Sara Belcher, Raine Hananui
and O. Ripeka Mercier

Legislating for Gene Technologies

a Māori view of the Hazardous Substances and New Organisms Act

Abstract

In Aotearoa New Zealand, gene technology is currently governed by the Hazardous Substances and New Organisms Act 1996. Recent Tiriti-led research has resulted in nationwide collaborations with mana whenua towards the culturally inclusive development of gene technology for invasive species management. This article reviews the Hazardous Substances and New Organisms Act's fitness for purpose from a Māori and Tiriti perspective. We make recommendations for future legislative review, including that regulation and policy 'give effect to' te Tiriti/the Treaty, that whakapapa and mauri considerations are accounted for in gene technology regulation, and that cultural impact assessments are based on whakapapa and mauri. Mātauranga-based impact assessments that use Māori concepts in a way that complements scientific understanding of gene technology, and Māori considerations (values and goals) should feature in the decision-making process. This will ensure that appropriate measures are taken by the Crown to 'mitigate adverse environmental, economic, social, cultural or spiritual impacts' (United Nations Declaration on the Rights of Indigenous Peoples) of genetically modified organisms and hazardous substances in Aotearoa New Zealand, and that properly resourced mana whenua can actively engage in decision making.

Keywords genetic modification, legislation, mātauranga Māori, mauri, whakapapa, taonga species

Sara Belcher is a senior lecturer in the School of Science in Society at Te Herenga Waka Victoria University of Wellington. **Raine Hananui** is a Kāi Tahu research assistant in Te Kawa a Māui, Te Herenga Waka Victoria University of Wellington, exploring social perceptions of biotechnological pest control. **O. Ripeka Mercier** is an associate professor in Te Kawa a Māui, Te Herenga Waka Victoria University of Wellington.

The purpose of the Hazardous Substances and New Organisms Act 1996 is to 'protect the environment, and the health and safety of people and communities, by preventing or managing the adverse effects of hazardous substances and new organisms' (s4). In 2024, the Hazardous Substances and New Organisms Act is the primary legislation governing genetic modifications such as gene editing in Aotearoa New Zealand (Everett-Hincks and Henaghan, 2019; Kershen, 2015). Under the Act, genetically modified or edited organisms (GMOs) are considered 'new organisms' even if they are developed within Aotearoa (s2A). No GMOs may be developed, imported, field tested or released in Aotearoa without prior approval from the Environmental Protection Authority (EPA), the national environmental regulator (ss34, 38A, 40, 109).

Gene technologies became prominent in the public consciousness in the 1990s (Smith, 2006), resulting in the Royal Commission on Genetic Modification in 2000. Over two decades later, genetic techniques and attitudes towards them have evolved considerably from those extant at the time the GMO provisions of the Hazardous Substances and New Organisms Act were last significantly updated in 2003 (Brankin, 2021; Clark et al., 2024; Penman and Scott, 2019). The development of more precise gene editing in the past decade in particular has resulted in renewed interest and discussion on the potential of gene technologies to help solve health, environmental and primary industry challenges in Aotearoa (Pantoja, 2021; Penman and Scott, 2019; Science Media Centre, 2024). Gene technologies applied in environmental contexts include techniques not considered by the EPA to be genetic modification, such as eDNA (Bunce and Freeth, 2022) and gene silencing (Palmer et al., 2022). However, issues of control and the lack of Māori rangatiratanga (self-determination) in the gene technologies space remain unresolved (Clark et al., 2024; Cram, 2005; Palmer, Mercier and King-Hunt, 2020).

Māori have taken part in the debate on gene technology since at least the 1990s (Smith, 2006; Tipa, 2016), and have expressed persistent concerns regarding the impact of genetic modification on the integrity of whakapapa (genealogy), mauri (life essence) and rangatiratanga, and subsequent effects on the ability of iwi and hapū to act as kaitiaki (guardians) of their taonga (cultural treasures) (Cram, 2005; Hudson et al., 2019; King-Hunt, 2023; Roberts and Fairweather, 2004). Article two of te Tiriti o Waitangi guarantees to Māori rangatiratanga over their whenua (lands), kāinga (settlements) and taonga (including the tangible and intangible) (Kawharu, 1989; Waitangi Tribunal, 2011). To honour te Tiriti, iwi and hapū must be meaningfully involved in decision making on gene technologies in a way that enables rangatiratanga, particularly when it impacts on Māori relationships with whenua and taonga.

Despite legislative shortfalls, the EPA, working with its statutory Māori advisory committee, Ngā Kaihautū Tikanga Taiao, has made considerable efforts since its inception in 2011 to improve its regulatory practice with respect to te Tiriti ...

These concerns are echoed by indigenous peoples elsewhere, leading to growing calls for indigenous people to be recognised 'as key stakeholders in decisions about gene-editing', with engagement activities that are 'designed, conducted, and analysed in ways that confront longstanding power imbalances that dismiss Indigenous expertise' (Taitingfong and Ullah, 2021:S74). This supports calls for states to 'mitigate adverse environmental, economic, social, cultural or spiritual impacts' (United Nations, 2007) in collaboration with indigenous peoples.

The Waitangi Tribunal reported in *Ko Aotearoa Tēnei,* its report on the Wai 262 claim, that the 'law and policy with respect to [genetically modified] organisms does not sufficiently protect the interests of mana whenua in mātauranga Māori or in the genetic and biological resources of taonga species' (Waitangi Tribunal, 2011). For most of the lifetime of the Hazardous Substances and New Organisms Act, Māori cultural values have been subordinate to scientific ones in GMO decision making by the EPA and its predecessor, the Environmental Risk Management Authority (disestablished in 2011) (Kurian and Wright, 2012; Oldham, 2018; Waitangi Tribunal, 2011; Wheen and Baillie, 2019). The Environmental Risk Management Authority in particular was criticised for privileging techno-scientific considerations over others (Kurian and Wright, 2012) and de-legitimising spiritual and cultural concerns (Oldham, 2018). The over-emphasis on science is partly due to the 'inherent science bias' in the decision-making process. The Hazardous Substances and New Organisms (Methodology) Order directs the EPA (and the Environmental Risk Management Authority before it) to begin with consideration of the scientific evidence (s25(1)).

Despite legislative shortfalls, the EPA, working with its statutory Māori advisory committee, Ngā Kaihautū Tikanga Taiao, has made considerable efforts since its inception in 2011 to improve its regulatory practice with respect to te Tiriti, such as the development of a mātauranga framework to integrate mātauranga Māori into EPA decision-making processes (Jenkins, 2019; Jones et al., 2020). As a nation we have made progress in creating more effective Tiriti partnerships, and in the last decade there has been a notable increase in Tiriti-led research (Collier-Robinson et al., 2019; Duncan and Robson-Williams, 2024), including research on the

potential for genetic technologies, and gene drive and gene silencing, to control invasive species (Black et al., 2022; Palmer et al., 2022).

There have been renewed calls from companies, scientists and political parties to update, 'future-proof' (Royal Society Te Apārangi, 2019) and liberalise gene technology regulation (Biotech New Zealand, 2022; Pantoja, 2021; Parmar, 2024; Science Media Centre, 2024; Science New Zealand, 2023). In its 2023 Harnessing Biotech plan, the New Zealand National Party describes its intent to end what it calls the 'effective ban' on genetic modification and gene editing by introducing dedicated gene technology legislation that 'provides for the use of gene editing and modification', establishes a new biotechnology regulator to take over decision making on genetic technologies from the EPA, and updating the Hazardous Substances and New Organisms Act and related legislation to 'avoid duplication of regulatory activities' (New Zealand National Party, 2023).

There is no argument that the Hazardous Substances and New Organisms Act was in dire need of a review prior to the inception of these proposed changes if it was to be brought into line with the changing sociocultural, technological and ecological landscape. This article presents recommendations from a clause-by-clause review of the Act undertaken by the first author from a Māori and Tiriti perspective. The recommendations range from highly specific suggestions for how the EPA and the Act might be adjusted to be more responsive to iwi, hapū and mana whenua, to more generalisable recommendations applicable to any legislation that governs natural heritage. With gene technology development in flux, any rebuilding of legislative frameworks must also protect and support social, cultural and ecological interests now and into the future.

The Act and te Ao Māori

Like most legislation in Aotearoa, the Hazardous Substances and New Organisms Act includes a Treaty clause to acknowledge the Crown's Tiriti obligations. Section 8 states that 'All persons exercising powers and functions under this Act shall take into account the principles of the Treaty of Waitangi (Te Tiriti o Waitangi).' This section should be amended to 'shall give effect to' to bring the Act into line with the Conservation Act 1987. The new terminology would provide a stronger statutory obligation for decision makers (Beverley, 1998) and is in line with the recommendation of the Royal Commission on Genetic Modification (Eichelbaum et al., 2001).

Iwi should have the opportunity to have members undergo the appropriate training to become warranted officers, and iwi encouraged to develop appropriate compliance measures.

An effective way to honour te Tiriti is to include Māori in decision-making processes. Mātauranga Māori, as a taonga, should inform those decisions for better outcomes overall (Bargh, 2017; Ngā Koiora Tuku Iho, 2023), but only as Māori choose, and with iwi retaining rangatiratanga over their mātauranga (Broughton and McBreen, 2015). Such mātauranga could include iwi-based impact and prioritisation frameworks, management targets based on cultural ecological limits, and the use of rāhui (temporary bans) (Prime, 1993) and tohu (ecological indicators). Cultural ecological limits are targets/limits established by traditional ecological knowledge and are usually more holistic than other management targets. Mātauranga would be used to frame mana whenua expectations and te reo Māori requirements, and define the effect on the cultural landscape.

Treaty rights, building partnerships and shared decision making

Consultation is an important part of this process of building effective co-governance partnerships. Consultation should be more than just a tick box exercise and to achieve this iwi need to be actively engaged and effectively resourced. Consultation processes should be designed to ensure that tangata whenua can engage at a depth and level appropriate for them and mana whenua have space to effectively inform decisions.

For effective consultation in the current EPA decision-making processes, mana whenua need to be identified and notified. Mana whenua are those iwi and/or hapū that have whakapapa links to the whenua on which the application states genetically modified or edited organisms will be developed, contained or released or a hazardous substance will be applied. Mana whenua are currently not specifically invited to submit an impact assessment, outline their reporting requirements, or state any conditions they may have for the development, containment, release or use of a new organism or hazardous substance, and should be enabled to do so. Providing this information should not come at cost to the mana whenua and should form part of the cost of the application.

Enforcement agencies, usually Crown entities, employ warranted officers who are trained and authorised to enforce EPA conditions and determine the existence and extent of breaches. Iwi should be entitled to some of the non-compliance charges, particularly if the damage extends to iwi lands. Iwi should have the opportunity to have members undergo the appropriate training to become warranted officers, and iwi encouraged to develop appropriate compliance measures. Costs incurred by iwi as enforcement agents should be covered by the Crown, as should the cost of warranting iwi members. Iwi should be treated similarly to other enforcement agents and specialist consultants (ministries, local government, Crown research institutes and universities) that have access to public funding and resources.

Mātauranga in the Act

Mātauranga Māori is a knowledge system that encompasses Māori ways of generating, organising and transmitting knowledge (Hikuroa, 2017; Mead, 2016) and is integral to rangatiratanga (Broughton and McBreen, 2015). Including mātauranga in decisions relating to gene technologies and new organisms would help ensure that Māori perspectives and knowledge are part of the decision-making process, thus supporting Māori rangatiratanga and kaitiakitanga rights and responsibilities. Key mātauranga concepts should inform decision making. Concepts of whakapapa, mauri, kaitiakitanga and rangatiratanga are extremely relevant to Māori in relation to gene technologies in both environmental and societal applications (Baker, 2012). These concepts are not mentioned in the Hazardous Substances and New Organisms Act. Application of these concepts may need to be informed by mana whenua at consultation, as iwi may have different definitions and meanings according to their mātauranga ā-iwi; each iwi is also likely to want to determine how they individually engage with legislation and the partnerships. These concepts will also determine how impact assessments are conducted, control requirements are set, and enforcement outcomes are framed and applied.

Impact assessments

To inform decisions, the EPA requires applications under the Act to include various ecological, social and economic assessments. These assessments include impact assessments; risk analysis; the setting of limits, standards, targets and controls; ongoing monitoring; damage and mitigation analysis; decisions about release dates, and the timing and instigation of reviews, reassessments and the granting of variations, suspensions and extensions; and, finally, the establishment of codes of practice. Mātauranga should inform all of these.

Section 36 of the Act sets minimum standards that new organisms, including GMOs, must meet. If they cannot meet the minimum standards, the EPA is required to decline the application. These standards include that the new organism cannot cause significant displacement of endemic species, deterioration of natural habitat or impact on human health, have an adverse effect on Aotearoa's genetic diversity, or be disease causing (unless it is intended for biocontrol purposes). Reframing these standards in the context of whakapapa, mauri and tangata whenua and changing 'significant' to 'any' impact would bring impact evaluation back in line with kaitiakitanga and mātauranga. The current wording of 'significant impact' introduces subjectivity, is rather arbitrary and introduces bias. Who decides what is a significant impact and how, who is omitted from this decision, and who benefits? No decisions will have to be made about what is a significant impact and what that means.

The social and cultural impacts of an application under the Act are a particularly important consideration for Māori and should feature prominently in impact assessments and risk analysis. In te ao Māori, social outcomes are just as relevant as environmental ones. Assessment of the impact on the cultural landscape should be led by tangata whenua and informed by mātauranga and should include the outcomes and impacts on rangatiratanga and the mana of the community. The inclusion of mātauranga will require an increased use of te reo Māori. Te reo Māori terms should be defined by mana whenua and te reo Māori should be used preferentially when describing Māori concepts.

Whakapapa

Whakapapa is a foundational concept in te ao Māori which deals with genealogical connections, particularly the tracing of descent from the atua (gods) to the present (Benton et al., 2013). All things, animate and inanimate, have whakapapa. It is the key to land rights and determines kinship responsibilities (ibid.). Mātauranga Māori tohu should be employed to define the impact of an application on whakapapa (Hudson et al., 2007).

Whakapapa would feature in impact and prioritisation frameworks to describe changing biodiversity and impacts on endemic species. Genetically modified/edited and new organisms have a direct impact on whakapapa, either from having whakapapa (genetic heritage) directly altered or by changing the interactions of organisms that whakapapa to the whenua with those that do not. Whakapapa at its most basic interpretation defines the genealogy of organisms; therefore, it may be considered the equivalent of the taxonomic description of an organism. Whakapapa can define an organism's cladistic, ecological (niche or trophic-level occupancy) or physical (phenological, temporal, successional, structural and processional) relationships (Roberts et al., 2004). Whakapapa is generally seen by Māori as something that should not be interfered with (Black et al., 2022). The degree and way that each proposed GMO or new organism will impact on whakapapa, and its acceptability, is something that mana whenua will have to determine on a case-by-case basis. For example, transgenic modification involving the transference of DNA from one species to another is likely to be viewed as having more impact on whakapapa than switching on or off an existing gene within a species.

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Mauri

Mauri is the essential quality or life force of a being and is an expression of the mana of the atua (power and prestige of the gods). Mauri is present in both animate and inanimate objects, so awa (waterways) and maunga (mountains) can be considered entities with their own life force (Benton et al., 2013; Pomare et al.,

2023, p. 60). Mauri may be characterised by the diversity and abundance of the organisms in the environment, and this includes non-native and pest organisms. A healthy mauri imbues hauora (health) in the people and is essential for our wellbeing. Mauri is adversely affected by the presence of diseases, the loss of key taonga species, pollution, and habitat degradation. Preserving and improving degraded mauri is therefore a vital kaitiaki activity and the success of kaitiaki is linked to the mana of the iwi.

Because mauri is a significant way to assess mana whenua outcomes, it is often a key tohu Māori use to assess the health of their environment. It should therefore be a key component of impact assessments and monitoring frameworks. The impact on mauri should be used as the overarching focus of ecological outcomes. All ecological, social and economic tohu or indicators should be geared to assess and report on mauri. The impact on mauri should be the primary consideration that all approvals, approval conditions and enforcement criteria are measured against. Preserving and restoring mauri should be the primary objective of all resource and environmental management decisions made in Aotearoa New Zealand. Assessment of mauri can be done in quantitative ways, such as using the mauri-o-meter (Morgan, 2010), or by qualitative assessment by knowledgeable people such as tohunga.

Review outcomes

In summary, the key desired review outcomes are a rewording of section 8 so that it reads 'give effect to' te Tiriti, and to engage with Māori terms such as whakapapa, mauri, kaitiaki etc. This would give Māori pivotal roles in defining the intent, powers and functions of the Act and how iwi engage with it. Properly resourcing mana whenua would provide them the capacity to engage to the extent and level they wish and the ability to effectively inform assessment frameworks (including risk assessments and impact monitoring), control requirements, release dates and time frames, the setting of group standards and codes of practice, granting of variations, suspensions and extensions, and reviewing frameworks. Mātauranga could support the enforcement and compliance frameworks, informing penalties, the appeal process and emergency response.

Actively engaging with a fully resourced and recompensed mana whenua at all stages of the application process informed by mātauranga Māori is arguably the best way to protect the integrity of our natural and cultural heritage and the wellbeing of people and communities, and build a cohesive and just society.

Conclusion

Currently, the Hazardous Substances and New Organisms Act does a poor job of engaging with mātauranga Māori and meeting the Crown's Tiriti obligations. The Act does not mention whakapapa or mauri, and these are vital concepts for understanding the impact of genetically modified organisms on ecosystem health. Mauri should drive any environmental management policy or legislative framework and the impact on whakapapa should be implicit in legislation governing genetic technology. The Act mentions the Treaty of Waitangi once and uses weak wording, implying that meeting Treaty obligations is a suggestion rather than a requirement. While an application requests that consultation with Māori is undertaken, there are no guidelines or confirmation that the consultation is adequate or appropriate from the mana whenua perspective.

The Hazardous Substances and New Organisms Act legislates a very important and rapidly evolving field. The distinction between what is a genetically modified organism and what is not is becoming very blurred. Transgenic organisms can easily be categorised as genetically modified organisms. Categorising an organism that has had the expression of existing genes altered is not so easy. The impact on mauri and whakapapa may be the only way to define outcomes in a way that we can interpret meaningfully. The technical attributes of the genetic modification are less relevant than the cultural or environmental outcomes for whakapapa.

The purpose of the Hazardous Substances and New Organisms Act is to 'protect the environment, and the health and safety of people and communities, by preventing or managing the adverse effects of hazardous substances and new organisms' (s4). Actively engaging with a fully resourced and recompensed mana whenua at all stages of the application process informed by mātauranga Māori is arguably the best way to protect the integrity of our natural and cultural heritage and the wellbeing of people and communities, and build a cohesive and just society. Mātauranga can provide the context that the science requires to assess ecological health and help ensure that kaitiakitanga is restored. This means that while science can provide the understanding of how, for example, introducing genetically modified rats (modified for single-sex selection) will affect populations of rats, and ecosystem functions such as food web interactions, mātauranga will inform our understanding of the impact these rats will have on the mauri and whakapapa, enabling us to see the holistic impact on ecological, cultural and economic health and on all the biodiversity of Aotearoa.

References

Baker, M. (2012) 'The Korowai Framework: addressing GE through tribal values', *New Genetics and Society*, 31 (1), pp.87–9

Bargh, M. (2017) 'Council–Māori engagement: new models on the horizon', *LG: NZ Local Government Magazine*, 54, May, pp.14–17

Benton, R., A. Frame and P. Meredith (2013) *Te Mātāpunenga: a compendium of references to the concepts and institutions of Māori customary law*, Wellington: Victoria University Press

Beverley, P. (1998) 'The mechanisms for the protection of Māori interests under part II of the Resource Management Act 1991', *New Zealand Journal of Environmental Law*, 2, pp.121–51, https://search.informit.org/doi/10.3316/informit.377255490087806

Biotech New Zealand (2022) 'NZ needs genetic modification in the world of climate change', 26 April, https://biotechnz.org.nz/2022/04/26/nz-needs-genetic-modification-in-the-world-of-climate-change/

Black, A., G. Garner, M. Mark-Shadbolt, J. Balanovic, E. MacDonald, O. Mercier and J. Wright (2022) 'Indigenous peoples' attitudes and social acceptability of invasive species control in New Zealand', *Pacific Conservation Biology*, 28 (6), pp.481–90, https://doi.org/10.1071/PC21049

Brankin, A. (2021) 'GMO: a matter of rangatiratanga', *Te Karaka*, 88, 29 June, pp.54–5, https://ngaitahu.iwi.nz/opportunities-and-resources/publications/te-karaka/gmo-a-matter-of-rangatiratanga/

Broughton, D. and K. McBreen (2015) 'Mātauranga Māori, tino rangatiratanga and the future of New Zealand science', *Journal of the Royal Society of New Zealand*, 45 (2), pp.83–8, https://doi.org/10.1080/03036758.2015.1011171

Bunce, M. and A. Freeth (2022) 'Looking further and deeper into environmental protection, regulation and policy using environmental DNA (eDNA)', *Policy Quarterly*, 18 (4), pp.33–9

Clark, A., P. Wilcox, S. Morrison, D. Munshi, P. Kurian, J. Mika, D. Chagne, A. Allan and M. Hudson (2024) 'Identifying Māori perspectives on gene editing in Aotearoa New Zealand', *Communications Biology*, 7 (1), 221, https://doi.org/10.1038/s42003-024-05896-1

Collier-Robinson, L., A. Rayne, M. Rupene, C. Thoms and T. Steeves (2019) 'Embedding indigenous principles in genomic research of culturally significant species: a conservation genomics case study', *New Zealand Journal of Ecology*, 43 (3), pp.1–9, https://www.jstor.org/stable/26841832

Cram, F. (2005) 'Backgrounding Māori views on genetic engineering', in J. Barker (ed.), *Sovereignty Matters: locations of contestation and possibility in indigenous struggles for self-determination*, Lincoln: University of Nebraska Press

Duncan, R. and M. Robson-Williams (2024) 'Co-designing a research programme for impact: lessons learned from practice by Aotearoa New Zealand's Biological Heritage National Science Challenge Ngā Koiora Tuku Iho', *Kotuitui: New Zealand Journal of Social Sciences Online*, 19 (2), pp.164–89

Eichelbaum, T., J. Fleming, J. Allan and R. Randerson (2001) *Report of the Royal Commission on Genetic Modification*, https://environment.govt.nz/publications/report-of-the-royal-commission-on-genetic-modification/

Everett-Hincks, J.H. and M. Henaghan (2019) 'Gene editing in Aotearoa: legal considerations for policy makers', *Victoria University of Wellington Law Review*, 50 (3), pp.515–50

Hikuroa, D. (2017) 'Mātauranga Māori: the ūkaipō of knowledge in New Zealand', *Journal of the Royal Society of New Zealand*, 47 (1), pp.5–10, https://doi.org/10.1080/03036758.2016.1252407

Hudson, M., A.L.M. Ahuriri-Driscoll, M.G. Lea and R.A. Lea (2007) 'Whakapapa: a foundation for genetic research?', *Journal of Bioethical Inquiry*, 4 (1), pp.43–9, https://doi.org/10.1007/s11673-007-9033-x

Hudson, M., A.T.P. Mead, D. Chagné, N. Roskruge, S. Morrison, P.L. Wilcox and A.C. Allan (2019) 'Indigenous perspectives and gene editing in Aotearoa New Zealand', *Frontiers in Bioengineering and Biotechnology*, 7, https://doi.org/10.3389/fbioe.2019.00070

Jenkins, K. (2019) 'Remember the flicking tail of the lizard: how mātauranga Māori is being woven into place-based regulatory decisions in Aotearoa', *Policy Quarterly*, 15 (2), pp.55–61

Jones, D., D. Hikuroa, E. Gregory, H. Ihaka-McLeod and T.T. Moko-Mead (2020) 'Weaving mātauranga into environmental decision-making', *New Zealand Science Review*, 76 (1–2), pp.49–54, https://doi.org/10.26686/nzsr.v76i1-2.7833

Kawharu, I.H. (1989) *Waitangi: Māori and Pākehā perspectives of the Treaty of Waitangi*, Auckland: Oxford University Press

Kershen, D.L. (2015) 'Sustainability Council of New Zealand Trust v. the Environmental Protection Authority: gene editing technologies and the law', *GM Crops and Food*, 6 (4), pp.216–22, https://doi.org/10.1080/21645698.2015.1122859

King-Hunt, A. (2023) 'Novel biotechnological controls for social wasp eradication: exploring religious and spiritual Māori perceptions using a Q-method and kaupapa Māori methodology', MA thesis, Te Herenga Waka Victoria University of Wellington, https://openaccess.wgtn.ac.nz/articles/thesis/Novel_biotechnological_controls_for_social_wasp_eradication_Exploring_religious_and_spiritual_M_ori_perceptions_using_a_Q-Method_and_kaupapa_M_ori_methodology/22186756

Kurian, P. and J. Wright (2012) 'Science, governance, and public participation: an analysis of decision making on genetic modification in Aotearoa/New Zealand', *Public Understanding of Science*, 21 (4), pp.447–64, https://doi.org/10.1177/0963662510382362

Mead, H.M. (2016) *Tikanga Māori: living by Māori values* (2nd edn), Huia Publishers

Morgan, T.K.K.B. (2010) 'The mauri model decision-making framework: robust decision-making for community cultural mosaics', in J.S Te Rito and S.M. Healy (eds), *Kei Muri i te Awe Kāpara he Tangata Kē: recognising, engaging, understanding difference*, proceedings of the 4th International Traditional Knowledge Conference, Auckland: Ngā Pae o te Māramatanga

New Zealand National Party (2023) 'Harnessing biotech', https://assets.nationbuilder.com/nationalparty/pages/17968/attachments/original/1686385900/Biotech_Policy.pdf?1686385900

Ngā Koiora Tuku Iho (2023) *Me Tū ā-Uru: an action plan for a flourishing and abundant environment*, Ngā Koiora Tuku Iho, New Zealand's Biolical Heritage National Science Challenge

Oldham, O.M. (2018) 'A critical analysis of the incorporation of tikanga Māori in decisions on genetic modification', *New Zealand Journal of Environmental Law*, 22, pp.87–112, https://heinonline.org/HOL/LandingPage?handle=hein.journals/nzjel22anddiv=8andid=andpage=

Palmer, S., P.K. Dearden, O.R. Mercier, A. King-Hunt and P.J. Lester (2022) 'Gene drive and RNAi technologies: a bio-cultural review of next-generation tools for pest wasp management in New Zealand', *Journal of the Royal Society of New Zealand*, 52 (5), pp.508–25, https://doi.org/10.1080/03036758.2021.1985531

Palmer, S., O.R. Mercier and A. King-Hunt (2020) 'Towards rangatiratanga in pest management? Māori perspectives and frameworks on novel biotechnologies in conservation', *Pacific Conservation Biology*, 27 (4), pp.391–401, https://doi.org/10.1071/PC20014

Pantoja, Y. (2021) 'Vested interests and business diplomacy: biotechnology companies and gene editing in New Zealand', *Policy Quarterly*, 17 (2), pp.56–61

Parmar, P. (2024) 'Liberal GE laws bring opportunities for NZ', 9 January, https://www.act.org.nz/liberal_ge_laws_bring_opportunities_for_nz

Penman, D. and B. Scott (2019) 'Gene editing: reflections from the panel co-chairs', Royal Society Te Apārangi, https://www.royalsociety.org.nz/assets/Uploads/Gene-editing-reflections-from-panel-co-chairs.pdf

Pomare, P., N. Tassell-Matamua, N. Lindsay, B. Masters-Awatere, K. Dell, B. Erueti and M. Te Rangi (2023) 'Te mauri o te kauri me te ngahere: indigenous knowledge, te taiao (the environment) and wellbeing', *Knowledge Cultures*, 11 (1), pp.55–83, https://doi.org/10.22381/kc11120234

Prime, K. (1993) 'Pest problems: the view of Nga Whenua Rahui', *New Zealand Journal of Zoology*, 20 (4), pp.247–50, https://doi.org/10.1080/03014223.1993.10420338

Roberts, M. and J.R. Fairweather (2004) *South Island Māori Perceptions of Biotechnology*, research report 268, Christchurch: Lincoln University, https://researcharchive.lincoln.ac.nz/handle/10182/745

Roberts, M., B. Haami, R.A. Benton, T. Satterfield, M.L. Finucane and M. Henare (2004) 'Whakapapa as a Māori mental construct: some implications for the debate over genetic modification of organisms', *The Contemporary Pacific*, 16 (1), pp.1–28

Royal Society Te Apārangi (2019) 'Calls for overhaul of gene-technology regulations and wide public discussion', 12 August, https://www.royalsociety.org.nz/news/calls-for-overhaul-of-gene-technology-regulations-and-wide-public-discussion/

Science Media Centre (2024) 'Regulating genetic technologies in Aotearoa: expert Q&A', 15 February, https://www.sciencemediacentre.co.nz/2024/02/15/regulating-genetic-technologies-in-aotearoa-expert-qa/

Science New Zealand (2023) 'Science New Zealand on gene technologies', February, https://sciencenewzealand.org/assets/Uploads/Files/SNZ-GE-Positioning-Paper-Feb-2023.pdf

Smith, C. (2006) 'Na takoto ana a papatūānuku: the state of biotechnologies and Māori', in M. Mulholland (ed.), *State of the Māori Nation: twenty-first-century issues in Aotearoa*, Reed Publishing

Taitingfong, R. and A. Ullah (2021) 'Empowering indigenous knowledge in deliberations on gene editing in the wild', *Hastings Center Report: Gene Editing in the Wild*, 51 (S2), pp.S74–S84, https://doi.org/https://doi.org/10.1002/hast.1323

Tipa, R. (2016) 'Environmental watchdogs', *Te Karaka*, 69, 3 April, pp.12–13, https://ngaitahu.iwi.nz/opportunities-and-resources/publications/te-karaka/environmental-watchdogs/

United Nations (2007) 'United Nations Declaration on the Rights of Indigenous Peoples', A/RES/61/295, https://www.refworld.org/legal/resolution/unga/2007/en/49353

Waitangi Tribunal (2011) *Ko Aotearoa Tēnei: a report into claims concerning New Zealand law and policy affecting Māori culture and identity: te taumata tuarua*, vol.1, Wellington: Waitangi Tribunal

Wheen, N. and H. Baillie (2019) 'GMOs, pests and participatory and representative democracy in decision-making about GM activities in New Zealand', *Asia Pacific Journal of Environmental Law*, 22 (2), pp.257–76, https://doi.org/10.4337/apjel.2019.02.04