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Review

Sustainable Characteristics of Traditional Villages: A Systematic Literature Review Based on the Four-Pillar Theory of Sustainable Development

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Abstract: The definition of sustainable characteristics of traditional villages can assist in determining the direction of development and evaluating the development results. Nevertheless, a clearly defined concept of the sustainable performance of traditional villages is required. (1) This paper addresses the phenomenon of traditional villages and their decline due to urbanization, industrialization, and the movement of people from rural settlements. The development of traditional villages causes several concerns. This study aims to present a more precise definition of the sustainability of traditional villages. (2) the Preferred Reporting Items for Systematic Evaluation and Meta-Analysis (PRISMA) guidelines conducted a systematic literature review. The data were searched using the Web of Science database, with consideration given to the values of relevance, authority, and impact. (3) The sustainability of traditional villages is explained based on the four-pillar theory of sustainable development, focusing on the economic, environmental, social, and cultural dimensions. (4) The findings provide a scientific framework for understanding the sustainability of traditional villages. These results will provide insights to the future preservation and development of traditional villages.

Keywords: traditional villages; sustainability; sustainable characteristic; four-pillar; environmental sustainability; cultural sustainability; economically sustainability; socially sustainability

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1. Introduction

Traditional villages are spatial units comprising communities where farmers have lived for generations in a specific area [1]. These villages are spontaneously established to meet the needs of their inhabitants and are continuously growing, remodeling, and adapting to accommodate changing requirements. Thus, a village can become a sustainable living environment lasting for centuries. However, urbanization and industrialization have led to the decline and disappearance of many villages [2–4]. This trend is exacerbated by the massive outflow of people from rural areas [5]. The decline of traditional villages has become a global issue [6,7]. According to the United Nations, approximately 45% of the world's people were living in rural areas in 2022, and many traditional villages are confronting sustainability challenges nowadays [8].

Globally, there is a growing trend of revitalizing traditional villages to address challenges, such as climate changes, economic disparities, and cultural erosions [8]. The tension between traditional and modern dwellings has made the sustainable development of vernacular dwellings a prominent research focus, attracting considerable attention from researchers [9,10]. It has also emerged as an effective strategy for traditional villages to navigate their future challenges. Although the concept of sustainable development is not new, it aims to balance environmental, economic, and social dimensions to guarantee the interests of future generations [11]. Since its inception, various definitions have evolved. As research on sustainability are conducted globally, the concept continues to expand, and sustainability becomes more specific. The United Nations has identified three dimensions

of sustainability: economic, social, and environmental [12]. Hawkes [13] considers culture as the fourth dimension of sustainable development, while Murphy [14] argues that culture should be incorporated into the social dimension. Nonetheless, many studies recognize culture as the fourth core dimension of sustainable development [15]. On 17 November 2010, the Executive Committee of the University of California, Los Angeles (UCLA) endorsed a policy statement that identifies culture as the fourth pillar of sustainable development [16]. Treating culture as a separate dimension facilitates sustainability research and makes the concept more understandable and operable. The Sustainable Development Goals (SDGs) solidify and operationalize the concept of sustainability. Focusing on economic, resource, environmental, and ecological dimensions, the SDGs represent a socio-economic model pursued by humanity, continuously to be explored and refined [17,18]. SDG 11 focuses on "sustainable cities and communities" (Target 11.4), emphasizing efforts to protect and preserve the world's cultural and natural heritage [19]. Vernacular dwellings are an important part of cultural heritage.

Despite the progress in sustainable development and its expansion across various fields, defining and measuring the degree of sustainability remains challenging for many researchers [20,21]. Sustainable development is often perceived as a vague and all-encompassing concept [22]. It appears as if it is a ubiquitous pattern, being a paradigm for development that covers a myriad of aspects that other development theories fail to factor in, thus becoming the global development paradigm [23,24]. As a result, the question of sustainable development threatens to become an empty catchphrase–in other words, a phrase that is repeated by everyone, though none of them can clearly describe what it means [25]. So, the traditional villages are also challenged with this issue as the existing attempts to investigate their sustainability entrap them in the misuse of the concept, which ultimately limits further development and promotion of these villages' sustainability.

This study aims to clarify the ambiguous definition of "sustainability" in research related to traditional villages. In particular, through the exploration and positioning of the four pillars of sustainable development and 17 UN SDG goals, this study aims to clearly identify the concept of sustainability, providing a clearer and more scientific framework for the sustainability of traditional villages. It will identify the characteristics of traditional village sustainability and how they are linked to SDGs. This approach will help traditional villages develop a correct vision for their future development, avoiding conceptual abuse.

2. Methodology

2.1. Data Collection Strategy

For the related study, a systematic review of the literature was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology [26,27]. The study data were obtained from the global academic database called the Web of Science (WOS) [28–30]. The WOS database was searched using the following strings: ("sustainability" OR "sustainable" OR "sustainable strategies" OR "sustainable design" OR "sustainable development") AND ("settlement" OR "village" OR "dwelling" OR "house" OR "architecture" OR "building") AND ("traditional "OR "native" OR "indigenous" OR "folk" OR "vernacular" OR "local" OR "rural" OR "historical"). We obtained a total of 2011 articles related to the sustainability of traditional villages. To ensure comprehensive coverage, articles and publication information with relevant research in their titles and abstracts were reviewed. The review process adhered to pre-defined selection and exclusion criteria. The identified general inclusion criteria consist of relevance, authority, and generalizability [31,32]. Relevance defines the material's contribution to the traditional village's sustainable development, authority relates to the source of the publication, and generalizability reflects the effects of the material out of the 131 articles identified according to these standards [31]. After a full-text search, 71 articles were ultimately selected, as depicted in Figure 1.

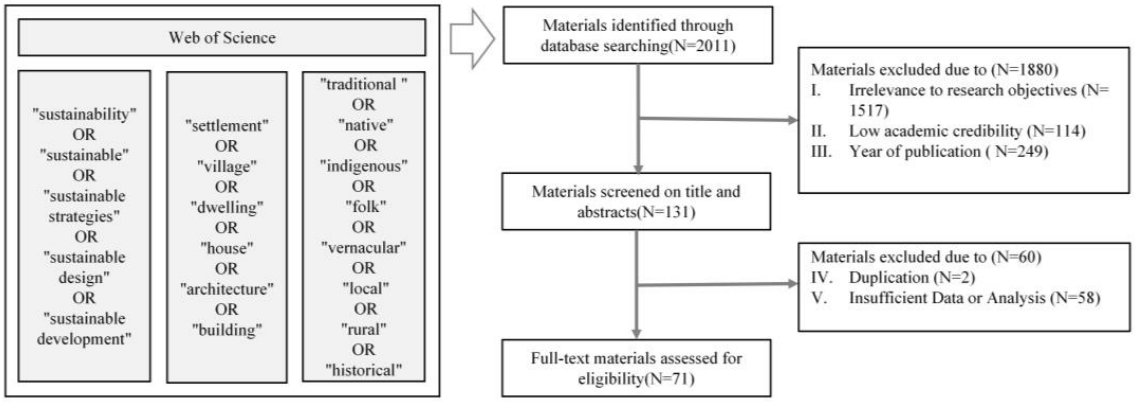

Figure 1. The literature selection process.

2.2. Data Analysis Strategy

2.2.1. Keywords Clustering Analysis

To enhance understanding of the main areas of the selected literature, the study identified, synthesized, and analyzed the keywords within the literature. This approach helps the researchers to build a map of the research area and conduct the investigation systematically [33,34].

2.2.2. Analysis of Key Information

The study used qualitative content analysis and recursive abstraction techniques [35–37]. Here, the information retrieval mainly focused on the research domain, content, methodology, and actual results.

Initially, the research topic was classified based on the content to assess the current status and main viewpoints of the research. Keywords were used as a guide to summarize relevant information. Discrepancies and irrelevant data were eliminated, and the collected information was integrated, correlated, and interpreted to achieve greater conciseness and coherence. Then, the extracted information was summarized and transformed into results. These results were then categorized. The data sharing common attributes and characteristics is combined and classified according to the research objectives. Finally, the research framework was synthesized to identify research gaps and provide suggestions for future exploration. This methodology ensures the authenticity and validity of the data extraction process.

3. Literature Review

3.1. Bibliometric Statistics

Based on the data in Figure 2, research on the sustainability of traditional villages between 2000 and 2004 was rare. This suggests that there was limited attention to this topic at the beginning of the 21st century. However, the number of studies increased significantly after 2005, with a notable surge in the following 2015. This increase indicates a growing global interest in the sustainability of traditional villages. The rise in research activity is also influenced by global emphasis on cultural heritage preservation and the Sustainable Development Goals (SDGs).

Figure 3 illustrates that the literature on the sustainability of traditional villages primarily originates from several countries and regions, including China, Cyprus, Turkey, Malaysia, Indonesia, Greece, and Portugal. Among these, China has the highest number of studies, reflecting its strong emphasis on the conservation and sustainability of traditional villages, which is also related to its large number of such villages. Cyprus and Turkey also contribute a significant number of studies driven by their focus on the sustainability of traditional villages, which is linked to their cultural heritage value and sustainable tourism initiatives.

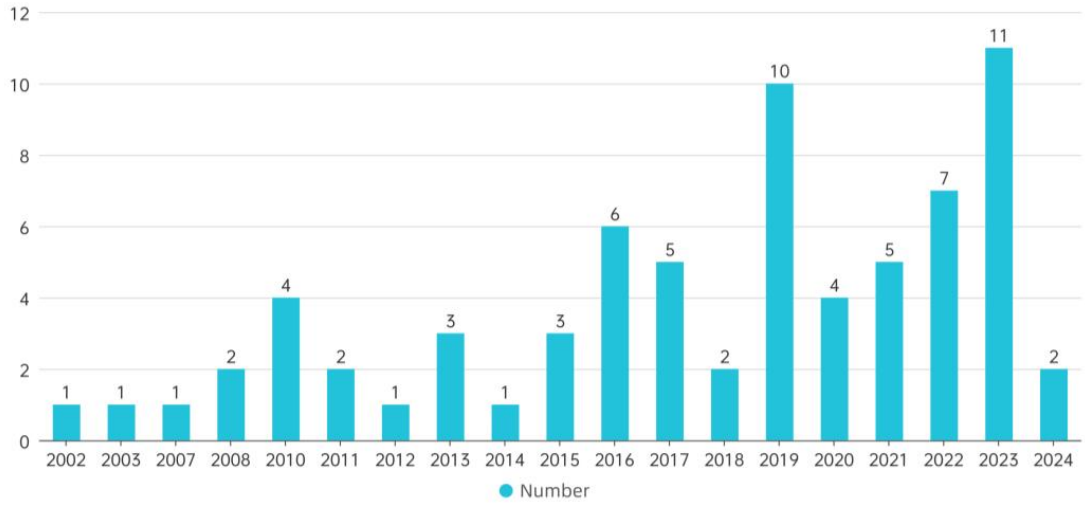

Figure 2. Study area of articles from 2000 to 2024.

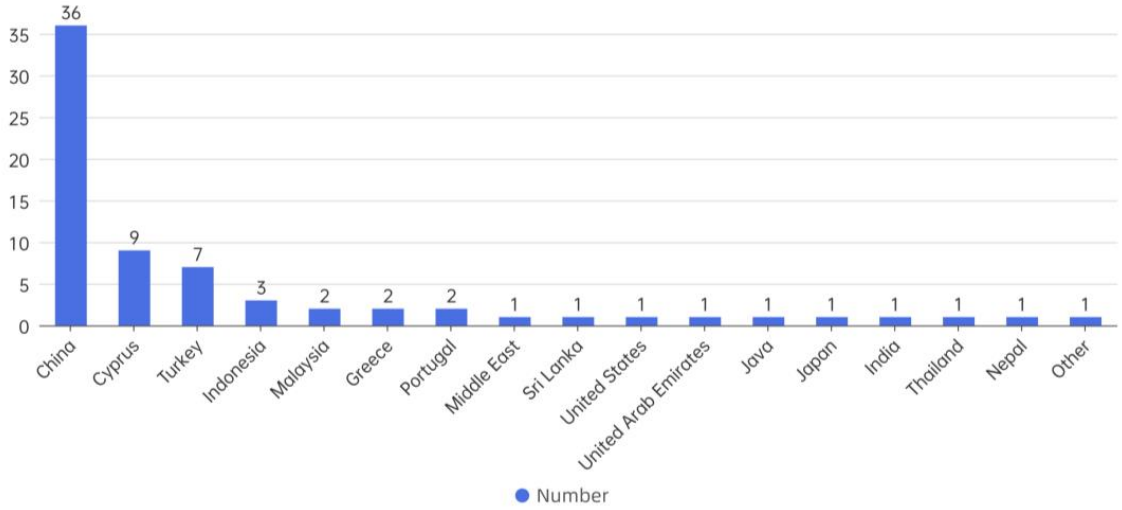

Figure 3. Main research countries.

The research on traditional village sustainability from various parts of the world provides a rich and extensive empirical foundation for exploring common sustainable features. By examining different contexts and countries, this research helps uncover universal principles that contribute to the traditional villages, thereby enhancing our understanding of global sustainability issues.

Figure 4 shows the keywords in sustainability research of traditional villages, which are classified and arranged according to the theory of four pillars of sustainability. The figure mainly includes the following:

1. Keywords related to traditional villages: They include "traditional settlement", "traditional village", "traditional architecture", etc., and represent the core concepts of the research object.
2. Keywords related to sustainability: They include "sustainability", "social and cultural sustainability", "sustainable economy", etc., and show the various dimensions and applications of sustainable development.
3. Keywords related to social: They include keywords related to public health, lifestyle, community participation, and security, such as "social sustainability", "public life", "participatory planning", "lifestyle satisfaction", etc.

4. Keywords related to the environment: This section includes keywords related to environmental protection and ecological environment, such as "environmental protection", "ecological design", "open-green areas", "space form", "sustainable technology", etc.
5. Keywords related to economics: The keywords related to economic growth and resource use, such as "economy", "ecotourism", "job creation", "energy consumption", etc.
6. Keywords related to culture: This category includes keywords related to cultural heritage, local traditions, and esthetic values, such as "cultural heritage", "local traditions", and "cultural identity".

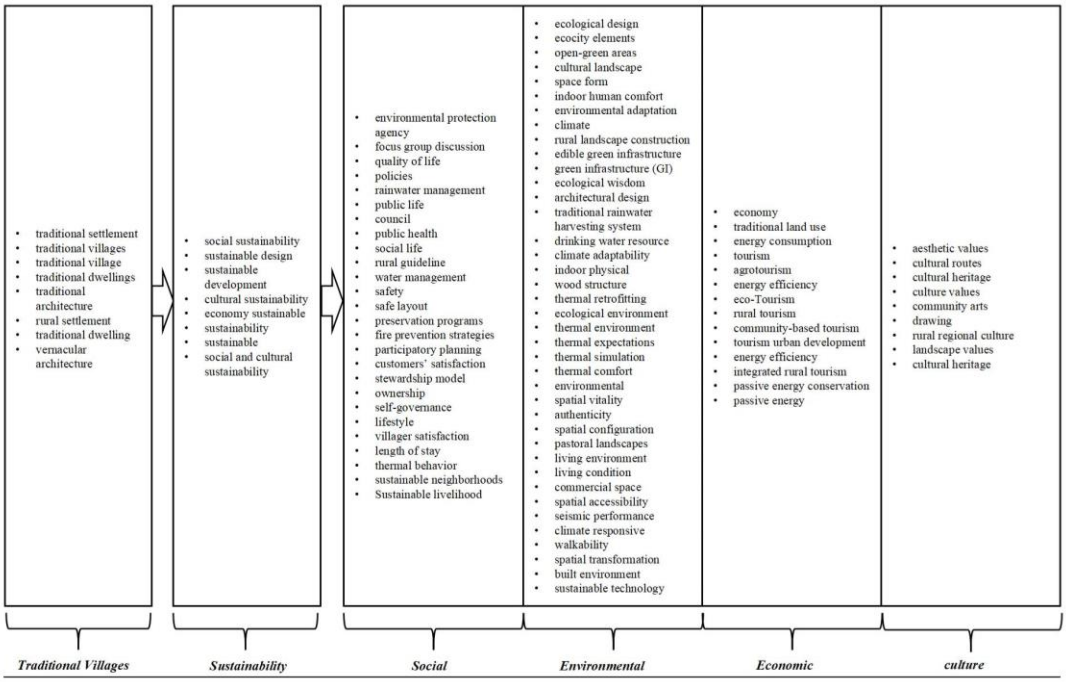

Figure 4. The keyword classification.

This figure shows a multidimensional analysis framework for the sustainability of traditional villages through a detailed classification of keywords. By categorizing the keywords, the research contents and their interrelationships in the study of the sustainability of traditional villages are presented. This will help us better understand the sustainability framework of traditional villages.

3.2. Research Topics

The study reviewed 71 articles, as detailed in Table 1. Detailed information from each article, including frameworks, methods, tools, and conclusions, provides a foundation for expanding this study and developing a comprehensive knowledge system on the sustainable characteristics of traditional villages.

3.2.1. Design Concept

Design concept refers to a set of beliefs and concepts that guide the design process. This theme identifies six design concepts related to the sustainability of traditional villages.

Cengiz and Askind [38] focus on building an eco-city by studying the urban design elements proposed by Saffron City in the Black Sea region of Turkey. This framework provides not only a sustainable perspective for Saffron City but also a reference model for other cities to achieve environmental, social, and economic sustainability.

Similarly, Singh [39] analyses eco-city elements in traditional towns, such as Girtipur in the Kathmandu Valley, highlighting the need to maintain sustainable practices in eco-city transformation and building healthy cities.

Arief and Subadyo [40] explore how traditional settlements achieve sustainable development in line with the eco-village concept by preserving their own customs and cultures in the Sasak aboriginal tribes of Lombok, Indonesia.

Wang and Chiou [41] explored the sustainable human habitat space of Dai villages in Xishuangbanna, Yunnan Province, to reveal the spatial and cultural connotations and ecological concepts of the villages.

He and co-authors [42] studied the changes in Hakka villages in Taiwan due to economic development and suggested that the changes in traditional villages should pay attention to the concept of the 'spirit of place'.

Yang et al. [43] proposed the conceptual framework of 'Regional Habitat Units' (RHUs), which emphasizes the importance of the scale of supra-urban areas and the continuous space.

3.2.2. Design Principles

Design principles are fundamental rules and criteria that guide decision-making in the design process. This section addresses eleven design principles relevant to the sustainability of traditional villages.

Derya Oktay [44] examines the importance of considering local traditions and climate-specific design in housing design to lead to sustainable development.

Kağan Günçe et al. [45] emphasize the importance of traditional Cypriot dwellings in the preservation of the cultural heritage and sustainability of the rural areas, highlighting the importance of retaining traditional design principles when developing new settlements.

Derya Pontikis [46] examines the issues of sustainability and environmental quality in the development of Cypriot cities and highlights the role of the traditional housing model in meeting the residents' needs and integrating local values.

Garcia and Aires [47] focuses on the use of traditional design principles to develop urban centers to improve energy efficiency and achieve sustainable development.

Filiz Erdoğan [48] focuses on the promotion of sustainable development and quality of life in the historic settlements of Sileh through the optimization of green spaces.

Chitrarekha Kabre [49] focuses on the assessment of the Cyclades Islands' traditional Greek dwellings, exploring their sustainable design principles in terms of climate responsiveness and thermal insulation.

Ram Singh [50] works on identifying and analyzing the key factors that promote walkability in cities in order to improve the sustainability of communities and the quality of public life.

Zhou and Yao [51] explore how Lingnan traditions incorporate ecological wisdom into landscape design to revitalize traditional villages and promote new rural development with Chinese characteristics.

Liu et al. [52] explored the spatial design of traditional villages and dwellings in the Jiangnan region, demonstrating how the spaces have evolved over time to maintain sustainability and artistic qualities.

In their study published in 2021, Esin Hasgül et al. [53] focus on exploring traditional construction methods of the vernacular architectural heritage of the Black Sea region of Turkey in order to create sustainable and energy-efficient modern rural housing and propose a new set of principles for the design of sustainable rural dwellings.

Wang et al. [54] focus on the sustainability of architecture in Turkish villages and propose a series of sustainable design paradigms.

3.2.3. Sustainability Strategies

Sustainable practices apply to a set of measures in terms of the design, planning, and execution of certain actions and policies in the context of sustainable development. Based on the abovementioned findings, 28 practical strategies for implementing traditional villages' sustainability are summarized in this section.

Turker and Dincyurek [55] emphasized the need to adopt an ecotourism model, exploring the importance of sustainable tourism in the village of Bafra in North Cyprus.

Shalaby [56] researched the traditional urban development process in the Middle East and suggested that traditional urban development involves multi-stakeholder participation, and the decision-making process is often through dialog between vested interests.

Philokyprou et al. [57] focused on the cooling strategy of the traditional building of the Historic Center of Nicosia, Cyprus, exploring its bioclimatic design strategies and architectural elements.

Lin and Jia [58] used Open Architecture Theory to analyze the architectural elements and design strategies of villages, pointing out that the development and transformation of villages are mainly based on the natural evolution of the needs of the inhabitants rather than external planning.

Gao and Wu [59] explored the role of rural tourism in China in preserving traditional villages, promoting rural development, and alleviating poverty, and proposed a model for the revival of traditional villages based on sustainable rural tourism.

Wang et al. [60] emphasized the importance of preserving the culture and heritage of traditional villages and reconciled the contradiction between development and preservation through a topological approach to sustainable development and urban-rural integration.

Based on Wolf's Head Village as the selected case, Chen et al. [61] analyzed the habitat of traditional villages and proposed sustainable land use strategies to promote the coordinated development of society, economy, and environment.

Maria Philokyprou et al. [62] highlighted the significant impact of local environmental conditions on building design and construction techniques by analyzing the environmentally responsive design strategies used for vernacular houses in different climatic regions of Cyprus.

In the qualitative research study, Murni et al. [63] explored how tourism can support cultural preservation in tourist areas using a cultural studies approach and the cultural preservation strategy of the traditional village of Desa Adat Kuta.

Chatkaewnapanon and Kelly [64] explored community art as a method to promote sustainable tourism based on critical practice tourism (CBT) of the community.

Li et al. [65] aimed to gain a deeper understanding of the relationship between people and land and emphasized the importance of sustainable development and cultural landscape preservation by studying the Panlin settlement in Chengdu city.

Xu et al. [66] focused on the climate adaptation of traditional dwellings in the Qinba Mountains, analyzing how these buildings adapt to the climate through natural ventilation, insulation, and other strategies to improve indoor comfort.

Akbar et al. [67] drew on the ecological wisdom of traditional settlements that minimize environmental impacts and made recommendations to improve the sustainability of new towns.

Martínez-Roget et al. [68] explored how tourism can contribute to sustainable development by increasing the length of stay (LOS) of tourists by examining tourism in the Schist Villages Network (SVN) in central Portugal.

Ou and Xiao [69] studied the application of sustainable design in the renovation of traditional dwellings in Qianyang Village and explored strategies for integrating cultural resources through the enhancement of rural tourism and eco-tourism.

The study conducted by Philokyprou and Michael [70] studied the environmental sustainability conservation of vernacular architecture in Cyprus, suggesting the integration of the environmental characteristics of vernacular architecture with sustainable enhancement strategies.

Yang et al. [71] explored the importance of cooperation among key stakeholders in promoting the sustainability of cultural heritage sites and emphasized the need for participatory planning in stimulating cooperation for cultural heritage sustainability.

In their study, Chen and others [72] explored the landscape of Hongcun waterways and its cultural significance in the Huizhou region of China. They suggested that the

resilience of social-ecological systems must be improved to meet the challenges of water pollution and tourism development.

Zhou and Zheng [73] introduced the concept of cultural routes and proposed a multicultural route model for the sustainable development of traditional villages in Chinese river basins.

Ning et al. [74] explored water management strategies in traditional villages in southern China, arguing that sustainable water management strategies rooted in local communities are key to combating climate change and promoting sustainable urban development.

Thus, Zhou et al. [75] analyzed the spatial configuration of the Bai Quadrangle in Gusheng Village, Dali, Yunnan Province, and emphasized the importance of socio-cultural connotations and environmental adaptations for the sustainable development of dwellings.

Barış Timur et al. [76] explored the potential for thermal retrofitting of traditional Anatolian dwellings, especially through the use of modern Heating, Ventilation, and Air Conditioning (HVAC) systems and other energy-saving interventions.

Chen et al. [77] constructed a novel spatio-temporal variable quantitative model to optimize design decisions for urban regeneration and sustainable development of traditional villages and towns.

Huang et al. [78] explored the advantages of the commercial layout of Longchuan Village by analyzing its streets and alleys and proposed optimization strategies to promote the development of traditional village tourism.

Li et al. [79] explored the conversion of traditional Yunnan dwellings into commercial accommodation by applying the AHP-QFD design methodology, aiming to balance traditional cultural preservation with commercial value.

In the study conducted by Xie et al. [80], energy-saving strategies for traditional brick dwellings in Beijing, China, were evaluated. It was found that increasing external insulation and optimizing solar energy use could significantly reduce the annual energy consumption and CO_2 emissions of the buildings.

Huang et al. [81] showed how the thermal performance of buildings can be optimized according to environmental characteristics, highlighting the importance of region-specific bioclimatic strategies in sustainable building.

3.2.4. Sustainability Evaluation

Sustainability evaluation is an overall assessment technique that is applied to determine and evaluate the sustainability consequences of the projects, policies, programs, or activities being implemented. The following eleven studies are chosen for this theme.

Concerning the fire risks that may threaten architectural heritage sites, Selen Durak et al. [82] aimed to assess the fire risks faced by architectural heritage sites in Turkey and proposed a series of reactive and proactive fire prevention strategies to raise public awareness of fire risks.

Kilic and Aydogan [83] described the spatial reflection of population movement and sustainable tourism in Gökçedar to assess the sustainability of Turkey in cultural heritage preservation and tourism.

Chen and Taniguchi [84] focused on evaluating the environmental balance of residential areas using ecological footprints and biological carrying capacity in Tsukuba City, proposing a tool to estimate the environmental load of residents' daily activities.

He et al. [85] were to develop a framework for assessing the spatial security of traditional settlements and identifying key criteria that affect security.

Meng et al. [86] evaluated the tourism development of the Kaju Tibetan Village, pointing out the impact of factors such as Tibetan life experience, accessibility, and village protection on sustainable development.

Xu [87] proposed the concept of cultural-ecological integrity to assess the organic evolution and sustainability of cultural landscapes.

The research by Zhang et al. [88] used the Importance-Performance Analysis (IPA) methodology and Structural Equation Modeling to develop a sustainable development

strategy to address inconsistencies in sustainable planning, and emphasize the importance of the cultural revival of traditional villages.

Wang et al. [89] analyzed the community rebuilding capacity of Wa Ondine Village after the fire and its effective fire-fighting measures through a village resilience assessment system, which successfully preserved its stilt-like buildings.

The study conducted by Wang and Jia [90] applied the theoretical framework of enduring architecture and explored an evaluation method for analyzing the factors of the long-term existence of traditional buildings in the context of the traditional case of Dachitou Village.

Liu et al. [91] explored the performance of traditional seaweed houses in terms of thermal comfort and developed the Adaptive Predictive Mean Voting (APMV) model to assess the thermal environment of dwellings.

In her theoretical article published in 2023, Assi [92] assessed the resilience of early housing models and how they adapted to changes in household mobility and demand.

Liu et al. [93] explored the importance of integrating villagers' opinions on tourism development in rural mountainous areas of China and proposed an evaluation method based on villagers' satisfaction.

3.2.5. Sustainability Elements

The sustainability factors concern the aspects that determine the ability of a system, an organization, a community, and a project to continue developing and evolving in the long run. Six papers were analyzed to understand the factors and items that establish sustainability in the complex of traditional villages.

Oktay et al. [94] confirmed that the village of Buyukkonuk in North Cyprus has the potential to become an eco-village through community development and olive oil production and that the traditional architecture and social dynamics of the village contribute to its sustainability.

Xu and Liu [95] introduced the unique architectural elements of Shu culture and their response to environmental and human factors, with the goal of promoting traditional residential architecture toward sustainable development.

Zhan and Jin [96] illustrate the cultural and environmental values of the Hani terraces in Honghe, Yunnan Province, stating that the terraces are a model for demonstrating sustainable lifestyles.

Han and Beisi [97] explored port cities in Southeast Asia, particularly Malacca and Penang, and demonstrated how changes in social structure affect urban layout and building types.

Thus, Jaffar et al. [98] aimed to identify the key physical factors that contribute to the social sustainability of traditional settlements by conducting a questionnaire survey at two historical sites, Kampung Pulau Duyong and Kampung Losong, in Kuala Terengganu.

An et al. [99] analyzed the spatial configuration of Tibetan dwellings in Gannan Prefecture through a spatial syntax approach. The study found that differences in the organization of space, as well as the sustainability of the dwellings, depended on regional cultural homogeneity and differentiation.

3.2.6. Construction Structure

This part provides an outline of the structural forms and constructional methods that determine the sustainability of traditional villages from five operational papers.

Ranjith Dayaratne [100] used natural materials and techniques to create environmentally friendly and sustainable solutions in traditional Sri Lankan architecture, which references earthen buildings.

Karaman and Zeren [101] focused on conventional methods of wood construction in conventional Turkish houses while underlining the importance of wood in conventional architectural design in Turkey in relation to present-day sustainable design.

Following this, based on the research of Idham [102], Joglo, and Limasan, two kinds of traditional construction in Central Java are compatible with environmental and social elements that can realize local sustainability.

In their study, Wang and Chiou [103] investigated the Dai balustrade dwellings in Xishuangbanna embody the principles of sustainable development through architectural design, physical structure, ecological considerations, and the use of wood and bamboo materials.

Zhou et al. [104] explored the sustainability of water cellars (a traditional rainwater harvesting system) in traditional Chinese villages, emphasizing the importance of finding a balance between heritage conservation and sustainable use.

3.2.7. Construction Technology

Construction performance involves the functionality of a facility, stability, reliability, ventilation, energy utilization, and effects on the environment. Below are three studies that can be linked to the concept of sustainability that explored the ways of enhancing the performance of structures in traditional villages.

In this paper, Alexandrou [105] studies traditional settlements in Mount Pilion, Greece, regarding their architectural features and climate-sensitive design.

Xu and He [106] studied the thermal behavior of historic dwellings in southern Hunan and their impact on the environment, which highlighted the importance of traditional building techniques and design elements.

Yu Bai et al. [107] focused on improving the seismic capacity of traditional residential buildings in Southwest China, especially in Yunnan Province, and aimed to enhance the sustainability and resistance of these buildings to frequent earthquakes.

3.2.8. Sustainability Policies

This section focuses exclusively on research related to policies and laws affecting the sustainability of traditional villages, with only one study reviewed. Marwah [108] assessed the sustainability of a conservation program of five traditional villages under Law No. 6 of 2014. The study highlights the potential role of the Bapermas PKB in managing the conservation budget and the importance of commitment to regulations to ensure the preservation and development of customs and culture.

Table 1. Sustainability theme.

No	Theme	No. of Study
1	Design Concept	6 [38–43]
2	Design Principles	11 [44–54]
3	Sustainability Strategies	27 [55–81]
4	Sustainability Evaluation	12 [82–93]
5	Sustainability Elements	6 [94–99]
6	Construction Structure	5 [100–104]
7	Construction Technology	3 [105–107]
8	Sustainability Policies	1 [108]
	Total	71

3.3. Summary of Previous Works

Reviewing 71 articles on eight themes in Table 2, we found that the studies presented the four-pillar sustainability theory from various perspectives. There is research to explore the sustainability of traditional villages from an economic perspective, such as utilizing innovative technologies to enhance energy efficiency and local economic development through increased tourism attractiveness. Some of them emphasize community participation and a sense of belonging to present social sustainability. Design concepts are also highlighted, such as the eco-city concept proposed by Cengiz and Askind [38]. These

concepts contribute to the environmental sustainability of traditional villages. Additionally, studies, such as Arief and Subadyo's [40], address preserving and revitalizing traditional culture and architectural styles to promote the cultural sustainability of traditional villages.

Table 2. Summaries of previous studies based on a related theme.

No.	Author and Year	Theme	Aim/Objective/Focus	Findings	Reflection of Four Pillars
1	Cengiz & Askind (2015) [38]	Design Concept	Eco-city	Proposed eco-city design features.	I, II, IV
2	Singh (2016) [39]			Proposed eco-city elements.	I, IV
3	Arief & Subadyo (2017) [40]		Eco-village	Reconstructed the traditional Sasak concept and typology of sustainable settlements.	I, II, III
4	Wang & Chiou (2019) [41]		Habitat Ecology Concept	Proposed a sustainable development program that combines traditional culture and eco-technology to build Dai dwellings with low energy consumption and high quality of life.	I, IV
5	He et al. (2021) [42]		Defense Space Theory	Proposed a new perspective of focusing on the changing "spirit of place".	IV
6	Yang et al. (2022) [43]		Regional Habitat Unit" (RHU) Concept	Proposed the framework of the "Regional Habitat Unit" (RHU).	II, IV
7	Derya Oktay (2002) [44]	Design Principles	Environmental Climate Design	Proposed sustainable housing solutions based on climatic conditions and cultural patterns.	I, II, III, IV
8	Kağan Günçe et al. (2008) [45]		Residential Cultural Design	Suggested the need for suitable environments to continue the natural way of life of local people.	I, IV
9	Derya Pontikis (2008) [46]		Sustainable Housing Models	Proposed principles for sustainable planning and design of housing.	I, II, IV
10	Garcia & Aires (2010) [47]		Energy Efficiency	Proposed a hypothesis for creating urban centers based on previously existing example designs that advocate energy efficiency sustainability.	I, II, III
11	Filiz Erdoğan (2012) [48]		Open Green Space	Discovered the importance of open green space to improve the quality of life	I, II
12	Chitrarekha Kabre (2015) [49]		Passive Design	Suggested climate responsiveness and passive design principles such as thermal comfort and building envelopes.	I, II, III
13	Ram Singh (2016) [50]		Street Pedestrian Design	Identified factors to improve urban walkability.	I, II

Table 2. *Cont.*

No.	Author and Year	Theme	Aim/Objective/Focus	Findings	Reflection of Four Pillars
14	Zhou and Yao (2019) [51]	Sustainability Strategies	Rural Landscape Design	Suggested combining garden art and village art to create designs with ethnic characteristics that combine leisure and living functions.	I
15	Liu et al. (2019) [52]		Spatial Design	Established a genealogy of the artistic characteristics of traditional villages in China.	I, IV
16	Esin Hasgül et al. (2021) [53]		Rural Housing Design	Suggested new applied principles for sustainable development of rural housing.	I, III
17	Wang et al. (2024) [54]		Design Paradigms	Suggested four design paradigms, including flexible layouts, integrated interface combinations, localized housing construction, and modular unit construction.	I, II
18	Turker & Dincyurek (2007) [55]		Ecotourism	Suggested implementing sustainable tourism planning.	II, III, IV
19	Shalaby (2010) [56]		Stakeholder Decision-making	Suggested a framework for the construction of traditional and sustainable processes.	II, IV
20	Philokyprou et al. (2014) [57]		Bioclimatic Design Strategies	Factors and elements contributing to improved thermal comfort are proposed.	I, III
21	Lin and Jia (2016) [58]		Built Environment Evolution	Proposed the impact of clan system and collective life on village layout.	II
22	Gao and Wu (2017) [59]		Rural Tourism	Proposed an integrated, traditional village revitalization model based on sustainable rural tourism.	II
23	Wang et al. (2017) [60]		Coordination of Conservation and Development	Suggested a test of the validity of its findings, i.e., the use of extension theory.	III
24	Chen et al. (2017) [61]		Land Use	Proposed strategies developed based on data analysis.	II, III, IV
25	Maria Philokyprou et al. (2017) [62]		Environmentally Responsive Design Strategies	Proposed sustainable design methods for traditional architecture.	I
26	Murni et al. (2018) [63]		Cultural Preservation	Suggested formal cultural preservation as the preservation of traditional arts and local culture.	IV
27	Chatkaewnapanon & Kelly(2019) [64]		Critical Practice Tourism CBT	Proposed an approach to tourism development based on community art practices.	II, IV

Table 2. *Cont.*

No.	Author and Year	Theme	Aim/Objective/Focus	Findings	Reflection of Four Pillars
28	Li et al. (2019) [65]		Development and Preservation of Cultural Landscapes	Strategies for maintaining cultural landscapes are proposed.	II
29	Xu et al. (2019) [66]		Climate Adaptation Strategies	Effective climate adaptation strategies for traditional earthen houses are proposed.	I
30	Akbar et al. (2020) [67]		New Town Sustainability	Suggested some recommendations for ecological practices in traditional settlements.	I, II
31	Martínez-Roget et al. (2020) [68]		Length of Stay	Suggested that increasing the length of stay contributes to the sustainable development of tourism.	II, IV
32	Ou & Xiao (2020) [69]		Integration of Cultural Resources	Suggested sustainable design strategies.	II, III, IV
33	PhPhilokyprou & Michael (2020) [70]		Environmental Adaptation	Proposed methods to enrich the conservation of vernacular dwellings.	I, III
34	Yang et al., (2021) [71]		Participatory Planning	Suggested that conservation efforts and cooperation are key factors in the sustainability of cultural heritage.	IV
35	Chen et al. (2021) [72]		Landscape Restoration	Recommendations for environmental management of watercourses are presented.	I, II
36	Zhou & Zheng (2022) [73]		Cultural Routes	Proposed an integrated approach to explore the cultural continuity of traditional villages in river basins.	IV
37	Ning et al. (2022) [74]		Resource Management	Found that traditional settlement water management systems are adaptable, cost-effective, and sustainable.	I
38	Zhou et al. (2022) [75]		Spatial Configuration	Developed a more comprehensive understanding of sustainable approaches to vernacular dwelling spaces.	I, II, IV
39	Timur et al. (2022) [76]		Thermal Interventions	Thermal intervention measures are proposed.	I, III
40	Chen et al. (2023) [77]		Landscape Pattern Evolution	Quantitative modeling of spatial-temporal variables is proposed.	I, IV
41	Huang et al. (2023) [78]		Commercial Space Optimization	Proposed strategies for optimizing the layout of commercial space in Longchuan Village.	I, III

Table 2. *Cont.*

No.	Author and Year	Theme	Aim/Objective/Focus	Findings	Reflection of Four Pillars
42	Li et al. (2023) [79]	Sustainability Evaluation	AHP- QFD Design Decisions	Developed a systematic and scientifically based decision-making methodology for the renewal and conservation of traditional buildings in the region.	I, II, IV
43	Xie et al. (2023) [80]		Energy Saving Strategies	Suggested that the introduction of energy-saving measures such as external insulation and solar energy utilization can significantly reduce annual energy consumption	I, III
44	Huang et al. (2024) [81]		Bioclimatic Design Strategies	Proposed bioclimatic design strategies.	I
45	Selen Durak et al. (2011) [82]		Fire Risk Assessment	Proposed a methodology for fire risk assessment of traditional settlements.	II
46	Kilic & Aydogan (2013) [83]		Cultural Heritage Preservation and Tourism Sustainability	Presented the importance of preserving natural areas and history as social memory.	I, II, III
47	Chen & Taniguchi (2016) [84]		Environmental Balance Assessment	Proposed an Improved Method to Calculate Ecological Footprint (EF) Values for Rating Environmental Balance in Rural Areas.	I
48	He et al. (2019) [85]		Safety Evaluation	A framework for safety standards and assessment is proposed.	II
49	Meng et al. (2022) [86]		Tourism Sustainability Evaluation	Established a sustainable evaluation index system for tourism.	I, II, III, IV
50	Xu (2022) [87]		Ecological Integrity Evaluation	Proposed principles, criteria, and methods for evaluating the ecological integrity of cultural landscapes.	I
51	Zhang et al. (2023) [88]		Importance-performance Analysis (IPA) Methods	Proposed an optimized IPA method based on structural equation modeling (SEM).	II, IV
52	Wang et al. (2023) [89]		Resilience	A resilience assessment system is proposed.	II
53	Wang & Jia (2023) [90]		Long-Lasting	Constructed an evaluation system for qualitatively evaluating the long-term performance of historic buildings in urban areas and traditional villages.	II, IV
54	Liu et al. (2023) [91]		Thermal Environmental Assessment	Proposed an APMV (APMV) model for evaluating the thermal comfort of seaweed houses.	I

Table 2. *Cont.*

No.	Author and Year	Theme	Aim/Objective/Focus	Findings	Reflection of Four Pillars
55	Assi (2023) [92]		Resilience of Housing Patterns	Presented a resilience evaluation of Shabiyat, a housing project in the UAE.	IV
56	Liu et al. (2023) [93]		Evaluation of Village Satisfaction	Proposed a method for evaluating the development of tourist villages based on villagers' satisfaction.	II
57	Oktay et al. (2003) [94]	Sustainability Elements	Developmental Elements	Suggested traditional materials and techniques for sustainable development.	I, II, III
58	Xu & Liu (2011) [95]		Vernacular Architectural Elements	Proposed the strength of the economy and the natural development of architecture.	I, III, IV
59	Zhan & Jin (2015) [96]		Physical Factors of Cultural Landscape Maintenance	Proposed the contemporary maintenance of landscapes through tourism and the aspirations of modern life.	I, II, III, IV
60	Han & Beisi (2016) [97]		Social Structure	Proposed drivers of urban evolution.	II, III, IV
61	Jaffar et al. (2019) [98]		Social Sustainability Factors	Presented the key physical characteristics of social sustainability.	II
62	An et al. (2023) [99]		Spatial Structure Elements	Preservation of the diversity of dwellings is proposed.	I, IV
63	Ranjith Dayaratne (2010) [100]	Construction Structure	Earth Buildings	Sustainability of traditional earthen building techniques in Sri Lanka.	I
64	Karaman&Zeren (2013) [101]		Wooden Construction Techniques	Conceptualization of a small residential timber structure restoration project in Turkey.	I
65	Idham (2018) [102]		Joglo and Limasan Traditional Javanese Building Structures	Proposed regional diversity of Joglo and Limasan, traditional Javanese architectural structures, and sustainable development methods.	I, II
66	Wang & Chiou (2019) [103]		Railing Buildings	Proposed the sustainable development program of combining traditional culture and ecological technology to build Dai dwellings with low energy consumption and high quality of life.	I, II, IV
67	Zhou et al. (2021) [104]		Traditional Water Cellars	Proposed the conversion of water cellars into roof rainwater harvesting systems.	I, II
68	Alexandrou (2010) [105]	Construction Technology	Thermal Comfort	Presentation of elements to maintain thermal comfort.	I, IV
69	Xu & He (2013) [106]		Thermal Behavior	Thermal behavior of historical houses in accordance with ecological standards.	I, III

Table 2. *Cont.*

No.	Author and Year	Theme	Aim/Objective/Focus	Findings	Reflection of Four Pillars
70	Yu Bai et al. (2019) [107]		Earthquake Resistance	Building technology solutions to increase the seismic capacity of residential buildings are presented.	I, II
71	Marwah (2016) [108]	Sustainability Policies	Banyumas Traditional Village Conservation Program	The sustainability of the conservation program is proposed.	II

I Environment; II Society; III Economy; IV Culture.

As depicted in Figure 5, over 25 research studies focus on a single pillar of sustainable development, while approximately 27 papers explore the intersection of two pillars. About 15 papers address three pillars, and around five studies integrate all four pillars. This distribution indicates a greater prevalence of research concentrated on one or two pillars. However, a relative deficiency of studies covers three or four pillars. This trend suggests that while researchers are actively engaged in cross-cutting studies among various sub-fields of sustainability, there remains significant potential for more comprehensive research that integrates the four pillars: environment, society, economy, and culture.

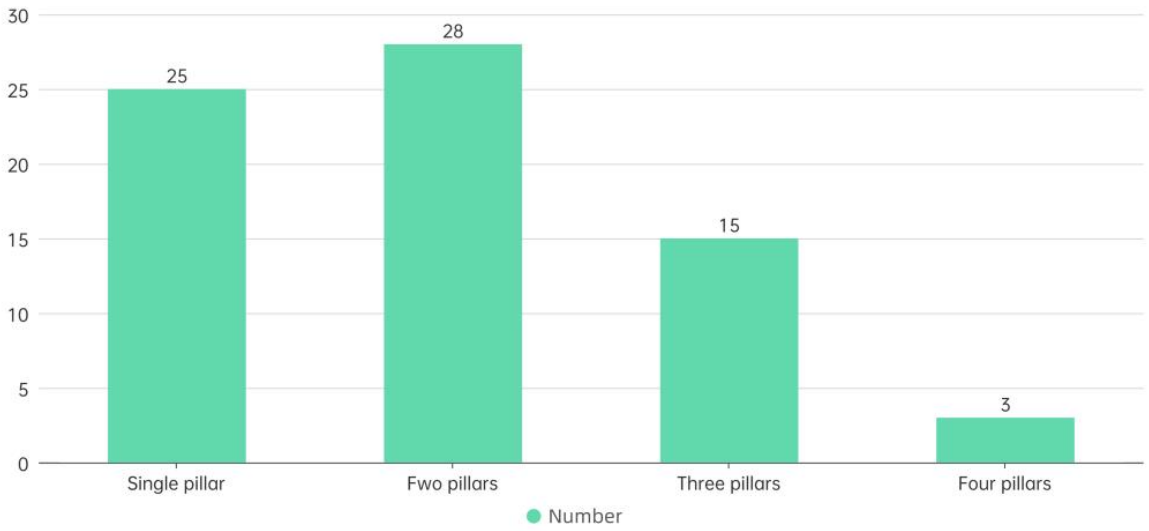

Figure 5. Statistics of the four pillars of sustainability in the literature.

4. Results

By extracting and summarizing the thematic content and innovations of the literature, it was found that the results align with the four pillars of sustainable development theory. Consequently, this study refines the characteristics based on the four pillars of sustainable development theory. These are reflected in four dimensions: environmental sustainability, cultural sustainability, economic sustainability, and social sustainability. Each dimension is further subdivided into sub-criteria, allowing for a more precise definition and assessment of the performance of traditional villages in terms of sustainable development. Figure 6 lists the four sustainability characteristics of traditional villages and their corresponding 27 sub-criteria, providing a clear framework and reference for future research and practice.

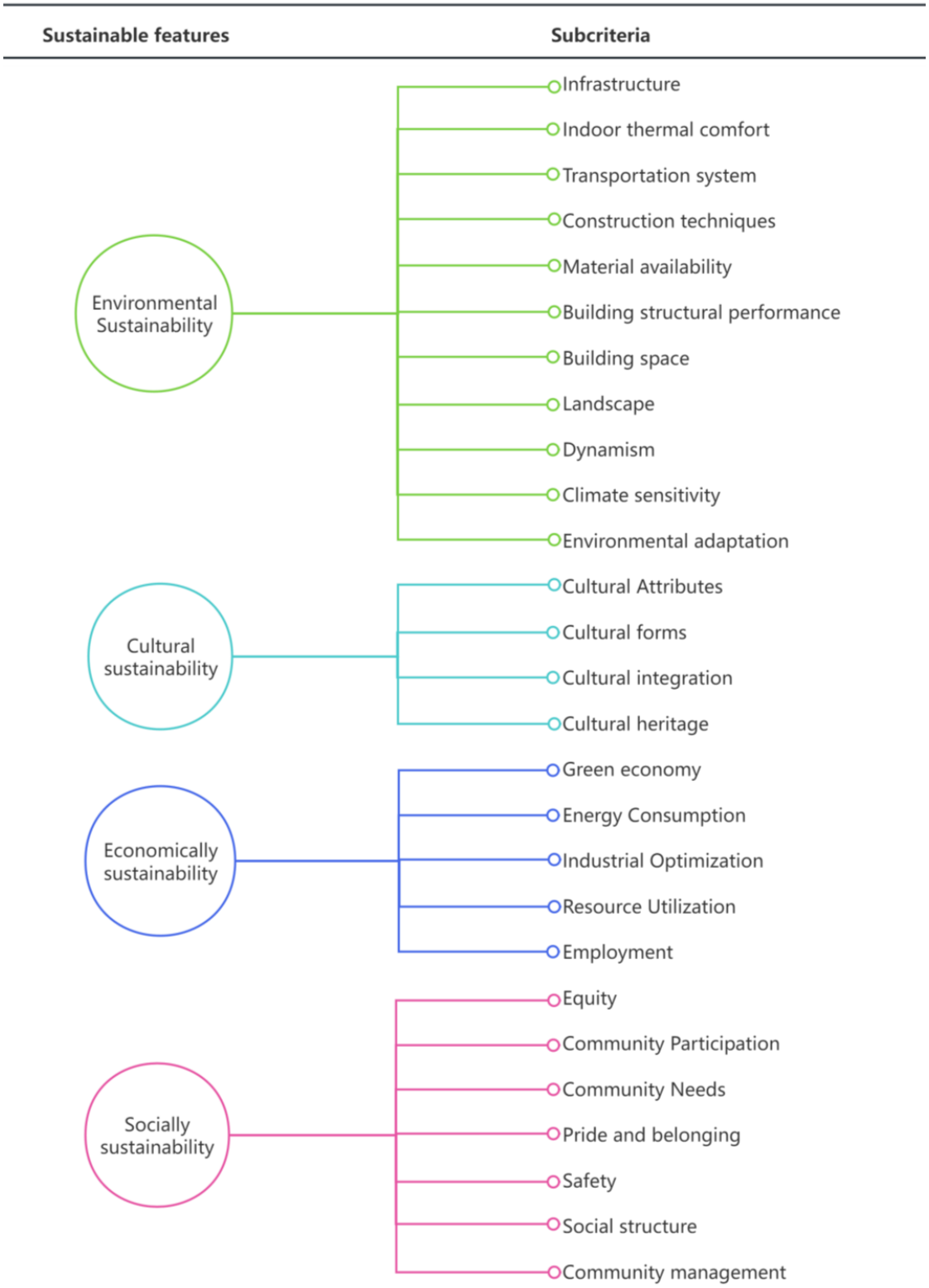

Figure 6. Sustainable features of traditional villages.

4.1. Environmental Sustainability

In traditional villages, environmental sustainability is reflected in maintaining a balance between the population and the environmental capacity. Ben-Eli [109] highlights that such a balance enables the community to realize its full potential and ensures that its activities do not cause irreversible environmental harm. This involves careful mainte-

nance and enhancement of the village's ecology, protection of habitats, implementation of resource-saving measures, and continuous improvement of eco-efficiency [110–112]. The environmental dimension of sustainability can be reflected in 11 items, as shown in Table 3.

Table 3. Environmentally sustainable features.

Subcriteria	Characteristics	References
Infrastructure	Improvement of infrastructure.	[59,98]
	Intensification public services.	[61]
	Use of traditional infrastructure.	[53]
Indoor thermal comfort	Passive thermal environment control.	[57,80]
	Thermal comfort.	[49,70,79,105]
	Regional differences in thermal comfort.	[91]
Transportation system	Accessibility of streets.	[77,78]
	An integrated transportation system that considers all elements.	[77]
	Walkability.	[50,55]
Construction techniques	Restoration of traditional construction techniques.	[46,53,70,100]
	Applying new technologies.	[47,53,58,94,103]
	Green building appropriate technologies.	[95]
	Indoor and outdoor physical environment control technologies.	[62,76,95]
Material availability	Use of local building materials.	[40,49,52,67]
	Use of traditional building materials.	[46,53]
	Use of new materials.	[103,107]
	Use of green building materials.	[49,57,95,100,103]
Building structure performance	Continuity and authenticity of the original structure.	[70]
	Diversity of residential structures.	[99]
	Structural reinforcement and structural safety.	[107]
	Functions of the structure.	[49,70,102,103]
	Replacement and restoration of structural elements.	[101]
	Resilience to earthquakes, fires, typhoons, and humidity.	[67]
Building space	Rationalization of space.	[75]
	Centralized arrangement of commercial spaces.	[78]
	Inclusiveness and multi-functionality of public space.	[67]
	Flexibility and adaptability of space.	[54,83,97]
Landscape	Continuity of the local cultural landscape.	[62]
	Integration and adaptation of landscape and natural environment.	[51,61,87]
Dynamism	Constant iteration.	[75]
	Constructive evolution.	[104]
Climate sensitivity	Adaptation to local climate.	[62,66,75,105]
	Improvement of micro-climatic conditions in the surroundings.	[70]
Environmental adaptation	Environmental synchronization of different natural features and the social environment.	[102]
	Environmental sensitivity.	[81,100]
	Adaptation of buildings to the natural environment.	[52,62,75,95]

4.2. Cultural Sustainability

Traditional village life is intrinsically linked to cultural inheritance. Although culture is intangible, it materializes through environmental elements, design concepts, architectural features, landscapes, and social practices [113]. Cultural diversity supports the sustainability of villages and infuses them with vitality and innovation. The sustainable characteristics of culture in traditional villages can be analyzed through cultural attributes, cultural forms, cultural integration, and cultural preservation, as detailed in Table 4.

Table 4. Cultural sustainable features.

Subcriteria	Characteristics	References
Cultural attributes	Diversity of culture and customs.	[41,69,73,105,108]
	Homogeneity and differentiation of regional cultures.	[52,56,99]
	Continuity of cultural connotations.	[55,56,73,75,88,97]
	The uniqueness of national culture.	[86]
	Integrity and continuity of the cultural context.	[88]
	Social and cultural flexibility.	[90]
	Cultural identity.	[45,55,95]
	The creativity of culture.	[63]
	Cultural resilience.	[92]
	The values of local culture.	[46,69,73,86,88]
Cultural forms	Life customs.	[86]
	Folk festival activities.	[45,86,108]
	Agricultural production, life skills, and tools, traditional handcrafts.	[88]
	Decoration, structure, and layout of traditional buildings.	[79]
	Village history.	[38,108]
	Religious beliefs.	[42]
Cultural integration	Organic integration between different cultures.	[88,97]
	Integration of traditional culture with eco-technology.	[103]
	Integration of cultural spirituality and governance.	[96]
	Integration of cultural resources and local activities.	[68,69]
Cultural preservation	Diverse forms of conservation.	[63]
	Continuing the spirit of local.	[42,61,96,108]
	Cultural construction and management.	[108]

4.3. Economic Sustainability

The sustainability of traditional villages primarily refers to the flexibility and capacity to adapt cultural and economic identities in response to market changes, shifts in village composition, and variations in resource availability and management [114]. Stoddart [115] defines sustainability as the operation of socio-economic activities within a constrained ecosystem context, ensuring resources are distributed efficiently and equitably across generations. White and Masset [116] assert that high community sustainability depends on the community's wealth and independence. These villages, as regional cultural heritage sites, can be leveraged in resource-dependent areas to foster local economic diversification [117,118]. Economic sustainability in traditional villages is reflected in their ability to balance economic growth and development, manage energy consumption and resource efficiency, industrial optimization, and local employment opportunities, as detailed in Table 5.

Table 5. Sustainable economy features.

Subcriteria	Characteristics	References
Green Economy	Balancing nature and economic development.	[39]
	Developing a sustainable economy, e.g., tourism.	[64,68]
	Optimization of economic structure and development of an eco-friendly economy.	[40]
	Diversified economy.	[61]
	Development of an experiential, creative, and esthetic economy.	[69]
Energy Consumption	Low operating costs (residential, energy, and water).	[40,70]
	Saving land, energy, water, and materials.	[61]
	Improvement of energy efficiency.	[66,76,80]
	Solar energy utilization.	[80,105]
	Use of renewable energy sources.	[47]
	Use of traditional energy systems.	[53,70]
	Low energy consumption, integration with nature.	[103]
Industrial Optimization	Development of cultural industries.	[69]
	Development of new industries, especially local specialties.	[60,69]
	Development of traditional agriculture.	[96]
	Optimization of business layout to better leverage business and tourism value.	[78]
	Transformation of business models.	[97]
Resource Utilization	Appropriate and sustainable use of local resources.	[57,62,75,94]
	Heterogeneity and scarcity of resources.	[86]
	Development of tourism resources.	[78]
	Utilization of cultural resources.	[88]
	Efficient utilization of natural resources.	[38,40]
Employment	Increased local self-efficiency.	[44]
	Job creation.	[53,64,94]
	Sustainable livelihoods for residents.	[59]

4.4. Social Sustainability

Social sustainability is defined as a social process that enables the meeting of the needs of the society. It incorporates social justice, equity, pluralism, a sense of place, amenity, and social security to create unity in society. Social sustainability, as defined in conventional villages, is inclined by availability, appreciation, participation, and control of resources, social interaction, hugely facilitated participation, and social compactness [119,120]. This comprises meeting service requirements, creating pride and place identification, and identification with cultural characteristics. It is essential to pay equal attention to safety and improving the living environment in terms of preventing personal harm and maintaining a healthy life style [121,122]. The consistency of social life, reasonable patterns of residential behavior, and efficient community management belong to the social sustainability factors. Moreover, the support and cooperation of local governments and dynamic management of the population are the key components that guarantee the sustainability of traditional villages and the stability of their social structure. These aspects are described in Table 6 below.

Table 6. Socially sustainable features.

Subcriteria	Characteristics	References
Equity	Equitable access to education, amenities, and resources.	[83]
	Equal cooperation between villagers, grassroots government, and diverse cooperative groups.	[61]
Community Participation	Stakeholder participation.	[56,64,71]
	Villager-led.	[93]
	Inclusiveness of community members.	[64]
	Participation of local residents in building together.	[55,61,63,69,93]
Community needs	Service needs fulfillment.	[48]
	Shift in residents' survival and development needs.	[77,79]
	Balancing the needs of authenticity and visitors.	[59]
	Adapting to villagers' livelihood needs.	[58,94]
Pride and belonging	Collective community identity.	[59]
	Sense of belonging.	[54,94]
	Local and regional identity.	[43]
Safety	Safe living environment.	[46,85]
	Safety awareness.	[82]
	Disaster awareness and resilience of the community.	[82,89]
	Community health, lower crime rates.	[50]
Social structure	Continuity of social hierarchy.	[75]
	Changes in social structure (family structure).	[97]
Community management	Layered and phased ongoing management system.	[61]
	Targeted management strategies.	[72]
	Community coordination and co-management.	[69,93]

The study reveals the sustainable characteristics of traditional villages, which are reflected in the following four dimensions: environment, culture, economy, and society, forming a comprehensive analytical framework. Environmental sustainability is characterized by supporting a balance of the ecosystem and strengthening environmental management through interactions with cultural and economic sustainability. Cultural sustainability protects and maintains traditional customs, cultural heritages, and community activities. It is essential in social sustainability which promotes community cohesion and identity. Economic sustainability emphasizes resource use, energy efficiency, and local economic development. Economic sustainability strengthens social stability and community economic recovery by promoting employment and local industrial development. Social sustainability includes equity, community participation, and social cohesion. Social sustainability supports the other characteristics by promoting inclusiveness and community management. The sustainability of traditional villages is not an isolated process but an integrated system with the four pillars: environment, culture, economy, and society.

5. Discussion

The findings of numerous studies on the sustainability of traditional villages have been presented by 71 investigations of traditional villages from diverse geographical regions. The studies predominantly focus on the fulfillment of a singular sustainability criterion from one or more perspectives, and there is a paucity of a comprehensive discourse on the sustainability of traditional villages. Consequently, the discourse on the sustainable characteristics of traditional villages remains incomplete, and the definition of a sustain-

able traditional village remains vague [86]. This study proposes a sustainability analysis framework for traditional villages that revolves around four core characteristics: environmental, cultural, economic, and social sustainability. These features form a cohesive framework that emphasizes their interrelated relationship to sustainable development in traditional villages.

The concept of environmental sustainability is reflected in 11 distinct dimensions. The aforementioned dimensions are as follows: infrastructure, indoor thermal comfort, transportation system, construction techniques, material availability, building structure performance, building space, building structure performance, building space, landscape, dynamism, climate sensitivity, and environmental adaptation. The investigation of environmental sustainability encompasses a comprehensive array of material elements within the village, including buildings, landscape, transportation system, infrastructure, and the surrounding environment. The utilization and upgrading of traditional infrastructure and the enhancement of public service facilities represent the features of sustainable infrastructure in traditional villages. The concept of indoor thermal comfort is reflected in the quality of thermal comfort, passive thermal environment control, and regional variability [49,57,70]. The continuity, authenticity, and diversity of the original building structure, as well as structural safety, structural repair, and structural resilience, primarily confirm the sustainability of existing research on the structural performance of buildings [101,102]. Maintaining traditional building structures and preserving the original architectural style are vital factors in ensuring the sustainability of traditional buildings. In the context of sustainable architectural space, existing studies have identified several key considerations, including the rationalization of space, flexibility, adaptability of space, inclusiveness and diversity of public space, and the centralized arrangement of commercial space. The rational utilization of local, traditional, new, and green building materials are distinctive features of sustainable traditional architecture. A substantial body of literature examines the sustainability of traditional villages from the perspective of construction techniques. The restoration of traditional construction techniques, the utilization of novel and environmentally conscious building techniques, and the implementation of distinctive indoor and outdoor physical environment control techniques represent the sustainable features of construction techniques [101,107]. Furthermore, the environmental sustainability of traditional villages is also reflected in their transport system. The accessibility of village streets, walkability, and an integrated transport system illustrate the village's sustainability [50,55,78]. Furthermore, the landscape constitutes an integral element of traditional villages. The continuity of regional culture and landscape, as well as the integration and adaptation of landscape and nature, indicate the sustainable landscape of traditional villages. The relationship between traditional villages and the geographical environment is primarily reflected in climate sensitivity and environmental adaptation. Adaptation to the local climate and improvement of the surrounding microclimate conditions exemplify the climate sensitivity of traditional villages. Natural features are synchronized with the social environment, and environmental sensitivity and adaptation to the natural environment are specific manifestations of environmental adaptability [62,81]. Many studies have demonstrated that the sustainability of traditional villages is also reflected in dynamism, which illustrates the continuous iteration and constructive evolution of traditional villages.

Cultural sustainability can be broadly defined in terms of four key aspects. The four critical focus areas in the context of cultural sustainability are cultural attributes, cultural forms, cultural integration, and cultural preservation. A substantial body of research has been conducted on cultural attributes, with traditional villages as a prominent case study. These settlements exhibit a plethora of cultural attributes. The culture of traditional villages is characterized by diversity, uniqueness, creativity, and homogeneity and diversity within the context of regional culture [73]. The continuity of cultural connotation and the completeness of cultural background, identity, resilience, and regional cultural values indicate the diversity of cultural attributes of traditional villages. The argument concerning cultural forms emphasizes promoting sustainable development in traditional villages by preserving

traditional cultural forms, including living customs, folk festival activities, skills and tools of production and life, and traditional handicrafts [63]. The conservation of traditional architectural embellishments, the preservation of the village's history, and the maintenance of religious beliefs are all manifestations of cultural sustainability. In contrast, cultural integration seeks to achieve the harmonious integration of diverse cultures, the integration of traditional culture and eco-technology, the integration of cultural spirit and local governance, and the integration of cultural resources and local activities [69,96]. The concept of cultural integration is polysemous. The cultural sustainability of traditional villages is also reflected in the protection of their cultural heritage. Diversification of protection forms, the continuation of local spirit, and the strengthening of cultural construction and management are the distinctive characteristics of the cultural protection of traditional villages [108].

The economic sustainability of traditional villages is reflected in five key aspects: Green Economy, Energy Consumption, Industrial Optimization, Resource Utilization, and Employment. The concept of a green economy is emblematic of economic sustainability. It is manifested in the advancement of tourism, the growth of an environmentally conscious economy, the emergence of an experience-based economy, the pursuit of creative esthetic economies, the pursuit of economic diversification, and the maintenance of a harmonious relationship between nature and economic development in traditional villages [64,68]. The characteristics of energy consumption in the economic sustainability of traditional villages are low operating costs; the saving of land, energy, water, and materials; the utilization of solar energy, renewable energy, and traditional energy; the reduction in energy consumption; and the enhancement of energy efficiency [47,61,80]. Optimizing the industrial structure and developing new industries is necessary for economic sustainability. The aforementioned studies demonstrate that the advancement of cultural industries, local specialties, traditional agriculture, the optimization of business layout, and the transformation of the business model of industrial optimization represent a tangible manifestation of the economic sustainability of traditional villages [69]. Furthermore, the economic sustainability of traditional villages is evidenced by the manner in which resources are utilized. The extant literature posits that the sustainable usage of local resources, the development of tourism resources, the excavation of cultural resources, the usage of natural resources, and the heterogeneity and scarcity of resources are the defining characteristics of resource utilization in traditional villages [86,96]. Furthermore, employment status within a given economy can be used to indicate its sustainability. The enhancement of the capacity for local subsistence, the generation of employment prospects, and the provision of sustainable livelihoods for residents are characteristics that exemplify favorable employment conditions in traditional villages.

The review of the existing literature reveals that the socially sustainable characteristics of traditional villages are primarily manifested in the following key areas: equity, community participation, community needs, pride and sense of belonging, safety, social structure, and community management. The concept of equity is primarily reflected in the equitable access to education, amenities, and resources, as well as in the equal collaboration between villagers, grassroots government, and various cooperative groups. The effective participation of the community is evidenced by the involvement of key stakeholders, the initiative of villagers, the inclusivity of community members, and the collaborative construction of residents [56,71]. The community can be characterized by a number of factors, including the satisfaction of service needs, the transformation of residents' survival and development needs, the balance between visitors' needs and the desire to maintain authenticity, and the adaptation of villagers' living needs. The collective identity, sense of belonging, and local and regional identity of the community are all aspects of the pride and sense of belonging jointly formed by the traditional village-dwelling groups [43]. The safety of traditional villages is evidenced by a secure living environment, a collective awareness of safety among residents, a community-wide consciousness of disaster prevention and resilience, and a low incidence of criminal activity [82,85,89]. The social structure is distinguished by the persistence of social hierarchy and the occurrence of alterations in social structure. Commu-

nity management, in contrast, is typified by hierarchical and phased continuity, targeted management, community coordination, and co-management [72,108].

Tables 2–6 categorize the related research according to the four pillars of sustainability (environmental, cultural, economic, and social) and construct a framework of sustainable characteristics of traditional villages. These findings are closely linked to the Sustainable Development Goals (SDGs). Table 3 highlights the environmental sustainability of traditional villages, such as the protection of architectural monuments and the improvement of infrastructure, which is consistent with Sustainable Development Goal 11 (Sustainable Cities and Communities), especially for its sub-goal 11.4, which emphasizes the protection and maintenance of the cultural and natural heritages worldwide, reflecting the characteristics of cultural sustainability in Table 4. In addition, elements of environmental sustainability, such as climate sensitivity and ecological adaptation, which are addressed in Table 3, are highly related to Sustainable Development Goal 13 (Climate Action), which emphasizes activities to respond to climate change and its impacts. Economic sustainability, discussed in Table 5, combined with SDG 12 (consumption and production) by addressing resource use and promoting energy-efficient practices. The economic features in Table 5 also emphasize improving sustainable economic activities, creating jobs, and promoting local industries, which combines with SDG 8 (Work Opportunities and Economic Growth). Table 6 addresses social sustainability, including equity, community participation, and social cohesion, which combines with SDGs 10 (Reduce Inequalities) and 16 (Peace, Justice, and Strong Institutions), which emphasize building inclusive societies and strong communities in Figure 7. These connections demonstrate how the sustainable features of traditional villages contribute to global sustainable development.

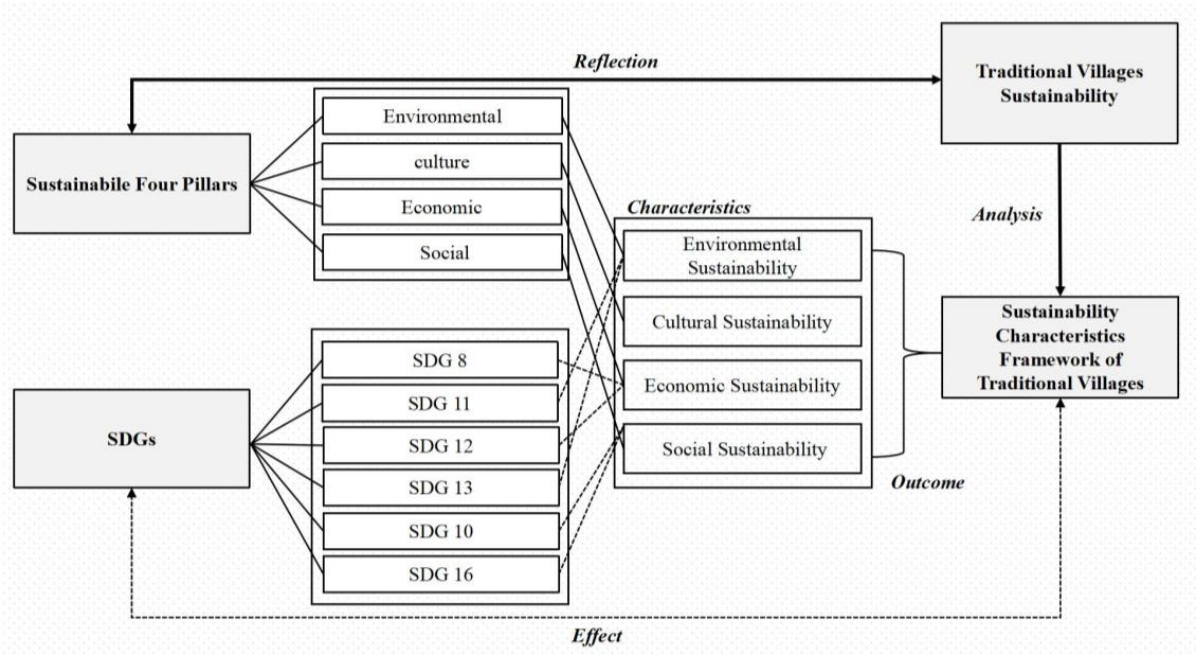

Figure 7. The connections between sustainable four-pillar, SDGs, and sustainable characteristics framework of traditional villages.

5.1. Limitations and Future Directions

Despite a comprehensive review of the relevant research on the sustainability of traditional villages, there are still some limitations. Firstly, the broad and complex nature of sustainability challenges the accurate understanding of the sustainable characteristics of traditional villages. Secondly, this research only reviews literature from the Web of Science database and thus excludes 71 articles. This is because the literature does not explore other databases, and studies in languages only focus on English. Thirdly, the geographic scope reflected in the literature is more concentrated in a few countries, and the research

results are related to specific cases in particular regions. It is recommended that future research adopt a more diverse range of contexts in order to illustrate the complexity of traditional village sustainability. Furthermore, it would be beneficial to explore quantitative methods for evaluating the accuracy of sustainability features and their impacts. This will facilitate the formulation of development strategies aligned with local communities' visions and capacities.

5.2. Theoretical and Practical Implications

Notwithstanding the aforementioned limitations, this study makes a theoretical contribution to the sustainable development of traditional villages. This literature review aims to propose a conceptual framework for the sustainability of traditional villages, to enhance the comprehension of the sustainability of traditional villages, and to advance theoretical research on the sustainable development of traditional villages. The existing literature has elucidated the overall sustainable characteristics of traditional villages, including environmental sustainability, cultural sustainability, economic sustainability, and social sustainability. This study analyses and synthesizes the concept of sustainability in traditional villages by integrating the existing literature on the sustainability of traditional villages. It contributes to the development of the theory of sustainable development. In particular, this study elucidates the four pillars of sustainability theory to explain the sustainable characteristics of traditional villages. It also sets forth a clear definition of traditional village sustainability from multiple perspectives and advances the application of sustainability theory in traditional village research.

The elucidation of sustainable features will facilitate the planning and design of traditional villages and inspire the direction of future development, thereby enabling sustainable development. Consequently, this review study provides a reference framework for stakeholders to understand the meaning of sustainability in traditional villages and make informed decisions regarding the planning and development of traditional villages. Furthermore, the study makes the goals of the Sustainable Development Goals concrete and practical. The sustainability of traditional villages will contribute to the sustainable development of villages and, more importantly, to the sustainable realization of cities, which will lead to the realization of the Sustainable Development Goals sustainability goals.

6. Conclusions

This study aims to establish a comprehensive sustainability analysis framework for traditional villages, including environmental, cultural, economic, and social dimensions, which is capable of evaluating global sustainable development standards of traditional villages. For environmental sustainability, it focuses on utilizing traditional materials and the capacity to adapt to climatic changes. Cultural sustainability emphasizes the conservation of cultural identity and local traditions. Economic sustainability is about the promotion of sustainable economic practices, including the development of local industries and the implementation of sustainable tourism initiatives. Social sustainability includes community participation and cohesion, which are crucial elements in social sustainability. The environmental and cultural aspects of the framework contribute to the achievement of Sustainable Development Goal (SDG) 11, which will function for sustainable cities and communities. Meanwhile, the economic and social aspects are related to SDG 8, which is about work opportunities and economic growth, and SDG 16, which means peace, justice, and strong institutions. The study emphasizes the necessity for organic, dynamic, and growth-oriented sustainable development of traditional villages, focusing on balancing economic viability, social needs, cultural richness, and environmental responsibility. This framework offers policymakers and community leaders actionable insights for the sustainable development of traditional villages, ensuring resilience and sustainability to accept modern challenges. This study contributes a multi-dimensional sustainability framework that bridges traditional practices with modern sustainability

goals, addressing a gap in the rural area development literature. Further research should explore the application of this framework in different cultures and areas to enhance its universality and adaptability.

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Abbreviations

PRISMA	Preferred Reporting Items for Systematic Evaluation and Meta-Analysis
SDGs	Sustainable Development Goals
MDGs	Millennium Development Goals
GI	Green Infrastructure
3D	Three Dimensional
AHP	Hierarchical Analysis Method
QFD	Quality Function Deployment
IPA	Importance-Performance Analysis
VRAS	Village Resilience Assessment System
APMV	Adaptive Predicted Mean Vote

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