian Aviation Regulations №381, implemented by the State Aviation Service of Ukraine in 2019, play a vital role in regulating environmental issues at airports. These regulations aim to ensure flight safety and protect the environment, including mitigating noise pollution. The implementation of ARU № 381 is an important step for Ukraine in aligning with European standards

and requirements for environmental protection in the aviation industry. It will contribute to reducing noise impact on the population and improving the ecological situation around airports.

However, alongside these achievements, it is important to note a different logic in the construction of the key stages of aviation noise management compared to the recommendations of Directive 2002/49 (Figure 3). In particular, the analysis of Ukrainian regulatory acts issued by the State Aviation Service has allowed for the development of an algorithm for noise management in airport vicinity, as presented in Fig. 4. As shown, important stages such as community engagement and document development are beyond the requirements of these regulations. There are also no clearly defined obligations to assess the impact of implemented measures once every five years, leaving only the function of a 5-year control that does not conclude with any auditing or verification upon the completion of the 5-year cycle.

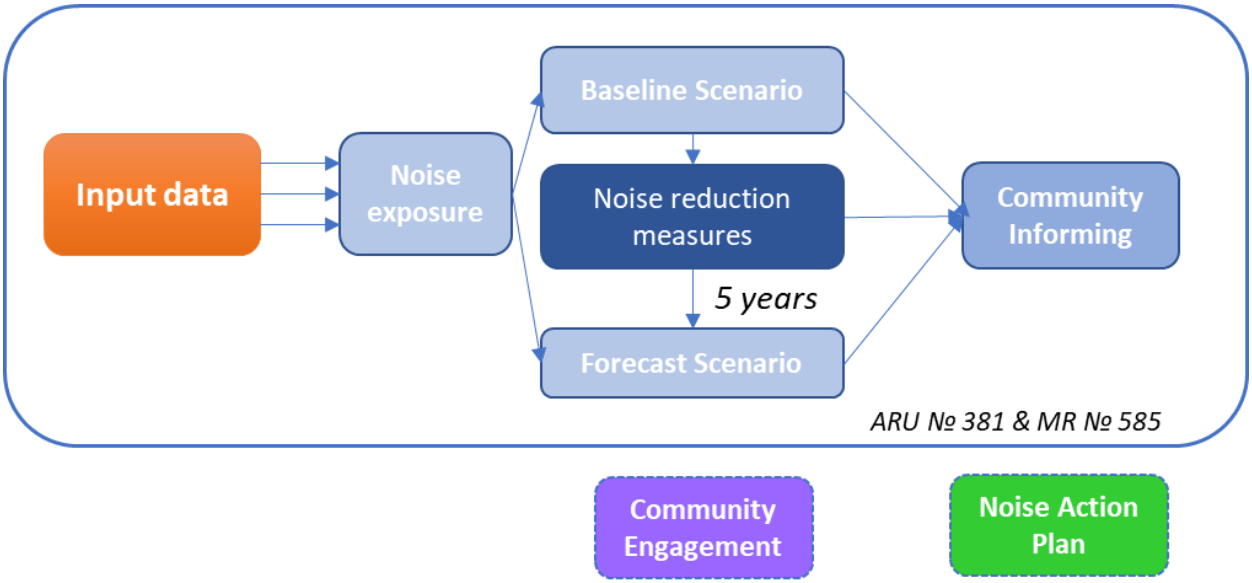

Fig. 4. The ARU № 381 cycle and key stages

A comparative analysis of EU Directive 2002/49/EC and ARU № 381 reveals several differences, with the main one being the level of implementation of these documents (Table 1), although there are also certain conceptual inconsistencies. In particular, ARU № 381 and MR №585 establish zoning requirements for the surrounding areas of all civil aviation airports in Ukraine, regardless of the volume of aviation transport, unlike Directive 2002/49/EC, which focuses on large noise sources - major airports with over 50,000 operations (take-offs and landings) per year (excluding training flights and light aircraft operations). The absence of a minimum number of operations requirement in ARU № 381 makes it challenging to determine noise levels according to the Lden criterion as defined in EU Directive 2002/49/EC.

Additionally, compliance with these regulations will help establish Ukraine's reputation as a responsible participant in the international aviation community and safeguard the health of the population residing near airports. The development and implementation of action plans to reduce aviation noise, as outlined in aviation regulations, are also crucial steps. In EU countries, Directive 2002/49 defines two key indicators, annoyance and sleep disturbance, which, when exceeded, require the formulation of action plans to reduce exposure and protect noise-free areas. ARU contains stricter

provisions regarding field acoustic measurements and recommendations for implementing a noise monitoring system.

Table 1

Compliance of ARU No. 381 (including Amendment No. 585) with the requirements of Directive 2002/49

The parameter of compliance	ARU № 381 [3]	MR № 585 [4]	EC Directive 2002/49 [2]
The level of the document.	Industry regulations.	Industry regulations and methodological recommendation	Pan-European
Scale	Any civil aviation airport of Ukraine		The main airport (serving over 50,000 operations per year) City airport
Noise criteria	*LAmax, LAeq, Lden*		*Lden, Lnight*
Time periods	Day: 07:00-23:00 Night: 23:00-07:00	Day: 08:00-22:00 Night: 22:00-08:00	Day: 07:00-19:00 Evening: 19:00 - 23:00 Night: 23:00- 07:00
Normative values of assessment criteria	According to the current National Standards or Building Codes, the values are not specified in the analyzed documents.		The noise levels for zoning are defined in the Appendix to the Directive
The primary method of obtaining data	Modeling and field acoustic measurements		Modeling
The necessity of validating modeling with field acoustic measurements.	+	+	-
Noise monitoring demands	The decision regarding the necessity of installing a noise monitoring system rest with the aerodrome operator		-
The system for informing the population	Noise Monitoring System		The NOISE Observation & Information Service for Europe
Web-site	https://nomos.avia.gov.ua/		https://noise.eea.europa.eu
Development of noise action plan	The development of recommendations regarding the necessity of implementation is required.		The development of an action plan is required.

Conclusions. At this stage in Ukraine, it is necessary to implement a national-level legislative act that would serve as an equivalent to the EU Directive 2002/49. Such a legislative act should create the political groundwork for managing major noise sources and harmonize EU noise management requirements with Ukrainian legislation. Additionally, there is a need to align the requirements of Ukrainian Aviation Regulations № 381 and the corresponding methodological recommendations

(MR № 585) with the current national requirements in the core part of the aviation noise impact assessment methodology. This requires a clear definition of the role of criteria for assessing aviation noise and the duration of research intervals.

Overall, the implementation of the main provisions of the Directive has contributed to raising public awareness about noise pollution issues and the development of strategic action plans. It has also enabled the comparative assessment of different modes of transport based on noise impact criteria, as demonstrated in studies such as the EEA's "Transport and environment report 2020. Train or plane?" (EEA, 2020).

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