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The Hybridisation, Resilience, and Loss of Local Knowledge and Natural Resource Management in Zambia

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Abstract
The contribution of Indigenous and local knowledge (ILK) to natural resource management has recently gained increasing prominence in academia, policymaking, and civil society. However, persistent knowledge gaps concerning the contribution of ILK to sustainable landscape management remain. We investigate existing local knowledge and practices of the Tonga of Kalomo District, Zambia, and their contribution to sustainable landscape management by combining walking interviews with photovoice. Especially Tonga women and youth are important knowledge holders for land management, agricultural practices, and tree conservation. We found that local knowledge is often 'hybridised' with 'external knowledge' when local knowledge alone is deemed insufficient. In some cases, introduced 'external knowledges' are simply reconstituted long-standing local practices. Nevertheless, local communities often perceive external knowledge holders as "knowing better." Finally, we show how local knowledge and associated practices have been simultaneously eroded and lost and describe those that have remained resilient to provide insights into the complexity of hybridisation processes where different knowledge systems interact.

Keywords Indigenous and local knowledge · Knowledge hybridisation · Natural resource management · Decolonising knowledge · Integrated landscape approaches · Tonga · Kalomo District · Zambia

Introduction

Forests and natural habitats are fundamental for achieving internationally agreed biodiversity and climate targets (Barlow et al., 2016; Betts et al., 2017; Griscom et al., 2017). Moreover, more than one billion people in the tropics live in proximity to forests (Fedele et al., 2021), and globally up to 1.7 billion people – notably Indigenous Peoples and Local Communities (IPLCs) – rely on forests for their livelihoods (Agrawal, 2005; Angelsen & Wunder, 2003; Shackleton & de Vos, 2022). Thus, the conservation and restoration of forests and natural ecosystems remain high on the international policy agenda (e.g., UN decade on ecosystem restoration).

Many international organisations, platforms, and conventions concerned with forests and natural resource management (e.g., the UN Permanent Forum on Indigenous Issues (UNPFII), Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), Nagoya Protocol, World Resource Institute (WRI); World Wildlife Fund (WWF), Convention on Biological Diversity; and the United Nations Framework Convention on Climate Change (UNFCCC) recognise the environmental stewardship contribution of IPLCs (Garnett et al., 2018; Sangha, 2020). Relatedly, there is increasing support for the rejection of contemporary conservation approaches that can be harmful to IPLCs through displacement and dispossession in favour of more locally and culturally appropriate rights-based approaches (Armenteras, 2021; Artelle et al., 2019; Chilisa, 2017; Domínguez & Luoma, 2020; Yang & Tuck, 2012). Such new approaches can mobilise previously marginalised knowledge, values, and governance systems to complement Western scientific

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knowledge and enhance engagement with indigenous perspectives (Malmer et al., 2020; Masiero, 2022). Collaborative approaches to knowledge mobilisation and learning that acknowledge plural values of nature and reconcile diverse knowledge systems[1] can contribute to the design and implementation of more equitable and sustainable strategies for natural resource management (Djenontin & Meadow, 2018; Yanou et al., 2023). Although literature reports erosion and loss of ILK due to interactions between different knowledge systems (e.g., Aswani et al., 2018), there is ample evidence that local and 'Western' knowledge systems are complementary rather than contradictory and that their interaction contributes to adaptation to environmental change (Congretel & Pinton, 2020; Makondo & Thomas, 2018), inclusive innovation (Ludwig & Macnaghten, 2020; Peddi et al., 2023), environmental conservation (Tengö et al., 2021), and increased resilience (Gómez-Baggethun & Reyes-García, 2013).

Integrated landscape approaches (ILAs) adopted by various organisations to promote more holistic landscape management strategies to address interconnected social-ecological challenges are an example of a new collaborative approach (Reed et al., 2015, 2020). ILAs aim to overcome sectoral barriers by enhancing synergies amongst stakeholders and land uses through multistakeholder negotiations to address common concerns and trade-offs (Bürgi et al., 2017; Reed et al., 2015; Sayer et al., 2013, 2017). However, limited attention has been given to the role of knowledge, particularly ILK, and associated power relations (Angelstam et al., 2013; Antonelli, 2023; Clay, 2016, 2019). The epistemic and cognitive differences of contrasting knowledge systems of interacting stakeholders remain a constraint for effective knowledge integration (Chambers et al., 2021, 2022). Limited attention to ILK for conservation and development goals and the consequences of the interactions with other knowledge systems in the ILA debate restricts the translation of well-intended rhetoric into meaningful practice.

We address this knowledge gap through an analysis of local knowledge and practices of Zambian Tonga communities where various organisations aim to implement an integrated landscape approach and different knowledge systems interact.[2] We ask: (1) how Tonga local knowledge and practice contribute to natural resource management in Kalomo District, Zambia; (2) how interactions with other knowledge systems affect landscape management; and (3) how participants perceive changes in applying local knowledge in dealing with past, current, and future landscape challenges.

We use the hybridisation concept (see below) to develop a conceptual framework based on three dimensions of Tonga environmental ethics for analysis of the implications of hybridisation processes for landscape and natural resource management. Our discussion positions our findings in the broader debates on knowledge hybridisation and integrated landscape approaches. We argue that insights into the complexity of knowledge hybridisation processes are needed where integrated landscape approaches or other collaborative approaches are implemented to achieve more effective and equitable landscape management.

Conceptual Framework: Building on Tonga Belief Systems

The Hybridisation of Indigenous and Local Knowledge

We use the term Indigenous and local knowledge (ILK) as "the understandings, skills, and philosophies developed by societies with long histories of interaction with their natural surroundings" (UNESCO n.d.).[3] Discussions of ILK in natural resource management over the last two decades have emphasised their dynamic nature due to the interaction with other knowledge systems. These interactions result in hybridisation, defined as processes where "traditional knowledge, practices, and beliefs are merged with novel forms of knowledge and technologies to create new knowledge systems" (Gómez-Baggethun & Reyes-García, 2013: 1).

There are several pathways through which ILK is subject to hybridisation, mainly accommodation of new information and exposure to external socioeconomic factors (Aswani et al., 2018). More specific pathways identified in the literature include knowledge differences across generations (Godoy et al., 2009), acculturation (Zent, 2001), and market integration effects (Reyes-García et al., 2013). Such processes are most common in rural areas where local communities are more vulnerable to socioeconomic changes

[1] We define a knowledge system as 'a body of propositions that are adhered to, whether formally or informally, and are routinely used to claim truth' (Díaz et al., 2015: 14). A knowledge system comprises agents, practices, and institutions that organise knowledge production, transfer, and use.

[2] This research was carried out as part of the Collaborating to Operationalise Landscape Approaches for Nature, Development and Sustainability (COLANDS) initiative, led by the Centre for International Forestry Research (CIFOR) in collaboration with the Universities of British Columbia and Amsterdam, and partners in the countries of implementation, Ghana, Zambia, and Indonesia (https://www.cifor-icraf.org/colands/).

[3] We use ILK when we speak about traditional knowledge and practices in general. However, we use the term "local knowledge" when specifically speaking about Tonga knowledge, because the Bantu-speaking Tonga population has a long history of long-distance migration and involuntary resettlement, as a result of which they can no longer be labelled "indigenous" in many places where they currently live (Colson 1970, 2006; Clark et al., 2016; Yanou et al., 2023).

Table 1 Selected Tonga socioecological principles and implications

Belief systems	Principles	Implications
Sharing ideology	Community members help each other by sharing resources and benefits to meet their subsistence needs	Embarks on a subsistence-based economy where people do not consume more than they need, which is more sustainable than a market-based economy (Abrahams, 2016; Kaoma, 2017). Caring for others also implies caring for the environment (Siwila, 2015)
Sacred places and rites	Women are custodians of nature (*mulela*); Earth priests are custodians of shrines (*Sikatongo*) and are usually male (Colson, 2006; Siwila, 2015)	Balanced gender roles in preserving a good balance with nature (Kaoma, 2017)
	Ancestors should be honoured as guardians of the land and ecological harmony and bringers of rain (*lwiindi*); seeds and crops should be dedicated to ancestors (Siwila, 2015)	Agricultural management; good harvest (Colson, 2006; Kaoma, 2017; Siwila, 2015)
	Ancestors and their graves (*malende*) must be respected and protected (Siwila, 2015)	Conservation of biodiversity wildlife and around sacred sites (Colson, 2006)
	Importance of the earth and its inherent forces and responsibility for protecting natural sites (Siwila, 2015)	Conservation of biodiversity and wildlife; maintaining a harmonious relationship with nature

Source: Compiled by the authors based on the references in the table

negatively impacting their environment and biodiversity. However, they also occur where local people are more resilient to globalisation and modernisation and able to defend their environment and practices (Aswani et al., 2018).

The interactions between ILK and the external policy and management environment and the consequences of hybridisation are complex (Aswani et al., 2018), showing different and partly contradictory patterns (Balanzó-Guzman and Ramos-Mejía, 2023). While interaction with science-based 'Western' knowledge in combination with environmental and socioeconomic challenges may lead to erosion of ILK (Aswani et al., 2018; Fernández-Llamazares et al., 2021), IPLCs may be able to effectively weave traditional or local knowledge with science-based or other "modern" knowledges (Aswani et al., 2018), resulting in slowing loss of ILK (Dewalt, 1994; Ramirez, 2007). The processes that sustain or erode people's ability to 'adapt and regenerate' local knowledge in the face of cultural change, acculturation, modernisation, economic development, and other transformative processes are still poorly understood (Reyes-García & Gómez-Baggethun, 2014). Building on Tonga environmental ethics and ILA principles, we present a conceptual framework to help explain ILK erosion and resilience in knowledge exchange.

Tonga Environmental Ethics[4]

The Tonga have lived in Zambia's Southern Province for centuries as part of the Bantu-speaking hunters and gatherers, cultivators and owners of small stock, and cattle herders who spread across Southern Africa around the first millennium (Colson, 2006). Tonga religious vocabulary was heavily influenced by ancient Bantu roots. In the 1950s, the construction of the Kariba Dam led to their forced resettlement across the Tonga Plateau, having initially refused to leave behind the graves of their ancestors and the shrines (*malende*, in Tonga language) (Siwila, 2015). The destruction of sacred places and sacred sites also obstructed performance of ritual ceremonies such as the annual rain-calling ceremony *lwiindi* (ecologically associated with agricultural management to thank the ancestors for the good harvest and pave the way to the following harvesting season) and other ceremonies associated with specific sacred sites (Kaoma, 2017; Siwila, 2015). Such sacred places and rituals are deeply entwined with ecological land and agriculture management strategies for good rain patterns and harvests and the protection of rivers and animals (Colson, 1997, 2006) (Table 1).

The Tonga are environmentally conscious, with ecologically based belief systems (Colson, 2006; Kaoma, 2017; Siwila, 2015) whose connection to nature is one of embodiment and commitment to a balanced human-nature relationship (Colson, 2006; Siwila, 2015). Land and livestock, for example, are represented as part of an individual's being and identity. If there are signs of a drought or a livestock disease, the entire community will gather to seek advice from the ancestors (Colson, 2006).

According to Colson (2006) and Araki (2001), Tonga culture in the pre-colonial Plateau was also based on 'sharing ideology' through which people relate to each other based on kinship rather than market-driven logic (Araki, 2001; Colson, 2006). However, socio-political changes have

[4] The term "environmental ethics" draws from Gwaravanda (2019) who used it in relation to Ubuntu.

significantly impacted such traditions, especially colonisation, an extremely disruptive process that ended an economy based on kinship ties and the recast the *sikatongo* (the Earth priest) as the village headman. Further development changes, such as dam construction, impacted the shrine cult, among others (Araki, 2001; Colson, 2006; Siwila, 2015; Thomson & Bennett, 2005).

Tonga environmental ethics can be grouped into three dimensions that guide our analysis of Tonga local knowledge and practices and how they have been affected by hybridisation processes. The *ethical dimension* is the overarching feature and refers to the values embedded in Tonga belief systems that guide individuals and relationships in Tonga environmental ethics. It encompasses notions of sharing and brotherhood, respect for ancestors, and caring for the Earth (Table 1). IPBES (2022) refers to these as relational values, encompassing a sense of place (here relation to ancestors, sacred sites), spirituality (here rites related to ancestors and their graves), and care and reciprocity (here sharing ideology) (IPBES, 2022).

The *environmental dimension* captures the importance of the environmental component related to Tonga philosophy and refers to the balanced human-nature relationship as fundamental to better addressing ecological challenges. With Tonga sharing ideology (Table 1) being related to Ubuntu (Mabele et al., 2022; Ramose, 1999; Sayer et al., 2013), caring for others also implies holistically caring for the physical environment, particularly sacred sites and shrines that reflect a strong bond with ancestors (van Norren, 2017).

The *collaboration dimension* is how individuals and their knowledge systems interact to reach common goals. Most Tonga ethical principles reflect sharing, exchange, support, and mutual help within the community (or the landscape) to reach a common good (Munung et al., 2021; see Table 1). Yet, the social makeup of the villages is strongly hierarchical, with the headmen having the highest political power in decision-making (also for natural resource management). Men follow in status, while women and youth have more marginal positions (Yanou et al., 2023). Despite these hierarchical relationships, sharing and caring (for others and the environment) are important values that provide a strong basis for collaboration. Knowledge hybridisation may occur when such collaboration involves external actors and is thus analysed under this dimension.

Integrated Landscape Approaches

We conducted our study in a consortium of research organisations, non-governmental organisations (NGOs), and natural resource management agencies mobilised to implement an integrated landscape approach (ILA) (see below). Despite a lack of consensus on the definition of ILAs (Reed et al., 2015; Sayer et al., 2013), it is well-recognised that they are designed to reconcile conservation and development goals at the landscape scale through broad stakeholder negotiation processes. Numerous guiding principles for ILAs have been developed in recent years (Sayer et al., 2013; Reed et al., 2015, 2017, 2020; van Noordwijk et al., 2015; Bürgi et al., 2017; Ros-Tonen et al., 2018). Sayer et al. (2013) emphasise a need to create space where multiple stakeholders can act towards common concerns and address social-ecological challenges (see Table S1 in the supplementary material).

However, ILAs face several challenges and criticisms, such as being a local trap that ignores spatial scale issues, the difficulty of achieving win–win outcomes due to the complexity of sustainability challenges, challenges regarding equitable engagement and deciding who should be involved and represented, conflicts that are difficult to avoid and manage during collaborative processes involving competing interests and power imbalances; and – of particular relevance for this research – incompatible epistemologies between ILK and the principles on which ILAs are based (Arts et al., 2017; Siangulube et al., 2022; Vermunt et al., 2020). We explore below if and how the three dimensions of Tonga environmental ethics can complement and strengthen ILA principles in theory and, ultimately, application.

Materials and Methods

Background to the Study Area

We conducted our study in Kalomo District (Southern Province), Zambia, between April and July 2022. Kalomo is one of the 13 districts of the Southern Province of Zambia with a population of 258,270. The district's governance is a mix of statutory and customary arrangements. The statutory or formal government is a decentralised system with layers at the national level (line ministries parliament) and district levels (District Administration). The political administration of the district encompasses two constituencies, 18 wards, and 56 zones. The customary governance system operates at the sub-district level and comprises three Chiefdoms: Sipatunyana in the South, and Chikanta and Siachitema in the north (Moombe et al., 2020; Siangulube, 2023; Siangulube et al., 2022).

Most of the district is a high plateau located 1000—1300 m.a.s.l. It has a temperate climate with an average annual temperature of 20^0C and three seasons: cool and dry (May–August), hot and dry (September–November), and warm and wet (December–April) (Moombe et al., 2020). There is an erratic rainfall pattern, between 800 and 1200 mm in the higher areas and less than 800 mm

in some lower parts (Mulenga & Wineman, 2014; Ngoma et al., 2021). It is experiencing the consequences of climate change with declining rainfall and extended drought periods (Moombe et al., 2020). The dominant vegetation is dry forest and woodlands. With an extension of 162,200 km^2, the Kalomo Hills Forest Reserve comprises the Miombo, Mopane, and Kalahari woodlands and the Munga and Savannah woodlands (Moombe et al., 2020) (Fig. 1). Agriculture is the main economic activity, focusing on maize and cattle, with groundnuts, cotton, sunflower, and sweet potato as secondary crops. The sale of fuelwood and charcoal is another major economic activity (Moombe et al., 2020; Yanou et al., 2023).

We selected this district because it was part of the COLANDS initiative that mobilised several stakeholders (government officers, customary authorities, local community members, NGOs, researchers, etc.) to implement an integrated landscape approach that brought together several knowledge systems, which provided an important context for analysing hybridisation processes.

Selection of the Villages

We conducted our survey in three villages, one in each of the three Chiefdoms: Chikanta, Sapatunyana, and Siachitema. The villages were chosen primarily for their location on the state-customary power continuum (Moombe et al., 2020), i.e., in relation to the Kalomo Hills Forest Reserve (KHFR) (centre of statutory power) and the Chief's palace (centre of customary power). The first village in Sapatunyana chiefdom is located outside the KHFR; the second village in Siachitema chiefdom is within the KHFR; and the third village in Chikanta chiefdom is within the KHFR's buffer zone (Fig. 1). The three villages present an interesting mix of cultural and economic characteristics (see Moombe et al., 2020).

Selection of Participants

During a scoping study in July–August 2019, the first author visited six villages in three different chiefdoms

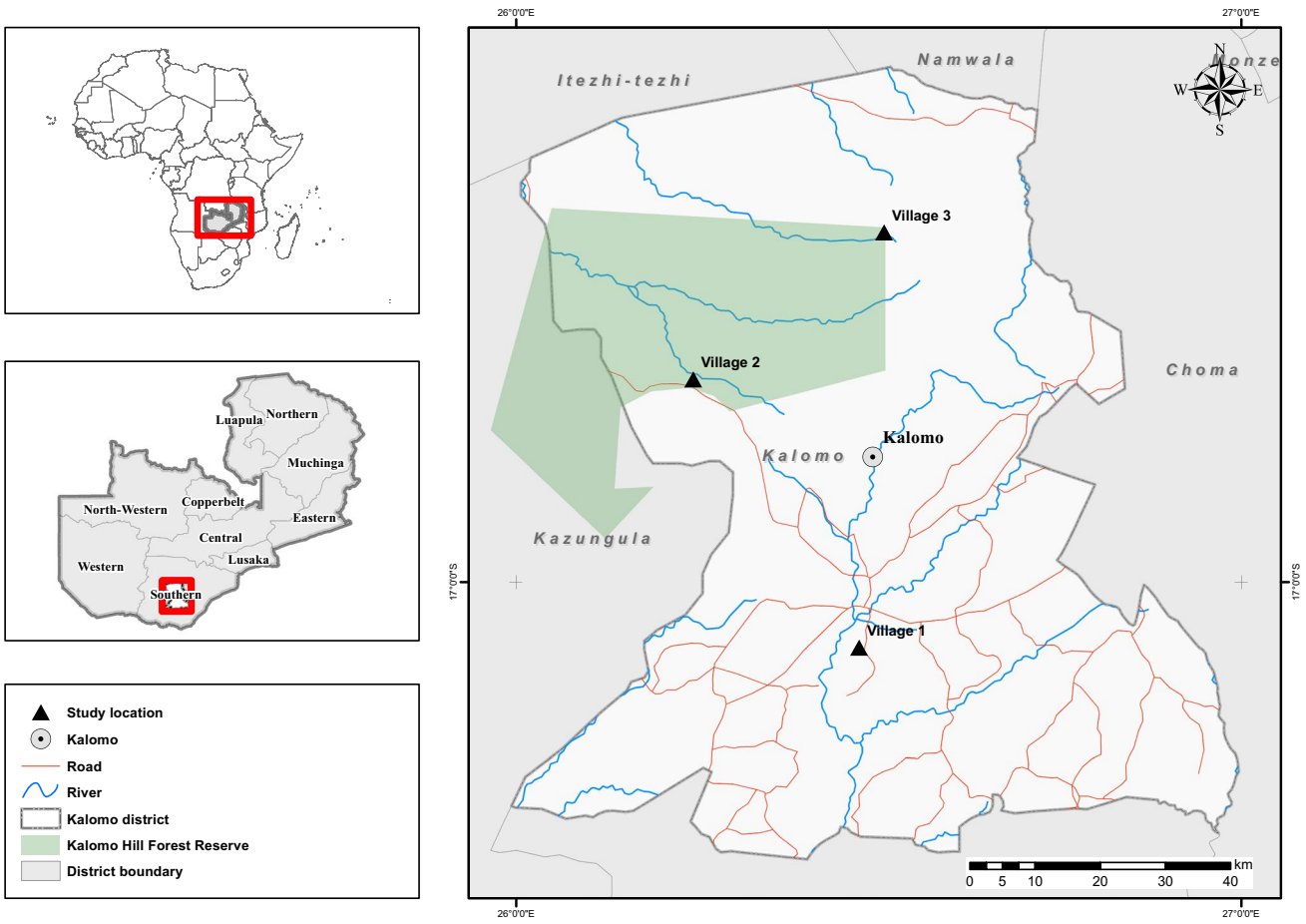

Fig. 1 Map of Kalomo District showing the three selected villages in the three Chiefdoms. Source: Made for the authors by Sari Narulita (GIS specialist, Lestari Capital)

and held introductory meetings with the headmen and 15–20 members of each community chosen by the headmen. We selected 24 participants, 12 male and 12 female, aged between 18 to 88 (youth, adults, and the elderly) from three villages based on their knowledge of traditional practices, gender balance, and good spread over age classes (purposive sampling) and availability (convenience sampling).

Data Collection Combining Photovoice and Walking Interviews

The first author conducted individual interviews where participants were encouraged to discuss their past and present local practices through stories, values, and photographs. Data collection focused on the active local practices that communities continue to use for managing natural resources, understanding some other local practices that have disappeared and why, how such local practices and landscapes have changed and adapted over the years, and what changes are expected in the future. Due to the wide range of topics that local knowledge can cover, there was no pre-determined protocol to gather this information.

We used visual techniques because they provide the opportunity to better capture the various ways different local actors perceive and intervene in the landscape (Boedhihartono, 2012). Photovoice allows engagement with participants, focus on the value of the resources, understandings of history, and imagining future scenarios (Boedhihartono, 2012). Several studies have applied photovoice to show local knowledge and practices about people's perception of a conservation issue and potential solutions. For instance, participants in Sri Lanka used photography and narrative to share their knowledge and perspectives through photovoice (de Haan et al., 2020). Combining photovoice with walking interviews, as 'talking while moving' is beneficial to initiating a conversational, geographic, and informational pathway rather than a typical interrogative encounter (Salmon, 2007). As a result, the knowledge generated differs significantly. In addition to justifications and ideologies, this method can help to access emotions, reflections, and beliefs (Anderson, 2004; Evans & Jones, 2011; Kinney, 2021; Martini, 2020). The latter, particularly, led us to favour photovoice over participatory mapping. Moreover, documenting and gaining insight into local knowledge and practices was more important for this study than their spatial dimension, which participatory mapping and other spatial tools capture better (McCall, 2021; Ros-Tonen et al., 2021). By adopting this approach, we sought to uncover specific knowledge(s) that contribute to community contextual conservation and development approaches (Amos et al., 2012; Derr & Simons, 2020; Kok, 2020; Lim et al., 2021; Milcu et al., 2014).[5] Such go-along interviews allowed for in-situ storytelling and participant observations and encouraged spontaneous conversation (Carpiano, 2009; Evans & Jones, 2011; Taggart, 2021).

Due to the lack of disposable cameras, we used one camera and combined the activity with go-along interviews (on foot and by vehicle). During the fieldwork, the go-along interviews typically consisted of hybrid participant observation and interviews, following the knowledge holders on their regular journey while asking questions, listening, and observing. When the participants talked about any activity involving local knowledge, they took a picture of it. We sometimes videorecorded the go-along interviews to better capture the knowledge holders' feelings while crossing the landscape. We used the vehicle to access areas where the participants specified that they wanted to take pictures of conservation or natural management practices and show us their daily local practices.[6]

First, we began the combined photovoice and go-along interviews (70–90 min) outside the participants' households. Second, we asked participants to take photographs of places and activities to capture conservation methods, livelihood traditions, spiritual values, and sacred places where they use their knowledge. To guide them, we asked the following questions:

1. Which local practices are you currently using to manage natural resources?
2. Can you show specific examples of practices related to forest conservation, tree management, land management, water management, soil management, seed management, sacred groves, wildlife management, and cattle management?
3. Are there other practices related to land or natural resource management?

After all the participants were interviewed and had taken their pictures, we organised a second round of photovoice through focus group discussion during which the participants shared their pictures and provided appropriate descriptions, location, time, and what the pictures represented to them. Due to time constraints, each participant could only select one image. Their description included responding to the following five questions, which are adapted from Amos et al. (2012), designed to encourage discussion among participants and investigate differences and commonalities:

[5] Prior to the activities, informed consent was obtained from all participants.

[6] We also used Avenza Map, a mobile app that helps to locate places people indicate they use local practices to manage natural resources. However, to avoid any potentially sensitive information, we decided not to disclose these data.

P Describe your **P**icture.

H What is **H**appening in your picture?

O Why did you take a picture **Of** this?

T What does this picture **Tell** us about your practices in managing natural resources?

O How can this picture provide **Opportunities** for things to be better in the future?

Data Analysis

We transcribed and coded all interviews using NVivo data analysis software. Coding is a qualitative analysis technique that allows researchers to explore, comprehend, and compare interviews by identifying and tracking specific themes. The research questions formed the basis of a list of potential codes, or themes, to track through the interviews. The coding was done based on the original set, adding additional codes as emergent knowledge categories were discovered. Once the coding stage was completed, we reviewed the quotations and codes and cross-tabbed queries to test ideas, explore patterns, and see the connections between the themes, pictures, people, and places (see Table S3, supplementary material).

Results

We present our results regarding Tonga local practices that are still in use following the three dimensions of Tonga environmental ethics (ethical, environmental, and collaboration). We also highlight local environmental practices that have been lost, how local knowledge has been intergenerationally transferred, and how the interaction between local and 'external knowledges' (i.e., scientific and 'expert' knowledge originating from outside the community, brought in by external actors such as extension agents, NGOs, etc.) within the communities brings about a hybridisation process. During focus group discussions, we also asked participants about their past and future landscape perceptions. However, we first clarify what local knowledge and practices mean to the Tonga communities to develop a locally contextualised definition of this term. All three communities agreed to identify Tonga local practices as daily practices that involve farming (mainly cash and subsistence crops such as maize), cattle management, and tree planting. For some participants, local knowledge is strictly related to the well-being of their household and livelihood. In addition, local knowledge always refers to any practice that was taught to them by older generations (e.g., parents and grandparents) (Table 2).

The Ethical Dimension: Sharing Ideology and Environmental Ethics

At the village level, people seem to be willing to share responsibilities for taking care of natural resources. In some cases, villagers collaborate to convert small communal portions of land within the village to forest where it is forbidden to cut trees, but everybody can benefit from fruit trees and increased land quality (Village 3). There are common regulations that villagers must follow to manage natural resources. Such regulations include illegal burning of the bush and cutting down trees for charcoal production. People appear to be aware of natural resource regulations and recognise their importance. The headman or headwoman ensures that community regulations and laws regarding cutting trees and

Table 2 Local knowledge definitions based on participants' response

Village	Local knowledge definitions based on participants' response
Village 1	"The knowledge we have here is farming and taking good care of our fields and cattle." (LKMu11)[a]
	"Local knowledge is like the way we keep trees and to know what help we get from trees." (LKMu9)
	"The knowledge I know is the knowledge of how we live here. (…) but knowledge is wisdom towards what you do or what you intend to do" (LKMu10)
	"Local knowledge is the knowledge we acquire as local people by observing what others do." (LKMu24)
Village 2	"Our local knowledge here is like our welfare; for many people, the knowledge they have is the knowledge for farming." (LKSi17)
	"This is the knowledge our forefathers left, the knowledge for places, the well-being of life and traditions." (LKSi8)
Village 3	"These are the things we live with, such animals, trees, forest and even water, cattle manure and make use of these things to help ourselves." (LKMt16)
	"This is the knowledge I use to manage farming, livestock which my parents taught me." (LKMT23)
	"Local knowledge for me is the knowledge that I have on agriculture, water, and domestic animals." (LKMt22)
	"This is the knowledge I use to manage farming, livestock which my parents taught me." (LKMt23)

Source: Focus group discussions, May 2022

[a]The codes assigned to the research participants are a combination of the kind of participant (in this paper local knowledge holders, LKH), the village they come from (Mt, Mu, Si), and the number given to them. See Table S2 in the supplementary material for details

charcoal-making are enforced and abided by; those who violate them – and this certainly happens – may face penalties.

It was unclear to what extent hybridisation also occurs in rules for natural resource management. Research participants were unable to determine whether environmental regulations include local practices or, in some cases, reported that they do not. Yet, people (including youth) are still very attached and respectful to traditional practices and what their elders taught them about managing the environment and the natural resources on which they rely.

The traditional gender roles in preserving a good balance with nature are, to some degree, reflected in decision-making at the household level. Many decisions about natural resource management are made by males or after deliberations between husband and wife. However, we noticed that the participants who led us through the field and explained agricultural practices in greater detail were mainly women, as in the past when female figures were the guardians of nature in the communities.

At the village level, the headman or headwoman ensures that community rules and laws regarding tree cutting and charcoal making are enforced and adhered to. Interviewees emphasised the importance of natural resource regulations and stated that those who violated them could be punished. Such regulations include the illegal burning of bush and cutting trees for charcoal. Although people seem to be aware of the natural resource management rules, we could not establish whether these rules include local practices. Such informal rules are not mentioned in the Registration and Development of Villages Act (enacted in 1971), which stipulates the functions and duties of the Chief, the Ward and Village Productivity Committees, the Ward Council, and the Ward Development Committee. Considering that environmental ethics and willingness to share responsibilities for natural resource management are still prevalent in the communities, collaboration and hybridisation of rulemaking seem to be important mechanisms to improve natural and landscape management in the area.

The Environmental Dimension: Local Natural Resource Management Practices Contributing Towards Conservation

Participants across the three villages took photographs demonstrating that the Tonga have intimate knowledge of their surrounding biophysical and spiritual landscape (Table 3). Nineteen participants (across the three villages) were able to share knowledge and practices on tree management as an important conservation method through photovoice. During the accompanying walks, they photographed several trees that are important to their health (used as medicine) and domestic animals (Fig. 2). Some trees are primarily used to feed goats; some are planted in fields to provide shade for crops, while others provide medicine for both humans and domestic animals, particularly cattle. These photographs were generally accompanied by a sense of pride and a willingness to share their knowledge. However, because of the charcoal activity in the area, participants reported that they must plant and maintain such trees themselves when many others are cut down mainly for charcoal production.

Table 3 Complete list of Tonga local practices

Themes	Village 1 n (%)	Village 2 n (%)	Village 3 n (%)	Total n (%)
Tree management	7 (29%)	6 (25%)	6 (25%)	19 (79%)
Cattle management	2 (8%)	3 (13%)	4 (17%)	9 (38%)
Soil management	6 (25%)	5 (21%)	5 (21%)	16 (67%)
Land management	6 (25%)	5 (21%)	5 (21%)	16 (67%)
Seed management	–	1 (4%)	2 (8%)	3 (13%)
Grass management	1 (4%)	5 (21%)	2 (8%)	8 (33%)
Water management	1 (4%)	1 (4%)	3 (13%)	5 (21%)

Source: Fieldwork survey 2022

After crop production, cattle management is the second most important activity in Kalomo, particularly for household subsistence and, in some cases, income. A large area of land is also used for grazing. However, land with trees is also considered beneficial for cattle:

> "Cattle [are] so dear to us who live in the village. It's so important to protect cattle because it's where the life of a person lies. My parents taught us which trees we can use to treat animals because it's not every time that we have money to buy medicine. There is a tree called Muzwa Malowa (*Xeroderris stuhlmannii*); this tree is good for treating cattle when you suspect your animals have stomach pains." (LKSi2)

Often, people simply go out into the bush and gather the medicine required to cure the cattle (Fig. 3):

> "We still use tree medicine to treat our animals if they are sick. Like now, I am from the bush to collect the medicine to treat my animals/cow is sick. It's like the leg is injured as it can't walk. Since morning it has just been sleeping here. As you can see, the leg is swollen. This medicine is called *Namilombe-lombe*; it comes from the Namilombe-lombe tree (*Ficus ingens*). I am going to boil it and give it my cow." (LKMt23)

Accompanying these moments was a sense of awareness about the importance of using traditional medicine, especially when drugs are prohibitively expensive.

Trees are also perceived to be important for land and soil management. Besides planting trees in the fields, spreading cattle manure and practising crop rotation are the main local land and soil management practices.

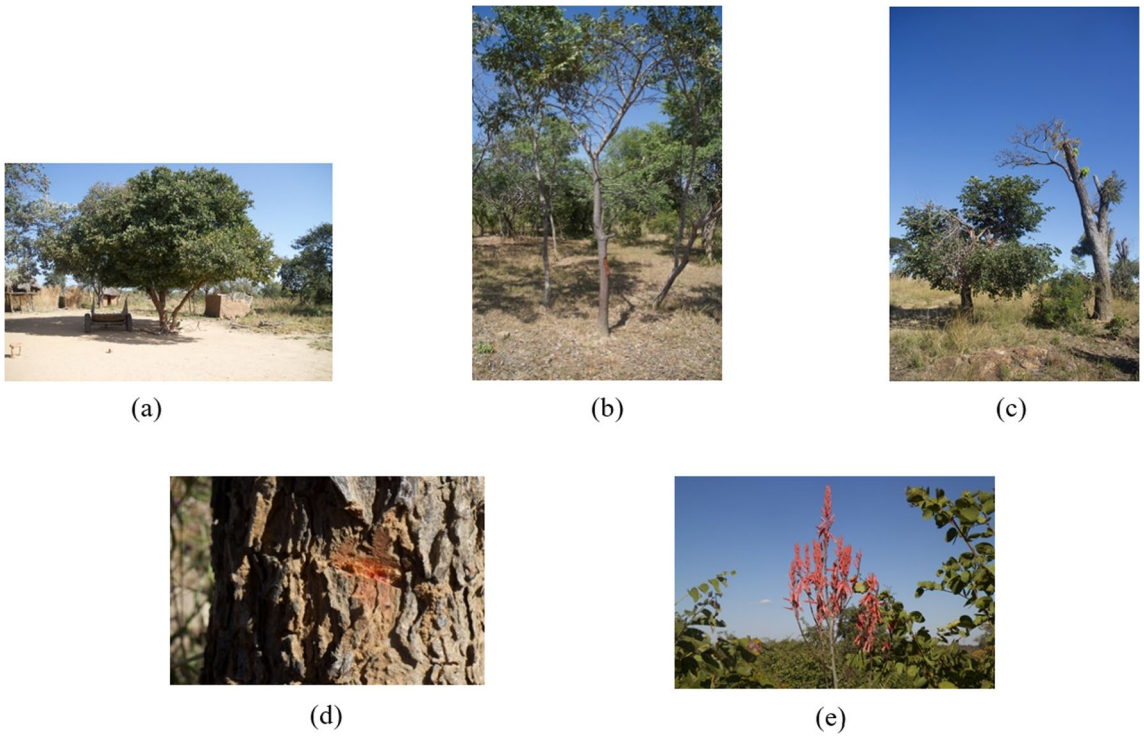

Fig. 2 Photos: **a** Mukunku tree (*Pseudolachnostylis maprouneifolia*), the leaves of which are eaten by goats. **b**"[…] We get the tree barks from the Mubwabwa tree in Tonga (*Commiphora pyracanthoides*). Like my child was very sick, she had a stomach problem. I took her to the hospital, but no change occurred. That's how people advised me to get the mutobolo roots (*Steganotaenia araliacea*) and mubwabwa (*Commiphora pyracanthoides*) barks to boil and give the child, and I did likewise, and my child is now ok." (LKMu7). **c** "The Mubombo (*Brachystegia longifolia*) tree shows that there is water here and it helps to hold the water." (LKSi12). **d** "Some trees, such as Muzwa Malowa (*Xeroderris stuhlmannii*), are protected or conserved because they are medicine for our animals." (LKSi2). **e** Aloe vera (*Aloe vera*) is used for curing corridor disease (*theileriosis*) in animals

Fig. 3 **a** and **b** Tree roots called '*mamulombe-lombe*' (*Ficus ingens*) are used as a medicine to treat animals

Participants photographed their fields to demonstrate how trees planted in the field play an important role in improving soil fertility and ensuring a good harvest season by leaving their leaves in the field and using them as compost. However, cattle manure appears to be the most used local practice, being mentioned by participants as an important practice for soil fertility, especially during long drought periods.

In addition, many participants acknowledged how crop rotation techniques help them deal with soil infertility and

Fig. 4 **a**-**b** These two pictures were taken by the same participant who walked us through his fields, where one side is cultivated with sunflowers and the other is cultivated with maize using cattle manure. "I know that where I have planted sunflowers, it will leave manure, and when I plant, the crop will grow very healthily. Sunflower is such a crop that gives the soil manure [that helps maintain soil fertility]. I cannot put fertiliser where I have planted sunflowers." **c** Tree planting in the field "is good because it acts as a shade to the maize and they can't dry up fast, and the leaves that fall function as manure". (LKMu Jani)

Fig. 5 "This is an example of how we preserve the seed; we add ash to seed." (LKSi13)

ensure good harvests. Although males make decisions over land and natural resources, it is mainly women who work in the fields and explained that they plant weather-resistant crops. Maize, sunflowers, and sorghum are the main staple crops, and farmers usually alternate every one or two years to maintain soil fertility (Fig. 4).

Seeds, especially sunflower seeds, are still collected and conserved according to local tradition in Villages 1 and 3. Overall, only two participants took pictures of how they still prefer conserving seeds in a traditional way, and certain traditional seeds have been replaced by modern seeds sold by seed companies and the government (Fig. 5). According to one participant:

> "Siluntuba seed has disappeared because it was a late mature seed, and this time, we plant early mature seeds because the rain pattern is low." (LKMu4)

Another important aspect of farming activity that participants identified and photographed is grass management. Farmers explained that they do not burn all the grass in their fields but rather allow it to decompose and fertilise the soil; grass in the fields also helps to retain moisture and serves as animal fodder (Fig. 6).

Fig. 6 **a** "The grass helps us, as cattle feed from it. We use it for roofing our houses, and it helps us to contain moisture. When the rain falls, the area does not dry up fast. Therefore we don't burn it." (LKS13) (**b**) and (**c**) "This is wet land. I don't burn this grass; it helps to hold the water so that it doesn't dry up so fast." (LKSi8)

Regarding water management, photographs show that deep wells built around the houses are useful for gardening and ensuring the availability of drinkable water. Trees, grass, and plants help to secure water and are maintained in the areas surrounding the wells (Fig. 7). As one participant noted:

> "Water wells and the grass around them block the water not to go about. This is a water well; we use this water for drinking and gardening. This well doesn't dry up because I don't allow people to burn the grass around because the grass helps to hold the water." (LKSi8)

All participants recognise the value of preserving local knowledge and practices as a zero-cost method of managing natural resources. Crop rotation, tree planting in the fields, and cattle manure are all considered efficient practices. However, many participants believe that cattle manure attracts weeds and termites to the crop, delaying the entire harvest.

The participants were able to show us material practices in their surroundings through go-along interviews. However, spiritual values, taboos, and beliefs were rarely or never mentioned. Participants stated that such practices are no longer active or have been lost in their communities (see below).

The Collaboration Dimension: Hybridisation of Knowledge Systems

Participants recognised hybridisation processes – *luzibo kusangana* (integrated knowledge) – and identified government officers, particularly those in agricultural and veterinary departments, international NGOs, and research organisations, as the three main actors with whom they most frequently exchange knowledge. The way they speak of "integrated knowledge" suggests they regard external knowledge as superior to their own local knowledge; their reactions were characterised by gratitude towards outsiders "who came to teach the people living in the communities." Participants see external actors as having knowledge that can help them face current challenges because "they know better." However, particularly in Village 3 – the most inaccessible village – these statements were accompanied by an ambivalent attitude towards the Agriculture Department. On the one hand, farmers express gratitude for government "assistance;" on the other hand, they also complain about the almost total lack of government presence and assistance. When people call the veterinary department, for example, they lament that it is not very responsive and takes a long time arrive. Participants reported that only the NGOs are assisting them in managing natural resources. Although the private sector was not mentioned, we observed that seeds are sold primarily through joint ventures between the private and public sectors, and the private sector also contributes to the construction of facilities in rural areas.

Hybridising local knowledge with external knowledge appears to be a widespread coping mechanism across communities and generations. Local practices were integrated with modern knowledge mostly in soil and water management, particularly among young people. However, participants reported that local knowledge retains value in both households and villages and that some 'external knowledge' builds on local practices. For instance, elderly participants explained how the Agriculture Department made specific recommendations to improve local practices through increased knowledge integration (hybridisation), such as mixing cattle manure and fertilisers to increase yields.

> "We combine manure and fertilisers to ensure that the maize cobs have bigger crops." (LKMu11)
> "[We use] both, because when you put manure, the land will not lose manure for a long period. The rea-

(a) (b)

Fig. 7 **a** "We conserve water by constructing water wells, which we use for gardening and home" (**b**) "The grass around it makes the water not dry up fast" (LKSi12)

son why we like fertiliser is that cattle manure cannot satisfy our fields and when you use manure prepare to have many weeds." (LKSi15)

However, one of the respondents also recognised that fertilisers are useful to have a good maize harvest and thus to be able to meet the basic needs of the household, especially to guarantee children's education:

"It seems it just grows on its own. I do not put fertiliser because fertiliser is so expensive, and [there is] no way I can put fertiliser into something that can grow on its own. (…) We mix manure and top-dressing fertiliser, which is more profitable because we only spend money to buy fertiliser. The reason why we put fertiliser is that it is for yields. Once the harvest is good, we sell to help ourselves, like to pay for school fees for our children and buy drugs for our animals." (LKSi15)

Although government officials support and recommend "knowledge integration" (*luzibo kusangana*), we found several instances in which so-called external knowledge introduced to support communities is de facto a local practice used for decades, suggesting that knowledge hybridisation occurs in both directions. An example is a manure practice whereby farmers leave manure in fields for several months for greater soil fertility. In Villages 1 and 3, where a dam was built with the assistance of a non-governmental organisation, a participant explained:

"It is integrated knowledge because when the NGO came, it found we had already blocked the water. We used an ox cart with the help of the family and neighbours. So, the NGO just added the knowledge to something we knew already and something we had already started doing. The NGO just told us our local knowledge of how to make food for fish. We get maize and sunflower, mix them, and then we feed the fish." (LKMu10)

Farmers agreed that combining multiple knowledge systems is beneficial to cope with environmental challenges, even though it implies that some local knowledge and practices are getting lost. The next section delves deeper into this process.

Knowledge Hybridisation as a Strategy to Deal with Landscape Challenges

While the photovoice activity revealed current local practices in three Kalomo villages, the focus group discussion gave deeper insights into the past, present, and future of local knowledge, its erosion and hybridisation with external knowledge, and implications for coping with landscape challenges.

Participants from the three villages shared similar memories, perceptions, and concerns about the changes experienced in the area over the last 30 years and their perspectives about the future of the lands they live in and farm. First, participants recalled plenty of trees in the area, whereas nowadays, trees are cut for charcoal which can be sold for high prices in town. Second, people used to own small plots of land that they would cultivate for two or three seasons before leaving it fallow to regenerate. Today, people are farming commercially, so they typically acquire large tracts of land, even near rivers. Third, rivers and water were clean, and wells were used to conserve them in the *dambo* areas.[7] People recall they were never ill because the water was always safe to drink. This was partly due to the prolonged period of heavy rains that lasted until October. Fourth, wild animals were abundant in the past, and cattle were absent. However, due to increased population, unsustainable hunting practices, and habitat destruction, wild animals are rapidly disappearing, and cattle, introduced by people from the North who have settled in the area since 1985 due mainly to the favourable farming conditions, are now abundant (Cliggett, 2000). Fifth, the communal shrines\ where people gathered to pray, especially for rain, are now being degraded by those who violate the traditional rules by cutting down trees, cultivating, or constructing houses in these areas.

Participants in the three villages expressed their concern about the future of their landscapes, predicting that many new issues will emerge in the future: land will be less available and fertile as a result of current cultivation practices; many people will become commercial farmers because they are 'money lovers' and see land as a business rather than a resource; there will be fewer trees; and local knowledge will be lost as the elderly own it and the younger generation is less interested in learning it.

After discussing changes in the landscape, we asked participants about their knowledge before and during the colonial period, which ended in 1964. Among the younger participants answers were understandably muddled. Participants did not specify any significant distinction between the periods. However, most (92%) were able to recall even minor changes in knowledge. Regarding agricultural and land management practices, they stated that cattle manure had been the primary source of fertiliser until synthetic fertiliser use began to spread after independence. This occurred particularly when, in the 1990s, fertiliser subsidies became part of the policy agenda in many sub-Saharan countries, including Zambia (Zinnbauer et al., 2007).

Regarding water management, in the past, people could find and identify many clean rivers from which animals

[7] Shallow wetlands characterised by grasses, rushes, and sedges, contrasting with surrounding woodland such as miombo woodland.

and people could drink. Today, water wells are one of the primary sources of drinkable water for household use that people protect to overcome periods of droughts.

> "Yes, there is a change because now rivers are drying fast because they have silted. Nowadays, we are even farming near rivers, and the soil is moving to the rivers, and rivers are silting. We never had a dam in the past, and animals survived with this water." (LKMu1)

While some local conservation practices have survived environmental changes, practices related to spiritual values and sacred places have been significantly eroded and, in some cases, are endangered or extinct (Table 4). Participants from all three villages acknowledge the loss of sacred places, such as the cult shrines (*malende*) and their associated taboos and beliefs. A *malende* was, and is, a natural site that serves communities linked by their reliance on land and natural forces. A *malende* is still regarded as a place of spiritual power, managed by clans, albeit less now that most people have converted to Christianity introduced with initial colonisation:

> "Many people, if not all, are practising Christianity as shrine practice was seen as an evil practice." (LKMt20)

In a few cases, people reported that they still go to the *malende*, if it is conveniently located while also attending Christian Sunday services, suggesting religious syncretism. Some *malende* are still present but, in many cases, completely unused by the community due to the relocation of their village to be closer to school facilities. The Kalomo Hill Forest Reserve has the sole remaining shrine, although it has been used by people outside the clan to graze and water cattle. Generally, taboos are also no longer taken seriously:

> "This shrine is for fish; it was a taboo to bring a black pot or basin here to fetch water, and pregnant women were not allowed to come here, and even men that had their wives pregnant were not allowed here because those who came, their pregnancies encountered miscarriage. After we shifted the don'ts to do's, the shrine became inactive." (LKSi19)
>
> "The river Simituli was a shrine where water never used to dry up. When we were growing up, we were told not to bring black buckets to the rivers. As time went by, due to the increasing population, people from different parts of the country settled here and started ignoring the rules that were in place. That's how Simutuli River started running out of water." (LKSi2)

One of the young participants showed us a *malende* that belongs to another village and told that during the drought, he usually asks the clan who manages it for permission to graze and water his cattle, a practice that in the past was completely forbidden. He stated:

> "This is the shrine, it does not dry up; this is where cattle drink from when all rivers dry up, and in this drinking area, the water is not hot." (LKSi6)

After sharing the local practices that people no longer use, participants noted several reasons that not all traditional local knowledge has completely vanished. First, some knowledge has been successfully transferred to younger generations who continue to use it, and second, some knowledge

Table 4 Stage of local knowledge erosion and related coping mechanisms

Local knowledge dimension[a]	Local practice	Stage of erosion	Coping mechanism
Conservation methods and livelihood traditions	Tree planting	Existing	Integrating 'external' knowledge
	Using trees and plants as medicine	Not at risk	Adaptation: local knowledge has been adapted and adjusted to social and environmental challenges
	Grass management	Deficient data on the practice	Adaptation: local knowledge has been adapted and adjusted to social and environmental challenges
	Applying cattle manure	Existing	Integrating 'external' knowledge
	Protecting water wells	Existing	Integrating 'external' knowledge
	Seed species conservation	Endangered/Extinct	Integrating 'external' knowledge
Sacred landscape & spiritual values	Shrine cult (*malende*)	Endangered	No adaptation. Replaced with Christian belief
Beliefs and taboos	Religious figures and rites	Extinct	No adaptation. Replaced with Christian beliefs
Climate indicators	Local weather observation	Deficient data on the practice	–

[a] Classification drawing from Yanou et al. (2023)

Source: Authors' construct based on interviews, May 2022

was adapted and integrated with 'external' knowledge types. Across the three villages, cattle manure, crop rotation, and water and seed management are still implemented according to local tradition.

Elders observe, however, that younger generations are often either uninterested in learning local knowledge or combine it with 'external knowledge' following recommendations of government officials. Concurrently, youth complained that no one teaches them local practices, yet several showed they mastered certain traditional practices related to agriculture. Indeed, all the young participants shared with us a variety of local practices they use daily, such as planting trees for soil management. Both youth and the elderly emphasised the importance of using both local and external knowledge provided by the agricultural and veterinary departments to overcome challenges related to soil degradation and reduced water availability and ensure household well-being.

Discussion

Our findings demonstrate that the immaterial aspects of local knowledge (e.g., shrine cults) are subject to erosion but that the three communities in Kalomo District still apply local Tonga knowledge for conservation and natural resource management. The results of the photovoice activity demonstrated the resilience of Tonga practices, particularly tree planting and techniques for applying cattle manure, and water, soil, seed, and grass management. However, interaction with external knowledge holders has resulted in hybridisation so that two or more knowledge systems co-exist in complementary ways. Thus local communities are learning and hybridising technologies and knowledge systems, and challenging and negotiating new environmental and social realities. Indeed, respondents welcome such integration due to the increasing challenges they are facing, including the effects of climate change (droughts and erratic rainfall) and soil erosion, displacement due to land dispossession, resettlement, and landscape fragmentation (Thomson & Bennett, 2005).

We initiated this study as part of a larger initiative[8] to operationalise an integrated landscape approach for improved landscape management based on multistakeholder collaboration and negotiation of competing land uses (Moombe et al., 2020; Reed et al., 2020; Sayer et al., 2013). ILAs build on ten principles (Sayer et al., 2013; Table S1) that are strongly grounded in Western science, notably conservation biology (Clay, 2016). This raises the question of how the ILA principles relate to the three dimensions of Tonga environmental ethics.

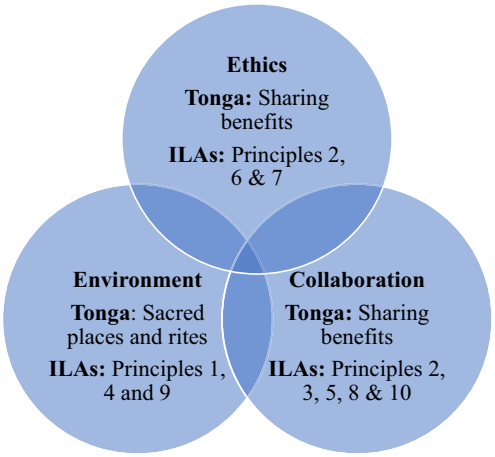

Fig. 8 Three dimensions of Tonga environmental ethics and ILA principles. P1 = Principle 1 = Continual learning and adaptive management; P2 = Common concern entry point; P3. Multiple scales; P4 = Multifunctionality; P5 = Multiple stakeholders; P6 = Negotiated and transparent change logic; P7 = Clarification of rights and responsibilities; P8 = Participatory and user-friendly monitoring; P9 = Resilience; P10 = Strengthened stakeholder capacity. See Table S1 in the supplementary material for an explanation of ILA principles. Source: Authors' construct

The overarching *ethical dimension* that characterises Tonga environmental ethics is also reflected in some ILA principles (Fig. 8). For instance, Principle 2 on the need for a common concern entry point emphasises the relevance of trust, rights, responsibility, and transparency in the process. Principle 6 emphasises a transparently negotiated change logic based on legitimacy and being informed about risks and uncertainties. Principle 7 emphasises the importance of having clear rights and responsibilities that are accepted by all. However, the ILA literature generally ignores relational values that dictate actions and behaviour and what this means for characterising and evaluating integrated landscape approaches (Carmenta et al., 2020). For instance, although ILAs are intended to be locally embedded and promote collaborative and equitable processes, most initiatives are initiated and implemented by external actors such as NGOs and research organisations, with the risk of insufficiently considering or building on existing local knowledge and practices (Ros-Tonen et al., 2018; Vermunt et al., 2020; Williams et al. 2020). As we have illustrated, local resource users, whose knowledge is often side-lined, may possess contextualised knowledge to manage natural resources but often lack agency and influence in decision-making, especially when implementation efforts are pre-conceived and originate outside the community and inadequately consider local dynamics or multiple epistemologies (Clay, 2016; Forsyth & Springate-Baginski, 2021).

[8] See https://www.cifor-icraf.org/colands/.

The *environmental dimension* is best reflected in ILA Principle 1, which promotes continual learning and adaptive management for better environmental outcomes; Principle 4, which recognises multifunctionality in landscapes; and Principle 9, which implies common action for recovery after perturbance for a resilient landscape (Sayer et al., 2013) (Fig. 8). Although ILAs recognise the importance of incorporating ILK in continual learning processes (Principle 1) and participatory and user-friendly monitoring (Principle 8), they insufficiently recognise that these knowledge systems are based on different worldviews key to transformational change (IPBES, 2022). We have seen that despite the erosion of belief systems and taboos, Tonga environmental ethics are based on a strong bond with ancestors and nature and a commitment to balanced human-nature relations that can strengthen the environmental dimension in ILAs.

The *collaboration dimension* resonates in all ILA principles, as ILAs fundamentally relate to improving collaborative processes, balancing interests, and addressing common concerns while recognising multiple epistemologies among different stakeholders. Notably, Principles 2 (common concern entry point), 3 (multiple scales), 5 (multiple stakeholders), 8 (participatory and user-friendly monitoring), and 10 (strengthened stakeholder capacity) centre on collaboration, which implies the interaction of different knowledge systems, hence hybridisation of ILK and external knowledge. Such hybridisation in collaborative processes like ILAs provides a strong basis for conservation and natural resource management and is a source of environmental resilience (Johnson et al., 2016; Tengö et al., 2017). Moreover, ILK is a good vehicle for people to understand how the physical environment works and how to cope with and overcome social and environmental challenges where few financial means are available. A stronger focus on local knowledge in collaborative processes helps preserve local cultures and history, with important implications for conservation.

However, our results show that hybridisation is a complex process. First, ILK is strongly related to cultural identity. We found that despite the erosion of traditional knowledge and practices for natural resource management, some are resilient and continue to be applied daily, indicating that they are strongly embedded in Tonga culture and history. Second, implementers of ILAs and other actors interested in integrating local knowledge into collaborative processes should be aware that the borders of the extent to which knowledge is local or external are blurred. Our results demonstrate that local knowledge has already been reconstructed by pre-existing relationships with NGOs, government agencies, and other actors, while 'expert knowledge' disseminated by NGOs and government extension services was partly built on local practices. Third, local knowledge has been reshaped over time and has become more compatible with bureaucratic planning, creating patronage-type relationships between the communities and practitioners or government representatives (Mosse, 1994, 2001). This shift is reflected in expressions of gratitude for the external knowledge introduced and the appreciation for "integrated knowledge." In such processes, loss of culture, spiritual power, and local knowledge in relation to dominant knowledge often coincides with a loss of authority in other areas (Colson, 2006; Shackleton et al., 2023). For instance, the arrival of an external religion such as Christianity, which is now the most widely practised religion in Zambia, has led to the loss of rites such as the shrine cult (*malende*) with implications for conservation practices (Colson, 2006; Shackleton et al., 2023). A few respondents mentioned combining attending Christian church services and practising *malende* rites. However, in most cases, spiritual beliefs and taboos were replaced with Christian values (Table 4). This suggests that religious syncretism observed elsewhere in Zambia (Makukula, 2018; Mildnerová, 2014) and sub-Saharan Africa more broadly (Ike, 2022) is limited in the study area.

Fourth, people in Kalomo use *luzibo kusangana* (integrated knowledge) when local knowledge is deemed insufficient to meet their needs, primarily in crop cultivation, water management, and cattle management. Even though hybridisation of knowledge occurs, local people tend to perceive 'external knowledge' to be better and there is a history of external actors arriving with pre-packaged knowledge and tools for the community to use. This relationship creates (and re-creates) dynamics in which local communities rely on outside assistance and knowledge, and practitioners create a space for local knowledge systems and holders solely for informative and consultative collaboration without recognising their legitimacy and authority. Such dynamics perpetuate colonial legacies that resulted in the erosion and loss of cultural beliefs and practices among local populations in their ancestral land (Shackleton et al., 2023), as also emerged from discussions with older research participants.

Fifth, the relational aspects and inherent power imbalances of interacting knowledge systems require further research. Awareness and understanding of power dynamics in knowledge hybridisation processes are crucial to understand how dominant and marginalised knowledge systems evolve (Masiero, 2022). Since our aim in this study was to gain insight into how Tonga traditional knowledge and practices and knowledge hybridisation contribute to conservation and natural resource and landscape management, we have not sufficiently addressed this issue here. Despite ample research on the intimate relationship between power and knowledge since the work of Foucault (1977) and its application to ILK by Escobar (1984, 2011), only a few studies have addressed power-knowledge relations in collaborative processes at the landscape level (Gonzales Tovar et al., 2021; Larson et al., 2022; Siangulube et al., 2022). These studies make clear that when hybridisation occurs, power imbalances should not be overlooked in knowledge integration and

collaboration processes, including the countervailing 'invisible power' (Siangulube et al., 2022) and 'spiritual power' of local communities (Shackleton et al., 2023).

Conclusion

Globally, Indigenous Peoples and local communities are increasingly recognised for their role in biodiversity conservation and the management of natural resources. Amongst academics, practitioners, and civil society organisations, Indigenous and local knowledge and practices are gaining acceptance and legitimacy. Our findings highlight the significance of local practices in managing the Kalomo landscape and how local knowledge has been adapted and hybridised over time and space in interactions with extension agents and NGOs and, hence, through the influence of the dominant Western knowledge system. In this hybridisation process, some local knowledge and practices get lost, while others show resilience to internal and external changes through the continued practice of traditional methods and by integrating external knowledge. Such hybridisation processes can be seen as important strategies for local knowledge adaptation to environmental and socioeconomic change.

Analysing knowledge interaction and hybridisation processes through the triptych of ethical, environmental, and collaboration dimensions, we argue that ILK (in this case, Tonga local knowledge) can enrich integrated landscape approaches dominated by Western knowledge through its stronger environmental ethics based on a sharing ideology and commitment to a balanced human-nature relationship. Hence, we argue that there is an urgent need to consider local knowledge and practices (embedded in the term ILK) and hybridisation processes as theoretical and practical starting points for implementing equitable, collaborative processes for landscape management, such as integrated landscape approaches.

In recent years, approaches and methods for addressing social and environmental challenges at the landscape level have advanced significantly. However, what is often still lacking is a shift beyond the rhetoric of collaboration to address the political dimension of knowledge sharing. We believe integrated landscape approaches that bring stakeholders with different knowledge systems together can run the risk of perpetuating the dominance of Western knowledge systems at the cost of Indigenous and local knowledge holders if they do not pay explicit attention to how ILK and associated worldviews are integrated into the learning and negotiation processes inherent in ILAs. Further research is needed to explore power dynamics in hybridisation processes and how landscape approaches can ensure equitable spaces to accommodate different knowledge systems, with respect for local knowledge systems and holders, their culture and rights.

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Author Contribution MY, MR, JR, SN, TS made substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data; drafted the work or revised it critically for important intellectual content; approved the version to be published; and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Data Availability The anonymised transcriptions can be made available by the corresponding author upon reasonable request.

Declarations

Ethical Approval Ethical consent for this study was obtained from the AISSR Ethics Advisory Board of the Amsterdam Institute for Social Science Research (AISSR) of the University of Amsterdam, applying the standards of the AISSR Integrity Protocol that "builds on the fundamental principles and responsibilities as formulated in Netherlands Code of Conduct for Research Integrity honesty, scrupulousness, transparency, independence and responsibility" (AISSR 2023: 3).

Competing Interests The authors declare no competing interests.

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