Visualising Mātauranga Māori for Iwi Outcomes

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Abstracts

Ko te Mātauranga Māori he puna nō te katoa, he mea āta whakatipu hoki e ngā whānau, e ngā hapū, e ngā iwi hoki o tēnā, o tēnā o ngā whakareanga maha. He mātauranga nō te hapori, he mea āta whakatō hoki ki roto i ngā wheako o te ia rā, he mea kawe ki te pūrakau, ki te waiata, ki ngā karangahanga whenua, ki te kani, ki te kawa, ki te whakapapa, ki te pūmahara, ki te whakakitenga, ki te matakite, ki te whakaakoranga me te tohu pūtake, hei tirohanga, ka mutu he mea āta ako mā te tirohanga, mā tāngata kē atu rānei o te hapori. Tēnei mea te Mātauranga Māori, he pūnaha whakatipu mōhiohio, he nukurau, he nanakia anō hoki, kua hangā mai ki te mātauranga ā-whānau, ā-hapū, ā-iwi anō hoki.

Kei te whakatau tikanga, kei te whakamahere, kei te whakamahi hoki ētahi hunga tangata i te Mātauranga Māori, ka mutu kei tēnā ōna anō whaihuatanga. Ko te aho e whakakotahi nei i ngā rōpū kāwanatanga me ngā kaunihera ā-rohe, ko te whakaaro e hāngai pū ana te mātauranga Māori ki te Māori, he mea whakahāngai hoki, ka mutu he rerekē i tēnā, i tēnā o ngā rohe. Ki tā te nuinga o ngā hunga tangata, ko te whakapakarihia o ō rātou ake māramatanga ki te mātauranga Māori tētahi tino whāinga ā-rautaki, kei reira hoki he āwhina i te ārahi whakataunga, i te whakahaerenga, i te tikanga mātai anō hoki, me te takoha atu ki te nanakia e taea nei e te mātauranga Māori, kia waihangatia mai ai he tatauranga tika mā tēnei whakareanga.

He maha ngā kauwaka e kawe atu nei i tēnei mea i te Mātauranga Māori. E kōrero nei ngā mana whenua i ō rātou hiahia ki te whakamahinga o ngā taputapu wāhi ā-nuku hei whakakitenga atu i te mātauranga Māori i te taha o te raraunga pūtaiao, kia tautokohia ai ngā whakataunga ki ngā hua ā-taiao nei. I tēnei pepa, ka kōrerohia e mātou ko Takiwa, koia he Geo-spatial Visualisation Tool e whakatakoto nei i te papa whakatū mō Takiwa Lakes, e hāngai nei ki ngā kaupapa wāhi ā-nuku e toru. Kua whai hononga te taputapu ki ētahi kaitiaki, e tika ai te horopaki, ngā kiko, me te whakahaere o te mātauranga Māori i tōna papa whakatū. He tino take ēnei i tēnei wā e aro pū nei ngā ohu tangata kia nui ake te whakamahinga o te mātauranga Māori i ngā whakataunga. Ko te whāinga o ngā hononga kaitiaki ko te whakatinana ake i ngā mahere whakahaere mā roto anō i te whakamatihiko i ngā raraunga me ngā kōrero i ngā mahere, me te whakaatu i ērā i te taha o ngā raraunga pūtaiao. E whakamana nei tēnei papa whakatū i ngā mana whenua mā roto i te whakaatu i ngā tohunga pūtaiao pēnei me te kounga, te nui rānei o te wai (te wāwahi rānei) i roto i te horopaki o te raraunga mātauranga Māori, pēnei anō me ngā whenua hirahira ki te Māori me ngā mahinga kai. Heoi, he take whakatū pihi te whakamahinga o te mātauranga Māori i ētahi wā, nō reira me whai whakaaro ki te whakangungu i te mana, i te tūturu, i te ngākau tapatahi ā-ahurea nei anō hoki o ngā hapori ka whai wāhi mai.

Mātauranga Māori is the shared intellectual capital generated by whānau, hapū and iwi over multiple generations. It is community knowledge embedded in lived experience and carried in stories, song, place names, dance, ceremonies, genealogies, memories, visions, prophesies, teachings and original instructions, as learnt through observation and via other community members. Mātauranga Māori is a dynamic, innovative, and generative system of knowledge constituted from mātauranga ā-whānau, mātauranga ā-hapū, and mātauranga ā-iwi.

Mātauranga Māori is being defined, framed, and operationalised with varying success by a range of institutions. The general premise is that government agencies and regional councils acknowledge mātauranga Māori as Māori-specific knowledge that is adaptive and regionally distinct. For most institutions, improving their understanding of mātauranga Māori is an important strategic aim that can help guide their decision-making, management, and monitoring procedures as well as contribute to the innovative potential of Māori knowledge in order to create culturally appropriate data for this generation.

Mātauranga Māori is transmitted through a number of mediums. Mana whenua are expressing interest in how geospatial tools can visualise mātauranga Māori alongside science data to support decision-making for environmental outcomes. In this paper we discuss Takiwa, a geospatial visualisation tool that provides the platform for Takiwa Lakes, in relation to three geospatial initiatives. This tool has developed kaitiaki layers to provide an appropriate context, content and control of mātauranga Māori within its platform. These are critical factors as agencies focus

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on increasing the use of mātauranga Māori for decision-making. The aim of the kaitiaki layers is to bring iwi management plans to life by digitising the data and information within the plans and presenting them alongside scientific data. This platform empowers mana whenua by presenting scientific indicators such as water quality and quantity (e.g. allocation) within the context of mātauranga Māori data such as sites of cultural significance and mahinga kai. However, the use of mātauranga Māori can be a sensitive issue and it is important that consideration is given to protecting the cultural authority, cultural authenticity, and cultural integrity of the participating communities.

Indigenous Knowledge

Every society, culture and language has developed its own knowledge system for describing the world grounded in traditional understandings and enriched through local experience and practical use. These knowledge systems are known by a range of terms including Indigenous Knowledge (IK), Traditional Ecological Knowledge (TEK), Traditional Knowledge (TK), and Local Ecological or Environmental Knowledge (LEK). Castellano (2000, p. 24), describes IK as knowledge that:

> *has been handed down more or less intact from previous generations. With variations from nation to nation, it tells of the creation of the world and the origin of clans in encounters between ancestors and spirits in the form of animals; it records genealogies and ancestral rights to territory; and it memorialises battles, boundaries, and treaties and instils attitudes of wariness or trust toward neighbouring nations. Through heroic and cautionary tales, it reinforces values and beliefs; these in turn provide the substructure for civil society.*

Embedded in lived experience and carried in stories, song, place names, dance, ceremonies, genealogies, memories, visions, prophesies, teachings and original instructions, IK is a shared-community knowledge (Smith *et al.* 2016). It has high intrinsic value and tends to be context-dependent and localised to particular communities, places and regions (see, for example, Berkes 1995, 2008; Cajete 1999, 2000; Grenier 1988; Houde 2007; Isaac 2015; Latulippe 2015; Menzies 2006; Reo 2011; Sillitoe *et al.* 2005; Smith *et al.* 2016; Wehi *et al.* 2009; Whaanga & Wehi 2015; Whyte, 2013).

IK is used interchangeable with TK and often reflects the positioning of the authors who 'operate under differing sets of assumptions and towards particular ends (Latulippe 2015, p. 118). While descriptions are not fixed or mutually exclusive, they tend to cluster in four general categories: ecological, critical, relational, and collaborative (Latulippe, 2015) (see Table 1).

Mātauranga Māori

Mātauranga Māori has been defined as 'the unique Māori way of viewing themselves and the world, which encompasses (among other things) Māori traditional knowledge and culture' (Waitangi Tribunal 2011, p. 6). Mātauranga Māori is a cumulative body of knowledge that has accrued over millennia. It carries meaning for Māori communities as

Table 1. Typology of traditional knowledge (TK).

Orientations	Description
Ecological	TK supplements Western science, offering unique insights into ecological processes
Critical	TK is embedded in uneven, colonial relations of power
Relational	TK emphasises the relationship between knowledge, place, and practice, recognising the kincentric relationship with the natural world
Collaborative	TK holds a position of empowerment for Indigenous peoples that enable Indigenous peoples to create conversations, spaces, institutions, and mechanisms across knowledge systems in order to protect their own knowledge systems.

it continues to be applied and adapted to a variety of contemporary contexts (Durie *et al.* 2012; Smith *et al.*, 2016). There are many manifestations of mātauranga Māori from its historical origins in Polynesia to its evolution in Aotearoa (Royal 2009), and over the past 20 years the term has become:

> *increasingly important as more and more people are engaged in efforts to understand what it means. Put simply, the term refers to Māori knowledge. However, once efforts are made to understand what the term means in a wider context it soon becomes evident that Mātauranga Māori is a lot more complex. (Mead 2012, pp. 9-10)*

At an epistemological level Hardy *et al.* (2015, p. 48–49) present four overarching features of mātauranga Māori:

(i) *The interconnectedness of people and nature*: Whakapapa places Māori within an ecological sphere at the same level and linked to the natural world. A whole-of-system approach takes into account the human-ecology relationship and their influence on each other.

(ii) *Sacredness of nature*: All things have a life force of their own, and as such have their place in the order of things. All living things and natural resources are taonga derived from the supernatural world, which evokes ethical concepts of reverence for creation as a whole including kinship, and reciprocity.

(iii) *Guardianship/ kaitiakitanga*: Māori ancestral connections to the natural world confer the responsibility to sustain and maintain the well-being of people, communities, and natural resources. Kaitiakitanga is the active practice of spiritual and physical guardianship based on tikanga to support the wise management and care of natural resources.

(iv) *Intergenerational passage of knowledge*: Māori possess a rich knowledge of ecological systems and relationships with the natural world, accumulated through their long history of resource use in specific locales, spanning many generations. The inter-generational connections between people and nature is strengthened as mātauranga is passed down through generations, combining practice, knowledge, and belief systems.

Use of matauranga Māori in research
The interface of mātauranga Māori and science has become increasingly relevant as the Vision Mātauranga policy (VM) is being implemented across a range of research funders[1] in Aotearoa (MoRST 2007). At a practical level the interdis-

ciplinary interface provides opportunities for knowledge exchange, innovation, and the creation of both mātauranga Māori and science (Durie 2005; Hudson *et al.* 2012; Smith *et al.* 2013; Hikuroa 2016). Mātauranga Māori is gaining a more visible presence within the research environment, as it is being used in an increasing number of practical contexts to support environmental management and ecological restoration (Bernhardt *et al*. 2011; Uprety *et al.* 2012; Hudson *et al.* 2016; Landcare 2016). However, as researchers and institutions become more open to the potential value of mātauranga Māori, there are a number of important factors that should be recognised so that communities do not feel like their knowledges are being misappropriated (Whaanga *et al.* 2017; Williams *et al.* 2017)

1. ***Acknowledging contemporary relevance and application***: Iwi partners value mātauranga Māori not only for its historic significance but its contemporary relevance.

2. ***Acknowledging cultural validity***: Mātauranga Māori informs not only traditional practices but also Māori and iwi participation within Council activities.

3. ***Accepting epistemological difference***: Mātauranga Māori brings a different value set and way of understanding phenomena to the table.

4. ***Acknowledging mana whenua responsibility for mātauranga Māori***: The management and use of mātauranga represents a core responsibility of mana whenua.

5. ***Developing a more nuanced understanding of mātauranga Māori***: Developing a more nuanced understanding of the different disciplines and content that exist under the broad definition of mātauranga Māori is necessary.

6. ***Exploring the interface of mātauranga Māori and science***: Recognising the difference between science as a content, science as a process, and science as a community is vital for understanding mātauranga as a body of knowledge, mātauranga as a system of knowledge, and mātauranga as a community of knowledge.

7. ***Incorporating mātauranga Māori within institutional workstreams***: Institutions have a diverse range of responsibilities and programmes of work which are expected to incorporate mātauranga Māori. Relationships with mana whenua, recognition of cultural intellectual property, and processes of knowledge management are all significant issues that should be addressed in partnership with mana whenua.

A key consideration for using mātauranga Māori is understanding that it is a body of knowledge comprising a range of different types of knowledge. The usefulness of any particular type of knowledge or specialist disciplinary information will depend on its relevance to the activity being undertaken. The table below outlines the how different dimensions of mātauranga Māori could align with different components, for example, in a freshwater management regime (Hudson *et al.* 2016a).

Table 2. Dimensions of mātauranga Māori relevant to freshwater management.

Governance	Treaty relationships, *mana whenua* status
Goals	Māori values, *whakataukī*, Māori environmental concepts
Objectives	Māori aspirations, historical accounts, Māori conceptual frameworks
Actions	Traditional Ecological Knowledge, cultural management practices, Māori modelling tools
Limits	Traditional Ecological Knowledge, Cultural protocols (*Tikanga*), Māori assessment frameworks
Monitoring	Cultural indicators (*Tohu*), Māori monitoring tools

Implementation challenges

Knowledge translation, dissemination, implementation, and uptake are becoming increasingly important to transitioning innovative research into policy and practice. The institutional drivers, such as VM, for incorporating mātauranga into research, policy, and/or decision-making processes arise in part from Treaty responsibilities with mana whenua. Mana whenua is a term used to describe hapū or Iwi with decision-making rights and kaitiaki responsibilities across specific areas and domains in the environment. Relationships with mana whenua require a better understanding of mātauranga Māori both to support the interface with science and its use within decision-making. This context creates specific implementation challenges to ensure programmes are delivered in a culturally appropriate manner, maintain their social licence[2] and their cultural licence[3]. Key elements of a recently developed implementation framework for Māori communities are community engagement, cultural centred approach, systems thinking, and integrated knowledge translation (Oetzel *et al.* 2017). The components of the framework are consistent with kaupapa Māori approaches and enhance implementation by prioritising both mātauranga Māori and rangatiratanga (self-determination). The core implementation challenges that have emerged from efforts to incorporate mātauranga Māori into policy and practice are:

1. **Ethics of engagement:** ensuring engagement processes are consistent with cultural expectations and ethical codes.

2. **Māori data sovereignty:** recognising the inherent rights and interests that Māori collectives have in mātauranga Māori and Māori data, and the importance of Māori governance of Māori data.

3. **Knowledge management:** having clear processes and rules about the collection, storage, and use of mātauranga Māori, especially secondary use.

4. **Modelling with mātauranga**: ensuring participation of any communities that use their mātauranga as inputs into modelling exercises. (Hudson *et al.* 2017)

Actively planning for these implementation challenges is vital for building trust and accountability into relationships with mana whenua and ensuring mātauranga is used in ways that maintain;

- te mana o te tangata (cultural authority),
- te wairua o te korero (cultural authenticity), and
- te mauri o te kaupapa (cultural integrity).

Case studies

Muaūpoko geospatial platform

Located in the western side of the Rimutaka and Tararua ranges to Te Whanganui-a-Tara (Wellington), Porirua, Kapiti Coast, Horowhenua, Manawatu to Rangitikei, Muaūpoko are the descendants of Tara, the eponymous ancestor of the Ngāi Tara tribe. Muaūpoko developed as a separate and unique iwi over time and established its own hapū, areas of occupation, use and access to resources from this region (Muaupoko Tribal Authority 2015–2017). One of the key sites of significance within the rohe is Punahou or Lake Horowhenua.

As part of a programme of monitoring and restoration, the Muaūpoko Iwi Authority developed a project, funded by Te Wai Māori Trust, to build a cultural indicators framework. The framework was to identify relevant targets and indicators that support the Trust and Muaūpoko to lead the restoration, maintenance, and preservation of their lakes and rivers. While numerous data-sets and indictors exist in the scientific communities and with regional councils and government, there are very few documented indicators that help to articulate the cultural values that are important to iwi.

The project made use of the Takiwa Geospatial Platform to organise the range of public and private datasets that the iwi identified as being relevant to freshwater decision-making. The geospatial platform provided easy access to the wide range of publically available datasets as well as the ability to store restricted datasets including mātauranga Māori. A series of workshops were conducted with kaumātua and mana whenua to identify cultural values and other dimensions of mātauranga Māori. Organising mātauranga in a way that both made sense to the iwi and was coherent in the context of the scientific data was an important step. Aligning iwi observations and narratives with indicators and models to support Muaūpoko-based decision-making was a key step. Not only was this consistent with the data–information–knowledge–wisdom framework (Mercier *et al*. 2012), it also built on a proposed organisational schema for layers relating to *mana* (cultural sites of significance – consistent across time and space), *mauri* (cultural indicators – vary across time and space), and *wairua* (cultural aspirations – reinforce identity across time and space). This schema is illustrated in Figure 1.

Tapuika: The importance of creating new Māori data

Tapuika is a tribe of Te Arawa that extends from coastal Western Bay of Plenty inland towards Rotorua. Its interior boundaries were formed as the *tupuna* Tia made his way inland discovering the Lake Taupō nui a Tia. His son Tapuika remained in the lands and, through *noho tuturu*, Tapuika claim *mana whenua* and *mana moana*. The Tapuika Claims Settlement Act 2014 created the Te Maru o Kaituna River Authority as 'a co-governance partnership mandated to restore, protect and enhance the environmental, cultural and spiritual health and well-being of the Kaituna River' (Bay of Plenty Regional Council, BOPRC 2019). Protecting and enhancing the wellbeing of the Kaituna river is a core responsibility of the Tapuika Iwi Authority and as a consequence they have engaged in research relationships and projects to better understand and coordinate scientific data and mātauranga about the health of the river (Waiti *et al*. 2017a & b). This included projects investigating current
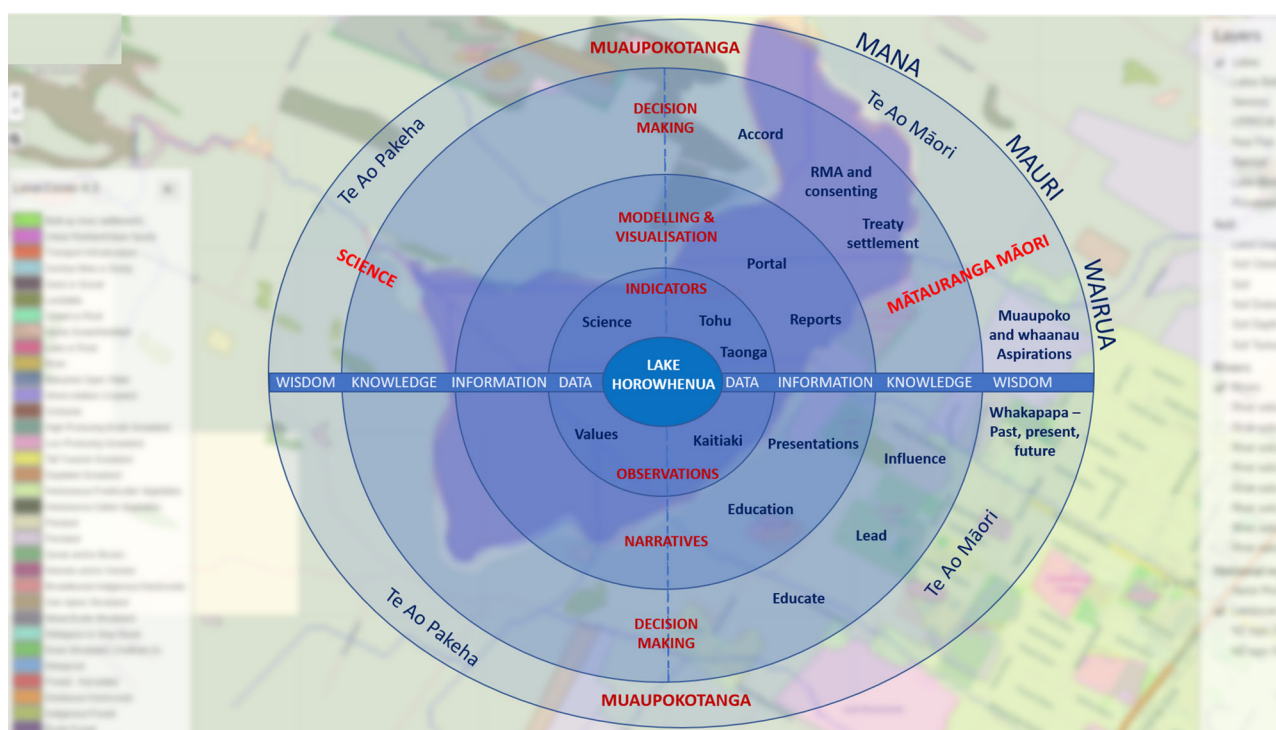

Figure 1. Muaupoko framework for a geospatial platform.

monitoring and historic data for five sites on the Kaituna river (see Table 3), in addition to Tapuika mātauranga (described thematically in Table 4).

Table 3. Attributes monitored by BOPRC each month at five different sites along the Kaituna River.

Dissolved oxygen	Flow	Specific conductivity
Temperature	Turbidity	Calcium
Suspended solids	Magnesium	Dissolved reactive phosphorus
Biochemical oxygen demand	pH	Ammonium
Potassium	Total Kieldahl nitrogen	*Enterococcus*
Chloride	Sulphate	Total phosphorus
E. coli	Faecal coliforms	

(Waiti *et al*. 2017b)

Alongside the research projects a decision was made to make use of the Takiwa geospatial platform to visualise a range of scientific data as well as Tapuika-specific mātauranga. The project team realised that, while Tapuika members retain important knowledge about their *whenua* (land) and *awa* (river), much of it was historical and experiential. As this mātauranga is in a different format to the scientific monitoring data, visualisation and analysis of the two forms of information alongside each other is more challenging. As a result, the team has since been working with Landcare Research to adapt a Kaupapa Māori Assessment Tool for Wai Ora Wai Māori. The tool is made up of '*qualitative and quantitative measures for stated attributes consistent with the National Objectives Framework (NOF) bands for assessing and reporting standards and condition of selected attributes*' (Landcare Research, 2016). The aim of this new component is to ensure that more consistent and regular mātauranga-based observational data can be collected and analysed alongside the scientific monitoring data.

Mahaanui Kurataiao: Visualising an Iwi Environmental Management Plan and collecting freshwater data

Mahaanui Kurataiao (MKT) is the environmental management unit for the *rūnaka* based around the Greater Canterbury region. As part of a project to better understand the groundwater resource MKT worked with Waiora Pacific to utilise the Takiwa geospatial platform and adapt it to locate scientific datasets within an *atua* (diety) based framework aligned to the Mahaanui Iwi Management Plan (Jolly & Nga Papatipu Runanga Working Group, 2013). In addition to visualising various publicly available datasets they have been able to add additional data about consents across their rohe (region) including volumes and lengths of each consent. This has provided the foundation for increasingly sophisticated analyses of water allocation and use and how this relates to issues of water quality for Te Waihora and the wider catchment (see Figure 2).

Discussion

As access to data increases, the way in which that data is contextualised and visualised is important. Framing data within an iwi worldview allows iwi to make sense of different types of data whether it emerges from a scientific inquiry or a mātauranga-based inquiry. The brief descriptions of

Table 4. Definitions of themes for Tapuika mātauranga.

Theme	Definition
Kaupapa	Principles and values that guide the management and usage of mahinga kai.
Tāngata	Iwi members who use, co-manage, and co-govern mahinga kai resources.
Tuku Iho	Using the past to inform the future. Significant historical kōrero, text, whakataukī (proverbial sayings), etc., that describe a past environmental state.
Take	Issues that impact the health and well-being of mahinga kai.
Tikanga	Practices and methods implemented in the field by kaitiaki and kaimahi (those doing the work).
Whakakitenga	Field observations by experienced kaitiaki and kaimahi (those doing the work).
Tohu	Signs and indicators used to interpret and monitor what is happening in the environment.

(Waiti *et al*. 2017a)

the case studies outlined above demonstrate how mana whenua have orientated the scientific datasets within iwi value-based frameworks, layering them alongside mātauranga-related content. Each iwi chose a framework which made sense to their context, and subsequent discussions have been held to see whether it is possible to switch views between different contextual frameworks to allow iwi to consider the data through a different lens (i.e., capitals approach v. mana whenua approach).

In each case researchers have been working with iwi to visualise different sorts of Māori content. They have used the concepts of *mana*, *mauri*, and *wairua* to conceptualise different types of content that can be generated from mātauranga Māori. Content in the *mana* domain relates to cultural sites of significance that represent the ongoing associations (both spiritually and culturally) that iwi have with their environment. Content in the *mauri* domain relates to assessments of the state of the environment (i.e., cultural health indicators). Content in the *wairua* domain relates to the historic associations with place, and how these can inform restoration activities to enhance relationships with the environment. Mātauranga tends to be information rich but data poor, so the generation of new Māori data is necessary for enhanced monitoring and modelling. Tools like *Cultural Health Indicators* (Tipa & Tierney 2006) or the *Wai Ora Wai Māori App* (Awatere *et al*. 2017) support the collection of new Māori data.

However, as the use of mātauranga Māori can be a sensitive issue for mana whenua groups, it is important that consideration is given to protecting the cultural authority, cultural authenticity, and cultural integrity of the participating communities. Few organisations have specific policies or protocols in place to manage the collection, use, and management of mātauranga Māori, a situation which contributes to the discomfort experienced by mana whenua groups. Recent literature around Māori data sovereignty has focused iwi attention on the need to establish clear protocols around the secondary use of data (Kukutai & Taylor 2016; Hudson *et al.* 2016b). It is important that discussions and agreements are made with mana whenua groups that clarify these boundaries and responsibilities so that information can only move from private spaces to public spaces with appropriate permissions. Data access should be determined
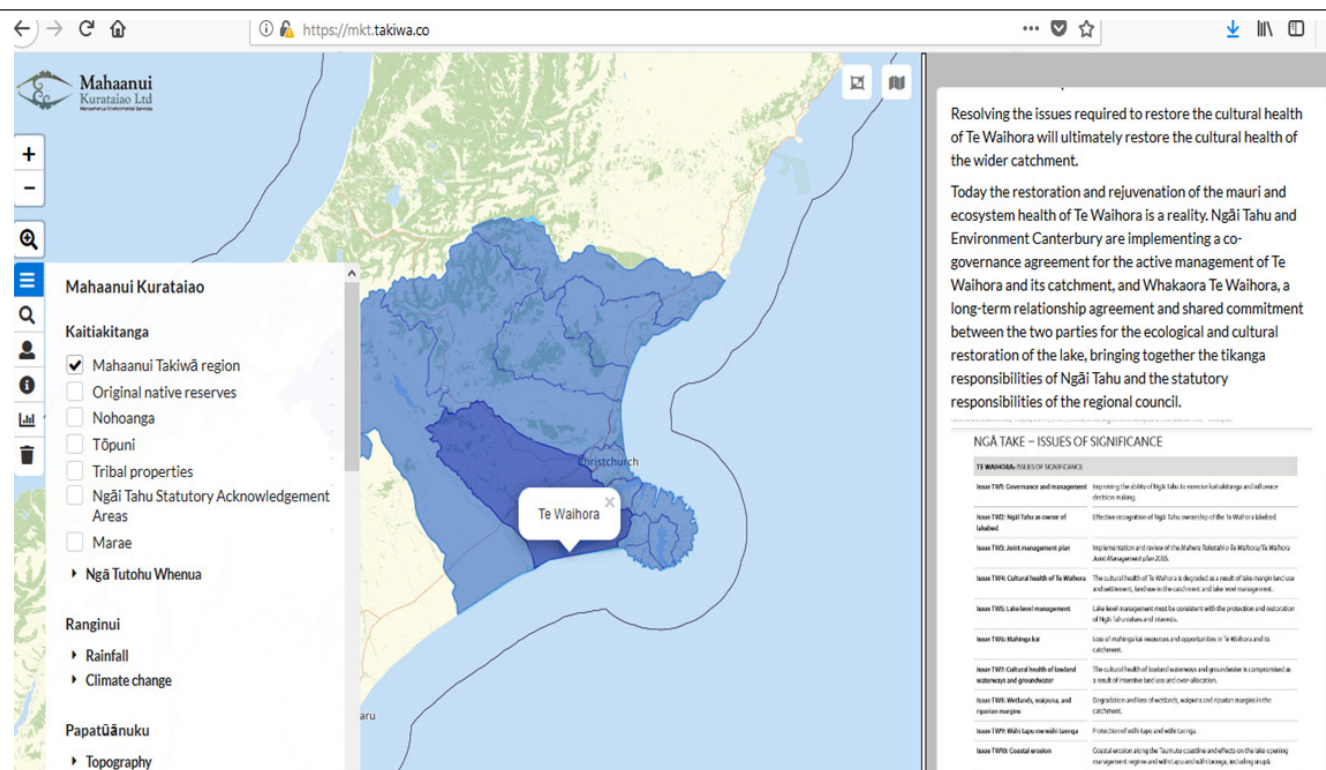
Figure 2. Screen capture from Mahaanui Kurataiao.

by the owner/provider of the data and managed by a mandated kaitiaki.

Data management is not a term normally associated with mātauranga Māori (Whaanga & Wehi 2015). Nonetheless, as the knowledge economy continues to grow and society shifts towards open data environments we have to be much smarter about creating tools that will allow us to utilise mātauranga Māori in culturally and ethically appropriate ways (Boulton *et al.* 2014; Hudson *et al.* 2018). Data infrastructures will only be useful if we have the ability to adequately use them so improving technical skills and building capacity in this key area will be an important activity. Similarly, Māori communities have to assume responsibility for the governance of data (both mātauranga-based and science-based) and sustain a 'response ability' around data for governance if we are to shift our capacity to use mātauranga Māori and Māori data from a 'reactive inquiry' space to a more proactive one focused on creating insights and initiatives.

Conclusion

Mātauranga Māori was traditionally transmitted through a number of mediums. Now mana whenua are expressing interest in how geospatial tools can visualise mātauranga Māori alongside science data to support decision-making for environmental outcomes. The key challenges for iwi entities in making their mātauranga Māori more readily accessible and usable is to develop platforms that provide the appropriate context, content, and control over the use of mātauranga Māori.

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