



Manaaki Whenua
Landcare Research

A well-being approach to soil health

MBIE Endeavour funded programme: Soil Health and
Resilience: oneone ora tangata ora

Outline of talk



- Overview and brief update on the three major research aims of the programme
 - I. Soil Resilience
 - II. Developing Māori views on Soil Health
 - III. Creating a Soil Health Framework that better integrates science with social and policy needs
- Focus of talk: A well-being approach to soil health

Soil Health



- Soil health: “the continued capacity of the soil to function as a vital living ecosystem that sustains plants, animals and humans”



Ecosystem Services /
Soil Natural Capital

- A holistic view of soil health considers the diverse values of stakeholders and the multifunctional capacity of the soil system to deliver all its functions.



Soil Security

Capability Condition
Capital Connectivity
Codification

Living Standards Framework
Well-being

Land Domains Reporting
(Councils/LMF, MfE, Stats NZ)

Research Aim 1: Soil Resilience



- Better quantify how different soils (and soil functions) react to land use change and intensification
- A number of different projects utilising long term experiments and land use comparisons





Research Aim 1: Coordinated Sampling Campaigns

- In conjunction with S-map MBIE programme, PFR and Waikato Uni - land use comparisons were made on different soils:
 - Canterbury – Pallic, Gley, Brown Soils
 - Waikato – Allophanic, Gley, Granular, Ultic Soils

➤ Quantifying the inter-relationships between soil C, compaction, soil structure and soil hydrology (e.g. the extent to which soil C affects soil water holding capacity in NZ soils)

Research Aim 1, Some Project Outputs to Date:



MINI-REVIEW

Microbial assemblages and bioindicators as proxies for ecosystem health status: potential and limitations

Carmen Astudillo-García¹ · Syrie M. Hermans¹ · Bryan Stevenson² · Hannah L. Buckley³ · Gavin Lear¹

Received: 18 March 2019 / Revised: 3 June 2019 / Accepted: 4 June 2019
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CSIRO PUBLISHING

Soil Research, 2019, 57, 657–669
<https://doi.org/10.1071/SR18210>

Effect of long-term irrigation and tillage practices on X-ray CT and gas transport derived pore-network characteristics

Karin Müller¹ ^A, Nicola Dal Ferro¹ ^{B,C}, Sheela Katuwal^C, Craig Tregurtha^D, Filippo Zanini^E, Simone Carmignato^E, Lis Wollesen de Jonge^C, Per Moldrup^F, and Francesco Morari^B

PRE

Journal of Applied Ecology



RESEARCH ARTICLE | Full Access |

Relationships of plant traits and soil biota to soil functions change as nitrogen fertiliser rates increase in an intensively managed agricultural system

KH Orwin NWH Mason, L Aalders, N Bell, N Schon, PL Mudge

First published: 26 September 2020 | <https://doi.org/10.1111/1365-2664.13771>

Decadal Changes in Soil Organic Matter Due to Microaggregate and Hot Water Extractable Pools

Soil Chemistry

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Storage of C and N within aggregates is important for long-term stabilization of soil organic matter (SOM). We investigated whether changes in C and N associated with physical soil fractions and the hot water extractable pool were correlated to changes in topsoil C and N over three decades. Archived soil samples from three soil orders collected from 46 sites across New Zealand were physically fractionated and the aggregate abundance (and C and N contents) of fractions determined; hot water extractable C (HWC) and hot water extractable N (HWN) were also measured. Together the change of C and N in hot water extractable SOM, microaggregate within macroaggregate, and free microaggregate fractions explained 60 and 47% of the change in whole soil C and N, respectively. Soil order was not a significant factor in the model suggesting that similar processes were operating in all three soil types. In summary, the development of strategies that enhance the storage of labile SOM and microaggregates could reverse the trend of loss of SOM and its associated ecosystem services.

Abbreviations: NSA, National Soil Archive; SOM, soil organic matter; HWC, hot water extractable carbon; HWN, hot water extractable nitrogen.

BURLEIGH DODDS SERIES IN AGRICULTURAL SCIENCE

Managing soil health for sustainable agriculture

Volume 1: Fundamentals

Soil and soil health: an overview

Mark G. Kibblewhite, Cranfield University, UK and Landcare Research, New Zealand

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Applied Soil Ecology

journal homepage: www.elsevier.com/locate/apsoil

The interactions between biochar and earthworms, and their influence on soil properties and clover growth: A 6-month mesocosm experiment

Stanislav Garbuz^{a,b}, Marta Camps-Arbestain^a, Alec Mackay^a, Brian DeVantier^a, Maria Minor^a

^a School of Agriculture and Environment, Massey University, PB 11222, Palmerston North, New Zealand
^b AgResearch, Grasslands Research Centre, Palmerston North, 4410, New Zealand

RA1, Other Project (and Associated) Outputs to Date:



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Microbial assemblages and bioindicators as proxies for ecosystem health status: potential and limitations

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^bAgResearch, Grasslands Research Centre, Palmerston North, 4610, New Zealand

Hermans et al. *Microbiome* (2020) 8:79
<https://doi.org/10.1186/s40168-020-00858-1>

Microbiome

RESEARCH

Open Access

Using soil bacterial communities to predict physico-chemical variables and soil quality

Syrie M. Hermans¹, Hannah L. Buckley², Bradley S. Case², Fiona Curran-Courmane³, Matthew Taylor⁴ and Gavin Lear¹



Geoderma 363 (2020) 114134

Contents lists available at ScienceDirect

Geoderma

journal homepage: www.elsevier.com/locate/geoderma

The Land Resource Circle: Supporting land-use decision making with an ecosystem-service-based framework of soil functions

Linda Lilburne^{a,*}, Andre Eger^a, Paul Mudge^a, Anne-Gaelle Aussel^b, Bryan Stevenson^a, Alexander Herzig^a, Mike Bear^b

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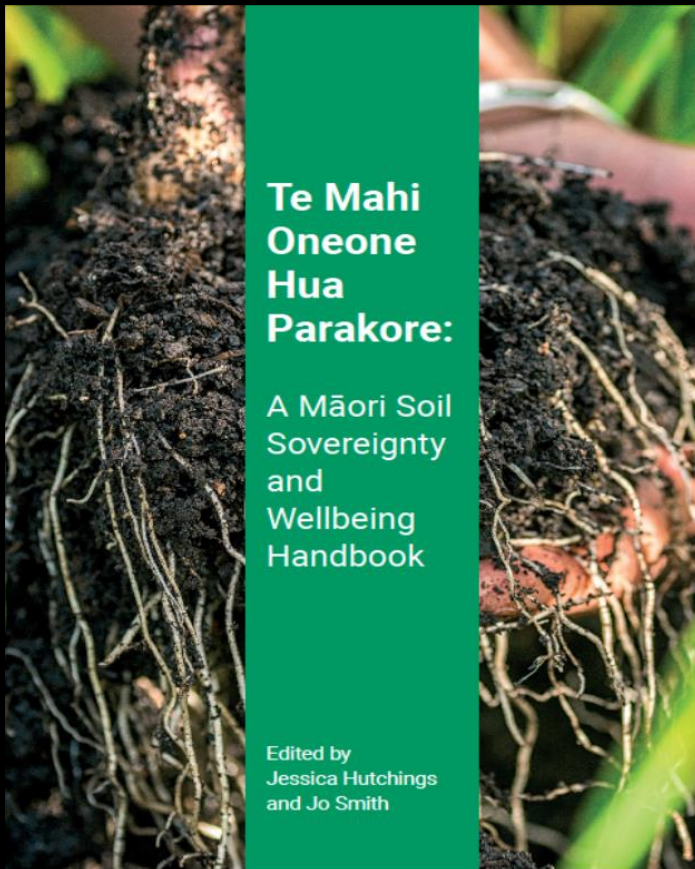
^bPlant & Food Research, Private Bag 4704, Christchurch Mail Centre, Christchurch, New Zealand



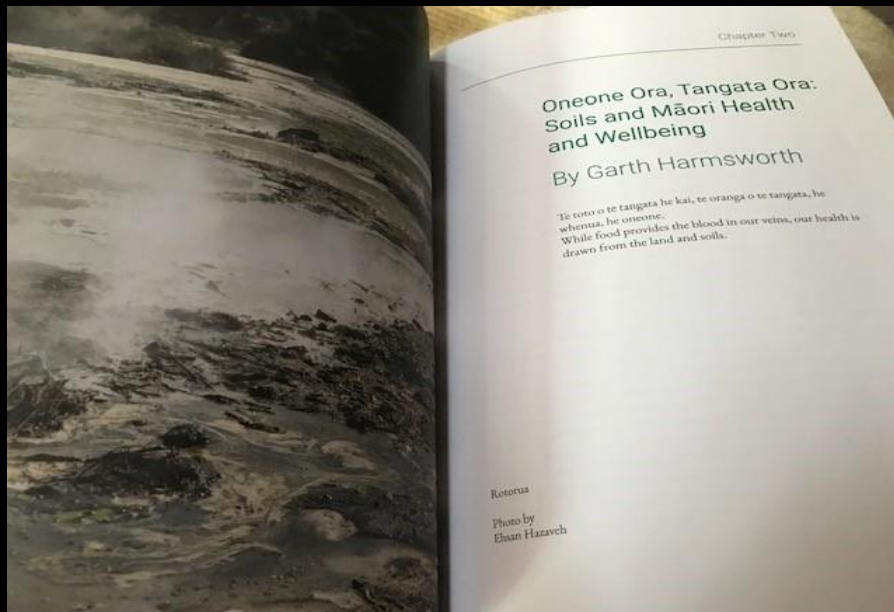
Research Aim 2: Developing Māori views on Soil Health

- Explores soil health from a Te Ao Māori perspective; thru concepts of the mana, mauri, whakapapa, wairua and hau of soil.
- Collaborating with Māori researchers and practitioners, Māori organisations, collectives, and landowners .

Research Aim 2: Key Output



Hutchings J. and Smith J. 2020. Te Mahi Oneone Hua Parakore: A Māori Soil Sovereignty and Wellbeing Handbook. 190p. ISBN 9780473516192. Free Range Press.





Research Aim 3: Creating an integrated Soil Health Framework

- Connecting various knowledge forms (including Māori perspectives) with traditional science to develop a more integrated framework for soil health.


[Integrating Science + Social + Policy Needs]

Research Aim 3: Key Outputs



Discussion

A Well-Being Approach to Soil Health—Insights from Aotearoa New Zealand

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Manaaki Whenua
Landcare Research

SOIL HEALTH AND RESILIENCE: ONEONE ORA, TANGATA ORA

SOIL HEALTH AND POLICY WORKSHOP

MEETINGS ON THE TERRACE, WELLINGTON



10:05



"Haere-mai, Tēna koutou,
...Kia ora. I'll introduce
the team here today..."



I'm Margaret, to
start please introduce
yourselves...if
you're from a XYZ
background
stand.



Kia Ora,
I'm from...



Concept of soil health expanding to include:

- ▶ Soil security
- ▶ Food security
- ▶ Ecosystem/human/global health



Q: "IF YOU COULD CHANGE
ONE THING ABOUT SOIL
HEALTH POLICY, WHAT
MIGHT THAT BE?"

Consistency
between
National and
Regional Policy

The value/
importance
of healthy
soil is reflected
in policy
decisions

Need a
coordinated
National Soil
Management
Group

Integrated
national
direction for
soil, land and
water

Policy into
regulatory/
non-regulatory
responses

What is soil health?

The continuing capacity
of the soil to function as
a vital living ecosystem
that sustains plants,
animals and humans.



Understanding what's driving soil health management and policy in NZ.

Need
regional plans
for integration

Soil issues:

- Land use change and suitability of soil types.
- Climate change.
- Land fragmentation and urban development.
- Soil loss - erosion, reduction in soil carbon and soil biomass - Compaction and contamination. Surveillance and monitoring.
- Relationships between water and land.
- Lack of soil knowledge - soil undervalued.
- Treaty settlement - cultural change.
- Long time frames.
- Integrated production systems.
- Complex farming systems and farming profitability.

NZ management
for soil report.
Where's that
group?

Who needs to change ?

- General public/catchment community.
- Central and local Government - policy makers, leaders, industry, Farmers. Anyone working with soils, science organisations.
- **Address issues**
- Integrate soil/land with in water policy framework.
- Value shift - SOIL MATTERS.
- More collaborations /partnerships between scientists, policy makers, industry and councils.
- More scientific expertise, capacity and integration of knowledge.
- Use clear and action-based terminology, link to standardised public policy outcomes and soil security.
- Consistent data type, capture & reporting, and availability.
- Soil health is part of the whole socio- ecological system.
- Need a "champion" for soil health.
- Cultural change - stewardship and Mātauranga Māori.
- Economically and physically running down the resources - where is the tipping point?
- Ecosystem services framework to capture links to human wellbeing.

What are we making policy about?

- **National**
- National policy statements.
- RMA, EPA policy for HAZNO, NPS freshwater.
- EMAR - landsoil.
- NES - contaminated land guidelines, Cadmium strategy.
- Forestation grant scheme.
- 3 waters review.
- Our land & water NSC.
- **Regional**
- Farm Environmental plans.
- Regional Policy - Soil health, biodiversity and water quality.
- Clean streams accord.
- **Sector**
- Dairy NZ - sustainable dairying water accord.
- Hort NZ - soil/erosion guideline.
- FANZ BMP fertiliser application - tiered fertiliser management system.

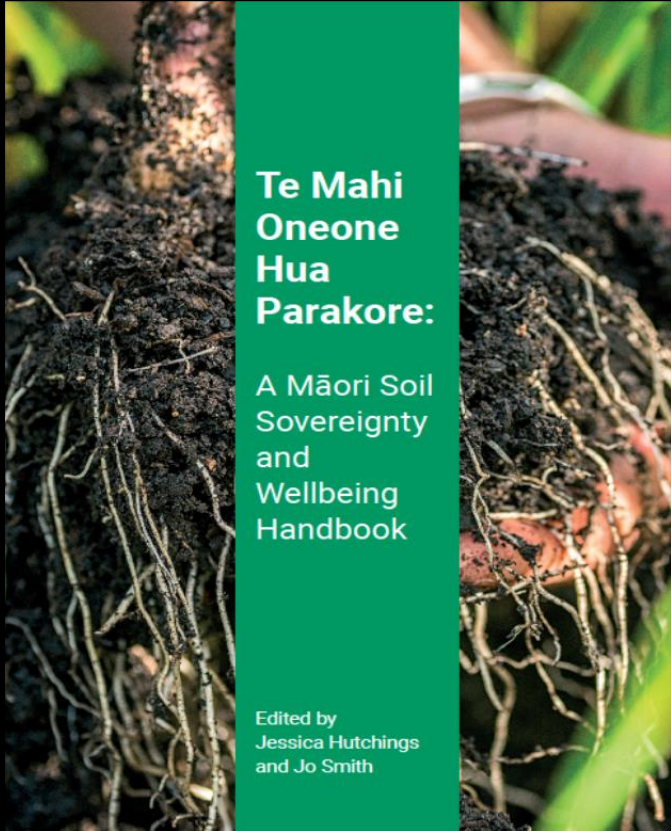
What are the implications?

- Siloed approach/fragmentation - don't have alignment regionally/nationally.
- Te Ao Māori can contribute to holistic approach of land/water policy.
- Need cross-sector policy making
- Need a National Soil Management Group.
- NPS is too focused on high value/versatility issues.
- Develop a clear vision across all sectors and conservation land Indicators/monitoring linked to function as an ecosystem.



1. What are the soil issues facing NZ now?
2. Who needs to change & in what way? What needs to happen to address these issues?
3. What are we actually making current policy about at national regional/sector level?

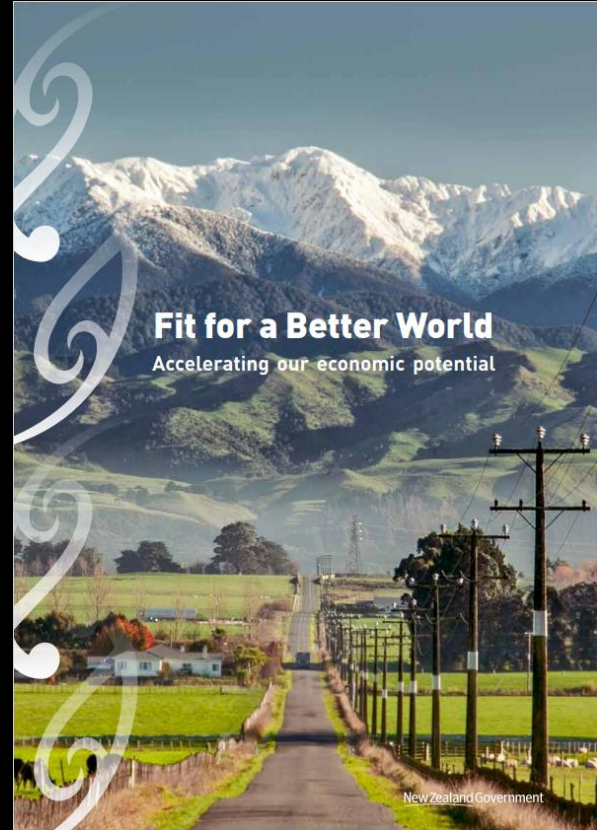




**Te Mahi
Oneone
Hua
Parakore:**

**A Māori Soil
Sovereignty
and
Wellbeing
Handbook**

Edited by
Jessica Hutchings
and Jo Smith



Fit for a Better World

Accelerating our economic potential

New Zealand Government



The Treasury's Living Standards Framework

To help us achieve our vision of working towards higher living standards for New Zealanders, we developed the Living Standards Framework. Our Living Standards Framework provides us with a shared understanding of what helps achieve higher living standards to support intergenerational wellbeing.

Our work is focussed on promoting higher living standards and greater intergenerational wellbeing for New Zealanders. These require the country's Four Capitals – human, social, natural and financial/physical – to each be strong in their own right and to work well together.

Distribution



The Four Capitals (natural, human, social, and financial and physical) are the assets that generate wellbeing now and into the future

Looking after intergenerational wellbeing means maintaining, nourishing, and growing the capitals

Natural Capital

All aspects of the natural environment that support life and human activity. Includes land, soil, water, plants and animals, minerals and energy resources.

Social Capital

The norms, rules and institutions that influence the way in which people live and work together and experience a sense of belonging. Includes trust, reciprocity, the rule of law, cultural and community identity, traditions and customs, common values and interests.



Human Capital

The capabilities and capacities of people to engage in work, study, recreation, and social activities. Includes skills, knowledge, physical and mental health.

Financial and Physical Capital

Financial and human-made (produced) physical assets, usually closely associated with supporting material living conditions. Includes factories, equipment, houses, roads, buildings, hospitals, financial securities.

The 12 Domains of current wellbeing

reflect our current understanding of the things that contribute to how New Zealanders experience wellbeing

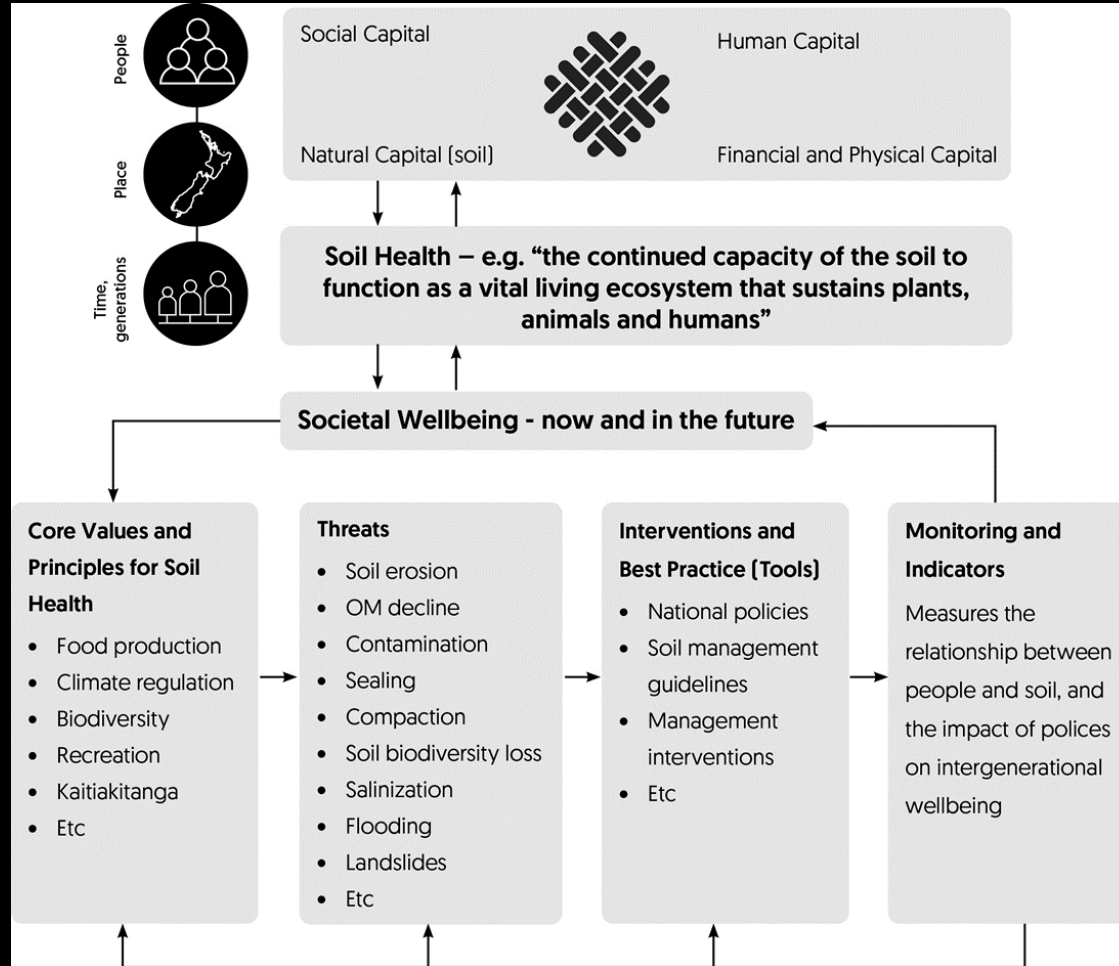
- Civic engagement and governance
- Cultural identity
- Environment
- Health
- Housing
- Income and consumption
- Jobs and earnings
- Knowledge and skills
- Time use
- Safety and security
- Social connections
- Subjective wellbeing

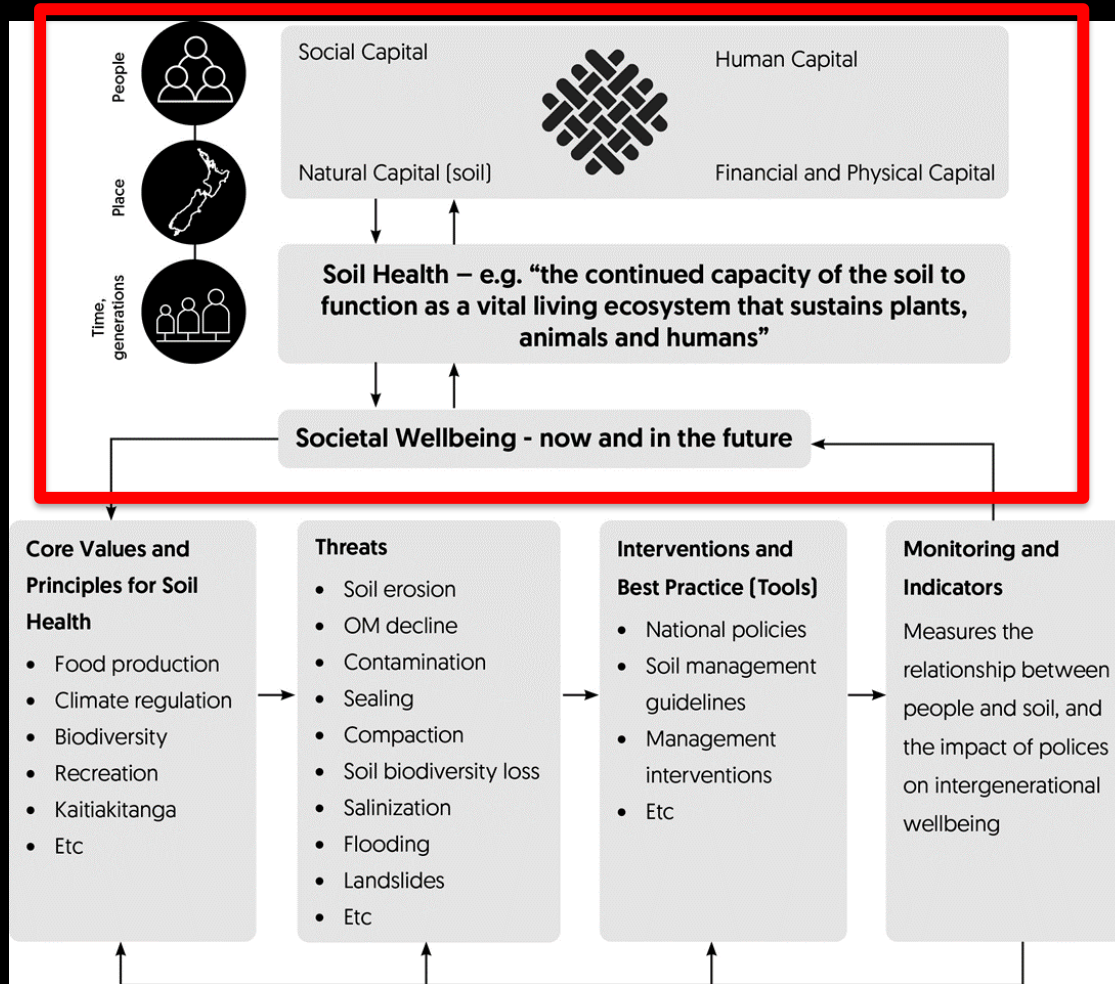
Resilience

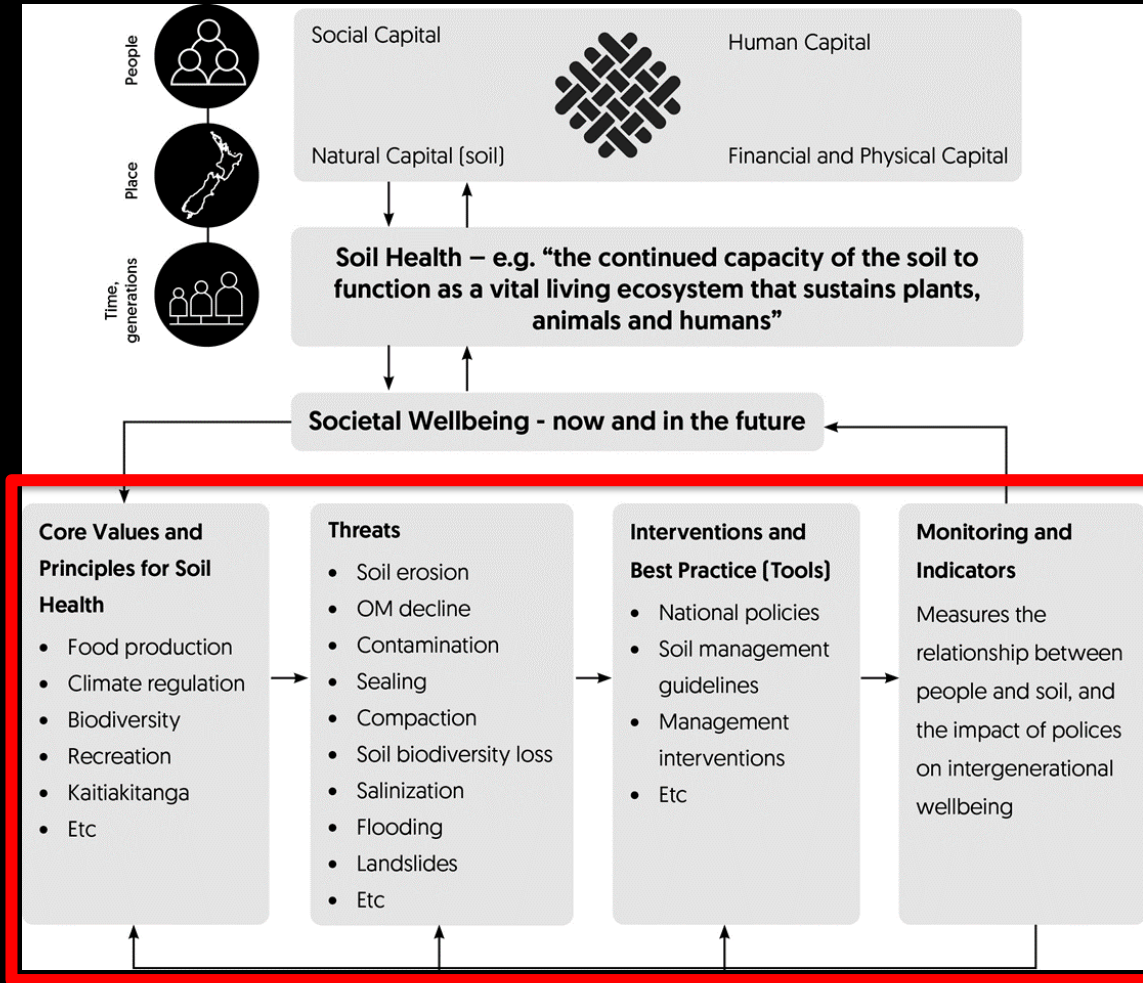
prompts us to consider how resilient the Four Capitals are in the face of change, shocks, and unexpected events













“Human and ecological ‘values’ have become powerful concepts in environmental management.”

Tadaki, M.; Sinner, J.; Chan, K.M.A. Making sense of environmental values: A typology of concepts. *Ecol. Soc.* 2017, 22, 1.



Soil health issues largely boil down to
“...societal negotiation in the face of
unavoidable trade-offs between various soil
uses...”

Bünemann, E.K.; Bongiorno, G.; Bai, Z.; Creamer, R.E.; De Deyn, G.; de Goede, R.; Fleskens, L.; Geissen, V.; Kuyper, T.W.; Mäder, P. Soil quality—A critical review. *Soil Biol. Biochem.* 2018, 120, 105–125.

Further information



Soil health and resilience: oneone ora,
tangata ora webpage

[https://www.landcareresearch.co.nz/
discover-our-research/land/soil-
and-ecosystem-health/soil-health-
and-resilience/](https://www.landcareresearch.co.nz/discover-our-research/land/soil-and-ecosystem-health/soil-health-and-resilience/)

