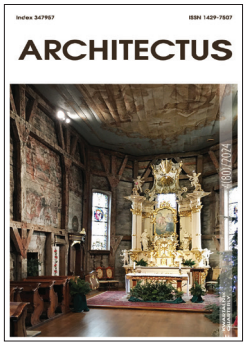

Architectus

2024
4(80)

DOI: 10.37190/arc240410

Dominika Agnieszka Kumorek*

Evaluation of awareness of existence and potential use of strategic noise maps among residents of the Wawer district in Warsaw

Abstract

Noise pollution currently stands as one of the foremost environmental threats. It has a negative impact on both the physical and mental well-being of users inhabiting affected spaces. It results in difficulties in everyday functioning, and with prolonged exposure, even permanent damage to health. The problem intensifies with the number of newly created noise sources and is particularly oppressive in areas where it did not occur until intensive development. Strategic noise maps (SNM) serve as a valuable tool to help in the fight against the constantly spreading noise. They are used to assess the level of noise in the environment and develop effective protection programs against it. Unfortunately, despite widespread availability, an obvious barrier to the full use of strategic noise maps is low public awareness of their existence, content, and potential utility. The article presents an original study aimed at assessing the awareness of residents of the Wawer district of Warsaw about the existence and possibilities of using strategic noise maps. The study used an online survey in which respondents shared their experiences and opinions about strategic noise maps. The survey results clearly showed that residents' awareness of the existence and concept of strategic noise maps is low. At the same time, awareness of the benefits of using strategic noise maps is quite high. The respondents also listed a number of barriers that they perceive as obstacles to their full use. The findings of the study led to conclusions, proposing solutions that could increase this awareness.

Key words: acoustics, strategic noise maps, noise, soundscape

Introduction

The research problem addressed in this paper pertains to the level of public awareness regarding the existence and potential applications of strategic noise maps (hereinafter: SNM). An analysis of the existing literature revealed a lack of information on this topic. The level of awareness is particularly crucial in areas that, for many years, have been considered quiet and requiring no intervention, but which now require special protection. In the case of Warsaw, this issue can be explored through the example of the Wawer district, which, despite the dynamic spatial changes of recent years, is still considered quiet and peaceful. The aim of the study presented in this article is to assess the degree of familiarity of its residents with the term "strategic noise maps" and their range of applications. The research method adopted was an online survey, divided into two parts: the first part focused on the respondents' knowledge and their potential experiences with the use of SNM, while the second invited them to share their opinions on the potential benefits of using and promoting SNM, as well as the barriers that limit their full utilization. The survey was distributed via the internet through one of the most popular forums related to the district's daily matters: "Wawer moja dzielnica" [Wawer my district]. Responses were collected in March and April 2024. The conclusions were presented in the form of proposed solutions that could contribute to the dissemination of knowledge about strategic noise maps. The research section was preceded by a literature review, including a verification of the current state of research at the time of publication.

* ORCID: 0009-0000-3477-5558. Faculty of Architecture, Warsaw University of Technology Doctoral School, Poland, e-mail: dominika.kumorek.dokt@pw.edu.pl

State of research

The definition of noise is often expressed using various terms. Noise is described as […] *any unwanted, unpleasant, or bothersome sound occurring in a particular place, time, and circumstances* (gov.pl 2024), as well as […] *undesirable, unpleasant, bothersome, or harmful mechanical vibrations of an elastic medium, transmitted through the air to the auditory organ, the senses, and parts of the human body* (Państwowa Inspekcja Pracy 2024). A common element in most definitions is the use of adjectives referring to subjective impressions, which depend on the individual perception of each person. The impact of noise on the human body has led to its recognition as an escalating social problem (Sadowski 1971). Today, the threat is particularly high, considering that noise, being invisible to the naked eye and often fading from public awareness in the presence of other stimuli, requires attentiveness to its pervasive nature, which is easily overlooked amid the overload of daily responsibilities. The problem is especially acute in highly urbanized areas, where the soundscape[1] is dominated by continuous noise. The effects of long-term noise exposure on the human body are undeniably negative and are associated not only with physical damage but also with psychological harm (Sadowski 1971). It is therefore not surprising that in recent years, noise has earned the title of the […] *plague of the 21st century* (Goines, Hagler 2007), as it brings about a number of health consequences, from fatigue, irritability, and insomnia to permanent hearing loss and damage to internal organs (Leśnikowska-Matusiak, Wnuk 2014). One of the tools aimed at alleviating the burdensome characteristics of the soundscape, particularly those associated with noise, is strategic noise mapping.

Strategic noise maps

Strategic noise maps are acoustic maps created in accordance with specific conditions outlined in European Union and national legislation. Their primary purpose is to assess and manage environmental noise levels (Dyrektywa… 2002). The practical application of the data contained in these maps lies mainly in the development of preventive programs and action plans designed to protect public health from noise exposure. In Poland, the criteria for areas requiring the preparation of strategic noise maps are defined by the Environmental Protection Act (Ustawa… 2001). According to the Act: *Strategic noise maps are prepared for: cities with populations exceeding 100,000; major roads; major railway lines; and major airports* (Ustawa… 2001, Art. 118. 2), with the obligation to update them every five years. The detailed scope of data, methods of presentation, and formats for their dissemination are specified in the Regulation of the Minister of Climate and Environment (Rozporządzenie… 2021).

The process of creating a strategic noise map begins with the introduction of a terrain model, including land-use data. The next step involves incorporating information about acoustic sources, such as the type of sources, traffic flow structures and volumes, materials, and construction details. Once the data is entered, the model is calibrated using actual measurements conducted in the field. A completed strategic noise map allows us to read long-term noise assessment indicators and see the spatial extent of their influence (Nurzyński 2021). This serves as a main data source for making informed planning decisions (Pawłat-Zawrzykraj 2021). Two key indicators typically included in SNM are L_{den} (pol. L_{DWN}) representing the noise level during daytime, evening, and nighttime, and L_{night} (pol. L_N), representing nighttime noise levels. The L_{den} indicator is used to assess the general annoyance caused by noise, while L_{night} is used to evaluate the risk of sleep disturbances (Kossakowski 2012). Both indicators are values in decibels. The graphical representation of a strategic noise map includes contour lines or colour patches, which indicate the areas affected by specific noise levels, shown in 5-decibel intervals. In addition to noise evaluation indicators, strategic noise maps also provide information on the […] *number of people exposed to noise, the number of dwellings, schools, and hospitals located in those areas, as well as areas where permissible or threshold values are exceeded* (Nurzyński 2021, 82).

Benefits and barriers in the current state of research

In the current state of research, the benefits associated with understanding the data presented in strategic noise maps are analysed from a multidimensional perspective. What is of particular importance, especially for potential residents and investors in newly developed areas, is the economic aspect. Studies conducted in urban areas of Poland demonstrate that the presence of noise in a prospective residential location significantly influences its attractiveness (Szopińska 2018). Road traffic noise is especially problematic, as it substantially diminishes the quality of daily life and, consequently, affects property prices (Szopińska, Putek-Szeląg and Krajewska 2017). This issue impacts all individuals residing in regions where noise levels are elevated. As the intensity of noise-related nuisances increases, the market value of affected properties declines, resulting in financial losses for property owners (Lipowczan 2013).

Access to the information contained within SNM allows prospective residents to make informed decisions regarding their choice of residence based on individual priorities (e.g., cost versus noise exposure). For investors, this information highlights the financial consequences of situating developments in areas exposed to noise pollution, while for existing residents, it provides insights into the stability of their property values.

An intriguing issue is the right to claims arising from the impact of disruptive sounds that disturb peace in residential areas (Nowosad, Poniatowski 2023), commonly referred to as neighbour noise. Under the provisions of the environmen-

[1] The concept of the soundscape was popularized by Canadian composer Raymond Murray Schafer, known for his research on the sonic environment. In his work *The soundscape: our sonic environment and the tuning of the world*, he described the soundscape as a collection of all the sounds within which humans operate, emphasizing their complexity and their dependence on time and place (Schafer 1994). A clear definition of the term is provided in the international standard ISO 12913-1: *Soundscape – acoustic environment as perceived or experienced and/or understood by a person or people, in context* (International standard… 2014, 1).

tal protection law (Ustawa… 2001), individuals have the right to request monitoring of noise levels. This procedure comprises two stages: measurement and evaluation of noise levels, followed by a determination of whether regulatory thresholds have been exceeded. The process concludes with an administrative decision, which, depending on the findings, may serve as a basis for legal claims (Bandarzewski 2023). Such claims may include: *Restoration of conditions compliant with legal standards and the implementation of preventive measures; or, if such actions are impractical or excessively hampered, cessation of activities causing the disturbance or violation* (Ustawa… 2001, Art. 323. 1). Strategic noise maps provide crucial data on the spatial extent of noise level ranges and thus serve as a foundational resource for initiating legal claims and noise-related complaints.

Despite the numerous benefits associated with understanding the information contained in SNM, there is a discernible issue regarding the existence of certain barriers that may limit residents' full utilization of these resources. A study conducted by a team from the University of Life Sciences in Lublin, which aimed to engage citizens in the process of […] *diagnosing noise pollution* (Sowisz et al. 2022, 145), revealed that […] the *involvement of participants in citizen science projects is minimal* (Sowisz et al. 2022, 153). Similarly, foreign researchers have also observed a lack of significant public interest (Shrivastava et al. 2004). The analysed literature highlights the issue of the methods of information sharing. Representations in the form of online 2D maps, textual descriptions, and noise protection programs appear to cause difficulties in terms of substantive comprehension (Murphy, King 2010). Furthermore, because acoustics is an inherently complex field that necessitates interdisciplinary collaboration, this leads to a limited understanding of its principles among various social groups, representatives of different age ranges, and educational levels (Tratnik 2007).

At present, the responsibility for disseminating knowledge regarding strategic noise maps predominantly lies in the hands of officials, who require expert technical support (Kubiszek et al. 2012). This support is often insufficient, which adversely affects the general public's understanding of the information provided. On the international stage, the issue of delegating responsibility for this matter to external consultants remains a subject of debate. Many authors emphasize the possibility of training employees, which would enable the management of acoustic mapping issues to remain within the hands of officials. At the same time, the authors identify the problem of insufficient financial resources allocated for training programs (Santos 2005).

Materials and methods

To gain insight into the social awareness of the existence and potential use of SNM, a survey-based study was conducted. The study was carried out among residents of the Wawer district in Warsaw, selected as the research subject. Wawer is the largest district in Warsaw. Located on the right bank of the Vistula River (Fig. 1) the district is

Fig. 1. Location of the Wawer district within the functional and spatial structure of Warsaw (elaborated by D.A. Kumorek based on: Urząd Miejski, "Warszawa dzisiaj" 2024)

Il. 1. Lokalizacja dzielnicy Wawer na tle struktury funkcjonalno-przestrzennej Warszawy (oprac. D.A. Kumorek na podstawie: Urząd Miejski, „Warszawa dzisiaj" 2024)

renowned for its natural wealth, particularly its forested areas, earning it the well-deserved title of "the green lungs of Warsaw".

Wawer is a predominantly residential district, primarily consisting of single-family housing, and is mainly inhabited by long-term residents. Due to its intimate, family-oriented character and favourable natural conditions, the area has undergone significant spatial transformations in recent years to accommodate a growing population and an increased number of users. The expansion of multi-family housing, the development of local road infrastructure connecting Wawer with other districts of Warsaw, and the intensification of service activities have contributed to the deterioration of the soundscape in the region (Fig. 2).

The prevalence of the issue is underscored by the heightened complaint efforts of residents striving to fight against the escalation of noise emissions (Pielaszek 2023). Additional measures undertaken by residents include individual noise protection strategies, such as the installation of soundproof balcony enclosures, varying degrees of professional and non-professional home acoustic barriers, and the provision of dense vegetation. However, these efforts often fail to enhance the visual perception of the area, lack consistency, and do not yield the anticipated outcomes, thus contributing to increased public dissatisfaction. Despite the problem and ongoing local interventions, the Wawer district in Warsaw continues to be perceived as a tranquil and quiet area, while simultaneously remaining a prime target for intensified development activities. Given the continuing spatial and functional transformations, the selected study area is particularly vulnerable to the amplification of annoyance resulting from new acoustic sources, as well as the escalation of already existing noise levels. These nuisances can be mitigated through the enhancement of public awareness, fostering an understanding of the importance of responsible planning actions that influence collective perceptions beyond individual experiences.

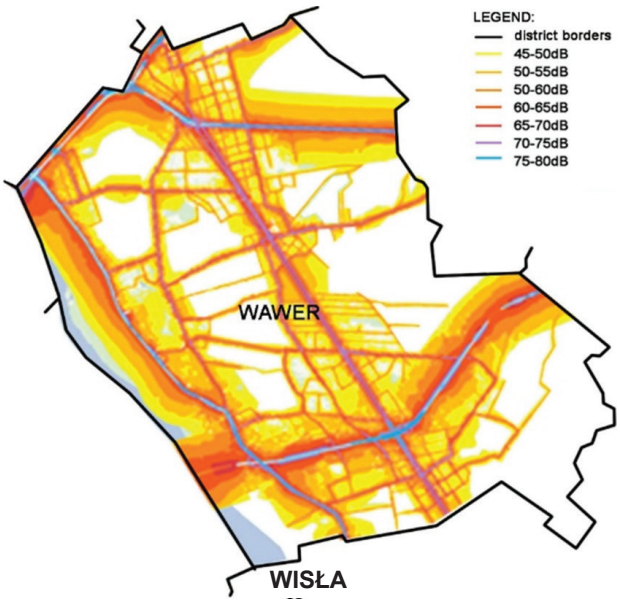

Fig. 2. Fragment of the acoustic map of Warsaw showing road traffic noise L_{den} (elaborated by D.A. Kumorek based on: Urząd Miejski, "Mapa hałasu" 2024)

Il. 2. Fragment mapy akustycznej Warszawy hałasu drogowego L_{DWN} (oprac. D.A. Kumorek na podstawie: Urząd Miejski, „Mapa hałasu" 2024)

Based on the analysis of the relevant literature, including the current state of research, several key issues were identified for discussion with the residents of the Wawer district. A set of six closed, single-choice questions was prepared, in which respondents were asked about their current knowledge of SNM, their experiences related to its use, and their opinions. The questionnaire also included a question about the subjective assessment (on a scale of 1–10) of the annoyance caused by noise in their place of residence, as well as two open questions regarding the potential benefits of using SNM and the barriers that might limit their full utilization. It was assumed that individuals who answered "no" to the first question regarding their familiarity with the term "strategic noise maps" would be provided with the definition and main concepts of SNM before continuing with the survey. To improve the response rate to individual questions, the survey was designed to require responses only to the closed questions and the linear scale question, with responses to the open questions remaining optional. Demographic data of the respondents, such as the survey's metric information, was excluded from the study. This decision was made in consideration of protecting the privacy and sense of freedom of the respondents, aimed at eliminating any doubts regarding the anonymity of the survey. Moreover, the main objective of the study was to gain an understanding of the specific opinions and experiences of the participants, which are independent of demographic characteristics. The use of this research method allowed for a focus on the substance of the responses rather than on personal data, which simultaneously helped reduce the time required to complete the survey and contributed to an increase in the volume of collected data. The survey was disseminated online through one of the most widely attended forums related to everyday matters in the district, namely "Wawer moja dzielnica". Responses were collected in March and April 2024. All participants gave informed consent to participate in the study.

Results

A total of 55[2] individuals participated in the study. The responses to the mandatory questions are presented in a bar chart (Fig. 3) and pie charts (Figs. 4a–f). Each chart is labelled with the number of respondents who selected a given answer, with percentage values provided in parentheses.

The study also received 40 responses to open questions. For the purpose of presenting the results, the responses were analysed, synthesized, and grouped thematically (Tables 1, 2), with repetitions and factual errors eliminated. Responses mentioned more than twice were highlighted in bold.

[2] The practical minimum sample size for statistical research is 30 data points, which should include a sufficient number of data points to draw statistically justified conclusions about the population (Pannell 2023).

Fig. 3. Distribution of ratings for noise annoyance levels in respondents' places of residence (elaborated by D.A. Kumorek)

Il. 3. Rozkład ocen poziomu uciążliwości hałasu w miejscu zamieszkania ankietowanych (oprac. D.A. Kumorek)

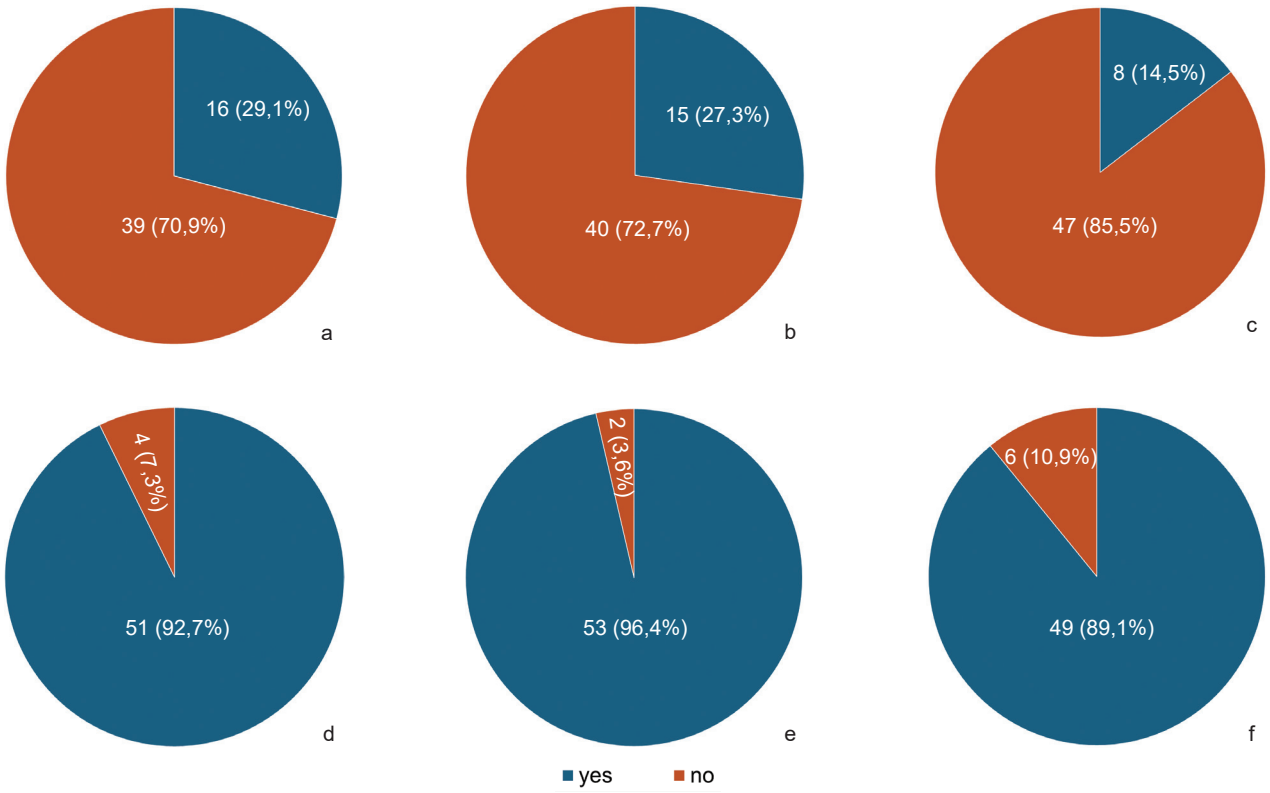

Fig. 4. Distribution of respondents:
a) familiar with the term "strategic noise maps",
b) aware of the existence of strategic noise maps for the Wawer district,
c) who have ever used the information contained in strategic noise maps,
d) who think that residents should have greater access to information about noise in their surroundings,
e) who believe that strategic noise maps can be useful in spatial planning and district development,
f) who agree that improving awareness of strategic noise maps can contribute to the development of the district (elaborated by D.A. Kumorek)

Il. 4. Rozkład liczby ankietowanych:
a) zaznajomionych z terminem „strategiczne mapy hałasu",
b) świadomych istnienia strategicznych map hałasu dla dzielnicy Wawer,
c) którzy kiedykolwiek korzystali z informacji zawartych na strategicznych mapach hałasu,
d) którzy sądzą, że mieszkańcy powinni mieć większy dostęp do informacji na temat hałasu w swoim otoczeniu,
e) którzy uważają, że strategiczne mapy hałasu mogą być przydatne w planowaniu przestrzennym i rozwoju dzielnicy,
f) którzy zgadzają się, że poprawa świadomości na temat strategicznych map hałasu może przyczynić się do rozwoju dzielnicy (oprac. D.A. Kumorek)

Table 1. Summary of respondents' answers regarding the benefits of using strategic noise maps (elaborated by D.A. Kumorek)
Tabela 1. Zestawienie odpowiedzi ankietowanych na temat korzyści wynikających z zastosowania strategicznych map hałasu (oprac. D.A. Kumorek)

Social benefits	Planning benefits
Availability of reliable information on the quality of the acoustic environment at the city scale	**The possibility of adapting public noise protection solutions to existing conditions**
The possibility to make conscious locational decisions, taking into account the acoustic quality of the environment, including the selection of residential areas, schools, and service locations	The potential for the visual integration of noise protection solutions with the landscape
Ensuring acoustic comfort	**The possibility to designate zones of acoustic annoyance**
Increasing public awareness of the negative effects of noise exposure	**The possibility to designate and protect quiet areas**
Health protection	**The possibility of separating noisy zones from residential areas**
Guarantee of no exceedance of the permissible sound level values	**The possibility to consciously plan road infrastructure with regard to the acoustic quality of the environment**
The existence of a reliable basis for submitting complaints and appeals	The possibility to implement traffic restrictions in areas with excessive noise levels
Enhancement of the sense of responsibility for individual planning activities	The possibility to make conscious decisions in planning technical infrastructure with consideration for acoustic environmental quality
The possibility to tailor individualized noise protection measures to specific needs and conditions	Enhancing the awareness of investment entities regarding the impact of their projects on the quality of the acoustic environment
The possibility of estimating property value based on information about its exposure to noise	**Improvement in the acoustic climate* quality within areas of new developments**

* Acoustic climate: […] *a set of sound phenomena occurring in a given area* (Marczak 2012, 7).

Table 2. Summary of survey responses regarding barriers/difficulties in the utilization of strategic noise maps, limiting their full potential (elaborated by D.A. Kumorek)
Tabela 2. Zestawienie odpowiedzi ankietowanych na temat barier/trudności w wykorzystaniu strategicznych map hałasu ograniczających ich pełne wykorzystanie (oprac. D.A. Kumorek)

Social barriers	Substantive barriers
Lack of awareness among residents about the existence of SNM	**Doubts regarding the accuracy of information contained in SNM**
The belief in the lack of dissemination of SNM	The long update period of SNM (5 years), which does not account for the dynamics of spatial and social changes
The belief that SNM are subject to a fee	The lack of consideration for real-time noise level variability, e.g., on a daily scale
Inability to use SNM	**Instances of noticing underestimation of noise levels on SNM compared to actual measurements**
Lack of competence in interpreting the information contained in SNM	The belief in administrative manipulation of noise level values for the purpose of reducing the number of complaints and appeals
The lack of educational actions aimed at informing the public about SNM	Doubts regarding the objectivity of the entities responsible for preparing SNM
The lack of involving local communities in the dialogue about the quality of the acoustic environment	**The lack of information on the impact of planned investments on the quality of the acoustic environment**
Society ignorance	Estimated sound level values, which result in the unrealistic nature of the results (5dB ranges)
Lack of collective responsibility for the acoustic quality of the environment	–
Budgetary barriers	**Regulatory barriers**
The belief in insufficient financial investment allocated for the dissemination of SNM	**The recognition of ambiguities in legal regulations, including the raising of permissible noise levels**
The belief that noise protection programs are not taken into account in municipal budgets	**The failure to incorporate the information contained in the SNM into the processes of drafting local development plans and issuing building permits**
The belief that economic (profit-driven) considerations are prioritized over the protection of acoustic environmental quality	The lack of regulations imposing on the investor the obligation to prepare an acoustic forecast when planning new developments

Discussion

Based on the results of the conducted survey, as evidenced by the responses to the closed questions, it can be inferred that awareness of the existence of strategic noise maps among residents of the Wawer district is low. Only 29.1% of the respondents are familiar with the term "strategic noise map", 27.3% are aware of the existence of SNM for the Wawer district area, and 14.5% have ever used the information contained in this map. At the same time, the awareness of the benefits derived from the use of SNM, assuming that respondents who were unfamiliar with the term during the survey have since been introduced to it, was relatively high. The statement that residents should have greater access to information about noise in their surroundings was agreed upon by 92.7% of the respondents, while 96.4% believe that strategic noise maps can be useful in spatial planning and district development, and 89.1% think that raising the awareness of strategic noise maps can contribute to the district's development. It is important to note that, in response to the question regarding the subjective annoyance of noise in their place of residence, the majority of the respondents rated it as "3" on a scale of 1–10 (1 being low annoyance and 10 being high annoyance), indicating a relatively low level of annoyance. The responses "6" and "2" were given only twice. Furthermore, it should be highlighted that the results of this question predominantly feature low ratings between 1 and 5. However, the perceived annoyance among respondents is quite varied. In the scale of 1–10, every level of annoyance was marked at least twice, which may reflect the differing quality of the acoustic climate in various areas of the district. The responses to the open-ended questions suggest that the residents' awareness of the benefits of using strategic noise maps is based on knowledge or assumptions consistent with the original purpose of creating such maps. Among the benefits identified by the respondents, the most frequently mentioned were the positive impact of accessible noise information on planning decisions at various scales, which in turn contributes to health safety and the comfort of potential investments. Additionally, it is particularly thought-provoking that, when asked about barriers to the use of strategic noise maps, respondents listed a variety of factors limiting their full implementation. This led to the creation of four distinct categories of barriers, i.e., social, substantive, budgetary, and regulatory. It was noted that the results of this study could not be compared with those of other authors in a control group due to the lack of existing studies on the same subject. Available research typically focuses on the awareness of the harmful effects of specific types of noise (Oluwasanya et al. 2024), rather than on tools aimed at mitigating noise, thus highlighting the scientific value of this study.

It should be noted that the conducted study is subject to certain limitations. Despite collecting a data set larger than the practical minimum sample size for statistical research, the sample size is relatively small when compared to the population of the Wawer district, which limits the ability to generalize the results to the entire population. This may stem from the low public interest in participating in the study or from the indirect distribution method of the research tool (the survey). In future research, this limitation could be minimized by establishing cooperation with managing entities, including the district office or neighbourhood councils. It is also important to highlight the inability to demonstrate the representativeness of the respondents due to the decision not to include demographic information in the survey. Furthermore, the timeliness of the study results may be influenced by the dynamic spatial and social changes occurring in the Wawer district, as well as the subjectivity of the respondents' perceptions, which are linked to their current experiences and emotional state. Data collected during the period of the study may become outdated over time. Despite these limitations, the study on the awareness of the existence and potential use of strategic noise maps among the residents of the Wawer district of Warsaw provided valuable insights into the current knowledge and attitudes of the local community regarding environmental acoustics. The study engaged residents in a dialogue about the subjectively perceived annoyance and needs, whose understanding is key to effective remedial actions.

Conclusions

In response to the identified challenges, actions have been proposed that could serve as potential solutions to enhance residents' awareness of the acoustic environment and use this awareness to protect and improve the quality of this environment. The conclusions are divided into thematically coherent groups based on the classification suggested in the presentation of the results.

Social actions

The primary goal of social actions is to raise residents' awareness through education and the promotion of issues related to the acoustic environment and strategic noise maps. Special attention should be given to equipping the public with a set of basic information, including key definitions necessary for understanding the content of the maps, such as noise assessment indicators, methods of preparing studies, and the spectrum of their applications in spatial planning and land development. Education can take both indirect and direct forms. The indirect approach may include providing clear, accessible content through specialist-prepared websites, instructional materials, or other forms of online presentations, while the direct form involves personal contact through meetings, workshops, and consultations. Direct education is particularly valuable as it allows for addressing individual questions and concerns from residents, which helps in the understanding process and engage the audience physically. It also provides a source of honest feedback. It is essential to ensure that the educational content, both indirect and direct, is comprehensible to everyone. Alternative representations of data from acoustic maps, such as innovative visualizations in the form of 3D maps or virtual reality (VR)-generated maps, could make the content more accessible to a wider audience and spark greater public interest (Murphy, King 2010). Internationally, there are ongoing efforts to develop dynamic representations of noise maps that

incorporate real-time changes, such as fluctuations in population movement and atmospheric conditions (Marki et al. 2022).

Promotional activities are particularly important in the context of public awareness regarding the term "strategic noise maps". These may include public campaigns aimed at spreading information about the existence, accessibility, and relevance of using SNM in the fight against noise pollution. A key aspect of such campaigns is collaboration with media outlets, especially local ones, which can directly address the area in which they operate by publishing materials related to noise and SNM. This will likely increase the interest of local residents. An essential element is also establishing cooperation with neighbourhood council boards to support educational activities through direct engagement, encouraging the community to engage in dialogue for the systematic collection of data from residents and sharing it with the entities responsible for creating strategic noise maps.

Substantive actions

Substantive actions should primarily ensure consistency between the noise levels presented in the strategic noise maps and actual measurements. This task lies within the competence of the entities responsible for developing the SNM, as well as potential subcontractors conducting actual measurements for the purpose of calibrating the map. Regardless of the executing unit, the process should be supervised by an objective body, and the values should be systematically monitored and updated. An interesting issue is the real-time monitoring of noise levels, the integration of which with an electronic mapping system could be one of the key development perspectives. Respondents also raised concerns about the failure to include planned and new investments and their impact on changes in SNM parameters, which is related to the relatively long update period compared to the construction time. Forecasts of changes in map indicators should be continuously updated, for example, using an additional "forecast" layer, enabling residents to make conscious location decisions regarding acoustics, while also building trust in the entities managing the SNM.

Budgetary actions

The results of the conducted research indicate that a key issue limiting the full utilization of strategic noise maps are, according to respondents, budgetary barriers caused by focusing on other priorities than noise pollution control. Meanwhile, noise pollution is a paramount issue as it causes harm to public health, which is society's most valuable asset. Therefore, the recommendation regarding budgetary changes is to include any actions aimed at improving the quality of the acoustic environment in the budget plans of various entities, including municipalities, cities, and provinces. Initiatives requiring increased financial investment primarily include educational and promotional activities that raise awareness and knowledge of the public regarding environmental acoustics, actions related to the development of technologies supporting continuous monitoring and assessment of existing acoustic conditions, including supporting innovation, as well as spatial interventions, including the modernization of existing structures that negatively impact the acoustic environment.

Regulatory actions

Regulatory actions aimed at improving public awareness of strategic noise maps may include:

– clarification and standardization of existing legal regulations concerning noise pollution control,

– imposing new obligations on investors related to noise pollution control, including the requirement to prepare forecasts of acoustic conditions resulting from the realization of planned investments and informing the public about these impacts,

– imposing an obligation on society to educate about noise and strategic noise maps in the interests of public health.

Helpful in the regulatory area may also be recommendations developed by environmental acoustics specialists, incorporating SNM into the spatial planning process. The tools for implementing these recommendations include planning documents, such as local master plans – both new ones and those in the process of being updated. Provisions in local master plans may include the separation of noisy transport infrastructure from new and developing residential areas (Gilani, Mir 2021) or the requirement to use natural soundproof barriers (Fang, Ling 2003). The inclusion of acoustic issues in municipal planning documents falls within the responsibilities of local governments, but effective regulatory changes must also be implemented at higher, supra-local and regional levels, including county and provincial levels. For example, […] *the county council may, by resolution, designate quiet areas within or outside an agglomeration, taking into account the specific needs of noise protection for these areas* (Ustawa… 2001, Art. 118b. 1), and the regional governor (marshal) is responsible for […] *developing a draft resolution regarding the environmental noise protection program for the region based on strategic noise maps* (Ustawa… 2001, Art. 119a. 1). Resolutions based on the real needs of society will be an effective complement to legislative actions for protecting acoustic environment quality. Key regulations related to the acoustic environment of residential areas include laws concerning design and construction activities, such as the Building Law (Ustawa… 1994). This law will serve as an effective tool for both enforcing obligations on investors and promoting noise-reducing solutions. Updates to the Building Law may include provisions requiring the use of noise-reducing materials and systems in construction, as well as quiet road surfaces in transport infrastructure (Gilani, Mir 2021).

Actions for building social trust

Actions aimed at building residents' trust in the authorities managing strategic noise maps and noise in general include all the previously mentioned measures, as well as the authorities' consistent efforts to achieve the origi-

nal objectives and goals of SNM. These efforts should ensure full accessibility and transparency of noise-related information, including the data integrated into SNM, the methods used in measurements, the development of maps, and action plans based on these maps, as well as periodic reports on the state of the acoustic climate in specific areas. It is important to emphasize that key actions in building social trust include actively engaging residents in public consultations and all direct interactions aimed at effectively solving reported problems, clarifying doubts, and improving social cooperation.

The conducted study contributes to the body of knowledge regarding residents' awareness of the existence and potential of strategic noise maps, as well as the barriers that limit their utilization. The results of the study were presented through numerical and percentage values, providing a clear source of information regarding the scale of the problem. The study also serves as an attempt to define proposed solutions which may prove effective in raising public awareness, and consequently, contribute to the assessment and improvement of the acoustic environment quality, with a focus on safeguarding the health of residents. A methodologically identical study conducted in other districts of Warsaw would serve as a basis for developing practical recommendations at the city level.

Translated by
Dominika Kumorek

References

Bandarzewski, Kazimierz. "Wpływ nowelizacji art. 115 Prawa ochrony środowiska na prawo mieszkańca do żądania skontrolowania poziomu hałasu." *Acta Universitatis Lodziensis Folia Iuridica*, special issue, (2023): 29–39. https://doi.org/10.18778/0208-6069.S.2023.03.

"Dyrektywa 2002/49/WE Parlamentu Europejskiego i Rady z dnia 25 czerwca 2002 r. odnosząca się do oceny i zarządzania poziomem hałasu w środowisku." Dz.U. L 189 z 18.7.2002, 12–25. Accessed April 12, 2024, at https://sip.lex.pl/akty-prawne/dzienniki-UE/dyrektywa-2020-367-zmieniajaca-zalacznik-iii-do-dyrektywy-2002-49-we-69296836.

Fang, Chih-Fang, and Der-Lin Ling. "Investigation of the noise reduction provided by tree belts." *Landscape and Urban Planning* 63, no. 4 (May 2003): 187–195. https://doi.org/10.1016/S0169-2046(02)00190-1.

Gilani, Ahmed Towseef, and Mohammad Shafi Mir. "A study on the assessment of traffic noise induced annoyance and awareness levels about the potential health effects among residents living around a noise-sensitive area." *Environmental Science and Pollution Research* 28 (July 2021): 63045–63064. https://doi.org/10.1007/s11356-021-15208-3.

Goines, Lisa, and Lois Hagler. "Noise pollution: a modern plague." *Southern Medical Journal* 100 (March 2007): 287–294. https://doi.org/10.1097/SMJ.0b013e3180318be5.

Gov.pl. "Hałas." Accessed April 12, 2024, at https://www.gov.pl/attachment/684404c6-b5b4-4010-986a-72e0b5cb16d0.

International Standard ISO 12913-1. "Acoustics – Soundscape. Part 1: Definition and conceptual framework." 2014. Accessed April 23, 2024, at https://cdn.standards.iteh.ai/samples/52161/229d6f3657604d89b8c382a04058a839/ISO-12913-1-2014.pdf.

Kossakowski, Paweł. "Strategic noise maps." *Structure and Environment* 4, no. 3 (2012): 35–43. http://bc.tu.kielce.pl/147/1/Kossakowski_Strategic.pdf.

Kubiszek, Artur, Jan Kaźmierczak, Marek Komoniewski, Waldemar Paszkowski, Arkadiusz Boczkowski, and Marcin Dąbrowski. "Sieciowy system doradztwa i konsultacji wspomagający proces tworzenia i użytkowania strategicznych map akustycznych." *Systems Supporting Production Engineering* 2 (February 2012): 16–29. Accessed April 12, 2024, at http://www.dydaktyka.polsl.pl/roz5/konfer/wyd/2012/2/R_2.pdf.

Leśnikowska-Matusiak, Ida, and Aneta Wnuk. "Wpływ hałasu komunikacyjnego na stan środowiska akustycznego człowieka." *Transport Samochodowy*, no. 3 (2014): 37–62.

Lipowczan, Adam. "Aspekty ekonomiczne wykorzystania map akustycznych." *Bezpieczeństwo Pracy: nauka i praktyka* 10 (2013): 8–12.

Marczak, Piotr. *Zagrożenie hałasem – wybrane zagadnienia*. Kancelaria Senatu. Biuro Analiz i Dokumentacji, 2012. Accessed April 23, 2024, at https://www.senat.gov.pl/gfx/senat/pl/senatopracowania/30/plik/ot-612_inter.pdf.

Marki, Ferenc, Peter Rucz, Nico van Oosten, Emir Ganić, and Ingrid Legriffon. "Towards Mapping of Noise Impact. Explaining ANIMA Efforts to Support New Approaches for Noise Impact Management Through Noise Management Toolset, Virtual Community Tool, and Dynamic Noise Maps." In *Aviation Noise Impact Management. Technologies, Regulations, and Societal Well-being in Europe*, edited by Laurent Leylekian, Alexandra Covrig, and Alena Maximova. Springer, 2022, 265–95. https://doi.org/10.1007/978-3-030-91194-2_11.

Murphy, Enda, and Eoin King. "Strategic environmental noise mapping: Methodological issues concerning the implementation of the EU Environmental Noise Directive and their policy implications." *Environmental International* 36, no. 3 (April 2010): 290–8, https://doi.org/10.1016/j.envint.2009.11.006.

Nowosad, Aleksandra, and Piotr Poniatowski. "Prawne aspekty hałasu «sąsiedzkiego». Cz. II: Odpowiedzialność cywilna." *Radca Prawny* 34 (January 2023): 41–57. https://doi.org/10.4467/23921943RP.23.003.18262.

Nurzyński, Jacek. *Akustyka w budownictwie*. Wydawnictwo Naukowe PWN, 2021.

Oluwasanya, T., Enyinda A. Chukwuemeka, Olisa Babatope, and Stephens Moboleji. "Level of Awareness of Transport Externalities on Noise Pollution in Akure, Nigeria." *International Journal of Latest Technology in Engineering, Management & Applied Science* 8 (February 2024): 93–9, https://doi.org/10.51583/IJLTEMAS.2024.130213

Pannell, Reagan. *The Importance of Identifying the Right Sample Size for Business Improvement*. Published April 5, 2023. Accessed July 11, 2024, at https://leanscape-io.translate.goog/the-importance-of-identifying-the-right-sample-size-for-business-improvement/?_x_tr_sl=en&_x_tr_tl=pl&_x_tr_hl=pl&_x_tr_pto=rq.

Państwowa Inspekcja Pracy. "Hałas." Accessed April 12, 2024, at https://www.pip.gov.pl/dla-pracodawcow/porady-prawne/halas?tmpl=pdf?-tmpl=pdf.

Pawłat-Zawrzykraj, Agata, Paweł Oglęcki, and Konrad Podawca. "Analysis of the Noise Pollution in the Bielański Forest NATURA 2000 Area in Light of Existing Avifauna (Warsaw, Poland)." *Forests* 12 (October 2021): 1316. https://doi.org/10.3390/f12101316.

Pielaszek, Roman. "Discussion of the noise measurement results of the Southern Bypass of Warsaw (S2) and assessment of security measures in the area of the Patriotów junction." Published March 20, 2023. Accessed July 11, 2024, at https://pielaszek.com/omowienie-wynikow-pomiarow-halasu-poludniowej-obwodnicy-warszawy-s2-i-ocena-zabezpieczen-w-rejonie-wezla-patriotow/.

"Rozporządzenie Ministra Klimatu i Środowiska z dnia 1 lipca 2021 r. w sprawie szczegółowego zakresu danych ujętych na strategicznych mapach hałasu, sposobu ich prezentacji i formy ich przekazywania." Dz.U. z 2021 r., poz. 1325. Accessed April 12, 2024, at https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20210001325/O/D20211325.pdf.

Sadowski, Jerzy. *Akustyka w architekturze, urbanistyce i budownictwie*. Arkady, 1971.

Santos, Conde Luis. "Noise mapping as a planning tool for the local authorities." *Twelfth International Congress on Sound and Vibration*, Lisbon 2005. Accessed 12 April, 2024, at https://www.academia.edu/9678972/NOISE_MAPPING_AS_A_PLANNING_TOOL_FOR_THE_LOCAL_AUTHORITIES.

Schafer, Murray R. *The Soundscape: Our Sonic Environment and the Tuning of the World*. Destiny Books, 1994.

Shrivastava, RamBihariLal Saurabh, Sudhakar Prateek Bobhate, Brahmanand Prithvi Petkar, and Punit Fulzele. "Community noise mapping: The need, identified challenges, and potential solutions." *Journal of Family Medicine and Primary Care* 13, no. 9 (September 2004): 3494–6, https://doi.org/10.4103/jfmpc.jfmpc_35_24.

Sowisz, Rozalia, Szymon Chmielewski, Ilona Woźniak-Kostecka, and Adam Gawryluk. "Nauka obywatelska na rzecz walki z zanieczyszczeniem hałasem." In *Wybrane zagadnienia z zakresu ochrony i zagrożeń środowiska*, vol. 2, edited by Marek Babicz, Bożena Nowakowicz-Dębek, and Kinga Kropiwiec-Domańska. Wydawnictwo Uniwersytetu Przyrodniczego w Lublinie, 2022.

Szopińska, Kinga. "Identyfikacja hałasu drogowego a badania rynku nieruchomości mieszkaniowych." *Biuletyn Stowarzyszenia Rzeczoznawców Majątkowych Województwa Wielkopolskiego* 49 (February 2018): 108–115.

Szopińska, Kinga, Ewa Putek-Szeląg, and Małgorzata Krajewska. "Wpływ hałasu na ceny lokali mieszkalnych położonych przy drodze krajowej – studium przypadku." *Nieruchomości w przestrzeni* 3 (2017): 301–315.

Tratnik, Etbin, "Kształtowanie świadomości narażenia na hałas – interaktywne narzędzie internetowe." *Bezpieczeństwo Pracy: nauka i praktyka* 5 (2007): 8, 9.

Urząd Miejski Warszawa. "Mapa hałasu." Accessed July 11, 2024, at https://mapa.um.warszawa.pl/mapaApp1/mapa?service=mapa_akustyczna&L=pl.

Urząd Miejski Warszawa. "Warszawa dzisiaj." Accessed July 11, 2024, at https://mapa.um.warszawa.pl/mapaApp1/mapa?service=mapa&L=pl&X=7514285.927594717&Y=5788261.102833839&S=2&O=0&T=0&komunikat=off.

"Ustawa z dnia 7 lipca 1994 r. – Prawo budowlane." Dz.U. z 1994 r. Nr 89, poz. 414. Accessed April 12, 2024, at https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=wdu19940890414.

"Ustawa z dnia 27 kwietnia 2001 r. – Prawo ochrony środowiska." Dz.U. z 2001 r. Nr 62, poz. 627. Accessed April 12, 2024, at https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=wdu20010620627.

Streszczenie

Ocena świadomości istnienia i potencjału wykorzystania strategicznych map hałasu wśród mieszkańców warszawskiej dzielnicy Wawer

Hałas jest obecnie jednym z największych zagrożeń środowiskowych. Wpływa negatywnie na kondycję fizyczną i psychiczną użytkowników przestrzeni, w której występuje. Skutkuje trudnościami w codziennym funkcjonowaniu, a w przypadku długotrwałej ekspozycji nawet trwałym uszczerbkiem zdrowia. Problem nasila się wraz z liczbą nowo powstałych źródeł hałasu i jest szczególnie uciążliwy na obszarach, na których do czasu intensywnego rozwoju nie występował. W walce z wciąż rozprzestrzeniającym się hałasem pomóc mają strategiczne mapy hałasu (SMH) służące ocenie poziomu hałasu w środowisku i opracowaniu skutecznych programów ochrony przed nim. Niestety mimo powszechnej dostępności ewidentną barierą w pełnym wykorzystaniu SMH jest niska świadomość społeczeństwa na temat ich istnienia, zawartości i potencjału w walce z hałasem. W artykule zaprezentowano autorskie badanie, którego celem była ocena świadomości mieszkańców warszawskiej dzielnicy Wawer na temat istnienia i możliwości wykorzystania SMH. W badaniu posłużono się ankietą internetową: respondenci podzielili się w takiej formie swoimi doświadczeniami i opiniami na temat SMH. Na podstawie wyników badania jasno wykazano, że świadomość mieszkańców zarówno na temat istnienia, jak i samego pojęcia strategicznych map hałasu jest niska. Jednocześnie świadomość korzyści płynących z wykorzystania SMH jest dosyć wysoka. Ankietowani wymienili także wiele barier stanowiących dla nich przeszkodę w pełnym wykorzystaniu SMH. Uzyskane wyniki posłużyły do sformułowania wniosków w postaci propozycji rozwiązań mogących posłużyć zwiększeniu świadomości w rozpatrywanym zagadnieniu.

Słowa kluczowe: akustyka, strategiczne mapy hałasu, hałas, krajobraz dźwiękowy