Implementation of the Land Use Planning and Management Practices at Ukrainian Airports: Gaps and Lessons Learned

O Konovalova[1,2] and O Zaporozhets[1]

[1] Research Centre of Environmental Problems of Airports, National Aviation University, 1 Liubomyra Huzara ave., Kyiv 03058, Ukraine

[2] E-mail: ekon@nau.edu.ua

Abstract: The paper provides an overview of international and national legislations and policies supporting noise management approaches and land use planning at airports in Ukraine with focus on gaps and challenges. As a case study for implementation of land use planning the project of the Research Centre of Environmental Problems of Airports at National Aviation University aiming to produce noise footprints for Zaporizhzhia International Airport according to the Ukrainian Aviation Rules AR-381 with resulting in recommendations for land use inside noise protection zones is presented.

1. Introduction

Civil airports are important national and regional infrastructure and transport centers. Airports have both social and economic impacts on the communities surrounding them. They contribute significantly to the national economy, as well as to the economies of the cities and regions where they are located, providing jobs and paying taxes to the regional budget. For passengers, airports are the symbol of inter-regional and global connectivity and mobility. For nearby residents, however, an airport may threaten their quality of life.

Noise is one of the most important concerns of residents. Aircraft noise is a major issue in most countries, especially in areas of high population. Today, we consider annoyance as the most obvious reaction to aircraft noise. Encroaching development in the vicinity of airports can result in public pressure to restrict operations or even close airports. With the clear indication that air travel is continuing to rise and communities becoming more vocal about noise impact, airports need to continue putting noise mitigation at the centre of their strategies.

Traditionally, noise has been the key environmental constraint to airport development.

By considering the implementation of balanced approach before noise becomes a constraint, airports will have the pole to manage their development. Land-use planning is perhaps the best way through which this can be done. For instance, if airports are able to develop long-term noise maps based on reliable prediction of the future intensity of movements, they will be able to resist the encroachment of noise sensitive activities such as public residences, schools, hotels, business centres, thus leading to fewer noise problems in the longer term.

2. Aircraft noise related legislative framework

2.1. ICAO guidance for land use planning and management

ICAO developed Land-use planning and management as one the four pillars of the Balanced Approach to aircraft noise management being an effective means to ensure that the activities nearby airports are compatible with aviation. The main goal of the land use planning is to minimize the population affected by aircraft noise by introducing land-use zoning around airports.

Within land use zoning ICAO consider compatible land-use planning and management as an instrument in ensuring that the gains achieved by the reduced noise of the latest generation of aircraft are not offset by further residential development around airports.

ICAO's main policies on land use planning and management are contained in Assembly Resolution A39-1, Appendix F, [1]focusing on minimizing aircraft noise problems through preventive measures, such as:

a) locate new airports at an appropriate place, such as away from noise-sensitive areas;

b) take the appropriate measures so that land-use planning is taken fully into account at the initial stage of any new airport or of development at an existing airport;

c) define zones around airports associated with different noise levels and establish criteria for the appropriate use of such land, taking account of ICAO guidance;

d) enact legislation, establish guidance or other appropriate means to achieve compliance with those criteria for land use; and

e) ensure that reader-friendly information on aircraft operations and their environmental effects is available to communities near airports.

The ICAO Balanced Approach (EC Directive 2002/30/EC) was transposed into law "Air Code of Ukraine" though the article 84 in Chapter X "Protection of the Environment". This article establishes the ICAO procedures with regard to the introduction of noise-related operating restrictions at Ukrainian airports. These include:

- taking into account costs and benefits of new measures (art. 84.5)
- being non-discriminatory on grounds of nationality or identity of air carrier or aircraft manufacturer and being no more restrictive than necessary in order to achieve the environmental objectives for a specific airport (art. 84.4)
- ensuring any performance-based operating restrictions are based on the noise performance of the aircraft as determined by ICAO certification procedures (art. 84.3).

2.2. European Union legislation related to aircraft noise

The Environmental Noise Directive, i.e. Directive 2002/49/EC [2], is the common legislative framework related to aircraft noise in all Member States of the European Union. The main requirements of the END Directive includes preparing noise maps and noise management action plans on a 5-year basis, for airports having more than 50,000 movements/year to assess, reduce and prevent the exposure of the population to noise. This approach ensures the provision of a common basis for action against noise exposure for all Member States of the European Union.

The Directive does not set limit or target values, nor does it prescribe the measures to be included in the action plans, thus leaving those issues at the discretion of the competent Member State authorities. This means that the implementation of the Directive is different from one Member States to another, due to their distinct legislations, policies and practices at the National level.

EU Directive relating to Environmental Noise (END 2002/49) is still not proved in national legal system and not fully implemented for environmental noise control. Strategic noise maps and Noise action planning are still absent for all major airports in Ukraine. If an analysis was to be performed with respect to the criteria and requirements defined by END, Ukraine has only one airport having over 50,000 aircraft movements per year –Kyiv/Borispol airport satisfies this condition at the moment (before the gap due to pandemic situation with COVID-19). However, a number of Ukrainian airports may be recognized as city airports, such as Kiev-Zhuliany, Odessa, Lviv, Dnepr, Zaporizhzhia and

other, because they are completely surrounded by urban agglomerations, so they also must be considered for END assessment.

2.3. Overview of Ukrainian legislation

At the earlier 2016 Civil Aviation Administration (CAA) developed and adopted the new State target Programme for Airports Development in Ukraine for the period to 2023 (Order of the Cabinet of Ministry №126 dated 24/2/2016). According to this Program, aerodromes became the property of the airport operators as state enterprises, which also got the necessary land plots in the permanent use.

On 23 May 2017 the Parliament of Ukraine adopted the Law of Ukraine "On Environmental Impact Assessment" No. 2059-VIII (the "EIA Law") which became effective since 18 December 2017. The EIA Law implements Directive 2011/92/ EU "On the Assessment of the Effects of Certain Public and Private Projects on the Environment". According to this document, reconstruction of airports with the runway more than 1600 m length is obligatory a subject for a procedure of environmental impact assessment engaging public and local residents for discussions. The environmental impact assessment (EIA) is mandatory in the process of decision-making on carrying out the proposed activity. Such a proposed activity shall be made subject to the EIA before the decision on carrying out the proposed activity is made. According to the procedure of Environmental Impact Assessment the timely, adequate and effective informing of the public is ensured in the process of the environmental impact assessment. Community is involved in the process and has the right to give comments, recommendations.

One of the principal documents for noise zoning is Ukrainian Aviation Rules “Requirements for operators related to noise zoning of the airport vicinity” AR-381 which was developed by CAA of Ukraine, adoption on March 26, 2019 [3] with the additional document called “Methodical instructions on airport vicinity zoning according to noise conditions” approved by CAA by the Order 585 dated 23.04.2020 [4].Those documents oblige airports to be responsible for the development of noise maps on a 5-year basis or in case of implementation of development projects with the influence on intensity of aircraft movements. Noise maps are developed through the use of computer modelling techniques with obligatory validation using noise measurements. The development process accounts for various factors, such as the number of aircraft movements, the fleet mix, the expected fleet changes, potential infrastructure changes and others. Through the use of aforementioned factors prediction noise maps are developed for the next 5 years. Limit values are focused on the determination of four noise criteria: equivalent noise levels L_{Aeq} *(dBA)* and maximum noise levels L_{AMax} *(dBA).*AlthoughAR-381 under the transposition of the END reference to the use of noise indicators $L_{den}$and L_{den}– for evaluation of aircraft noise impact on population, the document does not contain normative noise levels for noise zones.

The normative criteria of noise contamination are equivalent noise levels L_{Aeq} *(dBA)* and maximum noise levels L_{AMax} *(dBA)* during daytime (from 7:00 till 23:00) and nighttime (from 23:00 till 7:00) as it is set in the State Sanitary Norms [5] which are in force. On the other hand, time limits set by the Methodical instructions 585 assign the other values: daytime (from 8:00 till 22:00) and night-time (from 22:00 till 8:00) which give uncertainties for their implementation.

Noise levels are regulated with respect to restrictions for constructions around civil airports designated the areas as “Unsuitable for Construction”, “Protection against noise impact” and “Limitations for residential Construction”.

Annex 18 to the Sanitary rules N 173 defines 4 noise protection zones around the airports as presented in the table 1:

Table 1. Normative values for noise maps with respect to restriction of construction around airports

Day time	A	B	C	D
Day	$L_{Aeq}\leq 60$	$61\leq L_{Aeq}\leq 65$	$61\leq L_{Aeq}\leq 65$	$L_{Aeq}>65$
	$L_{AMax}\leq 80$	$81\leq L_{AMax}\leq 85$	$61\leq L_{AMax}\leq 85$	$L_{AMax}>85$
Night	$L_{Aeq}\leq 50$	$51\leq L_{Aeq}\leq 55$	$56\leq L_{Aeq}\leq 60$	$L_{Aeq}>60$
	$L_{AMax}\leq 70$	$71\leq L_{AMax}\leq 75$	$76\leq L_{AMax}\leq 80$	$L_{AMax}>80$

Annex N 19 to the Sanitary rules N 173 defines opportunity and conditions for construction of new buildings inside the noise protection zones

Table 2. Requirements for new construction inside noise protection zones

Designation of buildings	Construction of buildings inside zones			
	A	B	C	D
Residential buildings, kindergartens	is permitted	is permitted with increased sound insulation of external enclosures that provide noise reduction, ΔL_AdBA 25 30		is prohibited
Polyclinics, medical centers	is permitted in part of the zone with the levels in the daytime L_{Aeq}≤55 dBA without limitations, L_{Aeq}≤56-60 dBA with increased sound insulation (ΔL_A=25 dBA)	is permitted with enhanced soundproofing, which provides ΔL_A=30 dBA		is prohibited
Schools	is permitted	is permitted with enhanced soundproofing, which provides ΔL_A=25 dBA		is prohibited
Hotels	is permitted	is permitted with enhanced soundproofing, which provides ΔL_AdBA 25 30		
Administrative buildings, design and research organizations	is permitted	is permitted	is permitted	is permitted if the necessary sound insulation is provided

All certified airports in Ukraine had the noise maps (Noise Protection Zones), so as the maps for third party risk (Public Safety Zones), local air pollution (Sanitary Protection Zones) and electro-magnetic fields (EM Protection Zones). From 2006 to 2019 those maps were obligatorily included in certification procedures of the airports. Experts of the Research Centre for Airport Environmental Problems of National Aviation University have made the complex of investigations and, as a result, the zones of aircraft noise impact for the most of civil airports in Ukraine. Those projects were performed in the frames of aerodrome certification procedure for the following airports: Kiev Borispol, Kiev Zhulyany, Kiev Gostomel, Kiev Antonov, Odessa, Lviv, Dnepropetrovsk, Vinnitsa, Simpheropol, Chernitvsy, Rovno, Khmelnitsky.

Evaluation of noise contamination was also a part of projects of the Centre for Environmental impact assessment of projects of reconstruction of civil airports: for EURO-2012 – Borispol, Lvov, Kharkiv; Lviv-2010 – runway extension; Odessa-2018 – reconstruction of the runway.

With the adoption on AR-381 those maps are no more valid and effective.

3. Noise management and Land Use planning practice in Ukraine – case studies

In order to be able to understand the importance of Aircraft Noise Management and LUP for Ukrainian airports it is necessary to analyse trends in air traffic growth during last 10 years before the closure due to pandemic of COVID-19.

Passenger flows through Ukrainian airports during 2011 increased by 21%, had a peak in 2012 due to holding of the 2012 UEFA European Championship. It should be mentioned that according to Civil Aviation Administration (CAA) report 2015 year showed reduction in passenger traffic in comparison with 2014 for 3,7% due to unstable political situation. But if we analyse figures airport by airport, from January to September Borispol International Airport showed increase up to 4,9% reached 5583 thousand of passengers, Odessa International Airport also reported ↑14% reaching 752,2 thousand of passengers. The overall decrease was explained by the reduction of the passenger traffic in the following airports (data presented for the three quarters of 2015): Dnepr International airport (↓25.8%), Kharkiv International airport (↓23.8%), Kiev-Zhuliany International Airport (↓10,5%) andLviv International Airport (↓4.8%).During 2016 the volume of passenger air transportation has grown by 25.5%.

The total passenger traffic of Ukrainian airports in 2018 amounted to 20,55 million people. Compared to 2017, when all the country's airports served 16,49 million people, the figure in 2018 is 25% higher. Several airports even could be considered as rapidly-grown. Among them there are Kiev-Zhuliany (↑52%), Chernovtsy (↑51%), Lviv (↑48%), Khrarkiv and Borispol (↑19%) and Zaporizhzhia (↑15%).

The passenger traffic of Ukrainian airports for 11 months of 2019 amounted to 22 million 576 thousand passengers, which is 18,7% higher than the result for the same period last year. Passenger traffic on international flights increased by 20% and amounted to 20 million 404.2 thousand people. On domestic flights, the number of passengers served increased by 7,7% to 2 million 171,8 thousand passengers. The largest airports in Ukraine in terms of passenger traffic for 11 months of 2019: Boryspil – 14,206 million (↑ 21,6%); Lviv – 2,45 million (39,4%); Kharkiv – 1,227 million (↑39%); Zaporizhzhia – 392,8 thousand (↑6,3%); Dnipro – 318,6 thousand (↑14%).

Overall volume of cargo (except mail) operated by Ukrainian airports was reported as increased by 21,1% in 2017 comparing to 2016 and reached 43.7 thousand of tones and ↑9.5% in 2018 in comparison to 2017.

If we consider this grows in terms of aircraft movements (which is related to airport environmental issues – noise exposure – more directly, than passengers flow), we get the following trends.

Turning to Ukraine, we finalise that the main share of total passenger movements (more than 90%) is concentrated in 5 strategic international airports of Ukraine: Boryspil, Dnipropetrovsk, Odessa, Lviv, Kharkiv and Kyiv (Zhuliany Airport).

Statistic data starting from the year 2011 and later clearly evidenced Boryspil International Airport shared more than 60% of the total volume of air passenger handling, more than 70% of the total volume of cargo and mail handling among the airports of Ukraine

Active recovery of air traffic volumes in Ukraine, which had started in 2016 and converted into rapid increase of demand for air traffic in 2018-2019 substantiate the necessity of implementation the variety of measures and approaches considered in reducing and/or preventing the exposure and impact of aircraft noise.

Since the adoption of the AR-38, National Aviation University started performing projects of noise mapping for several civil airports and aerodromes, such as Zaporizhzhia International Airport, Kiev-Antonov-1 and Kiev-Antonov-2 aerodromes.

As a case study for implementation of land use planning we have chosen the project of the National Aviation University (NAU) aiming to produce noise footprints for Zaporizhzhia International Airport according to the Ukrainian Aviation Rules AR-381 with resulting in recommendations for land use inside noise protection zones.

The project is considered due to its concern for the following aspects:

Implementation of new legislation. According to Aviation Rules AR-381civil airports of Ukraine are obliged to assess noise impact on environment by establishing noise protection zones. Those zones are to be calculated and validated by measurements at least once every five years or in case of airport reconstruction and significant change in traffic, fleet and operational conditions.

Airport development plans. Construction of the new passenger terminal launched by Zaporizhzhia International Airport with the expected traffic capacity of 400 passengers per hour is scheduled to the completed in 2020.

According to the requirements of the AR-381 NAU will perform calculations of noise contours. Due to financial costs, measurements of aircraft noise in the residential areas near the aerodrome which are also mandatory according the AR-381 are not included in the project, but planned to be done as the next stage of the project. The other reason for the consideration of this project is that according to the Article 3 "Scope of application of the environmental impact assessment" of the Law of Ukraine "About Environmental Impact Assessment" airport is obliged to perform the procedure of environmental impact assessment of the project of the new passenger terminal construction. The terminal construction is included in the second category of the types of the proposed activity and objects likely to cause a significant impact on the environment in the paragraph 10 "Infrastructure projects".

Zaporizhzhia International airport, which is located is the regional city of Zaporizhzhia, is one of the key transport infrastructure enterprises providing services to the eastern and south-eastern regions of Ukraine. The airport is operated by Utility Enterprise "Zaporizhzhia International Airport". The aerodrome is located 12 km north-east from Zaporizhzhia city center.

The nearest residential area namely the Levanevskogo district of the Zaporizhzhia city is located at a distance of about 700 m from the Runway end 02. Summer cottages are located at about 840 m to the south-west from the same runway end. Novoivanovske village is located at a distance of 2300 m away from the runway end 20. In the transverse direction from the axis of the runway the nearest Pikhotna Street behind Donetsk highway is located at a distance of 1.4 km.

On the other side of the airfield the village of Hasanovka, Volnyansky district, is located at a distance of 1.8 km from the runway axis.

For the last 5 years Zaporizhzhia Airport has been steadily increasing its passenger traffic. 2019 was no exception also, when the number of passengers increased up to 434 thousand for the first time in two decades. Compared to 2018, when just 400 000 people were transported, this figure increased by 8.5%. Almost 326 thousand people were transported on international airlines (by 6.7 more in 2018), and on domestic airlines – 108 thousand (and increase of 14%).

It is worth noting that such a strong performance was achieved in 2019 despite the fact that the company heavily overhauled the airfield. Due to this, the airport has not received aircraft for almost a month and a half. Significantly, in the last month of 2019 the airport served 34% more passengers than in 2018 which is more than 41 thousand people. The increase was observed both on international airlines, which served more than 30 thousand (an increase of 33%) and on domestic airlines – almost 11 thousand of people (an increase of 36%).

The airport covers the area with above 4mln residents and this forms the basis of its market potential, likely to develop in the future.

Construction of the new passenger terminal launched by Zaporizhzhia International Airport with the expected traffic capacity of 400 passengers per hour is scheduled to the completed in 2020.

Trends in passenger traffic and the share of Zaporizhia airport in the total passenger traffic in Ukraine are given on the diagrams 1-2:

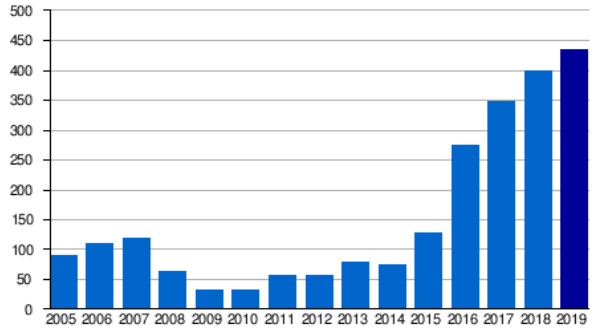

Diagram 1. Annual passenger traffic, thousands of passengers

Diagram 2. Zaporizhzhia International Airport passenger traffic and its contribution in the total passenger traffic of Ukraine

For calculation of noise contours on the basis of analysis of flight plans for the 2019 year the following scenarios were chosen:

1st scenario: the maximum intensity of aircraft movements reached in 2019 taking into account weighted distributions between aircraft routes.

2nd scenario: perspective intensity of aircraft movements equal to maximum operational capacity of the runway-apron-terminal system.

As a result of calculations, the noise protection zones were obtained.

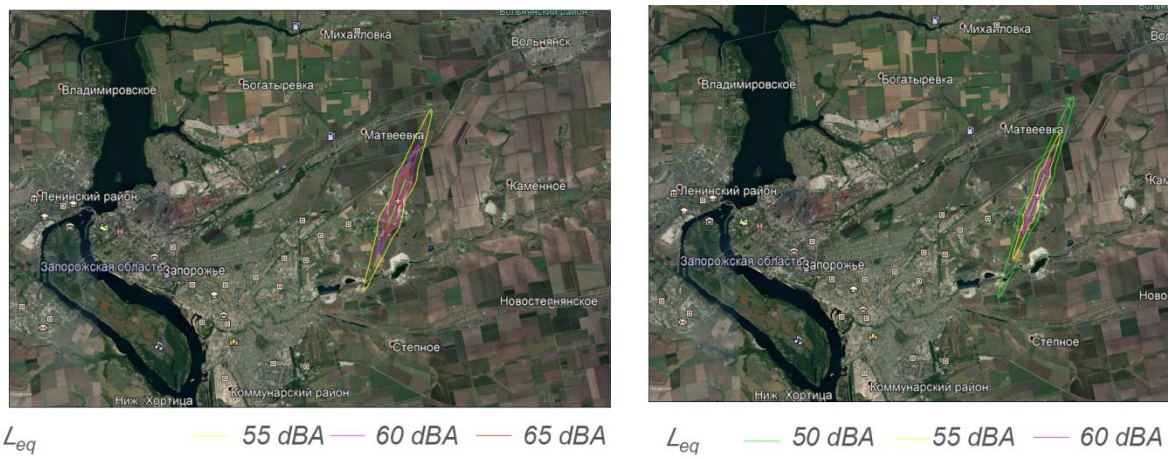

Figure 1. Noise contours (L_{Aeq}, *dBA*)for Zaporizhzhia International Airport: left – for daytime 7:00-23:00; right – for nighttime 23:00-7:00

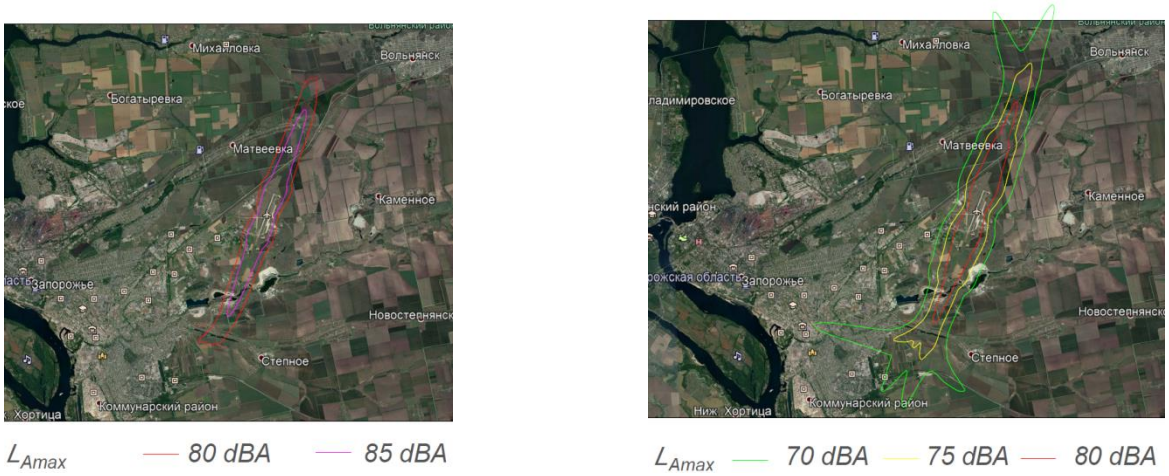

Figure 2. Noise contours (L_{Amax}, *dBA*) for Zaporizhzhia International Airport: left – for daytime 7:00-23:00; right – for nighttime 23:00-7:00

Analysis of the noise contours shows that noise contours overlay residential areas, therefore the complex program for land use planning is to be developed with recommendations for noise control measures writhing noise protection zones.

4. Conclusions and lessons learned

As the first conclusion it should be mentioned that, in general, Ukrainian legislation follows the principal requirements of ICAO. On the other hand, the process of implementation of those requirements lags behind in comparison to western European countries due to investments needed.

Still several types of aircraft certified according to Chapter 2 and Chapter 3 requirements are operated in Ukrainian airports. Their operation is associated with economic reasons – the lack of investments airlines need for fleet changing.

If to consider operational restrictions as an element of ICAO Balanced Approach to aircraft noise management, they are not implemented in most of Ukrainian airports due to low intensity of aircraft movements. As the very exceptional example – there are prohibited night-time operations at Antonov Airlines Kyiv-Antonov-2 aerodrome and even the day-time operations along the flight route directed to the urban regions of Kyiv city.

Aircraft noise management and land use planning can be approached as an integrated process which is in case of Ukraine included from the core functioning process of airport operations, defined by the requirements of Ukrainian Aviation Rules AR-381 and Air Code of Ukraine.

Legislation for noise zoning still includes L_{Amax} criteria, although this criterion is not decisive for noise impact – at least during the day. For strategic noise mapping it is recommended by ICAO and required by newish Ukrainian Aviation Rules "Requirements for operators related to noise zoning of the airport vicinity" AR-381 to use noise indexes such as L_{den} and L_{dn}, therefore there is a need to fully integrate those criteria in Ukrainian legislation for environment protection and health.

It is necessary to mention that existing legislation allows airports to build a systemic program to control noise exposure in their vicinity, taking into account both European and world best practice, which is very important because most of Ukrainian airport can be considered as city airports surrounded by residential territories. And due to current low intensity of aircraft movements, and, as a result, low priority of noise as an environmental problem nowadays, there are several cases when development of cities can be found as with no respect to the predicted development of airports.

Harmonisation of Ukrainian legislation related to noise challenges is one of the ways to improve current noise situation and can contribute to further implementation of the ICAO Balanced Approach.

Guidance related to effective implementation of interventions to reduce and/or prevent the noise impact and noise exposure is insufficient, therefore further in-depth research on the experience of other airports dealing with aircraft noise is needed.

Analysis of the best practices which is performed in the frames of European Project "ANIMA – Aviation Noise Impact Management through Novel Approaches" of the H2020 Programme of the European Commission and the Innovation and Networks Executive Agency is considered as the booster to improve the quality of noise management programs.

References

[1] Resolution A39-1: Consolidated statement of continuing ICAO policies and practices related to environmental protection – General provisions, noise and local air quality. (ICAO) 2019. https://www.icao.int/environmental-protection/Documents/Resolution_A39_1.PDF

[2] European Parliament, European Council 2002. Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise – Declaration by the Commission in the Conciliation Committee on the Directive relating to the assessment and management of environmental noise. https://eur-lex.europa.eu/

[3] Ukrainian Aviation Rules "Requirements for operators related to noise zoning of the airport vicinity" AR-381 (CAA) 2019 https://zakon.rada.gov.ua/laws/show/z0461-19?lang=en/

[4] Order 585 dated 23.04.2020 "Methodical instructions on airport vicinity zoning according to noise conditions" (CAA) 2020 https://avia.gov.ua/wp-content/uploads/2019/10/Nakaz-585-Pro-zatverdzhennya-metodichnih-rekomendatsij-2.pdf

[5] State Sanitary Rules for planning of inhabited localities 1996 (Order of Ministry of Health #173 dated 19.06.1996) https://zakon.rada.gov.ua/laws/show/z0379-96#Text