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Review

Traditional Ecological Knowledge versus Ecological Wisdom: Are They Dissimilar in Cultural Landscape Research?

Rosyi Damayanti T. Manningtyas [1,2] and Katsunori Furuya [2,*]

[1] Department of Landscape Architecture, Faculty of Agriculture, IPB University, Bogor 16680, Indonesia; rosyidamayanti@apps.ipb.ac.id
[2] Department of Environmental Science and Landscape Architecture, Graduate School of Horticulture, Chiba University, Chiba 271-8510, Japan
* Correspondence: k.furuya@faculty.chiba-u.jp

Abstract: Research into traditional ecological knowledge has become a reference in environmental management. This is followed by ecological wisdom that has emerged and has become a new discourse in landscape planning and design. However, traditional ecological knowledge and wisdom are similar in research and confounding when determining the research scope. Therefore, this study aims to define the distinction between traditional ecological knowledge and ecological wisdom in research through a systematic review of research articles, book chapters, and reviews published from 2017 to 2021. The selected primary studies were analyzed using bibliometric analysis run by VOS Viewer, followed by comparative analysis towards thematic codes. The coding process for the comparative analysis was conducted using NVivo. This study found that research on traditional ecological knowledge and ecological wisdom converges, especially on the topic of indigenous cultural capital, ecosystem services, and sustainability. The distinction between TEK and EW lies in their definition, agent, source, and scope. We propose a conceptual framework to understand the relationship between TEK and EW in the cultural landscape and clarify the scope of the analysis in this research. This study would help scholars develop research on both topics precisely and avoid bias in the theoretical discussion.

Keywords: cultural landscape; ecological wisdom; NVivo; traditional ecological knowledge; VOS Viewer

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1. Introduction

Cultural landscape has been defined as the representation of a composite work of nature and human society over time, influenced by the physical environment and social and economic forces, and [1] the creation of a cultural landscape involving planning and design processes by humans based on their knowledge, experience, and belief system towards their living environment. Therefore, cultural landscapes represent a way of life. It encourages people to create spaces for living, building a story through time and place [2].

However, human and biophysical changes have become a current issue in environmental sustainability. Interaction between humans and nature generates a cultural landscape that can sometimes be sustainable and cause destruction. Ecology, as a basis of landscape design, has been highlighted as evidence of the importance of integrating nature into the landscape design process. In line with this issue, there are some ideas to return to tradition and acquire indigenous knowledge and wisdom from cultural landscape heritage as a basis for sustainable development [3].

Considerable research has been conducted on the cultural landscape as a subject of interest, once it is about traditional ecological knowledge (TEK). TEK, also called by other names including indigenous knowledge or native science, refers to the evolving knowledge acquired by indigenous and local peoples over hundreds or thousands of years through direct contact with the environment [4]. It is concerned with the relationship of living

beings (including humans) with their traditional groups and environment. The study of TEK has argued for an effort to enhance environmental sustainability by learning how the indigenous population adapts to natural changes. However, numerous studies have reported the changes and losses of TEK, especially in medicinal, nutritional, and agricultural knowledge, in small societies [5–8]. In addition, since TEK formed a philosophical concept, there are difficulties in implementing landscape design to measure its work.

Furthermore, a novel concept has emerged in the landscape and urban planning fields called ecological wisdom (EW). EW is defined as the best expertise of pure improvisation for and from ecological practice that enables a person or community to make not only ethical judgements, but also take circumspect action on ecological practices [9]. Hence, this concept requires the ability to achieve the unity of moral knowledge and noble-minded actions in ecological practice, and the ability to conduct excellent ecological practice research [10]. In the eco-landscape design field, EW is defined as a suitable property design with minimal social or ecological intervention. It originates from the idea of re-learning local culture, which has been proven to integrate human behaviour and nature to produce a sustainable landscape [3].

However, there is a disagreement regarding the similarity between EW and TEK. Liao and Chan (2016) contended that TEK and EW are relatively indistinct. Both are closely linked in the literature [11] and are referred to as the knowledge-practice-belief complex. Moreover, Xiang (2016) attempted to conflate terminology into ecophronesis terms, which emphasizes the application of knowledge in wise action [12]. Nevertheless, there are other points of view that equalizing TEK and EW could be misleading at times because knowledge without wisdom could be abused [13]. Research on EW often overlaps with TEK since both examine the cultural landscape as a heritage site [14–18], and the question is what is the exact difference between TEK and EW? There is no clear framework to guide research on either topic.

The objective of this study is to review and define the distinction between TEK and EW based on its definition, agents, sources, and research scope. We also analyze the relationship between keywords used by scholars and identify the connection and convergence of the thematic code. We then construct a conceptual framework describing the TEK and EW relationships in research and propose potential areas for research improvement. The remainder of this study is organized into five sections. Section 2 describes the material and method used, while Section 3 explains the results of the keyword and thematic analysis. The discussion is provided in Section 4 by defining the distinction between TEK and EW and then proposing a conceptual framework for research improvement. Finally, Section 5 presents the conclusions of this study, which serves as a limitation and potential topic for future research. Hopefully, it can help scholars develop research on both topics and avoid bias in theoretical discussions or in the scope of research.

2. Materials and Methods

In this study, a systematic literature review was conducted of English articles, review papers, and book chapters in the cultural landscape context to answer the research question. It critically assessed all relevant literature on the designated research topic through a transparent systematic process [19–21]. The key steps adopted in this study include literature data collection, selection of relevant literature, data analysis and synthesis, and then reporting the review findings. The research question proposed in this study concerns the differences between TEK and EW. Therefore, it focuses on data from empirical and concept studies that are being used by researchers on both topics.

2.1. Data Collecting and Data Selection

The literature data were obtained from the Scopus database by following the PRISMA process [19,22–24], as shown in Figure 1. The search strategy was developed to identify the relevant literature by adopting search terms with a logic model: traditional ecological knowledge and the cultural landscape; and ecological wisdom towards relevant titles,

abstracts, and keywords from 2017 to 2021 in January 2022 as the latest references in the last five years. The consideration of the timeframe is also because the topic of EW began to be widely discussed after 2015 [25], while TEK has been and continues to grow. The initial search found 138 for TEK and 351 for EW studies that continued to the selection process, involving inclusion and exclusion criteria based on the title and abstract. Details of inclusion and exclusion criteria are shown in Table 1. Finally, 31 TEK and 25 EW studies were included in the analysis.

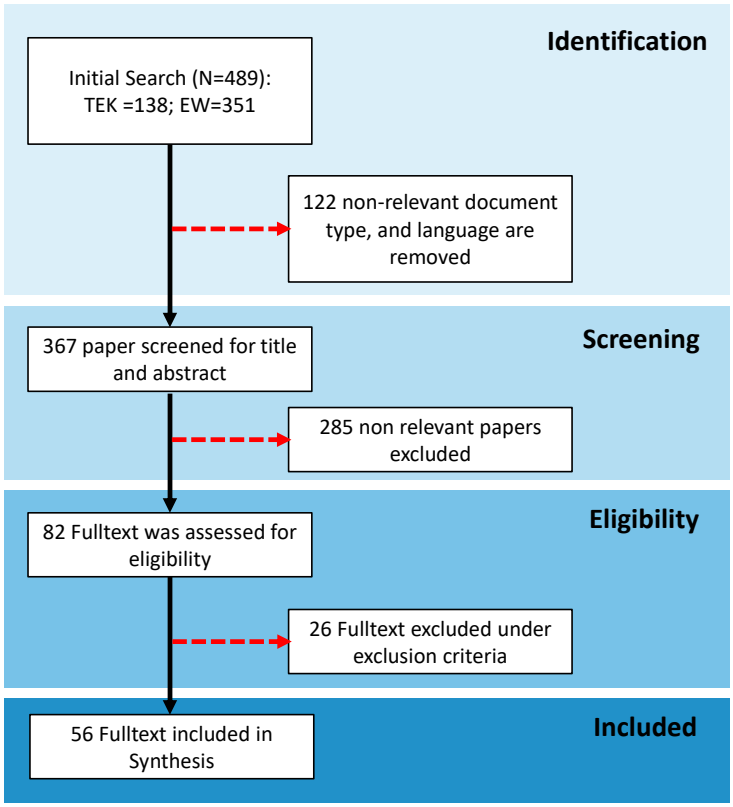


Figure 1. Data collecting and selection process.

Table 1. The inclusion and exclusion criteria.

Inclusion Criteria	Any studies discussing TEK or EW in the context of the cultural landscape
	Studies on TEK or EW conducted in a traditional landscape
Exclusion Criteria	Studies discussing TEK or EW in a context other than the cultural landscape
	Studies on TEK or EW conducted in something other than a traditional landscape

2.2. Data Analysis and Synthesis

In the first step, the bibliometric data of the primary studies were analyzed using co-occurrence through all keywords in the articles. It is used to examine the relation of keywords used in the context of given topics. This step results in a co-occurrence keyword map in thematic clusters using VOS Viewer software [26,27]. Based on the full counting method with the minimum number of keyword occurrences, 49 terms were found after excluding unrelated words. Furthermore, the terms were clustered into thematic clusters based on their relationships in the literature using cluster analysis. The cluster analysis was run using a random start value and 10 iterations, and the resolution of the cluster was set at a 0.5 value. Terms belonging to the same cluster have a close relation in comparison to terms in different clusters [25]. Each cluster is then labelled manually by observing the keywords that can express the cluster's content.

Second, a comparative analysis was conducted to define the distinction between TEK and EW in cultural landscape research. An open coding technique was used during the initial coding stage. The selected content of the text was used as a code, and each code was re-analyzed to create themes and categories. All coding processes were conducted using NVivo software [28]. The results were then synthesized using tables and diagrams to interpret and discuss the findings. Finally, this study elaborated on the findings to describe the implications of these insights for future research.

3. Results

3.1. The Thematic Cluster of Keywords

The thematic cluster analysis of keywords was conducted to examine the relation of keywords that are used in the primary studies and overviewing studies related to TEK and EW. The keyword mapping results showed two thematic areas in cultural landscape research: indigenous knowledge and environment, visualized by red circles, and sustainable ecology and culture, visualized by green circles (Figure 2). The keywords in the same cluster represent the closeness of the studies among the publications [27]. Table 2 lists the keywords belonging to each cluster.

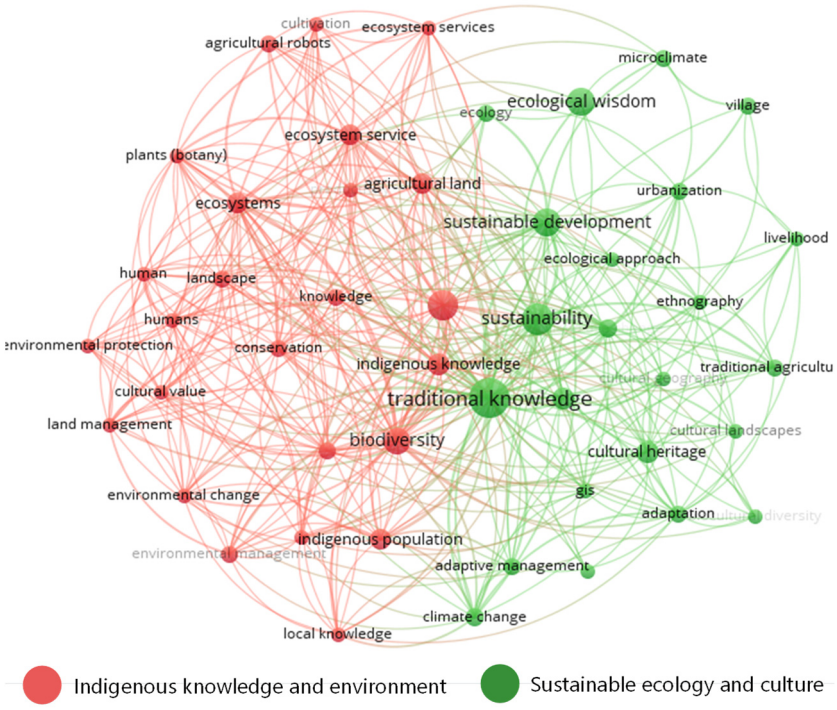


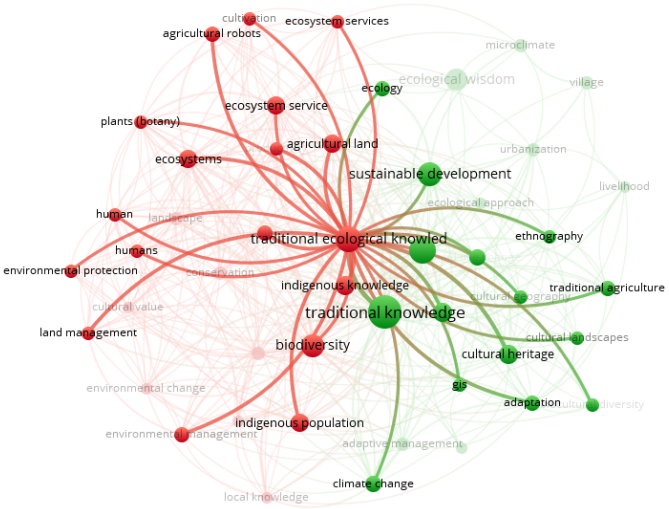
Figure 2. Keywords mapping.

Table 2. The keywords of each cluster.

Cluster	Keyword
Cluster 1: Indigenous knowledge and environment (red nodes) N = 25	Agricultural land, agricultural robot, biodiversity, conservation, cultivation, cultural value, ecosystem services, ecosystem, environmental change, environmental management, environmental protection, human, indigenous knowledge, indigenous people, indigenous population, knowledge, land management, landscape, local knowledge, management practice, plants (botany), productivity, **traditional ecological knowledge**
Cluster 2: Sustainable ecology and culture (green nodes) N = 23	Adaptation, adaptive management, biocultural diversity, climate change, cultural geography, cultural heritage, cultural landscape, ecological approach, **ecological wisdom**, ecology, ethnography, GIS, land-use change, landscape ecology, livelihood, microclimate, sustainability, sustainable development, traditional agriculture, traditional knowledge, urbanization, village

Most of the keywords were collected in circles and were located close to each other. Figure 2 also shows that the red cluster tended to diffuse into the green cluster. This indicates convergence between the studies. Convergence can be understood as a condition in which the boundaries between fields of science are blurred and tend to diffuse. This represents collaboration among multidisciplinary researchers on such topics in that area [29]. Therefore, Figure 2 proves the close study of TEK and EW in cultural landscape literature.

Moreover, further identification of keywords (Figure 3) shows that the keyword TEK belongs to the red cluster. This indicates that the study of TEK in cultural landscape research is closely related to the theme of indigenous knowledge and the environment. TEK is also connected to 32 keywords from both clusters, which represents a wide range of its discussion in research. However, the keyword EW belongs to the green cluster. This means that the study of EW is closely related to the theme of sustainable ecology and culture. EW was connected to only seven keywords from both clusters. This indicates that the topic of EW remains limited to discussion and requires further exploration [25,29]. Interestingly, the keywords TEK and EW were not linked to each other. This means that TEK and EW were neither mentioned together in the primary studies nor correlated in this research. This condition represents the distinct points of each study. However, some keywords related to EW were also related to TEK, particularly in terms of ecosystem service, sustainability, and landscape. This means that the discussion of EW is connected to TEK while discussing such topics [25]. Moreover, the term EW is linked only to keywords such as microclimate, urbanization, and ecological approaches. This represents the scope of EW research that can be specialized to these terms.



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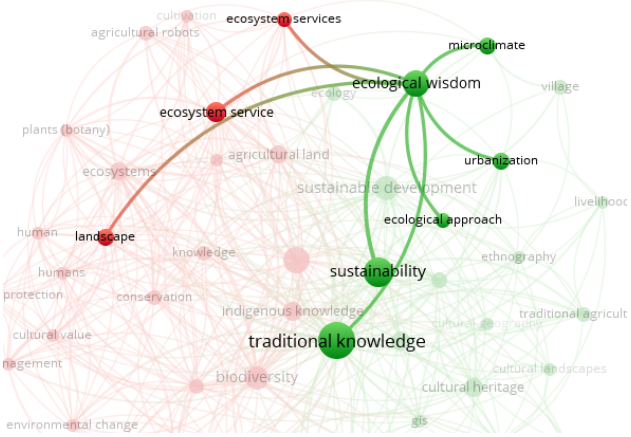


(**b**)

Figure 3. TEK (**a**) and EW (**b**) network in primary studies.

3.2. Comparative Analysis

A comparative analysis was conducted towards the content of primary studies to define the distinction between TEK and EW, both in reviews and empirical cultural landscape research. A comparison of the results is presented in Table 3. The details of the distinction between TEK and EW are described below.

Table 3. The comparison analysis of TEK and EW.

Component	TEK	EW
Definition	**Knowledge** about nature and environmental surroundings gained from practical experience and the belief systems of indigenous people	The **ability** to integrate knowledge on ecological theory and practical experience to understand the landscape system on specific sites to produce prudent actions or goods.
Agents	Indigenous community and traditional culture	Person, community, or organization with an ethical mind, either old or current generation
Sources	Adaptive process. Empirical observation and experience in interaction with nature	Ecological knowledge (scientific or traditional), practical experience, tacit knowledge
Research Scope	Ecosystem and cultural resource management; ecosystem and social system resilience, ethnobotanical knowledge; sustainable production	Ecological planning and design practices; ecological policy-making; sustainable landscape, and urban-rural management

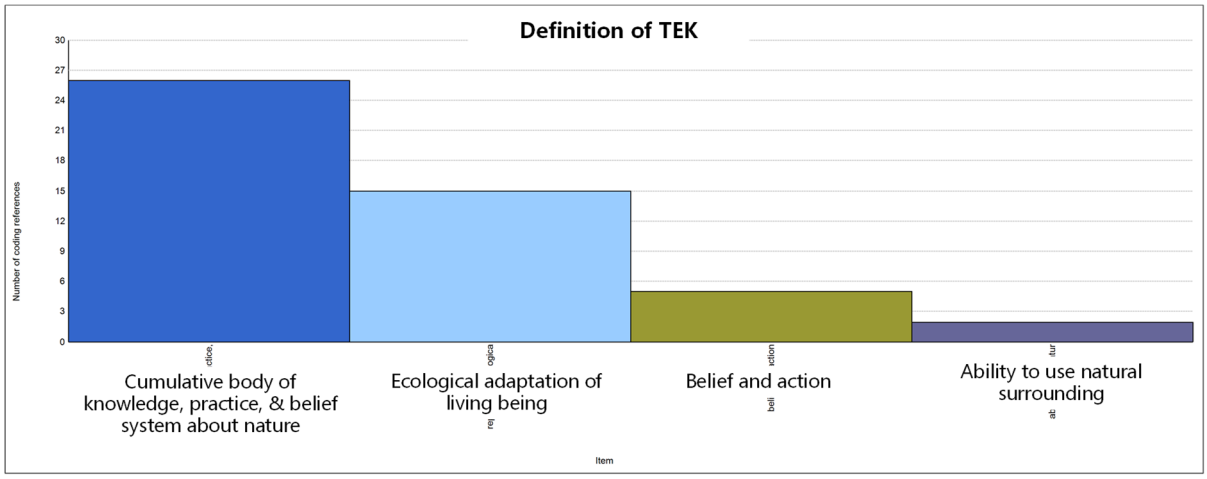
3.2.1. Definition

An analysis of the TEK literature showed that scholars understood TEK using four definitions. The first definition and the most cited statement (26 times) came from Berkes (2000) (reference [30]), who defined TEK as a cumulative body of knowledge, practice, and belief systems about nature and its environmental surroundings. It is an adaptive process that is passed down through generations through cultural transmission. TEK is interpreted as the knowledge to manage and interact with nature [31–35]. It is experiential knowledge created by ethnic groups or indigenous people because of dynamic interaction with their familiar local ecosystem (reference [23]), which also becomes an original instruction for caring for the surrounding environment [36]. Another definition describes TEK as a representation of the ecological adaptation of living beings [37–39]. It includes action and belief systems toward nature based on the experiences of indigenous people. TEK is also interpreted as the ability to use the natural surroundings [40]. The utilization of natural resources is limited to fulfilling the daily needs of indigenous people and communities and is mostly reversible. Thus, the TEK terminology emphasizes the knowledge of indigenous people that is generated from experience in interaction with nature. Figure 4a shows the definition of the TEK based on the number of coding references.

Meanwhile, EW is mostly (16 times coded in references) defined as the ability to make prudent actions in contextual ecological practices [41–44]. In particular, it is related to the ability to integrate ecological theory and practical experience to understand the landscape system on specific sites to produce real and permanent goods [9,10,41]. Another discussion describes EW as a good property design, idea, or strategy that has been ecologically proven over time [3,17,45–47]. EW has been successfully implemented through trial and error, and has become a good example of an eco-design product. Therefore, it can be used to create sustainable landscape planning and design.

Moreover, EW is also related to the knowledge, beliefs, and actions of people or communities, which generates an understanding of nature [10,48]. Belief and action in EW require the ethical mindset of people or communities toward nature as a basis for making interventions [10,43]. In brief, the terminology of EW emphasizes the ability to combine ecological knowledge, either scientific or traditional; and experience and ethics to make a prudent judgment or product in response to the local context, either landscape characteristics and/or culture. Therefore, EW is attached to individual and community

competencies and knowledge. Figure 4b shows the EW definition based on the number of coding references.



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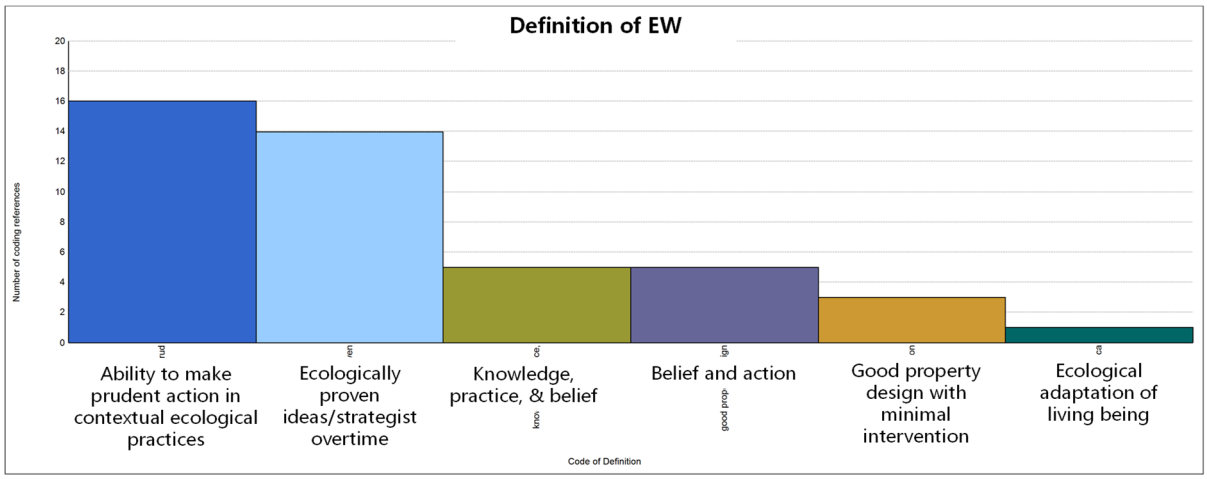

(**b**)

Figure 4. The definition of TEK (**a**) and EW (**b**) is based on the number of coding references, respectively.

The comparative analysis results (Figure 5) show that the definitions of TEK and EW overlap on three codes: representing an ecological adaptation of living beings, the cumulative body of knowledge, practice, and belief system toward nature, and belief and action. This indicates that both TEK and EW are related. Moreover, three of the four definitions of TEK are also coded as EW definitions, which means that TEK is a part of EW because it requires knowledge to generate wisdom. However, both fields are distinct, especially in terms of their abilities. TEK is defined as the ability to use natural surroundings, while EW emphasizes the ability to make prudent actions or good designs that could ecologically prove over time. Therefore, TEK is vulnerable to changes rather than EW as it can be changed in line with natural conditions.

3.2.2. Agents

TEK is always associated with indigenous people, communities, and traditional cultures. Research on TEK has mostly focused on the adaptive process [33,38,39,49–53], ethnobotany [35,40,54–59], landscape management [23,31,60–63], and traditional farming [32,34,61,64] of the indigenous community. These practices involve not only experienced knowledge but also norms and belief systems as part of traditional culture. They

developed TEK as a form of adaptation in that knowledge, experience, beliefs, and norms are blended to become a guide for using and managing the ecosystem. The traditional belief system and norms applied in the traditional community have mostly become a driving factor for the existence of TEK. It also distinguishes the indigenous community from other communities. Therefore, indigenous communities and traditional cultures can be considered agents of TEK.

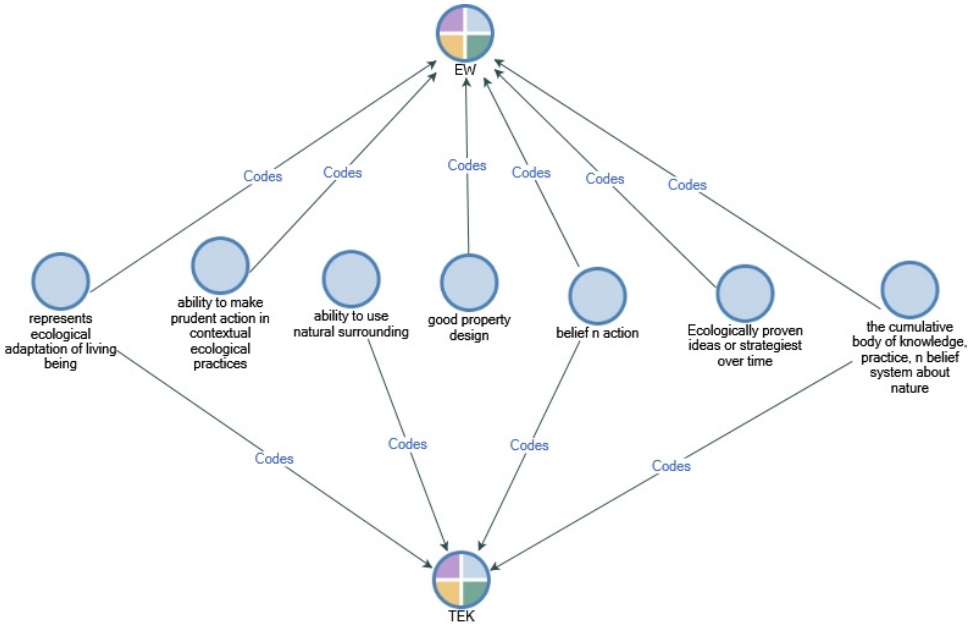

Figure 5. The comparison diagram of definitions between TEK and EW.

Furthermore, EW was developed either by a person, community, or organization because it is based on the human ability to act and do well in response to environmental conditions. Research on TEK has involved the ideas or strategies of persons or communities in dealing with environmental conditions, which is not limited to but includes indigenous [3,46,65–67] and current community/people [68–70]. The requirements to gain ecological wisdom are understanding both by science and/or experience, having an ethical mind, and having the ability to act effectively [10]. However, because EW needs to be proven over time, most studies have been conducted on heritage sites or traditional settlements. Current ideas and products that could be considered EW products include biomimicry [10,71], green infrastructure [72–75], and the sponge city concept [76–78]. All of these concepts have been proposed by the current generation, which emphasized nature's role as a laboratory and has been the source of the idea that it has been through trial-and-error experiments by the ecological system over time. A comparison diagram between the TEK and EW agents is shown in Figure 6.

3.2.3. Source

TEK is knowledge that comes from the adaptive process of indigenous people to-wards their environment. This is a long-term process that requires empirical observation [37,55,78], trial, and error in the resulting understanding of the living environment [36,58]. It also involves beliefs and norms in the process of intervention toward nature [40,53]. Based on these experiences, practical knowledge has been developed and handed down through generations. This knowledge would have existed if it had been practiced. Therefore, TEK in some areas is currently endangered, as it is no longer practiced by generations [18].

EW is an ability that comes from the accumulation and understanding of ecological knowledge (both traditional and scientific), ecological practice experience, and tacit knowledge [3,48,79]. Experience in ecological practices enhances the understanding of agents toward the natural system. It does not have to come from personal experience, yet involves

sharing experiences with expertise [48]. Furthermore, tacit knowledge is defined as the knowledge and understanding that comes from the internalization and assimilation of self-reflection, experience, and synthesis [10]. Deep reflection on and understanding of these three kinds of knowledge over time would enhance wisdom toward nature. The connection diagrams for the sources of TEK and EW are shown in Figure 7.

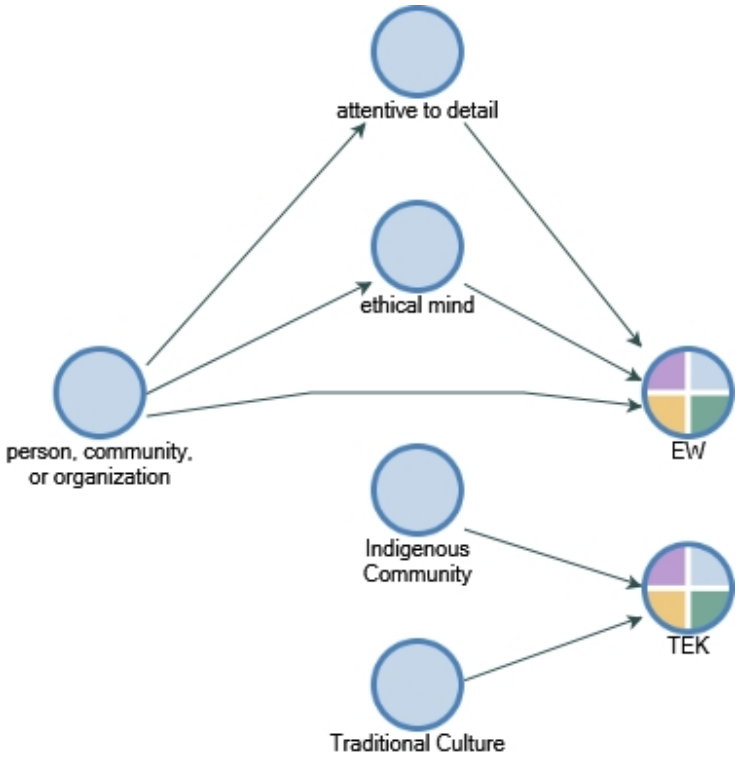

Figure 6. The comparison diagram of agents between TEK and EW.

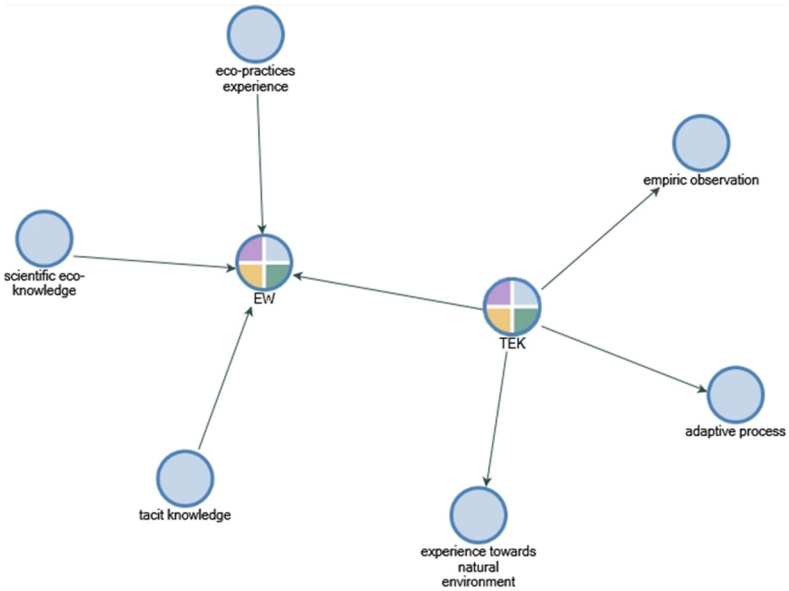

Figure 7. The connection diagram of sources between TEK and EW.

3.2.4. Research Scope

Identification of the research scope of primary studies found that the research scope of TEK in the context of cultural landscape research is classified into ecological and cultural resource management, including conservation, restoration, and preservation [50,61,62];

ethnobotanical knowledge [55–57]; ecological system resilience [35,50,80]; indigenous cultural capital [36,81,82]; and sustainable production and development [37,38,58].

Moreover, the EW research scope could be classified into four categories: sustainable development, which specified sustainable construction [42,83], sustainable agriculture [17,84], sustainable settlement, and urban development [42,45,46,65,66,85]; ecological planning and design practices, including eco-design of heritage sites [3,42,46], resiliency and urban planning [43,67,83,86,87], and watershed planning [47]; urban-rural management, which specified preserving the ecological wisdom of sites [17,65], stormwater management [47], and conservation of rural ecological and cultural systems [17,18,48,85]. The connection of codes (Figure 8) shows that TEK and EW reached a wide scope of research and induced convergence between both topics. The scope of TEK and EW overlapped when discussing indigenous cultural capital as the basis for sustainable development [46,48,67], as shown in Figure 8.

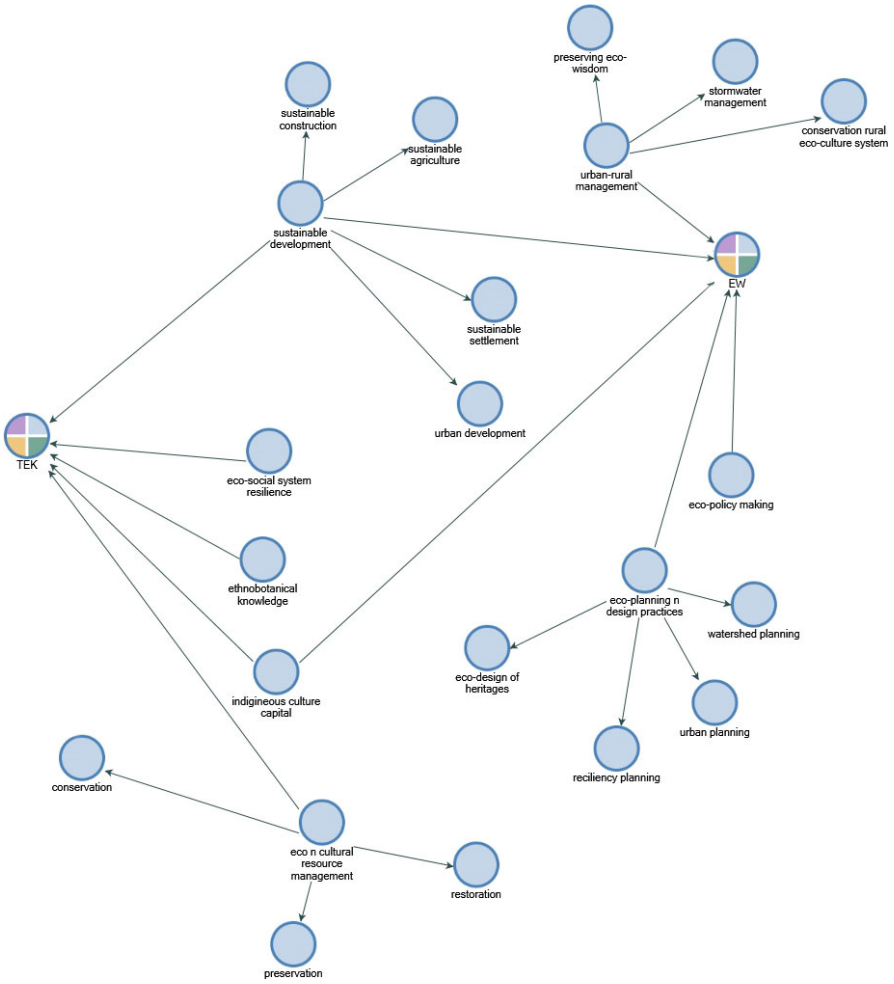

Figure 8. The connection diagram of the research scope between TEK and EW.

4. Discussion

4.1. Convergence and Distinction of Studies

Both thematic cluster analysis and comparative analysis of primary studies revealed that TEK and EW are relatively similar, especially in the literature on cultural landscapes. However, they were distinct at the same time. Based on thematic cluster analysis, all key-words in primary studies were located close to each other and shaped in a circle, which indicates the closeness of the study [26,29]. Although the primary studies are grouped into two clusters (Figure 1), indigenous knowledge and environment (red cluster) and sustainable ecology and culture (green cluster), the red cluster tends to diffuse to the green

cluster. This diffusion represents their convergence in research. The convergence of both clusters indicates interdisciplinary collaboration among researchers on this issue to generate an innovative solution for the problem in the cultural landscape context [29,88]. However, the observation of keywords TEK and EW reveals that TEK and EW are not linked to each other in primary studies. This indicates that neither topic was mentioned nor discussed together, which represents a distinction between studies. Compared to this study, previous research on measuring trends and hot topics in ecological wisdom showed that EW is still limited to discussion, yet linked to 20 terms [25]. This indicates that EW is more rare in a cultural landscape context rather than another field and needs to be further explored.

Furthermore, the comparative analysis attempted to define the distinction between both and found that TEK and EW differ based on the definitions used by scholars, agents, sources, and scopes. Based on this definition, TEK emphasizes knowledge (references [30,34,55,89]), whereas EW emphasizes the ability to act well [41–44]. TEK could be considered a source of EW because it requires knowledge to perform well [3,10,12]. According to the agents, TEK is general knowledge that is held and developed by the old generation of the indigenous community and transmitted to the current generation through cultural transmission. EW can be developed by either the old or current generation [42,44,48], either individually or collectively. Analyzing the research scope of TEK and EW reveals that the study of TEK focuses on resource-based management, which is specific to ecological and cultural resources. EW tends to focus on place-based management, which is specific to urban and rural ecosystems. This is because EW mostly discusses the ability to act, judge, and create permanent goods in response to the local context [43]. Moreover, TEK studies specifically discussed ethnobotanical knowledge and socio-ecological system resilience, while EW specifically studied sustainable construction and settlement, especially in traditional settlements that experienced urbanization. This study needed to understand the ecological wisdom that is applied in nature and arrange the concept of sustainability for our built environment [10,83]. EW also focuses on ecological planning and design practices, including resiliency planning, eco-design of landscape heritage, and environmental policy-making. Studies on TEK and EW have been correlated when discussing indigenous cultural capital as the basis for sustainable development. This study examines traditional knowledge, ecosystem services, and the wisdom of indigenous people regarding sustain-ability [14,15,18,83]. Therefore, the study of TEK and EW could be quite similar and linked to keywords, such as traditional knowledge, ecosystem services, and sustainability.

4.2. Conceptual Framework of TEK–EW Relationship in Cultural Landscape Research

To better understand the relationship between TEK and EW in cultural landscape re-search, a conceptual framework was proposed, as shown in Figure 9. This framework is derived from the conceptual model of ecological knowledge to the wisdom transformation process (reference [10]), which was modified and combined with the TEK framework and the research scope of both topics.

Figure 8 shows the formation process from TEK to EW. The long-term interaction between the living environment (shown on the left side of Figure 9), indigenous communities, and their traditional culture developed TEK. TEK is defined as knowledge derived from the adaptive process of the indigenous community. It includes empirical observation, direct experience in dealing with nature, beliefs, and ethical systems. TEK is transmitted to the current generation through cultural means. On the other hand, our current generation learns about nature by researching and generating scientific ecological knowledge (SEK), as shown in the lower left of Figure 9. Both TEK and SEK are important contributors to ecological knowledge. Interaction and internalization between ecological knowledge, eco-practice experience, and tacit knowledge over time by involving an ethical mind and holistic approach could generate ecological wisdom at the individual level. In the context of cultural landscape research, TEK focuses on the study of eco-cultural re-source management, ethnobotanical knowledge of indigenous communities, and social-ecological system resilience. All studies tended to explore studies linked to the current situation. EW focuses

on the study of urban and rural management, ecological planning and design practices, and environmental policy-making. These studies reveal the wisdom of ecological products/strategists to acquire it to create sustainable goods and policies in-volving scientific measurements. The convergence study between TEK and EW should be conducted within the scope of indigenous cultural capital, traditional knowledge, ecosystem services, and sustainable development. These studies involve the exploration of traditional knowledge and assessment of the ecosystem services of the cultural landscape as a kind of natural and cultural capital, and use it as a basis for sustainable development.

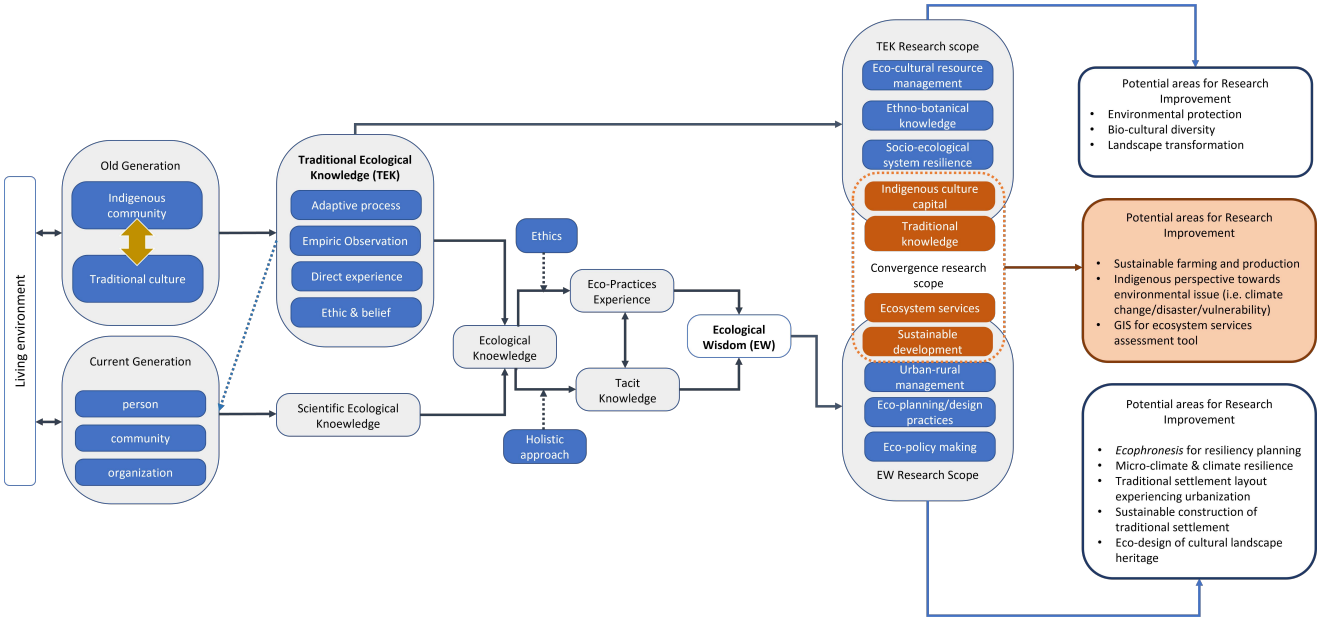

Figure 9. Conceptual framework of the TEK–EW relationship in cultural landscape research.

Based on the prospect analysis of each primary study, potential areas for research improvement were proposed. In the future, studies on TEK in cultural landscape research could focus on traditional knowledge about environmental protection, bio-cultural diversity, and landscape transformation as a development for eco-cultural system resilience, management, and ethnobotanical studies. Meanwhile, a study on EW could be specified as an ecophronesis for resiliency planning, micro-climate and climate resilience, wisdom in building layout and sustainable construction of the traditional settlement, and eco-design of cultural landscape heritage. Finally, the convergence study on TEK and EW should focus on sustainable farming and production from the indigenous community, indigenous people's perspective towards the current environmental issue and their adaptation, and the implementation of GIS to assess ecosystem services in the cultural landscape.

5. Conclusions

In this study, it is clear that research between TEK and EW is similar in the literature; however, both also have distinctions. The closeness study of TEK and EW represents convergence in this research. Studies on TEK and EW can be similar when related to topics such as ecosystem services, sustainability, traditional knowledge, and indigenous cultural capital. Further analysis of primary studies shows that the distinction between TEK and EW lies in the definition understood by scholars, agents, sources, and the scope of analysis of both studies. However, there was no clear framework to guide distinction research in either of these studies. Therefore, we propose a conceptual framework to better understand the relationship between TEK and EW, and their research scope, including convergence topics. We then suggest potential areas for research improvement in the cultural landscape field by dividing the areas into three categories: TEK research scope, EW research scope, and TEK–EW convergence topic. It would help scholars clarify the differences between TEK and

EW in research. This study had limitations since only empirical and concept studies from journal articles, book chapters, and reviews are included in the analysis, which excludes conference papers, such that some empirical studies may not be captured. Moreover, the topic of TEK has been studied for a long period and has been developed in many fields, followed by EW, which was originally discussed in the last few decades. Therefore, this study may not have been able to capture research trends in the cultural landscape prior to the proposed timeframe.

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