



Manaaki Whenua
Landcare Research

Te Tirohanga o Ngā Tohu: Taranaki Climate Resilience Tool Development



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Summary

Project and client

- The project has been funded by The Deep South National Science Challenge whose mission is: Changing with our Climate is to anticipate, adapt, manage risk and thrive in a changing climate.
- This project aims to contribute to the Deep South National Science Challenge mission and the needs of our iwi research partners by developing a climate change tool based on iwi priorities, values and environmental tohu (signs), specific to three northern Taranaki iwi: Ngāti Mutunga, Ngāti Tama and Ngāti Maru. The tool will support iwi to prioritise and plan for climate related impacts in vulnerable habitats.

Objectives

This project aims to develop a climate change tool based on iwi priorities, values and environmental tohu identified by Ngāti Mutunga, Ngāti Tama and Ngāti Maru by undertaking the following actions.

- 1 Summarising Māori ways of caring for their local taiao (environment).
- 2 Identifying local environmental tohu with hapū/iwi.
- 3 Developing a kaupapa Māori tool that supports understanding the local environment and tohu, under a changing climate.
- 4 Illustrating how process-based modelling alongside a kaupapa Māori based tool can help inform biodiversity management, under a changing climate.

Methods

This project embraces the methodology of Kaupapa Māori because it is led by Māori researchers in partnership with local iwi, is underpinned by Māori philosophy and principles, centres the validity and legitimacy of a Māori world view, and seeks to produce useful and transformative research.

The study design was co-developed with our iwi partners, and used wānanga as our research method. We held two wānanga with our iwi partners, and their iwi members, to address the key research aims/objectives.

Results

Ngāti Mutunga, Ngāti Tama and Ngāti Maru identified resilience as their ability to practice local tikanga and the ability to be adaptive with that tikanga in a changing climate. Their resilience is not merely about 'bouncing back from adversity' but involves a dynamic and adaptive process of reconnecting with the mātauranga (knowledge) and practices that their tūpuna had and integrating them into contemporary conservation efforts. Being connected to and understanding the natural world around them, enables resilience and adaptability.

Through the wānanga process we identified:

- the aspirations of the three iwi groups with regard to climate change.
- which tools and frameworks are currently available to meet these aspirations/needs.
- whether these tools meet the needs of the iwi.
- This then led to the development of the manu tukutuku (traditional kite) tool that could be used to identify and evaluate environmental tohu aligned to iwi aspirations, vulnerable habitats and species, social and cultural values and included the community through a multi-disciplinary mātauranga-based approach.
- Implementing the tool through wānanga, helped to identify some key vulnerable habitats and facilitated discussion on mātauranga-informed restoration approaches in northern Taranaki.

Conclusions

For Ngāti Mutunga, Ngāti Tama and Ngāti Maru, climate resilience in northern Taranaki is linked to environmental, social and cultural tohu.

The interactions of people with place, with cultural practices, and with mātauranga-a-iwi and atua domains from the mountains to sea all empower and support communities in the face of a changing climate.

The manu tukutuku tool supports an understanding of local environments that are both affected by and can mitigate the impacts of climate change.

Based on this information iwi can plan for and identify sites to restore; and also where to channel resources. The tool also provides opportunities for the use of other information and databases, using collaborative frameworks that uphold mātauranga-a-iwi and tikanga.

1 Introduction

In recent times, New Zealand (NZ) has been subject to severe storms and the remnants of tropical cyclones, resulting in severe impacts to the land and to communities. Given the scale of these impacts, there needs to be ongoing discussions to prevent and mitigate climate change related weather events. Including resilient infrastructure and strategies as well as appropriate land use (Manning et al. 2015). For example, the New Zealand Emissions Trading Scheme (ETS) in its current settings, has incentivised the planting of monocultural pine plantations (Carver et al. 2017). However, the current literature on environmental resilience in the context of climate change highlights the need for an emphasis on restoring indigenous and native forests over pine plantations or other foreign species (Prickett et al. 2023). This is particularly important where monocultural plantations dominate landscapes, increasing erosion and soil loss.

A report conducted by Manaaki Whenua – Landcare Research for the Ministry for the Environment in July 2023 showcased how, during cyclone Gabrielle, standing exotic forests were less effective in erosion control compared to indigenous forestry (McMillan 2023). Landscapes dominated by native species tend to show greater resilience to extreme weather events and patterns (Prickett et al. 2023). Indigenous forests have more secure long-term carbon storage, better erosion prevention, no forestry slash, more resilience to drought and flooding, and a reduced wildfire risk (Mercer 2021). It is essential to prioritise and promote sustainable land management practices that focus on the conservation and restoration of native vegetation, including approaches from te ao Māori (Harmsworth & Awatere 2013; Lyver et al. 2016; Timoti et al. 2017; Kawharu 2000; (Kawharu 2000; Harmsworth & Awatere 2013; Lyver et al. 2016; Timoti et al. 2017; Fernández-Llamazares et al. 2021; Hall et al. 2021; Harcourt et al. 2022; McAllister et al. 2023b).

The Aotearoa New Zealand Biodiversity Strategy (Conservation 2020) highlights the need to identify places for protection and restoration (Goal 12.5.1) as well as valued species, threatened ecosystems and places with cultural and recreational value (Goal 11.3.1). This is echoed by a recent DOC climate research action plan (Christie 2020), which highlights the need to better understand vulnerable ecosystems and develop approaches (such as models) that enable prediction and early response to changes in population dynamics and health of indigenous species. A recently released IPCC report (IPCC 2023) identifies the need for ‘diverse knowledges and cultural values, meaningful participation and inclusive engagement processes—including Indigenous Knowledge, local knowledge, and scientific knowledge—which facilitates climate resilient development, builds capacity and allows locally appropriate and socially acceptable solutions.’

Indigenous knowledge helps us understand ecosystem function, species range, potential threats (e.g. weeds and pests) and impacts on biodiversity due to changes in climate. It also, importantly, helps us understand the impacts that all these have on indigenous people and practices. Mātauranga-a-iwi (tribal knowledge systems) are an important tool for predicting and responding to fluctuations in indigenous species populations under a changing climate. The inclusion of holistic indicators that support social, cultural and environmental aspirations and values are the key to resilient Māori communities (Tadaki et al. 2022). The development of a locally specific tool to identify and evaluate climate change indicators can empower local communities and support local solutions.

2 Aims and client

The project was funded by The Deep South National Science Challenge whose mission is: Changing with our Climate is to anticipate, adapt, manage risk and thrive in a changing climate.

This project aims to contribute to the Deep South National Science Challenge mission by developing a climate change tool based on iwi priorities, values and environmental tohu (signs), specific to three northern Taranaki iwi: Ngāti Mutunga, Ngāti Tama and Ngāti Maru. The tool will support these iwi to prioritise and plan for climate related impacts in vulnerable habitats and evaluate whether indicators chosen meet iwi values..

The inclusion of mātauranga Māori (Māori traditional knowledge) for managing local habitats and species is also supported through the ANZBS biodiversity goals, particularly 11.3.1 and 12.5.1, which are to be implemented in partnership with iwi and hapū. When addressing biodiversity and conservation management generally, the main tools used by DOC are process-based models and statistical modelling. Within the current context of partnership approaches between DOC and hapū/iwi, there is a need to include mātauranga Māori tools and strategies for biodiversity management within a changing climate. Using local tohu and mātauranga that are relevant for tangata whenua, supports appropriate tikanga for planning and decision making to help iwi in biodiversity management and restoration, in a rapidly changing climate.

3 Objectives

This project will develop a climate change tool based on iwi priorities, values and environmental tohu identified by Ngāti Mutunga, Ngāti Tama and Ngāti Maru by undertaking the following actions.

- 1 Summarising Māori ways of caring for their local taiao (environment).
- 2 Identifying local environmental tohu with hapū/iwi.
- 3 Developing a kaupapa Māori tool that supports understanding the local environment and tohu, under a changing climate.
- 4 Illustrating how process-based modelling alongside a kaupapa Māori based tool can help inform biodiversity management, under a changing climate.

4 Research focus

This research focused on supporting three Taranaki iwi to anticipate, adapt, manage risk, and thrive in a changing climate by identifying the mātauranga they have, and continue to develop, through their connection to their local taiao. Alongside this, the research identified other tools and information available through the public domain to further strengthen and build on traditional mātauranga. Identifying values, goals, and aspirations for local communities in areas such as Taranaki, which are likely to be significantly

impacted by climate change, is critical for future planning. Building tools that help these iwi to plan ahead and look to solutions that meet the needs of their taiao and communities in a way that reflects their tikanga and mātauranga is important as iwi work closely with national and local government agencies.

5 Methods

By its very nature, this project embraces the methodology of kaupapa Māori because it is led by Māori researchers in partnership with local iwi, is underpinned by Māori philosophy and principles, centres the validity and legitimacy of a Māori world view, and seeks to produce useful and transformative research. A kaupapa Māori methodology, based on Māori self-determination and cultural aspiration principles, is presented by (Smith 2016) and includes the following features.

- It is related to being Māori.
- It is connected to Māori philosophy and principles.
- It takes for granted the validity and legitimacy of Māori, the importance of Māori languages and cultures.
- It is concerned with the struggle for autonomy over our own cultural well-being.

Our study design was co-developed with our iwi partners, and used wānanga as our research method. We held two wānanga with our iwi partners, and their iwi members, to address the key research aims. This approach allowed a safe space for knowledge sharing between a diverse range of skill sets, enabling intergenerational knowledge transfer, and fostering new knowledge creation. Information shared was written in situ and relayed back to participants, to ensure the key messages were captured correctly. All infographics and publications were reviewed by our iwi partners, for the same reason.

Two wānanga were held.

- 1 *On 27 March 2023:* at the offices of Te Rūnanga o Ngāti Mutunga. The purpose of this wānanga was:

to identify the values and aspirations for Ngāti Mutunga, Ngāti Tama and Ngāti Maru in relation to climate change within their rohe and what is currently missing when it comes to planning and resources their key priorities.

We reviewed current frameworks and tools to identify the strengths and weaknesses. We also identified some local tohu that could be used to understand climate change at the local level, and support future planning and resourcing. This was attended by 11 people and the summary was sent to all of our key iwi contacts to ensure that all three iwi values and priorities were represented.

- 2 *On 16 and 17 February 2024:* we held a manu tukutuku (traditional kite) wānanga at Urenui marae. The purpose of this wānanga was:

to develop a tool based on mātauranga Māori observations of te taiao (e.g. a manu tukutuku tool), and test whether it met the needs of Ngāti Mutunga, Ngāti Tama and Ngāti Maru iwi members who attended.

This wānanga was attended by 23 people and was facilitated by Ruth Woodbury (manu tukutuku expert from Hokianga), Tara-Lee Manu (member of Kauae Raro Collective and artist), Anne-Maree McKay and Mahuru Wilcox (project researchers).

All mātauranga elucidated by this research will remain under the control of our iwi partners and the original knowledge holders. Any analysis, writing and sharing of knowledge will require agreement from our iwi research partners, as in the Manaaki Whenua- Landcare Research (MWLR) social ethics agreement developed by all three iwi research partners and the MWLR research team. This agreement was developed in accordance with Te Ara Tika Guidelines for Maori Research Ethics and The New Zealand Association of Social Science Research (ASSR), which provides guidelines for ethical behaviour and decision making with respect to the conduct, management, publication and storage of research. The application was internally reviewed by the MWLR social ethics committee and approved on 10 January 2022, prior to any research activities.

6 Caring for taiao in a changing climate

Before European colonisation, Māori revered the natural world or taiao as an integral component of their cultural and ecological landscapes, and still do today (Jones 2012). These diverse ecosystems, from the mountains to the sea, played a crucial role in sustaining traditional practices, and physical and spiritual well-being, while also providing resources such as food, medicine, and materials for tools and shelter (Forster 2014; Awatere et al. 2021). Wetlands, freshwater, coastal habitats and forests were spaces with spiritual significance, representing the interconnectedness of people, place, knowledge and ways of being (Bargh et al. 2014). The loss of intact native habitats, and loss of connection of tangata whenua to many of their traditional lands, due to land loss and colonisation, all affect the ability to exercise rangatiratanga and grow local mātauranga to support communities in the face of global impacts like climate change (Lyver et al. 2016; Bryant et al. 2017; Timoti et al. 2017; Lyver et al. 2019).

To understand how Māori observe and monitor local environments, there needs to be a basic comprehension of the fundamental concepts of te ao Māori (the Māori world view), which underpins mātauranga Māori (Māori ways of knowing) in the environmental space. The holistic world view that indigenous peoples have, is missing from a process-based modelling approach (Barber & Jackson 2015) to climate change and identifying local priorities.

Māori see the world as interconnected and built on relationships; whether it is between people, places, or with other species, everything is connected (Selby et al. 2010). This holistic world view, with a solid foundation built on whakapapa relationships, is the fundamental driver of tikanga (customs) and therefore the ways of knowing, or mātauranga. This can be explained by two key, underlying concepts. First, the concept of whanaungatanga (kinship), which describes these interconnected relationships between

people, natural resources, place and bodies of knowledge. This is explained through whakapapa (genealogy) which can be thought of as the 'practical manifestation of the kinship principle' (Waitangi Tribunal 2011). Secondly, there is the value of kaitiakitanga which is often simplified to resource management. This is not just a practical concept, but has a strong spiritual core that guides traditions and behaviours, summarised during the Waitangi Tribunal Case (WAI 262) when kaitiakitanga was described as being 'a product of whanaungatanga – that is, it is an intergenerational obligation that arises by virtue of the kin relationship' (Waitangi Tribunal 2011).

Mātauranga Māori is thus made up of a core of traditional knowledge plus the values and ethics that go with it and new knowledge, some of which we have added as a result of our discoveries and research, and some we have borrowed outright from western knowledge and from our experiences of living with exponents of other belief systems and other knowledge systems. We are now reshaping, rebuilding, reinterpreting and reincorporating elements of mātauranga Māori to make it fit the world that we live in today.

(Mead 2012) p.14.

For Māori, connection to taiao and to one another is fundamental to well-being and relating to the world. When facing global impacts like climate change the term resilience is often used to understand how communities prepare and respond. The literature on restoration within Māori communities highlights the resilience embedded in indigenous approaches to ecological challenges. Māori resilience is not only a response to the immediate threats posed by colonisation and environmental degradation but is deeply rooted in a historical continuum of adaptation and survival (Hatton et al. 2017). In New Zealand, the whenua (land) has been subject to sustained pressures over centuries, yet the resilience of collective iwi and hapū is evident in their enduring commitment to restoring it (Jones 2012). Historical disruptions, such as land confiscations and the imposition of European land-use practices, prompted adaptive responses from Māori, fostering a resilience that goes beyond just environmental and cultural domains (Lyver et al. 2019).

Māori resilience literature emphasises the importance of traditional knowledge and tikanga as an essential vessel for resilience. In the context of Māori health, (Wolfgramm et al. 2021) acknowledge that unclear or unprioritised values within a community can result in conflict and misguidance. In te ao Māori, our tikanga – our values – underpins our world view and determines what happens, and why it happens (Reilly et al. 2018). Māori resilience is not only rooted in the ability to practice tikanga but also in its ability to be adaptive with that tikanga. This resilience is not merely about 'bouncing back from adversity' but involves a dynamic and adaptive process of reconnecting with the mātauranga and practices that our tūpuna had – and integrating them into contemporary conservation efforts.

In reference to Māori and taiao, Gabrieleon (2015) in her work with Ngāti Rangī, refers to resilience as 'a means of strengthening and protecting a community's livelihood, assets and way of life.' (Gabrielsen 2015). This wider concept of resilience has been challenged here in New Zealand, and criticised, because 'by examining and developing theories and models of resilience we buy into the idea that this is the way it is and we need simply to get better at bouncing back and being resilient.' (Penehira et al. 2014). Penehira et al

(2014) suggest that resistance is an alternative framing as it 'represents an approach of collective fight- back, exposing the inequitable distribution of power, and actively opposing negative social, political and economic influences.' In this context we see the value of both framings as climate change is a global phenomenon and as a small nation we are limited in our influence at the macro level. However, by creating and implementing localised approaches we engage in resistance and provide examples and pathways for a better future. The development of a climate change tool for Taranaki iwi is a way of including both resistance and resilience, through self-determination, community well-being and local mātauranga.

7 Results and discussion

This section describes our findings from two wānanga, and detailed discussions over Zoom, to refine and progress the tool development. We started by listing the aspirations of the three iwi groups with regard to climate change, identified which tools and frameworks are currently available and then whether these meet the needs of the iwi.

This led to the development of the manu tukutuku tool (Figure 2) which aligned to the iwi priorities, and to the vulnerable habitats and species identified. It also included the community through a multi-disciplinary approach which included mātauranga taiao and toi Māori. This tool was then tested in a wānanga to evaluate the suitability of environmental, social and cultural tohu in northern Taranaki. The implementation of the tool through wānanga, helped to identify some key vulnerable habitats and facilitated discussion on mātauranga informed restoration approaches in northern Taranaki.

7.1 Identifying local climate aspirations in northern Taranaki

Our first wānanga (27 March 2023) identified the values and aspirations for Ngāti Mutunga, Ngāti Tama and Ngāti Maru in relation to climate change within their rohe. We reviewed both their current and soon-to-be-developed environment plans and discussed some of the major changes they were observing in their taiao. The participants identified the following aspirations for their taiao and for their role as kaitiaki and tangata whenua.

- 1 Express and promote kaitiakitanga and uphold customary rights, obligations and responsibilities within the Taranaki rohe. This includes identifying high priority habitats and sites for restoration.
- 2 Reconnect, protect and enhance the environment for future generations. This includes physical and intergenerational connection to taiao through wānanga, observation and restoration.
- 3 Protect, maintain, and enhance the mauri (life essence) and wairua (spirit) of the taiao and strengthen the tangata whenua relationship with the natural environment within the Taranaki rohe. This will support community resilience to extreme weather events and knowledge to prioritise and plan for restoring vulnerable habitats and species.

- 4 Ensure the management of our taiao achieves meaningful cultural and environmental outcomes, and includes approaches that are adaptive and responsive to a changing climate.

What became obvious in this wānanga was that any tool developed for supporting mātauranga and environmental tohu in relation to climate change had to be holistic and include social and cultural tohu. We had a conversation about environmental monitoring, in a more traditional science sense, and the long-term sustainability of this. Wānanga participants also highlighted the need for a motivation that was went beyond solely monitoring impacts of climate change, which is not a novel concern in the environmental monitoring space (Tadaki et al. 2022). Before developing any new approaches, we reviewed what was currently available and might be relevant to the priorities in northern Taranaki.

We shortlisted a number of tools and frameworks to focus on those that were linked to taiao. We analysed monitoring tools like the freshwater and wetland cultural health indices (CHI) (Harmsworth 2002; Tipa & Teirney 2003; Tipa & Teirney 2006), and mauri compass (Morgan 2006) as they identified environmental indicators that aligned to local mātauranga, and included spiritual measures such as mauri. However, as each CHI was developed for a specific environment and not holistic in a mountains to sea approach they were not considered appropriate for this project.

Frameworks like Ngā Atua Kaitiaki (Walker et al. 2021), He Ara Wairoa (McMeeking et al. 2019) and Hua Parakore (Hutchings et al. 2018) use mātauranga Māori to understand changes in natural environments, and allow space for cultural and social practices too. In this context, the Hua Parakore and He Ara Wairoa were considered too site- and/or habitat-specific.

We also reviewed He Waka Taurua (Maxwell et al. 2020b) as a potential framework, but our iwi partners were quite specific that they wanted a locally specific tool that centred their mātauranga. It was noted by our iwi partners that The waka taurua framework may be useful when implementing a multidisciplinary approach to climate resilience, or the alignment with science tools or process-based models. Ngā Atua Kaitiaki (Walker et al. 2019) was identified as being the most useful for this research context, as it included a number of different environments impacted by climate change. Our iwi partners identified the lack of atua wāhine (female deities), and given Hine-i-te-repo (the female deity of wetlands) is considered one of the key atua for climate change resilience in Taranaki, the framework was limited. We did identify the importance of ngā atua (gods) in climate change resilience and how tangata whenua connect to local taiao, so this value was included as part of the tool and associated infographic.

We found that the many of the existing approaches available, were limited when it came to upholding and strengthening other cultural practices like toi Māori (Māori arts). Based on the aspirations listed above (p.6), and what was missing in current tools and frameworks, we identified that creating manu tukutuku (Figure 1) could be a vehicle for this climate change tool. Raranga (weaving) and making manu tukutuku are often compartmentalised as 'arts' and not given the same value as the 'sciences'. However, these practices require an intimate knowledge of multiple local environments and seasonal changes, as well as specific tikanga for harvesting and making. The natural resources

needed to make manu tukutuku come from some of the systems most affected by a rapidly changing climate in Taranaki, including the Ngahere (forests), whenua, coast, freshwater and wetland environments. Collecting and preparing the resources needed to make manu tukutuku encourages active connection with these diverse environments. Using the manu tukutuku as a tool relies on active engagement of people and local taiao, through cultural practices. It is reciprocal in its nature. When engaging in toi Māori, like making manu tukutuku, people have to get out into the environment, and therefore observe those resources and environments. Localised changes and climate impacts are observed when engaging in cultural practices like making manu tukutuku as the resources used, are also in those places most hard-hit by climate change (wetlands, coastlines, forests, gullies, fresh waterways etc).

The inclusion of multiple skills linked to the environment, not just those of environmental kaimahi (workers), increased the opportunities for connection and the sharing of knowledge across disciplines. Including others who regularly connect to, and harvest from, the local taiao brings in new ways of observing and understanding local taiao (Figure 1). By understanding the complexities of environmental tohu and developing a localised tool based on mātauranga-a-iwi, Ngāti Mutunga, Ngāti Tama and Ngāti Maru can ensure current and future biodiversity goals and climate change responses are aligned to their ways of knowing and aspirations for the health of their taiao and communities.

It takes our whole culture to understand our whole taiao.

(Anne-Maree McKay, Ngāti Mutunga)



Figure 1. Northern Taranaki iwi members creating manu tukutuku, combining local mātauranga taiao and toi Māori.

7.2 Manu tukutuku: weaving together the tohu of change

After listing the iwi aspirations for climate and some of the key changes they are observing, we identified the need for an approach that was holistic in its inclusion of environment, social and cultural components. We wanted a tool that aligned to the way our people traditionally engaged with their local taiao, and the importance of caring for their local resources and environments that sustained them. For participants, making manu tukutuku does this through:

- knowing what resources were needed
- knowing where to find local resources, across a number of different environments
- knowing when to collect particular resources
- knowing how to collect and prepare resources for use
- sharing knowledge on how to create manu tukutuku
- decorating the manu tukutuku using local pigments and paints from whenua
- understanding wind patterns and flying kites as tohu for Matariki and the year ahead
- creating manu tukutuku can be repeated and provide a snapshot in time, of local taiao and knowledge
- fostering opportunities for wānanga and getting together
- supporting and strengthening toi Māori and local mātauranga.

From here, we discussed how to bring this all together into an infographic that consolidates key aspirations (listed in Section 7.1), into action, ensuring tangata whenua feel empowered as they plan for and restore local taiao most at risk from climate change. The infographic below (Figure 2) has the manu tukutuku as the central focus, with each point along the top, reflecting the key values used to evaluate climate change tohu in northern Taranaki that include:

- well-being connected to whānau, hapū and iwi
- connection to ngā atua and tupuna
- tangata whenua connected to te taiao.

These values will help evaluate whether climate change tohu meet the needs of local iwi when it comes to understanding their taiao and future planning. These three values are discussed in more detail below (Sections 8.1-8.3).

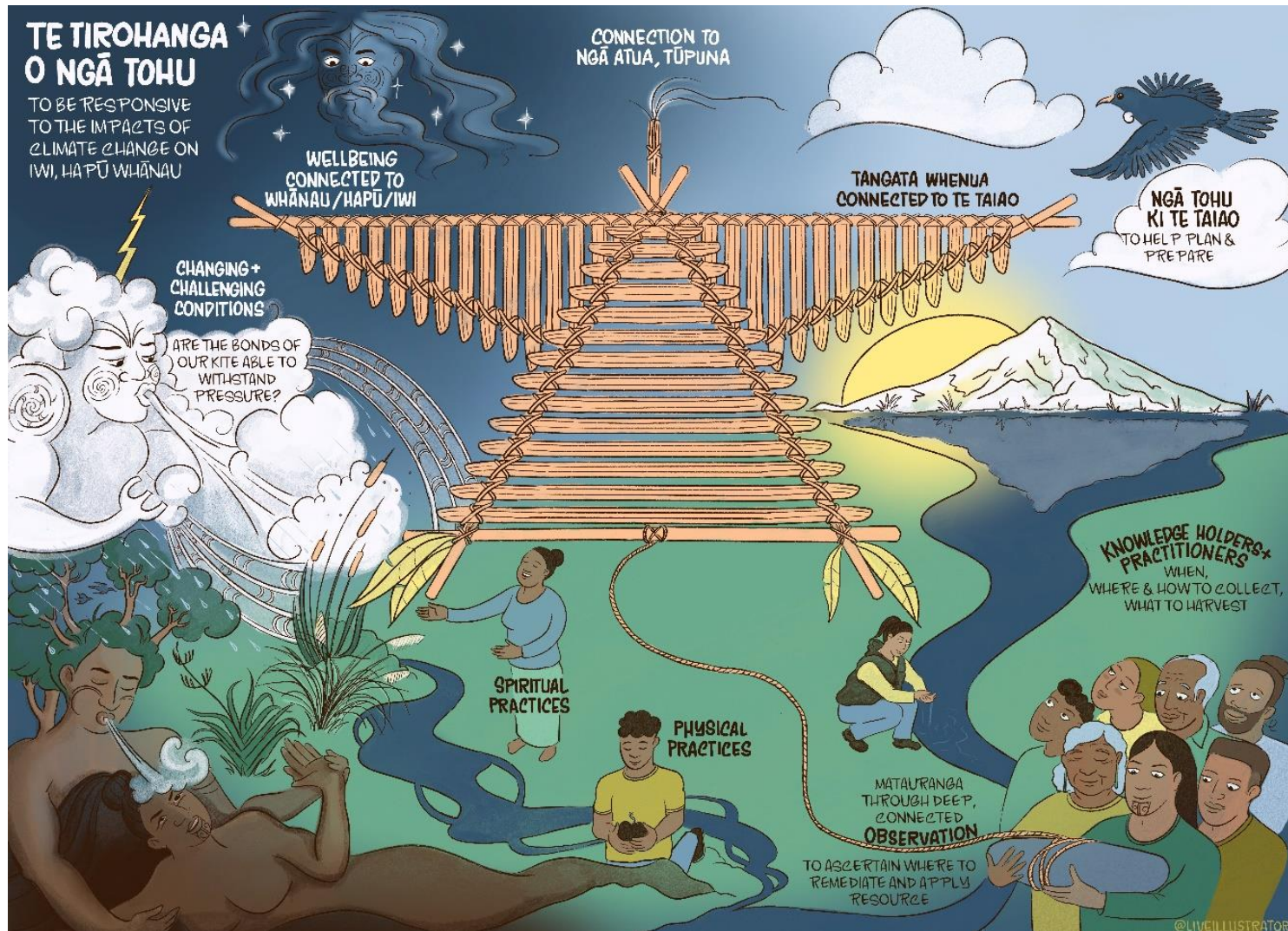


Figure 2. Manu tukutuku climate change tool for evaluating local tohu to prioritise resources for climate resilience. The three key values are shown along the top of the manu tukutuku.

7.2.1 Well-being connected to whānau, hapū and iwi

For Ngāti Mutunga, Ngāti Tama and Ngāti Maru, being connected to one another and strengthening culture, and knowledge about who they are as tangata whenua within their respective rohe was key to resilience. This was one of the values identified as part of the manu tukutuku tool, and used to evaluate the relevance of local tohu used to understand climate change impacts on a social and cultural level Connection to, and support from, others means that they can face those climate change impacts collectively (Figure 3). Working together as part of this project, and connecting at the manu tukutuku wānanga (Figure 4, Figure 5) were some tangible examples of this. Sharing local mātauranga is part of this connection and sense of well-being, with a number of people from different background and skillsets attending and contributing to the kaupapa of climate change and community resilience.



Figure 3. Collecting whenua and uku (soil and clay) at coastal erosion sites, discussing climate change impacts of the local stream and coastline, while fostering connection between tangata whenua and taiao. Onaero, Taranaki.

7.2.2 Connection to ngā atua and tūpuna

The strengthening of whakapapa ties of local tangata whenua to local taiao requires physical and spiritual engagement in the taiao. Locally specific mātauranga and tikanga are intimately linked to the knowledge of local taiao, in a number of atua domains, and to observing change. The wānanga attendees also discussed the importance of Hine-i-te-repo and the interaction with Tāwhirimātea (god of weather). While Tāwhirimātea can be destructive when interacting with Tangaroa (god of the ocean) and Tāne mahuta (god of the forests), wetland plants such as raupō (bullrush), harakeke (flax) and toetoe (native cutty grass) dance with the wind, bending and flexing in the most severe storms. They also rely on the winds to spread seeds. This sparked a discussion on repo (wetland) as a tohu of resilience in itself and the need to protect all remnants of Hine-i-te-repo for when Tāwhirimātea strikes hardest.

A very important part of this tool development was ensuring that old and new knowledge was shared (Figure 4, Figure 6) and passed on to future generations, and local tikanga was upheld so that the actions to mitigate and respond to climate change were reciprocal in nature and ensure sustainable harvest and long-term health of taiao and communities (Box 1).



Figure 4. Weaving together the taiao. Raupō from Hine-i-te-repo, kākaho (stems of toetoe) and harakeke (flax) from Tāne Mahuta, to be adorned with kōkōwai (red ochre) from Papatūānuku.

Box 1. Values in action: field trial example from manu tukutuku wānanga

Before collecting any kākaho (stems of toetoe), we had karakia to acknowledge the atua. Once the kākaho were harvested, the children took them up to the top of the hill to wave around, spreading the seeds down the valley and encouraging natural regeneration. The act of harvesting the kākaho is in itself reciprocal, as it encourages the plant to grow another seed head, accelerating the pace of that, as opposed to waiting until the seed head naturally decomposed on the plant. Understanding the atua domains and how to give back is an important value for tangata whenua.



The collection of raupō, used in the body of the manu tukutuku requires local seasonal knowledge, knowledge on harvesting tikanga and signs to know whether the repo are healthy and safe to enter. Much of this knowledge is passed down from kaumātua and the older generation. Knowing the location of repo used as harvesting sites has changed over time, as many wetlands have been drained and cleared for farming, but the tikanga has remained. The repo we went to were small, and restricted to private land and roadsides, where repo once covered the valley floors. It was noted that raupō are usually harvested in March/April, but we were able to harvest in February due to early dry off of the leaves.



The repo on the private farm looked like the water quality was ok, as it had minimal livestock number upstream and the water was clear, despite warm weather temperatures. Two of the tamariki volunteered to jump in and harvest the difficult to reach areas, and by doing that disturbed the iron oxide 'oily' film, suggesting the presence of paru (black mud) below. This was an unexpected find, only made possible by the physical interaction of the tamariki with the repo. The reciprocity that tangata whenua have with their taiao was also evident when harvesting raupō. Active and regular harvesting of the dry leaves ensures the seeds can land on the water instead of a thick mat of dead leaves, increasing the chance of germination. Raupō thrive when being harvested, and Māori benefit from this resource not just for toi Māori, but for using as natural insulation to line whare and for making floating vessels and waka.

7.2.3 Tangata whenua connected to taiao

Tangata whenua physically connecting to their local taiao was identified in our research as the third key value required for evaluating the relevance of environmental, social and cultural tohu (section 7.2 and Figure 2). As mentioned in section 6, physical connection to taiao is a critical part of the long-term success of this tool, and is currently missing in process-based modelling tools for climate change. All three iwi see themselves as intimately linked to their local taiao through whakapapa, and physically connecting with their taiao is a way of embodying those whakapapa links. Through harvesting and creating manu tukutuku, tangata whenua are accessing sites most vulnerable to climate change, observing tohu over time, connecting to different atua domains and accessing historical knowledge. The physical act of being in their local taiao was identified as being critical for long-term resilience and well-being. This cannot be substituted with online or conceptual frameworks, as the physical connection is the manifestation of whakapapa links of people to place.



Figure 5. Manu tukutuku adorned with kōkōwai, ready to be flown using the winds of Tāwhirimātea. Wānanga two brought together three generations of tangata whenua to share knowledge, joy and connection.

7.3 How values link to environmental tohu

As you move down the image of the manu tukutuku (Figure 2), you can see the *physical* and *spiritual* practices of creating manu tukutuku are linked to *observation* in local taiao through the aho (cord), to the local iwi who are the practitioners and knowledge holders. Tangata whenua are the grounding force of this process and tool, determining what the manu tukutuku looks like and recording observations of taiao over time.

Outside the central manu tukutuku in Figure 2 there are depictions of ngā tohu o te taiao. These include an extensive and diverse number of environmental tohu from the skies, to te tihi o mouna Taranaki (the tip of Mount Taranaki), over land and waterways to the sea and beyond. This tool can be used to evaluate environmental, social and cultural tohu observed while collecting resources for manu tukutuku. The tohu chosen may vary between iwi and over time, but signal the interconnectedness of the taiao and the diversity of environments affected by climate change. This is also illustrated through the atua depicted to the left in Figure 2, encouraging the inclusion of traditional knowledge and cultural practices as valid ways of understanding changing and challenging conditions due to climate change and what it means to be resilient as iwi Māori (i.e. are the bonds of our kite able to withstand pressure and change).



Figure 6. The creation process, allowing space for learning and sharing. One aspect of climate change often overlooked in discussions is the space for joy in what can be a very challenging topic to deal with. The creative process and flying manu tukutuku requires lightness.

7.4 Identifying and evaluating environmental tohu in northern Taranaki

When implementing the manu tukutuku tool (Figure 2) at the second wānanga in February 2024, we identified the following environmental tohu from habitats most affected by, and vulnerable to, climate change in northern Taranaki. The tohu listed below represented the three key values identified by the text above the manu tukutuku image in the infographic we created (Figure 2). The wānanga was an opportunity to test whether the values in the tool related to locally specific indicators, which included environmental, social and cultural tohu. For the tohu to be included, they had to include at least two of the three values identified in the tool (Table 1).

Table 1. List of climate change tohu identified as part of the manu tukutuku tool, during field testing wānanga. The way(s) in which each tohu is linked to climate change in northern Taranaki, and which of the three key values they meet, are identified in the central and right hand columns.

Climate change tohu	Vulnerability to/impact of climate change for the tohu	Well-being connected to whānau, hapū and iwi	Connection to ngā atua and tūpuna	Tangata whenua connected to taiao
Knowledge to make manu tukutuku	Loss of resources put knowledge at risk of being lost	√	√	√
Knowledge on where to collect manu tukutuku resources	Loss of resources puts local seasonal knowledge at risk	√	√	√
Local wānanga to share knowledge and keep mātauranga active and strong	May be reduced during times of extreme weather events and whānau, hapū and iwi priorities change. Facilitates active engagement with local environments, whānau and practitioners	√	√	√
Multiple generations present	Intergenerational knowledge transfer at risk if priorities shift	√	√	√
Raupō abundant and healthy	Wetland removal making catchments vulnerable to extreme weather events	√	√	√
Raupō leaves dry at the right time of year (March)?	Changing climate affecting the seasonal availability of raupō	√	√	√
Repo healthy and safe to access	Loss of wetlands (repo) and native vegetation in catchments linked to decline in water quality, especially in farmed areas	√	√	√
Presence of paru (black anoxic mud) in repo	Loss of wetlands and flooding events, reduces availability of paru	√	√	√
Kākaho (stems of toetoe) abundant and healthy	Often found along stream banks and gullies, kākaho can be lost in flooding events. Kākaho is a great soil stabiliser, but is often outcompeted by pampas (weed)	√	√	√
Kākaho are dry enough for harvest and aligned with raupō harvesting.	Climate change impacts season for kākaho flowering and availability	√	√	√
Toetoe is a local variety	Toetoe is a well-known variety for waterway and gully restoration, but many of the plants are from outside the rohe. Northern Taranaki iwi want to see their variety restored in their local area.	√	√	√

Climate change tohu	Vulnerability to/impact of climate change for the tohu	Well-being connected to whānau, hapū and iwi	Connection to ngā atua and tūpuna	Tangata whenua connected to taiao
Kākaho harvesting practices maintained (shaking seeds at harvesting site)	Practices like seed shaking (traditionally performed by children) shows reciprocity when harvesting and ensures healthy populations and local varieties are maintained	√	√	√
Harakeke abundant and healthy	Harakeke is very resilient to weather and a variety of soil conditions. Local varieties that can be used for a range of practices (from muka (fibre from flax) to raranga (prepared flax for weaving)) should be present in all environments from mountains to sea.	√	√	√
Harakeke harvesting practices maintained	Regular harvesting of harakeke and wānanga related to this keep local tikanga strong	√	√	√
Muka (fibre) flax variety present and used to make aho (cord) for flying	Ensuring muka varieties are present at a number of locations, makes them more resilient to climate related events	√	√	√
Local whenua and uku (soil and clay) collected to make pigments and paints	Local whenua collection places may be lost due to extreme weather	√	√	√
Local whenua and uku (soil and clay) collected from coastal and inland erosion sites	Tangata whenua feel safe to access their local collection sites and are connecting to a variety of habitats from coastal to waterways, to paru (black anoxic mud) in repo, and minor slips in upper catchment.	√	√	√
Are whenua and uku (soil and clay) collection sites being restored or getting worse (due to sea level rise, loss of native vegetation, inland or river flooding)?	Changing condition of whenua collection sites observed over time	√	√	√
Karengo (seaweed) used to make pigment binder is available and safe to access	Sedimentation from flooding can smother karengo collection sites. Seasonal swells and sea level rise can inhibit access to karengo collection sites.	√	√	√
Mātauranga used to make pigments and paints to decorate manu tukutuku are active and strong	Community well-being strengthened through shared knowledge and local tikanga for pigment making. Accessibility and number of collection sites impacted by climate change.	√	√	√

Climate change tohu	Vulnerability to/impact of climate change for the tohu	Well-being connected to whānau, hapū and iwi	Connection to ngā atua and tūpuna	Tangata whenua connected to taiao
Feathers of native birds available to decorate manu tukutuku	Tangata whenua have access to native bird feathers, and seasonal knowledge on when to find or collect them. Bird populations are healthy and resilient to harvest. Numbers and condition are impacted by climate change and extreme weather events.	√	√	√
Knowledge about the star Pūanga (Rigel) and flying of manu tukutuku as a tohu for the coming year is present	Local tikanga and knowledge about Pūanga and use of manu tukutuku as tohu for the coming year is present, and shared intergenerationally. The ability to practise and maintain this knowledge is impacted by climate change.	√	√	√
Knowledge of winds for flying manu tukutuku present	Experience of reading clouds and seasonal patterns to know when and where the best winds for flying are. Seasonal weather knowledge is impacted by climate change.	√	√	√
Knowledge of karakia for harvesting resources, and flying manu tukutuku present	Connection to local mātauranga, connection to atua and spiritual practices may be affected by loss of habitat through extreme weather events	√	√	√
Creating and flying manu tukutuku is a fulfilling and connected experience.	Climate change is often a heavy topic to discuss. Does the enabling of manu tukutuku wānanga create an uplifting experience, through connection to taiao, atua and one another?	√	√	√
Harvesting of resources and creating manu tukutuku facilitates conversations on climate change	Manu tukutuku making provides an opportunity to connect with a observe vulnerable habitats and species in northern Taranaki. Each manu tukutuku is a snapshot in time of local tohu affected by climate change.	√	√	√
A variety of skills/ practitioners involved in manu tukutuku wānanga	Connection of toi Māori experts, maramataka (almanacs) and environmental experts, kaitiaki, teachers, iwi health sector and rūnanga staff to identify priorities for iwi funding and resourcing for climate change resilience	√	√	√

7.5 Contributing to the bigger picture

The development and field testing of the manu tukutuku tool illustrated the importance of centring mātauranga-a-iwi when creating resources to uplift and empower iwi facing significant global challenges like climate change. To be in both a state of resistance (Penehira et al. 2014) and resilience, as discussed in section 6, local mātauranga and kaupapa must be determined by local iwi, hapū and whānau. This contributes to local solutions based on generations of knowledge, supporting rangatiratanga and empowering tangata whenua to engage in long-term actions. Once local climate priorities, values and tohu have been identified, there are opportunities for other knowledge systems to contribute to the vision of local iwi.

The waka taurua framework (Maxwell et al. 2020b) may be useful when iwi want to combine multiple knowledge streams or collaborate with non-Māori organisations because it upholds the importance and value of kaupapa Māori approaches (Maxwell et al. 2020a; Harcourt et al. 2022). In our first wānanga, we did discuss what other data is available for iwi to understand and predict different climate scenarios. Databases like the Land Cover Database (LCDB5; <https://iris.scinfo.org.nz/layer/104400-lcdb-v50-land-cover-database-version-50-mainland-new-zealand/>), soil maps (e.g. S-Map online: <https://smap.landcareresearch.co.nz/>), Land-use capability maps (LUC; https://ourenvironment.scinfo.org.nz/maps-and-tools/app/Land%20Capability/lri_luc_main), and species-specific data from individuals at Manaaki Whenua – Landcare Research all provide useful information to assess future scenarios; as do climate data from the National Institute of Water and Atmospheric Research (NIWA). However, these resources need to be guided by local iwi. When looking at locally specific information on taonga species and other environmental tohu, much of the data is not easily accessible.

Process-based models are useful for anticipating and scenario-testing climate change, but do not suffice when it comes to physical connection of tangata whenua to their local taiao. Intergenerational knowledge comes from being in, and being aware of, surroundings; and from noticing environmental changes over time (McAllister et al. 2023a). The wānanga clearly identified that resilience in the context of climate change goes beyond environmental tohu, and includes social and cultural tohu too (e.g. intergenerational knowledge transfer, engaging in cultural practices, and tikanga).

8 Conclusions

For Ngāti Mutunga, Ngāti Tama and Ngāti Maru, climate resilience in northern Taranaki is linked to environmental, social and cultural *tohu*. The interactions of people with place, with cultural practices, with *mātauranga-a-iwi* and *atua* domains, from mountains to sea all empower and support communities in the face of a changing climate. By understanding local environments that are both affected by and able to mitigate the impacts of climate change, *iwi* can plan and identify sites to restore. They can also plan and identify where to channel resources based on early warning signs of seasonal weather pattern changes (e.g. drought, floods or pressures on key *taonga* species).

Three key values were identified to help evaluate whether chosen *tohu* were holistic and relevant to the *iwi* priorities, and could be used for future planning. They include:

- 1 well-being connected to *whānau*, *hapū* and *iwi*
- 2 connection to *ngā atua* and *tupuna*
- 3 *tangata whenua* connected to *te taiao*.

The *wānanga* approach allowed a safe space for diverse knowledges and practices to be shared, and confirmed that the *manu tukutuku* tool was useful when identifying and evaluating environmental, social and cultural *tohu*. The *tohu* were diverse, yet provided a holistic picture of environmental, community and cultural resilience. The *manu tukutuku* created, served as a physical manifestation of the tool in action.

The success of this tool relies on long-term *iwi* engagement, with opportunities for the information to be used alongside (but not replaced by) other information sources. Using a collaborative framework like the *waka taurua* (Maxwell et al. 2020b), it can contribute to non-*iwi* led or collaborative research or models, but this must be determined by the *iwi* themselves. The tool may also be adapted for use by other *iwi*, who want to strengthen or revive *toi Māori* like making of *manu tukutuku* as a way to understand their vulnerable *taiao* in a way that fosters connection and *mātauranga taiao*.

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