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Review

Acknowledging Indigenous and Local Knowledge to Facilitate Collaboration in Landscape Approaches—Lessons from a Systematic Review

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Abstract: The need to recognize diverse actors, their knowledge and values is being widely promoted as critical for sustainability in contemporary land use, natural resource management and conservation initiatives. However, in much of the case study literature, the value of including indigenous and local knowledge (ILK) in the management and governance of landscapes tends to be overlooked and undervalued. Understanding ILK as comprising indigenous, local and traditional knowledge, this systematic review synthesizes how ILK has been viewed and incorporated into landscape-based studies; what processes, mechanisms and areas of focus have been used to integrate it; and the challenges and opportunities that arise in doing so. Queries from bibliographic databases (Web of Science, JSTOR, Scopus and Africa Wide) were employed. Findings from the review underscore that the literature and case studies that link landscapes and ILK are dominated by a focus on agricultural systems, followed by social-ecological systems, indigenous governance, natural resource management, biodiversity conservation and climate change studies, especially those related to early warning systems for disaster risk reduction. The growing importance of multi-stakeholder collaborations in local landscape research and the promotion of inclusive consultations have helped to bring ILK to the fore in the knowledge development process. This, in turn, has helped to support improved landscape management, governance and planning for more resilient landscapes. However, more research is needed to explore ways to more effectively link ILK and scientific knowledge in landscape studies, particularly in the co-management of these social-ecological systems. More studies that confirm the usefulness of ILK, recognize multiple landscape values and their interaction with structures and policies dealing with landscape management and conservation are necessary for enhanced sustainability.

Keywords: indigenous knowledge (IK); local/traditional ecological knowledge (LEK/TEK); landscapes; collaboration; interdisciplinary/transdisciplinary research; indigenous and local knowledge (ILK)

1. Introduction

The global movement towards more pluralistic and integrative approaches to understanding and addressing the complex sustainability challenges facing humanity today acknowledges the need to value multiple knowledge systems, to facilitate collaboration and mutual learning between different actors, and for integration across social and ecological systems, as well as the sustainable development goals [1–3]. In this review, we explore the connections and linkages between two

important concepts that are being widely promoted as critical for sustainability in contemporary land use, natural resource management, climate change adaptation and biodiversity conservation initiatives. These concepts are indigenous and local knowledge (ILK) (see [4]) and landscape level approaches (see [5]). The latter recognize important social-ecological connections and interrelations and include, for example, integrated landscape management (ILM) and landscape stewardship. We specifically consider how ILK is incorporated into case studies that take a landscape approach.

The importance of recognizing indigenous and local knowledge systems emerged in 1987 from the World Commission on Environment and Development (WCED) report on sustainable development. According to WCED, the disappearance of ILK would likely result in the loss to larger society of the traditional skills, practices and understandings necessary for the sustainable management of complex ecosystems [6]. International acknowledgement of indigenous and local peoples' knowledge systems and perspectives on environmental issues then began with work on traditional ecological knowledge (TEK) [7]. The 1992 United Nations Conference on Environment and Development (UNCED) (also known as the Rio Earth Summit) followed, which committed to take action globally, nationally and locally to achieve sustainable development by supporting the vital role indigenous and local people play [8]. In 2002, a decade later, the World Summit on Sustainable Development held in Johannesburg, South Africa formally acknowledged the historical relationships that indigenous and local people have to their lands over many generations [7]. Since then ILK has been incorporated into policy, research and practice across many different spheres of sustainable development, including the management of land and ecosystems. Moreover, it was the recognition of the accumulative wealth of indigenous, local and traditional knowledge, that led to the proposition that actors involved in landscape and natural resource management concerns need to work cooperatively with indigenous and local people.

For this review, we adopt the Intergovernmental Panel on Biodiversity and Ecosystem Service (IPBES) concept of ILK to incorporate several forms of knowledge outside of mainstream scientific knowledge [4]. These include traditional ecological knowledge (TEK), cultural knowledge (CK) [9], local knowledge (LK), traditional knowledge (TK), [10,11], folk knowledge (FK) [12] and indigenous ecological knowledge (IEK) [13]. Many of these terms are used interchangeably. IK is used mainly with regards to indigenous peoples, while TK/TEK and LK are more often used for local people who may or may not be indigenous, but nevertheless hold knowledge that is based on personal and collective experiences of their local environments overtime [14]. Various scholars have debated the most appropriate use of these different terms without consensus [15–17]. We have selected to use ILK as it is more encompassing and, consequently, we refer to the various identified knowledge systems (IK, IEK, CK, TK and TEK) as ILK throughout the paper. ILK is defined based on Berkes' [15] definition of IK, which is a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment. Such knowledge captures local natural resource management, historical and contemporary experiences, social norms, sociocultural governance structures and spiritual beliefs. Other authors have denoted ILK as being qualitative, intuitive, experiential, holistic, oral, adaptive, responsive, performative, collective, spatially heterogenous and constructed [1,18,19].

A recent literature review on indigenous knowledge (IK) highlighted that, today, there is valorization of ILK in political theory, sustainable development practice, collaborative international research agendas, biodiversity management and climate change adaptation and resilience frameworks [4,20]. For instance, the United Nations Framework Convention on Climate Change (UNFCCC), the Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES) all acknowledge the importance of ILK systems in climate change adaptation and biodiversity management. According to Thompson et al. [20], these new developments and interests emerge from the belief, and evidence, that ILK can contribute solutions to the unprecedented threats that humanity and the planet face today. The knowledge and beliefs

linked to indigenous and local practices have been important in offering theoretical advancement and practical approaches for the sustainable use and management of natural resources [19], as well as contributing to biodiversity conservation and other sustainability challenges [21–23]. Robinson and Wallington [24] underscore that the scope and content of ILK systems are complementary to science with regards to ways of governing dynamic and complex social-ecological systems. Other scholars have described indigenous and local people as scientists with their own developed cosmologies and worldviews that have fostered wellbeing of communities and their environments over generations [25]. With regards to the environment, several studies have revealed that indigenous and local people hold empirical and cultural knowledge about the environment contributing significantly to environmental governance [26]. For example, anthropologists and natural scientists have documented ILK related to plants, animals and natural phenomena [27,28].

The understanding of the potential role of ILK has led to its incorporation in contemporary landscape, conservation and adaptation research and practice [15,19,24]. For example, although indigenous and local people are often very vulnerable to the negative impacts of climate change, they are also recognized as possessing specific knowledge of use for adaptation [14]. The urgency of current crises related to climate, food and water thus poses an opportunity for engagement with the sustainable practices and solutions ILK presents [25]. Advocating for the inclusion of ILK in research and practice has the potential to empower indigenous and local people and support them finding their own, often more appropriate, solutions to climate change and other threats [7]. Some of the strengths of ILK include its legitimacy, credibility, salience and usability among others [29,30]. If successfully embedded within research and practice, ILK is considered to increase community buy-in and the perceived legitimacy of decision-making and policy formulation [21]. Furthermore, collaborative application of multiple knowledges is key to optimizing social-cultural-ecological resilience [31]. However, the acknowledgement of ILK is not always necessarily translated into ILK informed or ILK driven research or projects [21]. Numerous challenges have been identified in practice. In this review we unpack some of these challenges or barriers as well as the factors that can contribute to the successful incorporation of ILK into landscape projects.

Landscape approaches are one of the most widely advocated means to address growing pressures on land, water and biodiversity [32]. Landscape approaches emerged from the understanding that land management that considers agriculture, forestry, biodiversity and poverty alleviation as separate issues will not be enough: "the scale of the global challenges we face is too great; and there is a need for genuinely integrated approaches" [33]. Broadly speaking, landscape approaches provide a framework to integrate policy and practice for multiple land uses within a given area. This holistic approach, it is argued, can support more equitable and sustainable use of land and ecosystem services while simultaneously strengthening measures to mitigate and adapt to climate change. The understanding of a landscape approach inherently includes recognition of indigenous and local people and their ILK as a key component. For example, Principle 5 of the widely accepted 10 principles of a landscape approach [34], while not explicitly mentioning ILK, does refer to the importance of stakeholder involvement which includes local and indigenous people as land users and owners. Austin and colleagues [21] similarly assert that the landscape approach intentionally creates space for various forms of knowledge to co-exist, be co-produced, and/or integrated in collaborative ways. An important aim of landscape approaches is to integrate different scientific disciplines, indigenous and local knowledge systems (ILK) and Western science, and global to local needs [31,32,35].

We maintain, given the growing prominence of both ILK and integrated landscape approaches for addressing sustainability and climate change challenges, an overview of how ILK has been incorporated into landscape research and practice would be timely and fit appropriately with the theme of this special issue on collaboration in landscape management and governance, particularly the lessons for practice under a changing climate. In our review, we consider the approaches and processes that have been used for integration of ILK in landscape contexts, primarily through the consideration of case studies. We also examine the challenges and opportunities related to incorporating ILK at the

landscape level. Such an analysis will help us to understand whether ILK is given due attention in landscape approaches for climate change resilience. Additionally, the review will provide us with a better appreciation of what might be needed for this form of knowledge to be recognized and included in landscape level work in order to facilitate more inclusive and sustainable management of the landscapes concerned.

In the next section we provide an overview of the methods used for our systematic review. This is followed by the results and discussion section which covers a summary of the types and characteristics of the landscape studies reviewed; how LEK was integrated into these studies; and lastly the challenges and opportunities for studies that link landscapes and ILK. Each of these sections relates to a set of specific questions that we queried during the review process. The paper ends with a short conclusion.

2. Materials and Methods

2.1. Systematic Literature Review: Selection of Publications

Different types of systematic review exist based on both the methodological and analytical approaches adopted [36]. The major types of review are: (a) meta-analysis (statistical combination of results of quantitative studies with numerical analysis of measures of effect); (b) narrative (qualitative narrative synthesis with conceptual models); (c) scoping (both qualitative and quantitative synthesis that includes research in progress and characterizing quantity and quality of literature), (d) rapid (literature synthesis based on quantity, quality and overall direction of effect from what is already known in literature) and (e) mixed methods review (combination of all approaches) [36]. We adopted a Rapid Systematic Literature Review (RSLR) approach for this study because it is a rigorous method and has the advantage of allowing concessions for breadth and depth, and timescale. Since we considered 2002 as the initial date for our review and we examined what is known about the incorporation of ILK into landscapes from existing research following a systematic process, we considered RSLR a good fit for our study.

We considered an initial start date of 2002 because this was the date when the World Summit on Sustainable Development was held in Johannesburg, South Africa and the value of ILK, as well as the historical relationship indigenous and local people have with their environment, was formally acknowledged and recognized as critical for sustainable natural resource management [7]. Our aim for this review was to identify emerging trends in the characteristics of landscape-level studies in relation to ILK, as well as unpack the different ways in which ILK is incorporated into landscape approaches. RSLR is generally used to assess the state of knowledge on a given topic and structured to produce a summary of existing knowledge in addition to identifying any gaps and new directions for future research, as done, for example, by Ford and Pearce and Williams et al. [37,38]. Given that this review forms part of a special issue on "Collaboration and Multi-Stakeholder Engagement in Landscape Governance and Management in Africa: Lessons from Practice", we focused on challenges and opportunities for the incorporation of ILK in landscape approaches as well as the lessons for practice. Additionally, we were particularly interested in exploring case studies that recognize climate change adaptation and resilience as key elements of a landscape approach, as this is an important topic within our project and an essential consideration for any landscape level work going forward. Our review included both scientific (peer reviewed academic publications) and grey literature (working papers and reports) and followed a multistep search procedure as described below (Figure 1).

Firstly, keywords were identified for use in the publication search based on what we aimed to achieve in this review, i.e., to investigate how ILK has been incorporated into landscape research, with a focus on climate change resilience. The terms selected and used iteratively in the literature search included ("indigenous knowledge" OR "cultural knowledge" OR "traditional knowledge") AND ("landscapes") AND ("rural") AND ("urban") AND ("resilience") AND ("climate change"). Queries from bibliographic databases (Web of Science, JSTOR, Scopus and Africa Wide) were employed

following the search terms. Literature published from 2002 up to the final search date of 25 October 2019 was considered.

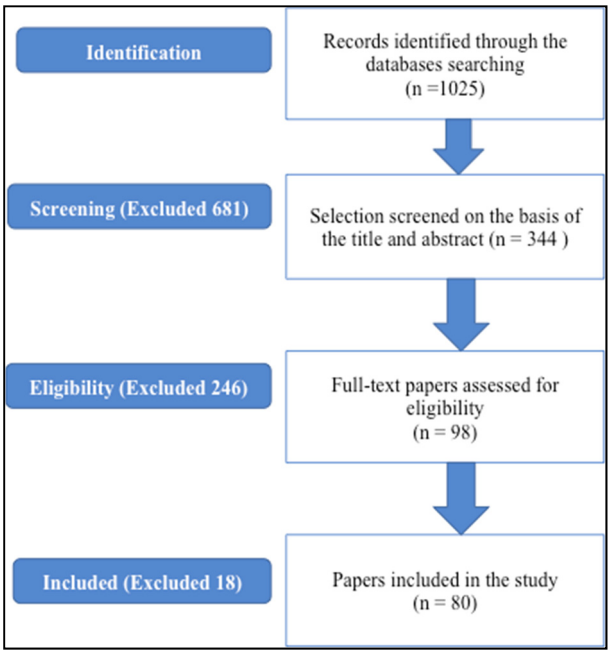

Figure 1. Flow diagram of the literature selection process for the systematic review.

Secondly, the publications extracted from the selected databases were carefully examined using the inclusion criteria developed for this review, namely: (a) the selected study focuses on the landscape approach and/or coupled human-environmental or social-ecological systems; (b) the study makes reference to ILK or associated synonyms; and (c) mention is made of stakeholder engagement. The initial search process yielded a total of 1025 studies across all the databases. During the screening process (Figure 1), 169 duplicate studies were removed. Title screening excluded another 512 publications that were not directly related to the aim of this review and were non-English. Abstract screening excluded a further 246 publications. The excluded publications related to household level studies, literature reviews or studies based on theoretical investigations rather than case studies, studies that did not mention ILK or its associated synonyms in the abstract, and studies that focused explicitly on natural/environmental systems without the link to people and society.

The third step involved full screening of the remaining publications. This screening resulted in 18 exclusions. These exclusions included studies that did not explicitly incorporate ILK as a key aspect of the study. A total of 80 publications were finally considered for in-depth review (see Supplementary Materials, Appendix S1), where appropriate information related to ILK inclusion in landscape studies was extracted and analyzed.

2.2. *Analysis of Selected Publications*

We employed both qualitative (content) and quantitative (descriptive) methods to analyze the final 80 publications. These studies were coded as per the themes and variables described below and the results captured in Microsoft excel. These were later grouped and synthesized. The coding and synthesis were broadly guided by a set questions which were based on a thorough review of ILK and landscape management literature as summarized in the introduction. We then undertook further analysis and reflection based our main objectives for this review which related to: (a) a broad characterization of the studies selected; (b) identification of how ILK was included in the studies; and (c) extraction of the challenges and opportunities for incorporating ILK so as to engender more resilient landscape management and practice.

Typical systematic literature review variables investigated across the publications included year of publication, geographical location of the study, data sources, and funding sources, among others. We also extracted the main scientific areas/fields within which ILK was explored in each of the studies, through in-depth reading of the publications. We then explored several ILK relevant themes (especially in the main findings and conclusions) related to: (a) reflections on the value of ILK in the studies; (b) the actors/stakeholders included in the research process and management of the landscapes; (c) the processes of engagement with actors and local and indigenous people; (d) key lessons related to the incorporation of ILK into the case studies; and (e) the challenges identified within studies incorporating ILK.. These themes or categories represent the breadth of thematic coverage related to ILK, landscape approaches and collaboration relevant for this review. Through this process we were then able to uncover some of the lessons for the effective integration of ILK into landscape and climate change studies.

3. Results and Discussion

3.1. What Are the Characteristics of the Selected Landscape Studies That Integrate ILK?

We found that there has been a gradual increase over time in landscape level studies that include reference to ILK and local perspectives. Sixty-six (81%) out of the eighty studies reviewed were published within the last decade, with more than half (56%) being published within the last five years. These studies have been undertaken mainly in Africa, Asia and South America (accounting for more than 70% of the reviewed studies) with some collaborative efforts between developing and developed regions (about 30%) (Figure 2). While donor funded projects dominated the case studies reviewed, it was not clear how 34% of the studies were enabled, while projects without clear donor funding support (individual funded research) made up 14% of the selection.

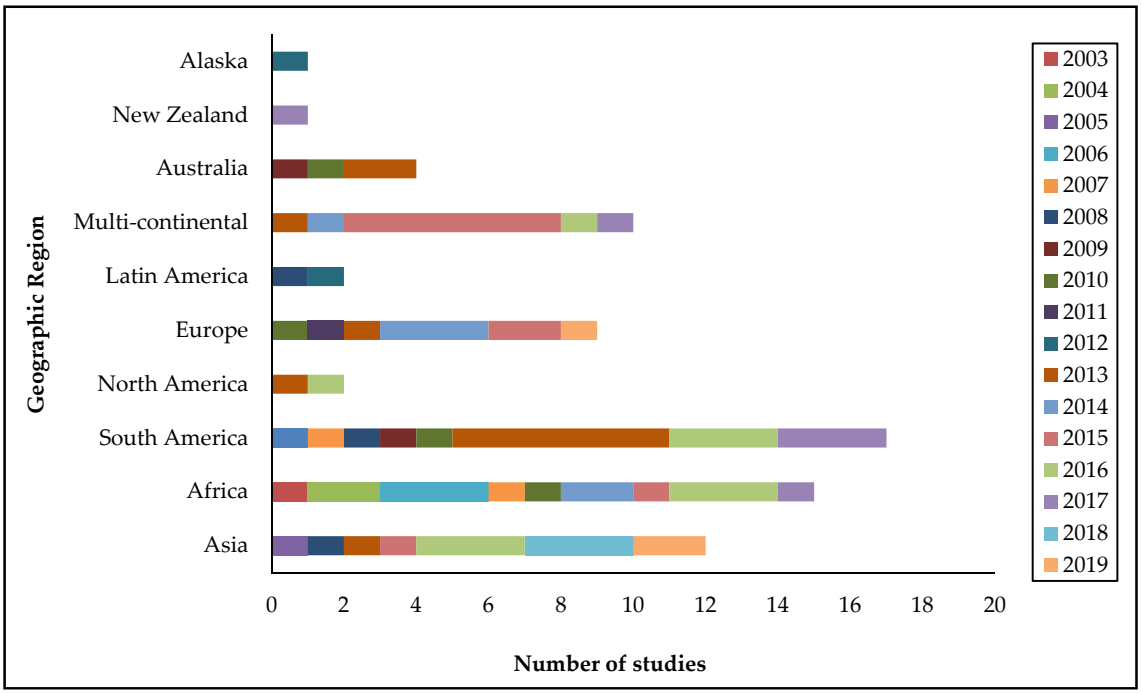

Figure 2. Number of studies per geographic region according to their year of publication.

The landscape studies over the review period had varying objectives, which are reflected in several prominent landscape level research themes and areas of scientific research. For more than 50% of the reviewed studies, ILK was associated with themes such as land use and ecosystem diversity and/or services; rangeland and other types of natural resource management; power relations in planning

processes; the incorporation of local perspectives and knowledge into community development plans; social networks and resilience in rural settings; and lastly understanding how cultural resource management has evolved over the years, as well as best practices for landscape management and sustainable farming systems.

The main areas or fields of scientific research that the publications covered (for both rural and urban landscapes) are presented in Table 1. These fields included agricultural systems (27%), followed by social-ecological systems (25%), indigenous governance (15%) and natural resource management (15%), conservation and protected area management (12%), and disaster risk reduction and climate change studies, especially those related to early warning systems (8%).

Table 1. Areas of scientific research with ILK incorporation.

Area of Scientific Research Related to Landscapes	Research Focus	Representative Studies
Agricultural systems	Agricultural systems studies document traditional knowledge and practices in agriculture. These studies highlight issues related to ILK in relation to plants (including medicinal plants) and animals with their uses.	Tashiro et al. (2019); Carney and Elias (2006); Tenza et al. (2017); Nawe and Hambati (2014); Davies et al. (2014); Divya et al. (2015); Agnoletti et al. (2015); Assefa and Hans-Rudolf (2017); Neto et al. (2013); Hart and Vorster (2006); Kunwar et al. (2016); Mapinduzi et al. (2013); Epule and Bryant (2016).
Conservation and protected areas management	Studies related to this theme focus on ecological knowledge and its place in the community, as well as the relationship between knowledge transmission and biodiversity and protected area management.	Doumbia (2006); Dudgeon (2005); Frost et al. (2015); Wehi and Lord (2017); Fauchald et al. (2013); Linstädter et al. (2016); Boillat et al. (2013).
Indigenous governance	Indigenous governance covers governance responses to socio-ecological risk. It focuses on habitat conservation and how indigenous local experts develop environmental policy goals based on their traditional knowledge for management of habitat change.	Freeman et al. (2015); Förster et al. (2015); Eilola et al. (2014); Kebbede (2010); Beilin et al. (2013); Gu and Subramanian (2014); Horstkotte et al. (2014); Bardsley and Bardsley (2014); Lamarque et al. (2014)
Disaster risk reduction and climate change studies	Studies falling into this theme were related to understanding early warning systems for disaster risk reduction under changing climate. These studies explore responses based on how traditional knowledge and local practices are being used to cope with climate change.	Franco-Maass et al. (2016); Gómez-Baggethun et al. (2010); Mathez-Stiefel et al. (2017); Boillat and Berkes (2013); Riva et al. (2013)
Natural resource management	The natural resource management related studies focused on the application of ILK in relation to natural resource management. These studies seek to establish resilient natural resource use and management including forest reserves through the integration of ILK.	Mala & Oyono (2004); Uprety et al. 2016; Cumming et al. (2015); Wohling (2009); Giannecchini et al. (2007); Chazdon (2009); Diaz et al. (2016); Leys and Vanclay (2010); Abate (2016); Castella et al. (2013)
Social-ecological systems	SES studies focus on societal transformation, social-ecological resilience, and perceptions in shaping rural livelihoods and human development. Studies broadly cover sustainable pathways of change incorporating indigenous beliefs and cultural observations into linkages between people and ecosystems.	Feola (2015); Heidi and Eakin (2008); Stone-Jovicich (2015); Schönenberg et al. (2017); Delgado-Serrano et al. (2016); Oteros-Rozas et al. (2013); de Vingo et al. (2019); Valdivia et al. (2010); Ortega-Huerta et al. (2007); Oteros-Rozas et al. (2015); Stump (2013); Walter and Hamilton (2014); Raffles (1999); Von Glasenapp (2011); Bruun and Olwig (2015)

Our findings suggest that there has been increased interest in scholarship related to the integration of ILK and local perspectives into more equitable and resilient landscape management over the last 10 years. This is encouraging, and somewhat expected, as ILK's importance in landscape, biodiversity conservation and natural resource management has received much attention in recent years in high level processes and documents such as those produced by IPBES, IPCC and UNFCC. These documents recognize the dynamic contribution of ILK in advancing climate resilience, biodiversity monitoring and recovery efforts among others. As a result, we are seeing more mention of ILK in landscape governance approaches across a range of landscapes, whether urban or rural or focused on conservation and ecosystem services or sustainable agriculture. The dominant focus on agricultural and social-ecological systems in our result suggests that there is a need to enhance ILK incorporation into the design and implementation of research related to protected area management as well as early warning systems for disaster risk reduction and climate change adaptation. Since ILK comprises knowledge of the local environment held collectively by landscape residents [39], it is increasingly being seen as essential for encouraging collaboration and for seeking bottom-up and locally relevant solutions to landscape and climate change challenges. Many communities, especially in rural areas, employ ILK extensively in their day-to-day lives, given their dependence on natural resources for their livelihood security. Their knowledge is connected, diverse and is about human and non-human aspects of the local landscape [30]. This is acknowledged across all the studies we reviewed, where we have also seen evidence of a growing interest in linking knowledge systems and livelihood strategies, which, in turn, link to landscape use and management. The interconnection between people, their livelihoods and their landscapes, as well the ecosystem services received from these landscapes featured strongly in all the studies we reviewed.

3.2. How Has ILK Been Identified and Integrated into Landscape Studies?

We identified several ways in which ILK has been explored and incorporated into landscape-level studies and implementation designs. Most studies (75%) employed mixed methods (both quantitative and qualitative approaches). Only 2% used solely quantitative methods, while 23% used only qualitative methods. Quantitative methods are usually adopted by studies using more top-down approaches. Moreover, quantitative methods with their scaling up potential are not necessarily fully accepted by indigenous people and local communities [21]. Only 13% of the studies we reviewed mentioned collaboratively co-producing knowledge to address identified knowledge gaps. We then distilled out various means by which researchers engaged with indigenous and local people. The engagement processes included a combination of consultation with experts and stakeholders, key informant interviews, focus group discussions, multi-stakeholder workshops, participatory processes (e.g., using participatory learning and action tools), households surveys and transect walks with local community members. Since the majority of the studies were conducted at the local level, the stakeholders or actors involved in the engagement processes for exploring ILK comprised primarily of recognized, knowledgeable individuals or experts from the community (e.g., farmers, community elders, persons over 65 years) as key informants. A few of the studies used relatively sophisticated methods. For example, Garnett et al. [32] used a spatial mapping technique to estimate the contribution of indigenous peoples and local communities to the protection and maintenance of biodiversity and provided an overview of the global importance of indigenous lands for conservation. Quantitative methods that are appropriate for cross-cultural use such as GIS mapping [40,41] and statistical analysis [42] also exist. Participatory GIS mapping can be used to capture differentiated views regarding boundaries and to calculate land area under different forms of management, as well as identify culturally important sites.

Our results reveal an acknowledgement and effort within the last two decades towards researching landscapes alongside diverse partners and knowledge holders, including local communities. A wide range of methods and tools have been used across the studies to engage with stakeholders and to draw out ILK related to the landscape and its components. Furthermore, in many of the studies a

diverse range of stakeholders and community members were engaged. Such engagement, with a range of different actors, can stimulate greater mutual learning and openness to alternative perspectives and worldviews. This, in turn, can facilitate enhanced knowledge and understanding of local landscapes, result in higher quality research and ultimately encourage improved governance outcomes. Each stakeholder should be able to bring their own knowledge content, knowledge producing processes and underlying beliefs to the table. Exchange of knowledge across different stakeholders is considered fundamental to achieving sustainable results [34]. To safeguard the legitimacy of the knowledge and of participating knowledge holders, the knowledge content needs to be analyzed, such that one form of knowledge is not favored or seen as more legitimate than another. This can often be best achieved in a co-production process. However, we found that very few of the studies specifically mentioned employing a knowledge co-production process in which different stakeholders are brought together in the same space. Evidence related to the principles of a landscape approach stress the need for collaboration [34]. Future studies need to include methods that enable a collective process of knowledge production, which, in turn, can facilitate relationship building, shared activities and knowledge exchanges to produce rich evidence that will have significant landscape impact and buy-in.

3.3. What Are Some of the Challenges for Effective Integration of ILK into Landscape Studies and Approaches?

Our review has revealed that integration of ILK into landscapes management and governance is not without its challenges. From the studies reviewed, 32 publications (40%) highlighted challenges that could hinder sustainable incorporation of ILK into landscape governance and management. These challenges were grouped as follows: continued limited recognition of the values and rights of ILK systems (42%); overlooked opportunities for cross-scale interactions (32%); and declining knowledge on ILK systems (26%).

Several of the studies reviewed mentioned that too little attention has been paid to preserving cultural traditions among communities and their landscapes, particularly in the face of development pressures, and this is resulting in a loss of ILK (e.g., [5,43–46]). One of these studies reported that, development interventions and market forces have dissipated traditional culture and social capital [47]. Others alluded to the inadequate representation of local actors in transdisciplinary studies on landscape management and therefore limited recognition of the value these actors can bring [48–51]. Project structures and approaches do not always adequately cater for all relevant actors' involvement, hence limiting the recognition of ILK and its potential contribution to landscape management and governance [51].

In relation to the challenge related to inadequate cross-scale interactions, several studies highlighted issues such as insufficient development support for ILK (e.g., [44,52–55]) as well as rigid management and governance structures that constrain institutional arrangements that could support ILK interactions across scales [56–59]. One study stressed that while ILK is recognized as essential at the local level for supporting communities' capacities to adapt to changing environmental conditions, this is underappreciated at the national level [60].

Regarding declining knowledge on ILK systems, some of the studies reviewed ascribed the increasing use of modern technologies, linked to a declining trend in natural resource availability (e.g., [61–63]), and fragmented knowledge [55,64,65], with a resultant decline in traditional practices, as reasons for the erosion of ILK. However, these are not the only factors. We found from other studies, such as that by Grenier [66], that rapid population growth, growth of international markets, changing educational systems, environmental degradation, and development processes including pressures related to rapid modernization and cultural homogenization all play a critical role in the loss of ILK.

The limited recognition of the value of ILK identified from our review may be due to poor stakeholder engagement efforts or inadequate attention to innovative ways of incorporating ILK into study designs. Other factors discussed in other literature may also be important. For example, MacGregor [7] reflected that indigenous and local people may be wary of participating in some studies or projects because of a history of exploitation, lack of recognition and respect for their values and

rights, and a lack of safeguards for the control and proper use of their knowledge. Other scholars have divulged how some ILK may be intentionally withheld as its considered secret or private within certain spaces [21]. As explained by Bohensky [67], parallel integration and/or co-production of knowledge between disparate knowledge systems is needed. However, integration needs to be done in a way that does not lead to diminution of the integrity of either form of knowledge or cause harm to knowledge holders themselves, but rather sets out responsibilities in a transparent and accountable manner. To ensure recognition of the value and role of ILK in landscape approaches, future studies need to identify and give much more ethical attention and respect to local practices and beliefs as well as 'sacred' knowledge systems that offer support for landscape protection and management.

The issue of ineffective cross-scale interactions can be difficult to address. Other studies we consulted also show that the design of response management at the national level is such that government structures often view ILK as competing with development support programs [3,19,52]. Thus, aligning national programs with the objectives of local and indigenous communities seldom happens. Consequently, this deflects attention away from support for ILK, local practices and the rights of indigenous people [19]. ILK matters in landscape approaches, hence recognition of its relevance at multiple levels is important and should be encouraged to avoid loss of validity among local knowledge holders and to improve landscape management. Specifically, we suggest that national programs should also co-opt indigenous and local values and knowledge into their programs to effectively gain some level of cross-scale interaction (local, regional and national levels) and support.

Given that there is evidence that ILK is being lost, protecting remaining ILK is thus critical [7]. The call to include ILK as an integral component of environmental and landscape governance and management in order to influence decisions that affect ILK and enhance its protection has been emphasized by numerous scholars [7,21]. Our review also suggests increased inclusion of local information and traditional practices in future landscape studies and projects will not only enhance landscape management, but also help ensure preservation of ILK.

3.4. What Factors Enable and Support ILK Integration in Landscape Studies and Approaches and What Are Some of the Lessons Emerging from the Reviewed Publications?

In-depth examination of the main findings, conclusions and recommendations of the reviewed studies revealed a set of factors that relate to the successful integration of ILK into landscape approaches. These included: inclusivity; use and transmission of ILK in landscape management; integrated and holistic landscape management; consideration of stakeholder's perceptions; contextual understanding; working with society; acknowledging cultural capital; and recognizing multiple sources of knowledge related to landscape change and management. These concepts mirror the principles outlined in the landmark paper by Sayer et al. [34] regarding the conditions required for successful landscape management. Lessons related to the incorporation of ILK have been drawn from several of the reviewed studies that have specifically advanced integration of ILK and are summarized in Table 2. They highlight the value that ILK can bring to landscape management.

From the review we found that participatory research activities and approaches that (a) incorporated ILK; (b) upscaled local approaches; (c) incorporated in-depth knowledge and perspectives at a local level; and (d) co-designed activities with relevant stakeholders (reflecting elements of inclusivity) all contributed to developing more inclusive and sustainable landscape management [56,68,69]. We also found that using integrative approaches (such as having explicitly defined objectives for inclusion of local people, processes for collaborative participation, and trans-disciplinary/cross-sectoral approaches) for addressing landscape management had various benefits. These benefits included the potential for stakeholders to better understand each other [53]; management of the local environment towards more favourable long-term outcomes [70]; and the ability to better address the inherent complexity of landscape management [53]. Results from the review further showed that identifying and considering local peoples' needs, priorities and knowledge resulted in a positive feedback loop between ecosystem health and landscape management decisions that favours sustainability [71]. Tenza and colleagues in

two separate studies [65,72] showed that consideration of stakeholders' perceptions and views beyond initial consultations offered impetus for action and raised the prospect for indigenous communities to retain both their cultural and biological diversity. One of the most effective ways identified for supporting ILK integration in landscape approaches is acknowledging cultural capital through recognition of cultural and traditional values and co-opting the values which stimulate strong community support for projects [49,52,73]. Another concept that supported successful ILK integration in landscape studies was recognition and appreciation of multiple sources of knowledge for landscape management. For instance, a study by Assefa and Hans-Rudolf [74] showed that, by integrating local expert knowledge and realities with scientific knowledge, sustainable agroecological farming practices, which were well adapted to local conditions, could be promoted. Other benefits identified from the integration of ILK with scientific approaches included the design and implementation of socially acceptable resource management systems for long-term sustainability [75], and recognition of the dynamism of indigenous knowledge as an adaptive asset mitigating human and non-human environmental changes [48].

Table 2. Summary of key success factors, concepts and lessons from landscape studies that have integrated ILK.

Key Lessons on Integration of ILK from Reviewed Studies	Representative Studies
a. Recognizing holistic management and restoration of the integrity of ecosystems that will benefit humans through the provision of resources that are important for them.	Dudgeon (2005).
b. Understanding that indigenous people (description of gender-specific knowledge and expertise) understand their context and have valuable knowledge and perceptions of changes in the landscape.	Glasenapp et al. (2011); Doumbia (2006); Carney and Elias, M (2006)
c. Recognizing that operation and application of indigenous knowledge needs to occur at multi-scalar levels.	Sharma et al. (2015).
d. Recognizing that local knowledge can be valuable in enhancing adaptive responses to landscape change.	Boillat and Berkes. (2013); Nawe and Hambati (2014)
e. Appreciating that traditional ecological knowledge has been historically instrumental in ensuring biodiversity conservation and enhancing local livelihoods. It remains an important asset for resilience of farmers and for responding to climate change and other social-ecological shifts.	Ruiz-Mallén and Corbera (2013); Riva et al. (2013)
f. Acknowledging that rural communities possess extensive knowledge of their land resources and listening to their perspectives.	Nawe and Hambati (2014)
g. Involving stakeholders in the research process provides voice to multiple perspectives on social-ecological futures.	Balvanera et al. (2017); Oteros-Rozas et al. (2015)
h. Integrating both local and/or indigenous and scientific knowledge can greatly contribute to the process of landscape resource management.	Mathez-Stiefel et al. (2017); Wehi and Lord (2017)
i. Inter and trans-disciplinary research inevitably leads to extraordinary and inclusive communication efforts.	Schönenberg et al. (2017); Stone-Jovicich and Samantha. (2015)
j. Multiple factors, that need to be understood, are contributing to decline in traditional knowledge and practices.	Atreya et al. (2018)

3.5. What Are the Knowledge Gaps and Directions for Future Research in Landscape Studies?

Despite the discussion above regarding the importance of collective knowledge production, in our review we found few studies that actively attempted to co-produce knowledge with local communities over the review period (13%) (see Supplementary Materials, Figure S1). This could be as a result of a

limitation in the literature review process, i.e., not including knowledge co-production as a key search term, or it could reflect that there are still few studies taking this approach. Knowledge co-production as a core approach in landscape-level work appears to be still gaining traction; the only studies referring to co-production in our selection were recent. Another notable gap in research on ILK identified from the review is the limited number of landscape studies that address climate change as a key entry point or core theme (8%). Although reference is made to ILK in all the studies reviewed, details of the experiences and relationships between people, place and governance structures, including between actors/partners in a specific case study or project and participating communities and organizations were limited. Few of the studies provided specifics on socio-cultural and ecological influences on the landscape, local behavior and gendered perspectives, among others. An improved understanding of the relations between different people and their places could result in a richer appreciation of local practices and cultural norms important for landscape management [76].

The three gaps mentioned above need greater attention in future studies. There is clearly an opportunity for future studies to enhance dialogue between key stakeholders through more collaborative learning and sharing. To achieve this, Austin and colleagues [21] suggest the need to empower indigenous and local knowledge holders to mobilize their knowledge for more context relevant understandings and outcomes from case studies. A collaborative knowledge production effort adds new perspectives to address contemporary ecological and social challenges [25,77]. Similarly, through collaborative processes it is possible to explore differences in knowledge holdings between different stakeholders and the implications these differences have for their working relationships. Since it is crucial to mobilize all available knowledge [21], engagements that facilitate the expression of multiple forms of knowledge are encouraged. We urge future studies to consider creative ways of fostering dialogues and collecting stories that help provide a more relational picture of the landscape and its residents [78].

Just as ILK is increasingly seen as critical for resilient landscapes, so should an understanding of the impacts of climate change and possible solutions to these impacts. This cannot be done without including indigenous and local people's knowledge and understanding of the changes taking place and the practices they have employed in the past. Warming temperatures, floods, droughts, increasing sea levels with resultant disappearance of food sources, wildlife extinction, economic losses, climate-related diseases with negative effect on livelihoods, among others, are the consequences of climate change. Climate change disproportionally affects the poorest and most marginalized communities living in vulnerable regions, among them indigenous people, whose livelihoods depend on natural resources [79]. According to Nakashima et al. [80], indigenous peoples' knowledge can provide important insights into the processes of observation, adaptation and mitigation to such climate change consequences. Traditional knowledge of agriculture and local ecosystems could be an invaluable adaptation tool for indigenous and local peoples, hence future studies should explore ILK to drive climate adaptation at the landscape level.

4. Conclusions

Our review shows a growing interest in research related to the integration of ILK in landscape approaches. Studies that explore such integration are likely to continue as the value of ILK in biodiversity conservation, landscape management and climate change adaptation is further promoted through global mechanisms such as the UNFCCC, IPBES, UNEP and UNESCO (through their Man and Biosphere Reserve program). We found several research themes and fields represented in the case studies we reviewed, with a predominance of studies related to agricultural systems, followed by social-ecological systems, indigenous governance, natural resource management, biodiversity conservation and climate change studies, especially those related to early warning systems for disaster risk reduction. The low number of studies specifically addressing climate change suggests the need for more research at the nexus between ILK, climate change and landscape governance and management. Local landscape users have intimate knowledge of any changes in their environment and landscapes, as well as

knowledge of past and contemporary practices for dealing with some of these changes. Such ILK could play an important role in fostering more climate resilient landscapes. We also found that many of the studies we reviewed were conducted in the global south where some of the greatest landscape challenges are found. Moreover, there is strong support and funding for practical work in landscape management in regions like Africa, Asia and South America. The dominance of donor funding for the case studies, suggest that many of the studies may be linked to implementation projects. This is typical of transdisciplinary research that aims to work closely with stakeholders.

We found several factors that supported or created challenges to the integration of ILK in landscape approaches. Important challenges such as ineffective cross-scale interactions, incomplete representation of key stakeholders/actors in projects and minimal attention paid to local practices and rights of indigenous people were identified. Systematically untangling these components and engaging in best practice towards knowledge integration will help towards paving a more inclusive way forward in the application of the landscape approach. Our review demonstrated that this might be done by improving engagement between scientific knowledge and ILK through methodologies that bring different stakeholders into the same space. Other potential enablers could include supporting the development of strategies to empower marginalized communities; promotion of social learning based on experiences of past events among local communities; co-production and co-management of knowledge systems for landscape studies; adaptable and inclusive governance systems to facilitate collaboration; and a holistic approach to enhance ecosystem resilience and inclusive sustainable knowledge transfer (see Supplementary Materials, Table S1). Recognizing that one of the major objectives of the landscape approach is to effectively inform the co-design and implementation of future landscape management strategies and governance systems, then there is need to promote a holistic methodological framework that (a) evaluates all forms of knowledge (scientific and traditional knowledge), (b) considers any potential trade-offs, (c) supports decision-making that includes multiple perspectives, and finally (d) enhances engagement of indigenous people and their knowledge in new knowledge creation. Without this systematic inclusion of ILK in landscape management it may prove difficult improve ecosystem health, climate resilience and livelihoods.

In conclusion, our review has demonstrated the growing importance of multi-stakeholder collaborations in local landscape research and the promotion of inclusive consultations that have helped to bring ILK to the fore in the knowledge development process. This, in turn, can support improved landscape management, governance and planning for more climate resilient landscapes. However, more research is needed to explore ways to more effectively link ILK and scientific knowledge in landscape studies through collaborative, knowledge co-production processes that give specific attention to the voices of local land users and other stakeholders. Furthermore, more systematic documentation of the experiences, learning and relationships built through such processes and how these influence landscape governance and management is required. Lastly, more studies that confirm the usefulness of ILK, recognise multiple landscape values and their interaction with structures and policies dealing with landscape management and governance are necessary for wider adoption of landscape approaches that incorporate ILK as a key element.

Supplementary Materials: The following are available online at http://www.mdpi.com/2073-445X/9/9/331/s1, Figure S1: Number of studies according to their content in terms of (a) knowledge co-production, (b) collaboration/engagement mentioned, (c) future recommendations given, Table S1: Summary of recommendations from the publications reviewed, Appendix S1: List of publications considered in the review.

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