




Operationalizing the Nature Futures Framework to Catalyze the Development of Nature-Future Scenarios

Achieving soil health in Aotearoa New Zealand through a pluralistic values-based framework: mauri ora ki te whenua, mauri ora ki te tangata

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Abstract

Globally, soil policy and management have been based on a limited understanding of values and perspectives, and mainly dominated by a Western-centric soil science perspective. Further, this understanding has tended to be highly focused on instrumental values—particularly the soil’s productive potential and use. In this paper, we use the Nature Futures Framework (NFF) to analyse how Aotearoa New Zealand’s agricultural productive sectors express their relationship with soil and soil health. Our analysis highlights the multidimensional nature of soil values across society. Importantly, the results are consistent with work undertaken on Indigenous Māori perspectives of soil and soil health. Māori perspectives strongly connect soil to their people and take a holistic or well-being approach to soil. We then present a soil health and well-being framework that can incorporate a plurality of values from people of diverse backgrounds, including landowners, industry, farmers, and Indigenous peoples. We use a bi-cultural model approach—“waka taurua”—to demonstrate how the plurality of values from non-Indigenous and Indigenous groups in Aotearoa New Zealand can be used to shape process, dialogue and understanding, to develop shared goals to maintain and enhance the soil resource, and to achieve soil health and human well-being. There needs to be a shift in how soil policy and management is approached to achieve international calls to manage soils sustainably. Our approach using the NFF indicates that people assign multiple, co-existing values to soil. The resulting dialogue on values enriches our understanding of soils and soil health, and our relationships and connections with nature, improves the way we define threats and risks, and will lead to more targeted actions to achieve desired sustainable outcomes.

Keywords Soil health · Well-being · Nature Futures Framework · Values · Policy

Introduction

Soils form an integral part of our social and cultural fabric and are fundamentally important to human and societal well-being (McNeill and Winiwarter 2004; Brevik et al. 2018). This realisation has seen a growing focus on the need to manage soils sustainably, such as when United Nations Secretary-General Ban Ki-moon appealed for the adoption of more sustainable soil management practices at the end of the International Year of Soils in 2015 (United Nations 2015). Managing soils sustainably requires an understanding of the core values people hold about soil and soil health (Friedrichsen et al. 2021). However, while understanding the core values is critical, there is a limited understanding of what these values are for soil beyond some of their instrumental values

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(i.e. what nature does for us) (Stronge et al. 2020; Friedrichsen et al. 2021). As Friedrichsen et al. (2021) point out, these instrumental values, which dominate the current soil science paradigm, do not account for the plurality of values that soil health provides to human well-being. They demonstrate that a wider set of additional relational soil health values are held by commodity wheat farmers and crop advisors within the United States agricultural sector.

Relational values “include preferences, principles and virtues about human-nature relationships” (Chan et al. 2018, p. A1) and resonate with views on human well-being (Chan et al. 2016). Alongside instrumental values and intrinsic values (protecting nature for nature’s sake), relational values highlight the multiple ways people value nature and the benefits they derive from it (Pascual et al. 2015; Chan et al. 2016, 2018; Pereira et al. 2020). These three value perspectives are captured in the Nature Futures Framework (NFF), a triangular framework with each corner representing one of the ways people value nature (Pereira et al. 2020). Emerging from work conducted by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), the NFF provides a simple way to illustrate the complex mixture of values for appreciating nature (Pereira et al. 2020). Not only does the NFF help make visible the wider range of values relating to nature, it also helps highlight the equal importance of the three value perspectives. Incorporating pluralistic values is increasingly recognised as essential for achieving better environmental management decisions (Tadaki et al. 2017; Ellis et al. 2019; Maxwell et al. 2020a; Pereira et al. 2020). Therefore, understanding the plurality of values and perspectives people assign to soil is critical for developing meaningful and sustainable land and soil policy as well as appropriate management practices to achieve environmental sustainability.

In 2016 Manaaki Whenua-Landcare Research (MWLR— an Aotearoa New Zealand Crown Research Institute) began leading the science programme, *Soil health and resilience: oneone ora, tangata ora* (MWLR 2021b). A research aim of the programme is to understand and connect wider societal values and Indigenous Māori perspectives of soil health. This will provide a more diverse and inclusive knowledge base to better inform the development of integrative soil policy, management, and decision-making of land resources and soils in Aotearoa New Zealand and globally. In Aotearoa New Zealand the importance of Indigenous Māori perspectives on soil health have increasingly been recognised and there has been significant progress in understanding key soil health concepts, values, and principles important to Māori (MWLR 2021a). Māori perspectives strongly connect soil to their people and take a holistic or well-being approach to soil (Harmsworth and Roskrige 2014; Hutchings et al. 2018; Hutchings and Smith 2020a; Handelsman 2021; MWLR 2021a). While Māori perspectives on soil health

have become better understood, Stronge et al. (2020) noted that there was a paucity of understanding the diverse values people assign to soil across wider Aotearoa New Zealand society—the general population—particularly the agricultural stakeholder and sector groups (e.g. pastoral farming, arable cropping, horticulture, viticulture).

In this paper, we report on work to identify the scope of soil health values within a broad range of agricultural stakeholder and sector groups. The aim was to identify values beyond just instrumental values that currently dominate soil health thinking in Aotearoa New Zealand. Building on international research (i.e. Friedrichsen et al. 2021), we identified assigned soil values across Aotearoa New Zealand’s agricultural sectors and discuss the implications for soil policy and management. Finally, we present a multidimensional framework for soil health which aligns Māori knowledge and perspectives with Western-centric perspectives to incorporate a range of values from people with diverse backgrounds that can embrace other knowledge systems, values, and perspectives in a collaborative and equitable way. We recognise that if we are to truly meet international calls to identify and prioritise soil issues, develop best practice, and sustainably manage soils, then soil policy and management needs to shift beyond the current dominant narrow Western-centric paradigm. It requires an approach that is inherently holistic, integrative, and inclusive of society, that can accommodate a plurality of knowledge systems, values, and perspectives.

Assessing soil health values using a NFF

To identify the range of soil health values beyond those instrumental values currently dominating soil science thinking we conducted semi-structured interviews with 26 people from across Aotearoa New Zealand with a strong connection to the agricultural sectors (Table 1).

As a research method, interviews can “yield rich insights into people’s biographies, experiences, opinions, values, aspirations, attitudes and feelings” (May 2011, p. 131). Our interview guide consisted of eight open-ended questions,

Table 1 Summary of interviews

Category	Number of interviewees
Agricultural advisor	3
Community gardens and urban farms	4
Conservation	1
Dairy and livestock	6
Forestry	1
Horticulture	4
Researchers	5
Viticulture	2
Total	26

which were piloted with stakeholders prior to conducting the interviews. These questions spanned the breadth of research interest from the *Soil health and resilience: one-one ora, tangata ora* science programme (MWLR 2021b) and explored participants' connections to soil, benefits of and threats to a healthy soil, how soil is valued from social, cultural, environmental and economic perspectives, indicators of soil health, soil information sources, strategies to protect soils, and the value of soil to New Zealanders and the wider society (Kannemeyer et al. 2022). For this paper, however, we only report on the analysis of the values people assigned to soil.

Interviewees were purposively selected (Patton 2015) so that they had a range of experiences with soil and collectively brought research, community, landowner, leadership, environmental, farming, forestry, and citizen knowledge to our investigation. Our aim was to select information-rich participants who have detailed knowledge or experience of working with and around soil. Potential participants were recommended by key experts connected to the *Soil health and resilience: oneone ora, tangata ora* science programme and/or by agricultural industry bodies. We also used snowball sampling (Patton 2015), with 9 of the 25 interviews coming from the recommendations of other interviewees. The purpose of studying information-rich cases was to yield insights and in-depth understanding, rather than empirical generalisations (Curry et al. 2009; Patton 2015).

All interviewees gave consent for the interviews to be recorded. Participants were given the schedule of questions prior to each interview and interviews typically lasted

between 45 and 90 minutes. The interviews were carried out virtually using either Microsoft Teams or Zoom video conferencing technology. All interviews were transcribed using a professional transcription agency and transcripts were read for accuracy with the recording and if requested were returned to the interviewee for confirmation of an accurate account of the interview.

We used an adapted NFF (PBL 2018; Pereira et al. 2020; Lundquist et al. 2021) to thematically analyse how different interviewees expressed their relationship with soil and soil health. The framework provides three broad categories: intrinsic values, instrumental values, and relational values (Fig. 1).

Thematic analysis is a widely used, qualitative process or method for identifying, analysing, coding (organising), describing, and reporting themes from data (Fereday and Muir-Cochrane 2006; Nowell et al. 2017). All coding and data analysis was carried out by the first and second authors. We took a deductive/inductive approach to thematic analysis. Deductive, in that we used the definitions from the NFF framework for relational, instrumental, and intrinsic values to initially explore the interview transcripts. However, because these categories are broad, the specific codes which emerged from within them followed an inductive process. These codes were then inductively categorised into sub-themes (Table 2). Interview transcripts were coded using the qualitative data management software NVIVO 12.

Fig. 1 Nature Futures Framework applied to soil (adapted from PBL 2018)

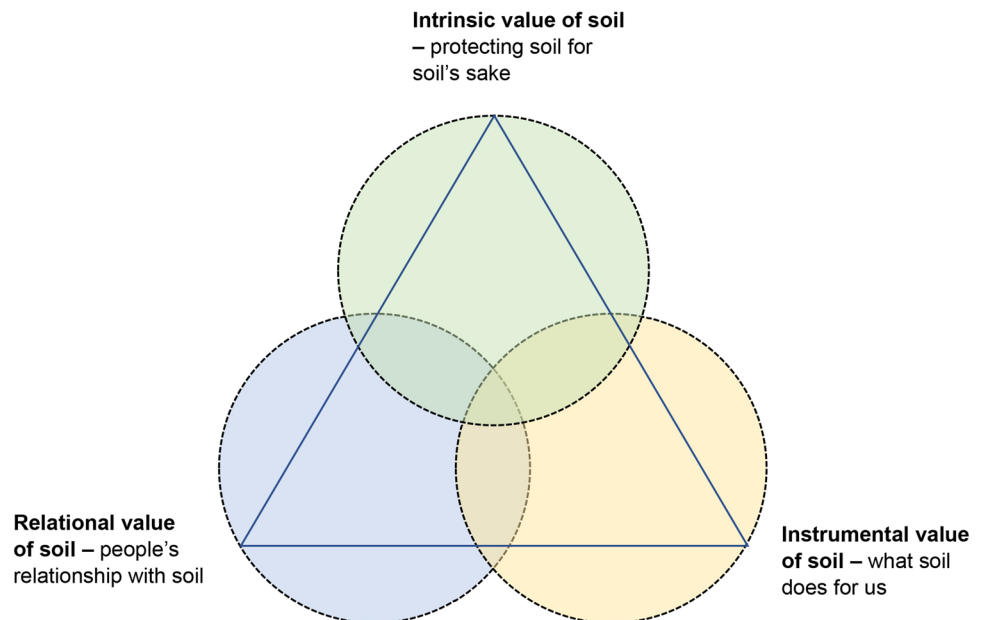


Table 2 Analysis codebook

Theme	Sub-theme	Code
Protecting soil for soil's sake (intrinsic)	Soil as a living entity Soil biodiversity Soil as fundamental to all existence Soil characteristics	Biologically diverse, fundamental to all existence, indigenous vegetation and ecosystems, living entity, microbiomes, soil characteristics, soil types, history of soil
People's relationship with soil (relational)	Connectedness to people to place to culture Livelihoods Well-being Responsibility for care	Ancestry, intergenerational, connection to people, family, care, stewardship, connection to place, disconnection, feeling safe, security, cultural benefits, cultural connection, knowledge sharing, livelihoods, restoration, social connections, social responsibility, spirituality, well-being, economic foundation, community connection to soil
What soil does for us (instrumental)	Food and fibre production Soil functions	Food production, land use, carbon storage, fibre production, farming, gardening, forestry, wine industry, nutrient filter, impacts, threats, housing, production control, resilience, soil management, sustainability, ecosystem services

Assigned soil values by Aotearoa New Zealand agricultural stakeholder and sector groups

Interviewees noted all three value perspectives (intrinsic, relational, instrumental) as important when they talked about soil and how they were connected to it; an aspect largely neglected by the dominant Western-centric soil science paradigm with its focus on instrumental values. This finding highlights the equal importance of the three value perspectives to people and was consistent across all the sectors' interviewees.

Protecting soil for soil's sake

Interviewees recognised that soil had intrinsic values that should be protected for its own sake. This was expressed through four emergent themes: soil as a living entity, soil biodiversity, soil as fundamental to all existence, and soil characteristics.

Interviewees saw soil as a living entity independent of people; a "living and breathing layer at the surface of the earth" [SHV04] that supported a wide range of biodiversity that were important in their own right:

And it has life in it, so the soil includes what lives in it, the minerals and the air and the water and all the microbes and all that sort of stuff, so it's a bit of a community really isn't it? [SHV20]

Related to both of these themes was the idea that soil was fundamental to all existence, underpinning all life on earth. This was primarily reflected in comments about soil being unique and irreplaceable.

It's an amazing resource that we have, and we need to keep that resource, and we can't just manufacture stuff in the factory to replace [it] [SHV19]

Further related to soils uniqueness was the recognition of the range of soil types, the diversity of characteristics they possess, and the influence that has on the landscape and the biodiversity that it supports.

Diversity, I'm kind of thinking about in terms of the range of soil types that you get... and that also influences the biodiversity of the soils that grow – the biology that lives in them and also on them in terms of the plants [SHV24]

However for one interviewee, it was the concern that this intrinsic value was going unrecognised, and what that means for how we define soil health, that was of primary concern.

[we] have the Kauri eggcup podzol, which is super special internationally. ... So, you have a kauri tree, and because it lives there for 500 or a thousand years and it has leaf litter that forms – that has tannins and phenols and oxides that basically strip out the nutrients and organics from the soil, it forms these white bleached eggcups underneath – only underneath the canopy of the kauri. And it's thicker near the trunk where the leaf litter is densest, and it thins out to the edge. So, you have these really distinctive very cool eggcups which are preserved because we don't have ... the bioturbation that they have overseas. So, they're super precious and they're an absolute imprint of what kauri does so you only get them here. ... So, [soil health] is supporting the values that you have for that soil. And that's the major issue I see with the soil protection at this stage. They're focused on only protecting agricultural and horticultural health. And that's such a small propor-

tion and so defined compared to the health of a kauri podzol [SHV01]

People's relationship with soil

People also viewed soil in the context of relational values. These relational values covered a wide range of relationships between people and soil and were expressed as connectedness (to people, to place, to culture), livelihoods, well-being, and a responsibility for care.

For some, connections to people were quite individualistic and personal:

Every time I touch soil it brings me a memory of my grandfather. [SHV02]

For others, it was about social cohesion and building and maintaining relationships with people through the practice of working together with soil and sharing knowledge about soils and practices.

I mean it's one of these sorts of things that's happened organically, and it's just become really, really popular and now it's like most days there'll be one or two or 10 people working in the garden, sharing ideas, talking to each other about what they're planting. We have a big contribution from the Chinese community and they're growing vegetables that perhaps Europeans are not familiar with and so there's lots of knowledge being shared. [SHV18]

People identified with being brought up on the land. It was synonymous with who they were. This expression of identity manifested itself as either a connection to place, culture, and/or livelihoods.

...my granddad passed away in March, and he was cremated. But in his coffin, there was a sod of turf or a sod of topsoil from the farm that he grew up on. ... we are all connected to a place, if you're lucky enough to realise that – how you're connected to a place, which is also a connection to soil as well within that place. [SHV03]

I think the other thing for me with living in Australia for a big chunk of my time is whenever I return to Australia, which I haven't lived there for a very long time, but for me it's seeing that red soil and so I have that emotional connection with how I perceive countries, I guess. [SHV05]

You're just connected to it more mentally, personally, spiritually sort of thing instead of it being a job. It's sort of a lifestyle, livelihood you could call it. Yep, you just have a real connection to it because you're brought up on it and it's not just only myself being brought up in it, my dad, grandfather, his grandfather, we go back

seven generations, growing up on farms right back from being in India, yeah. [SHV22]

Interviewees also made the connection between soil and its health with their families, and/or the wider community's physical and mental health and well-being. This was often expressed as "healthy soil equals healthy people" [SHV10]. Interviewees also discussed the benefit it had on their emotional well-being, either through reducing stress or by creating feelings of security through their connectedness to the land:

And when I say "safe", it's like whenever I'm on the farm or I'm in a paddock that's being farmed on, whether it be beef and sheep or horticulture or an orchard, I just sort of feel safe, that's like my – that's my comfort zone [SHV22]

Finally, interviewees recognised they had a responsibility to care for the soil, both now and for the future. This was expressed through narratives around the fulfilment that came from nurturing and caring for the soil for their own benefit, for the benefit of others, and even for the benefit of other species.

So, when we talk about soil we talk about the human interface, not just the fact that we rely on it, but the fact that we impact on it considerably as well and that it's part of our responsibility to maintain it. [SHV13] So, there is a level of protection around our soil, there's a level of nurturing, there is a genuine heartfelt authentic desire to ensure that what we have here is able to be nurtured for the next generation, like what has been passed to us [SHV20]

What soil does for us

Given the dominance of the Western-centric soil science paradigm it was not unexpected that all the interviewees mentioned instrumental values. Likewise, given our focus on the agricultural sectors it was no surprise that the instrumental values people discussed were dominated by food and fibre production and the soil properties and functions that support production and provide a benefit to people:

I don't see any value in our topsoil for anything other than food value, whether it be grain or the running of stock and all that sort of thing. But that's the value of our soil is to sustain our population for food. [SHV14] Soil is where we get all our food from. And that's why soil is important, it feeds us. Without soil we would starve. [SHV21]

[A] very significant percentage of the carbon storage is stored in the soil [SHV18]

A plurality of values

As noted above, all three value perspectives (intrinsic, relational, instrumental) were seen as important by interviewees. When discussing how they valued soil, interviewees often described a multidimensional position where at least two or all three perspectives on soil coexisted. For example, the understanding that soil was a living entity in its own right (intrinsic) often coexisted with the feeling of having a responsibility to care for it (relational)—“if I care for the soil, the soil will care back for me” [SHV22]. In other cases, all three perspectives were bound together in people’s descriptions of the importance of soil:

I guess it’s almost a living creature, soil. I know it has organisms and that, but it’s living in that it does a change and it grows, and it provides for life as well... We obviously are looking for soil to provide nutrition to our trees. So, the chemical properties of soil. We look for infrastructure, for making roads and landings. So physical, also we don’t want to reduce productivity through things like compaction and erosion. And then more and more we’re actually looking at the biology, so how that’s helping us tap into tree health and productivity... I’d have to say economic is the first one [value] that pops to my mind because it does allow for our livelihood. And then probably environmental jumps in second. Just we make a living from land, that means we care about the land, so we have to care about it, so that other generations can follow in our footsteps. [SHV25]

This multidimensionality or plurality of values was a dominant feature of our interviews and supports the way the values are depicted as overlapping circles in the NFF (Fig. 1). It highlights that the way people actually perceive and understand soil differs from the dominant narrow soil science narrative which currently underpins most soil policy.

Moving towards a more holistic values-driven approach to soil policy and management

Soil issues, policy, and management in Aotearoa New Zealand are largely informed by a Western-centric soil science paradigm and as a result soil policy and management are highly focused on the instrumental values provided by soils—particularly its productive value. For example, a 2015 government report (MPI 2015, p. 4) on the requirements for soil management in Aotearoa New Zealand stated, “practicing excellent land and soil management underpins product integrity and is crucial to New Zealand’s brand and supporting premium prices in global markets”. It also largely framed

the risks and threats to soil within this primary sector and production paradigm. Most soils policy in Aotearoa New Zealand has therefore been historically driven by the pressures and threats posed to the productive nature of land and soil (MPI 2015; PCE 2016; MfE 2018; MPI and MfE 2019; MfE and StatsNZ 2018, 2019, 2021). This has resulted in a narrow set of solutions being determined to address soil issues, threats, and priorities, with no specific or coordinated strategic actions derived from, or based on, a broader set of societal values to protect and manage soils sustainability.

Legislation from the early 1940s (Soil Conservation and Rivers Control Act 1941) through to more recent times (i.e. the Water and Soil Conservation Act 1967, the Resource Management Act 1991) mainly responded to the threat posed to soils from erosion (and its secondary effects of sedimentation and flooding). Local government responded to legislation and issues through various regional and local initiatives, objectives, and rules to protect land and soils by actions largely to maintain agricultural production and mitigate erosion (e.g. typically through identification of erosion-prone agricultural land, exotic tree planting and forestry on erosion-prone land, limiting pastoral use in erosion susceptible areas). This was largely aimed at erosion-prone hill and mountainous country in Aotearoa New Zealand particularly affected by high intense rainstorms, and lower cropping land affected by surficial erosion (e.g. wind, rain). This narrow focus on erosion (although a significant problem) meant that sight was lost on the broader range of issues and threats affecting our soils and their health. Further, there has been limited discussion and understanding of the human connection to soil and the broad range of human values, experiences, and dependencies associated with soil. For example, it is only since the early 2000s that dialogue has shifted to the issue of the loss of highly productive agricultural land or highly versatile soils due to increased urbanisation, land fragmentation, and lifestyle subdivision (Curran-Cournane et al. 2018, 2021). This resulted in the development in 2018 of a proposed national policy statement for the protection and management of highly productive land (MPI and MfE 2019). However, despite the importance of the issue, the proposed national policy statement is still a threats-driven response based largely on instrumental values, that has been Government led and informed by Western science. With limited dialogue with Māori, it also lacks a comprehensive Indigenous perspective.

Recognising that people assign a plurality of values to soil helps articulate and frame our thinking and understanding about issues, risks, and threats to soils. It is important to understand these values (including Indigenous values) before defining the risks and threats to soil and implementing management practices. Generally, because land and soils policy in Aotearoa New Zealand is dominated by a Western-centric soil science paradigm, the plurality of stakeholder

values identified in this research are seldom considered. There is also a lack of understanding by policy makers on how the wider set of societal knowledge, values, and perspectives (e.g. relational values) can be used to prescribe a set of actions and interventions to achieve a common purpose. Indigenous Māori perspectives also tend to be rarely considered, and there are ongoing difficulties understanding how Te Ao Māori/mātauranga Māori (Māori aspirations, knowledge, and values) can be effectively included in research, science, planning, and policy.

A similar situation exists internationally. A review of recent international policies pertaining to soil (van der Putten et al. 2018) illustrates that soil policy and management are highly focused on a soils instrumental or productive value. This typically frames the risks and threats to soil from a dominant Western-centric agricultural production paradigm, which in turn drives the majority of most soils policy (Montanarella 2017; van der Putten et al. 2018; Montanarella and Panagos 2021a, b). This narrow approach fails to take account of the plurality of values people hold for soil, for example, intrinsic, relational, and indigenous soil health values (Friedrichsen et al. 2021). Indigenous perspectives are conspicuously absent in the review of recent international soil policy by van der Putten et al. (2018). When Indigenous perspectives have been considered, the focus is still on their instrumental value of soil (see for example Dawoe et al. 2012; Norgrove and Hauser 2016; Kome et al. 2018; Singh et al. 2022).

The need to consider a large range of values and knowledge is also reinforced in the revised World Soil Charter (FAO 2015) whereby the charter's principles outline the policy and management requirements needed to ensure the sustainable management of soils globally (FAO 2015). Implementing soil management in widely differing socio-economic contexts, interdisciplinary initiatives by many stakeholders, making decisions locally, and incorporating Indigenous values and knowledge into soil management decisions are all stated under principle 6 (FAO 2015).

The sustainable management of natural resources (including soil) requires understanding and accounting for the holistic values and aspirations of a large range of stakeholders and sectors, including Indigenous peoples (FAO 2015; Chan et al. 2016; Ellis et al. 2019; Maxwell et al. 2020a, b; Stronge et al. 2020; IPBES 2022). A key feature of the interviews from this study was the plurality of values people expressed when discussing how they valued soil. This plurality is also reflected in Māori concepts, knowledge, and perspectives of soil. This study builds on previous kaupapa Māori research carried out from 2014 to 2020 to explore and understand key concepts, key soil health values and principles important to Indigenous Māori (see for example Harmsworth and Roskrige 2014; Hutchings et al. 2018; Hutchings and Smith 2020a; MWLR 2021a, c, d). Some of these Māori soil

health values and principles are more fully described in the Appendix and key indigenous concepts were summarised by MWLR (2021d) and include:

- Understanding and concepts are derived from Māori beliefs, philosophy, knowledge, values, and perspectives.
- Soil health can be understood holistically from both a cultural and science perspective (reinforcing whole ecosystem approaches and interconnections—microbes to animals, plants, to people).
- Intergenerational connections (whakapapa) between people, land, and soils are integral.
- The mauri or life force, vitality, and energy of the soil is a key concept. There must be a focus and responsibility on maintaining the mauri or life force/energy/vitality of the soil ecosystem, to ensure human well-being.
- A spiritual dimension, or wairua, is a key dimension linked to the capacity and vitality of the soil to sustain life.
- Mana is a term which gives authority and status for making decisions about the soil, for caring, looking after, and managing the land and the soil. '...Te Mana o te Whenua, te mana o te oneone, te mauri o te oneone—The mana of the land, the mana of the soil, enhances the mauri of the soil'. Mana also elevates the importance of soil as a living resource and treasure.
- Indigenous Māori culture gives a long-term view of soil resilience that connects with intergenerational thinking (Te Ao Tūroa) about sustainability, e.g. 'resilient soils, resilient and healthy people'.

While there is a commonality, and both Western-centric and Māori values and perspectives may be overlapping, their origins are different, and they are based on quite contrasting beliefs, values, and knowledge systems. It is important to respect the integrity of each with its own understandings, teachings, tools, actions, and approaches for addressing soil health issues. We see this as having important implications when applying the NFF to how nature is valued, including soils. The strength of the NFF is that it encourages people to think more holistically about a plural set of values, especially those they assign to the environment. However, while the NFF broadens the perspective on how soils are valued, it is still a Western-centric framework. A crucial aspect of understanding and accounting for the holistic values and aspirations of Indigenous peoples is that those values, knowledge, and perspectives retain their own origin and integrity, and are not integrated or assimilated into Western science approaches (Maxwell et al. 2020b; Reid et al. 2021). While the pluralistic values thinking presented in the NFF complements Indigenous Māori philosophy, knowledge, and values, the NFF only really provides an improved

understanding of the plurality of Western values and their links to nature, soils, and soil health.

A paired soil health framework

Achieving the sustainable management of soil requires bringing diverse backgrounds and knowledge systems together in a way that can address a common purpose or agreed goal, and “embed the diverse values of nature into policymaking” (IPBES 2022). As noted above, this needs to be carried out in a way that pairs different knowledge systems rather than integrating or assimilating one into the other, usually into a dominant Western-centric paradigm (Maxwell et al. 2020b; Reid et al. 2021).

In Aotearoa New Zealand “the way we use knowledge is changing, particularly towards a broader knowledge set and values that informs research, planning, policy and decision-making” (Harmsworth 2021, p. vii). This trend is driving interest in frameworks which incorporate Te Ao Māori/mātauranga Māori (Indigenous Māori science knowledge and perspectives) next to Western-centric science, to improve decision-making on shared goals and desired outcomes (Harmsworth 2021).

The incorporation of Indigenous values and knowledge in environmental decision-making next to local knowledge, values, and science, is important in Aotearoa New Zealand under Te Tiriti o Waitangi 1840 (Treaty of Waitangi 1840). The Treaty provides a constitutional basis for the country, in all forms of policy and legislation, by which the principles of participation, partnership and protection are promoted and given effect. Indigenous knowledge systems can coexist with (and pre-date) Western-centric knowledge systems but at present are largely neglected by the dominant Western-centric soil science paradigm (Friedrichsen et al. 2021).

Stronge et al. (2020) provided a well-being framework to promote soil health by providing new ways of connecting science and core values to desired outcomes and policy. It positioned soil health within a well-being framework to show how the interconnections and interdependencies between soil management, soil health, and societal well-being contribute to four main capitals: social, human, natural, and financial/physical. We believe Indigenous knowledge and values can coexist with science in such a framework. Furthermore, connecting Indigenous knowledge into decision-making processes alongside the dominant Western-centric paradigm would provide a more holistic foundation on which to base effective policy for the development of strategies, actions, and the sustainable management of soils. Figure 2 provides a new version of this soil health–well-being framework (Stronge et al. 2020) that pairs mātauranga Māori with Western-centric soil science, stakeholder and sector group

knowledge, values, and perspectives to support policy and give effect to well-being from soils.

The recognition and bringing together of multiple worldviews in this framework (Fig. 2) are facilitated through a bi-cultural participatory process approach called the Waka-Taurua model (Maxwell et al. 2020b). Waka-Taurua is being increasingly used as a metaphorical framework in Aotearoa New Zealand to share and understand differing values, knowledge, and perspectives. In a literal sense, a Waka-Taurua involves the lashing together of two single waka (canoes) to form a temporary double-hulled canoe to achieve an agreed or common goal. Poles tied between the two waka allowed a papanoho (deck or shared space) to be constructed between the two hulls, creating a shared space (Maxwell et al. 2020b). Applied as a metaphorical framework, “each canoe represents the worldview and values of the people who are coming together to achieve a common purpose.... It recognises that each group is inherently different, and the knowledge, values and actions of each, are not made to fit into the other” (Maxwell et al. 2020b, p. 2). The papanoho (deck) acts as a shared engagement space to implement a joint approach for achieving the common goal or purpose (Maxwell et al. 2020b). While developed as a concept to help bring together Indigenous Māori worldviews (Waka Māori) with Western approaches (Waka Taiwi) (and applied as such in Fig. 2), the concept has transferable properties (Maxwell et al. 2020b) so could also be used to bring together multiple, but conflicting, Western worldviews (i.e. different sector groups) to address a common issue.

A central tenet of the framework in Fig. 2 is its focus on the well-being benefits people derive from soil, rather than the ecosystem services that give rise to those benefits (Stronge et al. 2020). This recognises that the benefits are not solely derived from the ecosystem service but are co-produced through a combination of the service and the anthropogenic capital assets (i.e. social, human, financial, physical) (Pascual and Howe 2018). This process, represented in the top half of the framework, underpins the multidimensional nature of soil health values. It acknowledges the interconnectedness of all the capital assets, and the role they all play in differentiating and influencing people’s perceptions of soil and soil health. The heterogeneity of perspectives due to people, place, and generations is also acknowledged in the top half of the framework, which underpins the hierarchical nature of soil health values. This central tenet is also consistent with Māori values and perspectives that have strong linkages to the environment and ecosystems from which they derive human health and well-being (Harmsworth and Awatere 2013; Harmsworth 2020).

The bottom half of Fig. 2 provides a process for informing the development of good policy and management interventions. A crucial aspect of the Waka-Taurua model is to ensure that different values, knowledge, and perspectives

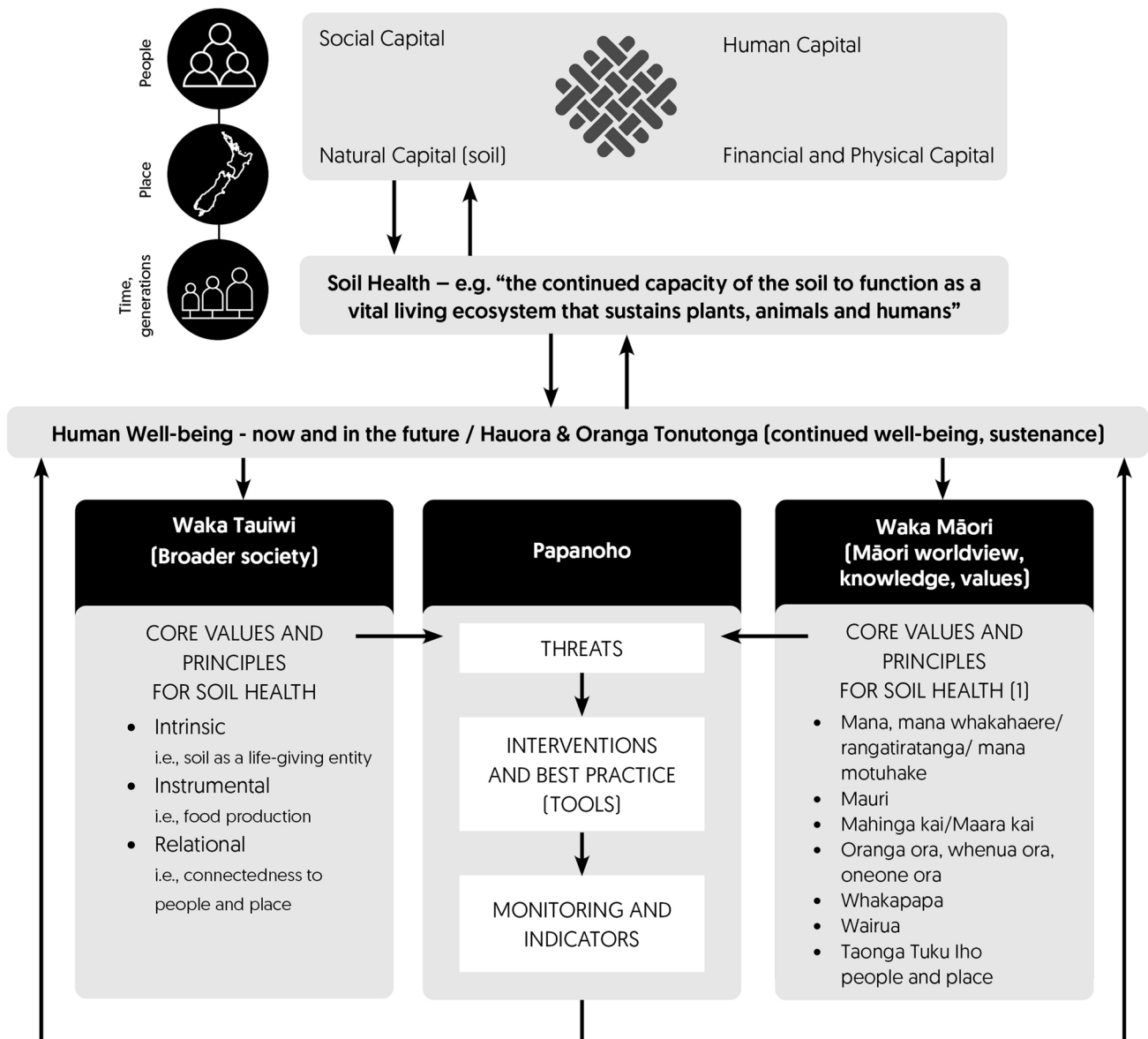


Fig. 2 Soil health and well-being framework (adapted from Stronge et al. 2020; Maxwell et al. 2020b) (1. See Appendix for definitions of the Māori soil health values and principles listed)

retain their own origin and integrity, and although independent of each other, become complementary providing a richer base for knowledge, understanding, and policy implementation. In this context the papanoho (deck) acts as a shared space to negotiate and develop “mutually beneficial tools, actions and approaches derived from both canoes” (Maxwell et al. 2020b, p. 3) to achieve the most optimal solution(s) and implement appropriate (e.g. cultural, social) interventions to achieve shared goals.

The tools, actions, and approaches will vary with different circumstances, so it is important that these are thoroughly considered in the context and values to which they are being applied. What we propose in the bottom half of

the framework is a set of principles, based on Holloway’s (1993) intervention logic, to guide the decision-making process. Ultimately the goal of good environmental policy and management is resource protection and sustainability. Key to this is identifying the value or values at risk of harm or damage (Holloway 1993; Chan et al. 2012). This knowledge is the critical starting point. Failure to start here has flow on effects to the other steps and compromises the ability to manage resources (e.g. soils) sustainability. If you do not know what soil values you are trying to protect, or promote, then you cannot accurately assess what the threat(s) is to that value. If you get the threats wrong, then the intervention to address those threats will not result in any improvement or

protection of the value you deem important, and resources are wasted. If you are doing the wrong intervention, then the monitoring or indicators being used to assess the success of the intervention will not show any improvement in the value you want to protect—and the value will continue to degrade. This logic process, or set of principles, applies equally to Indigenous and non-Indigenous tools, actions, and approaches. Its application can help inform and guide negotiation for which mutually beneficial tools, actions, and approaches are used to achieve the best solution to the shared issue.

We believe our framework demonstrates how soil policy and management could be more effectively approached in Aotearoa New Zealand and globally. It is the only soil health framework we are aware of that respects the integrity of contrasting knowledge systems (i.e. not assimilating one type of knowledge or values into the other, or fitting or diluting one knowledge system/form into another) (Harmsworth 2021). As our work (and others i.e. Friedrichsen et al. 2021) shows, people assign a plurality of values to soil and soil health that complements Indigenous knowledge, values, and perspectives of soil (Harmsworth and Roskrige 2014; Hutchings et al. 2018; Hutchings and Smith 2020b). As such, a discussion on pluralistic values is an essential place to start when working collaboratively on shared goals for the management, protection, maintenance, and enhancement of soils. Pluralistic values-driven conversations will produce quite different actions and outcomes than current conversations dominated by the pressures and threats posed to a soils productive value, as they encompass much broader issues and more diverse ways of expressing relationships with soil. This in turn broadens the conversation around what the threats are, what actions need to be taken, and what the appropriate indicators are for assessing the success of the response (Fig. 2).

The range of pluralistic values identified, within or between knowledge systems, will mean that people often hold different value sets and opinions regarding soil and its use, which can lead to differing priorities and sometimes conflict. Bünemann et al. (2018, p. 120) note that soil health issues largely boil down to “societal negotiation in the face of unavoidable trade-offs between various soil uses”. Our framework does not eliminate differences or conflicting views. Instead, by recognising and embracing the plurality of values it opens up a space for people to engage in meaningful dialogue on the sustainable management of soils and soil health. Furthermore, by embracing diverse values, knowledges and perspectives it provides an inclusive and richer base for understanding soil issues, distinguishing threats, and discussing goals, actions and priorities. This wider knowledge base is essential for informing and implementing policy, improving the identification of threats (e.g. threat to a specific value), and ultimately addresses issues

to mitigate problems (e.g. degradation, damage, health) by developing best practice for good soil management through effective local actions.

Conclusions

Addressing the diversity in soil values, both across and within sectors, is critical for developing meaningful sustainable soil policy and sustainable soil management and practices. However, while understanding that core values of soil are critical, there is a limited understanding of what these pluralistic values are beyond a narrow band of instrumental values. In this paper we used an adapted NFF to analyse how stakeholder and sector groups across Aotearoa New Zealand’s agricultural productive sectors expressed their relationship with soil and soil health. This analysis highlights the multidimensional nature of values people assign to soil and soil health; an aspect largely neglected by the current, dominant Western-centric soil science paradigm. This work complemented earlier work undertaken to understand and reinvigorate the core soil health values and principles important to Aotearoa New Zealand’s Indigenous Māori (Harmsworth and Roskrige 2014; Hutchings et al. 2018; Hutchings and Smith 2020a). If we are to truly meet international calls to sustainably manage soils, then there needs to be a shift in how soil policy and management is developed and implemented. It must take into account the multidimensional ways people see and understand soil ecosystems, and value soils and nature. This will require a move beyond the current dominant and narrow Western-centric approach, to one that embraces other knowledge systems, values, and perspectives in a collaborative and equitable way. There is an urgent need to develop frameworks that allow all parties to (w)holistically show their connection to soils and prioritise issues, threats, and risks.

We present a multidimensional, integrated, soil health and well-being framework that can incorporate a plurality of values from people with diverse backgrounds. We used a bi-cultural model approach “waka taurua” to show how the duality of values from non-indigenous and Indigenous groups in Aotearoa New Zealand can be used to shape process, dialogue and understanding of soils. The resulting framework demonstrates the connection between people’s values, their issues, and concerns. It helps identify risks and threats, and helps determine desired aspirations and goals, especially in regard to defining soil health and well-being. It forms an essential building block for the inclusion and understanding of multi-stakeholder and Indigenous voices and perspectives to achieve a common purpose or shared vision to achieve sustainable soil management. In terms of Indigenous partnership, this approach allows recognition

of cultural diversity, and upholds Indigenous rights for decision-making.

The framework therefore provides an effective basis for the inclusion of values and priorities across multiple agencies, institutes, and sectors to co-design and implement best-practice and support and inform (w)holistic and effective decision-making and management. We believe this framework represents an advanced and innovative shift in how current global soil policy is developed and implemented. An integrated framework such as this provides a more effective model to incorporate diverse values, knowledges, cultures, and perspectives that can underpin decision-making. It will be important to utilise these types of approaches and frameworks in future to ensure soils are protected and managed wisely and sustainably. This represents an important vehicle for achieving long-term desired aspirations and better soil health outcomes, where soil ecosystems related to societal and cultural values can be maintained and enhanced for future generations.

Glossary

Ao	World, earth, cloud	Māori	Indigenous people of New Zealand, Māori means “ordinary”, “common”
Aotearoa	Māori name for New Zealand, land/world (ao), of the long (roa), white (tea) cloud (ao)	Mātauranga Māori	Māori knowledge and philosophy
Aotearoa New Zealand	Common alternative name for New Zealand	Oneone	Soil
Hauora	Healthy, Fit for purpose, well, human health	Oneone ora	Soil health, healthy soils
Kaupapa Māori	Māori led, Māori purpose, Māori methods, Māori led research for Māori by Māori	Oranga ora	Healthy, being healthy, well-being
Mauri	Energy, vitality, essence, life force, life giving qualities, sustaining life force or spirit, restoring balance to the system	Papanoho	Deck, space, or middle area between two linked waka
Mauri ora ki te whenua	Giving energy, life, vitality, health to the land, reinstating energy	Rangatiratanga	Self-determination, independence, away from dependency
Mauri ora ki te tangata	Giving energy, life, vitality, health to people, humans, breath of life	Tangata	People, humans
Māra kai	Gardens, cultivation, cropping land	Tangata ora	Healthy people, healthy living systems
Mahinga kai	Food growing and gathering area, area of cultural resources for collection or harvest	Taonga tuku iho	Treasured possessions sustained or passed through generations, intergenerational guardianship
Mana	Prestige, power, authority	Te ao Māori	Indigenous Māori worldview
Mana Motuhake	Special, independence, self-determination	Te ao turoa	Sustainable world, long standing
Mana Whakahaere	To have authority and status to manage and set policy	Te mana o te whenua	Power and prestige to the land, giving prestige and importance to the land
		Tiriti o Waitangi	Treaty of Waitangi. Treaty of good faith to uphold indigenous rights signed between the British Monarchy and its representatives (The Crown or British Government) and Māori and tribal representatives (iwi/hapū) in 1840
		Wairua	The spiritual dimension to life, spiritual practice, soul
		Waka	A vessel or vehicle for a journey, to reach a destination
		Waka Māori	Māori worldview, as part of the twin hulled waka model
		Waka tauīwi	A non-Māori worldview, as part of the twin hulled waka model
		Waka taurua	A twin hulled waka, used as a metaphor for dialogue and understanding between people with different knowledge systems, values, perspectives, a bi-cultural model
		Whakapapa	Ancestral lineage, ancestral connections, genealogical relationships
		Whenua	Land, placenta
		Whenua ora	Giving health and vitality to the land, healthy soils

Appendix: Examples of Māori soil health values and principles (adapted from Manaaki Whenua-Landcare Research 2021a)

Core values/principles	Description examples
Mana, mana whakahaere, rangatiratanga, mana motuhake	Power, prestige, and authority to make management decisions through planning and actions that give benefit back to nature, resources, and soils. Mana comes from whakapapa (ancestral connection) and rangatiratanga (chiefly status, self-determination) in all tribes to express indigenous customary rights. Mana also elevates the status of the resource, such as soil, to one of power, prestige, dignity, and legal right. That is, mana for the resource to be sustained in a fit and healthy condition
Mauri	Essence, life force, energy, or vitality. The sustained capacity and power of the soil to provide food, life, and well-being, e.g. a well-functioning vital living soil ecosystem in balance with nature supports life and well-being
Mahinga kai/Mara kai	Ability for nature and soil to produce and sustain healthy food for harvest, collection, and consumption. All food grown has a mauri
Oranga ora, whenua ora, oneone ora	A state of health, which sustains people, food and resources and their mauri and wairua. A holistic way of defining acceptable states and condition of health, based on values, for whenua (land), oneone (soil), kai (food), and tangata (people). Ability of soil to provide and ensure the health and well-being of people in accordance with cultural values

Core values/principles	Description examples
Whakapapa	Genealogy, layers, descent, ancestral connection, and lineage that link people, to place, land, and soil, reinforcing interconnections and interdependencies between and with all parts of nature. It connects people to Atua (gods and domains) and all living organisms and ecosystems. Whakapapa goes back to the beginning of time, the primordial parents, Papatūānuku and Ranginui. It also forms relationships between and within families and tribes, e.g. whānau/hapū/iwi
Wairua	The spiritual dimension, whereby people derive spiritual fulfilment and well-being from nature and soil. It is another strong element within relational values strengthening connection. Wairua is the glue that binds the living to the non-living, the heavens to the Earth, and atua to people, to give mauri and spiritual health which transcends through people, food, and resources
Taonga Tuku Iho	Treasures through time to achieve sustainability (Te Ao Turoa). It sits within key concepts such as kaitiakitanga (environmental guardianship) to attain a certain permanence in resource quality and condition. Taonga tuku iho establishes intergenerational equity, to pass treasures such as a healthy soil from one generation to the next
Tau utuutu	Is giving back what you take. It restores balance in the system, by giving human benefit back to the resource, soil, or ecosystem (through a set of actions and practices)

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Data availability Data is available upon reasonable request to the main author.

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