Te Kotahi
Research Institute

CHI Frameworks

A REVIEW OF SIGNIFICANT ATTRIBUTES IDENTIFIED WITHIN CULTURAL HEALTH INDICATOR FRAMEWORKS IN AOTEAROA

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Executive Summary

Te Arawa Lakes Trust are collaborating with Te Kotahi Research Institute to investigate how Cultural Health Indicators can better inform the implementation of their Lakes Environment Plan with a view to integrating science and Mātauranga Māori as a way of realising the intentions of Te Mana O Te Wai, which in terms of Te Tūāpapa o ngā wai o Te Arawa, are the seven aspirations set out in their cultural values framework.

Mātauranga Māori can not be assimilated and generalised within reductionist scientific paradigms. Te Arawa Iwi and Hapū are wary of the adoption of reductionist science-based interpretations of mana, mauri, taonga species and whakapapa. Yet these are all commonly shared ways of understanding the relationships that Te Arawa Hapū have with their wai Māori. These culturally-derived ways of knowing are beyond the realm of reductionist science and require decision making approaches that can include culturally-specific knowledge.

If cultural health indicators are a geographically specific means of enabling the measurement of a particular attributes of a Hapū or Iwi, then to be appropriately recognised, the method of inclusion is at least as important. Culture is defined here as a geographically specific expression of identity. Cultural health indicators are the appropriate geographically specific means of representing that identity and its flourishing which enables that culture to be recognised and/or measured. Therefore cultural indicators, their definition, and their measurement must be the sole prerogative of the relevant Hapū, and how these ways of knowing are effectively empowered in decision making processes and frameworks is critical, as decisions are no longer being made by Iwi and Hapū in isolation.

An analysis of cultural health indicators used in international contexts has provided a set of attributes that reflect their suitability and the range of issues that need to be dealt with. These attirbutes are provided in this report. An analysis of the context of the application of cultural health indicators in Aotearoa NZ has identified salient features that better enable frameworks to effectively communicate the ways of knowing relevant to lake environment management. These are also identified in this report

The Treay of Waitangi is now recognised in New Zealand law and Te Tiriti O Waitangi provides the way of knowing one's identity and belonging in Aotearoa NZ. Mana, mauri, taonga, whakapapa and the many forms of wai contribute to this understanding. Nō wai koe, of what waters are you? These ways of belonging are understood to differing degrees amongst the New Zealand people.

These different understandings create bias which must be differentiated in frameworks to clearly describe the different ways that a decision is experienced within the community. The Tangata Whenua are those that made allowance for Tangata Tiriti to live in Aotearoa NZ. Tangata Whenua in their own rohe are responsible for the appropriate expression of their identity and are the Hapū whose mana is asserted with regard to cultural health indicators. Tangata Tiriti are educated in their way of belonging and acknowledge the privilege afforded them by Te Tiriti O Waitangi. Others who are manuhiri are developing their understanding of their place in Aotearoa NZ. These different ways of belonging create the need to represent these different worldviews and how they experience decision making impacts.

Best practice, therefore, would require that cultural health indicators are used within a decision making framework that can accommodate the complexities identified. Models of reality created by a framework must be developed and verified by and with the relevant Hapū. While some indicators may be readily transferable across models, the accuracy and appropriateness of a model cannot be assumed unless the cultural indicator sets to be used are verified with the impacted Hapū.

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Introduction

Acknowledgement that Indigenous knowledge cannot be assimilated and readily generalised within the typically reductionist scientific paradigm is emerging in different ways including international declarations, treaties with Indigenous Peoples, educational reforms, resource management and research. This improving awareness is incremental, often project by project, and is useful in that the examination of the inherent differences between these two distinct ways of knowing is revealing the contrasting weaknesses of science approaches. Understandably, as a result of these differences, Indigenous Peoples themselves are often wary of science-based interpretations due to past failures of the imposition of rules drafted by scientists and enforced by governments in the areas of wildlife conservation and resource management. Mander (1991) for example shared compelling examples of such scientific failures in his book, In the Absence of the Sacred.

Reductionist scientific perspectives stop at the point where reality (e.g. mass balance) is understood to be the same for everyone, and so excludes consideration of worldviews and context, essentially how outcomes are understood and experienced, because experiences are culturally derived and beyond the realm of reductionist science. It is for this reason that the incorporation of the cultural, environmental and social considerations of Indigenous and local communities into impact assessment was negotiated as part of the UN Convention on Biological Diversity in 2004. From those negotiations came the Akwé: Kon voluntary guidelines for the conduct of cultural, environmental and social impact assessment. The aspirations held by Indigenous Peoples in relation to these guidelines is evident in the Mohawk term Akwé: Kon, a holistic term meaning ‘everything in creation’ (Convention on Biological Diversity Guidelines, 2004).

The holistic worldview reflected in Akwé: Kon is evident in many indigenous cultures of the world, and contrasts strongly with the reductionist tendencies often evident in scientific research. The Tangata Whenua of Aotearoa NZ adhere to understandings of creation that resonate strongly with the Mohawk and other Indigenous Peoples of the world, that humankind are an inseparable part of their ecosystems of origin. The identifier Tangata Whenua itself reinforces this understanding, positioning the indigenous peoples of Aotearoa NZ as the people of the land.

Communicating the Tangata Whenua way of knowing within research introduces the need for the inclusion of culturally-specific knowledge. This report discusses the state of knowledge of cultural indicators and their relevance to decision making in Aotearoa New Zealand. The structure used here is to first provide a definition of cultural indicator, explore the prevalence

of cultural indicator use within international contexts via ten case studies, then compare the characteristics evident to cultural indicator use in Aotearoa New Zealand.

Finally, for any research to be useful it must be fit for purpose. A primary purpose of research drawing on Indigenous ways of knowing is to indicate the likely consequences of a course of action in a way that is perceived as credible to the end-user. The research output is likely to be useful and credible to the user if it is able to communicate with a person's present understanding of an issue and predict consequences of possible alternatives in a way that builds and then retains the confidence and trust of the user to a degree sufficient to then influence the subsequent actions of that user. For this reason, the way in which cultural indicators are incorporated into the research is potentially more important than the augmented understanding provided by the cultural indicators themselves.

Differences between Indigenous and Scientific ways of knowing

Research published in 2008 (Young et. al.) investigated the linkages between cultural and scientific indicators of river and stream health. This research shared cultural indicators grouped according to the domains of atua in a pseudo-scientific way. What is relevant to this investigation is the comparative features table which clearly distinguishes between the ways of knowing, highlighting that cultural indicators are more reliant on the kaitiaki/researcher experiencing the state of mauri themselves, that usually a prior knowledge of the site and association over time are prerequisites to conducting research. Conversely scientific ways of knowing are more reliant on measurements not necessarily requiring the scientist/researcher to be present personally, rather relying on abstracted information of site characteristics that 'de-nature' sites for comparison on the basis of universal measures.

Definition of Cultural Indicator

Most dictionary definitions are consistent and state that an indicator is something that acts as a sign or indication of change, or an instrument that registers or measures something. The meanings provided for the qualifying adjective cultural however are much less consistent.

The origins of the word "culture" are French, which in turn derives from the Latin "colere," meaning to tend to the earth and grow, or cultivation and nurture. It is sensible then to use a meaning consistent with these origins; the way of life, especially the general customs and beliefs, of a particular group of people (Cambridge English Dictionary); a particular set of customs, morals, codes and traditions from a specific time and place; the ideas, customs, and social behaviour of a particular people or society; the characteristics and knowledge of a particular group of people, encompassing language, religion, cuisine, social habits, music and arts. Tikanga-ā-iwi means the practices of a people specific to themselves and is used to define this area of learning in Te Marautanga o Aotearoa (Ministry of Education, 2007) Māori-medium curriculum for primary and secondary kura.

Durie (2005) defines indigeneity as geographic specificity characterised by unity with the environment, geographic relationship and belonging, endurance over many generations, a system of knowledge, a unique language, and the development of a distinctive culture. In summary Durie is describing an enduring relationship between peoples and their ecosystems of origin.

Consistent with these definitions, culture is defined here as a geographically specific expression of identity. Therefore cultural indicators are the appropriate geographically specific means of representing that identity which enables that culture to be recognised and/or measured. It follows then in Aotearoa NZ that cultural indicators must be identified and defined by the Iwi or Hapū who have occupied a particular location for a length of time sufficient to have developed a unique connection to a place. Thus cultural indicators, their definition, and their measurement are the sole prerogative of Indigenous Peoples (IP), and in Aotearoa New Zealand, this is Iwi and Hapū.

Observations from International Case Studies

International case studies have demonstrated a range of examples of cultural indicators in decision-making processes, which draw on local cultures and values to capture indigenous ways of knowing. The incorporation of culturally-grounded indicators has revealed complex mechanisms already in place in indigenous societies to regulate and protect resources, which incorporate sustainable resource management, traditional economies and systems of reciprocity. Inclusion of these indicators can complement physical measurements, facilitate collaborative stewardship of the environment, and support community-led decision-making and ownership of projects.

From analyis of multiple case studies there are numerous characteristics that resonate with Indigenous ways of knowing here in Aotearoa NZ (Mahi Maioro Professionals, 2019; McCarter et. al.; Sterling et. al., 2017; Wambrauw & Morgan, 2017). The observations taken from the case studies reveal several ways of establishing relevance, beginning with relationships to tikanga or historic practices and beliefs:

1. complex mechanisms already exist in indigenous societies to regulate and protect resources
2. sustainable resource management and maintenance of traditional practices is the priority
3. the traditional economy is governed by shared cultural values and rules
4. systems of reciprocity increase group productivity and well-being, and prevent greed
5. the traditional economy ensures equitable distribution of wealth and opportunity
6. approaches that historically produced thriving social and ecological communities
7. abundant resources support reciprocal relationships between people and place
8. achieve healthy and productive ecological, social and cultural communities

Therefore it is important to recognise that Indigenous societies are not bereft of knowledge and requiring salvation, but rather already have sophistocated approaches that ensure the

integrity of social structure and sustaining their ecosystems of origin. The case studies imply that these approaches focus on and value reciprocity, sharing equitably in wealth, and collective flourishing.

Indigenous ways of knowing, cultural indicators and complexity:

1. indigenous epistemologies can provide a more complete understanding of ecosystems
2. indigenous approaches focus on understanding human-environment interactions
3. rely on social or cultural indicators that add more complex understandings of well-being
4. retain relevance when there is paucity of scientific data, significant and increasing threats
5. stronger reliance on disaggregated information versus a single index number
6. disaggregated information can provide clearer insights into cause and effect
7. build trust in process before introducing increasing levels of complexity
8. an understanding of cumulative impacts that can avoid unknown irreversible consequences

Indigenous epistemologies produce cultural indicators that describe complex understandings of ecosystems and are capable of retaining relevance under conditions that would be challenging for purely scientific approaches. The preference for disaggregated information indicates that modelling should ideally retain intuitive connection to the data relied upon for decision making. These observations also reflect that Indigenous epistemologies are quite capable of dealing with complexity.

Indigenous ways of knowing, cultural indicators and local relevance:

1. indicators for access to customary lands, forest and marine resources, traditional items
2. decision-making about access to and use of resources occurs primarily at the local level
3. cultural indicator derivation, data collection and analysis are at the community level
4. adept observers function as repositories of traditional ecological knowledge
5. revitalise culture and community by communicating the socio-cultural fit of projects
6. can develop strategies that are more consistent with local culture and values
7. learnings from place-based application are of value to place-based decision-makers
8. customisable to reflect landscape circumstances and community characteristics

Local relevance drives a reliance on community formulation of indicators as consistency with traditional beliefs and community context is necessary to generate community trust in a model. This retained connection to place and people is a distinguishing difference to scientific ways of knowing.

Indigenous ways of knowing and cultural indicator fitness for purpose:

1. indicators are developed for communities to track what they believe is important
2. have a specific indicator set for cultural well-being and prioritise appropriately
3. indigenous measurement is context-dependent and may contradict national characterisation
4. seasonal and ecological indicators are often customised to monitoring needs
5. guidelines exist for collection of relevant local and traditional knowledge
6. community-level indicators support community-driven management
7. indicators serve as a framework for community discussion and ownership

International case study analysis highlights the community orientation of cultural indicators in terms of what is important, how they are measured, and how and when they are relevant.

Indigenous ways of knowing and worldview relevance:

1. cultural lens recognises the physical, psychological, and spiritual inter-relationships
2. ecosystem wealth is intrinsically connected through genealogy reinforcing spiritual bonds
3. rely on local descriptions, priorities, and understandings
4. dimension prioritisation based on the community's own worldview
5. land as a public good and whanau are the custodians of the land
6. strength of biocultural connections is indicative of the health of the entire ecosystem
7. identify linkages between economic development, community and culture
8. intergenerational collaborative stewardship model that defines how resources are managed

While the Papua and Toquaht case studies (Murphy et. al., 2020; Wambrauw & Morgan, 2017) demonstrate that frameworks can be transferable, these two examples illustrate that a process must explicitly acknowledge the presence of bias, the importance of worldview, and the existence of ontological differences between different parts of society, to ensure that the introduction of an external process is not reminiscent of historical colonisation processes. An Indigenous Peoples' ontology will determine how change is experienced and so their worldview must be explicitly empowered within any processes they are expected to benefit from. Contrary to commonly held scientific belief, reality is not universal as Indigenous epistemologies include spiritual and genealogical bonds that traverse time and space.

Indigenous ways of knowing and inclusiveness:

1. reliance on multiple ways of knowing and knowledge systems
2. able to reflect socially and culturally diverse sources of information
3. holistic combination of mixed measurement systems (qualitative and quantitative)

4. can be successfully applied cross-culturally
5. all available knowledge is drawn upon
6. independent evaluation process that implicitly empowers indigenous knowledge
7. whānau self-reliance is maintained when access, power / control over the land is intact
8. focus on accessibility and usage rights
9. strengthen the innovation already present in traditional approaches to management
10. demonstrates power of diversity and inclusion revealing different facets of development

Approaches that are inclusive of all knowledge sources, all ways of knowing, and all impacted, will produce results that are understandable to all, relevant and valued.

The majority of approaches separated cultural indicator sets using typically four or five dimensions. Cultural indicator measurements for assessment:

- can identify benefits and consequences of actions, priorities, and sequences of events
- half scored individual indicators on a five-point scale
- all identify culturally-relevant criteria to benchmark or standardize indicator scores
- collaborative resource management, mauka makai, contributes to shared data platform

Cultural considerations are evident and made explicit in all of the case studies. All of the case studies identified culturally-relevant criteria to benchmark or standardize indicator scores, with indigenous concepts dominating the measurement for some approaches. While frameworks and models that use cultural indicators that originate outside Aotearoa NZ are in use, their direct relevance here relies more on the advantages associated with their processes for successfully incorporating cultural ways of knowing into decision making than the cultural indicators themselves. The reasons for this were identified in the definition of cultural indicators and are elaborated on in the Akwé: Kon guidelines. The examples provided all use place-based understanding emphasising the value of Indigenous ways of knowing and demonstrate how frameworks can be successfully adapted for different contexts.

A Context for Cultural Indicator introduction in Aotearoa NZ

The term cultural indicators can be used for a variety of purposes from measuring the instrumental value of cultural identity within the national or regional economy to measurements of cultural well-being typically aligned to cultural impact assessments.

Cultural indicators of excellence from tertiary education

Cultural indicator sets have been created with the intention of acknowledging Te Tiriti O Waitangi compliance in education contexts since University Academic Audits commenced in

1995. Initial audit factors focused on creating space for Māori, Treaty awareness, and introducing Māori knowledge and culture (Woodhouse, 1995). These quantitative audit factors initiated change within tertiary education but were found to lack the sophistication required to meaningfully assess wānanga (Walker, 2005). Thus Te Wānanga O Raukawa created a matrix of ten values that measure the quality of "ahuatanga Māori". The values are:

- Manaakitanga (kindness, generosity, hospitality, care, support)
- Rangatiratanga (chiefly dignity and behaviour marked by noblesse oblige)
- Whanaungatanga (kinship, relationships)
- Kotahitanga (unity, sense of group belonging)
- Wairuatanga (spirituality locating man within and not above the natural order)
- Ūkaipōtanga (nurturing mother, earth mother)
- Pukengatanga (repository of higher learning)
- Kaitiakitanga (guardians, care for the natural order)
- Te Reo Māori (Māori language)
- Whakapapa (genealogy of knowledge, Māori epistemology).

It is interesting to note that selections of the first eight values in the list above are often referred to as the 'tanga's (sic) that must be considered in culturally influenced decision making processes. Returning to Walker's article, the conclusion sets the bar for quality in higher education as the inclusion and reproduction of language, culture and whakapapa (epistemology) in the curriculum. This could be likened to the retention and continued relevance of Iwi or Hapū identity.

Cultural Indicators in Aotearoa NZ Today

Cultural indicator sets are now being created on a project by project basis in keeping with the need to ensure the integrity of the indicators and essentially their local relevance. The extant literature is dominated by cultural indicator sets related to the ecosystem and in particular the health of freshwater, wetlands and forests. Due to the plethora of reports, theses and journal articles, selected examples have been summarised below.

Recent forest ecosystem services research (Lyver et. al., 2017) confirms the importance of cultural ecosystem services in Aotearoa NZ. Mapping forest values from interviews, four biocultural themes were identified, and the cultural concepts most commonly associated with these were documented. Twenty-eight concepts were identified with mauri, mahinga kai, oranga, and te ohanga whairawa being those most commonly used.

In particular mauri was associated with all four primary ecosystem services categories (biocultural descriptors), and the observation is made that if mauri taiao is healthy and vibrant it follows that ecosystem services central to the local community will also be supported. In this way, mauri is able to represent the relationship between and the socio-ecological

resilience of a Māori community and their ecosystem of origin. It is this relationship that is vitally significant as it constitutes the embodiment and growth of the culture and cannot be substituted by physical sustenance alone.

Table 1: Cultural Ecosystem Services Māori Values (Lyver et. al., 2017)

Biocultural Descriptor	**Most common concept**	**Top four pairings of values**
Importance of place	Ahikāroa	Paired with whakapapa, whenua and oranga
Capacity of forest	Mahinga Kai	Paired with mātauranga, Te kiri o papa, ngā taonga tuku iho, and oranga
Connection of forest and community	Mauri	Paired with mahinga kai, Te kiri o papa, kaitiakitanga, mātauranga, and Te ohanga whairawa.
Future aspirations		

Harmsworth (2002, 2013) identifies general principles for cultural indicator development for wetland ecosystems that it is suggested apply generally to all cultural indicators;

- Indicators originate from a Māori epistemology of origin, knowledge, and application.
- Indicators are interconnected through whakapapa linkages (genealogy) to Atua.
- Indicators are built from inter-generational knowledge, technology, relationships, experience, and interaction with ecosystems over long periods of association with a place.
- Indicators reflect values, including rangatiratanga, kaitiakitanga, whakapapa, wairuatanga, mauri, and tapu. Values define tikanga (practices) and kawa (protocols) for the local area.
- Tikanga and kawa inform customary use, based on observations and learnings, related to seasonal phases, animal behaviour, and resource condition.
- Indicators have local context, meaning, and relevance to whānau, marae, Hapū, and Iwi. Indicators are important for assessing or monitoring, and can indicate current state, change, trends over time, such as changes in harvest levels of specific taonga species.
- Cultural indicators must be developed in collaboration with whānau, marae, Hapū, Iwi, and kaitiaki communities to ensure that they are relevant and connected to place.

These principles strongly resonate with those from the international case studies, and are all demonstrated in the values identified by Lyver et. al (2017) in relation to cultural ecosystem services.

Table 2: Cultural Monitoring Framework Comparison

Framework Attribute	**Mauri of Waterways Kete** Jefferies & Kennedy, 2009	**Mauri Model Decision Making Framework** Morgan, 2006	**Cultural Health Index** Tipa & Tierney, 2006 Adapted to contexts: forest, marine, takiwā	**Cultural Flows** Nelson & Tipa, 2012 Scenario Modelling
Ontology (Reality)	RM planning regime grounded in Māori values	Mauri Model (4 nested dimensions of mauri/ wellbeing)	Site relevance, mahinga kai & stream health	Cultural opportunity mahinga kai & ecosystem attributes
Epistemology	Retrospective audit	Past/present/ future	Current state	Proposed state
Worldview bias	Iwi/Hapū perspective	Sensitivity analysis of worldviews	Iwi/Hapū perspective	Iwi/Hapū perspective
Measurement basis	Protection of mauri	Impact on mauri	Current stream health	Stream flow impact
Metrics used	Mauri	Mauri	Mahinga kai & mauri	Mahinga kai & other
Structure of analysis	5 x mauri protection indices comprising 3-5 indicators each	Indicator sets are disaggregated for each dimension	Binary determination of relevance, scores averaged for index	Statistical analysis of stream flow linked to indigenous values
How is it measured?	Agreement rank 1-5	mauriOmeter +/-	Ranking 1 - 5	Ranking 1 - 7
Assessment mode	Qualitative	Absolute measure	Qualitative	qualitative / statistical

The Ngā tohu o te taiao: Sustaining and enhancing wai māori and mahinga kai project (Awatere & Harmsworth, 2014) provides a comprehensive review of indigenous knowledge, mātauranga based frameworks for planning and monitoring, and reviews four cultural monitoring frameworks. The framework reviews demonstrate similarities in terms of the basis for measurement, but more importantly differences in terms of what the frameworks are able to do, and their epistemological and ontological positioning. The cultural monitoring frameworks are summarised below.

Mauri to varying degrees is the basis for understanding the current or preferred state of freshwater in the frameworks reviewed above. However apart from their common reliance on understandings of mauri to know, the Mauri Model differs in many ways from the other three frameworks.

Ontology and epistemology is approached differently for the frameworks. Three accept the current ontology of New Zealand's Resource Management planning regime, seeking to communicate Iwi preferences related to cultural well-being within the statutory framework or to audit the planning regime's performance. The Mauri Model instead repositions reality as four dimensions of mauri, effectively redefining what is important and enabling Iwi preferences to be expressed across all four dimensions. The mauri dimensions are aligned to the RMA well-beings which means that when necessary the Mauri Model findings can be communicated within that regime. Likewise the epistemology or way of knowing of Iwi and Hapū (via impact upon mauri) is positioned explicitly within the Mauri Model as the basis for reality, and the means of measurement. In this way any worldview bias evident in decision making, including the planning regime or developers can be quantified and understood for all those involved.

How mauri is measured is a difinitive differentiation between the frameworks as the Mauri Model uses the unique absolute measure of mauri (Morgan, 2008) called the mauriOmeter. The mauriOmeter allows the robust measurement of indicator mauri whether measured using quantitative or qualitative knowledge. The remaining frameworks use less intuitive, qualitative measurement based on arbitrary scales of agreement, availability of kai, and stream health. In fact the most recent 2012 cultural flows framework (Nelson & Tipa, 2012) states that it deliberately avoids the explicit quantification of mātauranga Māori, and rather 'outputs from a scenario model present data based on attributes derived from Māori ways of knowing' (Awatere & Harmsworth, 2014).

When published, a cultural flows report has mandatory recognition under the Resource Management Act (RMA, 1991). This positions Māori ways of knowing on an equal footing with the statistics-based rationalisations of science regarding stream flows and water quality. However while this approach may 'level the playing field' in adversarial fora such as the Environment Court and the Waitangi Tribunal, the framework is exposed by the same weakness as the mono-cultural scientific assessments that it is intending to challenge. That is, it explicitly represents a Māori epistemology which then has to be weighed against a commercially driven activity that is justified within the RMA planning ontology by the dominant mindset of our society. The Mauri Model in contrast avoids this positioning by

including all available knowledge as disaggregated dimensions of mauri, and then prioritising these within the framework to represent the understandings of different worldviews.

In conclusion regarding the four frameworks considered here in Table 2, due to the different values and beliefs underpinning the Māori ontology and epistemology, it is important to clearly state how these differences are accommodated within the framework. This clarity is essential so that the analysis results are able to be communicated and understood within decision making contexts where others' ontologies are involved and will have influence as well.

Discussion

The majority of indicator sets and frameworks adopt or adapt existing conceptual ontologies. Sterling et. al. (2017) noted that many of the culturally grounded indicator sets used internationally have been framed using existing conceptual frameworks that have already determined how to convert data from indicators into decisions. Examples include DFPSIR (Driving Forces-Pressures-State-Impacts-Responses) and SES (Social-Ecological Systems). The result is that decisions on the relevance of information and the selection of indicators, and the relative importance of indicators have already introduced bias before any evaluation is undertaken. Therefore, even when included through participatory processes, cultural indicators can be overwhelmed by the sheer scale of over-representation of other ways of knowing as demonstrated in the IWG framework (Indicators Working Group, 2019).

The Mauri Model Decision Making Framework (MMDMF) quantifies and then utilises the bias inherent in a stakeholder worldview for this reason. Designed to be transparent, inclusive, and holistic, the MMDMF states its ontological basis and identifies *Mauri* as the appropriate measure of sustainability. It is a unique approach to indicator set development that includes processes designed to ensure repeatability and objectivity in the evaluation being undertaken. It offers a holistic and inclusive way to understand the world other than in monetary terms (Morgan 2008) and offers an alternative to contemporary neoliberal capitalism.

By using the concept of mauri to represent the potential of phenomena possessing physical and/or metaphysical characteristics, the capability to measure both physical quantities and metaphysical qualities allows for a wide, inclusive range of indicators that better reflect the physically, culturally, psychologically, and spiritually defined reality of Indigenous Peoples. As an expert-weighted decision matrix, the MMDMF is therefore holistic, simple to use, objective, and produces repeatable results. The MMDMF is unique, as it provides a culturally neutral template within which Indigenous values are explicitly empowered alongside scientific data. The MMDMF is intended for use at the community level and the process can be applied in any community, with outcomes focused on sustainability. Independent research determined the MMDMF to be an exemplar sustainability indicator set when benchmarked against the Bellagio STAMP principles for sustainability and concluded that the Mauri Model is relevant regardless of community (Challenger, 2013).

Decision making frameworks based on systems thinking can facilitate enhanced understandings of sustainability and potentially enlighten societies to behave differently. It has been established in this research that in community settings, frameworks must be contextually relevant and based on epistemological concepts that are more strongly aligned with sustainability. Indigenous epistemologies are commonly based on principles of interconnectedness, relevance over long periods of time, intergenerational equity, and uniqueness to place (Durie 2005), principles that resonated in the international case studies as well as Harmsworth's principles (2002, 2013). In this regard, cultural indicator sets and frameworks should provide credible qualitative or quantitative data-driven insights that facilitate a better understanding of a system while distilling its complexity.

Returning to stakeholder worldviews, the quantified priorities created using the MMDMF will reveal the inherent bias of stakeholders in a useful way as it reflects the dimensions most

strongly influencing a stakeholder's understanding of a situation, and their likely areas of expertise. Similarly, the MMDMF allows Tangata Whenua to contribute their own understandings based on indigenous knowledge to ensure that they are effectively included in resource management decision making processes.

The transferability of the MMDMF in international contexts (Papua, Hawai`i, China, Canadian First Nations, Rarotonga) as well as its relevance nationally identifies it as a potential pathway to more sustainable decisions and actions. Thus, through integrating systems techniques and the Indigenous concept of mauri, the MMDMF creates an opportunity for cross-cultural communication and action.

International studies have recognised that universal measurement systems may not be very well aligned for local contexts, cultures, and needs (Sterling et. al., 2017), so understanding how to build culturally-relevant indicator sets is an essential aspect of determining preferred actions in the face of increasing environmental, social, and economic instability. Incorporating the insights provided here, the process of identifying cultural indicators is likely to now become more time consuming and less transferable, however a greater time investment will likely be compensated for by the more robust and enduring decisions that result. Further these cultural indicators are not in competition with scientific indicators but rather complementary as they interpret changes and provide understandings of these in different ways.

Neither organisational processes nor ecological processes can be understood in isolation (Olsson et al. 2004), likewise cultural indicators cannot be separated from their ecosystem of origin. There is a necessity for cultural indicators of ecosystem mauri and other dimensions to provide historical depth and engage indigenous knowledge to effectively communicate the socio-cultural interactions that often govern ecosystem functioning and resilience. Ideally, when an indigenous community, such as Te Arawa, are involved in framework and cultural indicator development, the opportunity is provided to co-create indicators that capture the social, cultural, environmental and economic context for managing ecosystems holistically. Locally-developed indicators and criteria greatly facilitate local understanding of their use, and therefore may also increase community ownership, adoption, and acceptance.

Thus, the development of cultural indicators for decision making must be locally focused and relevant. Extension to a wider ranging spatial scale than the community they stem from raises the potential for perpetuation of colonising processes of the past. Cultural indicator sets need to be specific enough to reflect the cultural context of their ecosystem of origin first and foremost, only then is it likely that understandings will be able to be compared and possibly aggregated across regions to trigger appropriate decision-making in other contexts such as at the national and international level. To achieve the later however will likely require effective representation at the decision-making table from the Indigenous communities from which the enhanced understandings are being generated.

Conclusion

The purpose of this report has been to explore the state of knowledge of cultural indicators internationally and in Aotearoa NZ. However, the scope of this investigation revealed broader issues that require attention before cultural indicator sets can simply be tacked onto existing scientific modelling approaches. In all case studies that reflected best practice, the cultural indicator sets were developed as part of the project. While some indicators are transferable, the accuracy and appropriateness of the evaluation cannot be assumed unless the cultural indicator sets to be used is verified with the relevant Indigenous community.

The weakness of the majority of scientific modelling and its application within the reductionist scientific paradigm is the assumption that accurate representations of reality can be effectively achieved by only acknowledging the instrumental value and physical characteristics of the environment. A potential weakness of more holistic approaches that incorporate the intrinsic value of the ecosystem is that within the scientific paradigm these understandings can become inefficient due to the sheer complexity created. The challenge therefore is to avoid the constrained approach of only acknowledging the instrumental value but also ensure that the approach is manageable in terms of scale to ensure the effective incorporation of concepts not readily understood in the scientific paradigm.

Cultural indicator sets can potentially address issues with frameworks whose superficial scope is a constraint by providing the substance of the missing deeper more meaningful understanding available from Iwi and Hapū. However, the decision-making processes and framework within which the indicator sets are to be used must also be consistent with the holistic way of knowing of Iwi and Hapū, and the method of indicator measurement for all indicators must be consistent across indicator sets and robust in its application.

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