

**REVIEW****Soundscapes in Arab Cities: A Systematic Review and Research Agenda****Tallal Abdel Karim Bouzir<sup>1,\*</sup>, Djihed Berkouk<sup>2,3</sup>, Theodore S. Eisenman<sup>4</sup>, Dietrich Schwela<sup>5</sup>, Nader Azab<sup>2</sup>, Mohammed M. Gomma<sup>2,6</sup> and Samiha Boucherit<sup>7</sup>**<sup>1</sup>Institute of Architecture and Urban Planning, Blida University, Blida, 09000, Algeria<sup>2</sup>Hekma School of Engineering, Computing and Design, Department of Architecture, Dar Al-Hekma University, Jeddah, 22246, Kingdom of Saudi Arabia<sup>3</sup>Department of Architecture, Biskra University, Biskra, 07000, Algeria<sup>4</sup>Department of Landscape Architecture and Regional Planning, University of Massachusetts Amherst, Amherst, USA<sup>5</sup>University of York, Environment Department, Stockholm Environment Institute (SEI), York, UK<sup>6</sup>Department of Architectural Engineering, Faculty of Engineering, Aswan University, Aswan, 81542, Egypt<sup>7</sup>Department of Architecture and Industrial Design, Università degli Studi della Campania "Luigi Vanvitelli", Aversa, CE, 81031, Italy

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**ABSTRACT**

In the context of Arab cities, this study explores the intricate interplay between cultural, historical, and environmental elements that shape their unique soundscapes. The paper aims to shed light on this underrepresented field of study by employing a three-fold research approach: systematic review, a comprehensive literature review, and the formulation of a future research agenda. The first part of the investigation focuses on research productivity in the Arab world regarding soundscape studies. An analysis of publication trends reveals that soundscape research in Arab cities is still an emerging area of interest. Critical gaps in the existing body of literature are identified, highlighting the importance of addressing these gaps within the broader context of global soundscape research. The second part of the study delves into the distinctive features that inform the soundscapes of Arab cities. These features are categorized into three overarching groups: (i) cultural and religious life, (ii) daily life, and (iii) heritage and history, by exploring these factors, the study aims to elucidate the multifaceted nature of Arab urban soundscapes. From the resonating calls to prayer and the vibrant ambiance of traditional cafes to the bustling markets and architectural characteristics, each factor contributes to the auditory tapestry that defines Arab cities. The paper concludes with a forward-looking research agenda, proposing sixteen key questions organized into descriptive and comparative categories. These questions emphasize the need for a more profound understanding of sound perception, sources, and the impact of urban morphology on the soundscape. Additionally, they highlight the need for interdisciplinary research, involving fields such as urban planning, architecture, psychology, sociology, and cultural studies to unravel the complexity of Arab urban soundscapes.

**KEYWORDS**

Soundscape; Arab cities; traditional architecture; cultural identity; Arab urban morphology



## 1 Introduction

The term “Arab world” refers to a geographically and politically defined region that is characterized by a shared language and culture. Consisting of 22 countries that are members of the Arab League [1], this region spans 13.14 million km<sup>2</sup>, or about 10% of the Earth’s surface. It is home to a population of 456.8 million, constituting 5.8% of the world’s population [1–4].

This diverse region, with its long history spanning thousands of years and rich culture, has played a significant role in shaping the unique identity of Arab cities. The influence of various civilizations such as the Roman, Persian, and Ottoman empires, as well as more recent colonial power like the British, Italian and French has contributed to this identity [5,6]. Additionally, the Muslim religion has also had a major impact on the social, economic, architectural, and urban aspects of Arab cities [7–9]. Moreover, the climate has left its mark on the identity of Arab cities by contributing to shaping traditional architecture and urban planning [10–13]. The cities in this region are the result of an interaction between harsh climatic conditions, social and economic needs, and various historical factors [14,15].

Among other parameters, the soundscape is closely linked to the identity and intangible heritage of cities because it allows residents and visitors to experience a unique atmosphere that reflects the culture, history, and traditions of the city [16,17], especially in the Arab region [18–20]. Within this context, this study focuses on the subject of soundscape, which is a relatively new concept developed in 1977 by the Canadian researcher Schaefer in his book “The Soundscape, our sonic environment and the tuning of the world,” to describe all sounds perceived by humans in their environment and without positive or negative judgment [21]. Moreover, Farina has defined it as an acoustic composition resulting from a voluntary or spontaneous combination of natural and/or urban sounds [22,23]. The ISO 12913 series on soundscape, specifically Part 1 (ISO 12913–1:2014), defines it as “an acoustic environment which is perceived or experienced and/or understood in its context by one or more persons” [24]. Soundscape research goes beyond simply considering the sound environment as a potential source of nuisance, as is approached in the field of noise pollution. Instead, it focuses on the interaction between human perception and the physical sound environment, exploring how sounds influence our auditory experience and our relationship with the space around us [25].

This study is a comprehensive exploration of the soundscape of Arab cities. By delving into the distinct dimensions of the sound environment of these cities, we shed light on the unique acoustic features shaped by a convergence of cultural [26–29], historical, and environmental influences, including architectural design, social and cultural practices [3,18,19,30,31]. In the face of rapid urbanization and the influence of global architectural trends, it is imperative to underscore the crucial need to preserve this auditory heritage [17,32,33], which extends beyond a mere collection of urban sounds. The acoustic landscape of Arab cities, as a living archive of the history, culture, and traditions of the region, is at risk of erosion. It constitutes an essential part of the identity of these cities, which face contemporary challenges.

This systematic research will lay the foundation for a deeper exploration and preservation of the auditory heritage of Arab cities. It aims to thoroughly analyze several key aspects, including the presence of topics in the scientific literature, identification of predominant trends, highlighting existing gaps, and proposing a research agenda for future studies. Ultimately, this study raises awareness about the significance of the soundscape in preserving the cultural identity of Arab cities while warning of the threats that loom over this precious acoustic legacy, such as rapid urban development, economic crises, armed conflicts, and the imposition of global architectural trends. The fragility of this auditory heritage in the face of these challenges underscores the urgency of this research. By comprehensively understanding and documenting the soundscape of Arab cities, we hope to contribute to its long-term preservation, ensuring that future generations can continue to enjoy this rich auditory expression of the history, culture, and traditions of the region, aligning with sustainability perspectives.

## 2 Methods

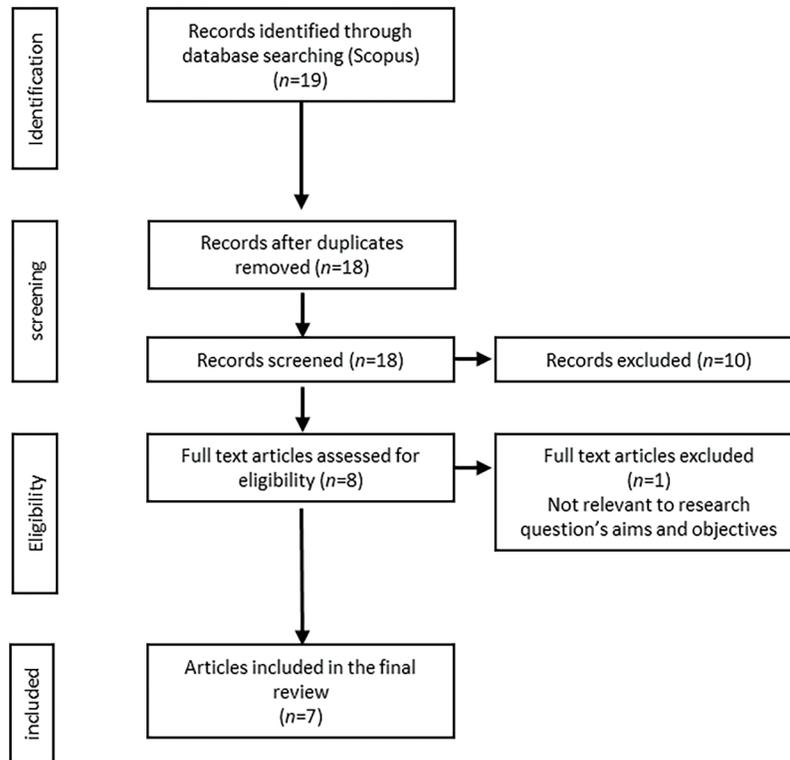
This study adopts a three-part methodological approach. Firstly, a systematic review is conducted to examine existing studies, evaluate the presence of this research topic in the region, identify current trends, and highlight remaining gaps [34,35]. A comprehensive search of relevant literature is performed in the Scopus database, which provides a wide range of information including title, author, institution, country, abstract, keywords, references, citations, and impact factor [34–36].

In our search, the following query was submitted to the Scopus database: TITLE-ABS-KEY (soundscape) AND TITLE-ABS-KEY (the 22 Arab countries listed in Table 1 (country by country)). language = all; year = all; document type = all (for an overview of scientific publications). No time limits for the search were applied. The last search was performed on 16 December 2022. While using two or three databases is a common approach in systematic review studies, the Scopus database alone was shown to be effective in covering the most relevant literature in built environment studies, and acoustics more specifically [37,38].

**Table 1:** Area and population of Arab countries in 2023 [2]

Country	Region	Surface m <sup>2</sup>	2023 population
Algeria	Africa	2, 381, 741	45, 606, 480
Bahrain	Asia	785	1,485, 509
Comoros	Africa	1, 861	852, 075
Djibouti	Africa	23, 200	1, 136, 455
Egypt	Africa	1, 001, 450	112, 716, 598
Iraq	Asia	435, 052	45, 504, 560
Jordan	Asia	89, 318	11, 337, 052
Kuwait	Asia	17, 820	4, 310, 108
Lebanon	Asia	10, 450	5, 353, 930
Libya	Africa	1, 759, 540	6, 888, 388
Mauritania	Africa	1, 030, 700	4, 862, 989
Morocco	Africa	446, 550	37, 840, 044
Oman	Asia	309, 500	4, 644, 384
Palestine	Asia	6, 020	5, 371, 230
Qatar	Asia	11, 490	2, 716, 391
Saudi Arabia	Asia	2, 149, 690	36, 947, 025
Somalia	Africa	637, 660	18, 143, 378
Sudan	Africa	1, 878, 000	48, 109, 006
Syria	Asia	185, 180	23, 227, 014
Tunisia	Africa	163, 610	12, 458, 223
UAE	Asia	98, 648	9, 516, 871
Yemen	Asia	527, 970	34, 449, 825

In this systematic review methodology, rigorous inclusion criteria were systematically applied to refine the selection process. These criteria comprised three essential components: (1) a specific emphasis on studies addressing the subject of soundscape; (2) a geographical context requirement, mandating that studies be conducted within the Arab world or include case studies in the Arab region; (3) a strict inclusion of only peer-reviewed journal articles. The systematic application of these criteria, illustrated in Fig. 1, ensured a methodically thorough exploration of the topic during the systematic review. The assessment of the eligibility of the studies was performed independently in a non-blinded standardized manner by two reviewers.



**Figure 1:** Flow of information through the different phases of the systematic review

Data were extracted from each included study regarding (1) the country where the study was conducted/ designed; (2) the publication year; (3) the journal of publication; (4) the language of the paper; (5) sponsorship details; (6) the author's affiliation; (7) the methodology, indicating whether the study relied on measurements, software simulations, and/or surveys with users; (8) case studies and the studied cities; (9) the factors influencing the soundscape. The Vosviewer software was utilized to visualize the collected data.

Secondly, a literature review was conducted to identify and describe the typical characteristics and key elements that shape the soundscape of Arab cities. This exploration involved examining the role of architectural design, urban planning, cultural practices, and historical factors in the formation of the soundscape. Finally, this study provides perspectives and suggests potential avenues for future research by identifying gaps in our current understanding of the subject and highlighting areas that require further investigation.

### 3 Results and Discussion

As described in the previous section, this research adopts a three-part methodological approach. The presentation and discussion of the results align with the same logic as follows: a comprehensive review

of existing studies, the identification of key soundscape elements in Arab cities, and, lastly, the formulation of a research agenda proposal.

### 3.1 Assessing Research Productivity in the Field of Soundscape in the Arab World

The search through the Scopus databases returned 19 results. After removing duplicates, the abstracts of 18 records were read by two authors and 10 items were excluded because the topic of the papers was not relevant (e.g., different research field) and/or did not address the review research question. The full texts of the remaining 8 papers were accessed and 1 of them was excluded because it failed to meet the eligibility criteria. The remaining 7 papers were included in the review. Fig. 1 summarizes the selection process of the review records.

**Table 2:** Summar of research on soundscapes in the Arab world

Title	Main findings	The factors that shape the soundscape
The concept of privacy in the social practice of the living environment through sonic phenomena: Case of the old city of Constantine (Algeria) [39] (2003)	<ol style="list-style-type: none"> <li>1) Privacy in the outside space and its social practice is often influenced by the quality of the physical environment.</li> <li>2) Various activities in the medina significantly alter the surrounding privacy conditions, leading to greater permeability between inside and outside, particularly through sound phenomena.</li> <li>3) Despite efforts to maintain privacy, the exterior sound environment is fully perceived, challenging the notion of preserving a certain degree of privacy.</li> <li>4) Ongoing studies on the old city of Constantine highlight the need to reassess the concept of privacy in urban areas considering the impact of the sound environment.</li> <li>5) Noise in such old cities not only disrupts but also contains information, significantly reducing and weakening the concept of privacy.</li> </ol>	<ol style="list-style-type: none"> <li>1) Quality of the physical environment</li> <li>2) Daily life and uses of urban spaces.</li> <li>3) Urban morphology characteristics</li> <li>4) Time of day and weather conditions.</li> </ol>
Examining the associations between oases soundscape components and walking speed: Correlation or causation? [40] (2020)	<ol style="list-style-type: none"> <li>1) No significant correlation between traffic noise and human sounds with mean walking speed.</li> <li>2) Moderate and significant negative correlation between birds and nature sounds with mean walking speed.</li> <li>3) Increase in geophony and biophony predominance associated with reduced mean walking speed.</li> <li>4) Soundscape components can influence mean walking speed.</li> </ol>	<ol style="list-style-type: none"> <li>1) Quality of the physical environment.</li> <li>2) The relationship between the three main components i. biophony (sounds from living organisms), ii. geophony (sounds from natural elements), and iii. anthrophony (sounds generated by humans).</li> <li>3) Urban morphology characteristics.</li> <li>4) Daily life and uses of urban spaces.</li> </ol>

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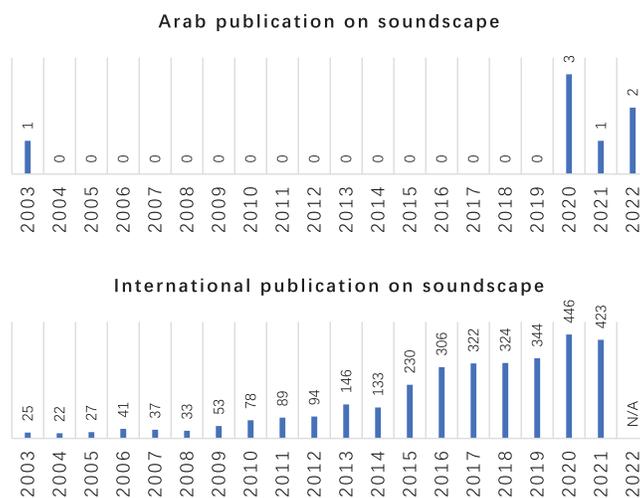
Table 2 (continued)		
Title	Main findings	The factors that shape the soundscape
Evaluation and analysis of the Algerian oases soundscape: Case of El Kantara and Sidi Okba [20] (2020)	<ol style="list-style-type: none"> <li>1) Each soundscape in El Kantara and Sidi Okba exhibits unique characteristics and is distinguished by sound levels and various components.</li> <li>2) The national road plays a significant role in generating disturbances in these oases, with traffic noise being the major contributor.</li> <li>3) Traffic noise causes a shift in the soundscape of these oases from Hi-Fi to Lo-Fi due to the noticeable imbalance among the studied soundscape components.</li> <li>4) The old urban fabrics possess Hi-Fi soundscapes characterized by low sound levels and minimal traffic noise.</li> <li>5) The studied oases have experienced a loss of their distinctive sound identity, with their soundscapes resembling those of larger cities like Biskra, the provincial capital, particularly in locations near these roads.</li> </ol>	<ol style="list-style-type: none"> <li>1) Spatial and temporal dimensions of public spaces.</li> <li>2) Physical characteristics of sound environment (sounds level, frequency, duration).</li> <li>3) The relationship between the three main components i. biophony (sounds from living organisms), ii. geophony (sounds from natural elements), and iii. anthrophony (sounds generated by humans).</li> <li>4) Relationship between urban morphology and the physical characteristics of sound environment.</li> </ol>
The Urban soundscape chronotopy of public squares: The case of the November 1st, 1954 square in Bejaia (Algeria) [41] (2020)	<ol style="list-style-type: none"> <li>1) The soundscape of public spaces reflects urban form and social representations throughout history.</li> <li>2) Daily life and uses of public spaces are essential for evaluating the sound environment.</li> <li>3) Sociocultural characteristics of regions influence the unique events, markers, and sound references in different soundscapes of public spaces.</li> </ol>	<ol style="list-style-type: none"> <li>1) Spatial and temporal dimensions of public spaces.</li> <li>2) Urban morphology characteristics.</li> <li>3) Daily life and uses of space.</li> <li>4) Cultural identity of the space experience.</li> <li>5) History of the space.</li> </ol>
Assessing and characterizing the perception of soundscape in the Urban Park: A case study of Zayed Park, Egypt [42] (2021)	<ol style="list-style-type: none"> <li>1) Efforts to create urban parks, encroachment, and poor planning have been identified as hindrances to achieving park objectives.</li> <li>2) The presence of heavy traffic around parks creates noise pollution that affects the park environment.</li> <li>3) The study explored how visitors in Zayed park in Egypt perceive different aspects of the soundscape.</li> <li>4) Natural sounds like flowing streams and fountains were perceived to enhance satisfaction with park visits, but excessive intensity may lead to annoyance and dissatisfaction.</li> </ol>	<ol style="list-style-type: none"> <li>1) Spatial and temporal dimensions of public spaces.</li> <li>2) Perception by individuals and their overall experience of space.</li> <li>3) The relationship between the three main components i. biophony (sounds from living organisms), ii. geophony (sounds from natural elements), and iii. anthrophony (sounds generated by humans).</li> <li>4) Daily life and uses of space.</li> <li>5) Physical characteristics of sound environment (sounds level, frequency, duration).</li> </ol>

(Continued)

Table 2 (continued)		
Title	Main findings	The factors that shape the soundscape
	<ol style="list-style-type: none"> <li>5) The sound of fountains can cause auditory irritation, especially when its noise level is significantly higher than road traffic.</li> <li>6) High annoyance sounds are often associated with road traffic noise, particularly from highways or expressways.</li> <li>7) Participants showed a decreased ability to hear traffic sounds in Zayed central park, and there was a strong inverse relationship between hearing traffic sounds and visitor pleasantness.</li> </ol>	
Evaluation of soundscape variations through the open public spaces in Saharan cities: A case of Biskra, Algeria [43] (2022)	<ol style="list-style-type: none"> <li>1) The study found statistically significant correlations between pleasantness, loudness, presence of mechanical sounds, presence of non-mechanical sounds, and sound exposure level.</li> <li>2) In the city of Biskra, the issue of noise pollution is severe, with over 45% of measured noise levels exceeding international safety standards for public health and the environment.</li> <li>3) The results of Pearson correlation tests indicate a significant relationship between soundscape components (mechanical and non-mechanical sounds), evaluation variables of soundscape quality (pleasantness, overall loudness), and L Aeq,1min.</li> </ol>	<ol style="list-style-type: none"> <li>1) The relationship between the three main components i. biophony (sounds from living organisms), ii. geophony (sounds from natural elements), and iii. anthrophony (sounds generated by humans).</li> <li>2) Physical characteristics of the environment (urban morphology).</li> <li>3) Time of day and weather conditions.</li> </ol>
The soundscapes of cafe terraces in coastal cities in Algeria before and after the COVID-19 lockdown [44] (2022)	<ol style="list-style-type: none"> <li>1) Soundscapes of cafe terraces reflect important facets of acoustics design in urban public open spaces.</li> <li>2) Pre-lockdown period soundscapes characterized by indices related to function, space, and time.</li> <li>3) Post-lockdown period soundscapes mainly represented by indices associated with relaxation and function.</li> <li>4) Decreased presence of human sound and increased predominance of traffic sounds in post-lockdown terrace soundscapes.</li> <li>5) Higher presence of biological and geophysical sound components in pre-lockdown terrace soundscapes compared to post-lockdown soundscapes.</li> </ol>	<ol style="list-style-type: none"> <li>1) The relationship between the three main components i. biophony (sounds from living organisms), ii. geophony (sounds from natural elements), and iii. anthrophony (sounds generated by humans).</li> <li>2) Time of day and weather conditions.</li> <li>3) Daily life and uses of space.</li> </ol>

### 3.1.1 Trends in Soundscape Research in the Arab World: Publication Years and Distribution by Country

The exploration of soundscape research in the Arab world reveals a nuanced trajectory over the past two decades. The thematic emergence began in 2003 with an article in “Acta Acustica Stuttgart,” delving into the soundscape of the ancient city of Constantine in Algeria [39]. This pioneering work initiated formal research on the soundscape theme, marking its introduction approximately two decades ago. However, a noticeable gap ensued, with 17 years passing without substantial publications on the subject, as illustrated in Fig. 2. The resurgence of interest in 2020 witnessed the publication of three articles focusing on Algerian Oasis’s soundscape (El Kantara and Sidi Okba) and the urban soundscape of city of Bejaia [20,41], followed by an article on the soundscape of the parks in the City of Sheikh Zayed in Egypt in 2021 [42], and two additional articles concentrating on Skikda and Biskra in Algeria in 2022 [43,44].



**Figure 2:** Annual number of soundscape studies published internationally (data from [36]) and in the Arab world

Despite this resurgence, the comparative analysis of limited publications (7) in the Arab world on the subject of soundscape over the past decade, as summarized in Table 2, against the extensive global literature documented in the study titled “Visualizing the Knowledge Domain in Urban Soundscape” (encompassing over 3000 publications on soundscape) [36], highlights a stark disproportion. Arab researchers’ scientific contributions account for only 0.2% of the global scientific literature. This emphasizes the urgent need to consistently foster and support research on the Arab soundscape to make a substantial impact on advancing this field.

By focusing on Arab urban soundscapes, researchers can develop a comprehensive understanding of their unique characteristics, effectively address noise-related challenges, and ultimately enhance the quality of life, public health, and environmental sustainability in Arab cities.

Furthermore, our investigation into the Scopus database further emphasizes a concentrated focus on soundscape studies in only two of the 22 Arab countries—Algeria and Egypt. Algeria, with a total of six studies, has been a primary locus of exploration. Egypt, comparatively, has seen limited exploration, with a recent study. These findings underscore a significant gap in soundscape research across most Arab countries, underscoring the urgency to continue and expand studies in this field. A comprehensive overview of soundscape research distribution in Arab countries is presented in Table 3.

**Table 3:** Soundscape publication in Arab countries

Country	N papers	Studied city	Studied areas
Algeria	6	Biskra,	Urban soundscape
		Constantine	Urban soundscape
		Bejaia	Urban soundscape
		Skikda	Cafeteria terraces soundscape
Egypt	1	Sheikh Zayed	Urban parks soundscape
Rest of Arab countries	/	/	/

In terms of the zones studied in Arab research, researchers have primarily focused on urban areas. Five studies have been conducted on the soundscape of public spaces in the cities of Biskra and its oases, Constantine, and Bejaia. In addition, two studies have examined the soundscape of cafeteria terraces and urban parks in the cities of Skikda (Azzaba) and Sheikh Zayed, respectively.

These results highlight the limited attention given to research on urban soundscape in the Arab world, in contrast to the international academic landscape. While in-depth studies are conducted on various case studies, including tourist zones, historical blocks, university campuses, and hospital outdoor spaces, other research areas are also explored. Some studies focus on the correlation between the soundscape and different aspects of life such as health and comfort. Other studies examine the methods and techniques used to evaluate and analyze the soundscape. An expanding research field involves the development and application of methods elaborated by the ISO series on soundscape. Furthermore, review articles and systematic reviews on this subject are increasingly published, aiming to deepen the understanding of this theme by analyzing published studies to determine research trends. On an international scale as well, several studies specifically focus on the indoor soundscape, seeking to elucidate this phenomenon within buildings, especially in public spaces [19,36–38,45–48].

### 3.1.2 Journals

The analysis of journal co-citations is an important tool for understanding the influence of individual journals in a specific research field [36,49]. It helps researchers gain insights into the most influential journals and easily access relevant information. In the context of research on soundscape in the Arab world, this analysis has revealed that publications on this subject are not concentrated in a specific journal (Table 4). Instead, the seven articles studied were published in different journals. The first article appeared in *Acta Acustica* (Stuttgart) in 2003 and the most recent article was published in *Environmental Research, Engineering and Management* in 2022. It is worth noting that only four of these articles are freely accessible, while the others are behind paywalls. This could limit the dissemination of these research findings and their accessibility. Furthermore, it is important to note that unlike contexts such as Europe, America, Australia, and other developed countries where several specialized journals on environmental acoustics are edited by universities, associations, and research groups, none of the mentioned journals are edited by Arab institutions. This further emphasizes the need for greater involvement of Arab academic institutions and journals in promoting and supporting research on soundscape within the region. Such involvement could enhance the visibility and accessibility of Arab contributions in this field and foster collaboration among Arab researchers and institutions.

**Table 4:** Prominent journals in soundscape research in the Arab world

Source	Documents	Citations
Acoustics Australia	1	3
Acta acustica (stuttgart)	1	0
Cybergeo	1	1
Engineered science	1	1
Environmental research, engineering and management	1	0
Noise and vibration worldwide	1	0
Sustainability (switzerland)	1	8

### 3.1.3 Language of Papers and Sponsor

The publication language of scientific articles is influenced by various factors, including the predominant language in the research field, editorial and national policies, the intended audience, and collaborations on an international scale [50,51]. In the field of soundscape studies, most articles published in the Arab world are in English, with the exception of one research study published in French in Algeria, which is the country's second national language. The publication of research in Arabic languages is limited within the scientific community due to the scarcity of Scopus-indexed scientific journals and the low international recognition of research published in these languages. The majority of researchers in the Arab-speaking world choose to publish their research in English to increase the visibility and impact of their work within the international scientific community.

While language choices significantly shape the dissemination of soundscape research in the Arab world, the financial landscape poses another critical dimension to the development of this field. Sponsors play a crucial role in funding research studies due to the substantial costs and resource requirements involved [52]. However, it is important to note that, according to the analysis of the studied research in the Scopus database, no sponsors have provided support for soundscape research in Arab countries, even in the wealthiest ones like Saudi Arabia, Qatar, and the United Arab Emirates. This lack of financial support may contribute to the limited number of publications in this field and could potentially discourage researchers from pursuing soundscape studies.

### 3.1.4 Co-country Analysis and Main Contributing Institutions

In the context of urban soundscape research in the Arab world, this study examines the international collaboration network and showcases the relationships among various countries. Six countries actively participated in this research endeavor. The publication count ranking is as follows: Algeria (6 publications), Italy (3 publications), Saudi Arabia (2 publications), Egypt (1 publication), and France (1 publication). Notably, Algeria, Italy, and Saudi Arabia emerge as pivotal hubs for international collaboration in scientific research on urban soundscape in the Arab world. However, it is important to highlight the limited overall participation of Arab countries, with Algeria standing out as the most active contributor. This analysis emphasizes the potential for collaboration and progress in the field of urban soundscape in the Arab world, underscoring the need for broader engagement and involvement from a more diverse array of Arab and non-Arab countries.

By analyzing Table 5, which provides a comprehensive summary of institutional contributions to soundscape research in the Arab world, we can observe that Algerian institutions, particularly the Department of Architecture at Biskra University and the Institute of Architecture and Urban Planning at Blida University, stand out with their high level of contribution. Both institutions have produced 4 documents and obtained 11 citations, indicating recognition for their research in the field of soundscape. The University della Campania "Luigi Vanvitelli" in Italy, with its Department of

Architecture and Industrial Design, has contributed with 3 documents. Although the number of citations is relatively low, the total link strength is 5, suggesting significant collaborations with other institutions, particularly Algerian universities in Biskra and Blida. On the other hand, Egyptian institutions such as the Department of Architectural Engineering at Cairo University and the Department of Architecture at the Faculty of Engineering and Information Technology at Onaizah Colleges, along with the German University in Cairo, have all contributed with 1 document. However, their total link strength is 2, indicating less involvement in international collaborations. Research laboratories such as the ABE Laboratory at Constantine 3 University and the RNAMS Laboratory at Oum El Bouaghi University in Algeria have both contributed with 1 document, with a total link strength of 2. Some institutions, like the University of Sétif in Algeria and the School of Design and Architecture at Dar Al-Hekma University in Saudi Arabia, have a low contribution in terms of documents and total link strength.

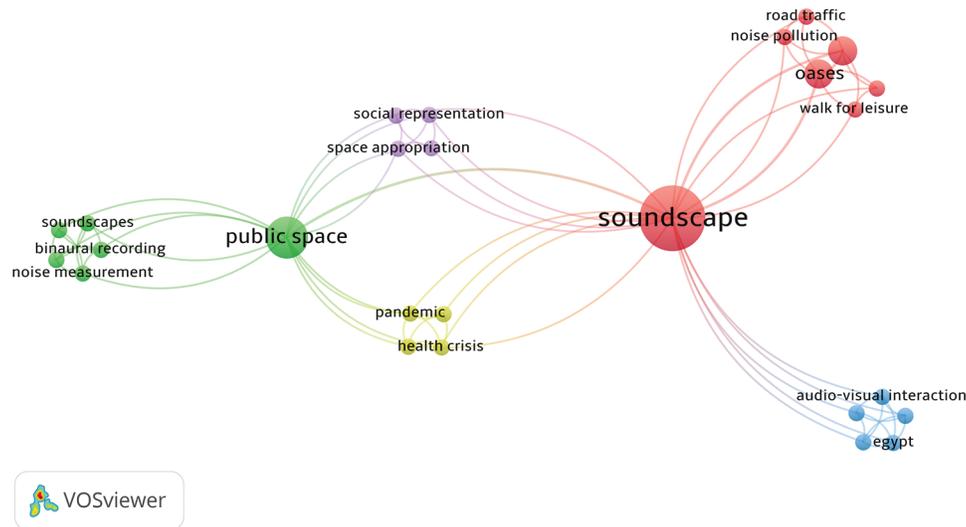
**Table 5:** The contributions of institutions to research on soundscape in the Arab world

Institutions	Documents	Citations	Total link strength
Department of Architecture, Biskra University, Biskra, Algeria	4	11	6
Institute of Architecture and Urban Planning, Blida University, Blida, Algeria	4	11	6
Department of Architecture and Industrial Design, Università Degli Studi Della Campania “Luigi Vanvitelli”, CE, Aversa, Italy	3	1	5
Department of Architectural Engineering, Faculty of Engineering, Cairo University, Giza, 12612, Egypt	1	1	2
Department of Architecture, Faculty of Engineering and Information Technology, Onaizah Colleges, Al Qasim, 2053, Saudi Arabia	1	1	2
Department of Architecture, Faculty of Engineering and Material Sciences, German University in Cairo (GUC), New Cairo, 16482, Egypt	1	1	2
ABE Laboratory, Faculty of Architecture and Urbanism, Constantine 3 University, Algeria	1	1	2
RNAMS Laboratory, University of Oum El Bouaghi, Institute of Urban Technical Management, 04000, Algeria	1	1	2
LAM Laboratory, University of Setif, Architecture Department, 25003, Algeria	1	0	0
School of Design and Architecture, Dar Al-Hekma University, Jeddah, Saudi Arabia	1	0	3
National School of Architecture and Landscape of Bordeaux, Talence, France	1	1	2

### 3.1.5 Keyword Co-Occurrence Analysis

Keywords play a crucial role in summarizing information about the subject and main content of a research paper. They also highlight research trends by analyzing their temporal evolution [36]. In exploring the most important research areas in the literature on urban soundscape, this section analyzes the temporal variations in centrality and frequency of co-occurring keywords. The graphical representation of these keywords in Arab world studies (Fig. 3) reveals two central focal points: the soundscape and public space, which are interconnected through direct and indirect links with other

keywords. Surrounding these central points, five clusters emerge, primarily comprising keywords from the same thematic family. However, it is worth noting some limitations, such as the absence of keywords related to nature, sound sources, and human perception. This analysis enhances our understanding of the key themes addressed in the literature on urban soundscape in the Arab world, identifies priority research areas, and highlights future exploration prospects.



**Figure 3:** Cluster map of author keywords

The first pole, which is solely related to the public space, includes the word “soundscape” grouped with “binaural recording” and “noise measurement”. Two other poles serve as a link between the soundscape and the public space are consist of the keywords “social representation” and “space appropriation”. Additionally, two other keywords relating to “public health” and “pandemic” come from a study conducted in 2021, which explored the impact of COVID-19 on the soundscape. Two other poles linked with “soundscape” encompass words such as “road noise”, “noise pollution”, “walkability” and “audio visual interaction” are present.

Notably, when comparing the international research landscape on this subject, it is observed that there are certain gaps in the list of keywords extracted from soundscape research in the Arab world including the absence of keywords related to nature, sound sources and human perception, ISO. Concerning the temporal analysis of the evaluation of keywords over time, it has not been feasible due to the relative recency of this subject in Arab countries, starting practically in 2020.

This analysis provides valuable insights into the research on urban soundscape in the Arab world. Firstly, it identifies two central themes: the soundscape and public space, which are interconnected through various keywords. The formation of five keyword clusters surrounding these central themes highlights the existence of cohesive research areas within the literature. Additionally, the presence of bridging concepts, such as “social representation” and “space appropriation,” emphasizes the interplay between the soundscape and public space. However, the absence of keywords related to nature, sound sources, and human perception suggests potential gaps in the literature. To address these limitations, future research can explore these neglected areas and further deepen our understanding of the urban soundscape in the Arab world.

### **3.2 Typical Features of Arab Cities that Inform Soundscapes**

Arab cities have unique characteristics as a logical consequence of their ancient history marked by several different eras and their varied and rich culture results from the interaction of several micro-cultures within a large region as well as their geography. This has had an impact on their soundscapes, giving them a distinct sound identity. Through the analysis of numerous studies and research on the

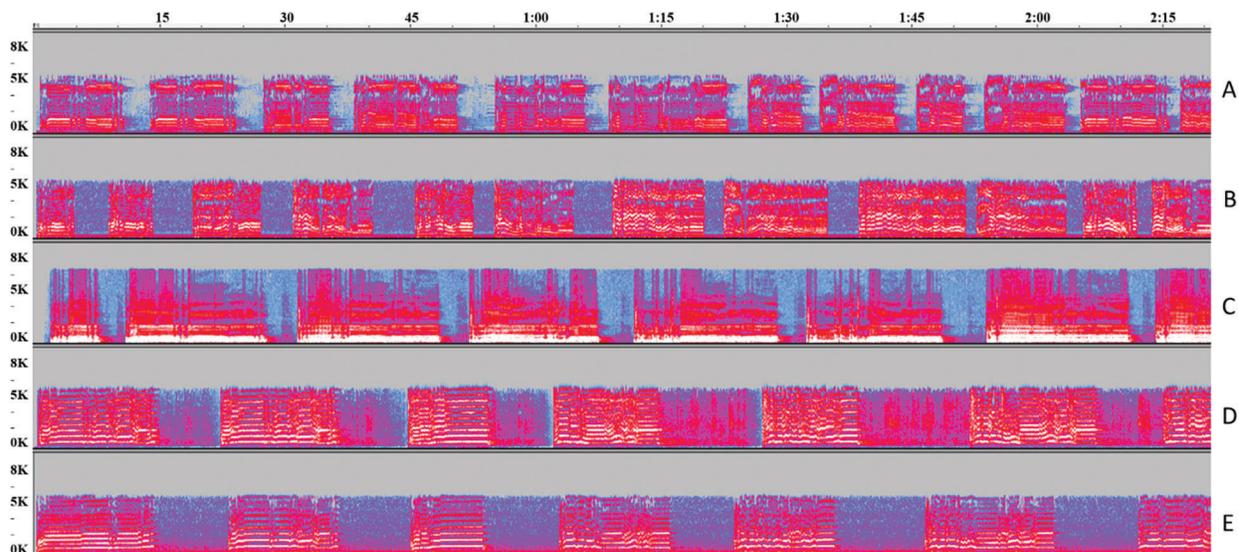
soundscape (see Table 2), several key factors have been identified that shape the overall acoustic environment. These factors can be summarized as follows:

Firstly, the nature of sound sources and the presence rate of different sound types, namely biophony (sounds from living organisms), geophony (sounds from natural elements), and anthrophony (sounds generated by humans) [31]. Secondly, the physical characteristics of the environment, particularly the urban morphology. Additionally, seasonal variations, time of day and weather conditions introduce temporal variations into the soundscape. Furthermore, daily life, use of space, human activities, interactions, and the cultural identity associated with a particular space shape the character of the soundscape [53]. The history of a space also leaves its imprint on its soundscape. Other important parameters include individual factors such as sound identification based on hearing levels, perception of sound sources, and individual preferences and needs. Moreover, the physical characteristics of the acoustic environment, psychological factors, and contextual elements such as surrounding activities, time of day, and weather conditions all contribute to shaping the soundscape. These typical features that inform the soundscapes of Arab cities can be categorized into three overarching groups.

### 3.2.1 Cultural and Religious Life

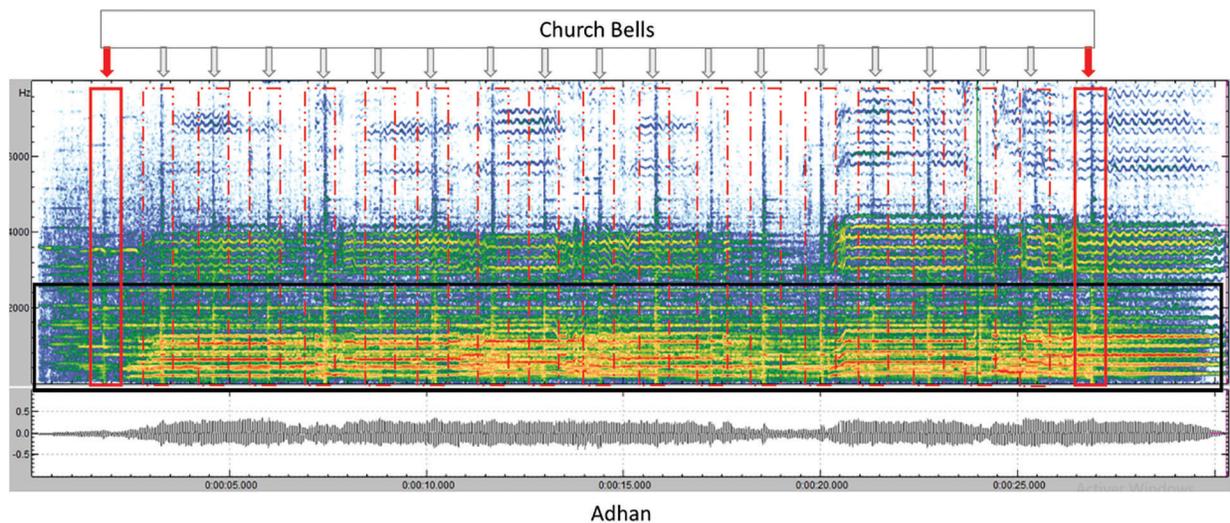
#### a) Calls to prayer and church bells

The call to prayer, known as the Athan, is one of the most distinctive and frequent sounds in Arab cities [54,55]. Five times a day it is sounded from the high minarets of mosques through loudspeakers to announce the time of Muslim prayer [56]. The Athan serves as both a temporal and spatial marker. It helps organize daily life in society and its singing style can vary across different regions [57,58]. While the lyrics remain the same, subtle differences in tone, rhythm, and intonation can be easily noticed. Experts can even identify the region based on the sound of the Athan [54,59]. Fig. 4 illustrates this by showing the spectrograms of the Athan from different regions, highlighting the differences in sound characteristics such as duration, amplitude, and frequency [60]. This variation contributes to cultural diversity, influences the sound identity of Arab cities, fosters a sense of belonging for members of the Muslim community, and adds an element of exoticism for foreign visitors.



**Figure 4:** Spectrograms of Adhan from different Arab regions (Adhans soundtrack from [61]). A: Adhan of the holy mosque in Mecca, Saudi Arabia. B: Adhan of the Dafna mosque in Qatar. C: Adhan of the Medina mosque in Medina, Saudi Arabia. D: Adhan of the Muscat mosque in Oman. E: Adhan of the Tunis mosque in Tunisia

Church bells also contribute to the soundscape in the Arab world [21,62], but to a lesser degree than the Adhan. In areas where Muslim and Christian communities coexist, the sound of church bells may be heard alongside the Muslim call to prayer. This creates a mixture of sounds that can be musically unique and that gives a specific sound identity to these regions such as the case of Egypt and Lebanon, where it is not uncommon to hear church bells coexisting with the adhan (see Fig. 5) [62–64].



**Figure 5:** Spectrogram of a soundscape comprising the Adhan (Islamic call to prayer) and the ringing of church bells resound simultaneously from Beirut, Lebanon (soundtrack from [65])

#### *b) Religious celebrations*

Religious celebrations such as Eid al-Fitr, Eid al-Adha, Ashura and Christian celebrations in some countries hold great significance in the Arab world since ancient times [66]. These celebrations involve events organized by the community. The nature of these celebrations varies from one region to another, even in the same country. As a result, Arab countries exhibit a unique and lively atmosphere in the neighborhoods, squares, and city centers during these public festivities. The celebrations include public gatherings, songs, prayers, traditional music, fireworks, and other customs. This soundscape is closely tied to the religious and cultural identity of the community, promoting a sense of belonging [28,53,67].

#### *c) Mosques*

Mosques are Muslim places of worship that have been a central feature of Arab cities since ancient times [26,68]. Their architecture, size, activity and location can significantly impact the surrounding soundscape, as noted by Barakat in his research [69]. He suggests that there may be a relationship between the sound of the Athan and the shape of the city, which requires further investigation [70]. As mentioned earlier, the regular calls to prayer broadcast from the minarets of the mosques create a special soundscape in the surrounding neighborhoods. Additionally, the overlapping adhan sounds from multiple mosques create a complex panoramic soundscape [53,71–73]. The same applies to the prayers, many of which are broadcast live through the minaret’s loudspeakers, especially during Ramdan and other religious events. This broadcasts have a longer lasting influence on the soundscape of Arab cities compared to of the Athan [74,75].

In addition to prayer, mosques also offer venues for various public events that contribute to the soundscape and unique sound identity of Arab cities. These venues can be used for religious and cultural events such as weddings, funerals and public awareness platforms. They also serve as educational spaces with regular Quran recitation and preaching sessions [74].

#### *d) Traditional cafes*

Traditional cafes play a significant role in shaping the soundscape of Arab cities, giving them a unique auditory character. These cafes are important social centers where people gather to have conversations and participate in cultural activities, creating a vibrant and dynamic environment [76–78]. The lively discussions, laughter, music and the sounds of smoking shisha and playing traditional dice games contribute to the overall soundscape of the urban landscape [41,44]. For example, in cities like Cairo and Marrakech, traditional cafes in the medina area contribute to the soundscape, not only influencing the auditory experience of Arab cities but also reflecting the cultural identity and heritage of these dynamic urban spaces [79–83]. The presence of traditional cafes not only shapes the auditory experience of Arab cities, but also mirrors their cultural identity and heritage, showcasing the dynamic nature of these urban spaces.

### *3.2.2 Daily Life and Businesses*

#### *a) Lively traditional markets*

The market or the souk is another key element of the soundscape of Arab cities, especially the traditional ones. It serves as an important public, economic and symbolic space, and has been a structural element of the city since ancient times. Typically situated in the heart of the city alongside other important features like the mosque and the madressa (religious educational establishments) [53,84–86], the traditional souks are bustling centers of commerce and social interaction. The soundscape of these areas is characterized by a cacophony of sounds of vendors shouting, customers negotiating prices and the sounds of carts transporting goods through the narrow alleys difficult to access by car [84,87–89].

Souks often have specialized areas for different types of goods, such as spices, fabrics, and jewelry. Each area has its own set of sounds [26,39,89,90]. For example, in the spice souk, we hear the sounds of pouring, mixing and grinding spices. In other traditional souks like the Jemaâ El Fna square souk in Morocco and the souk of the old town of Constantine in Algeria, that the soundscape is also marked by the noise that comes from artisanal trades such as the noises of boilermakers and artisanal carpentry [39,80,81].

Visiting the Arab souks is a multi-sensorial experience that encompasses unique elements of light, smell, and temperature. Similarly, the soundscape of markets is also distinctive and is often associated with the sound identity of Arab cities. For visitors, these sounds play a crucial role in the overall cultural experience [39,80,81].

#### *b) Arts and crafts*

Craftsmanship also plays a vital role in shaping the urban soundscapes of Arab cities. This is particularly evident in public squares, streets of traditional neighborhoods and markets [53,80,81]. Depending on their craft, artists have a knack of producing sounds that seamlessly merge with the existing urban sounds, resulting in a vibrant, intricate, and one-of-a-kind auditory experience [39,53].

### *3.2.3 Heritage and History*

#### *a) The architecture of Arab cities*

The acoustic environment of cities, including Arab cities, has been greatly influenced by their urban design [91–94]. These cities share key characteristics such as an organic layout, high building density, and narrow, human-scaled streets [26,29,95,96]. This arrangement promotes reverberation and sound amplification within neighborhoods, while also providing protection against external noises, such as traffic from the surrounding roadways [93,97]. Furthermore, the presence of large central squares, typically housing a souk (marketplace) and a mosque, contributes to a vibrant and dynamic soundscape in these cities [30,80,81]. Additionally, the integration of features such as fountains, Arabic gardens, courtyards, and traditional architectural elements like arches and vaults also plays a significant role in

shaping the unique acoustic environment by introducing sounds and influencing the behavior of sound waves in public spaces [20,31,41,53].

#### *b) Fountains*

Fountains have often played an important role in shaping the soundscape and sound identity of Arab cities, especially in their historic centers. According to several studies [98–100], the pleasant sound of water flowing from these fountains not only adds to their acoustic identity, but also enhances the overall ambiance of these locations. Additionally, the fusion of these sounds with other elements, such as traditional musicians, craftsmen and street vendors sounds, has contributed to the creation of the urban Arab unique soundscape [26,27].

#### *c) Public place*

The public square has been a significant and integral part of urban planning in Arab cities since antiquity. It also plays a vital role in shaping social, cultural and religious life [26,29,95,96]. The soundscape of these traditional public squares is typically a mix of diverse sounds, creating a unique sonic identity that mirrors the pace and activities of daily life. This includes calls to prayer, vendor chatter, the sounds of craftsmen work, sounds from economic activities and traffic noises.

The Jemaa el-Fna square in Marrakech, Morocco, located at the entrance to the medina, is classified as a world heritage site by UNESCO. This place exemplifies the relationship between the soundscape and the public square, characterized by sounds from cultural, social, economic and religious activities. These include the sounds of adhan, traditional music and performances, the sounds of food vendors and handicrafts, and the lively sounds of the crowds. This unique combination of sounds gives Jemaa el-Fna a distinct sonic identity, which is an integral part of its non-material heritage [80,81,86,101]. It is important to highlight that this intangible heritage is also recognized and classified as an acoustical heritage. Therefore, it should be considered in perspectives on heritage protection, emphasizing the significance of preserving this cultural richness for future generations [102–104].

### **3.3 A Research Agenda for Studying Arab Urban Soundscapes**

Preliminary findings from this research suggest that there is a gap in the exploration of the soundscape of Arab cities. Therefore, it is crucial to further emphasize this topic in order to improve the understanding of its fundamental aspects, components, and distinctive features. For directing further research in this field, the following sixteen key questions, organized in two categories (descriptive and comparative), can be considered (see Table 6).

**Table 6:** Key research areas for exploring the soundscape in Arab cities

GRP	Potential research questions
<b>Descriptive questions:</b>	<b>Perception and experience:</b>
	<ol style="list-style-type: none"> <li>1) How do residents and visitors in Arab cities perceive and experience the soundscape in different urban areas?</li> <li>2) What are the subjective preferences and attitudes towards sounds in Arab cities, and how do they influence individuals' well-being and quality of life?</li> </ol>
	<b>Sound sources and characteristics:</b>
	<ol style="list-style-type: none"> <li>1) What are the key components of the soundscape in Arab cities, considering the diversity of sources, spatial and temporal variations, and their impact on residents' quality of life?</li> </ol>

(Continued)

<b>Table 6 (continued)</b>	
<b>GRP</b>	<b>Potential research questions</b>
	<p><b>Impact of morphological features on the soundscape in Arab cities:</b></p> <ol style="list-style-type: none"> <li>1) How do specific morphological features of Arab cities influence the propagation, reflection, and overall acoustic environment of the soundscape?</li> <li>2) How can urban planning and architectural strategies leverage these morphological features to promote a more pleasant soundscape while preserving cultural identity?</li> </ol> <p><b>Impact on urban life:</b></p> <ol style="list-style-type: none"> <li>1) What are the effects of the soundscape in Arab cities on social interactions, behaviors, and activities of residents?</li> <li>2) How does the perception of safety and comfort relate to the soundscape in Arab cities, and how can urban planning support positive social interactions?</li> </ol> <p><b>Sound planning and design:</b></p> <ol style="list-style-type: none"> <li>1) What strategies and interventions can be implemented to improve the soundscape in Arab cities and enhance the quality of life?</li> <li>2) How can urban planning, architectural design, and the management of public spaces integrate sound considerations to create more harmonious and pleasant sound environments in Arab cities?</li> <li>3) What are the perceptual and cultural aspects of soundscapes in different architectural styles in Arab cities?</li> <li>4) How can urban design strategies enhance positive soundscapes in Arab cities?</li> </ol> <p><b>Cultural soundscapes:</b></p> <ol style="list-style-type: none"> <li>1) How do traditional music and religious rituals contribute to the sonic identity of Arab cities?</li> <li>2) What are the cultural meanings and significance associated with specific sounds in Arab cities?</li> </ol> <p><b>Historical soundscapes:</b></p> <ol style="list-style-type: none"> <li>1) How has the soundscape of Arab cities evolved over time, and what are the key historical events that shaped it?</li> <li>2) What are the changes in the perception and use of sound in Arab cities across different historical periods?</li> </ol> <p><b>Laws and regulations for soundscape management:</b></p> <ol style="list-style-type: none"> <li>1) What are the existing laws and regulations concerning soundscape management in Arab cities, and how effective are they in controlling and managing the urban soundscape?</li> <li>2) What are the challenges encountered during the practical application of these laws and regulations, and how can the legal and regulatory frameworks be improved?</li> </ol> <p><b>Comparative questions:</b></p> <ol style="list-style-type: none"> <li>1) How does the soundscape of Arab cities compare with the soundscape of other regions in terms of historical and cultural influences, and architectural styles?</li> <li>2) How do the inhabitants of Arab cities perceive their soundscape compared to other communities globally, and what insights can be gained from international and cultural research on soundscape perception?</li> </ol>

The first group of issues focuses on the descriptive approach and analysis of the soundscape in Arab cities. The goal is to understand the soundscape as a whole and identify the relationship between morphological characteristics, the particularity of life, and the soundscape.

Studying the perception and sound experiences of residents and visitors in Arab cities (issue 1) can help us understand how the soundscape is perceived and experienced in different urban areas. This is important because it provides information on subjective preferences and attitudes towards sounds, and how they affect the well-being and quality of life of individuals. Exploring noise sources and their characteristics in Arab cities is also crucial (issue 2). Researchers can aim to identify key components of the soundscape, considering the diversity of sources, their spatial and temporal variations, and their impact on residents' quality of life. This will help (i) identify prominent noise sources and develop effective interventions for noise pollution management; (ii) improve overall quality of life; (iii) preserve cultural heritage; (iv) contribute to urban planning. Additionally, identifying specific sound characteristics and patterns in Arab cities will help preserve cultural identity and create unique sound environments.

Another interesting subject to study is the impact of the specific morphological characteristics of Arab cities on their urban soundscape (issue 3). Elements such as urban density, building height, traditional architecture, street layout and building materials can influence sound propagation, reflection and the overall acoustic environment. Understanding these effects in the context of Arab cities will help develop urban planning and architectural strategies that promote a more pleasant soundscape while preserving cultural identity. On the other hand, studying the impact of the soundscape on urban life (issue 4) is another intriguing area for future studies. Understanding how the soundscape in Arab cities affects social interactions, behaviors, activities, and perceptions of safety and comfort is essential for urban planning. By evaluating these interactions, it will be possible to design urban environments that promote conviviality and encourage positive social interactions.

Soundscape planning and design (issue 5) is an important research topic that has several gaps in the scientific literature. It is crucial to seek strategies and interventions to enhance the soundscape in Arab cities in order to promote a better quality of life. By incorporating sound considerations into urban planning, architectural design and the management of public spaces will help to create more harmonious and pleasant sound environments. Examining best practices and experiences from other cities or cultures will help identify effective approaches that can be adapted to the specific context of Arab cities. Furthermore, it is important to examine the laws and regulations concerning the management of the soundscape in Arab cities (issue 6). Analyzing the presence of policies and legal measures to control and manage the urban soundscape is a crucial step, as it will identify potential gaps in current legislation and provide recommendations for improving legal and regulatory frameworks. Equally important is the evaluation of the effectiveness of the implementation of these laws and regulations, and the resolution of problems encountered in their practical application.

On the other hand, conducting comparative research is crucial for gaining a thorough understanding of the soundscape of Arab cities in relation to other regions. This research should focus on identifying similarities and differences between Arab soundscape and that of other regions, to help to identify the influence of the historical and cultural aspects of the region on the current soundscape. Another important aspect is understanding the perception of Arab cities inhabitants towards the soundscape, which can be achieved by comparing it to the perception in other communities through international and multicultural research. One such study is already in progress is the Soundscape Attributes Translation Project (SATP) [105]. Given the vastness and cultural diversity of the Arab world, it is also important to compare soundscapes in different Arab regions, even within the same country, to identify the correlation between local traditions and lifestyles and the soundscape.

#### 4 Limitations of the Study

The study has several limitations that should be acknowledged. First, it is important to recognize that the findings may not cover all the studies on soundscape in the Arab world. This is because the search was limited to studies published in the Scopus database and did not include potential studies from other databases or the gray literature. Second, the inclusion criteria focused only on studies published in peer-reviewed journals, which may have excluded valuable other sources like conference proceedings or books. Lastly, the selection process relied on the relevance of studies based on their title, keywords, and abstract, which could have led to the exclusion of relevant studies that did not use these terms in their abstract or title.

#### 5 Conclusions

The exploration of the soundscape in Arab cities is an area of research that has been largely neglected, despite its increasing importance in recent years, especially in developed countries. This research, aims to address the lack of studies on this subject, which currently accounts for only 0.2% of the world's scientific productivity. The research identifies and categorizes major questions and research directions that need to be addressed in order to enhance our understanding of soundscapes in Arabic cities. These questions and directions can be grouped into two groups, a descriptive component that focuses on perception, sound sources, and how the urban morphological characteristics influence the soundscape and its relationship with quality of life. On the other hand, a second strand of research proposed a series of comparative studies to contextualize soundscapes in Arab cities from a global perspective. By comparing historical and cultural influences, architectural styles and perceptions of residents with those of other regions and communities, we can gain unique insights and potentially identify best practices that can be adapted to the specific context of Arab towns.

This research agenda outlines 9 themes for future studies on soundscapes in Arab cities. It highlights the significance of interdisciplinary research, bringing together expertise from urban planning, architecture, psychology, sociology, and cultural studies. By addressing the research questions outlined, we can deepen our understanding of soundscapes in Arab cities and contribute to the creation of strategies and interventions that promote a more pleasant and sustainable acoustic environment while also preserving cultural identity.

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## References

1. Toffolo, C. E. (2008). *The arab league*. New York, USA: Infobase Publishing.
2. Arab Countries/Arab League Countries (2023). World population review. <https://worldpopulationreview.com/country-rankings/arab-countries> (accessed on 21/06/2023).
3. Bouzir, T. A. K., Berkouk, D., Schwela, D., Lahlouh, M. (2023). *A review of noise pollution policies in the Arab world*, pp. 1–18. <https://doi.org/10.1007/s40857-023-00294-9>
4. Verner, D. (2012). *Adaptation to a changing climate in the Arab countries: A case for adaptation governance and leadership in building climate resilience*. Washington, USA: World Bank Publications.
5. Abu-Lughod, J. L. (2018). *Cairo: 1001 years of the city victorious*, vol. 5221. Princeton University Press.
6. Gates, C. (2011). *Ancient cities: The archaeology of urban life in the ancient near East and Egypt, Greece and Rome*. London, UK: Taylor Francis.
7. Yassin, A. A., Utaberta, N. (2012). Architecture in the Islamic civilization: Muslim building or Islamic architecture. *Journal of Islamic Architecture*, 2(2), 52–60.
8. Farrag, E. (2017). Architecture of mosques and Islamic centers in non-muslim context. *Alexandria Engineering Journal*, 56(4), 613–620.
9. Bennison, A. K., Gascoigne, A. L. (2007). *Cities in the pre-modern Islamic world: The urban impact of religion, state and society*, vol. 3. Milton, UK: Routledge.
10. Memarian, G., Brown, F. (2004). The shared characteristics of Iranian and Arab courtyard houses. In: *Courtyard housing*, pp. 49–62. London, UK: Taylor Francis.
11. Salman, M. (2018). Sustainability and vernacular architecture: Rethinking what identity is. In: *Urban and architectural heritage conservation within sustainability*. London, UK: IntechOpen.
12. Benslimane, N., Biara, R. W. (2019). The urban sustainable structure of the vernacular city and its modern transformation: A case study of the popular architecture in the saharian region. *Energy Procedia*, 157, 1241–1252.
13. Bouzir, T. A. K., Zemmouri, N. (2018). Evaluation of the sound environment of the city of Biskra (Algeria). *Journal of Applied Engineering Science Technology*, 4(1), 7–11.
14. Günaydin, A. S., Yücekaya, M. (2020). Evaluation of the history of cities in the context of spatial configuration to preview their future. *Sustainable Cities and Society*, 59, 102202.
15. Zaidan, E., Abulibdeh, A. (2021). Master planning and the evolving urban model in the gulf cities: Principles, policies, and practices for the transition to sustainable urbanism. *Planning Practice Research*, 36(2), 193–215.
16. Parker, M., Spennemann, D. H. (2022). Classifying sound: A tool to enrich intangible heritage management. *Acoustics Australia*, 50(1), 23–39.
17. Maffei, L., Brambilla, G., di Gabriele, M. (2010). Soundscape as part of the cultural heritage. In: *Soundscape and the built environment*, vol. 58, no. 5, pp. 532–539. CRC Press.
18. Chougle, A. A. A. (2020). *Sounds of Qatar: Preserving Qatari aural culture through digital sound archives (Ph.D. Thesis)*. Hamad Bin Khalifa University, Qatar.
19. Mu, J., Wang, T., Zhang, Z. (2022). Research on the acoustic environment of heritage buildings: A systematic review. *Buildings*, 12(11), 1963.
20. Bouzir, T. A. K., Berkouk, D., Zemmouri, N. (2019). Evaluation and analysis of the Algerian Oases soundscape: Case of El Kantara and Sidi Okba. *Acoustics Australia*, 1–10. <https://doi.org/10.1007/s40857-019-00173-2>
21. Schafer, R. M. (1993). *The soundscape: Our sonic environment and the tuning of the world*. Vermont, USA: Simon and Schuster.
22. Pijanowski, B. C., Farina, A., Gage, S. H., Dumyahn, S. L., Krause, B. L. (2011). What is soundscape ecology? An introduction and overview of an emerging new science. *Landscape Ecology*, 26, 1213–1232.
23. Farina, A. (2013). *Soundscape ecology: Principles, patterns, methods and applications*. New York, USA: Springer.

24. ISO 12913-1:2014 (2014). Acoustics—soundscape—Part 1: Definition and conceptual framework. (International Organization for Standardization, Geneva, Switzerland). <https://www.iso.org/standard/52161.html> (accessed on 04/03/2023).
25. Liu, F., Jiang, S., Kang, J., Wu, Y., Yang, D. et al. (2022). On the definition of noise. *Humanities and Social Sciences Communications*, 9(1), 1–17.
26. Hakim, B. S. (2013). *Arabic Islamic cities rev: Building and planning principles*. Milton, UK: Routledge.
27. Ajaj, A., Pugnaroni, F. (2014). Re-thinking traditional arab architecture: A traditional approach to contemporary living. *International Journal of Engineering and Technology*, 6(4), 286–289.
28. Raymond, A. (2005). Urban life and middle eastern cities: The traditional Arab city. In: *A companion to the history of the middle East*, pp. 207–226. Malden, USA: Blackwell publishing.
29. Kiet, A. (2011). Arab culture and urban form. *Focus*, 8(1), 10.
30. Al Emadi, M. M. (2022). *Similarities are differences: Soundscape approach in creating identities of Doha and the Northern areas in Qatar (Ph.D. Thesis)*. Hamad Bin Khalifa University (Qatar).
31. Rehan, R. M. (2016). The phonic identity of the city urban soundscape for sustainable spaces. *HBRC Journal*, 12(3), 337–349.
32. Bartalucci, C., Luzzi, S. (2020). The soundscape in cultural heritage. *IOP Conference Series: Materials Science and Engineering*, vol. 949, 12050. Bristol, UK, IOP Publishing. <https://iopscience.iop.org/article/10.1088/1757-899X/949/1/012050/meta> (accessed on 10/02/2023).
33. Bijsterveld, K. (2013). *Soundscapes of the urban past: Staged sound as mediated cultural heritage*. Transcript Verlag. <https://library.oapen.org/handle/20.500.12657/31458> (accessed on 19/12/2023).
34. Pollock, A., Berge, E. (2018). How to do a systematic review. *International Journal of Stroke*, 13(2), 138–156.
35. Linnenluecke, M. K., Marrone, M., Singh, A. K. (2020). Conducting systematic literature reviews and bibliometric analyses. *Australian Journal of Management*, 45(2), 175–194.
36. Yang, J., Lu, H. (2022). Visualizing the knowledge domain in urban soundscape: A scientometric analysis based on CiteSpace. *International Journal of Environmental Research and Public Health*, 19(21), 13912.
37. Yang, T., Aletta, F., Kang, J. (2021). Sound environments in large public buildings for crowd transit: A systematic review. *Applied Sciences*, 11(9), 3728.
38. Aletta, F., Oberman, T., Kang, J. (2018). Associations between positive health-related effects and soundscapes perceptual constructs: A systematic review. *International Journal of Environmental Research and Public Health*, 15(11), 2392.
39. Rabah, D. C., Hamza, Z. (2002). The concept of privacy in the social practice of the living environment through sonic phenomena (case of the old city of Constantine. Algeria). *The Journal of the Acoustical Society of America*, 111(5), 2350.
40. Berkouk, D., Bouzir, T. A. K., Maffei, L., Masullo, M. (2020). Examining the associations between oases soundscape components and walking speed: Correlation or causation? *Sustainability*, 12(11), 4619.
41. Ikni, K., Debache-Benzagouta et Philippe Woloszyn, S. (2020). La chronotopie du paysage sonore urbain des places publiques : Le cas de la place 1er novembre 1954 à Béjaïa (Algérie). *Cybergeo: European Journal of Geography*. <https://doi.org/10.4000/cybergeo.34704>
42. Ali, M., Gabr, H. S., Mahmoud, A. H., Aboubakr, D. (2021). Assessing and characterizing the perception of soundscape in the Urban park: A case study of Zayed park, Egypt. *Engineered Science*, 16, 393–402.
43. Bouzir, T. A. K., Berkouk, D., Boucherit, S., Khelil, S., Matallah, M. E. et al. (2022). Evaluation of soundscape variations through the open public spaces in Saharan cities: A case of Biskra, Algeria. *Environmental Research, Engineering and Management*, 78(4), 39–51. <https://doi.org/10.5755/j01.arem.78.4.31244>
44. Berkouk, D., Bouzir, T. A. K., Boucherit, S., Khelil, S., Mahaya, C. et al. (2022). Evaluation of the soundscapes through the cafe terraces before and after the COVID-19 lockdown in coastal cities in Algeria. *Noise Vibration Worldwide*, 53(7–8), 377–389.
45. Aletta, F., Oberman, T., Mitchell, A., Kang, J., Nguyen, T. et al. (2023). Preliminary results of the soundscape attributes translation project (SATP): Lessons learned and next steps. *Forum Acusticum 2023*, Turin, Italy.

46. Aletta, F., Guattari, C., Evangelisti, L., Asdrubali, F., Oberman, T. et al. (2019). Exploring the compatibility of method A and method B data collection protocols reported in the ISO/TS 12913-2:2018 for urban soundscape via a soundwalk. *Applied Acoustics*, 155, 190–203.
47. Aletta, F., Torresin, S. (2023). Adoption of ISO/TS 12913–2:2018 protocols for data collection from individuals in soundscape studies: An overview of the literature. *Current Pollution Reports*. <https://doi.org/10.1007/s40726-023-00283-6>
48. Li, H., Lau, S. K. (2020). A review of audio-visual interaction on soundscape assessment in urban built environments. *Applied Acoustics*, 166, 107372.
49. Horte, O. S., Eisenman, T. S. (2020). Urban greenways: A systematic review and typology. *Land*, 9(2), 40.
50. di Bitetti, M. S., Ferreras, J. A. (2017). Publish (in English) or perish: The effect on citation rate of using languages other than English in scientific publications. *Ambio*, 46, 121–127.
51. Curry, M. J., Lillis, T. (2013). *A scholar's guide to getting published in English: Critical choices and practical strategies*. Bristol, UK: Multilingual Matters.
52. Arnott, J. C., Kirchhoff, C. J., Meyer, R. M., Meadow, A. M., Bednarek, A. T. (2020). Sponsoring actionable science: What public science funders can do to advance sustainability and the social contract for science. *Current Opinion in Environmental Sustainability*, 42, 38–44.
53. Hassan, S. A., Taha, H. S. (2021). The role of the urban soundscape in identification of Baghdad traditional city. *IOP Conference Series: Materials Science and Engineering*, vol. 1105, 12113. IOP Publishing.
54. Moosa, H. (2019). Hidden potentials in historic cities: Soundscape in historic cairo as an application. *International Design Journal*, 9(3), 209–220.
55. Tassia, R. D., Sudarsono, A. S., Sarwono, S. J. (2019). *The implementation of acoustic environment simulator to improve the soundscape of iconic space*. Berlin, Germany: Universitätsbibliothek der RWTH Aachen.
56. Al Bakri, T., Mallah, M., Nuserat, N. (2019). Al Adhan: Documenting historical background, practice rules, and musicological features of the Muslim call for prayer in Hashemite kingdom of Jordan. *Musicologica Brunensia* 54(1), 167–185. <https://doi.org/10.5817/MB2019-1-12>
57. Riskedahl, D. (2020). The Muslim call to prayer in Canada's pandemic soundscape. *City Society*, 32(2), 1–9.
58. Suleman, Z. K. (2022). *Silent adhan: Exploring the muslim call to prayer in metro Vancouver (Ph.D. Thesis)*. University of British Columbia, Canada.
59. Al-Oudat, N., Alshbatat, A. I. (2014). A unified call-to-prayer framework in muslim world. *International Journal of Electrical and Computer Engineering*, 4(3), 314–321.
60. Campo, J. E. (2009). *Encyclopedia of Islam*. New York, USA: Infobase Publishing.
61. Listen and download records of Adhan (Call to Prayer) by the most beautiful voices. <https://www.assabile.com/adhan-call-prayer> (accessed on 25/11/2023).
62. Rodriguez Suarez, A. (2023). The religious soundscape of Mount Lebanon in the 18th and the first half of the 19th century. *British Journal of Middle Eastern Studies*, 1–17. <https://doi.org/10.1080/13530194.2023.2209026>
63. Hackett, R. I. (2012). Sound, music, and the study of religion. *Temenos-Nordic Journal of Comparative Religion*, 48(1), 11–27.
64. Fahmy, Z. (2020). *Street sounds: Listening to everyday life in modern egypt*. Stanford, USA: Stanford University Press.
65. Annan, K. (2019). The sound of Adhan and a church bell in Beirut. <https://www.youtube.com/watch?v=7VmuoV8Ti3g> (accessed on 08/01/2023).
66. Melton, J. G. (2011). *Religious celebrations: An encyclopedia of holidays, festivals, solemn observances, and spiritual commemorations*, vol. 1. California, USA: Abc-clio.
67. Barakat, H. (1993). *The Arab world: Society, culture, and state*. California, USA: Univ of California Press.
68. Khan, H. U. (1990). The architecture of the mosque, an overview and design directions. In: *Expressions of Islam in buildings*, pp. 109–127. Indonesia: Aga Khan trust for culture.

69. Barakat, M. (2012). Urban acoustic simulation: Analysis of urban public spaces through auditory senses. *Digital Physicality—Proceedings of the 30th eCAADe Conference*, pp. 587–592. Prague, Czech Republic. <https://doi.org/10.52842/conf.ecaade.2012.1.587>
70. Shan, H., Liang, Y. (2021). Research on the courtyard mosque soundscape—A case study in the Huajue Alley mosque. *IOP Conference Series: Earth and Environmental Science*, vol. 835, pp. 12006–12018. IOP Publishing.
71. Aletta, F., Kang, J. (2020). Historical acoustics: Relationships between people and sound over time. *Acoustics*, 2(1), 128–130. <https://doi.org/10.3390/acoustics2010009>
72. Gül, Z. S. (2019). Acoustical impact of architectonics and material features in the lifespan of two monumental sacred structures. *Acoustics*, 1, 493–516. <https://doi.org/10.3390/acoustics1030028>.
73. Sudarsono, A. S., Sarwono, J., Dwitassia, R. (2020). Understanding urban soundscape through soundscape composition. *INTER-NOISE and NOISE-CON Congress and Conference Proceedings*, vol. 261, pp. 3301–3308. Seoul, Korea, Institute of Noise Control Engineering.
74. Macaulay, D. (2008). *Mosque*. New York, USA: Houghton Mifflin Harcourt.
75. Afrough, E., Khanmohammadi, K., Qanbarinik, S. (2018). The cultural interaction of the mosque and society from the perspective of religious teachings. *Journal of Islam and Social Studies*, 6(22), 30–57.
76. Benthadbane, F., Khreis, S. (2021). The urban profiles of peace tourism in arab cities: Opportunities for change towards sustainability. Case study: As-salt (jordan) and constantine (algeria) cities. *Geo Journal of Tourism and Geosites*, 38(4), 1175–1188.
77. Shtaya, D. A., Ghodieh, A. (2019). Variation in the nature of the activities, interactions, and behavior patterns of visitors of public spaces in the city of amman: The new Abdali and Al-Balad districts as a case study. *International Journal of Social Science and Economics Invention*, 5, 181–193. <https://doi.org/10.23958/ijsssei/vol05-i11/171>
78. Furlan, R. (2016). Modern and vernacular settlements in Doha: An urban planning strategy to pursue modernity and consolidate cultural identity. [https://www.researchgate.net/publication/320921010\\_The\\_Development\\_of\\_Vital\\_Precincts\\_in\\_Doha\\_Urban\\_Regeneration\\_and\\_Socio-Cultural\\_Factors](https://www.researchgate.net/publication/320921010_The_Development_of_Vital_Precincts_in_Doha_Urban_Regeneration_and_Socio-Cultural_Factors) (accessed on 01/11/2023).
79. Kyvelou, S. (2015). L'Écologie sonore au service d'une vision renouvelée d'attractivité et de frugalité territoriales. *Géographies, Géopolitiques et Géostratégies Régionales*, 3(1), 45–54.
80. McGuinness, J. (2007). Moving into Morocco. In: *Places we share: Migration, subjectivity, and global mobility* Lanham, USA: Lexington books.
81. Kapchan, D. (2014). Intangible heritage in transit: Goytisoló's rescue and Moroccan cultural rights. In: *Cultural heritage in transit: Intangible rights as human rights*, pp. 177–194. Philadelphia, USA: University of Pennsylvania Press.
82. Ismail, M. R. (2014). Sound preferences of the dense urban environment: Soundscape of Cairo. *Frontiers of Architectural Research*, 3(1), 55–68.
83. Kelman, A. Y. (2010). Rethinking the soundscape: A critical genealogy of a key term in sound studies. *The Senses and Society*, 5(2), 212–234.
84. Furlan, R., Faggion, L. (2015). The Souq Waqif heritage site in Doha: Spatial form and livability.
85. Elsayed, H. A., AboWardah, E. S., Ramadan, M. G. (2019). Traditional market design towards cohesion between social sustainability and bioclimatic approach. *IOP Conference Series: Materials Science and Engineering*, 3rd World Multidisciplinary Civil Engineering, Architecture, Urban Planning Symposium (WMCAUS 2018), vol. 471, 072002. Prague, Czech Republic, IOP Publishing.
86. Hamza, N. (2022). *Architecture and urban transformation of historical markets: Cases from the Middle East and North Africa*. Milton, UK: Taylor Francis.
87. Jahawi, S. (2015). *A study of socio-spatial behaviour in traditional and contemporary shopping environments in Dubai, UAE (Ph.D. Thesis)*. Heriot-Watt University, UK.
88. Dashti, R. J. (2016). *Place attachment and female identity in traditional Souk Wajif: Implications for interior design (Ph.D. Thesis)*. University of Minnesota, USA.

89. Gharipour, M. (2012). *The bazaar in the Islamic city: design, culture, and history*. Cairo, Egypt: The American University in Cairo Press.
90. King, D. C. (2008). *The United Arab Emirates*. New York, USA: Marshall Cavendish.
91. Offenhuber, D., Auinger, S. (2013). *Urban configuration and the soundscape*. Bonndorf: Stadtmusik.
92. Hong, J. Y., Jeon, J. Y. (2017). Relationship between spatiotemporal variability of soundscape and urban morphology in a multifunctional urban area: A case study in Seoul, Korea. *Building and Environment*, 126, 382–395.
93. Balderrama, A., Kang, J., Prieto, A., Luna-Navarro, A., Arzmann, D. et al. (2022). Effects of Façades on urban acoustic environment and soundscape: A systematic review. *Sustainability*, 14(15), 9670.
94. Hong, J. Y., Jeon, J. Y. (2017). Exploring spatial relationships among soundscape variables in urban areas: A spatial statistical modelling approach. *Landscape and Urban Planning*, 157, 352–364.
95. Dhingra, M., Chattopadhyay, S. (2016). Advancing smartness of traditional settlements-case analysis of Indian and Arab old cities. *International Journal of Sustainable Built Environment*, 5(2), 549–563.
96. Shehata, A. M. (2022). Current trends in urban heritage conservation: Medieval historic Arab city centers. *Sustainability*, 14(2), 607.
97. Bouzir, T. A. K., Zemmouri, N. (2017). Effect of urban morphology on road noise distribution. *Energy Procedia*, 119, 376–385.
98. Axelsson, Ö., Nilsson, M. E., Hellström, B., Lundén, P. (2014). A field experiment on the impact of sounds from a jet-and-basin fountain on soundscape quality in an urban park. *Landscape and Urban Planning*, 123, 49–60.
99. Chitra, B., Jain, M., Chundelli, F. A. (2020). Understanding the soundscape environment of an urban park through landscape elements. *Environmental Technology Innovation*, 19, 100998.
100. Hong, J. Y., Lam, B., Ong, Z. T., Ooi, K., Gan, W. S. et al. (2020). The effects of spatial separations between water sound and traffic noise sources on soundscape assessment. *Building and Environment*, 167, 106423.
101. Slitine El Mghari, N. (2022). The Moroccan city: A quest for cultural memory in Francophone and Arabophone contemporary literature. *The Journal of North African Studies*, 27(1), 40–61.
102. Zhu, X., Oberman, T., Aletta, F. (2024). Defining acoustical heritage: A qualitative approach based on expert interviews. *Applied Acoustics*, 216, 109754.
103. Brezina, P. (2013). Acoustics of historic spaces as a form of intangible cultural heritage. *Antiquity*, 87(336), 574–580.
104. Karabiber, Z. (2002). The conservation of acoustical heritage. *Proceedings of the 5th EC Conference*, pp. 286–290. Cracow, Poland.
105. Aletta, F., Oberman, T., Axelsson, Ö., Xie, H., Zhang, Y. et al. (2020). Soundscape assessment: Towards a validated translation of perceptual attributes in different languages. *Inter-Noise and Noise-Con Congress and Conference Proceedings*, pp. 3137–3146. Seoul, Korea, Institute of Noise Control Engineering.