



Ancestral Traditions of the Future: Where is traditional knowledge and practice preservation directed?

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Research

Abstract

Background: Traditional knowledge and practice prevalence is on an overall decline. In this study, we examine preservation strategies reported in the literature, follow-up measures, and categories of traditional knowledge and conservation practices that are being attempted by non-profit organizations.

Methods: To answer these questions, we reviewed the literature for keywords related to TKP preservation and also searched databases of organizations with missions to preserve such knowledge. We found a range of traditional knowledge and practice preservation strategies that we categorized, and we provide a state of the current literature. The literature revealed anecdotal and qualitative follow-up measures with much emphasis on intellectual property rights.

Results: The strongest argument we found came from anecdotal evidence showing the fundamental importance of experiential learning with elders on ancestral land for the purpose of passing traditions, ideas, and knowledge from one generation to the next. Further, non-profit organizations focused on policy and community education as predominant objectives in their mission statements. These results show the importance of follow-up measures (both quantitative and qualitative) on initiatives done in the field.

Conclusions: TKP programs perform well when communities and local elders are consulted as they can foster culturally appropriate programs and provide a way to attract appreciation from the greater population. Overall, we recommend that both researchers and non-profit organizations assess these trends and caveats to help them form and direct their objectives to best conserve traditional knowledge and practices. Follow-up measurements, possibly based on museum-like surveys, would allow researchers to gain data for future initiatives.

Keywords: Traditional knowledge and practices, ethnobiology, TKP, Indigenous Peoples' Issues, Intellectual Property Rights, Preservation Strategies, ethno-education, protection of TKP, oral tradition, botanic gardens

Background

Traditional knowledge and practices (TKP) have contributed to fields including biodiversity conservation, environmental science, biomedical research, and climate change (Antons 2010, Fenta 2004, Finn *et al.* 2017, Gadgil *et al.* 1993, Jeeva 2006, Pandey 2002, Riedlinger & Berkes 2001, Turner *et al.* 2022, Wekundah 2012). The decline of this knowledge has led researchers to study TKP preservation (Anderson *et al.* 2012). Here, we examine TKP preservation initiatives and trends in the non-profit sector. These include projects of academic researchers and non-profit organizations aimed at documenting, conserving, or promoting the practice of traditional knowledge.

Traditional knowledge is largely passed on as oral tradition through narratives and experiences leading to tacit knowledge (Eyssartier *et al.* 2008, Soldati 2016), but amended and modified by the experience of each generation, and often leads to visible interactions with the landscape known as traditional practices. Two well-known practices are the use of herbal medicine and ceremonial dances. Others include, but are not limited to, practices related to shelter, food, heat, drink, agriculture, song, speech, story, philosophy, law, and ethics (CONABIO, n.d.).

Although TKP is not a guarantee of sustainable land use, scholars agree that it deserves a prominent place in a healthy conservation program (Cunningham 2001, Turner *et al.* 2022). The concepts of cultural keystone species and places show the connection of TKP to the ecosystems where these cultures thrive (Cuerrier *et al.* 2015, Garibaldi & Turner 2004). Many keepers of TKP live and work in sensitive areas located at the frontlines of environmental conservation and climate change (IASG 2014). Additionally, TKP can diminish due to industrial development, residential and commercial expansion, emigration of TKP keepers, and external societal pressures (Twarog 2004). Out of these circumstances have arisen ideas, strategies, initiatives, and organizations aimed at preserving the continued practice of TKP.

The United Nations has recognized the importance of those who hold TKP by publishing the Declaration on the Rights of Indigenous Peoples (United Nations 2008) and forming the Inter-Agency Support Group on Indigenous Peoples' Issues (IASG 2014). Additionally, the Convention on Biological Diversity has created the Traditional Knowledge Information Portal to incorporate TKP into conservation plans (CBD 2015). The World Health Organization (WHO), the International Union for the Conservation of Nature (IUCN), and the World-Wide Fund for Nature (WWF) also acknowledge the need to preserve traditional knowledge and practices of, in this case, medicinal plants (WHO 1993). The Nagoya Protocol asserts a connection between resources and the traditional knowledge connected to them (Ruiz Muller *et al.* 2017). This shows the recognition of TKP on the world stage.

Traditional knowledge and practices have intrinsic value to the communities that hold them. This intrinsic value includes social, cultural, spiritual, economic, scientific, intellectual, commercial, and educational contributions (dos Santos-Duisenberg 2010). This knowledge ebbs and flows with the needs of the community, yet sometimes it disappears (Pacón 2004). This exerts keepers of TKP to adapt and modify their practices to meet the needs of a changing world (Ondrusova 2004).

Land management of protected areas can benefit from the involvement of communities who include TKP in the management process (Berkes & Turner 2006, Gómez-Baggethun *et al.* 2010). Exclusion of local communities from conservation schemes prevents them from experimenting and continuing to develop their TKP (Gómez-Baggethun & Reyes-García 2013). Beyond land management, one must consider that plants, animals, and cultures coexist in the same ecosystem, forming cultural landscapes where biodiversity and TKP are intertwined (Reyes-García 2007). Because of this, Reyes-García (2010) and Vandebroek *et al.* (2011) suggest that TKP preservation and involvement of local communities can, and probably should, be directed at benefiting the health of the cultural landscape (Reyes-García 2010, Vandebroek *et al.* 2011).

In this study, we asked which trends in TKP research and preservation practices can guide us to generate initiatives that meet community and landscape needs. To identify potential factors and assess their effects, we conducted a systematic review of published research on TKP preservation strategies. We also analyzed mission statements of non-profit organizations who work to support TKP. We see this as a step in initiating TKP conservation strategies that can show distinct benefits to the landscape and cultures that depend on it.

Materials and Methods

Literature review

We reviewed the literature to assemble a bank of articles for analysis. To achieve this, we queried academic databases with accompanying search terms as shown in Table 1. The systematic review guidelines published by the Centre for Evidence-Based Conservation served as our guide during the assessment of articles and extraction of information (Collaboration for Environmental Evidence 2013). All queries took place between October 2016 and February 2021.

Our search produced a total of 3,558 results over an unrestricted year range up until February 18, 2021. Filtering for studies related to TKP preservation reduced this number to 119 articles. We assessed these articles and selected those that describe an initiative, project, action, situation, or discernible idea or recommendation about preserving traditional or Indigenous knowledge. Articles were excluded if the article itself was the only instrument presented as documenting knowledge to preserve it. This reduced our sample to 41 articles that outlined a preservation strategy and 31 of them included a proposed recommendation. We analyzed these articles for the strategy type, location, assessment, and the authors' premise.

Table 1. Queried databases with accompanying search terms

Database	Search Term	Articles Selected	Year Range
Academic Search Complete	"traditional knowledge preservation"	17	All
UN Trade and Development publications	"traditional knowledge"	12	All
Google Scholar	"ethnobotanical garden" OR "ethnobotanical gardens"	43	All
Google Scholar	"traditional knowledge conservation" OR "traditional knowledge preservation" OR "traditional ecological knowledge conservation" OR "traditional ecological knowledge preservation"	44	All
Google Scholar	"ethnobotanical trails" OR "ethnobotanical trail"	3	All

Data analysis

We created an attribute database for TKP preservation projects based on the literature reviewed. These attributes included strategy, categorized strategy, country, people, and post-assessment result. Following this, we created a map of TKP preservation endeavors based on the location data cited in the articles using the open-source geographic information system QGIS (QGIS Development Team 2017). The location data were obtained from articles as given by location data, identifying a certain group of people that generally reside in a geographic area, or by citing the country or territory.

Traditional knowledge preservation organizations

To assess trends in current TKP preservation strategies applied by the non-profit sector, we analyzed mission statements of organizations who strive to promote TKP. We searched the list of Indigenous and non-profit organizations published by the International Work Group for Indigenous Affairs (IWGIA n.d.) and the Guidestar database of non-profit organizations (Guidestar 2017) for organizations that aim to preserve traditional knowledge and practices. The search terms "traditional knowledge", "traditional ecological knowledge", and "Indigenous knowledge" were used. The mission statements of the resulting organizations were categorized according to the TKP conservation classification system of Tang and Gavin (2016). This classification system has five primary categories: Indigenous capacity building, community-based TKP conservation activities, education and awareness building, policy and legislative support, and research and documentation of TKP. These classifications were developed to serve as a structure to examine trends in TKP conservation actions (Tang & Gavin 2016).

Results

Traditional knowledge and practice preservation initiatives

This review yielded information on 48 studies of TKP preservation initiatives, which covered a diverse array of strategies on all continents (except Antarctica). We present a summary of these strategies in Table 2.

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Table 2. TKP preservation strategies are displayed by category along with the country and people. Post assessments and summarized results are also displayed for cited works. The acronym for traditional ecological knowledge (TEK) is used if mentioned in the cited work.

Strategy	Category	Country	People	Post Assessment	Result	Citation
Collaboration with indigenous groups	Indigenous capacity building	Mexico	Comcáac	Opinion	Tension between knowledge systems can lead to clever new ideas given much collaboration	Wilder <i>et al.</i> 2016
Financial and administrative support	Indigenous capacity building	India	Indian cultures	None	None	Gupta 2000
Museum collection	Research and documentation of TEK	USA	Native Americans	Opinion	Databases remove TKP from its holistic context	United Nations 2005
Co-management regime	Indigenous capacity building	Canada	Canadians, US citizens, and First Nations	None	None	Brockman <i>et al.</i> 1997
Sample collection network	Indigenous capacity building	Mexico	Maya	Opinion	Disagreement of communities on sharing TKP related biodiversity	Ceceña 2000
Medicinal plant supply for gardens	Community-based TEK conservation activities	Ghana	Local communities	None	None	Waylen 2006
Hunting supply	Community-based TEK conservation activities	Nunavut	First Nations	None	None	Brockman <i>et al.</i> 1997
Hunting supply	Community-based TEK conservation activities	Alaska	Native Americans	None	None	Brockman <i>et al.</i> 1997
Land management	Community-based TEK conservation activities	Throughout tropics	NA	None	None	Posey & Dutfield 1996
Ethnobotanical garden	Community-based TEK conservation activities	Belize	Q'eqchi'	Opinion	Community run projects are more sustainable	Audet <i>et al.</i> 2013
Ethnobotanical garden	Community-based TEK conservation activities	None	NA	None	None	Jones & Hoversten 2004
Ethnobotanical garden	Community-based TEK conservation activities	France	NA	None	None	Brousse 2015

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Ethnobotanical garden	Community-based TEK conservation activities	Canada	First Nations	None	None	Dias & Janeira 2005
Ethnobotanical garden	Community-based TEK conservation activities	Costa Rica	Costa Rican Communities	None	None	Waylen 2006
Ethnobotanical garden	Community-based TEK conservation activities	Uganda	Women and Children of Uganda	None	None	Waylen 2006
Medicinal plant supply for gardens	Community-based TEK conservation activities	South Africa	HIV/AIDS patients	None	None	Waylen 2006
Botanic garden	Community-based TEK conservation activities	NA	NA	None	None	Martellos <i>et al.</i> 2016
Visual art	Community-based TEK conservation activities	Canada	Inuit	Opinion	Indigenous art helps people heal from historical trauma done to their people	Crawford 2014
Basket commerce	Community-based TEK conservation activities	USA	Tohono O'odham	None	None	O'Neill 2001
Medicinal plant commerce	Community-based TEK conservation activities	Afghanistan	Rural Afghans	None	None	Ottens <i>et al.</i> 2006
Ecotourism	Community-based TEK conservation activities	China	Tibetan Kham speakers	Opinion	TKP awareness can help people value and restore ecosystems	Chunhui <i>et al.</i> 2012
Ethno-education	Education and awareness building	Suriname Colombia	Amazon locals	Opinion	Tribal peoples desire basic needs and ethno-education	Murray 2006
Ethno-education	Education and awareness building	Canada	Eeyou-Cree	Anecdote	Renewed interest in learning when youth spend time on the land learning from elders	Mathew 1999
Multi-generational excursions	Education and awareness building	Australia	Girringun Aboriginal	None	None	Zurba 2010

Interdisciplinary communication between healers	Education and awareness building	Colombia	Afro-Colombians	None	None	López <i>et al.</i> 2011
TKP-themed television	Education and awareness building	Canada	Canadians and First Nations	None	None	Brockman <i>et al.</i> 1997
TKP-themed radio	Education and awareness building	Mexico	Tarahumara Raramuri	None	None	Tang <i>et al.</i> 2016
Policy for TKP	Policy and legislative support	Pacific Islands	Pacific Islanders	None	None	Kariyawasam 2008
Policy for TKP	Policy and legislative support	Canada	Residents NWT	Opinion	Unclear how to implement policy and lack of cross-cultural training	Brockman <i>et al.</i> 1997
Official language status	Policy and legislative support	Canada	Residents NWT	Opinion	Number of speakers continues to decline	Brockman <i>et al.</i> 1997
Policy for TKP	Policy and legislative support	Brazil	World	Opinion	Declaration of Belém catalyzes TKP rights in Brazil	Soldati & Albuquerque 2016
Digital database	Research and documentation of TEK	India	Indians	Opinion	Shows prior art of TKP	Poorna <i>et al.</i> 2014
Digital database	Research and documentation of TEK	South Korea	Koreans	Opinion	Shows prior art of TKP	Poorna <i>et al.</i> 2014
Digital database	Research and documentation of TEK	Taiwan	Chinese ancestry	Opinion	Shows prior art of TKP	Poorna <i>et al.</i> 2014
Digital database	Research and documentation of TEK	Venezuela	Amazonian ethnic groups	Opinion	Shows prior art of TKP	Poorna <i>et al.</i> 2014
Digital database	Research and documentation of TEK	South Africa	Durban area	Opinion	Increases accessibility	Poorna <i>et al.</i> 2014
Digital database	Research and documentation of TEK	Australia	Anangu and other groups, western and central Australia	Opinion	Increases accessibility	Poorna <i>et al.</i> 2014
Digital database	Research and documentation of TEK	USA	Tulalip	None	None	Twarog 2004
Digital database	Research and documentation of TEK	India	Indians	None	None	Twarog 2004

Digital database	Research and documentation of TEK	Canada	Kaska	None	None	United Nations 2005
Digital database	Research and documentation of TEK	Venezuela	NA	Opinion	Existence of database to protect potential IP	Vivas Eugui & Ruiz Muller 2001
Digital database	Research and documentation of TEK	China	NA	None	None	Du <i>et al.</i> 2013
Digital database	Research and documentation of TEK	Australia	Ethnic groups across Australia	Opinion	TKP must be accessible to community members	Stevens 2008
Library collection	Research and documentation of TEK	Canada	Inuit	Opinion	TKP must be accessible to community members	Stevens 2008
User contributed stories	Research and documentation of TEK	Australia	Yolngu	Opinion	TKP must be accessible to community members	Stevens 2008
Information management	Research and documentation of TEK	NA	NA	None	None	Maina 2012
User contributed stories	Research and documentation of TEK	NA	NA	None	None	Hunter 2005
User contributed stories	Research and documentation of TEK	Australia, Galiwinku	Yolngu	Opinion	Presence of indigenous centres can help communities	Beale 2003

When assessing the data, we found that follow-up measures, either quantitative or qualitative, were scarce. Furthermore, all but one of the follow-up assessments were opinion-based. The only data-based follow-up assessment depicted a case where a local elder called students after ethno-educational sessions for a post-hoc interview. These interviews took place months or years after the sessions. His qualitative assessment depicted how students had a renewed interest in learning after attending the ethno-educational sessions with elders (Mathew 1999).

Location of TKP preservation initiatives

An analysis of location data shows that Southern Asia is a leader in examples of digital databases meant to prevent biopiracy by showing prior art of TKP. Australia has original library and database techniques aimed at facilitating entry and access to TKP. Community partnership programs seem to be common in Sub-Saharan Africa. The Americas show an even mixture of strategy categories. The distribution of TKP preservation initiatives is presented in Figure 1.

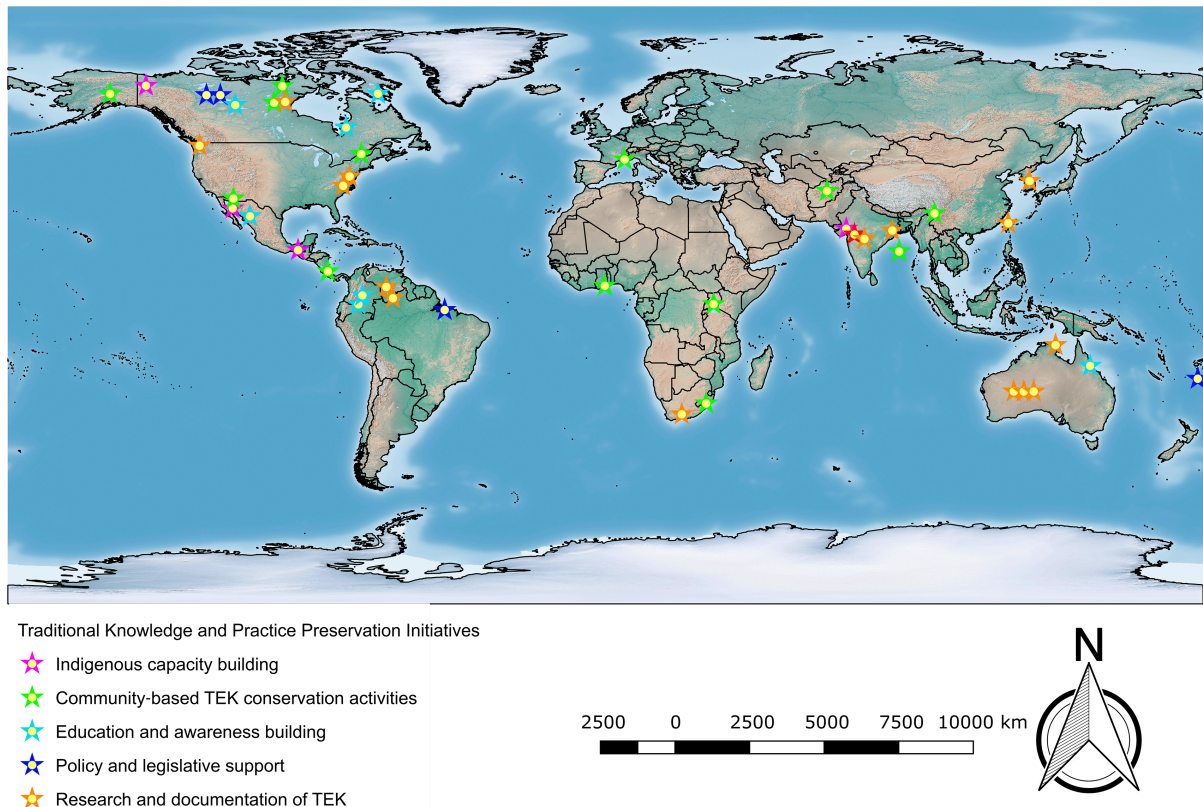


Figure 1. Traditional knowledge and practice preservation strategies occur around the globe. Here we depict the initiatives from our literature search as a reference to the general location of these varied approaches ($N = 45$). World map data was sourced from Natural Earth (Natural Earth 2012).

Post assessments of initiatives

Although the majority of studies do not possess a post-assessment measure, some authors produced a post-assessment. We analyzed these 23 assessments and present their name, strategy, country, people, and assessment description in Table 3.

Researcher-proposed strategies

Researchers proposed strategies that fall within the five main categories presented by Tang and Gavin (2016). These categories are Indigenous capacity building, community-based TEK conservation activities, education and awareness building, policy and legislative support, and research and documentation of TEK. The key premise of each recommendation is summarized in Table 4.

Table 3. Post assessments of TKP preservation strategies.

Name	Strategy	Country	People	Assessment	Citation
Itzamma Garden and Medicinal Plant Project	Ethnobotanical Garden	Belize	Q'eqchi'	Community run gardens evade funding swings of academia and NGOs	Audet <i>et al.</i> 2013
Declaration of Belém	TKP rights	Brazil	World	Declaration of Belém and Posey's letter spurred TKP rights discussion	Soldati & Albuquerque 2016
Baimaxueshan National Nature Reserve Ecological Restoration and Traditional Knowledge Preservation through Eco-cultural Tourism	TKP and ecotourism	China	Tibetan Kham speakers	Involving local elders in pastureland restoration seemed to boost the value of TKP in the minds of surrounding people	Chunhui <i>et al.</i> 2012
Cree School Board Outdoor Education	Ethno-education	Canada	Eeyou-Cree	After intergenerational courses held on native lands, adolescents had a renewed interest in learning.	Mathew 1999
Biodiversity Index collaboration with the Comcáac	Collaboration with indigenous groups	Mexico	Comcáac	Tensions between knowledge systems can lead to clever insights for diligent collaborators	Wilder <i>et al.</i> 2016
National Museum of the American Indian Repatriation	Artifact repatriation through database	Australia	Ethnic groups across Australia	Skeptical that TKP removed from its context still has value	Stevens 2008
Tuktu and Nogak Project	TEK Caribou hunt	Canada	Inuit	Skeptical that TKP removed from its context still has value	Stevens 2008
Our Story Database	User contributed stories	Australia	Yolngu	Skeptical that TKP removed from its context still has value	Stevens 2008
Traditional Knowledge Digital Library	Digital Database	India	Indians	Non-codified tacit knowledge is difficult to store, yet imperative since it can help protect intellectual property rights	Poorna <i>et al.</i> 2014
Korean Traditional Knowledge Portal	Digital Database	South Korea	Koreans	Digital databases can help prevent biopiracy	Poorna <i>et al.</i> 2014
Chinese Traditional Medicine Database System	Digital Database	Taiwan	Chinese ancestry	Digital databases can help prevent biopiracy	Poorna <i>et al.</i> 2014
BioZulua Project	Digital Database	Venezuela	Amazonian ethnic groups	Digital databases can help prevent biopiracy	Poorna <i>et al.</i> 2014
Ulwazi programme of Durban	Digital Database	South Africa	Durban area	TKP can be disseminated via freeware and library services	Poorna <i>et al.</i> 2014
Ara Irititja Project	Digital Database	Australia	Anangu and other groups, western and central Australia	TKP must be accessible to communities	Poorna <i>et al.</i> 2014

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Inuit Art	Visual art	Canada	Inuit	Visual arts can help people examine and heal from historical trauma	Crawford 2014
Galiwin'ku Indigenous Knowledge Centre	User contributed stories	Australia, Galiwinku	Yolngu	TKP resource centres help communities find solutions to their needs	Beale 2003
Smithsonian Center for Folklife and Cultural Heritage	Collection	USA	NA	Databases take TKP out of their holistic context and preserve them in a static state	United Nations 2005
The Library of Congress	Digital database	USA	NA	Databases take TKP out of their holistic context and preserve them in a static state	United Nations 2005
The Database of Official Insignia of Native American Tribes DONATI	Digital Database	USA	Native Americans of USA	Databases take TKP out of their holistic context and preserve them in a static state	United Nations 2005
BioZulua Database	Digital Database	Venezuela	NA	TKP and the problems it solves are in continuous evolution as opposed to a static state	Vivas Eugui & Ruiz Muller 2001
Amazon Conservation Team	Ethno-education and TKP conservation	Suriname Colombia	Amazon locals	Conservation strategies that take community needs into account succeed	Murray 2006
Northwest Territories' Official Languages Act	Grant official language status	Canada	Residents NWT	Indigenous language speaker numbers still declined after gaining official language status; government policy alone cannot save language	Brockman <i>et al.</i> 1997
Northwest Territories' Government Wide Traditional Knowledge Policy	Government wide policy for TKP	Canada	Residents NWT	How policy is often unclear and cross-cultural training is often lacking	Brockman <i>et al.</i> 1997

Table 4. Recommendations found in the literature for conservation or preservation of traditional knowledge and practices.

Categorized Recommendations	Citation
Indigenous capacity building	
Apply TKP to conservation and agriculture	Oviedo <i>et al.</i> 2004
Collaborate with communities to generate new ideas	Wilder <i>et al.</i> 2016
Create access to markets	Twarog & Kapoor 2004
Create TKP community associations	Ondrusova 2004
Empower women and children	Oviedo <i>et al.</i> 2004
Focus on community run projects	Audet <i>et al.</i> 2013
Preserve indigenous identity	Twarog & Kapoor 2004
Promote traditional diets	O'Neill 2001
Provide financing	Twarog & Kapoor 2004
Strengthen local capacity	Vivas Eugui & Ruiz Muller 2001
Support women and elderly	United Nations 2005
Community-based TEK conservation activities	
Alternative to IPR: Geographic indicator	United Nations 2014a
Alternative to IPR: Pay and use system	United Nations 2014b
Commercialize TKP resources	Twarog & Kapoor 2004
Emphasize conservation instead of monetization of resources	United Nations 2001
Include TKP in conservation programs	Chunhui <i>et al.</i> 2012
Involve communities in management and decision making	Brockman <i>et al.</i> 1997
Promote community involvement	Oviedo <i>et al.</i> 2004
Promote indigenous language	Oviedo <i>et al.</i> 2004
Promote TKP for development and trade	United Nations 2001
Protect biodiversity	Twarog & Kapoor 2004
Sell traditional goods online	Twarog & Kapoor 2004
Sell value added products	Ottens <i>et al.</i> 2006
Education and awareness building	
Disseminate TKP in educational activities	Brousse 2015
Encourage language use	Oviedo <i>et al.</i> 2004
Inform TKP practitioners about IPR	Ondrusova 2004
Inform TKP practitioners about IPR	Vivas Eugui & Ruiz Muller 2001
Intergeneration projects connect youth with elders	Zurba 2010
Produce indigenous language media	United Nations 2005
Promote ethno-education	Twarog & Kapoor 2004, Ondrusova 2004, Oviedo <i>et al.</i> 2004, United Nations 2005
Promote intergenerational ethno-education on native lands	Mathew 1999
Promote TKP awareness in media	Brockman <i>et al.</i> 1997, United Nations 2005, Poorna <i>et al.</i> 2014
Promote TKP dialogue in botanic garden setting	Dias & Janeira 2005
Promote traditional and civil society communication styles	Twarog & Kapoor 2004
Provide training programs	United Nations 2001, Vivas Eugui & Ruiz Muller 2001, Oviedo <i>et al.</i> 2004, Waylen 2006
Recognize strengths of customary practices	United Nations 2005
Spur communication between traditional healers and conventional physicians	López <i>et al.</i> 2011
Use online communication to connect youth from distant communities	United Nations 2005

Use traditional art to examine and recover from historical trauma	Crawford 2014
Policy and legislative support	
Acknowledge ancestral rights	Cabrera Medaglia 2004
Acknowledge IPR alone does not protect knowledge	Vivas Eugui & Ruiz Muller 2001
Acknowledge that TKP may be collective	Cabrera Medaglia 2004
Acknowledge TKP as valuable even if it is in the public domain	Cabrera Medaglia 2004
Alternative to IPR: <i>Sui generis</i> systems	United Nations 2001, Vivas Eugui & Ruiz Muller 2001, Kaushik 2004, Oviedo <i>et al.</i> 2004
Be aware of distinctions between rights to genetic resources and rights to the associated TKP	Cabrera Medaglia 2004
Be consistent in TKP protection	Roberts 2004
Communities need legal representation	Vivas Eugui & Ruiz Muller 2001
Conserve lands	Oviedo <i>et al.</i> 2004
Conserve resources	Oviedo <i>et al.</i> 2004
Create local registers of TKP	Cabrera Medaglia 2004
Define TKP protection	Vivas Eugui & Ruiz Muller 2001
Develop identification system for TKP	Ondrusova 2004
Develop legal framework to deal IPR issues and TKP	Twarog & Kapoor 2004
Develop legal framework to deal IPR issues and TKP	United Nations 2001
Have contact centres to respond to communities' needs	Beale 2003
Must not assume IPR systems will work for a community	Vivas Eugui & Ruiz Muller 2001
Promote plant variety protection programs	Greengrass 2004
Protect rights of prior art	Poorna <i>et al.</i> 2014
Realize it is hard to get large groups of people to agree and agreement may change in the future	Ceceña 2000
Realize that government policy alone cannot save a language	Brockman <i>et al.</i> 1997
Recognize communities as central actor in conservation	Vivas Eugui & Ruiz Muller 2001
Recognize existing IPR laws are not sufficient	Kariyawasam 2008
Recognize the obligation of the state to protect cultural identity	United Nations 2005
Recognize land rights	United Nations 2005
Review difficulties in legal framework	United Nations 2001
Share benefits earned from TKP	Twarog & Kapoor 2004
Tackle the problem of planning and enforceability	Vivas Eugui & Ruiz Muller 2001
Use existing alternatives to patents: trademarks, trade secrets, appellations of origin	Vivas Eugui & Ruiz Muller 2001
Research and documentation of TEK	
Digital libraries may help prevent biopiracy	Du <i>et al.</i> 2013
Disseminate research findings to local communities	Waylen 2006
Documentation may help prevent biopiracy	Poorna <i>et al.</i> 2014
Enable metadata forms that keepers of TKP can edit	Hunter 2005
Evaluate instruments used to protect TKP	Vivas Eugui & Ruiz Muller 2001
Promote community-based TKP documentation	Oviedo <i>et al.</i> 2004, United Nations 2005
Publish conclusions of TKP work groups	United Nations 2001
Reassess library categorization to include community members	Stevens 2008
Reassess library categorization to include community members	Maina 2012
Use botanic gardens to preserve TKP	Jones & Hoversten 2004, Martellos <i>et al.</i> 2016

Non-profit and academic sector trajectories

The non-profit sector focuses time, energy, and funds on preserving TKP. Policy receives the most emphasis with 40% (Figure 2). Documentation and research including digital databases lag behind with 5%. When viewing the focus of strategies presented in academic articles, the most emphasis is placed on research and documentation, followed by community-based conservation activities. Policy support, which is the largest focus of non-profit organizations, is one of the lowest in academic circles (Figure 3).

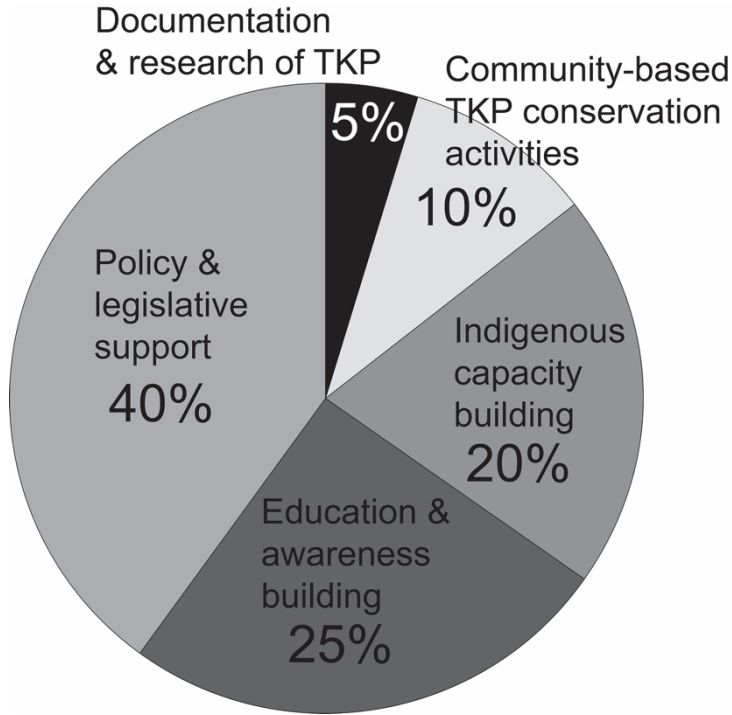


Figure 2. Organizations that aim to preserve and support TKP in some fashion. Their mission statement categorizations show differences in emphasis and strategies as outlined by Tang and Gavin (2016) and then compared as a percentage of total initiatives ($N = 83$).

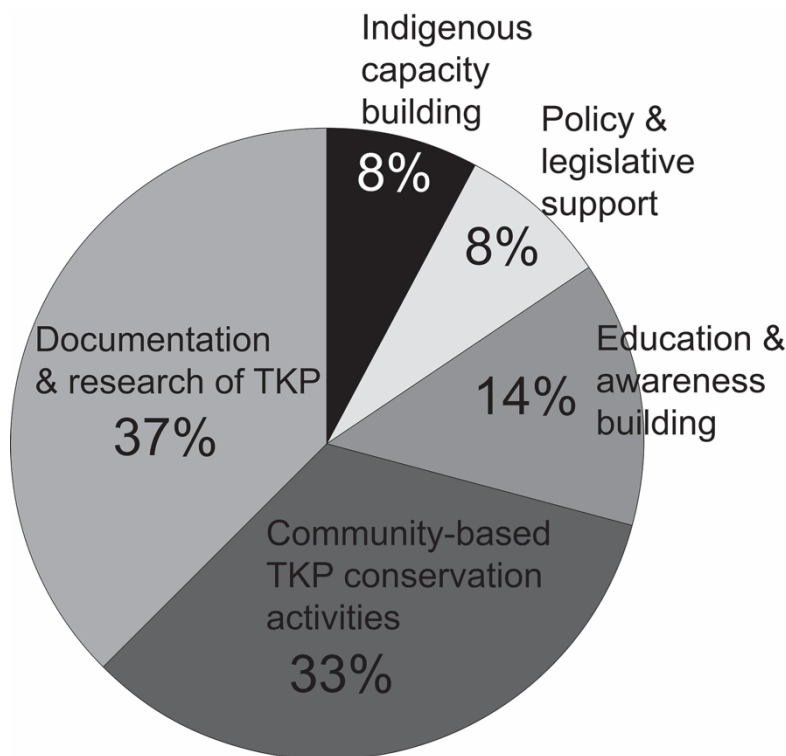


Figure 3. Academic studies that identify TKP preservation initiatives were categorized as per the categories of Tang and Gavin (2016) and then compared as a percentage of total initiatives ($N = 51$).

Discussion

In this investigation, we analyzed traditional knowledge and practice preservation strategies for the purpose of guiding future work. Our analysis of current strategies, follow-up assessments, recommendations, and directions of the non-profit sector show gaps in the field that provide opportunities for researchers. This study offers five observations. First, there is a need for both quantitative and qualitative post-intervention assessments and measurements. Second, location data show varying emphasis of TKP initiatives in some geographic regions. Third, of the sparse follow-up data, anecdotal evidence indicates that inter-generational shared time on native lands results in the most successful interventions. Fourth, recommendations largely express difficulties merging traditional and conventional systems. Fifth, the non-profit sector predominately focuses on policy and legislation, and focuses least on documentation and research of TKP.

Traditional knowledge and practice preservation strategies around the world

This study shows the limits of the literature on TKP conservation. Authors discuss and refer to preservation initiatives, yet rarely give an assessment of their programs. When assessments are discussed, there is little to no quantitative or qualitative data to support any conjectures. Given the importance of traditional knowledge and practice systems in ethnobiology (Salick *et al.* 2003) and the availability of tools to quantify changes in TKP over time (Reyes-García *et al.* 2013, Vandebroek & Balick 2012), our analysis shows the need and possibility for studies in applied conservation of TKP.

Researchers can draw on methods from museum evaluations. Museums routinely do post hoc assessments in the form of visitor evaluations. These methods are simple and would easily fit into a research plan. These evaluations include participant involvement in planning and then evaluation of attitude changes, learning, intent to return, and intent to recommend a given program (Bickman & Hamner 1998, Harrison & Shaw 2004, Rowe & Frewer 2000). With slight modification, researchers can use these existing concepts to evaluate the impact and efficacy of their TKP research and projects.

An easily accessible list of TKP initiatives around the world would benefit research, community involvement, and interaction with volunteers. This would also benefit local partners as they would know what is actually available along with potential feedback from past initiatives.

Lessons from post-assessment data

Post-assessment opinions highlight areas of hope and concern for TKP conservation initiatives. When taken together, a progression of ideas becomes clear. First, TKP preservation projects are most effective when local elders are consulted to help guide the project (Audet *et al.* 2013, Chunhui *et al.* 2012, Royte 2005). Subsequently, potential programs facilitating inter-generational learning on the land can stimulate youth learning (Mathew 1999). Later, when interacting with outside organizations, different knowledge systems may pose barriers to project completion, but the struggle of learning and working with multiple knowledge systems and philosophies can give rise to novel and beneficial ideas (Wilder *et al.* 2016). The aspects that have been praised, and seem to have good results, mainly share the concept of addressing needs on a personal level, such as between parent and child, or leaders discussing options for their community. Moreover, external types of approaches garnered criticism in the literature. For example, documenting TKP in a static state takes it out of its holistic context (United Nations 2005, Vivas Eugui & Ruiz Muller 2001). Given that TKP is not static, but changing (Pacón 2004), both documentation of current knowledge and policies to help ensure continued practice should be considered. Further, good policy changes with intentions of protecting or promoting TKP are often difficult on a practical level. It often remains unclear how to implement the policy and, cross-cultural training is, many times, lacking (Brockman *et al.* 1997). Even with training and implementation instructions, there is no guarantee that a new policy will change an outcome. For example, the number of Indigenous language speakers in the Canadian Northwest Territories is still declining even though all local languages have been given official status (Brockman *et al.* 1997). While policies are important for reasons such as societal inclusion, it appears that the continuation of TKP depends on personal interaction, social status of the knowledge holder, and the way of life of the community as opposed to an external system.

Recommendations from the literature

Recommendations on Table 4 varied in specificity and clarity. In the category of "Indigenous capacity building," recommendations focused on notions of empowerment, infrastructure creation, and collaboration.

The recommendations from the "Community-based TKP conservation activities" centred on commercializing products (Twarog & Kapoor 2004). The idea is that an increased monetary value would incentivize continued use

of TKP. Yet, market value may drive land-use change, and external companies may enter the area such as what happened in the case of quinoa (*Chenopodium quinoa* Willd.) and maca (*Lepidium meyenii* Walp.) (Hermann & Bernet 2009, Jacobsen 2011, McDonnell 2021, Smith 2015, Tavui 2016). Interestingly, there was also a call for emphasis on conservation instead of monetization of resources (Ottens *et al.* 2006, United Nations 2001). Along these lines, the objectives of community members often align with an emphasis on conservation (Cuerrier *et al.* 2012a). This was seen with James Bay Cree elders emphasizing conservation over monetization of genetic resources (Cuerrier *et al.* 2012b). Whatever plan is used, Cash *et al.* (2003) admonish planners to be methodical and implement and evaluate initiatives in the context of hands-on field experience, yet this may be at odds with local decision making which may be more experience and relationship-based.

If resources will be commercialized, Berkes and Davidson-Hunt (2007) suggest management take a community-based focus with the management being done by people close to the resource as opposed to external overseeing agencies. This suggestion alludes to the concept of biocultural design, which takes into account potential benefits and drawbacks of new social enterprises (Mardones *et al.* 2021). One point to consider would be potential changes that may affect groups or communities when TKP is commercialized.

The recommendations from the "Education and awareness building" section focus on promoting the cultural value of TKP, disseminating it via schools and through new technologies, creating dialogue between societies, and creating awareness of intellectual property rights (IPR) amongst community members. One suggestion was to use online communication technologies to connect distant, yet culturally complementary communities (United Nations 2005). In this way, youth from a small community can collaborate with youth from another isolated community as Internet access spreads (IWS 2017, Owiny *et al.* 2014).

Additionally, the qualitative data in some references support the idea that intergenerational ethno-education, where elders and youth can learn on their native land is needed, desired, and productive for TKP preservation (Audet *et al.* 2013, Chunhui *et al.* 2012, Mathew 1999, Royte 2005). Indeed, Cuerrier *et al.* (2012b) have shown the importance of inter-generational workshops to maintain TKP. Although related to climate change, Downing and Cuerrier (2011) have illustrated the link between elders and youth for preserving cultural practices, leading possibly to community wellness and adaptation to global warming which visibly affects their northern climate.

The recommendations from the "Policy and legislative support" section highlight the main problem that TKP and conventional IPR systems do not match with the collective nature of TKP (Cabrera Medaglia 2004, Kariyawasam 2008). Many authors suggest acknowledging the value of TKP and creating a new system as designated by the Latin term *sui generis*. Yet, what this *sui generis* system could, or should, be is lacking. Others feel that instead of trying to invent a new system, both external groups and local communities should focus on existing alternatives to patents (Vivas Eugui & Ruiz Muller 2001). These alternatives may work for a given community in their current form, which include trademarks, trade secrets, and appellations of origin. Other authors bring up the difficulty of getting large groups of people to agree, and if an agreement is reached, there is no guarantee that the agreement won't change in the future (Ceceña 2000, Moerman 2008). Delving into legal rights often requires communities to form one of various forms of corporations and file documents through this legal entity. For these formalities of IPR protection, communities need high-quality legal counsel (Vivas Eugui & Ruiz Muller 2001). Yet, even so, the legal ideologies are foreign and often contradictory to local systems, traditions, and beliefs.

The sources in the "Research and documentation of TKP" section state that documenting TKP can protect it from biopiracy. The current position is that if a use for a resource is documented, then this documentation shows prior art, and, therefore, it cannot be patented by an external party. However, it does not prevent a person or company from patenting a process pertaining to some preparation or procedure related to that use. Some researchers suggest that community-based documentation initiatives pose the best option (Maina 2012, Oviedo *et al.* 2004, Stevens 2008). If this community-based model includes multiple generations, it could help bolster inter-generational interaction. While researchers often discuss the potential benefits of community-run projects, it would be equally beneficial to discuss and measure potential challenges. Reaching a consensus, particularly, between groups of different age and economic levels may cause projects to stall. Reporting on this would give valuable follow-up data to the literature.

Another option involves nurturing living collections such as botanic gardens. These can help document, disseminate, and promote TKP to the local community and beyond (Jones & Hoversten 2004, Martellos *et al.* 2016). Botanic gardens can inform the public on TKP, and they can include the public in various forms of conservation

through citizen science programs (Martellos *et al.* 2016). Given the estimated 250 million visitors to botanic gardens each year (Ward *et al.* 2010), they serve as a useful TKP educational tool. Morgan *et al.* (2009) found positive changes in youth who participated in garden education programs. These included increased environmental awareness, social and personal growth, and positive life experience and cultural appreciation. If garden administrators include Indigenous youth and elders in teaching and educational facilitation, the real-life experience of these teachers add to the quality of the lessons.

Non-profit and academic trajectory

The non-profit sector showed a large proportion of mission statements focusing on "Policy and legislative support". This support focused mainly on representation of Indigenous peoples or community needs. "Education and awareness building" and "Indigenous capacity building" were included in mission statements 25% and 20% of the time respectively. "Community-based TKP conservation activities" and "Documentation and research of TKP" had small shares at 10% and 5% respectively. This data shows the popularity of supporting Indigenous rights and policy along with notions of capacity building.

Inter-generational educational and community-based initiatives received enthusiastic praise in various research articles, and digital databasing and archiving is widely discussed in the literature, but the non-profit sector seemed to lean towards policy and legal representation. Policy support was discussed 8% of the time in academic publications, but documentation and research were discussed 37% of the time. This illustrates a disconnect between academic and non-profit actions. It is common for research activities to be disjointed from application. For example, biomedical research often does not reach the clinic and agricultural research often never enters the farm field in practice. While it is important to acknowledge not all research is applicable it would serve researchers, non-profit managers, and community members to be aware of this disconnect.

Highlights from the literature

Communication

Recommendations for communication focus on two main channels. These channels comprise communication between elders and youth, and communication between keepers of TKP and conventional industry. For example, the Kugluktuk Angoniatit Association in the Bathurst Inlet region of Nunavut created a project to stimulate TKP communication between youth and elders. This project consisted of interviews done by the local youth with the goal to document and report TKP of the region (Thorpe *et al.* 2001). These types of projects provide a means to document knowledge of elders while fostering youth–elder interaction and passing down knowledge, thus bridging the intergenerational gap.

Another form of communication suggested is dialogue between TKP practitioners and conventional industry. For example, some researchers call for traditional healers and conventional physicians to communicate about remedies and patient treatments with the goal of providing treatment options adaptable to the patients' needs with the added safety from a joint understanding between healers and physicians (López *et al.* 2011). Mutual understanding of two world views allows participants from each philosophy to contribute their expertise. Often called "two-eyed seeing," this approach acknowledges the value of both TKP and science and encourages working and learning together (Bartlett *et al.* 2012).

Some authors recommend collaboration between Indigenous groups and outside organizations (Popova 2014). Possible benefits of collaboration may be seen, for instance, in a combination of ecotourism with experiences of local elders and knowledge holders. The idea is that these elders may show what species were historically present on a landscape and help attach value to the ecosystem (Chunhui *et al.* 2012).

Ethnobotanical gardens

Ethnobotanical gardens present one of the most visually appealing strategies to preserve traditional knowledge and practices related to plants, humans, and animals (Balick & Cox 1996). Ethnobotanical gardens served as living pharmacies for European medical students during the early modern era (Heywood 1987). More currently, the Q'eqchi' Mayan-Itzamma Garden in Belize provides medicinal plants to local traditional healers (Audet *et al.* 2013). Along with gardens come risks and challenges of plant establishment (Audet 2009), and elements of design and planning along with labour intensive maintenance. Model garden plans exist, and planners can learn from these (Jones & Hoversten 2004). One core tenant is to create community-run gardens. This avoids shifts in funding and guides the project towards sustainability but may rely on volunteer labour (Audet *et al.* 2013). Also, one main goal

of garden administrators should be to help familiarize young people with traditional plants (Martin 1995). Indeed, gardens are known to be excellent educational tools (Barabé *et al.* 2012).

Educational institutions

Some educational institutions incorporate ethno-education. Two examples include the Banfora Centre of Traditional Pharmacopoeia in Burkina Faso and Tumulkin Learning Centre in Belize. These schools combine conventional learning with traditional practices and experiences based on TKP (Dakuyo 2004, Tumulkin Learning Centre n.d.). In this way, youth may fulfil their schooling in a competitive world, yet still, retain and grow their cultural heritage.

Intellectual property rights

Current IPR regulations allow a person or corporation to register proprietary knowledge for certain processes. But large groups of people do not fit this mould. The main critique brought up time after time is that one may not know exactly to which person, group, or groups of people the intellectual property belongs (Moerman 2008, Yupari *et al.* 2004). Further, current regulations on IPR do not provide protection mechanisms for knowledge that is held for long periods of time (Cameiro da Cunha 2004). This leads to a conundrum in that the current goal is to promote TKP, while conventional patent regulations limit dissemination. Instead of a positive impulse, in that TKP grows, they are negative in that they restrict the number of people who can use a given innovation (Roberts 2004). This is an ongoing struggle with no clear solution.

Geographic indicators

Geographic indicators provide a chance for local communities to protect marketable products. These provide regulations on the location in which a product may be produced. This can help local producers on tight profit margins, but can also lead to degradation of biodiversity as is the case with *Agave tequilana* F.A.C. Weber where this marketing protection pushed production of only one species (United Nations 2014a).

Libraries and digital databases

Digital databases play a role in documenting, protecting, and disseminating TKP. The tacit nature of TKP does not lend itself well to the information management schemes of libraries (Maina 2012, Rahman 2004). Because of this, some researchers suggest that librarians must incorporate new strategies in their classification systems. Examples of this include the Brian Deer Classification System, curation services for TKP at the Galiqin'ku Indigenous Knowledge Centre in Australia, and editable metadata by keepers of TKP (Beale 2003, Hunter 2005, Maina 2012). Also, some information, especially about medicinal plants, may pose problems as many Indigenous groups do not want their knowledge to be divulged. Thus, access becomes problematic with who can and cannot access databases and libraries and who controls the access.

Conclusion

Various initiatives for TKP preservation show promise in fostering community engagement. Programs perform well when communities and local elders are consulted as this strengthens culturally appropriate programs and provides a way to attract appreciation from the greater population. The differing emphasis of researchers and non-profit organizations show opportunities for collaboration where policy and educational efforts could be based on research data. Further, research activities on documentation and conservation could be translated into initiatives supported by the non-profit sector. It is worth noting that few studies showed follow-up data. We recommend follow-up measurements, possibly based on museum-like surveys, be used to gain data on projects. Based on the articles analyzed, this follow-up data would help with data-driven decision making, which provides benefits to elders, community members, and the cultural landscape as a whole.

Declarations

List of abbreviations: TKP – Traditional knowledge and practices; TEK – Traditional ecological knowledge; IPR – Intellectual property rights

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