Storing and sharing: A review of Indigenous and Local Knowledge conservation initiatives

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Abstract

Despite its relative adaptive capacity and its many values, Indigenous and local knowledge (ILK) is rapidly eroding. Over the past decades a myriad of efforts have emerged to prevent this erosion. In this work, we reviewed and systematically coded 138 ILK conservation initiatives published in academic papers in order to explore trends in participation, digitalization, timing, location and approach of the initiatives. We also explored factors influencing initiative inclusiveness. Our findings reveal that ILK holders are generally absent from most phases of the studied initiatives, although IT-based and *in situ* initiatives (i.e., education and community-based conservation) appear as the exceptions. We also found that *ex situ* initiatives (i.e., research/documentation and policy/legislation efforts) are predominant, despite the challenges they reportedly face. These findings call for re-formulating the ways in which *ex situ* ILK conservation is done

and for supporting *in situ* and IT based initiatives, as they offer the potential to lead the participatory turn.

Introduction

Indigenous and Local Knowledge systems (ILK), understood as the different adaptive knowledge systems cumulated during generations of social-ecological interactions in a localized context (Berkes et al. 2000; Reyes-García 2015), include know-how, practices, skills and innovations related to different aspects of human life (e.g., agriculture, medicine or environmental management)[1]. These knowledge systems conform a fundamental part of the communities' cultural expression and identity and have been usually understood in contrast to scientific knowledge (Agrawal 1995; Reyes-García et al. 2014; Tengö et al. 2014; Tang and Gavin 2016).

Research suggests that ILK contributes to biodiversity conservation and environmental management (Dominguez et al. 2010; Porter-Bolland et al. 2012) as well as to food production and health enhancement, thus increasing knowledge holders' wellbeing (e.g., McDade et al. 2007; Calvet-Mir et al. 2011). ILK is also important for communities' cultural heritage and identity (UNESCO 2003) and a key element providing resilient livelihoods, especially in contexts of social-environmental change (von Glasenapp and Thornton 2011; Gómez-Baggethun et al. 2012).

Despite its importance and relative adaptive capacity, ILK is rapidly eroding due to factors such as knowledge-holders' integration into market economies (Godoy et al. 2005; Reyes-Garcia et al. 2005), lack of ILK-sensitive biodiversity conservation regulations

[1] Many terms have been proposed to define this concept, including Traditional Knowledge, Indigenous Knowledge, Folk Knowledge or Local Knowledge. Here, we use the term Indigenous and Local Knowledge (ILK) recently proposed by the Intergovernmental Science−Policy Platform on Biodiversity and Ecosystem Services (https://www.ipbes.net/deliverables/1c-ilk), except when referring to the work of other authors, when we use their own terminology.

(Gómez-Baggethun et al. 2010; Hernández-Morcillo et al. 2014), and lack of inter-generational transmission, a process reinforced by transculturation and de-contextualized schooling (McCarter and Gavin 2011; Tang and Gavin 2016). Moreover, the use and transmission of ILK is also threatened by Intellectual Property Rights (IPR) issues, such as the appropriation of plant material and knowledge through private property rights (Kariyawasam 2008; Lakshmi Poorna et al. 2014).

These issues have triggered changes in IPR law and global policies, some of which now aim at promoting the inclusion of ILK and ILK-holders in biological conservation efforts (Alexander et al. 2004). Moreover, Indigenous Peoples and Local Communities (IPLC) have increasingly taken part in global citizen action and used Information Technologies (IT) and social media to push forward their claims, including the respect for and the conservation of their ILK (Benyei et al. 2017; Reyes-García et al. 2018). In fact, both internally and externally driven ILK conservation actions have been flourishing in recent years (Tang and Gavin 2016) including initiatives aiming at the static documentation of ILK, or what we call here 'storing', as well as initiatives to dynamically reproduce, transmit and revitalize ILK use, or what we call 'sharing'.

The diversity of ILK conservation initiatives can be interpreted through the lens of the dichotomy *in situ* vs. *ex situ*, a classification well accepted in biodiversity conservation (Altieri and Merrick 1987), but not yet systematically used in the field of ILK conservation (see McCarter and Gavin 2014 as an exception). As part of this dichotomy, on the one hand, some initiatives adopt a rather static vision of ILK that draws on the literature on ILK-loss and that argues that ILK should be preserved in its original form to prevent its loss. Initiatives in this line include national ILK inventories (i.e., databases and related IPR protection mechanisms) and ethnobotanical studies (e.g., Pardo de Santayana et al. 2014). On the other hand, some initiatives acknowledge the dynamic

nature of ILK arguing that this body of knowledge should be maintained in ways that allow adaptation to change. Initiatives in this line include community-based and education activities such as contextualized schooling programs (McCarter et al. 2014).

In addition, at least three different classifications of ILK conservation initiatives have been proposed. A first classification focuses on defensive mechanisms (i.e., databases) to protect Traditional Knowledge (TK) (Lakshmi Poorna et al. 2014). This classification includes three categories: 1) preserving codified TK (e.g., the Indian Traditional Knowledge Digital Library, www.tkdl.res.in), 2) preserving non-codified/oral TK (e.g., the Ulwazi project, http://www.ulwaziprogramme.org), and 3) preserving oral and recorded TK through community archives (e.g., the Ara Irititja Project, http://www.irititja.com). A second classification focuses on strategies for the maintenance of Indigenous Ecological Knowledge (IEK), and includes five non-exclusive categories: 1) securing intellectual property, 2) databases, 3) formal education, 4) biocultural conservation, and 5) community-based IEK maintenance (McCarter et al. 2014). Finally, Tang and Gavin (2016) recently proposed a more extensive classification focusing on Traditional Ecological Knowledge (TEK) conservation actions. Their classification includes five overarching categories with several subcategories: 1) Indigenous capacity building (including institutional development, alliance and partnership development and Indigenous financing), 2) community-based TEK conservation activities (including traditional lifeway programs, environmental conservation activities, and TEK commoditization), 3) education and awareness building (including TEK inclusion in formal education, customary education, and Indigenous media/informal learning), 4) policy and legislative support (including global conventions and national or *sui generis* laws) and 5) research and documentation of TEK (including TEK research and TEK databases).

While this work has contributed to the classification of ILK conservation initiatives and the understanding of the different approaches that underlay ILK conservation, a number of issues regarding ILK conservation initiatives remain under-examined. For example, although much has been discussed about the importance of including IPLC in ILK conservation (McCarter et al. 2014, Tang and Gavin 2016), few studies have systematically measured ILK holders' *participation* in ILK conservation initiatives or empirically measured the factors influencing initiatives' *inclusiveness*. Participation in ILK conservation can be analyzed through participation ladders, an approach that originally examined citizen's engagement in social programs to create a spectrum of inclusiveness possibilities (see Arnstein 1969). Non-participation (i.e., when citizens remain as objects over which decisions and programs are imposed) would be at the bottom of the ladder, while citizen control (i.e., when citizens take an active role in several moments of the program) would be at the top of the ladder. These ladders have been used to categorize citizen science (Haklay 2013) or participatory monitoring initiatives (Danielsen et al. 2008; Turreira-García et al. 2018), but have not yet been used in the field of ILK conservation. Moreover, participation is influenced by a myriad of internal and external factors (Nov et al. 2011; Haklay 2016), which have not been necessarily considered in previous work regarding ILK conservation. For instance, citizens science and participatory mapping scholars have shown that *digitalization*, or the increase in the use of digital or information technology (IT) tools (Brennen and Kreiss 2016), favors true participation by challenging project's power structures (Dunn 2007; Stevens et al. 2014). However, this issue has not been yet addressed in studies exploring ILK conservation initiatives.

ILK conservation initiatives could also be analyzed considering external factors such as their *timing* and *location*. Analyzing the time when ILK conservation efforts occurred

could provide insights on how the field has evolved over the past decades; and analyzing their geographical distribution could contribute to understanding which areas have been prioritized in terms of ILK conservation (see Tang 2012 for a similar approach concerning TEK-related studies).

Finally, an updated analysis of the *approaches* underlying ILK conservation initiatives and their issues could contribute to better understanding current trends regarding the choice of ILK conservation actions and its impact on the inclusiveness of these efforts (for previous work in this line see Tang 2012; McCarter et al. 2014; Tang and Gavin 2016).

In this study, we systematically coded 138 ILK conservation initiatives documented in peer-reviewed articles and used quantitative analyses to provide an updated picture of 1) trends in ILK-holders' *participation*, 2) trends in *digitalization, timing, location and approach*, and 3) factors influencing *inclusiveness* of ILK conservation initiatives.

Materials and Methods

Data collection

During March 2017, we searched for ILK conservation initiatives described in the scientific literature. Specifically, we used a web-based search engine for scientific peer-reviewed publications in English (Scopus; https://www.scopus.com/). The search included the simultaneous use of keywords related to three main concepts: i) traditional knowledge, folk knowledge, Indigenous knowledge, or local knowledge; ii) conservation, protection, revitalization, or maintenance, and iii) initiative, project, program, plan, or strategy. The terms were not combined in the search (i.e., we used "traditional" "knowledge" instead of "traditional knowledge") to avoid excluding more specific initiatives (e.g., "traditional ecological knowledge" initiatives). A preliminary search

suggested that the keyword “conservation” mostly resulted in entries related to biodiversity, not to knowledge conservation, thus resulting in thousands of documents most of which were not related to ILK conservation initiatives but to broader issues such as the values of ILK or the interlink between ILK and natural habitat or natural resource management. Therefore, we also included a set of restrictions to our search (e.g., excluding “nature conservation”, “protected areas” or “management”). The final keywords used were: TITLE-ABS-KEY ("indigenous" "knowledge" OR "folk" "knowledge" OR "traditional" "knowledge" OR "local" "knowledge" AND "conservation" OR "maintenance" OR "revitalization" OR "protection" AND "initiative" OR "program" OR "project" OR "plan" OR "strategy" AND NOT "management" OR "habitat" OR "protected areas" OR "nature conservation").

The search resulted in 293 documents, out of which 103 presented or mentioned at least one ILK conservation initiative in the title or abstract. We used ILK conservation initiative, defined as an action, program or strategy to document, protect, reproduce, transmit or revitalize ILK, as our sample unit. Some documents reported more than one ILK conservation initiative, in which case we collected information separately for each initiative. Our final sample comprises 138 ILK conservation initiatives. We collected information on the level of ILK-holders’ *participation* and on the initiatives’ *digitalization* (IT tools used), *timing* (when it took place), *location* (where it took place) and *approach* (what ILK conservation strategy was used). To complete information missing from the documents, we consulted other initiative-related documents and web sites. Remaining missing information was coded as ‘no answer’ (NA).

We entered data in a Microsoft Office Access 2007 database designed for this research. The information on each ILK conservation initiative was coded by the two first authors, who used a codebook with consensual definitions and consulted one another in case of

doubts. Inter-coder consistency was tested by comparing the coding for the same first 10 articles (ordered by title) and discrepancies in coding were used to refine the codebook.

Variable description

ILK-holders' *participation* was measured using a set of variables recording which stakeholders (i.e., NGO's, IPLC/ILK holders, government, researchers, local authorities, private sector, international organizations, multiple, and other) participated in the different phases of the initiative (i.e., ideation, design, financing, ILK contribution, ILK management, and dissemination) (see Méndez-López et al. 2018 or Turreira-García et al. 2018 for a similar approach; Table 1). We also created two dummy variables to capture the initiatives' *inclusiveness*, one captured high participation levels (1= ILK holders participated in more than one phase of the initiative) and another captured whether the management of the gathered ILK was exclusively in the hands of the ILK holders (=1) or not. To assess the initiatives' *digitalization*, we used a dummy variable recording the use of information technology (IT) tools (1= IT tools used). To capture *timing***,** we classified initiatives by their initiation decade (e.g., "72-92", "93-03", "04-15") and temporal continuity (1=the initiative lasted more than 3 years, 0=otherwise). To capture *location***,** we used variables recording the region and the continent where the initiative took place (following the classification from Encyclopedia Britannica 2006), categorized the initiatives' scale (i.e., local, regional, national, or global), and differentiated between initiatives taking place in western-industrialized regions (i.e., US, Canada, Australia, New Zealand or Europe) and elsewhere and between initiatives targeting indigenous communities or not (1=yes). To assess the initiative's *approach*, we followed Tang and Gavin's 2016 classification of TEK conservation actions (i.e., capacity building, community-based activities, education/awareness, policy/legislation, and research/documentation). We also used a variable recording the ILK domain targeted

(i.e., “agricultural” - e.g., landrace knowledge or agroecological practices; “cultural” - e.g., traditional languages, crafts and artistic expressions; “ecosystem” - e.g., knowledge on ecosystem elements and interactions or natural resource management practices, “medicinal” - e.g., medicinal uses of plants, and “multiple” - e.g., initiatives targeting several domains of ILK) and two dummy variables, one recording whether the initiative had a specific IPR protection objective (1=yes) and one recording whether it had specific ILK conservation goals (1=yes). The Access database was imported to RStudio Version 1.0.153 for data processing and analysis.

Table 1. Variables used in the analyses

Group	Variable	Type	Definition
Timing	I_ReferenceYear	Interval	Year when the initiative started
	I_ReferenceDecade*	Factor with 3 levels	Grouped I_ReferenceYear in approximated 10yr periods from first initiation year
	I_Continuity*	Binary	Did the initiative take place for more than 3 years? (1=yes)
Location	L_Region	Factor with 31 levels	In which region did the initiative take place?
	L_Continent	Factor with 8 levels	In which continent did the initiative take place?
	L_Scale*	Factor with 3 levels	What was the scale of the initiative?
	L_Industrialized*#	Binary	Did it take place in the US and Canada, Australia, New Zealand or Europe? (1=yes)
	L_Indigenous	Binary	Did the initiative specifically targeting indigenous communities? (1=yes)
Approach	I_ApproachMain	Factor with 19 levels	Categories based on Tang and Gavin (2016)
	I_ApproachGroup2*#	Factor with 5 levels	Categories based on Tang and Gavin (2016)
	I_TypeILK_2*#	Factor with 5 levels	What type of ILK did the initiative target?
	I_IPRObjective*	Binary	Did the initiative state having a specific IPR protection objective? (1=yes)
	I_ConservationGoal*	Binary	Was knowledge conservation the specific and main goal of the initiative? (1=yes)
Digitalization	M_IT*#	Binary	Did the initiative use any IT tools? (1=yes)
Participation	M_PrivateDataManagement	Binary	Was the ILK gathered exclusively managed by the ILK holders or the community? (1=yes)

	P_Ideation	Factor with 9 levels	Who participated in the ideation of the initiative?
	P_Design	Factor with 9 levels	Who participated in the design of the initiative?
	P_Financing	Factor with 9 levels	Who participated in the financing of the initiative?
	P_Datacontribution	Factor with 9 levels	Who contributed with data/traditional knowledge?
	P_DataManagement	Factor with 9 levels	Who participated in the data management of the initiative?
	P_Dissemniation	Factor with 9 levels	Who participated in the dissemination of the initiative results?
	P_Inclusiveness*#	Binary	Did the ILK holders participate in more than one phase of the initiative?
*Included in MCA, # included in LOGIT analyses, the rest were used in the descriptive analyses			

Data analysis

We used descriptive and exploratory analyses to unveil trends in our data. To explore trends in ILK-holders' participation, we analyzed the frequency in which ILK-holders participated in the different phases of the initiative. To explore trends in ILK conservation initiatives' digitalization, timing, location and approach, we conducted a descriptive analysis of our variables and produced summary metrics. Finally, to explore the factors influencing ILK conservation initiatives' inclusiveness we used Multiple Correspondence Analysis (MCA) and generalized linear models (GLM) with a binomial error structure based on a logit link (logistic regression). The MCA was performed to assess potential underlying structures in our dataset and explore potential associations between inclusiveness (P_Inclusiveness) and other variables (i.e., I_ReferenceDecade and I_Continuity for timing, L_Scale and L_Industrialized for location, I_ApproachGroup2, I_TypeILK_2, I_IPRObjective and I_ConservationGoal for approach, and M_IT for digitalization) (Le Roux and Rouanet 2010; see Table 1). The GLM were performed to model the probability of inclusiveness (P_Inclusiveness= 1) as a function of digitalization, approach and location, variables that were selected because they contributed to the same MCA dimension than *inclusiveness*, and thus emerged as

potentially affecting ILK holders' participation. The model was built using manual stepwise forward regressions by which each variable was added manually to the model and kept when it significantly increased its explanatory power (Crawley 2007). The significance of each model term was checked using Chi2 tests and we used the Akaike Information Criterion (AIC) to compare the models and select the parameters included in the final model. The final model was the one that most parsimoniously explained the greatest variation in inclusiveness (AIC= 118.3, see Supplementary material). This model (expressed by the function: P_Inclusiveness ~ I_ApproachGroup2 + M_IT + I_TypeILK_2 + L_Industrialized) was checked for absence of multicollinearity using the VIF index (no multicollinearity was found) and for absence of auto-correlated errors using the Durbin-Watson test. Post-analysis diagnostic plots (residuals, q-q plots) were used to check other assumptions of the model. We also used the McFadden R^2 to assess the model fit and effect plots to interpret the odds ratio coefficients. All models were developed using the glm function in R (R Development Core Team 2009).

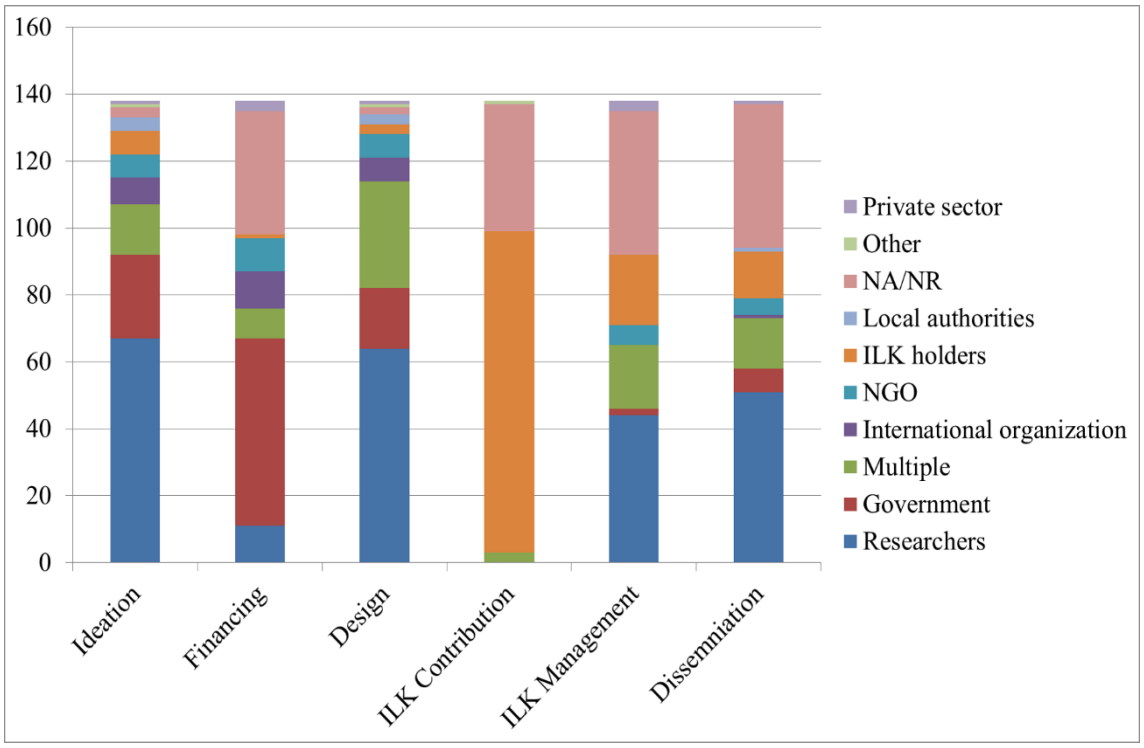
Results

Participation in ILK conservation

The ILK gathered by the initiatives analyzed in this study was exclusively in hands of the ILK holders in only one fifth of the initiatives (21.7%). In fact, ILK holders were not only largely absent from ILK management, but also from other phases of the initiative's development (Figure 1). Indeed, only 34 initiatives (24.6%) included ILK holders in more than one phase. Moreover, even when included in more than one phase, ILK holders were more likely to participate in the initiative's later stages than in its inception (i.e., ILK holders participated in ILK management in 15.2% of the initiatives and in dissemination in 10.2% but only participated in ideation in 5.1% of the initiatives and in design in 2.2%).

For instance, some of the most inclusive initiatives (e.g., Traditional Life Skills Project in Namibia (Klein 2011) or Ojibwemodaa! project in the USA (Hermes et al. 2012)) were proposed by researchers or the government. Thus, although ILK holders were fully engaged in most phases of these initiatives, they were still absent from their inception. ILK holders' contribution to financing the initiatives was even rarer, with only one documented initiative (Fundación Indígena and Kothari 1997).

Figure 1. Stakeholders' participation in the different stages of the initiatives. Note that NA/NR stands for no answer-not relevant (did not include that phase).



Other trends in ILK conservation

Only 24.64% of the studied initiatives used IT tools. Most (65.2%) started after 1993, with initiation peaks in 2002 and 2010, and almost half of the initiatives (44.9%) lasted

more than three years, although several (32.6%) did not state their initiation and/or ending year, for which we could not calculate their duration (Figure 2).

Figure 2. Initiation year for the studied initiatives

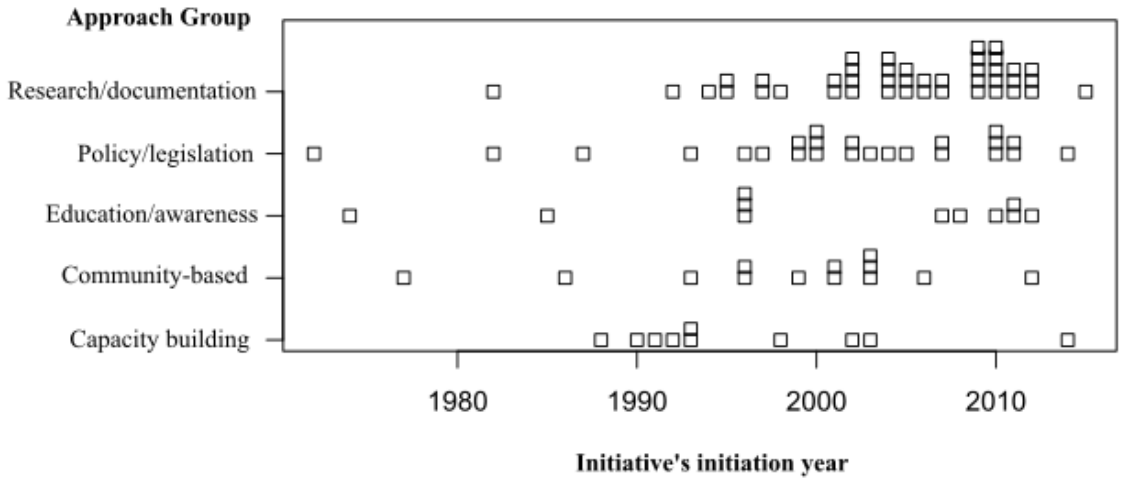
The studied initiatives were mainly located in Asia (30.4%) and Oceania (21%), and particularly in South-Central Asia, including India and the Himalayas (15.9%), and Australia (10.2%). Some initiatives (10.9%) took place in multiple regions. We did not find any initiative in Europe, but 5.8% were found in United States and Canada. Most studied initiatives were developed at a local scale (53.6%) and in areas with Indigenous communities (72.5% of the initiatives specified targeting Indigenous communities).

About half (48.6%) of the initiatives had a research/documentation approach, including ethnobotanical research, the most common approach subcategory (15.9%). Policy/law was the second most frequent approach (18.8%), including IPR law approach (5.1%).

However, 23.2% of the initiatives had some IPR protection goal even if IPR law was not their main approach. The rest of the initiatives followed either a capacity building (7.2%), a community-based (12.3%), or an education and awareness (9.4%) approach.

Initiatives with a capacity building or a community-based approach were generally initiated in the 1990's, while initiatives with a research/documentation and policy/legislation approach were initiated in the 2000's and onwards (Figure 3).

Figure 3. Initiatives' initiation year by approach group (following Tang and Gavin 2016).

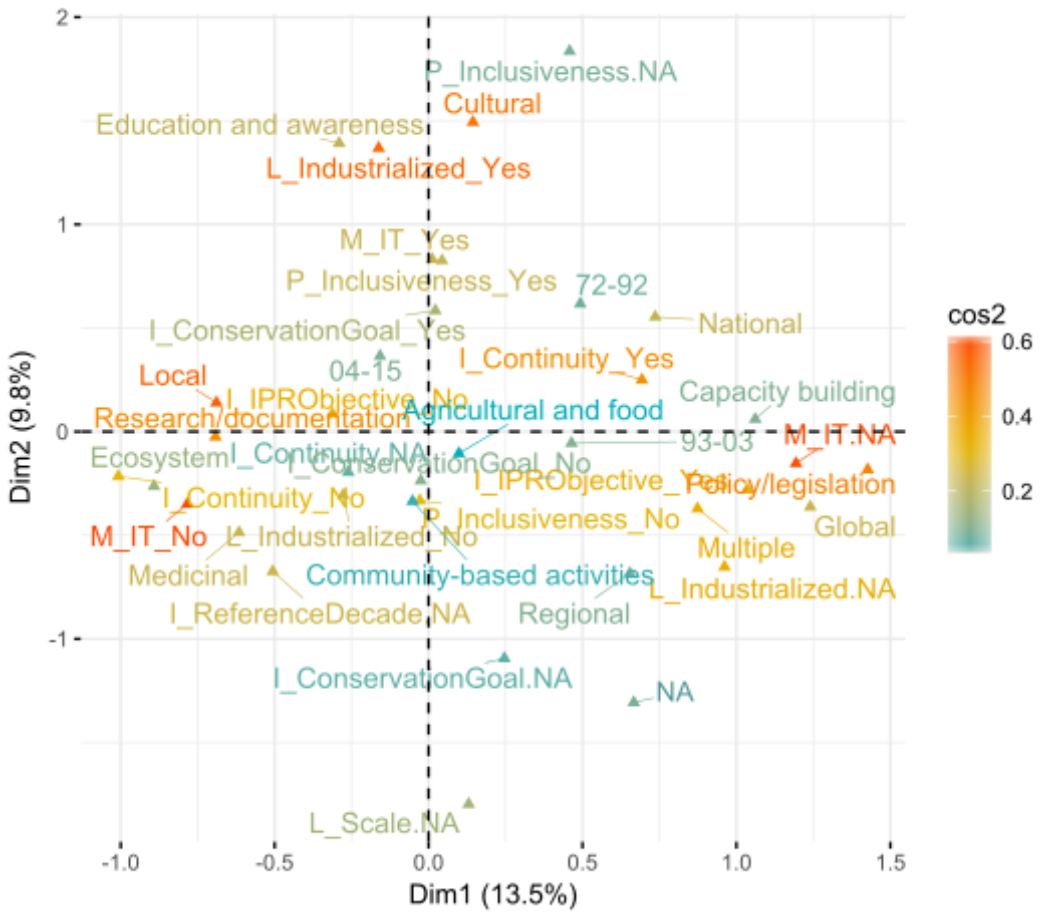


Finally, most of the studied initiatives targeted medicinal (26.8%) or cultural knowledge (18.8%) although only 32.6% of the initiatives specifically targeted ILK conservation. Rather, in most studied initiatives, ILK conservation was a side effect or a means to economic development or environmental conservation. For example, subprojects 138 and 570 of the Pilot Program for the Protection of Brazilian Tropical Forests (Little 2005) focused on creating an alternative source of income for local communities by developing a medicinal garden, which, as a side effect, contributed to traditional medicinal knowledge conservation. Similarly, the PLEO method tested in Cameroon (van der Hoeven et al. 2004), focused on integrating ILK in animal population calculations, tangentially helping revitalize this knowledge.

Factors influencing initiatives' inclusiveness

We found no clear underlying structure in our data (i.e., no clear relationship between the previously described trends), as only 23.3% of the variability in our data was explained by the MCA's first two dimensions. However, some of the categories of the variables analyzed seem to meaningfully contribute to the same MCA dimension and have a high Cos2. This means that they might be significantly associated (Husson et al. 2017, see Figure 4 and Table 2).

Figure 4. Contribution and Cos2 of variable categories to the MCA's first two dimensions. Note that if a variable category is well represented by two dimensions, the sum of the Cos2 is close to one (Husson et al. 2017).



The first dimension of the MCA seems to capture two groups of initiatives. On the one side (close to the Dim2 axis but to the right of the Dim1 axis), there were initiatives having

a policy approach (*Policy/legislation*), taking place globally (*Global*), and lasting more than three years (*I_Continuity_yes*). Examples include global long-term policy measures emerging from the World Intellectual Property Organization (WIPO) or the Council for the Uruguay Round Agreement on Trade Related Aspects of Intellectual Property Rights (e.g., Lettington 2002). On the other side (close to the Dim2 axis but to the left of the Dim1 axis), there were initiatives having a research/documentation approach, taking place locally (*Local*), lasting less than three years (*I_Continuity_No*), and not using IT tools (*M_IT_No*). Examples include researcher-led ethnobotanical studies aiming at documenting ILK in a specific geographic area and over a brief period of time to preserve ILK in scientific publications or books (e.g., Aziz et al. 2016).

The second dimension of the MCA (close to the Dim1 axis) captures initiatives having an education and awareness approach (*Education and awareness*), using IT tools (*M_IT_yes*), focusing on cultural knowledge (*Cultural*), occurring in USA, Canada, Australia or New Zealand (*L_Industrialized_yes*), and including ILK holders in more than one phase of the initiative (*P_Inclusiveness_yes*). Examples include projects documenting North American Indigenous cultural artifacts by building online platforms, initiatives in which the community contributes, manages and learns from the information and artifacts displayed, engaging both young and old community members (e.g., Solomon and Thorpe 2012).

Thus, these analyses suggest that the initiatives characterized by being more inclusive also tend ***i)*** to have an educational approach, ***ii)*** to use IT tools, ***iii)*** to target cultural ILK, and ***iv)*** to be located in western-industrialized contexts.

Table 2. Contribution (in %) of the main variable categories to the first two MCA dimensions.

Dimension 1	%	Dimension 2	%
Policy/legislation	10.5	L_Industrialized_Yes	15.9
M_IT_No	7.7	Cultural	15.9
Local	7	Education and awareness	6.9
I_IPRObjective_Yes	6.8	M_IT_Yes	6.4
Research/documentation	6.4	P_Inclusiveness_Yes	6.3
I_Continuity_No	6.3		
I_Continuity_Yes	5.9		
Multiple	5.8		
Global	5.2		

Results from the final logistic regression model support his result in that they point out that initiative's approach, use of IT tools, type of ILK targeted, and location in western-industrialized contexts were in fact significantly associated with the likelihood of an initiative being more inclusive (McFadden $R^{2=}$ 0.37, see Table 3).

Table 3. Results from the analysis of deviance (ANOVA) of our model expressed by the function: P_Inclusiveness ~ I_ApproachGroup2 + M_IT + I_TypeILK_2 + L_Industrialized

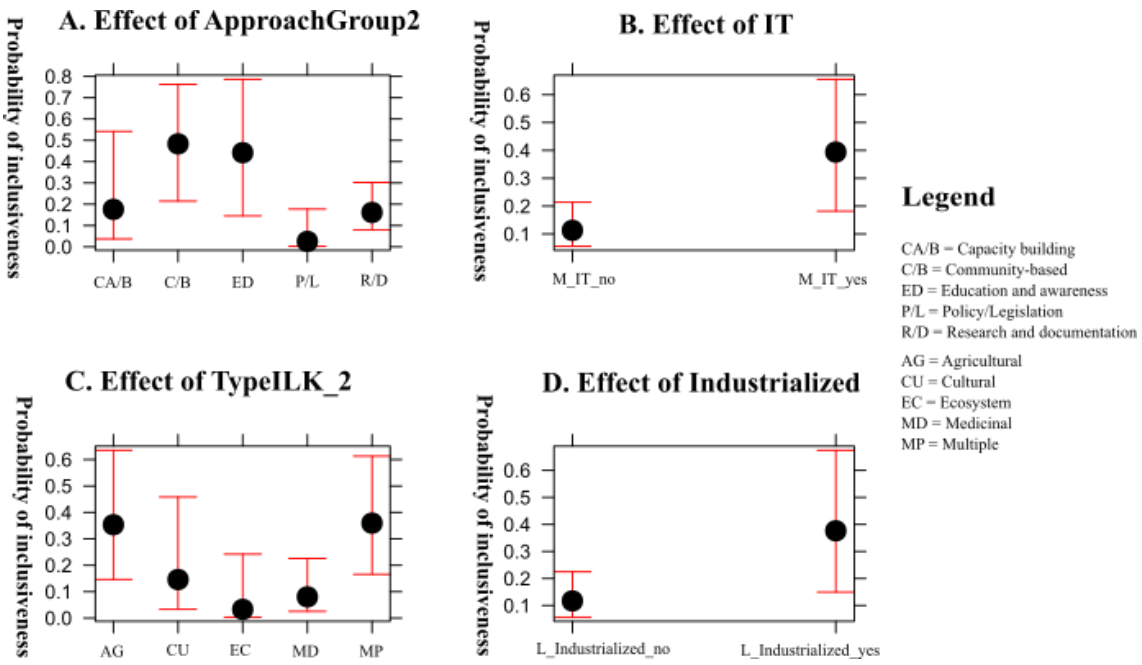
P_Inclusiveness	**Df**	**Deviance**	**Resid. Df**	**Residual. Dev**	**Pr (>Chi)**
NULL			126	143.380	
I_ApproachGroup2	4	16.0033	122	127.377	0.003015 **
M_IT	1	15.4093	121	111.967	8.656e-05 ***
I_TypeILK_2	4	11.6648	117	100.302	0.020026 *
L_Industrialized	1	4.0405	116	96.262	0.044419 *

Signif.: 0 '***' 0.001 '**' 0.01 '*' 0.05

Initiatives using IT tools and located in an industrialized context had a significantly higher probability of been inclusive (Figure 5B and 5D, p-values 0.013 and 0.051 respectively). Moreover, having a policy/legislation approach decreased significantly the probability of the initiative being inclusive when compared to initiatives with a community-based approach (Figure 5A, p-value 0.009). Finally, initiatives targeting ecosystem or medicinal ILK had significantly lower probabilities of being inclusive than initiatives targeting

agricultural (Figure 5C, p-values 0.031 and 0.021 respectively) or multiple domains or types of ILK (Figure 5C, p-values 0.029 and 0.019 respectively).

Figure 5. Effects of the variables on the initiative's inclusiveness (P_Inclusiveness)



Discussion

Results from our analysis reveal important gaps and inclusiveness issues in ILK conservation that can meaningfully contribute to the discussions in this field. However, as these results might be biased, we start the discussion presenting potential caveats of our work and discussing how those might affect our results.

Potential caveats of our study

The single most important caveat of this work relates to sampling, thus potentially affecting the overall generalizability of the results presented. Our sample only includes initiatives documented in peer-reviewed articles. This might result in a systematic sampling bias regarding the initiatives' timing (i.e., results may be influenced by trends

in journal digitalization and changes in publication culture), approach (i.e., researchers might have documented more documentation/research initiatives than community-based initiatives) and inclusiveness (i.e., scientists tend to document initiatives they have lead, leading to an under-representation of NGO/IPLC-led initiatives). Moreover, our sample also excluded documents in languages other than English, which could affect location results (for example, we only found 9% of initiatives located in South America). Our sample might also be biased through our selection of keywords (i.e., traditional, local, folk), as suggested by the fact that we mostly retrieved initiatives involving Indigenous communities (72.5%), and none located in Europe. We acknowledge that these sampling biases might make our results only generalizable to initiatives developed by or relevant to the academic world (thus excluding a large set of initiatives developed by NGO's and IPLC that would not be reported in the sampled documents).

Another caveat of this study is the use of a single method and analytical approach. Considering the holistic, dynamic and organic nature of ILK (McCarter et al. 2014), we acknowledge that this is a very important issue that might lead us to a reductionist view of ILK conservation.

These caveats affect our interpretation of results and were taken into consideration in the following discussion.

Inclusion and the politics of TK conservation

Our results revealed important inclusiveness issues related to the participation of ILK holders in ILK conservation initiatives reported in the scientific literature. We found that in most initiatives studied, ILK holders did not participate beyond the collection of ILK and that, when they did participate, they did so in the later phases of the initiative. Moreover, in most of the examined initiatives the ideation and design phases were led by

researchers. Interpreted through the lens of participatory ladders, our result unveils a tendency towards non-participation or tokenism (following Arnstein's categories, 1969) revealing that the real objective of many initiatives is to "educate" participants rather than to enable their participation. Moreover, even when initiatives "enable participants to hear and to be heard" (in Arnstein's words), ILK holders still lack the power to ensure that their views will be taken into account beyond ILK collection. This result brings attention to the fact that ILK holders continue to be widely absent from initiatives aiming at ILK conservation and that researchers continue to design ILK conservation initiatives in which ILK-holders only contribute their knowledge. These results can be interpreted as a consequence of existing knowledge hierarchies that promote ILK integration into western-scientific knowledge systems (as opposed to other ways of knowledge co-creation), a process that has been contested by several authors (Agrawal 1995; Nadasdy 1999; Tengö et al. 2014). However, given the biases in our sample, it is possible that this result do not reflect inclusiveness in initiatives led by the communities.

Our findings also suggest that some types of initiatives are more inclusive than others. For instance, initiatives targeting ecosystem or medicinal ILK seem to be less inclusive than initiatives targeting agricultural or multiple types of ILK, a finding that could just be reflecting the dominance of an "extractivist" approach to ILK documentation among initiatives in our sample. Contrarily, initiatives that used IT tools were more inclusive than the rest, a finding in line with results from other fields such as participatory GIS (Dunn 2007), participatory monitoring (Benyei et al. 2017) or public participation in science in general (Stevens et al. 2014). Indeed, Information and Communication Technologies (ICTs) are considered to be key elements in enabling true participation and in challenging the power structures in participatory projects. It should be noticed, however, that the use of IT tools does not necessarily guarantee full participation, nor

does the lack of it compromises the participatory nature of an initiative, as we can see in the cases presented by Lakshmi Poorna and colleagues (2014), which are all IT-based but do not necessarily engage ILK-holders in all the phases of the initiative.

Finally, we found that initiatives with a community-based or an education and awareness approach tended to have higher probability of being inclusive than initiatives with a policy/legislation and research/documentation approaches. In other words, *ex situ* initiatives such as databases and ethnobotanical inventories were less inclusive than *in situ* initiatives such as inter-generational school activities, which have already been described as better serving ILK dynamic maintenance (e.g., McCarter et al. 2014). While not surprising, the result is relevant in that it complements with quantitative results the challenges of *ex situ* (research and policy) approaches and the strengths of *in situ* (education and community-based) approaches previously reported in the literature (McCarter et al. 2014; Tang and Gavin 2016).

Other gaps in ILK conservation

Our results highlight that trends found in previous research regarding the frequency of ILK conservation actions or approaches still prevail. Initiatives that follow research/documentation or policy/legislation approaches, i.e., *ex situ* approaches to ILK conservation, were prevalent among the initiatives reviewed (and more so in recent years). These findings are generally in line with Tang and Gavin's results (most initiatives followed a research/documentation approach, 2016) and with McCarter and colleague's findings (securing IPR was the most widely documented approach, 2014). In contrast, initiatives with an education/awareness or community-based approach, i.e., *in situ* initiatives, were scarce (see the Parque de la Papa project described by Graddy 2013 as an exception), and more frequent in the 1990's than in the 2000's. Moreover, in our

sample of peer reviewed articles we rarely found initiatives that tried to combine both paradigms (i.e, *ex situ* and *in situ*), for example through community databases that actively engage school students or other community members (see the Ara Irititja project described by Lakshmi Poorna et al. 2014 for an exception). While it is possible that these findings only reflect sampling biases, they can also be showing that academic ILK conservation is increasingly shifting towards more *ex situ* approaches, a trend that should be revised considering the challenges related with removing ILK from its situated context and from the control of the ILK-holders (Zent 1999; Agrawal 2002; Campbell and Vainio-Mattila 2003; McCarter et al. 2014).

Our results also reveal important trends regarding the focus of ILK conservation initiatives. The initiatives analyzed targeted some types of knowledge more frequently than others and not many initiatives focused on ILK conservation on itself. Many initiatives primarily had biological conservation or economic development goals, ILK conservation being a secondary objective or side effect result. Moreover, agricultural ILK was somewhat less targeted, especially when compared to medicinal ILK (19 versus 37 ILK conservation initiatives). Initiatives targeting other domains or types of ILK, such as climate knowledge or knowledge about traditional tools, were even less frequent (two and one initiatives respectively). These results reveal a possible tendency towards favoring the protection of one type of ILK (medicinal) over others, possibly reflecting a system of values for different types of knowledge that could be influenced by epistemological and power issues such as knowledge hierarchies or knowledge commoditization tendencies (e.g, commoditization of medicinal knowledge). These issues have been previously described by the literature on the scientific-lay knowledge divide and politics of knowledge (Nadasdy 1999; Burke and Heynen 2014). Our findings also reveal a tendency towards favoring the conservation of ILK potentially relevant for biological conservation

(for examples see McCarter et al. 2014). However, this approach should be re-examined since its effectiveness is not fully understood and since it limits the potential contributions of ILK to other fields, although in most cases the ILK conservation and biodiversity conservation are not mutually exclusive (McCarter et al. 2014; Reyes-García 2015).

Finally, our findings also contribute to the discussions on ILK legal protection. Although most initiatives emerged after the CBD agreements (which had important sections regarding benefit sharing and rights over ILK), few initiatives had an IPR approach. This might reflect the numerous challenges faced by legislative solutions to ILK protection. For instance, some authors have described that the mismatch between collectively managed knowledge systems and individual-rights based IPR could hinder the protection of ILK via IPR mechanisms (Reyes-Garcia et al. 2003; Lakshmi Poorna et al. 2014; McCarter et al. 2014). While several authors have claimed that intellectual property legislation alone will not be able to address and reverse ILK degradation (Oguamanam 2004; McCarter et al. 2014), our results call for further attention to the issue of IPR, especially considering the problems derived from an inappropriate or absent ILK legal protection (Lakshmi Poorna et al. 2014).

Conclusion

Responding to calls for a more comprehensive understanding of ILK conservation initiatives (Tang and Gavin 2016), we conducted a systematic review of 138 ILK conservation initiatives exploring trends in participation/inclusiveness, digitalization, timing, location, and approach. We withdraw two main conclusions from our results. First, despite the existence of a myriad of complementary ILK conservation efforts reported in the academic literature and despite their many challenges (McCarter et al.

2014), *ex situ* strategies (i.e, documentation and policy/legislation efforts) prevail. Second, ILK holders are generally absent from the development of the initiatives reviewed, with IT based and *in situ* (education and community-based) initiatives being generally more inclusive. This type of initiatives, we argue, are the ones that could lead the participatory turn challenging the knowledge hierarchy divide.

Based on our findings, further research on the topic should tackle several issues. One, there has not been yet a systematic study of ILK conservation initiative effectiveness, and this is a gap that must be addressed by creating systematized protocols of initiative evaluation that include aspects related to the initiative's inclusiveness. Two, there is a need for further reviewing the literature and including non-academic documents in different languages in order to overcome our biases. Three, there is a need for qualitatively complementing our results in order to disentangle issues such as motivation or social networks behind ILK conservation. And four, there is a need to re-formulate the way in which *ex situ* conservation is done but also for the support to scientific projects that are community led and include educational activities. Such work is critical in order to inform decision making regarding the funding and promotion of those initiatives that are more inclusive towards ILK-holders and that break the knowledge divide contributing to a more just and locally sensitive ILK conservation.

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