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Local knowledge and practices among Tonga people in Zambia and Zimbabwe: A review

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ABSTRACT

There is increasing recognition of the role of Indigenous and local knowledge systems in sustainable land use and conservation practices. However, the evidence base remains fragmented, while local knowledge remains marginalised in many national biodiversity strategies and development plans. This applies to the Tonga people of Zambia and Zimbabwe. Here, we synthesise existing evidence of Tonga knowledge and practices to explore their potential contribution to the implementation of integrated landscape approaches that aim to incorporate multiple stakeholders' objectives in landscape-scale management. Based on a semi-systematic literature review, we identify how various dimensions of Tonga knowledge contribute to biodiversity, food security, soil conservation, and other well-being dimensions. Research gaps identified include significantly less documented evidence of Tonga knowledge and practices in Zimbabwe and limited attention to the biophysical impact of local practices on land and natural resources. Furthermore, there is limited attention to the historical processes that have led to the erosion of Tonga local knowledge and the political disempowerment of Tonga knowledge holders. The findings contribute to greater recognition and validation of Tonga local knowledge and practices in natural resource governance, particularly how such knowledge can contribute to integrated landscape governance. Finally, the review helps to define a future research agenda based on the knowledge gaps identified.

1. Introduction

In recent decades, there has been an increasing recognition that more pluralistic and integrative strategies for environmental governance are needed (Zafra-Calvo et al., 2020; Pascual et al., 2021). Such approaches seek to build collaborations between stakeholder groups and reconcile different knowledge systems to develop new transdisciplinary ways of tackling interrelated social and environmental challenges (Djenontin and Meadow, 2018; Turnhout et al., 2020). Collaboration that better integrates Indigenous and local knowledge (ILK)[1] is often considered more effective for achieving local adaptation to global environmental change processes (Turnhout, 2012; Uprety et al., 2012b; Gómez-Baggethun et al., 2015; Reyes-García and Benyei, 2019), enhancing biodiversity and forest conservation (Garnett et al., 2018b; Reyes-García and Benyei, 2019; Fa et al., 2020) and improving sustainable land and natural resource management more broadly (Turnhout et al., 2012; Franco-Moraes et al., 2021). As such, a growing number of global organisations, policy negotiations, and reports are beginning to recognise the contribution of ILK to conservation and development (IPBES, 2019, 2021); see Table S1 in the supplementary material for an overview).

Within the current global policy discourse, the 30 by 30 initiative, Global Deal for Nature (GDN), the Bonn Challenge, and the Half-Earth initiative are gaining momentum with support from numerous international organisations and governments (Wilson, 2016; CBD, 2019; Dinerstein et al., 2019; Schleicher et al., 2019). However, a greater understanding of the interconnection between species, habitats, and human populations and activities is required to pursue effective and ethical conservation. It is, therefore, crucial to consider the impact that such global initiatives could have on Indigenous People and Local Communities (IPLCs). For instance, Schleicher et al. (2019) caution that the Half Earth proposal to protect half of the planet would affect more

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[1] See next section for definition.

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than one billion people currently living within those areas. Similarly, Mehrabi and colleagues (2018) estimate that "globally 15–31% of cropland, 10–45% of pasture land, 23–25% of non-food calories, and 3–29% of food calories from crops could be lost if half of Earth's terrestrial ecoregions were given back to nature" (Mehrabi et al., 2018, p. 1). Given that these proposed strategies will clearly impact IPLCs, the Rights and Resources Initiative (RRI, 2020) argues that allowing the estimated 1.6–1.9 billion forest-dependent people to govern and protect their customary territories and lands, via a rights-based conservation approach to implementation becomes an essential prerequisite (RRI, 2020). Hence, a better understanding of the role of IPLCs and how their knowledge and practices might inform conservation planning is needed. However, the representation of ILK in research, academia, and environmental governance has, thus far, been limited (Gorman et al., 2020).

Processes that attempt to reconcile scientific and ILK (i.e., knowledge co-production) often fail due to the difficulty of addressing power dynamics in a context where scientific expertise is deemed to have greater authority than other knowledge systems. This results in the depoliticisation (having no political recognition and power) of knowledge reproduction and ignorance of the differences between knowledge holders and their beliefs, interests, and positions (Turnhout et al., 2020). Moreover, neither scientific nor ILK is consistently ecologically effective. Indeed, if ILK can become maladaptive and lose relevance over time (Uprety et al., 2012), so too can established scientific knowledge or fact equally be debunked (Hardin, 1968; Ostrom, 1999; Charnley et al., 2007; Berkes, 2010). However, in part due to the tension between the growing acknowledgement of ILK and its poor integration in natural resource governance in practice, the evidence base on the utility of ILK in sustainable landscape management is inconsistent, fragmented and in many areas not well established, with only recent evidence being reported (Reyes-García et al., 2016).

The fragmented evidence base applies to the environmental knowledge and practice of the Tonga, a Bantu-speaking people living in Zambia and Zimbabwe. Although they have maintained their knowledge system across generations, there is scant evidence on Tonga land-use knowledge and practices and their environmental impact. The most recognised research on the Tonga was conducted in the 1970–1980 s by the American anthropologist Elizabeth Colson (Colson, 1970, 1986, 1997, 2000). Given Zambia's recent commitment towards more inclusive and equitable land management strategies (O'Connor et al., 2020) and the adoption of Act No. 16 "to provide for a transparent legal framework for the protection of, access to, and use of, traditional knowledge" (Government of the Republic of Zambia 2016, p. 451), there is an urgent need to update and synthesise existing knowledge on how the Tonga have managed natural resources and interacted with the environment over time. Against this background, we aim to present a synthesis of the contemporary literature on the knowledge and practices of Tonga people and how these affect their environment and livelihoods. We do so within the framework of a broader initiative to operationalise integrated landscape approaches in Zambia[2] based on meaningful, respectful collaborations between IPLCs, government agencies, researchers, and other landscape actors. The ultimate aim is to assess the value of local knowledge for landscape resilience and sustainability and the potential for more equitable knowledge exchange and production processes within integrated landscape governance (Gómez-Baggethun et al., 2013; Garnett et al., 2018b; Reyes-García and Benyei, 2019; Fa et al., 2020; Franco-Moraes et al., 2021). More broadly, this paper aims to contribute to the global debate on the role and significance of local knowledge and practices in achieving global sustainability (Adom, 2016; Magni, 2017; IPBES, 2019; Williams et al., 2020).

The rest of this paper is structured as follows. The next section situates the ILK concept in the broader literature. We then briefly describe the history of Tonga people and the area where they live. After explaining the methods applied for the semi-systematic literature review, we present the synthesis of reviewed papers across six dimensions. The final section discusses the implications and limitations of the review, after which we conclude the paper with suggestions for future action and research.

2. Materials and methods

2.1. A semi-systematic literature review

This paper uses a semi-systematic literature review to collect, analyse and synthesise data on Tonga people's knowledge and practices related to land use and natural resource management. There is no clear definition of a semi-systematic review, but the methodology is midway between a systematic literature review and a rapid review (see Table S2).

2.2. Review questions

The review addresses two main questions:

1. What local knowledge and practices do Tonga people hold and apply to manage and conserve their environment?
2. How have these practices affected their biophysical environment?

2.3. Defining search terms and search strategy

We selected the Scopus, ISI Web of Knowledge and Google Scholar databases for the literature search. The search terms and Boolean operators were Tonga AND (Zambia OR Zimbabwe). Searches were conducted in the English language only. The ISI Web of Knowledge and Scopus yielded 83 and 102[3] entries published between 1975 and 2020.[4] Google Scholar was screened to identify additional literature of relevance. This was done until saturation, i.e., until five pages were screened without relevant hits. Fig. 1 provides a Prisma flow diagram of the search and selection process (Moher et al., 2009).

2.4. Defining the scope and inclusion and exclusion criteria

Based on the primary research questions described above, the scope of the review is 1) to synthesise the evidence on Tonga local knowledge and practices related to sustainable land and natural resource management, 2) to identify those beliefs, interventions, and customs that are beneficial to their physical environment and well-being, 3) to discuss the usefulness of local knowledge and practice in the context of integrated landscape approaches.[6] Table 1 describes the inclusion and exclusion criteria used to assess the relevance of articles during the screening process. Titles, abstracts, and full texts of accessible publications were screened sequentially.

2.5. Data analysis

References were stored and analysed in Excel and categorised according to the dimensions in Table S2 in the supplementary material to extract information related to ILK applied to natural resource use,

[2] Collaborating to Operationalise Landscape Approaches for Nature, Development and Sustainability (COLANDS). This initiative, implemented by a broad partnership led by the Centre for International Forestry Research (CIFOR), aims to implement, document and evaluate integrated landscape approaches in Ghana, Zambia and Indonesia (Reed et al., 2020). See: https://www2.cifor.org/colands.

[3] TITLE-ABS-KEY Tonga AND (Zambia OR Zimbabwe).

[4] The first hit in the Web of Science was from 1983.

[6] For literature on integrated landscape approaches see Sayer et al., 2017; Reed et al., 2015; Bürgi et al. (2017); Reed et al. (2017); Sayer et al., 2016.

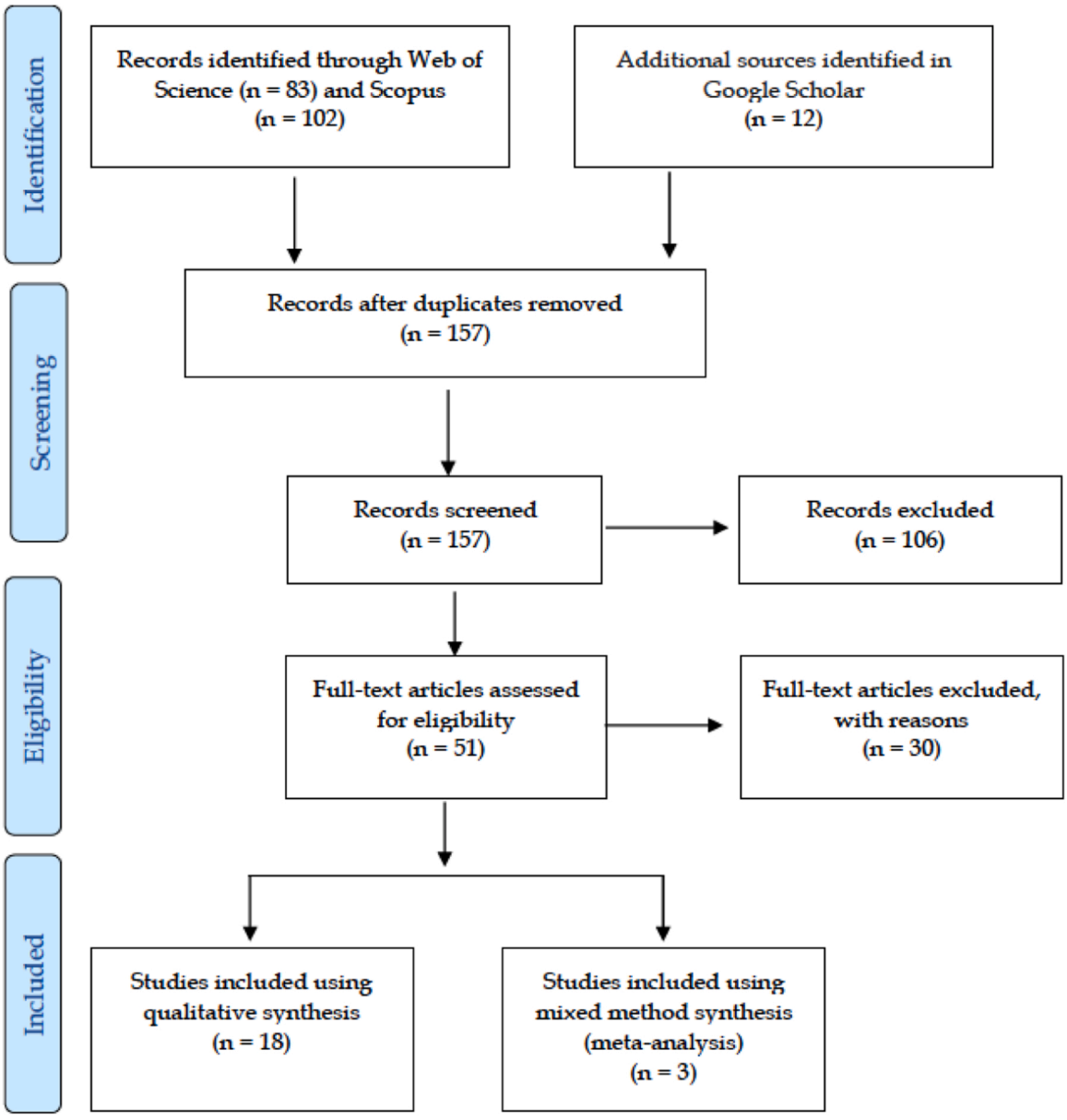

Fig. 1. PRISMA[51] flow diagram showing the document sources, screening process, and output of the literature selection.

management, and conservation. Texts and data were interpreted following the narrative analysis method (Booth et al., 2014; Tricco et al., 2015).

3. Indigenous and local knowledge: terminology and interpretations

Indigenous and local knowledge (ILK) has been variably defined and applied in different disciplines (McGregor, 2004; Tengö et al., 2017; Sharma-Wallace et al., 2018; IPBES, 2019). Table 2 provides an overview of terms widely used for knowledge systems outside the Western scientific realm. In the words of Berkes (in Inglis, 1993), "there is no universally accepted definition for traditional ecological knowledge" (Berkes, 1993, p.3) and scholars, policymakers, and practitioners continue to disagree about which term is the most appropriate. Many studies use the terms in Table 2 interchangeably (Inglis, 1993; Reyes-García et al., 2016; Cebrián-Piqueras et al., 2020), although conservationists and resource managers tend to prefer traditional ecological knowledge (TEK) (Uprety et al., 2012a). Two commonly cited definitions of TEK emphasise the historical dimension of this knowledge and its transmission from one generation to the other (Inglis, 1993; Olson, 2013) (see Table S2). Ecological knowledge (Hardesty, 1977) and local ecological knowledge (LEK) (Olsson and Folke, 2001) rather emphasise the place-based and culturally specific nature of knowledge and beliefs. Indigenous knowledge (IK) (Wilson, 2001; Turner and Berkes, 2006; Thompson et al., 2020) is specific to the knowledge of Indigenous Peoples in their territories, whereas the term Indigenous and local knowledge (ILK) (Wilson and Ballard, 2017a; IPBES, 2019) also recognises local communities as holders of comprehensive ecological knowledge, resulting from long-standing interaction with their environment. As ILK encompasses components of all the other terms in use (TEK, LEK, IK, LK), it is the preferred term in this paper, where we discuss non-Western knowledge systems in general. However, we use "Indigenous" more cautiously in relation to Tonga knowledge, because as a Bantu-speaking people with a history of migration south- and eastwards from Nigeria to Kenya, the Tonga cannot be classified as Indigenous in the same way as the Khoi whom they displaced (Vansina, 1995; Sunderland, 2004). Therefore, we believe that the most

Table 1
Inclusion and exclusion criteria for studies based on the population-intervention-comparator-outcome (PICO) framework (Reed et al., 2014; van Ewijk and Ros-Tonen, 2021).

Criteria	Inclusion	Exclusion
Population	Tonga communities living in Zambia and/or Zimbabwe.	Studies that fall outside of the geographic scope of the region (Zambia and/or Zimbabwe).
Intervention	Tonga knowledge and practices related to natural resource use, management and conservation.	Studies unrelated to local knowledge applications in natural resource use, management and conservation.
Comparator	Studies that compare Tonga knowledge and practices 1) in different geographical settings and 2) through time.	
Outcome	The study demonstrates that knowledge and/or practices have/have not directly or indirectly impacted land and natural resource use and management.	Results that do not demonstrate a linkage between local knowledge and/or practices and nature.
Additional criteria	Articles in English; Narrative review; Empirical data.	Non-English studies; Theoretical studies; Studies focusing on natural sciences, medicinal sciences, biology, engineering, chemistry, toxicology, remote sensing, mining, tourism studies, psychology, and sub-disciplines thereof.

appropriate term for Tonga knowledge and practices is local knowledge.

Building on the definitions in Table 2, we understand local knowledge as a complex system of culturally specific beliefs, taboos and practices that emerged from long-standing interactions with peoples' environment and which has historically evolved and adapted through time, space and (internal and external) influences. To guide the analysis of Tonga local knowledge in this paper, we make use of the dimensions in Table 3. The most straightforward dimension – livelihood traditions – is the set of knowledge and practices that secure basic needs through sustainable natural resource use (Zulu et al., 2019). Next, several dimensions – taboos and beliefs, spiritual values, sacred landscapes and conservation methods – contribute to plant, animal and nature conservation (Escobar, 1984; Boillat and Berkes, 2013; McGregor, 2014; Asselin, 2018; Fa et al., 2020). Finally, there is a set of climate indicators that offer adaptive strategies to deal with climate change. Together, these dimensions illustrate the potential of ILK to contribute to knowledge co-production (Boillat and Berkes, 2013; Needham et al., 2020; Norström et al., 2020b; Turnhout et al., 2020) and more pluralistic approaches to environmental governance (Muradian et al., 2013; Blythe et al., 2018; Lam et al., 2020; Needham et al., 2020; Norström et al., 2020a; Pascual et al., 2021). As such, these dimensions demonstrate the potential for ILK to contribute towards environmental and environmental governance challenges (Thompson et al., 2020).

4. Background: the history and geography of 'the River people'

The Tonga people (also referred to as Batonga) are the main ethnic group in Southern Zambia and Northern Zimbabwe, with a small group living in Mozambique. They identify as *Bazlwizi*, 'the River People' (Thomson and Bennett, 2005) and their language (ChiTonga) is spoken by about 1.38 million people in Zambia and 300,000 in Zimbabwe. In the pre-colonial period, the Tonga people lived relatively isolated along the Zambezi river, organised as a stateless society (Thomson and

[5] PRISMA = Preferred Reporting Items for Systematic Reviews and Meta-Analyses (Moher et al., 2009).

Table 2
Terminology and definition of Indigenous and local knowledge.

Terminology	Definitions	References
Ecological knowledge	"The study of systems of knowledge developed by a given culture to classify the objects, activities, and events of its universe"	(Hardesty, 1977, p. 291)
	"(…) ecological knowledge is used in this sense of knowledge of the land. It is a fairly broad consideration of ecology, but not broad enough to encompass all aspects of knowledge"	(Berkes, 1999, p. 5)
Traditional ecological knowledge	"TEK is a cumulative body of knowledge and beliefs, handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and their environment. Further, TEK is an attribute of societies with historical continuity in resource use practices; by and large, these are non-industrial or less technologically advanced societies, many of them Indigenous or tribal."	(Gadgil et al., 1993, p. 151)
	"Knowledge that has a patterned distribution […], is about how to interact with the local environment, [and which] is shared by members of the same cultural group, and is transmitted across generations."	(Olson, 2013, p. 141)
	"Traditional Ecological Knowledge (hereafter TEK) consists of the body of knowledge, beliefs, traditions, practices, institutions, and worldviews developed and sustained by Indigenous, peasant, and local communities in interaction with their biophysical environment."	(Gómez-Baggethun et al., 2013, p. 2)
Local knowledge	"Appropriators who have lived and appropriated from resource system over a long period of time have developed relatively accurate mental models of how the biophysical system itself operates, since the very success of their appropriation efforts depends on such knowledge. They also know others living in the area well and know what norms of behaviour are considered appropriate by this community."	(Ostrom, 1999, p. 526)
Local ecological knowledge	"Local ecological knowledge (LEK) is knowledge held by a specific group of people about their local ecosystems. Because it is labelled "ecological," it concerns the interplay among organisms and between organisms and their environment. LEK may be a mix of scientific and practical knowledge; it is site-specific and often involves a belief component. LEK differs from traditional ecological knowledge (TEK) in the sense of historical and cultural continuity of resource use."	(Olsson and Folke, 2001, p. 87)
Indigenous knowledge	"A way of knowing that has evolved from the relationship between many generations of Indigenous people and their traditional territories."	(Thompson et al., 2020, p. 1)

(*continued on next page*)

Table 2 (*continued*)

Terminology	Definitions	References
Indigenous and local knowledge	"Local and Indigenous knowledge refers to the understandings, skills and philosophies developed by societies with long histories of interaction with their natural surroundings. For rural and Indigenous peoples, local knowledge informs decision-making about fundamental aspects of day-to-day life."	(Wilson and Ballard 2017b, p. 5)

Table 3
Dimensions and definitions of Indigenous and local knowledge.

Dimension	Definition	References
Livelihood tradition	Set of activities and knowledge that secure basic needs through sustainable resource use.	(Zulu et al., 2019)
Taboos and beliefs	Taboos are informal norms that determine human behaviour. Beliefs are structured observations that produce knowledge. They are typically based on empirical observations by individuals or generalised observations based on personal experience reinforced by shared experience, stories, and instructions, as well as oral history and customary teachings.	(Berkes et al., 2000; Colding and Folke, 2001)
Sacred landscapes	Restricted places with cultural significance confined either to a certain clan, family or individual's attachment to a forest resource.	(Kangwa, 2014; Kanene, 2015; Siwila, 2015)
Conservation methods	Information about past and current use of the environment (e.g. land uses and occupancy, harvesting level, etc.).	(Kanene, 2016)
Spiritual values	Spiritual values are a way to deal with uncertainty. Values translated into actions and activities confined to a certain community, family or individual's attachment to a forest resource.	(Berkes et al., 2000)
Climate indicators	Local observations of the effects of climate change on the biophysical and social systems made by individuals with a long history of environmental interaction	(Reyes-García et al., 2016)

Bennett, 2005; Kangwa, 2014). The Shona ethnic group refers to them as the Tonga, meaning 'people who rebel against their Chief' (Kangwa, 2014).

Prior to the construction of the Kariba Dam, the Tonga mainly practised flood retreat cultivation in their *incelela*, small plots of land along the riverbank. These plots had mineral-rich soils (Thomson and Bennett, 2005), and their system provided multiple benefits allowing the population to cover their basic needs and harvest twice a year (Thomson and Bennett, 2005). However, incursions by neighbouring ethnic groups, such as Lozi, Kololo and Ndebele, negatively impacted human activities and cattle population (Dixon-Fyle, 1976; Murphy, 2003; Thomson and Bennett, 2005).

In the 1950s, the construction of Kariba Dam began to provide electricity but led to resettlement, resulting in further impoverishment (Dixon-Fyle, 1976; Thomson and Bennett, 2005; Baudron et al., 2007; Moorsom, 2016). The construction of the dam was a real divide among Tonga families, *"who were not happy to leave the valley"*, affecting their livelihoods and traditions (Thomson and Bennett, 2005, p. 8). Although the dam was built to provide electricity in Zambia and Zimbabwe, up to today, Tonga people have scarce access to electricity.

During the colonial and post-colonial periods, the development strategies also impacted the Tonga people in Zimbabwe. The Southern Rhodesian government displaced the Tonga minority from the ecologically rich Zambezi River plains between 1956 and 1959 to construct the Kariba Dam shared with Zambia (Mashingaidze, 2013). Binga District was deeply affected, and the area suffered from severe food crises at the end of the colonial period. The consequences of such a big development intervention are still being felt in the district, with Tonga people experiencing several cycles of access and alienation from the government, development organisations, and host populations.

Zambia gained independence in 1964, leading to another series of structural changes. The Zambian government needed to reconsider and reconfigure the past colonial system and its effects, particularly in rural areas (Dixon-Fyle, 1976). One of the first measures the government adopted was to modernise the agrarian system by introducing maize control boards (MCBs) that provided small-scale Zambian farmers with inputs such as fertiliser and hybrid seeds and encouraged them to practice more intensive agriculture (Dixon-Fyle, 1976). The Tonga people were one of the first ethnic groups to follow the European agricultural model, and their traditional flooded retreat agriculture transformed into cattle raising and maize cultivation, which they still practise today.

Currently, the Tonga people in Zambia live in the area that coincides with the Plateau Tonga and Kalomo District (Fig. 2). Kalomo is one of the thirteen districts of the Southern Province of Zambia with a total population of 258,270 inhabitants. The political administration sees two constituencies and eighteen wards. The customary administration includes three Chiefdoms: Chief Sipatunyana Chiefdom in the South and Chief Chikanta and Chief Siachitema in the Northern parts of the district, respectively. The district is mainly a high plateau with an altitude of 1000–1300 m above sea level. Located 50 km west and with an extension of 162,200 km^2, the predominant vegetation is part of the Kalomo Hills Forest Reserve (the Miombo, Mopane and Kalahari woodlands and the Munga and Savannah woodlands). The main land use is agriculture, with a focus on maize and cattle, complemented by the cultivation of groundnuts, cotton, sunflower, and sweet potato (Somanje et al., 2017; Moombe et al., 2020).

In Zimbabwe, the Tonga or BaTonga people live in and around the Binga District, Binga village, on the south-eastern shore of the Kariba area, and other parts of Matabeleland. The population is up to 300,000 and consists mostly of subsistence farmers. Binga was built to resettle the Tonga people when they were forced to leave the area where the Kariba dam was built, and the original territory of the Tonga was flooded as a result. The district is one of the forgotten areas of Zimbabwe, despite its great tourism potential because of the Zambezi River and Kariba Lake and rich wildlife resources. Currently, the Tonga valley can be identified as a place inhabited by a migrant farming community in a *chronic liminality* condition (Cliggett, 2014), which refers to a transitional state characterised by the structural vulnerability of both people and ecosystems.

5. Results

5.1. The evidence base: general characteristics of the included studies

From an initial set of 197 publications, we identified 21 publications of relevance. Most articles included in the analysis are based on qualitative methods (n = 18), with 3 articles using a mixed-method design; 19 studies focus on the Tonga people in Zambia, two on the Tonga in Zimbabwe, and none on both. One article focuses on livelihood traditions (Zulu et al., 2019); six studies focus on taboos, beliefs, and spiritual values (Sibanda, 2001, 2004; Kanene, 2015, 2016; Milupi et al., 2017; Chileshe, 2020); seven publications describe and explain the value and function of sacred landscapes (Colson, 1997, 2006; O'Brien and O'Brien, 1997; Kangwa, 2014; Kanene, 2015; Siwila, 2015; Kaoma, 2017); seven studies highlight conservation practices (Baudron et al., 2007; Bowman,

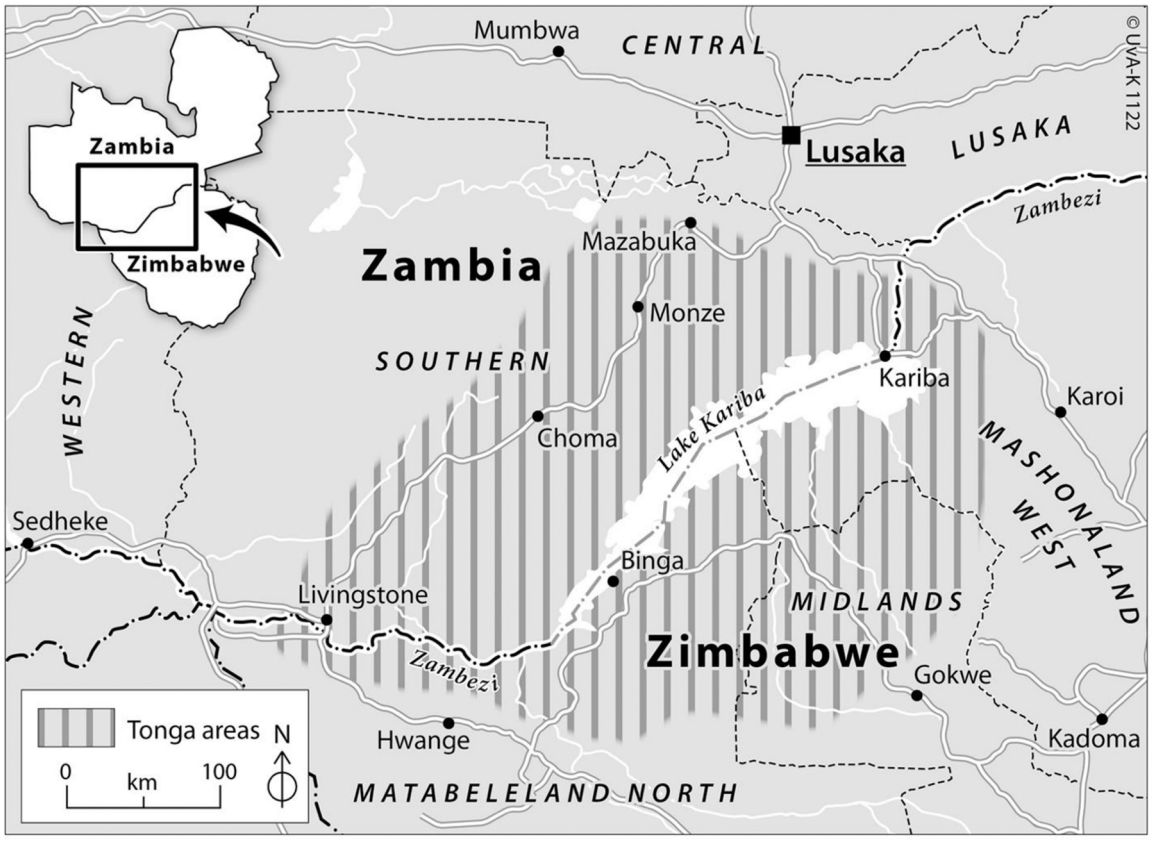

Fig. 2. Map of Tonga areas in Zambia and Zimbabwe (UvA-Kaartenmakers).

2011; Nyanga et al., 2011; Wahl and Bland, 2013; Kanene, 2016; Milupi et al., 2017; Somanje et al., 2017); and four papers highlight climate change indicators (Nyanga et al., 2011; Chisanga et al., 2017; Matsa, 2019; Mbewe et al., 2019). Below we present our findings guided by our review questions and the dimensions of Tonga land-use knowledge and practices outlined in Table 3.[7]

5.2. Tonga knowledge and practices

5.2.1. Livelihood traditions as sustainable living

We found only one study (Zulu et al., 2019) that focuses on traditional livelihood strategies, specifically the collection of non-timber forest products (NTFPs) that contribute to household food, medicine, fodder, and energy needs. Despite this scarcity of data, NTFPs are generally considered to have a high environmental and development value, contributing to rural income, particularly for poor households (Ros-Tonen, 2000; Paumgarten and Shackleton, 2011; Sunderland et al., 2014). Zulu et al. (2019) note that many Tonga households, specifically the elderly, still possess a deep knowledge of plant uses and the sustainable harvest of NTFPs with potential for food security, market trade, and novel agroforestry strategies. The reviewed study focuses on wild yam (*Dioscorea hirtiflora* or lusala, busala, or lwidi in the Tonga language), an edible Indigenous tuberous climbing plant native to Zambia (Zulu et al., 2019). Its seasonal presence in Southern Zambia suggests it is an important food plant for both food and income. Despite this, *D. hirtiflora* is not recognised in policy documents that otherwise do pay attention to NTFPs (e.g. Forestry Department, 2016). As a result, little is done to curb the threats to the habitat of this plant due to deforestation.

5.2.2. Taboos, beliefs, and totemism as a conservation strategy

Amongst the sustainable practices of the Tonga, taboos, traditional beliefs, and practices play, intentionally or not, an important role in the protection of the environment. The Tonga consider animal and tree taboos as a way to provide extra benefits, avoid adversities and, ultimately, conserve nature (Sibanda, 2001, 2004; Kanene, 2015, 2016; Milupi et al., 2017). Table 4 groups them according to the six natural resource management categories distinguished by Colding and Folke (2001).

Kanene (2016) claims an intentional conservation strategy, arguing that selective harvesting strategies are used in harvesting medicinal plants: for some plants, the Tonga people only use the leaves for curative purposes, whereas they use only the bark of other plants (Kanene, 2016). However, examples are not given, and Martinez et al. (2019) suggest the simultaneous use of several components (leaves, bark, roots) of medicinal plants utilised in Zambia and Zimbabwe.

A traditional belief that unintentionally contributes to the conservation of certain trees is the non-use of firewood from species such as mululwe (*Cassa abbreviata*), mubanga (*Pericopsis angolensis*), muzungula (*Kigelia africana*), mopane (*Colophospermum mopane*), mubombo (*Acacia* spp.) and mukuyu (*Ficus ingens*), because people believe they are home to snakes that embody ancestral spirits (Kanene, 2016) and, therefore, if burned, could provoke family conflicts.

Totems also play a role in species conservation. These ritual objects symbolise clan identity with which they have a special spiritual relationship (Chileshe, 2020). Examples are culturally important animals. For example, each Tonga clan has a name associated with a fowl or other animal, including both the most common (e.g., goat, dog, cattle) and animals most vulnerable to extinction (e.g., lion) (Kanene, 2016). The Muleya clan, for instance, has a goat as a totem, the Mudenda clan has an elephant, and the Muchindu clan has a lion totem (Kanene, 2016). These totems are considered sacred and cannot be killed. Killing scavenger

[7] In the analysis, spiritual values and sacred landscapes will be taken together.

Table 4
Taboos categories for natural resource management.

Taboo category	Definition (Colding and Folke, 2001)	Tonga taboo
Segment taboo	Ban the use of a particular species for a determined time for individuals of a particular age, sex, or social status	Not identified in the reviewed literature
Temporal taboo	Ban access to resources during certain periods. Taboos may be imposed sporadically, daily, or on a weekly to a seasonal basis	Closed hunting season for certain sacred animal species, such as lion
Methods taboo	Ban the use of certain methods and techniques for the withdrawal of species	*Njeka wa cheka* is a practice to avoid resources depletion, e.g., through selective harvesting of medicinal plants
Life history taboo	Ban the use of certain vulnerable stages of a species' life history based on its age, size, sex, or reproductive status	Not identified in the reviewed literature
Specific-species taboo	Ban the killing and detrimental use of specific species in both time and space (e.g., food taboo)	Lion, elephant and eland are totem species that particular clans consider sacred and cannot be killed; scavenger bird species cannot be killed either.
Habitat taboo	Regulate both access to and use of resources from particular habitats in space and time	Places of power; *Gonde Malende* is a land shrine-protected area where the Liwindi Gonde ceremony is celebrated. In this area, activities leading to deforestation are forbidden.

birds is also a taboo amongst Tonga. Such birds are known to clean the environment of the carcasses of cattle (Kanene, 2016). Elands are also totems within the Tonga beliefs system, with groups following *njeka wa cheka*, a practice that suggests harvesting only the essential amount that you need so that the resource will not be exhausted (Sibanda, 2004). The relationship between totem and taboo is very close, as in some cases, the animal symbolised by the totem could not be eaten or only eaten after performing certain rituals. Moreover, hunting or eating a totem animal in many clans is subject to restrictions or completely forbidden. In this regard, totemism becomes a strategy to promote species preservation and create a connection between tribal groups and nature (Grenier, 1998; Kanene, 2015, 2016).

5.2.3. Spiritual values and sacred landscapes: knowledge for natural resource conservation

The Tonga not only believe that the sustainable use of natural resources contributes to their protection but also that living in harmony with nature and praying to their ancestors does so. It was only during the nineteenth century, forced by European culture, that the Tonga began to organise their traditional ceremonies around religious figures. Earth priests (*sikatongo*) and female custodians of royal artefacts (*mulela*) became the mediums between the community and the ancestors (Colson, 1997; Kangwa, 2014; Siwila, 2015; Kaoma, 2017).

Religion, traditional beliefs and practices related to shrines (in Tonga language called *malende*) also contribute to the protection of an area (Kanene, 2015). As a communal place, shrines confer an eco-political status to the Tonga people. They play an important role in bringing the community together in a territory with a high dependency on natural resource use (Kangwa, 2014). There are two types of territorial shrines: a *place of power* and a *land shrine* (Colson, 2006; Kangwa, 2014). The former is a territory associated with natural forces (with waterfalls, large trees, caves etc.) where people go and ask for help from natural spirits in crisis times (Kangwa, 2014). A land shrine is a human settlement, a neighbourhood with common ancestors, usually marked by a shelter (*kaanda*) (Colson, 1997). Each neighbourhood has at least one land shrine where people can be hosted to protect themselves from natural hazards or to celebrate a cult. These sacred sites are protected and conserved through a combination of taboos, restrictions, and limitations, such as on fuelwood gathering or tree felling (Kanene, 2015).

The *Gonde Malende* is the main shrine for the Tonga people in Zambia and is located in Monze District (O'Brien and O'Brien, 1997; Kanene, 2015). The shrine is not just a place of production and management of natural resources but also a place where nature is preserved during times of drought (Kangwa, 2014; Kanene, 2015). Ecological rituals take place at territorial shrines, during which women are guardians of the ceremonies. One such ceremony is called *Lwiindi Gonde* and is celebrated as a rain-calling ritual, especially during the dry season (Kangwa, 2014; Kanene, 2015). The term *Gonde* refers to a dense forest that is considered to result from Tonga practices. In the *Gonde* area, Tonga people normally avoid any form of deforestation to maintain the sanctity of the grove and the high presence of snakes and *Lwaanga* trees in this area is interpreted as an expression of ancestral spirits living within the shrine (Kanene, 2015). Such beliefs and practices encourage the conservation of snakes in the area and enhance ecological integrity. Punishments and moral sanctions are in place for those who do not respect the rules, which encompass seasonal hunting or bans for certain species.

Over the years, many sacred places have disappeared due to external interventions, e.g., to make a place for European farms and settlements. Christian converts refused to respect communal taboos and to participate in ceremonies. Finally, the construction of the Kariba Dam destroyed many *malende,* and the government has converted many land shrines into tourist attractions (Kangwa, 2014).

5.2.4. Conservation methods for sustainable agriculture

The literature documents several water and grass conservation practices contributing to land-use management. The Tonga are prominently agricultural people and chief producers of maize and other food crops with deep knowledge of sustainable soil conservation practices (Nyanga et al., 2011; Wahl and Bland, 2013; Kanene, 2016). For sustainable land management, the Tonga practice intercropping, involving maize, sunflowers, groundnuts, soya, beans, and sweet potatoes. Besides providing a varied nutritional value and dietary diversity for the community, crop rotation also helps to conserve the soil, increase crop yields, and reduce pests (Kanene, 2016). Moreover, the Tonga apply organic (livestock) manure, an efficient and sustainable practice for repairing soil texture and recovering soil nutrients (Baudron et al., 2007; Kanene, 2016). Finally, fallowing and zero tillage are applied to reduce soil erosion, suppress weeds, and enhance soil fertility (Kanene, 2016; Somanje et al., 2017). Musanga and muunga trees are used for soil preservation (Kanene, 2016), while *Faidherbia albida* (previously classed as *Acacia albida*) is used as a soil quality indicator and therefore recommended as a maize intercrop (Wahl and Bland, 2013). Moreover, *Faidherbia albida* provides shade and fodder for cattle during the dry season (Wahl and Bland, 2013).

Regarding water sources, Tonga communities consider them sacred habitats of gods. For this reason, customary laws mandate people to keep water sources pure, meaning that people are not allowed to cultivate near water sources and defecating in open water is also prohibited (Kanene, 2016). Grass conservation is an important practice among Tonga: burning grass contributes to fresh pasture growth and kills pests (Kanene, 2016; Milupi et al., 2017).

5.2.5. Climate change indicators: local knowledge for resilience

In support of their agricultural conservation practices, Tonga communities use signs and indicators to predict the weather in daily undertakings (Nyanga et al., 2011; Chisanga et al., 2017; Matsa, 2019; Mbewe et al., 2019). Data on the frequency and reliability of common local knowledge indicators in the Munkochi Chiefdom shows that 28.1% of the respondents use biological and geographical signs/indicators against 9.4% of the respondents using biological and meteorological signs/indicators (Mbewe et al., 2019). The study also explains how biological indicators (e.g., tree fruiting and flowering, insect movement and behaviour, and abundance of certain fruits and mushrooms),

geographical indicators (e.g., temperature extremes, wind movement), and meteorological indicators (e.g. moon appearance, lightening) are used as signs/indicators for weather forecasting. In the Sedumbwe area, a local sign/indicator system is used in weather foresting with 80% reliability (Chisanga et al., 2017). Both studies stress the need to integrate local knowledge systems of weather forecasting into the conventional weather forecasting system (see also Murphy et al., 2016). Also, Matsa's study (2019) provides evidence of climate change indicators from a Tonga community in Binga District, Zimbabwe. Examples include drying perennial rivers and springs, late onset of the rain, early cessation of the rain season, change in wind patterns, diminishing pastures, warmer winters, and hotter summers. The study also documents coping strategies, including polyculture, planting early maturing varieties of staple food, planting drought-resistant crops, and collecting and drying wild fruits and selected crops for future use.

5.3. *Effects of Tonga knowledge and practices on their physical environment*

The effects of each of the Tonga knowledge and practices that emerged from this review are summarised in Table 5. As with other local knowledges, Tonga knowledge and practices have multiple benefits for the environment in which they live. Beliefs and taboos, religion and sacred places play a crucial role in plant, animal, and water conservation by creating sustainable practices and sacred areas that contribute to species preservation. Similarly, livelihood practices, agricultural methods, and attention to weather and climate indicators are developed to provide and cover basic needs, such as food security and health care, as well as to advance cultivation methods. All these practices contribute to creating an integrated system of natural resource management through which the Tonga have lived sustainably.

6. Discussion

Indigenous and local knowledge has increasingly gained attention amongst scholars, politicians, practitioners, and civil society. Yet, the validity and authority of the contribution of these knowledge systems and their associated practices to conservation remain under-researched. This review revealed numerous practices used to support Tonga livelihoods, maintain cultural identities and, crucially, sustain the environment. Taboos and beliefs encompass rules and principles beneficial for animal and plant conservation through harvest and hunting bans. These laws – often and mainly – administer circumscribed territories that are considered a proper natural shrine to please ancestors and where biodiversity and natural resources are protected. Yet, shrines are not the only places where the Tonga live sustainably according to self-established rules. Their traditional livelihood strategies include practices for NTFPs, which play a crucial role in Tonga basic needs and offer a potential for sustainable agricultural practices. Several studies also show the importance of applied conservation methods that enhance grassland, water, and soil conservation. Last but not least, climate change indicators help to understand local weather hazards better and increase climate resilience. It should be noted that the various dimensions of Tonga knowledge and practices cannot be separated from one another: as most worldviews of IPLCs, they holistically encompass both livelihood and environmental protection practices (Hart, 2010), thus ensuring livelihoods and basic needs now and in the future.

There are several limitations to this review. First, due to the Covid-19 pandemic, we faced difficulties getting access to older papers and books in particular, as we could not access hard copies in libraries. Second, the search revealed limited attention to Tonga knowledge and practices in Zimbabwe, with most papers referring to the people in Zambia. Third, little attention is paid in the reviewed literature on factors contributing to the erosion of Tonga local knowledge and how this knowledge can contribute to their empowerment.

Yet, our findings are particularly relevant and timely in light of the ongoing negotiations of the Convention on Biological Diversity (CBD) working group to develop a post-2020 biodiversity framework. The findings emphasise the importance of acknowledging the fundamental role of IPLCs in biodiversity conservation. No less than 1.65 billion IPLCs occupy biologically important (but currently unprotected) land (RRI, 2020), while 80% of global biodiversity is within IPLC territories (World Bank, 2016). Therefore, future conservation commitments must incorporate ILK, aim to secure IPLC land and tenure rights, and avoid (at all costs) displacement for protection strategies. Indeed, for initiatives such

Table 5
Effects of Tonga knowledge on their environment.

Category	Local knowledge	Effects of Tonga knowledge on their environment	Reference
Taboos and beliefs	a) Hunting season for certain sacred animal species b) *Njeka wa cheka* is a practice to avoid resource depletion c) Selective harvesting for medicinal plants d) Lion, elephant and eland are totem species e) Avoid killing scavenger bird species	a) Plant conservation b) Animal conservation	(Sibanda, 2004; Kanene, 2015; Milupi et al., 2017; Chileshe, 2020)
Spiritual values and sacred landscapes	a) Place of power or land shrine where there are fuelwood and tree felling prohibitions b) Please the ancestors c) Seasonal hunting	a) Plant conservation b) Animal conservation c) Water conservation	(Colson, 1997, 2006; O'Brien and O'Brien, 1997; Kangwa, 2014; Kanene, 2015; Siwila, 2015; Kaoma, 2017)
Livelihood traditions	Sustainable NTFPs harvest	a) Food security b) Medicine c) Fodder d) Energy	(Zulu et al., 2019)
Conservation methods	a) Intercropping b) Fallowing c) Burning grass d) No cultivation near riverbanks e) Zero tillage	a) Potential for agroforestry methods b) Grass conservation (fresh pasture growth and kills pests) c) Water conservation d) Soil preservation	(Baudron et al., 2007; Bowman, 2011; Nyanga et al., 2011; Wahl and Bland, 2013; Kanene, 2016; Milupi et al., 2017; Somanje et al., 2017)
Climate change indicators	a) Local knowledge system weather forecasting b) Polyculture c) Planting early maturing varieties of the staple maize d) Planting drought-resistant crops e) Collecting/drying wild fruits for future use f) Drying some crops for future use g) Probability planting h) Eating wild fruits as household meals	Contribute to sustainable agricultural practices and climate resilience	(Nyanga et al., 2011; Chisanga et al., 2017; Matsa, 2019; Mbewe et al., 2019)

as protecting 30% of the global land area by 2030 to succeed as proposed by the CBD working group[8] in a socially just manner, the voices and knowledge of IPLC will need to be carefully and respectfully heard and integrated. Finally, knowledge exchange between IPLCs and research organisations and other stakeholders can be an effective strategy to reinforce knowledge co-production and participatory processes in environmental governance through integrated landscape approaches (Reed et al., 2019, 2020; O'Connor et al., 2020; Tengberg et al., 2021).

Integrating IPLCs into national and landscape-scale decision-making processes can help create more equitable collaboration and ultimately improve conservation and natural resource management strategies. However, while integrating IPLCs and their local knowledge offers opportunities for collaboration, several obstacles remain. Firstly, there is still the need for ILK to gain the respect and validation of other knowledge systems. Then, mutual trust, power imbalances, and the lack of clear integration methods and procedures are among the challenges that integration processes must contend with.

However, these are challenges that must be confronted. The ongoing global policy negotiations around climate and biodiversity are largely dominated by actors from the north with specific worldviews and assumptions around human-nature relationships. Many proposed strategies for addressing the biodiversity crisis are still rooted in the notion that human populations must be segregated from nature or market-based interventions must be applied to save nature from humanity (Buscher and Fletcher, 2019). These strategies disproportionately impact IPLCs and are often predicated on, respectively, their removal from ancestral lands or the provision of inadequate and uncalled-for alternative livelihood strategies or integration into capitalised market economies. Furthermore, such strategies fail to consider alternative approaches or worldviews, such as those of IPLCs that often have a more holistic conception of, and relationship with, their surrounding natural environment. Yet, there is growing evidence of the contribution of IPLCs to sustainable natural resource management and their ability to conserve biological diversity, particularly when afforded adequate rights to land and resources (Garnett et al., 2018a; Fa et al., 2020; RRI, 2020; Hajjar et al., 2021). Enhanced recognition of this contribution – while recognising that erosion of ILK occurs and limits the role of ILK vis-à-vis current global environmental challenges – might locally be crucial to reversing biodiversity loss and reimagining humanity's relationship with the 'natural' world.

In this regard, systematic reviews can help by synthesising fragmented evidence and improving the understanding of the benefits and constraints of ILK for environmental management. Moreover, further research on ILK and contextualised knowledge co-production and integrated governance would contribute to a better understanding of local practices and identify ways for more equitable collaboration between local knowledge holders and scientific know-how for sustainability.

7. Conclusion

This paper reviewed existing literature on Tonga local knowledge and practices relevant to landscape management. The review revealed that various dimensions of Tonga knowledge contribute to biodiversity conservation, food security, soil conservation, and other well-being dimensions. Research gaps identified include limited documented evidence of Tonga knowledge and practices in Zimbabwe and limited attention to the biophysical impact of local practices on land and natural resources. Furthermore, there is limited attention to the historical processes that have led to the erosion of Tonga local knowledge and the political disempowerment of Tonga knowledge holders. We recommend addressing these knowledge gaps in future research.

The findings contribute to greater recognition and validation of Tonga local knowledge and practices in natural resource governance, particularly how such knowledge can contribute to integrated landscape governance. In conclusion, we argue that Indigenous and local knowledge is central to land use and conservation goals, and any effort towards integration in knowledge co-production processes should be aligned with the governance structures, motivation, ambitions, and capacity of IPLCs. Hence, we suggest the need to develop more equitable and, thus, pluralistic design processes that incorporate IPLCs in well-designed integrated landscape approaches.

[8] https://www.cbd.int/meetings/POST2020-PREP-01, accessed 20 March 2021.

CRediT authorship contribution statement

Malaika Pauline Yanou: Conceptualization, Development or design of methodology; Creation of models, Formal analysis, Investigation, Writing – original draft, Writing – review & editing, Visualization. **Mirjam Ros-Tonen**: Supervision, Development or design of methodology; Creation of models, Writing – review & editing, Visualization. **James Reed**: Supervision, Writing – review & editing, Funding acquisition. **Terry Sunderland**: Supervision, Writing – review & editing, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.envsci.2023.02.002.

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