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Sustainable development of vernacular architecture: a systematic literature review

Jia Zong, Wan Srihani Wan Mohamed, Mohamad Fakri Zaky Jaafar and Norsidah Ujang

Faculty of Design and Architecture, Universiti Putra Malaysia, Serdang, Selangor, Malaysia

ABSTRACT

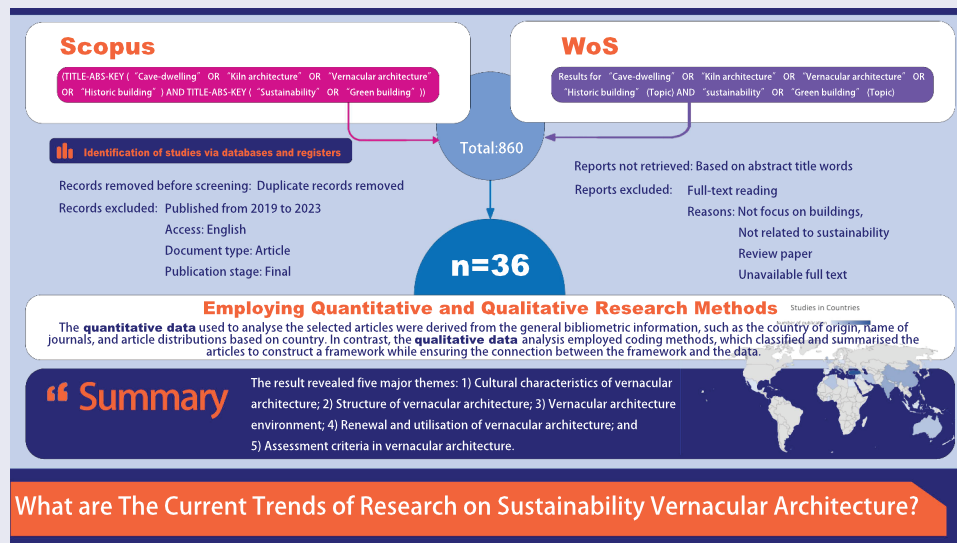
The sustainable evolution of vernacular architecture effectively addresses climate change and environmental challenges, yet comprehensive reviews are scarce. Therefore, this study aimed to explore the history and progression of vernacular architecture and address the requisite knowledge and methodologies for its sustainable development via a systematic literature review. A meticulous screening process of relevant articles was performed in two research databases (Scopus and Web of Science) using the keywords “Cave-dwelling,” “Kiln building,” “Historical architecture,” and “Vernacular architecture” that represents vernacular architecture and “Sustainable” and “Green building” for sustainability. A total of 36 articles published between 2019 and 2023 were then selected for the quantitative and qualitative analyses using the ATLAS.ti 23 software. The result revealed five major themes: 1) Cultural characteristics of vernacular architecture; 2) Structure of vernacular architecture; 3) Vernacular architecture environment; 4) Renewal and utilisation of vernacular architecture; and 5) Assessment criteria in vernacular architecture. In summary, the current research on vernacular architecture remains primarily focused on architectural studies, with minimal consideration from the user’s viewpoint. Thus, it is essential to enhance the comfort and functionality of vernacular architecture, preserve its local culture, and meet the users’ demands.

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Systematic review;
Sustainability; ATLAS.Ti 23



1. Introduction

The energy consumption by the construction industry is expected to continue to rise in line with the steady growth of the global population. Statistically, nearly half of the world’s carbon emissions are contributed by the construction industry (Zhai and Previtali 2010). The onset of the global energy crisis has driven the international community to pay more attention to preserving and protecting fast-depleting environmental resources. Interestingly, energy-efficient buildings

with architectural designs have the potential to reduce carbon emissions by 60% (Tzikopoulos, Karatza, and Paravantis 2005). Historical buildings initially represent sustainable characteristics that respond to the micro-climate and the location of the structure (Abdelrazek and Yilmaz 2020). Many of these unique structures also possess significant cultural heritage values and play a crucial role in addressing climate change and other key environmental challenges (Redden and Crawford 2021). In view of this, energy-efficient architecture

CONTACT Jia Zong  gs58615@student.upm.edu.my  Faculty of Design and Architecture, Universiti Putra Malaysia, Serdang, Selangor 43400, Malaysia

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has gained considerable traction in the construction industry.

In a recent study, Martinovic, Zecevic, and Salihbegović (2023) believed that vernacular architecture is one of the most representative forms of sustainable building. In fact, a significant portion of vernacular architecture has demonstrated higher efficiency in energy conservation, contrary to the expectations of most scholars. As a result, an increasing number of researchers have begun to evaluate the energy-saving performance of traditional residences (Engin et al. 2007; Fabbri and Tronchin 2006). These studies assessed various traditional homes to inspire more scholars to explore the efficient energy-saving characteristics of vernacular architecture.

Generally, vernacular architecture has the potential to be a valuable source of inspiration and learning material to promote more influential and meaningful modern architectural strategies. However, these rich historical and cultural heritage structures have gradually lost their unique characteristics and appeal over time and become nondescript locations (Yazici and Aslan 2019). This is undoubtedly a significant loss to vernacular architecture and leads to the growing energy consumption in the construction industry. In related research fields, more focus is given to the sustainability of architectural construction technology (Qtaishat, Emmitt, and Adeyeye 2020). Recent environmental focus has also shifted towards assessing the impact of buildings, particularly their role in addressing the challenges of climate change, on the natural environment (Redden and Crawford 2021).

In recent decades, research on sustainable vernacular architecture has made numerous advances, as scholars have consistently focused on vernacular architecture. The physical appearance of traditional buildings primarily depends on several factors, such as human interaction with the environment, adaptability to the environment, and the maximisation of environmental resources. Various forms of vernacular architecture exist as a result of the diverse natural resources available in different regions. Therefore, natural resources are considered a significant factor that influences the establishment of traditional architecture (Shaikhli and Shafie 2020). However, the functionality of traditional vernacular architecture can no longer fulfil the increasing demands of modern living, causing many of these buildings to be left abandoned and deteriorate (Djebbour and Biara 2020; Vehbi, Günçe, and Iranmanesh 2021). In response to this threat, Halilovic (2020) suggests that the development of architecture based on sustainable principles can protect these valuable architectural cultures from being exposed to imminent destruction.

A fundamental aspect of European heritage management and preservation programs is the conscious

and effective reuse of historical buildings as a starting point for developing conservation. In this context, buildings with a historical background show their unique construction and space, influencing changes in usage and updates in performance (De Gregorio, De Vita, and Paris 2023). Aigwi et al. (2020) and Greco (2020) revealed that researchers often prioritise underutilised historical structures in empirical studies when assessing the performance of historical buildings for adaptive reuse and intervention. Nevertheless, research on the sustainability of vernacular architecture focuses on the uniqueness of each case.

In the past five years, there has been a growing interest in sustainable vernacular architecture. Despite the steady increase in research on vernacular architecture, there is a clear lack of review papers that thoroughly examine the sustainable development of vernacular architecture as a basis for further investigation. Since vernacular buildings are highly influenced by their environment, their strategies for sustainable development also vary accordingly. In view of this, there is a need to identify common issues and development trends affecting the research and development of vernacular architecture, ultimately promoting the progress of sustainable development of vernacular architecture. Therefore, this study aims to explore valuable insights and formulate effective guidelines for the sustainable development of vernacular architecture. Moreover, this systematic literature review attempts to identify research gaps and provide research directions for the future development of vernacular architecture. Two key research questions were established as follows:

Research question 1 (RQ1): What are the current trends of research on sustainability vernacular architecture from 2019 to 2023?

Research question 2 (RQ2): What insights can be gained from sustainable vernacular architecture, including its definition, relationship with the environment, sustainable technical practices, and impact on the preservation of local culture?

RQ1 focuses on identifying the characteristics and trends of articles published between 2019 and 2023. A comprehensive comparative analysis should be conducted to consider several factors, such as research location, journal source, and publication timeline. This analysis is expected to provide insights into the research field, highlighting the critical content and contributors in this area. Meanwhile, RQ2 involves various aspects of the sustainable development of vernacular architecture, including its definition, the relationship between architecture and the environment, the construction techniques used in sustainable vernacular architecture, and the significant impact of sustainable vernacular architecture on the preservation and protection of local architectural culture.

2. Background literature

2.1. Vernacular architecture

“Vernacular architecture” refers to the art of spontaneously constructed, community-based, and environmentally oriented buildings and shelters (Thappa, Sharma, and Kumar 2022). This unique design reflects the Indigenous society, environmental technology, and local culture. The architectural language of a region, influenced by material and cultural factors throughout history and passed down to future generations through buildings, constitutes its vernacular architecture (Ceylan 2022). Murillo Camacho, Fouseki, and Altamirano (2023) emphasised that governments, heritage groups, and energy industries recognise buildings with historical and cultural significance and cannot be replaced. Despite their high environmental performance, vernacular architecture is commonly overlooked in architectural planning due to operational issues (Redden and Crawford 2021).

Evidently, vernacular architecture exhibits a very high cultural value that is related to its historical and artistic values, as well as integrity and authenticity (Murillo Camacho, Fouseki, and Altamirano 2023; Vehbi, Günçe, and Iranmanesh 2021). When researching the development of vernacular architecture, it is essential to prioritise preserving the building’s historical and cultural heritage. Hence, restoration (recovery) plans for heritage residential buildings and the construction of new ones aim to create a diverse living environment for the population at different economic levels. Nevertheless, restoration plans are faced with various conservation challenges (Murillo Camacho, Fouseki, and Altamirano 2023).

There has been a growing interest in research focusing on vernacular architecture over the past five years. Based on the cultural value of architecture, the research by Greco (2020) and Polo López et al. (2021) proposed an exploration to improve the adaptability and usability of vernacular and heritage buildings while prioritising the preservation of their historical and cultural aspects. In another study, Bertagni, Boarin, and Zuppiroli (2020) focused primarily on the structural integrity of historical buildings, stressing the need to reinforce historical building structures to prevent loss of life and property. Given the increasing demand for carbon reduction in various countries, existing buildings often play a vital role in reducing energy consumption (Wong 2019). Adaptive reuse is a fundamental policy and method to achieve sustainability. This approach aims to preserve both the tangible and intangible values of the architecture and the original building materials’ resilience. This effectively reduces the wastage of resources (Vehbi, Günçe, and Iranmanesh 2021).

2.2. Sustainable development of vernacular architecture

The concept of sustainability dates back over 50 years ago, in 1969, when the International Union for Conservation of Nature (IUCN) adopted a new direction (Adams 2006). The Club of Rome published “The Limits to Growth” (Meadows et al. 1972), and later the Brundtland Commission Report (1987) formally integrated “sustainable development” into the mainstream. The Brundtland Report highlights that the sustainable development concept is built upon three fundamental pillars: environment, economy, and society. Vernacular architecture is one of the best representations of buildings that combine climatic environments and residential functions, which is a crucial characteristic of sustainability (Juan et al. 2019).

The increased demand for more buildings, better quality of life, and higher energy consumption is attributed to accelerated urbanisation and population growth. This has prompted more research on climate adaptation strategies, such as traditional design methods, architectural techniques, and building materials (Juan et al. 2019). Accordingly, Grodzka and Solbiati (2023) and Agyekum, Kissi, and Danku (2020) pointed out the low recognition of sustainable development in vernacular architecture despite the widespread research, and the sustainability assessment criteria applied to vernacular architecture still need to be meticulously reviewed. Besides, Aigwi et al. (2020) suggest the need to establish an assessment parameter to guide the decision-making process for the adaptive reuse of historical buildings.

Furthermore, Djebbour and Biara (2020) observed that many historical buildings no longer meet modern living standards and require readjustment based on their intended use. As such, incorporating sustainability into rural architecture can help preserve local culture (Ekici, Özçakır, and Bilgin Altinöz 2022). The interaction between the reuse of vernacular architecture and sustainable development aims to balance project needs and sustainability standards, which relies heavily on assessing the sustainability of vernacular architecture (Djebbour and Biara 2019). Nevertheless, Djebbour and Biara (2020) found that the concept of sustainability in vernacular architecture is still evolving, with few practical assessment cases worldwide.

The ultimate goal of structural or cultural research on vernacular architecture is to achieve sustainable development of vernacular buildings. Previous studies show that researching the sustainability of vernacular architecture can preserve its culture, reduce resource waste, and minimise the environmental effects of construction. However, research on the sustainability of vernacular architecture is still in its early stages, partly due to the general perception that vernacular buildings as outdated and not ideal in terms of building

performance. Consequently, vernacular architecture is undervalued in architectural planning (Redden and Crawford 2021).

3. Materials and methods

This study employed a thematic review approach to identify key aspects of a theme or themes and the research gaps by analysing previous research. This method, which many previous studies have utilised (Jain et al. 2022; Li, Hassan, and Saharuddin 2023; Sentia et al. 2023; Zhu et al. 2023), enables thematic grouping that facilitates researchers to showcase the characteristics most relevant to their research. This method includes searching and analysing data obtained from the target databases. After the screening and retrieval process, the selected articles were managed and analysed via the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Sohrabi et al. 2021).

3.1. Databases and search terms

Various strategies were applied to identify and retrieve a broad range of relevant studies within the scope of this Systematic Literature Review (SLR) (Hiebl 2023). This search process was conducted in November 2023 in two main databases, specifically Web of Science (WoS) and Scopus. For each characteristic (vernacular architecture, sustainability), multiple search terms were used to maximise the likelihood of finding the relevant articles. In the case of vernacular architecture, researchers have a particular interest in cave-dwellings as it is a form of vernacular architecture and is also considered a type of green building. Therefore, the search terms for this part were: "Vernacular architecture" OR "Historical building" OR "Cave-dwellings" OR "Kiln architecture." For the sustainability part, the search terms used included: "Sustainability" OR "Green building." The keywords in each category were linked with OR and between categories with AND. After completing the search process in both databases, a total of 860 articles were retrieved, as shown in Table 1.

3.2. Inclusion/exclusion criteria

The inclusion criteria for the paper selection are as follows: 1) Articles that were published between 2019 and 2023; 2) The article must contain at least one of the

following keywords: "Cave-dwelling" OR "Kiln architecture" OR "Vernacular architecture" OR "Historic building"; 3) The article is written in the English language; and 4) The article employed quantitative, qualitative, or mixed-method studies, depending on the research topic from different dimensions. The 2019–2023 publication period was selected after considering several factors. Firstly, the widespread use of online resources during this period facilitated researchers' understanding of the present state of vernacular architecture and the integration of numerous research methods for the sustainable development of vernacular architecture. Secondly, the latest research trends and progress of sustainable vernacular architecture can be effectively determined by focusing on the literature published within the past decade. Finally, a thorough review of the literature can be achieved by targeting more specific category searches, thus enhancing the researcher's understanding of the sustainable development of vernacular architecture.

Meanwhile, the exclusion criteria were determined as follows: 1) Articles that focused on buildings not considered vernacular architecture (for example, high-rise buildings, large stadiums, and functional buildings); 2) Articles that were not related to the sustainable development and green building assessment of vernacular architecture; 3) Articles that do not directly address the research questions about the sustainability, reuse, green assessment, or cultural development of vernacular architecture; 4) Non-empirical studies, such as literature reviews, theoretical papers, opinion pieces, and editorials. Only original research findings based on empirical reporting were considered; 5) Articles written in languages other than English; and 6) Papers without a full text.

3.3. Article selection and descriptive overview

The identification process via both WoS and Scopus databases yielded 860 documents, which were stored in Mendeley. The first screening phase involved the removal of 29 duplicate articles before further narrowing down the selection process by excluding 481 papers based on the predetermined exclusion criteria, including the time frame, language, article type, and publication stage. In the second screening phase, two independent reviewers were tasked to screen eligible articles based on their titles, abstracts, and keywords, of which 266 articles were removed. After completing a full-text review, 36 articles that fulfilled both inclusion

Table 1. Search strings from Scopus and WoS to identify relevant articles.

Database	Search terms	Number of articles retrieved
Scopus	(TITLE-ABS-KEY ("Cave-dwelling" OR "Kiln architecture" OR "Vernacular architecture" OR "Historic building") AND TITLE-ABS-KEY ("Sustainability" OR "Green building"))	669
Web of Science (WoS)	Results for "Cave-dwelling" OR "Kiln architecture" OR "Vernacular architecture" OR "Historic building" (Topic) AND "sustainability" OR "Green building" (Topic)	191
Total		860

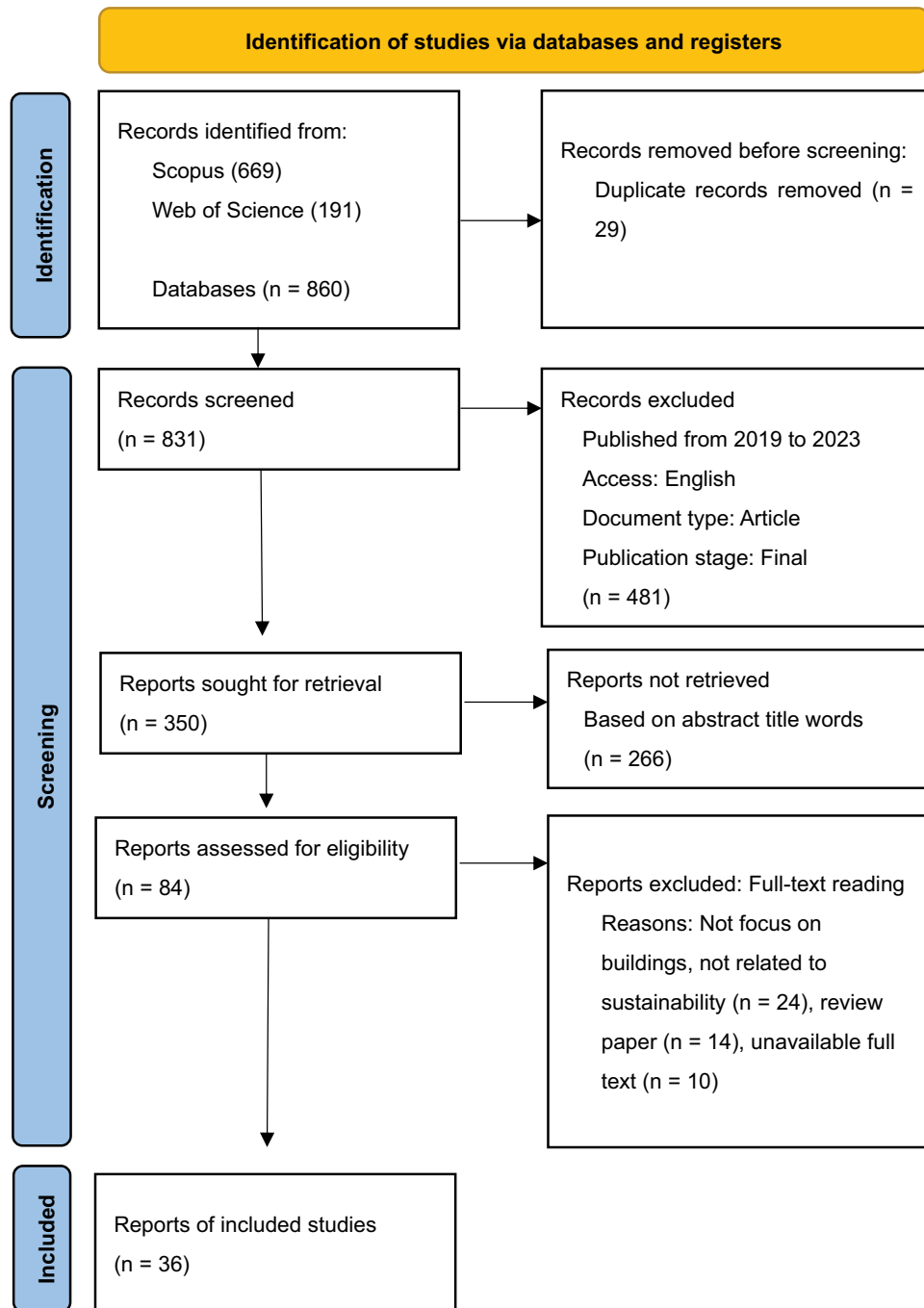


Figure 1. PRISMA flow diagram of the research process.

and exclusion criteria were selected for the subsequent quantitative and qualitative analysis. Figure 1 summarises the article selection search screening and analysis of previous literature through three stages.

3.4. Analysis and synthesis methods

The retrieved files of the 36 articles were imported to the ATLAS.ti 23 software for the review and synthesis process according to the method described by Zairul (Zairul 2020, 2021; Zairul et al. 2022). The thematic analysis was performed by constructing specific themes following a comprehensive reading of the

full-text articles (Clarke and Braun 2013). Themes were determined through an iterative process of achieving consistency when comparing the similarities and differences among the reviewed articles (Samsudin et al. 2022). Each article was categorised according to the author, journal name, journal number, publisher, and year of publication. Subsequently, quantitative and qualitative analysis of the research findings was carried out. In this study, the quantitative analysis was conducted to address RQ 1, while the qualitative evaluation primarily addressed RQ 2.

The quantitative data used to analyse the selected articles were derived from the general bibliometric information, such as the country of origin, name of

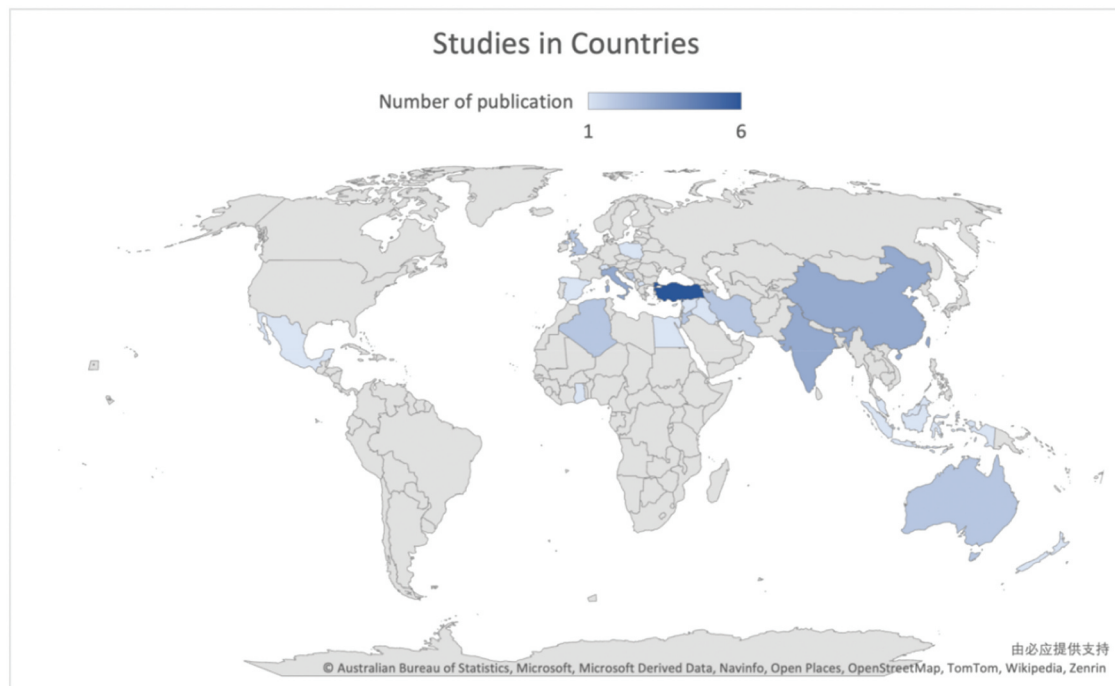


Figure 4. Distribution map of research articles published based on their country of origin.

the stop-word list. As shown in [Figure 2](#), the word cloud highlights the terms “use,” “heritage,” “cultural,” “energy,” “sustainable,” and “design” as the most prominent concepts. In terms of the number of articles published, six articles were published in 2019, which then peaked at 11 in 2020 before a sharp decline to four in 2021. Interestingly, a continuous growth in research on the sustainability of vernacular architecture is visible from 2021 to November 2023. The trend in publication numbers related to research on sustainable vernacular architecture is presented in [Figure 3](#). Note that this analysis did not exclude any limits and is based on the results of all 36 selected papers.

4.1. Quantitative results

According to [Figure 4](#), the survey results indicate that Turkey published the highest number of articles (6) on the sustainability of vernacular architecture in the past five years, followed by China, India, and Italy. For instance, [Ceylan \(2022\)](#) examined 14 independent samples in the eastern region of Turkey and assessed their contribution to the sustainable development of vernacular architecture. In another study, [Yazici and Aslan \(2019\)](#) applied the visual advantages of historical buildings in garden landscapes to achieve sustainability in landscape environments. The study also focused on resident participation in the sustainable development of cultural preservation of vernacular architecture. Furthermore, [Kürüm Varolgüneş \(2020\)](#) assessed the impact of climate on the indoor comfort of vernacular buildings and new houses based on field surveys.

Meanwhile, [Ergöz Karahan et al. \(2023\)](#) and [Bekar, Kutlu, and Ergün \(2023\)](#) emphasised the sustainable reuse of vernacular buildings.

In Italy, [Polo López et al. \(2021\)](#) and [Bertagni, Boarin, and Zuppiroli \(2020\)](#) assessed the development of sustainability assessment criteria for vernacular architecture based on the existing green building standards. [Piparsania and Kalita \(2022\)](#) and [Jagatramka, Kumar, and Pipralia \(2020\)](#) also carried out similar approaches to assess the sustainability of vernacular architecture in India. Although some countries have long committed to the sustainable development of vernacular architecture, the sustainable development of vernacular architecture still requires further research.

The reviewed articles discussed the current state of integration of vernacular architecture with sustainable development within the last five years. Most of the studies on vernacular architecture focused on the aspect of cultural preservation, while only a few studies concentrated on models of sustainable development of vernacular architecture. In particular, research on the sustainability of vernacular architecture in China is in the early stages and focused primarily on evaluating the physical conditions of vernacular architecture ([Hong et al. 2020](#); [Juan et al. 2019](#); [Zhao et al. 2020](#)). It is also notable that the research trend on the sustainability of vernacular architecture has been steadily increasing. The growing number of scholars from various countries paying attention to the sustainable development of vernacular architecture leads to more detailed studies. In summary, the quantitative analysis in this section characterised the trends of published articles

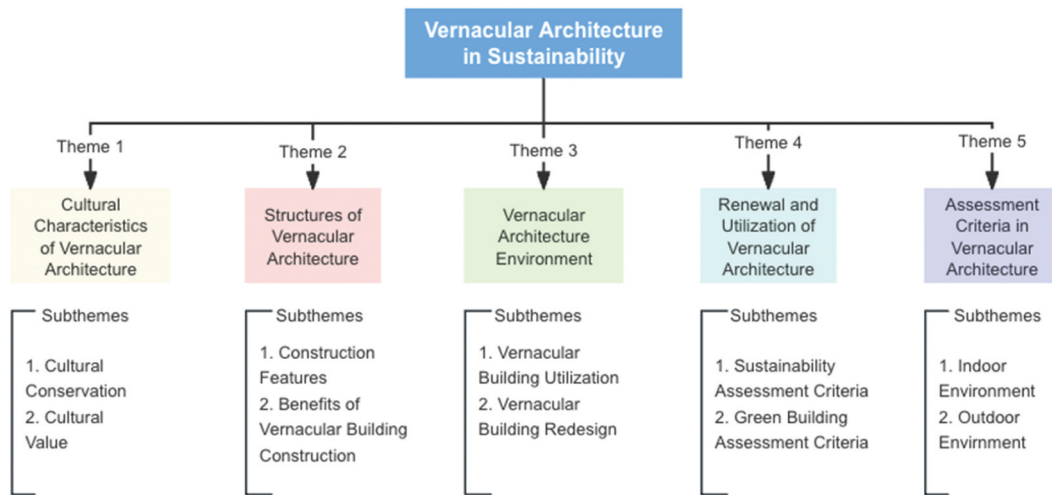


Figure 5. Key themes in the sustainable development of vernacular architecture.

related to the sustainable development of vernacular architecture based on the publication time and origin, which answered RQ1.

4.2. Qualitative results

A thorough assessment of the selected literature was conducted via qualitative analysis to answer RQ2. All 36 full-text articles on the sustainable development of vernacular architecture were examined and coded. The coding process was performed beginning with a structured focus on the articles and progressed throughout the text via a bottom-up, inductive approach. Initial codes were then combined and categorised to form unique themes, while rarely mentioned codes or those that could not be categorised were removed. The vernacular architecture and sustainable development were first conceptualised and defined. Subsequently, the different perspectives of vernacular architecture worldwide were analysed to determine the factors that promote, hinder, and influence the sustainable development of vernacular architecture. Finally, the analysis focused on cases of sustainable development in vernacular architecture, the aspects of sustainable development in vernacular architecture, the impact of vernacular architecture on environmental sustainability, and the methods to promote cultural, structural, environmental, and functional sustainability of vernacular architecture. Figure 5 presents the five key themes that were generated from the qualitative analysis. Future research on the sustainability of vernacular architecture can be inferred from existing studies and conceptual frameworks.

4.2.1. Theme 1: cultural characteristics of vernacular architecture

The inductive analysis found that 15 of the 36 reviewed articles assessed the cultural preservation of vernacular

architecture. Hence, the first theme focuses on the current state of preservation of vernacular architecture and the motivations for preserving them. It also provides an overview of the methods used for preserving vernacular architecture and summarises the latest research findings in the field.

Vernacular architecture is a crucial medium that represents regional cultural characteristics. Its distinct architectural and planning features vividly highlight the cultural richness of the area, securing its place in vernacular architecture literature (Ceylan 2022). The significance of vernacular architecture lies in the profound meanings, uses, and values it contains (Murillo Camacho, Fouseki, and Altamirano 2023), which should be considered essential elements of broader socio-cultural processes. From the user's viewpoint, the importance of vernacular architecture culture in sustainable aesthetics is as significant as its functional value (Bekar, Kutlu, and Ergün 2023). Besides, Shaikhli and Shafie (2020) demonstrated the influence of the natural environment on architectural features. Moreover, the natural elements in vernacular architecture are well-integrated with the environment, society, and the development of sustainable aesthetics.

The opportunity to renovate historical buildings depends on their cultural significance in their location (Redden and Crawford 2021). It is necessary to fully understand the historical background, cultural connotation, and social significance of these buildings during the renovation process to develop more scientifically sound and reasonable renovation plans (Djebbour and Biara 2020). Juan et al. (2019) and Murillo Camacho, Fouseki, and Altamirano (2023) stressed that the cultural value of the architecture can be preserved only by respecting the authenticity of the existing buildings. However, architectural authenticity and architectural renovation are contradictory. Historic buildings may undergo irreversible consequences, such as inevitable collapse, if they are not renovated and improved.

Therefore, modern elements should be added during the renovation process without compromising the historical characteristics of these buildings (Abdelrazek and Yilmaz 2020; Aigwi et al. 2020). This approach ensures that historical buildings keep their unique cultural charm after renovation and enhance the city's cultural development (Djebbour and Biara 2020).

Apart from architectural value, vernacular buildings are rich in social value. Abadi and Khakzand (2022) stated that the development of tourism in rural areas emphasises the preservation of vernacular architecture. This approach intends to safeguard both the environmental and cultural values of the region. Acknowledging tourism as a crucial factor in stimulating local industries and contributing to local economic development, the preservation of vernacular architecture and local culture in rural areas is conducive to supporting the growth of rural tourism. However, vernacular buildings are generally old and may lack the modern amenities found in contemporary buildings, which can cause inconvenience for residents. Therefore, it is imperative to study and explore the sustainable development of vernacular architecture. For example, agritourism emphasises protecting the vernacular architecture of villages to maintain the environmental and cultural values of the area (Abadi and Khakzand 2022) and concurrently fulfilling the residents' housing needs. Thus, achieving both goals contributes to the significant sustainable development of agritourism.

Furthermore, the cultural background of vernacular architecture is closely associated with the cultural context of the region. Therefore, the design methods for the reuse of vernacular architecture should be compatible with the local climate and environment (Rahim et al. 2023). Greco (2020) also mentioned that inclusive design solutions for historical buildings should honour the historical and cultural environment and, at the same time, improve the architectural environment according to modern living requirements.

Despite the numerous frameworks on sustainability in the field of architecture, they mainly focus on environmental standards and are unable to incorporate cultural indicators for assessment (Qtaishat, Emmitt, and Adeyeye 2020). However, Piparsania and Kalita (2022) indicated that the sustainability assessment framework can assess social and cultural indicators. Meanwhile, Petrevska and Nestoroska (2023) and Thappa, Sharma, and Kumar (2022) emphasised that the sustainability of vernacular architecture exhibits several aspects. The revival of traditional buildings in villages should achieve environmental, social, and cultural sustainability in order to realise the sustainable development of the rural economy. However, Crawford (2011) argued that the performance of building functionality is not sufficient to achieve sustainable

development of the architectural environment. Therefore, the economic benefits brought by architectural culture should also be taken into consideration. Moreover, Ekici, Özçakır, and Bilgin Altinöz (2022) highlighted the importance of rural residential areas in cultural heritage protection, and sustainable development models provide valuable guidelines to preserve vernacular architecture culture. In other words, architectural cultural heritage is a precious legacy left to humanity that must be preserved and protected for future generations (Murillo Camacho, Fouseki, and Altamirano 2023; Yazici and Aslan 2019).

Current research on the cultural preservation of vernacular architecture primarily identifies their cultural values and explores their development. The reviewed articles suggest that scholars generally recognise the cultural value of vernacular architecture. In addition, the methods of protecting the culture of vernacular architecture are continuously being developed, ranging from inheriting and protecting the vernacular architecture culture through physical conditions, such as local environment, regional culture, and local climate, to exploring the potential cultural, social, environmental, and economic sustainable development of vernacular architecture from a sustainability perspective. Finally, the sustainable development assessment standards are used to evaluate the sustainability assessment criteria of vernacular architecture. This led to a more comprehensive understanding of the methods for cultural preservation of vernacular architecture.

4.2.2. Theme 2: structures of vernacular architecture

Vernacular architecture is a type of local traditional building in which the architectural features are inspired by nature, follow the local climate, and adapt to the local environment (Rahim et al. 2023; Redden and Crawford 2021; Shaikhli and Shafie 2020). In view of this, researchers have consistently focused on understanding the architectural structure of vernacular architecture and exploring their sustainability (Martinovic, Zecevic, and Salihbegović 2023). Most studies conclude that vernacular architecture is influenced by the environment and evolves into structures with local characteristics, which makes these structures well-adapted to the local environment and climate. In addition, Hong et al. (2020) found that vernacular buildings perform better in terms of emission reduction and energy saving due to their materials, structure, and layout compared to those of modern buildings.

Some research that evaluates the interaction between architecture and climate uses traditional vernacular architecture to propose building designs that can adjust to and function well in different climate conditions to ensure sustainable development for

future generations without harming the environment (Juan et al. 2019). Given the significant impact of pollution and energy consumption of modern buildings on the environment, sustainable development of historical buildings is seen as an essential approach to reducing energy consumption (Abdelrazek and Yılmaz 2020).

Previously, Rahim et al. (2023) revealed that the use of traditional construction techniques in vernacular architecture has allowed them to adapt to extreme weather and natural disasters over time. These traditional construction techniques were developed from natural environments (Yazici and Aslan 2019) and exhibit unique and cultural aspects that should be protected and preserved (Ceylan 2022). For example, the materials used in vernacular architecture are often green, such as wood and stone, suggesting that vernacular architecture can be considered a form of green building in terms of materials (Agyekum, Kissi, and Danku 2020). The building materials and structures of vernacular architecture also vary in terms of orientation, spatial dimensions, and house functionality, depending on the region, although all have undergone long-term development.

Besides the use of energy-efficient and eco-friendly building materials, many vernacular buildings utilise natural conditions. For example, Hong et al. (2020) reported that most of the courtyard lights in the research area originate from reflected light, which reduces the occurrence of glare. Traditional architectural courtyards can also create wind pressure, which forms a natural ventilation system that keeps traditional buildings cool in the summer. Furthermore, vernacular architecture serves as an exemplary model for the design and construction of new houses with regard to occupant satisfaction, indoor thermal comfort conditions, and a healthy living environment (Kürüm Varolgüneş 2020).

Vernacular architecture incorporates local cultures and holds a significant position in architectural literature due to its distinct architectural features (Ceylan 2022). It also plays a vital role in maintaining the national culture in rural areas (Petrevska and Nestoroska 2023). Moreover, vernacular architecture represents the specific natural environment and unique lifestyle of the local population in a particular region. Therefore, on top of being environmentally, climatically, and ecologically friendly, vernacular architecture significantly influences local culture, social institutions, living conditions, and economic development (Kürüm Varolgüneş 2020).

In short, the architectural structure of vernacular architecture is characterised by local cultural features resulting from a long-term accumulation of wisdom by the local people in the region. It is well-adapted to the local environment and climate, as well as reflecting and preserving the local culture. The materials used

in vernacular architecture are also energy-efficient and environmentally friendly. Therefore, the architectural structure of vernacular architecture promotes environmental sustainability, socio-cultural sustainability, and socio-economic sustainability (Thappa, Sharma, and Kumar 2022).

4.2.3. Theme 3: vernacular architecture environment

The extensive literature analysis has indicated the close association between vernacular architecture and the local environment. Given that the architectural characteristics and culture of vernacular architecture are inspired by the local natural environment (Yazici and Aslan 2019), numerous studies have focused on the indoor and outdoor environments that constitute vernacular architecture (Hong et al. 2020; Juan et al. 2019; Kürüm Varolgüneş 2020; Murillo Camacho, Fouseki, and Altamirano 2023; Polo López et al. 2021; Redden and Crawford 2021; Shaikhli and Shafie 2020; Zhao et al. 2020).

In one study, Redden and Crawford (2021) found that the adaptive reuse and improvements of vernacular architecture effectively reduced resource waste, preserved land use, and decreased greenhouse gas emissions. Meanwhile, Kürüm Varolgüneş (2020) conducted a case study by assessing the bioclimatic, social, economic, and cultural aspects of Bingöl vernacular architecture. The study revealed the ability of vernacular architecture to enhance indoor and outdoor comfort spaces using natural energy. Hence, vernacular architecture promotes ecological sustainability by aligning architectural space with the natural environment and fostering sustainable development in rural environments.

The effect of natural climate on indoor spaces in vernacular architecture buildings can be significantly mitigated due to the various types of materials used. Recently, Juan et al. (2019) and Zhao et al. (2020) simulated and tested the indoor environment of cave-dwellings built with different materials. The studies reported that the physical properties of the cave-dwellings allow them to effectively cope with the summer heat and provide a more comfortable indoor environment over six months (Zhao et al. 2020). The adaptability of using natural resources in vernacular architecture has also been assessed by Studies by Martinovic, Zecevic, and Salihbegović (2023), Hong et al. (2020), and Polo López et al. (2021). The research on the thermal conductivity of building materials by Martinovic, Zecevic, and Salihbegović (2023) clarified the impact of vernacular architecture materials on heat transfer. On the other hand, Hong et al. (2020) assessed the influence of the architectural form of vernacular architecture on the indoor environment. The study also proposed that improving architectural forms leads to

enhanced lighting and indoor ventilation, especially in vernacular architecture. In comparison, Polo López et al. (2021) evaluated the sustainability of resource regeneration in vernacular architecture and suggested the establishment of an integrated solar system for historical buildings.

In summary, this theme has demonstrated the extensive studies on the relationship between architecture and the indoor and outdoor environment. Although these studies have different objectives, they agree on a common point: vernacular architecture serves its inhabitants, and the synergy between vernacular architecture and the environment aims to enhance the comfort of occupants' living environment. Therefore, it is necessary to understand the needs of stakeholders regarding the architectural environment when renovating the environment of vernacular architecture to improve their comfort.

4.2.4. Theme 4: renewal and utilisation of vernacular architecture

The Fifth Assessment Report (AR5) by the Intergovernmental Panel on Climate Change (IPCC) emphasises the renovation of existing building stock as a critical indicator of achieving a low-emission building sector (Lucon et al. 2014). Considering this, a growing number of studies have focused on assessing the renovation and utilisation of vernacular architecture. Some studies explored the functional reuse and transformation of vernacular buildings, while others investigated the impact of the reuse of vernacular architecture on sustainable development. In addition, more recent research has considered renovating and reusing vernacular architecture through the integration of building functions and green building principles.

Various techniques for building reuse have been proposed. Misirisy and Gunge claimed that building reuse involves both reusing the structure and modernising the function of the original building through rational planning (Djebbour and Biara 2020). Ergöz Karahan et al. (2023), Farashah et al. (2023), and Greco (2020) point out that the user needs in terms of building functionality can be delivered by learning from the preservation of historic buildings. Apart from that, several studies explored flexible architectural reuse methods. For instance, De Gregorio, De Vita, and Paris (2023) proposed the "box within a box" process, which provides a framework that takes advantage of the flexibility of space and land architecture for the adaptive reuse of an industrial building in Spain. The link between energy characteristics and the reuse of building environments is also a key research topic (Rajković et al. 2022; Zhao et al. 2020). Overall, the rational reuse of historical, vernacular, and traditional buildings leads to less resource extraction, reduced material demand, and markedly decreased energy

waste and prevent environmental pollution from building replacements (Redden and Crawford 2021). Moreover, various stakeholders, such as designers, planners, users, governments, and the public, gain benefits from the continuous research on the sustainable application of reusing vernacular and historical buildings in the architectural environment. This research ultimately contributes significantly to preserving their cultural, social, and economic sustainability.

As a form of architecture with local characteristics, vernacular architecture plays an essential role in the cultural resilience of a region (Aigwi et al. 2020). Djebbour and Biara (2020) suggested considering the sustainability of functional rationality, compatibility of new uses with the original design, and the use of the building land before integrating historical buildings with modern functions. Interestingly, Petrevska and Nestoroska (2023) proposed feasible solutions for revitalising villages through vernacular architecture. The results showed an enhanced recognition of rural culture by tourists when maintaining and promoting the vernacular architecture culture, leading to the sustainable development of the rural economy. Successful cases of sustainable development of vernacular architecture have also been reported in several studies (Bekar, Kutlu, and Ergün 2023; Thappa, Sharma, and Kumar 2022). From a regenerative sustainability viewpoint, the reuse of vernacular architecture is akin to regenerative thinking. At the same time, the sustainable development of vernacular architecture is considered a component of an ecological building system (Ahmed 2023).

In summary, a significant number of researchers have investigated the renovation and reuse of vernacular architecture, mainly focusing on the rationalisation of functions in vernacular architecture. Concurrently, several scholars have associated the renovation and reuse of vernacular architecture with its sustainable development. Evidently, the renovation and reuse of vernacular architecture offer beneficial impacts for environmental sustainability, cultural sustainability, and socio-economic sustainability.

4.2.5. Theme 5: assessment criteria in vernacular architecture

The widely applied sustainable development theory has led to a plethora of interpretations and definitions (Visvaldis, Ainhua, and Ralfs 2013). An example of the definition of sustainable development is "The ability to meet the needs of the present without compromising the ability of future generations to meet their own needs." In addressing the multiple aspects of sustainable development, the Green Building Assessment Tools (GBAT) have emerged as an established system for evaluating building environments. The development and enhancement of numerous GBATs are associated with managing sustainable issues (environmental, social, and

economic) within the built environment (Olakitan Atanda 2019). GBAT is currently considered the gold standard for sustainable norms worldwide (Olukoya and Atanda 2020). The Lifecycle Assessment (LCA) tools and the standard-based tools are the two main instruments that make GBAT assessments practical.

Building assessment tools are developed to support the integration of sustainable development principles within the architectural profession. These tools are designed to achieve specific goals for the sustainable growth of the building industry (Atanda and Olukoya 2019). Their application's only goal is to evaluate, advance, and improve the building industry's understanding of sustainability through data analysis, surveys, and distinction (Cole 2005; Nguyen and Altan 2011). Many countries have developed specific building assessment tools tailored to their national context. Among them include the Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB – Germany), Leadership in Energy and Environmental Design (LEED – USA), Comprehensive Assessment System for Built Environment Efficiency (CASBEE – Japan), and Building Research Establishment Environmental Assessment Method (BREEAM – United Kingdom) (Atanda and Olukoya 2019). Extensive research has been conducted on several standard-based assessment systems, including Green Star, CASBEE, BREEAM, and LEED (Atanda and Öztürk 2020).

Furthermore, the environmental category is available in internationally recognised green building evaluation standards, including DGNB, BREEAM, and LEED (Bertagni, Boarin, and Zuppiroli 2020). Previously, Wong (2019) compared 11 well-known assessment programs for historical buildings comprising BREEAM, LEED, BEAM Plus, CASBEE, GBLs, HQE, GBI, Green Mark, MyCrest, Green Star, and GBC. The results found a total of 15 assessment themes that were connected to renovations: waste, innovation, pollution, culture, social aspects, economy, service quality, heritage value, management, transportation, energy, indoor environment quality, materials, water, sustainable sites, and waste.

Nevertheless, the lack of preservation considerations in sustainable assessment standards has limited their application to buildings of historical significance (Bertagni, Boarin, and Zuppiroli 2020; Ergöz Karahan et al. 2023). Alternatively, researchers have begun using green building assessment tools to study and develop sustainability assessment criteria for vernacular architecture following its designation as a form of green building. For example, Rahim et al. (2023) analysed the local wisdom and sustainable features in vernacular architecture using sustainable assessment methods. Similarly, Aigwi et al. (2020) assessed the applicability of parameters for historic buildings in New Zealand. The study also revealed that the basic performance framework of the assessment criteria adapted well to vernacular architecture.

In addition, Rajković et al. (2022) and Polo López et al. (2021) combined the impact of environment and energy on vernacular architecture into the assessment criteria. The former suggested improvements in vernacular architecture according to environmental climate from the perspectives of building and energy. On the other hand, the latter investigated the integration of solar photovoltaic and thermal systems in buildings, reviewing and fine-tuning green building assessment criteria in the context of vernacular architecture. In short, the extensive research on sustainability assessment criteria for vernacular architecture reflects the possibility of developing sustainability assessment standards for vernacular buildings (Aigwi et al. 2020; Djebbour and Biara 2019; Grodzka and Solbiati 2023; Halilovic 2020; Jagatramka, Kumar, and Pipralia 2020; Redden and Crawford 2021; Yazici and Aslan 2019).

Researchers have also integrated cultural standards of vernacular architecture into the sustainability assessment criteria. For example, Piparsania and Kalita (2022) and Aigwi et al. (2020) pointed out the need to include indicators of social and cultural aspects when applying green building assessment standards to vernacular architecture. Additionally, the vernacular architecture assessment involves direct engagement with residents in a participatory manner. However, there are limited reports on this particular research area. Among the few available studies include that of Farashah et al. (2023), who focused on the reuse of historical buildings as hotels and assessed them from hotel users' viewpoint. Besides, Ekici, Özçakır, and Bilgin Altinöz (2022) and Qtaishat, Emmitt, and Adeyeye (2020) incorporated user participation through surveys to gather data on user needs, which then informed improvements in the study of vernacular architecture.

In summary, these studies support the efforts for the sustainable development of vernacular architecture. Furthermore, local culture can be better protected and preserved for future generations by renovating and reusing vernacular buildings. As research advances, more scholars are considering residents' views and perceptions of vernacular architecture. Studies are also starting to focus on developing sustainability assessment criteria for vernacular architecture.

5. Discussion

5.1. Research findings

This review analysed the sustainable development of vernacular architecture through a mixed approach. The PRISMA method was used to review 36 articles extracted from the Scopus and WoS databases. Subsequently, two different methods were employed for analysis and exposition. The first part consists of the quantitative analysis, which presented numerical data

from ATLAS.ti 23 regarding the trend of the research over the past five years and the publishing countries of the 36 articles. The second part involved the qualitative analysis, which examined the key research areas in vernacular architecture, including cultural preservation of vernacular architecture, construction structure, renovation and reuse, indoor and outdoor environments, and assessment standards of vernacular architecture. This study also focused on the widespread application of sustainable development in the 21st century, a time of resource conservation, environmental focus, and sustainable development.

Vernacular architecture, with its rich local cultural value, offers profound implications for sustainable development research, contributing to resource conservation and the preservation of local culture. Additionally, the application of sustainable development theory across social, cultural, and economic dimensions in the renovation and reuse of vernacular architecture can promote better development of rural areas. The results of the study identified five critical themes for the sustainable development of vernacular architecture: 1) Cultural characteristics of vernacular architecture; 2) Structure of vernacular architecture; 3) Vernacular architecture environment; 4) Renewal and utilisation of vernacular architecture; and 5) Assessment criteria in vernacular architecture. The findings indicate that sustainability assessments of vernacular architecture currently focus on single-case studies. Hence, this warrants more researchers to explore the sustainability of vernacular architecture.

5.2. Research significance

This study has implications in both theoretical and practical aspects. Theoretically, this study systematically describes the sustainable development of vernacular architecture. For example, although sustainability assessment criteria for vernacular architecture vary in each study, they effectively enhance the sustainability of vernacular architecture. It is also evident that standards related to the cultural sustainable development of vernacular architecture are incorporated. The selection of sustainable assessment criteria for vernacular architecture considers various factors, such as the environment, climate, resources, culture, economy, and society. The theoretical contribution also aims to augment the knowledge base of sustainable development of vernacular architecture, identify research gaps, and propose future research directions.

There are two practical significances from this study. First, it gathers and analyses previous practical case studies on the renovation and reuse of vernacular architecture, offering more possibilities for the revitalisation of vernacular, historical, and traditional buildings. Second, vernacular architecture receives more attention and better protection. As a form of

architecture that represents local culture, vernacular architecture is closely associated with the local environment, climate, and history. Hence, vernacular architecture can be better preserved with greater attention.

5.3. Research limitations

Like most studies, this research has limitations that must be highlighted. One of the contributing factors stems from the methodological constraints of thematic reviews, such as publication bias (Li, Hassan, and Saharuddin 2023). Some of the research articles were unretrievable. At the same time, it is highly impossible to investigate every research database individually. The retrospective nature of thematic reviews is another contributing factor, where the interpretation of the analysis results might be slightly biased due to irrelevant interpretations in the context in which the research was conducted.

Apart from that, the selection of keyword combinations may have limited the scope of the retrieved results. Since the qualifiers contain "cave-dwelling" and "kiln building," the literature search results are biased towards countries with prevalent cave architecture, such as Turkey and China. Besides conducting the literature search in only two databases and omitting the others, the search content dismissed review articles, book chapters, reports, and unpublished materials. These publications could have contained relevant information regarding the sustainable development of vernacular architecture.

In addition, the review process only considered peer-reviewed articles written in English. Therefore, this study might not be exhaustive, and the situation of vernacular architecture conservation is not optimistic. Other uncontrolled factors could have also affected the outcome of this study. For example, many abandoned vernacular, traditional, and even historical buildings have been destroyed. Hence, research articles that include empirical research results will remain an essential source of information. Future studies should consider selecting recently published research articles to assist in the progression of research.

5.4. Research contributions

Despite certain limitations, this review offers several contributions to the sustainable development of vernacular architecture. Firstly, this study analysed the essential characteristics of the 36 selected articles, such as sample characteristics, country of publication, and the number of published papers based on region. Secondly, this research summarised five major themes in current vernacular architecture research, including cultural preservation, architectural structure, renovation and reuse, indoor and outdoor environments, and sustainability assessment criteria of vernacular

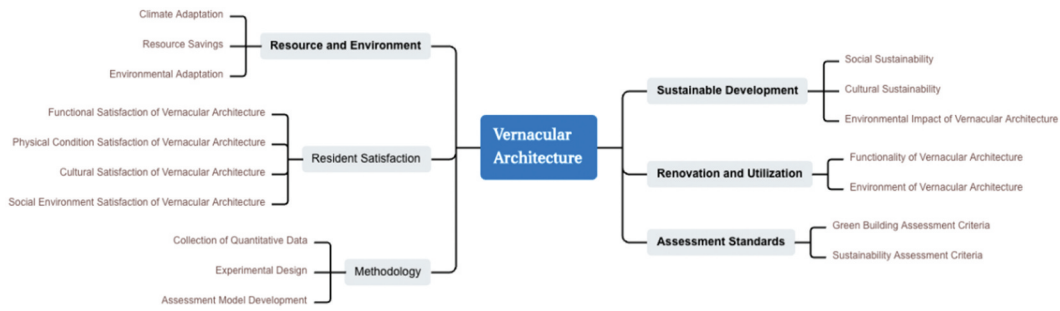


Figure 6. Summary of the 17 potential future research directions in vernacular architecture.

architecture. Thirdly, the thematic analysis of the literature showcases reliable empirical research focused on the sustainable development of vernacular architecture. Finally, this study proposed five future research directions for vernacular architecture, which may assist researchers in identifying relevant themes within this field of study.

5.5. Future research

The thematic review in this study offers 17 potential new directions for future research that can enhance the sustainability studies of vernacular architecture. These new directions focus on renovating and reusing vernacular architecture with minimal impact on the environment, thereby reducing the consumption of environmental resources and better preserving the cultural heritage of vernacular architecture. Figure 6 presents the five categories of future research directions for vernacular architecture based on the current state of research and the proposed framework.

Sustainable development: Sustainable development has been consistently a prominent topic across various fields, and vernacular architecture aligns precisely with the three main aspects of sustainable development, namely social sustainability, cultural sustainability, and environmental sustainability. Therefore, future research in this direction should emphasise achieving sustainable development in these three aspects of vernacular architecture. Efforts to realise sustainable rural construction from the sustainable development of vernacular architecture should also be evaluated, thereby promoting local social, economic, and cultural development.

Renovation and utilisation: Many of the articles discussing the renovation and reuse of vernacular architecture focus on single-case studies, mainly exploring the reuse of modernised functions in individual buildings. Over time, people may develop new functional needs for vernacular architecture beyond its use for living, tourism, and sightseeing. As the renovation and reuse of vernacular architecture will continue to generate new functional demands driven by societal development, future research should consistently

study the renovation and reuse of vernacular architecture in response to varying needs.

Assessment standards: To date, there are 11 well-known building assessment standards worldwide (Wong 2019) that vary slightly according to the environment and national conditions of each country. Comparatively, both green assessment standards and sustainability assessment standards for vernacular architecture are still in their infancy. There are very few studies dedicated to establishing assessment standards specifically for vernacular architecture. Hence, future studies should consider developing innovative assessment standards that are tailored to vernacular architecture.

Resource and Environment: As research on the resources, environment, materials, and climate of vernacular architecture is ongoing, future studies should pay more attention to the harmonious relationship between vernacular architecture and resource environment. Thus, the goal should be to design and construct more nature-friendly forms of architecture by learning from the relationship between vernacular architecture and nature.

Resident satisfaction: Future research should also give greater consideration to users. While indicators to measure architectural satisfaction have been developed for decades, there is yet any model or theory that can be practically used to determine the satisfaction of residents in vernacular architecture. Therefore, research surveys on residential satisfaction with vernacular architecture could be developed through four aspects of the building: the functional use, the physical condition, the social environment, and the architectural culture of vernacular architecture.

Methodology: In future research, larger sample sizes should be used to obtain more comprehensive data on vernacular architecture. Experimental designs should also be utilised to understand the actual effects of vernacular architecture's physical condition. Another viable research option is to develop alternative assessment models that are specifically tailored to evaluate vernacular architecture. Finally, strengthening research on quantitative data is also one of the directions. Although most research on vernacular architecture is assessed through qualitative analysis, empirical

research has the potential to provide extensive quantitative insights.

6. Conclusion

This review study concluded that the current research on vernacular architecture remains largely focused on architectural studies, with minimal consideration from the user's viewpoint. Despite that most vernacular architecture combined with sustainable development met the requirements of the sustainable development theory, sustainable assessment standards that are compatible with vernacular architecture are still limited. As a form of local traditional building, vernacular architecture is increasingly unable to meet people's living needs, leading to abandoned vernacular buildings around the world. While the number of sustainable research on vernacular architecture steadily grows, most of the published reports involve case studies on local vernacular architecture. Additionally, vernacular architecture faces more opportunities and challenges with the diversification of social activities. Interestingly, the opportunity lies in the increasing awareness and interest in the protection of local culture, which will undoubtedly attract more attention to vernacular architecture. However, the challenge is to address the rising demand from people's material lives becoming richer for architectural space.

Regardless of the positive outcome, this paper exhibits a degree of publication bias. Due to the specific search terms used in this research, the results are relatively directive. Therefore, future studies are required to put more emphasis on establishing a robust theoretical system for the sustainable development of vernacular architecture. This involves considering the future direction and challenges of sustainable development of vernacular architecture, which may provide valuable insights and a more comprehensive understanding of the topic. Ultimately, it is essential to enhance the comfort and functionality of vernacular architecture, preserve its local cultural characteristics, and meet the users' multiple demands for place attachment and architectural functionality in order to fulfil the user's perspective. Different research perspectives on vernacular architecture are also beneficial for exploring other possibilities for its future development.

Disclosure statement

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Notes on contributors

Jia Zong is a PhD student at the Department of Architecture, Faculty of Design and Architecture, Universiti Putra Malaysia.

Her research interests include vernacular architecture and the sustainable development of traditional architecture.

Wan Srihani Wan Mohamed is a lecturer at the Department of Architecture, Faculty of Design and Architecture, Universiti Putra Malaysia. Her research interests involve self-built houses.

Mohamad Fakri Zaky Jaafar is an Associate Professor at the Department of Architecture, Faculty of Design and Architecture, Universiti Putra Malaysia. His research interests involve green buildings, and building thermal comfort studies.

Norsidah Ujang is an Associate Professor at the Department of Landscape Architecture, Faculty of Design and Architecture, Universiti Putra Malaysia. Her research interests include urban regeneration, place attachment, place identity, social urbanism and sustainable pedestrian environment.

References

- Abadi, A., and M. Khakzand. 2022. "Extracting the Qualitative Dimensions of Agritourism for the Sustainable Development of Charqoli Village in Iran: The Promotion of Vernacular Entrepreneurship and Environment-Oriented Preservation Perspectives." *Environment, Development, and Sustainability* 24 (11): 12609–12671. <https://doi.org/10.1007/s10668-021-01958-0>.
- Abdelrazek, H., and Y. Yilmaz. 2020. "Methodology Toward Cost-Optimal and Energy-Efficient Retrofitting of Historic Buildings." *Journal of Architectural Engineering*, 26(4). 26 (4). [https://doi.org/10.1061/\(asce\)ae.1943-5568.0000433](https://doi.org/10.1061/(asce)ae.1943-5568.0000433).
- Adams, W. M. 2006. *The Future of Sustainability: Re-Thinking Environment and Development in the Twenty-First Century*. <https://api.semanticscholar.org/CorpusID:131297662>.
- Agyekum, K., E. Kissi, and J. C. Danku. 2020. "Professionals' Views of Vernacular Building Materials and Techniques for Green Building Delivery in Ghana." *Scientific African* 8:8. <https://doi.org/10.1016/j.sciaf.2020.e00424>.
- Ahmed, N. 2023. "Re-Exploring Vernacular Architecture from the Lens of Regenerative Thinking: A Case Study Gharb Sohail Village in Egypt." *Journal of Sustainable Architecture and Civil Engineering* 32 (1): 58–76. <https://doi.org/10.5755/j01.sace.32.1.32499>.
- Aigwi, I. E., J. Ingham, R. Phipps, and O. Filippova. 2020. "Identifying Parameters for a Performance-Based Framework: Towards Prioritising Underutilised Historical Buildings for Adaptive Reuse in New Zealand." *Cities* 102 (May): 102756. <https://doi.org/10.1016/j.cities.2020.102756>.
- Atanda, J. O., and O. A. P. Olukoya. 2019. "Green Building Standards: Opportunities for Nigeria." *Journal of Cleaner Production* 227:366–377. <https://doi.org/10.1016/j.jclepro.2019.04.189>.
- Atanda, J. O., and A. Öztürk. 2020. "Social Criteria of Sustainable Development in Relation to Green Building Assessment Tools." *Environment, Development, and Sustainability* 22 (1): 61–87. <https://doi.org/10.1007/s10668-018-0184-1>.
- Bekar, İ., I. Kutlu, and R. Ergün. 2023. *Importance Performance Analysis for Sustainability of Reused Historical Building: Mardin Sabanci City Museum and Art Gallery*. Open House International. <https://doi.org/10.1108/OHI-04-2023-0080>.
- Bertagni, S., P. Boarin, and M. Zuppiroli. 2020. "The Dialogue Between Structural Interventions and Sustainability Criteria in Rating Systems for Cultural Heritage: The

- Experience of GBC Historic Building." *International Journal of Architectural Heritage* 14 (1): 139–161. <https://doi.org/10.1080/15583058.2018.1511001>.
- Braun, V., and V. Clarke. 2006. "Using Thematic Analysis in Psychology." *Qualitative Research in Psychology* 3 (2): 77–101. <https://doi.org/10.1191/1478088706qp0630a>.
- Ceylan, S. 2022. "Vernacular Architecture of Turkish Eastern Black Sea Region: A Case Study in Senoz (Büyükdere) Valley." *Open House International* 47 (3): 513–532. <https://doi.org/10.1108/OHI-08-2021-0174>.
- Clarke, V., and V. Braun. 2013. "Teaching Thematic Analysis: Overcoming Challenges and Developing Strategies for Effective Learning." *The Psychologist* 26 (2): 120–123. <https://doi.org/10.4135/9781412963909.n451>.
- Cole, R. J. 2005. "Building Environmental Assessment Methods: Redefining Intentions and Roles." *Building Research & Information* 33 (5): 455–467. <https://doi.org/10.1080/09613210500219063>.
- Crawford, R. 2011. "Life Cycle Assessment in the Built Environment." In *Taylor and Francis* (Issue March 2011). Routledge. <https://doi.org/10.4324/9780203868171>.
- De Gregorio, S., M. De Vita, and A. Paris. 2023. "Industrial Heritage Rethinking: Flexibility Design for Eco-Friendly Environments." *Buildings* 13 (4): 1048. <https://doi.org/10.3390/buildings13041048>.
- Djebbour, I., and R. W. Biara. 2019. "Sustainability Comparative Assessment of Adaptive Reuse of Heritage Buildings as Museums: A Case of Tlemcen." *Environmental Research, Engineering and Management* 75 (3): 7–20. <https://doi.org/10.5755/j01.arem.75.3.22133>.
- Djebbour, I., and R. W. Biara. 2020. "The Challenge of Adaptive Reuse Towards the Sustainability of Heritage Buildings." *International Journal of Conservation Science* 11 (2): 519–530. <https://doi.org/10.36868/ijcs>.
- Ekici, S. C., Ö. Özçakır, and A. G. Bilgin Altinöz. 2022. "Sustainability of Historic Rural Settlements Based on Participatory Conservation Approach: Kemer Village in Turkey." *Journal of Cultural Heritage Management and Sustainable Development* 14 (4): 497–520. <https://doi.org/10.1108/JCHMSD-05-2021-0087>.
- Engin, N., N. Vural, S. Vural, and M. R. Sumcrkan. 2007. "Climatic Effect in the Formation of Vernacular Houses in the Eastern Black Sea Region." *Building & Environment* 42: 960–969. [10.1016/j.buildenv.2005.10.037](https://doi.org/10.1016/j.buildenv.2005.10.037).
- Ergöz Karahan, E., Ö. Göçer, D. Boyacıoğlu, and P. Shrestha. 2023. "Measuring "Sustainable Development" in Vernacular Settlements: A Case Study Behramkale, Türkiye." *Journal of Cultural Heritage Management and Sustainable Development*. <https://doi.org/10.1108/JCHMSD-06-2022-0100>.
- Fabbri, K., and L. Tronchin. 2006. "The Relationship Between Climate and Energy in Vernacular Architecture in Central Italy." Proceeding of the 23rd Conference on Passive and Low Energy Architecture, Geneva, Switzerland. 6–8 September 2006.
- Farashah, D. P., A. E. Mohammadhossein, S. Yadollahi, and Z. Ghaderi. 2023. "Postoccupancy Evaluation of Historic Buildings After Their Adaptive Reuse into Boutique Hotels: An Experience from Yazd, Iran." *International Journal of Building Pathology and Adaptation* 41 (4): 849–874. <https://doi.org/10.1108/IJBPA-04-2021-0044>.
- Greco, A. 2020. "Social Sustainability: From Accessibility to Inclusive Design." *EGE-Expresión Gráfica En La Edificación* 12 (12): 18. <https://doi.org/10.4995/ege.2020.14072>.
- Grodzka, E. M., and C. Solbiati. 2023. "The Problem of Assessing the Sustainability of Adapted Historic Buildings with BREEAM Certification Using Examples in Poland and Great Britain." *International Journal of Sustainable Engineering* 16 (1): 140–154. <https://doi.org/10.1080/19397038.2023.2230465>.
- Halilovic, M. 2020. "Vernacular Architecture Sustainability Principles: A Case Study of Bosnian Stone Houses in Idbar Village." *Periodicals of Engineering and Natural Sciences* 8 (4): 2564–2574. <https://doi.org/10.21533/pen.v8i4.1760>.
- Hiebl, M. R. W. 2023. "Sample Selection in Systematic Literature Reviews of Management Research." *Organizational Research Methods* 26 (2): 229–261. <https://doi.org/10.1177/1094428120986851>.
- Hong, X., L. Zhengbing, W. Changyou, Z. Junyan, and Z. Liang. 2020. "The Research on Sustainable Technology of the Traditional House in the Southern Area of Hubei Province." *Journal of Asian Architecture & Building Engineering* 19 (4): 354–366. <https://doi.org/10.1080/13467581.2020.1749640>.
- Jagatramka, R., A. Kumar, and S. Pipralia. 2020. "Sustainability Indicators for Vernacular Architecture in India." *ISVS E-Journal* 7 (4): 53–63.
- Jain, R., K. Jain, A. Behl, V. Pereira, M. Del Giudice, and D. Vrontis. 2022. "Mainstreaming Fashion Rental Consumption: A Systematic and Thematic Review of Literature." *Journal of Business Research* 139:1525–1539. <https://doi.org/10.1016/j.jbusres.2021.10.071>.
- Juan, X., L. Ziliang, G. Weijun, Y. Mengsheng, and S. Menglong. 2019. "The Comparative Study on the Climate Adaptability Based on Indoor Physical Environment of Traditional Dwelling in Qinba Mountainous Areas, China." *Energy & Buildings* 197:140–155. <https://doi.org/10.1016/j.enbuild.2019.05.045>.
- Kürüm Varolgüneş, F. 2020. "Evaluation of Vernacular and New Housing Indoor Comfort Conditions in Cold Climate – a Field Survey in Eastern Turkey." *International Journal of Housing Markets and Analysis* 13 (2): 207–226. <https://doi.org/10.1108/IJHMA-02-2019-0019>.
- Li, R., N. C. Hassan, and N. Saharuddin. 2023. "College Student's Academic Help-Seeking Behavior: A Systematic Literature Review." *Behavioral Sciences* 13 (8): 637. <https://doi.org/10.3390/bs13080637>.
- Lucon, O., D. Üрге-Vorsatz, A. Zain Ahmed, H. Akbari, P. Bertoldi, L. F. Cabeza, N. Eyre, et al. 2014. "Buildings." In *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by O. enhofer, R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, S. K. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press. <https://doi.org/10.1193/1.1585751>.
- Martinovic, S., N. Zecevic, and A. Salihbegović. 2023. "Vernacular Residential Architecture in the Context of Sustainability - Case Study of Svrzo's House Complex." *Journal of Sustainable Architecture and Civil Engineering* 32 (1): 19–40. <https://doi.org/10.5755/j01.sace.32.1.32753>.
- Mayring, P. 2018. "Quality Standards for Qualitative Evaluation Research." *Zeitschrift Fur Evaluation* 17 (1): 11–24.
- Meadows, D. H., D. L. Meadows, J. Behrens, and W. W., III Behrens. 1972. *The limits to growth, a report for the club of rome's project on the predicament of mankind*, Universe Books ed. New York.
- Murillo Camacho, K. S., K. Fouseki, and H. Altamirano. 2023. "Sustainability and Energy Efficiency in the World Heritage Site of the Historic Centre of Mexico City." *Heritage* 6 (9): 6343–6357. <https://doi.org/10.3390/heritage6090332>.
- Nguyen, B. K., and H. Altan. 2011. "Comparative Review of Five Sustainable Rating Systems." *Procedia Engineering* 21

- (0): 376–386. <https://doi.org/10.1016/j.proeng.2011.11.2029>.
- Olakitan Atanda, J. 2019. "Developing a Social Sustainability Assessment Framework." *Sustainable Cities and Society* 44:237–252. <https://doi.org/10.1016/j.scs.2018.09.023>.
- Olukoya, O. A. P., and J. O. Atanda. 2020. "Assessing the Social Sustainability Indicators in Vernacular Architecture—Application of a Green Building Assessment Approach." *Environments - MDPI* 7 (9): 1–24. <https://doi.org/10.3390/environments7090067>.
- Petrevska, B., and I. Nestoroska. 2023. "Reviving the Past and Inspiring the Future: The Role of Vernacular Architecture in the Development of Tourism in North Macedonia." *ISVS E-Journal* 10 (6): 1–14. <https://www.scopus.com/inward/record.uri?eid=2-s2.0-85166360681&partnerID=40&md5=b2d623a400c009d5a581731cf8abc709>.
- Piparsania, K., and P. C. Kalita. 2022. "Development of DASH: Design Assessment Framework for Sustainable Housing." *Sustainability (Switzerland)*, 14(23). *Sustainability* 14 (23): 15990. <https://doi.org/10.3390/su142315990>.
- Polo López, C. S., E. Lucchi, E. Leonardi, A. Durante, A. Schmidt, and R. Curtis. 2021. "Risk-Benefit Assessment Scheme for Renewable Solar Solutions in Traditional and Historic Buildings." *Sustainability (Switzerland)* 13 (9): 1–35. <https://doi.org/10.3390/su13095246>.
- Qtaishat, Y., S. Emmitt, and K. Adeyeye. 2020. "Exploring the Socio-Cultural Sustainability of Old and New Housing: Two Cases from Jordan." *Sustainable Cities and Society* 61:102250. <https://doi.org/10.1016/j.scs.2020.102250>.
- Rahim, M., A. Munir, F. Marasabessy, and Darmawijaya. 2023. "Local Wisdom and Sustainable Features of Tidore Vernacular Architecture." *Civil Engineering and Architecture* 11 (2): 531–549. <https://doi.org/10.13189/cea.2023.110201>.
- Rajković, I., M. Bojović, D. Tomanović, and L. C. Akšamija. 2022. "Sustainable Development of Vernacular Residential Architecture: A Case Study of the Karuč Settlement in the Skadar Lake Region of Montenegro." *Sustainability(Switzerland)*, 14(16). 14 (16): 9956. <https://doi.org/10.3390/su14169956>.
- Redden, R., and R. H. Crawford. 2021. "Valuing the Environmental Performance of Historic Buildings." *Australasian Journal of Environmental Management* 28 (1): 59–71. <https://doi.org/10.1080/14486563.2020.1772133>.
- Samsudin, N. S., M. Z. Mohammad, N. Khalil, N. D. Nadzri, and C. K. Izam Che Ibrahim. 2022. "A Thematic Review on Prevention Through Design (PtD) Concept Application in the Construction Industry of Developing Countries." *Safety Science* 148 (November 2021): 105640. <https://doi.org/10.1016/j.ssci.2021.105640>.
- Sentia, P. D., S. Abdul Shukor, A. N. A. Wahab, and M. Mukhtar. 2023. "Logistic Distribution in Humanitarian Supply Chain Management: A Thematic Literature Review and Future Research." *Annals of Operations Research* 323 (1): 175–201. <https://doi.org/10.1007/s10479-023-05232-6>.
- Shaikhli, N. A., and I. A. Shafie. 2020. "The Effect of Natural Energy Sources on the Sustainable Form of Vernacular Architecture." *International Journal of Advanced Research in Engineering and Technology* 11 (6): 378–391. <https://doi.org/10.34218/IJARET.11.6.2020.034>.
- Sohrabi, C., T. Franchi, G. Mathew, A. Kerwan, M. Nicola, M. Griffin, M. Agha, and R. Agha. 2021. "PRISMA 2020 Statement: What's New and the Importance of Reporting Guidelines." *International Journal of Surgery* 88 (March): 39–42. <https://doi.org/10.1016/j.ijsu.2021.105918>.
- Thappa, A., A. K. Sharma, and S. Kumar. 2022. "Understanding Vernacular Architecture in Terms of Sustainability: Lessons from Turkey and India." *ISVS E-Journal* 9 (1): 1–13.
- Tzikopoulos, A. F., M. C. Karatza, and J. A. Paravantis. 2005. "Modeling Energy Efficiency of Bioclimatic Buildings." *Energy & Buildings* 37 (5): 529–544. <https://doi.org/10.1016/j.enbuild.2004.09.002>.
- Vehbi, B. O., K. Günçe, and A. Iranmanesh. 2021. "Multi-Criteria Assessment for Defining Compatible New Use: Old Administrative Hospital, Kyrenia, Cyprus." *Sustainability (Switzerland)* 13 (4): 1–20. <https://doi.org/10.3390/su13041922>.
- Visvaldis, V., G. Ainhoa, and P. Ralfs. 2013. "Selecting Indicators for Sustainable Development of Small Towns: The Case of Valmiera Municipality." *Procedia Computer Science* 26 (December): 21–32. <https://doi.org/10.1016/j.procs.2013.12.004>.
- Wong, P. F. 2019. "A Framework of Sustainability Refurbishment Assessment for Heritage Buildings in Malaysia." In *IOP Conference Series: Earth and Environmental Science* (Vol. 268, Issue 1), edited by C. W. Tong, W. ChinTsan, and B. S. L. Huat. <https://doi.org/10.1088/1755-1315/268/1/012011>.
- Yazici, K., and B. G. Aslan. 2019. "The Visual Quality Effects of Historical Building Gardens on Urban Texture in the Sustainable Landscape." *Fresenius Environmental Bulletin* 28 (5): 3756–3767. <https://www.prt-parlar.de/.../>.
- Zairul, M. 2020. "A Thematic Review on Student-Centred Learning in the Studio Education." *Journal of Critical Reviews* 7 (2): 504–511. <https://doi.org/10.31838/jcr.07.02.95>.
- Zairul, M. 2021. "A Thematic Review on Industrialised Building System (IBS) Publications from 2015-2019: Analysis of Patterns and Trends for Future Studies of IBS in Malaysia." *Pertanika Journal of Social Sciences & Humanities* 29 (1): 635–652. <https://doi.org/10.47836/PJSSH.29.1.35>.
- Zairul, M., I. A. Ismail, M. Azli, M. Jamil, A. Azlan, H. Ab Jalil, and N. M. Sharef. 2022. "Smart Classroom Adoption in Higher Education: A Thematic Review." *December* 12 (14). <https://doi.org/10.6007/IJARBSS/v12-i14/15825>.
- Zhai, Z. (., and J. M. Previtali. 2010. "Ancient Vernacular Architecture: Characteristics Categorization and Energy Performance Evaluation." *Energy & Buildings* 42 (3): 357–365. <https://doi.org/10.1016/j.enbuild.2009.10.002>.
- Zhao, X., P. Nie, J. Zhu, L. Tong, and Y. Liu. 2020. "Evaluation of Thermal Environments for Cliff-Side Cave Dwellings in Cold Region of China." *Renewable Energy* 158:154–166. <https://doi.org/10.1016/j.renene.2020.05.128>.
- Zhu, Q., R. Rahman, H. Alli, R. Ahmad, A. Raja, and A. Effendi. 2023. "Souvenirs Development Related to Cultural Heritage: A Thematic Review." *Sustainability* 15 (4): 2918. <https://doi.org/10.3390/su15042918>.