

Welcome to Landcare Research

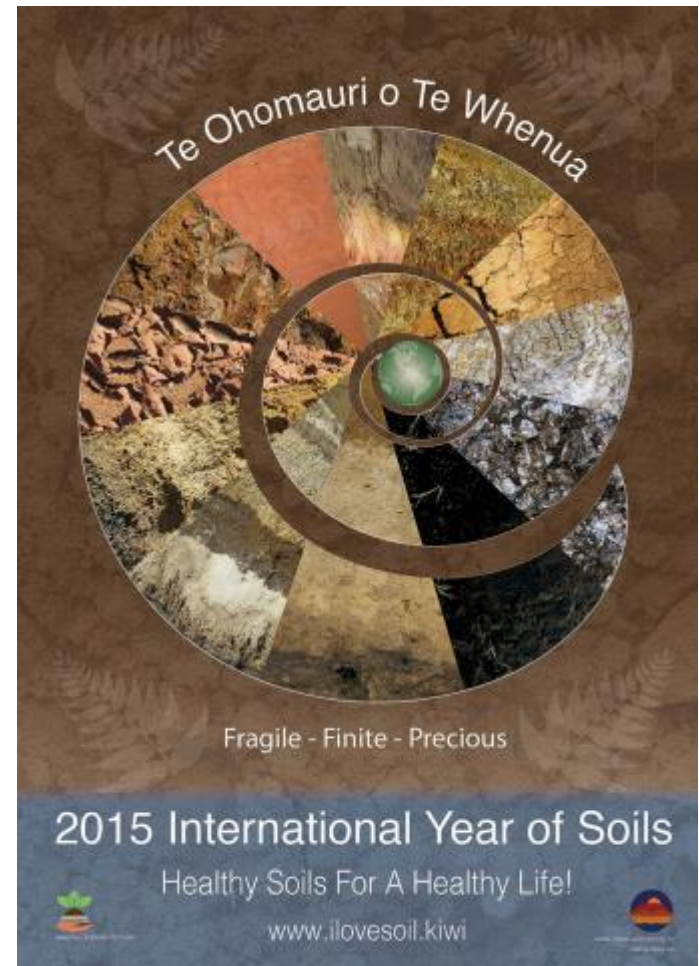


Landcare Research
Manaaki Whenua

2015 International Year of the Soil

Allan Hewitt
Landcare Research, Lincoln

LINK Seminar, Wellington
July 23, 2015



Int. Union Soil Sciences

- 6 messages for the people of planet Earth

Soils are:

- healthy basis for our **food production**
- basis for vegetation
cultivated for feed, fibre, fuel, medicines
- combat and help adapt to **climate change**
– role in carbon cycle
- host $\frac{1}{4}$ of Earth's **biodiversity**
- store and filter **water**
→ drought & flood resilience
- **a non-renewable resource,**
the basis of our food security, and future.



How good are NZ soils?
Are they really up to this expectation?

Some NZ IYS activities ...

Mystery Creek Field days
June

Contributions to International bodies

World Soil Charter
Global Soil Partnership,
Global Soil map
Pacific Soil Partnership
Intergovernmental Technical
Panel on Soils.

**Travelling
Norman Taylor
Lecture,**
Nov & Dec



Four sessions
soil on Radio NZ
Nights with Bryan
Crump

I love soils web site

Screening of the film “Symphony of the Soil”
at the Napier Museum, Theatre and Gallery

Launch of book, titled
“Celebrating Soil”

**Soil-themed
public seminar series**
Lincoln Uni. Sept. Oct.

Themed talk and soil pits
LandWISE Conference –
Farm of 2030,
May

... and many others

How good are NZ soils?



Join Capt. Cook & Joseph Banks on the Endeavour in 1769

They noticed the great tall trees:

The size of the plants ...especially the timber trees.. sufficiently evinced the richness of the soil”



Others agreed,

The soil is “fat and rich”

**“... a future granary
of the Southern Hemisphere”**

This assessment was based
on a European rule-of-thumb:

“big trees – fertile soil”

But
the rule-of-thumb started to crumble

**By 1860's, farmers noticed
yield decline in grain and root crops.
The early flush of nutrients could be exhausted.**

**The rule big-trees - fertile soil
did not seem to apply to NZ soils and flora
& has since identified as the “Biometric Fallacy”**

However:

**historian Tom Brooking (2011): “Despite this – we
still have this reverberating ideal of the fertility of the
land”**

**This question
“how good are our soils”?
is an important question**

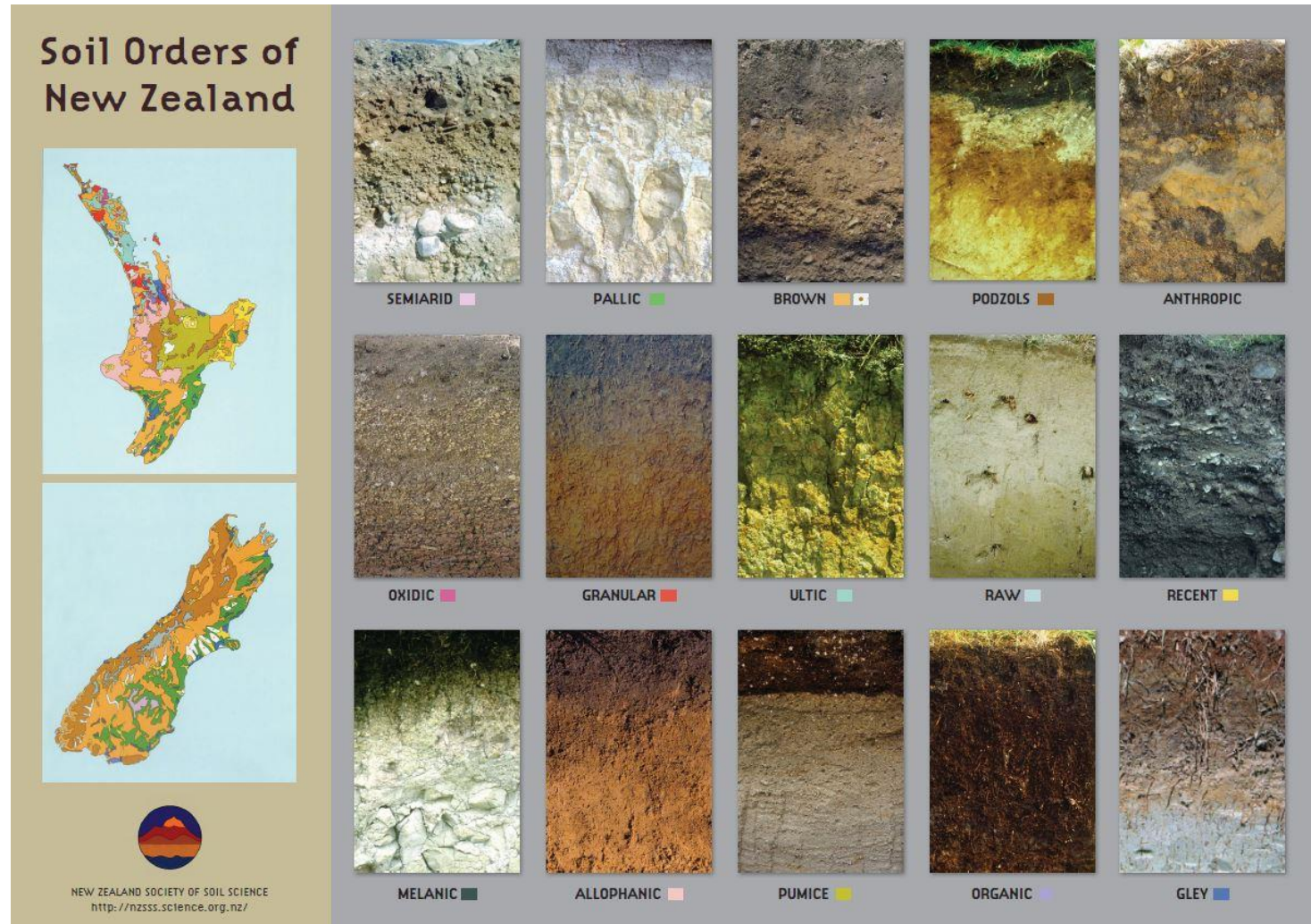
**If our soils are essentially highly fertile,
then have we not run them down?**

But

**If our soils are essentially poor
then our land managers must be
applauded for the high production achieved?**

What have we learned since 1769?

We've learned that we have a remarkable diversity of soils
- reflecting the diversity of ecosystems and geology



Classification: Order (15) > Group > Subgroup > Family(1348) > Sibling(4528)

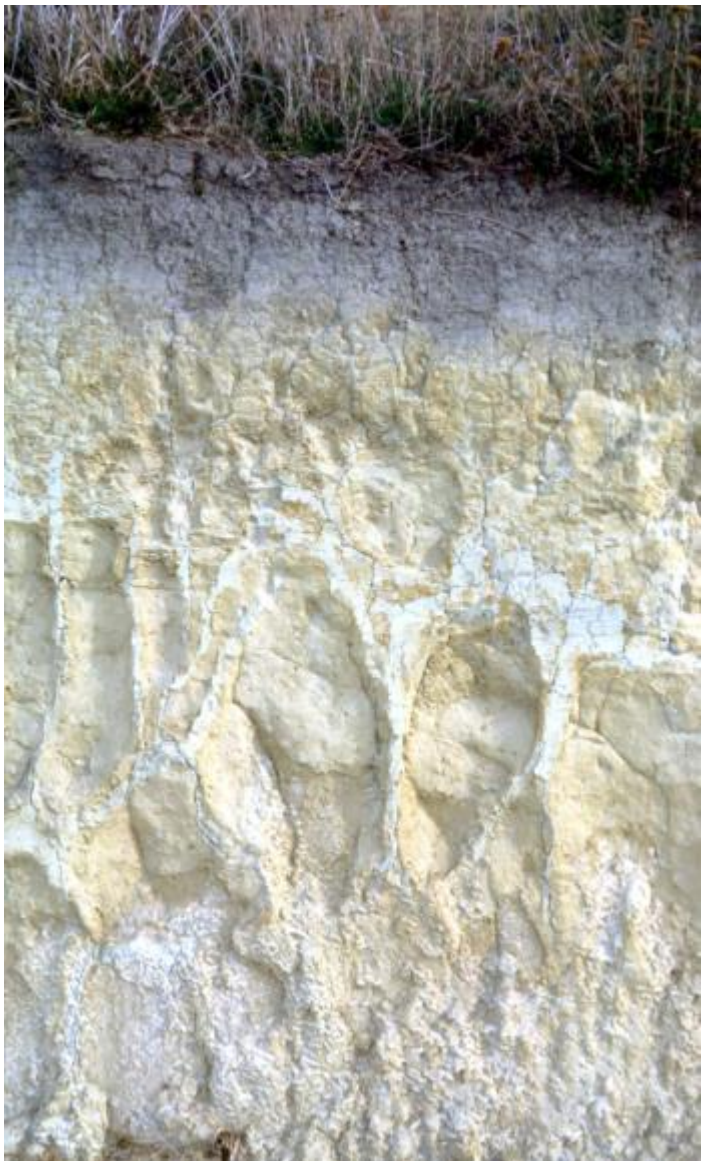


Brief survey

- Structure stab. **Low**
- Root depth **High**
- Topsoil carbon **High**
- P reserve **Low**
- Sum cations **Low**



Typic Orthic Podzol
Te Kopuru sandy loam



Brief survey

- Structure stab. **Low** 
- Root depth **Mod** 
- Topsoil carbon **Low -Mod** 
- P reserve **Mod** 
- Sum cations **Mod** 

Mottled Fragic Pallic Soil
Opua silt loam



Brief survey

- Structure stab. **High** 
- Root depth **High** 
- Topsoil carbon **High** 
- P reserve **High** 
- Sum cations **High** 

Has issues of
P fixation & challenging engineering properties

**Each soil has its
strengths and weaknesses**

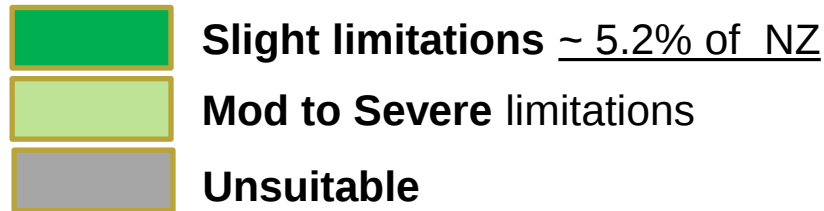
Typic Orthic Allophanic Soil
Ohaupo silt loam

**How can we systematically
evaluate our soils?**

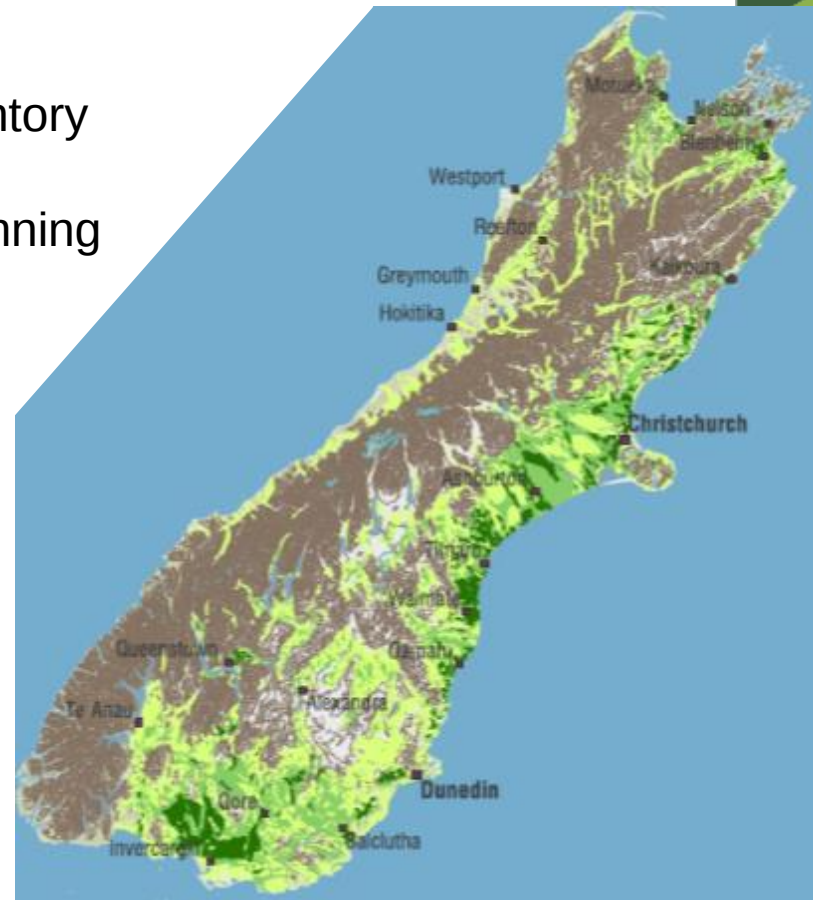
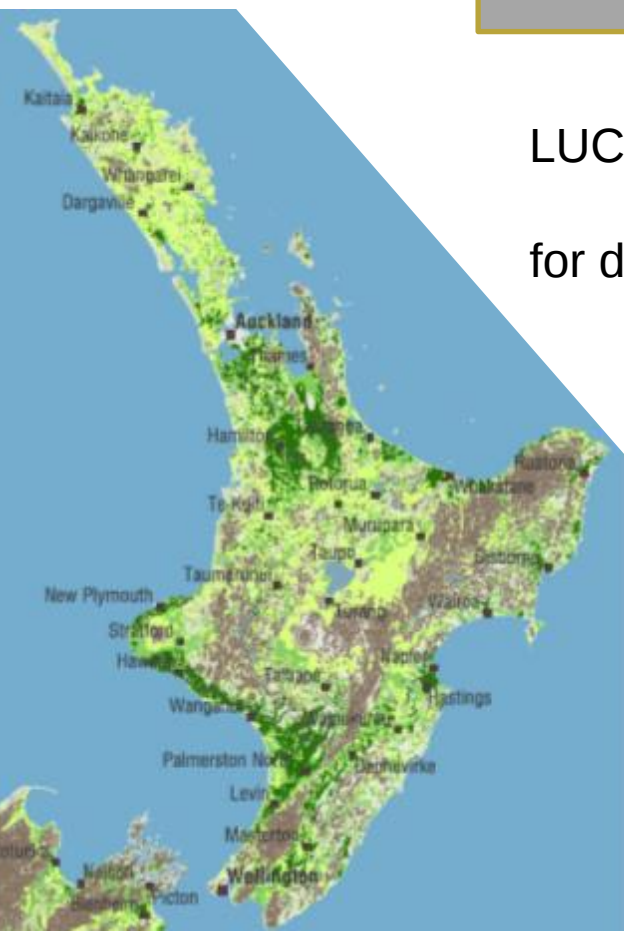


1. Land use capability

Land Use Capability – for Arable Cropping
Used by many Districts to delineate “High Class land”



LUC is based on land inventory
proved useful
for district and regional planning



2. High Class Soils

Purpose is to recognise highly versatile soils
with wide range of use options
based on inherent (or enduring)
soil profile properties



Immature Semiarid Soil
Molyneux stony sandy loam

High Class Soil criteria:

- | | | |
|-----------------------|----------|-------------------------------------|
| ▪ High root volume | - No | ☐ |
| ▪ Loamy (not stony) | - vStony | ☐ |
| ▪ Well aerated | - Yes | ☒ |
| ▪ Mod/high water cap. | - No | ☐ |

The Molyneux fails high class
but is valued for stone fruit production
= **specialist soil**

3. Soil Natural Capital

“Capital” - one of the inputs to a business
used to create something for sale at a profit

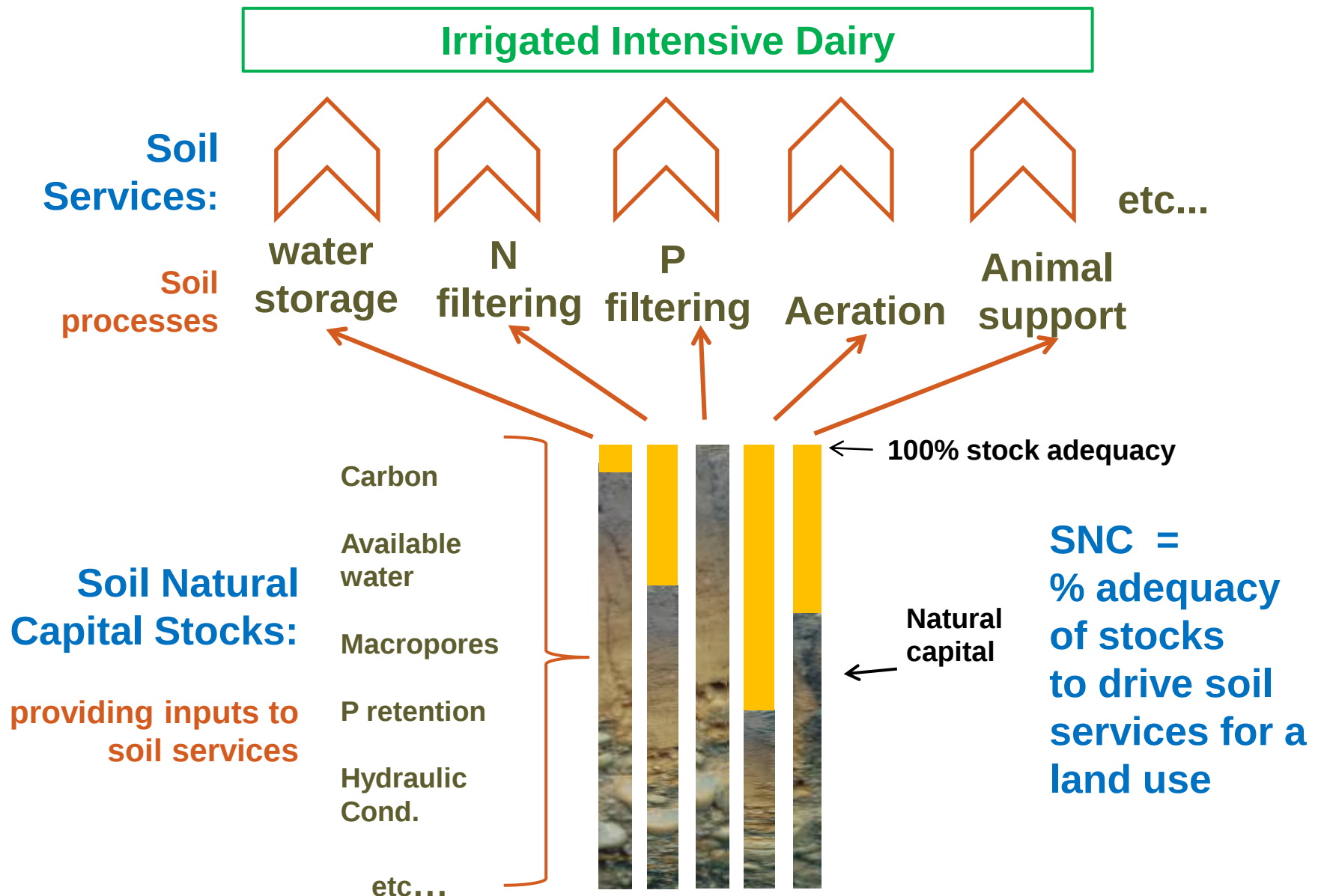
“Natural capital” is part of the worlds stock of natural resources
- that create goods and services

By **“soil natural capital”** we recognise that
soils are one of these natural capital stocks
that can be valued for the services they provide
e.g. filtering of contaminants, or nutrient supply to plants

**The goal is for soils to be factored into the economy
– and have its value recognised**

**Here we pursue the idea that goods soils
Provide many soil services**

3. Soil Natural Capital adequacy



3. Using SNC stock adequacy to evaluate our soils



PAW	220	206	148	76	46
Soils:	Flaxton	Waimakariri	Barrhill	Eyre	Rangitata



3. SNC stock adequacy – dairy

Ecosystem service

SNC stock adequacy%

Pasture quantity	98	94	76	48	20
N filtering	100	100	88	19	6
Denitrification	70	0	0	0	0
P filtering	42	16	16	7	3
Microbial filtering	30	90	50	50	30
Water storage	100	68	51	16	3
Average	73	61	47	23	10

= Summary of soil asset

Flaxton



Waimakariri



Barrhill



Eyre



Rangitata



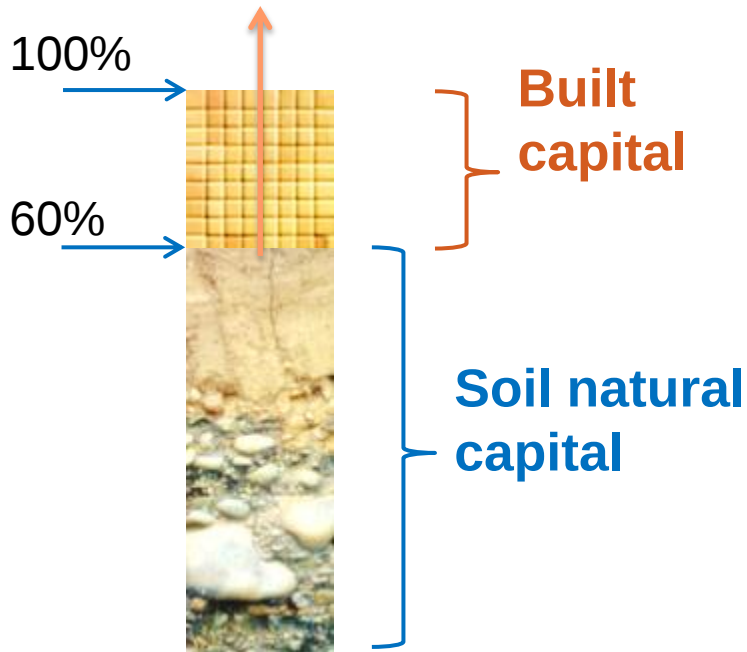
Three applications of SNC stock adequacy % - Proposed -

**Quantitative basis for understanding the
relationship: soil resource – land use**

1. Indicator of built capital

Irrigated dairying

water
storage

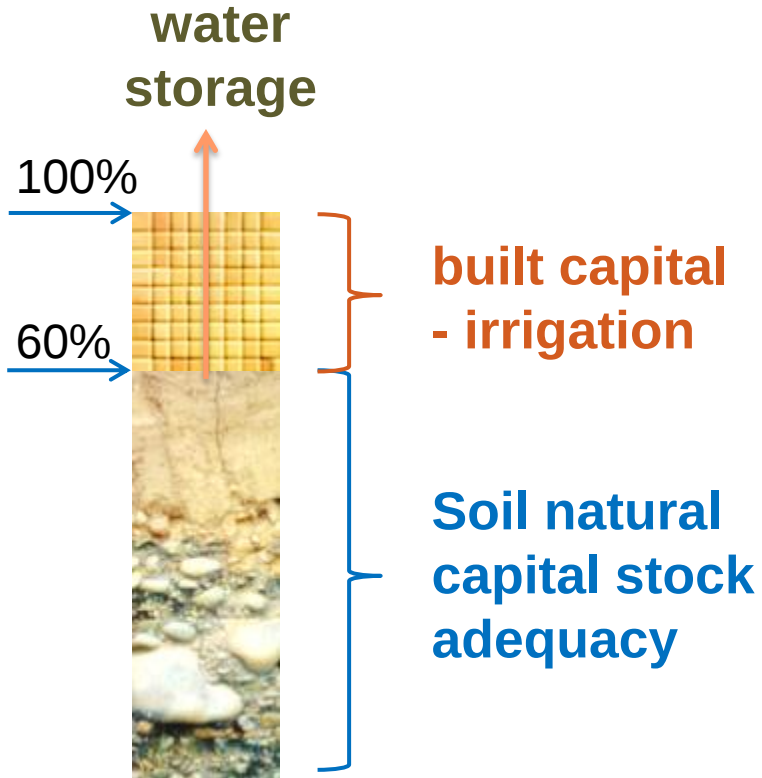


For best soil performance
we need 100% water storage

But the soil provides 60% optimum

The inadequacy must be substituted
by adding built capital
as additional irrigation costs

2. Soil use efficiency



Propose:

The stock adequacy as an indicator of
Soil use efficiency

As a measure of the goodness-of-fit
between
use need
& soil provision

3. Spatial optimisation

to configure the location of uses
to better match soil provision to land use need.

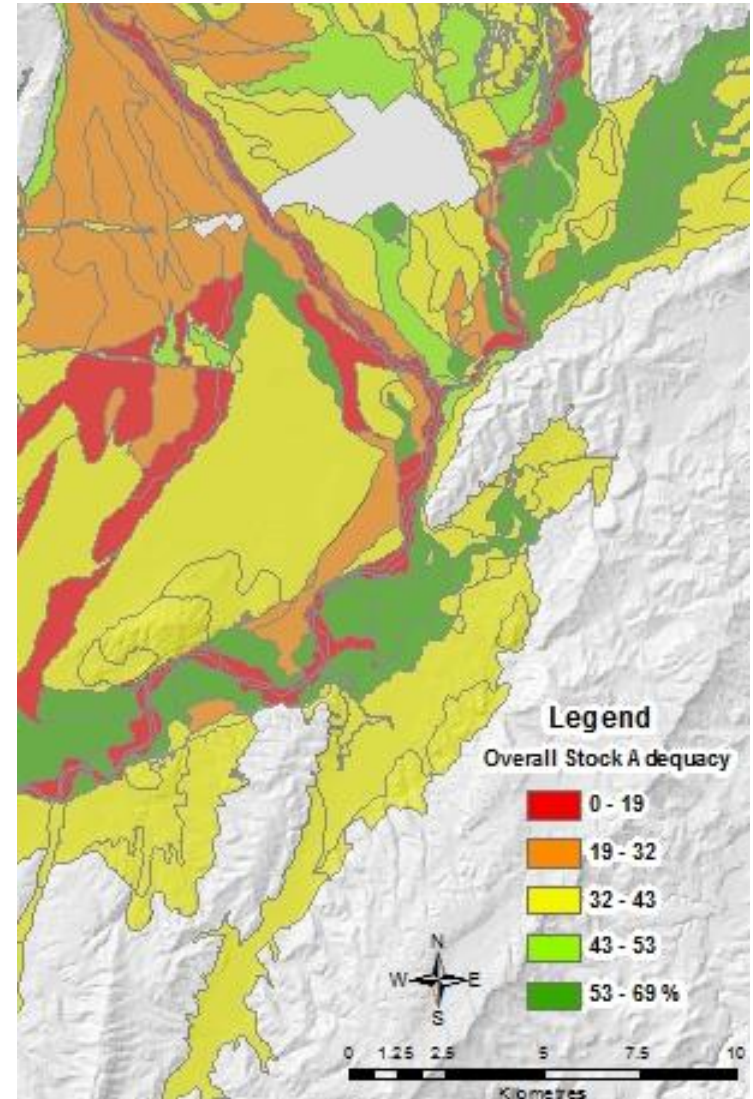
At regional scale

- Understand and plan to capture soil capital benefits.
- Encourage better soil/use fit over time

At farm level

- to provide deeper knowledge of farm potential and risks, to fine tune management

Perhaps a way for a region / farm to capitalise on its soil natural capital?



Finally an answer



So, does NZ have good soils?

1. Any soil can be good
when its stocks are well matched
to enterprise needs
2. We have versatile high class soils
but nationally small in area ~5.2%
3. We value specialist soils – for crops needing niche land
e.g. viticulture on the Gimlet Gravels
4. Even where they are not highly productive
They can be high performers in their services to the environment.

So, does NZ have good soils?

Our soils are not great.

But

If we factor in our production system -people, -technology and -infrastructure, then we can say:

with wise management our soils can deliver in the future

but with poor management we can squander our resource

Highly productive soils national and international relevance-1

We engage at a local level in debating soil use at urban boundaries. --- but it is also a national issue.

Yes, we can agree that soils are a crucial, non-renewable resource, for our future

we must be mindful that the highly productive ones
are very limited

A highly relevant factor is the strong competition
between land uses in NZ

This confers risks to our highly productive soils.

See: NZ Royal Soc. paper “Competition for land use in NZ” (2011)

Highly productive soils national and international relevance-2

1. How do we inform the players in this competition about how to capture the Soil Capital advantage?
2. To what degree can competition be resolved by multiuse planning, guided by matching enterprise need to soil capital?
3. And how do we ensure that highly productive soils not lost as an unintended-casualty?

Highly productive land national and international relevance - 3

In a wider context

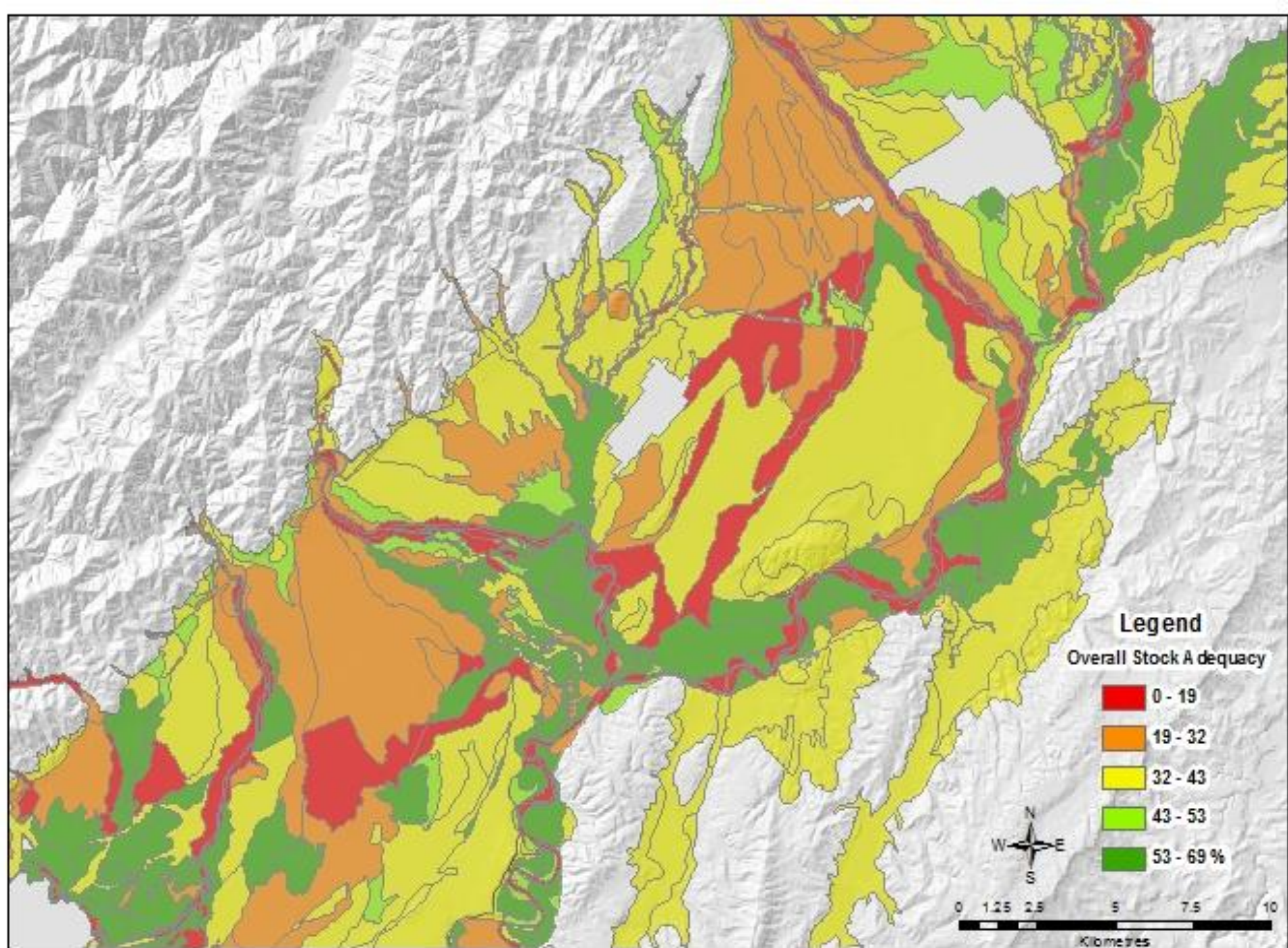
- we are faced with global problems:

Loss of agricultural land by; desertification, erosion, population pressure, etc... with consequent risks of diminished food supply

What are our national and international responsibilities?

**What might our strategy be
as a food producing nation in a hungry world?**

What is the real value of our natural capital globally?



What does “manage them wisely” mean?

- Taking every opportunity to capitalise on the soils natural capital at regional to farm scales
- Give as much emphasis to natural capital, as to mitigation
- Estimate the risks to the soil and environment by enterprise type and location
- Understand and manage the resistance and resilience of dynamic soil properties (soil health)

Etc...