

# Welcome to Landcare Research



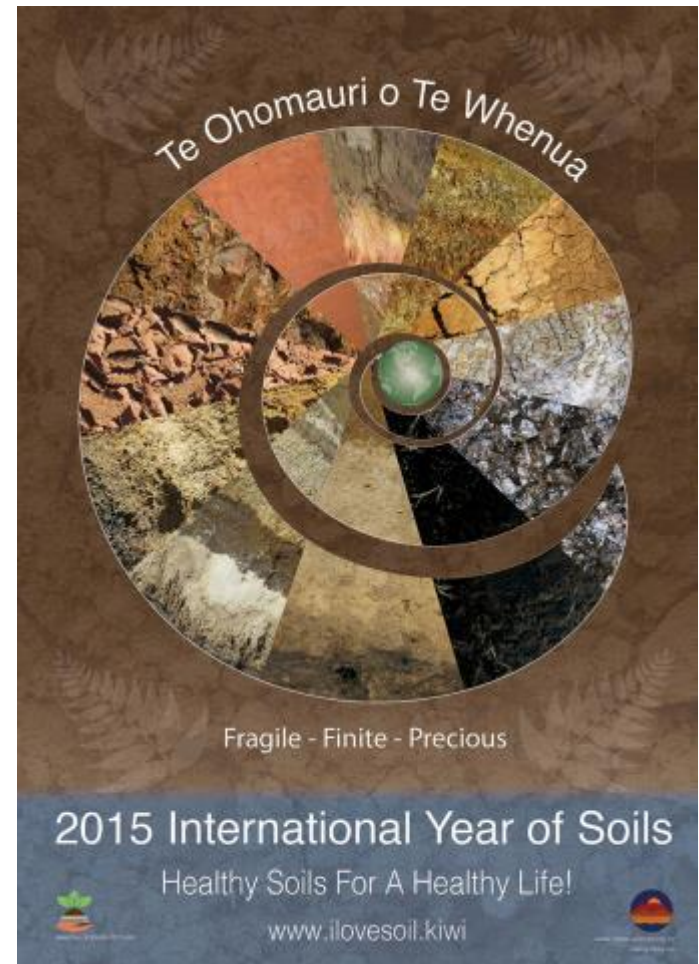
**Landcare Research**  
**Manaaki Whenua**



# 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 ¼ of Earths **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



**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?**

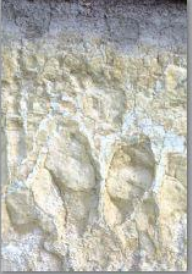


# We've learned that we have a remarkable diversity of soils - reflecting the diversity of ecosystems and geology


**Soil Orders of New Zealand**




SEMARIARID




PALLIC




BROWN




PODZOLS




ANTHROPIC




OXIDIC




GRANULAR




ULTIC




RAW




RECENT




MELANIC




ALLOPHANIC



PUMICE



ORGANIC








GLEY

NEW ZEALAND SOCIETY OF SOIL SCIENCE  
<http://nzsss.science.org.nz/>

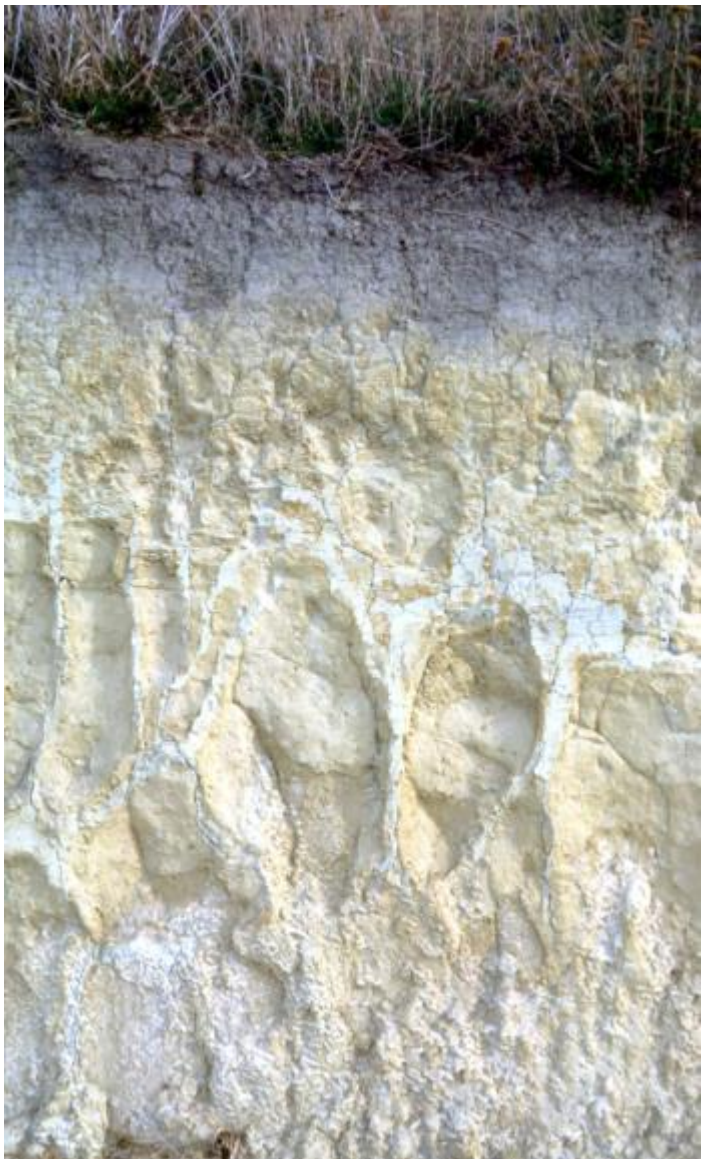
**Classification: Order (15) > Group > Subgroup > Family(1348) > Sibling(4528)**








## 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**

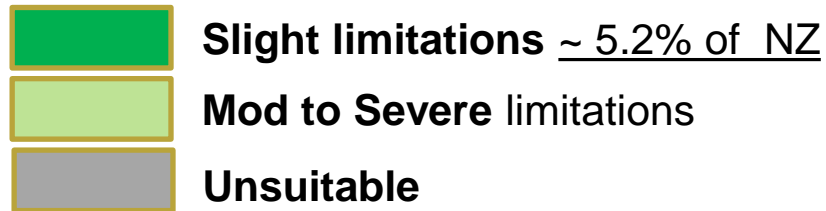
**Typic Orthic Allophanic Soil**  
Ohaupo silt loam

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

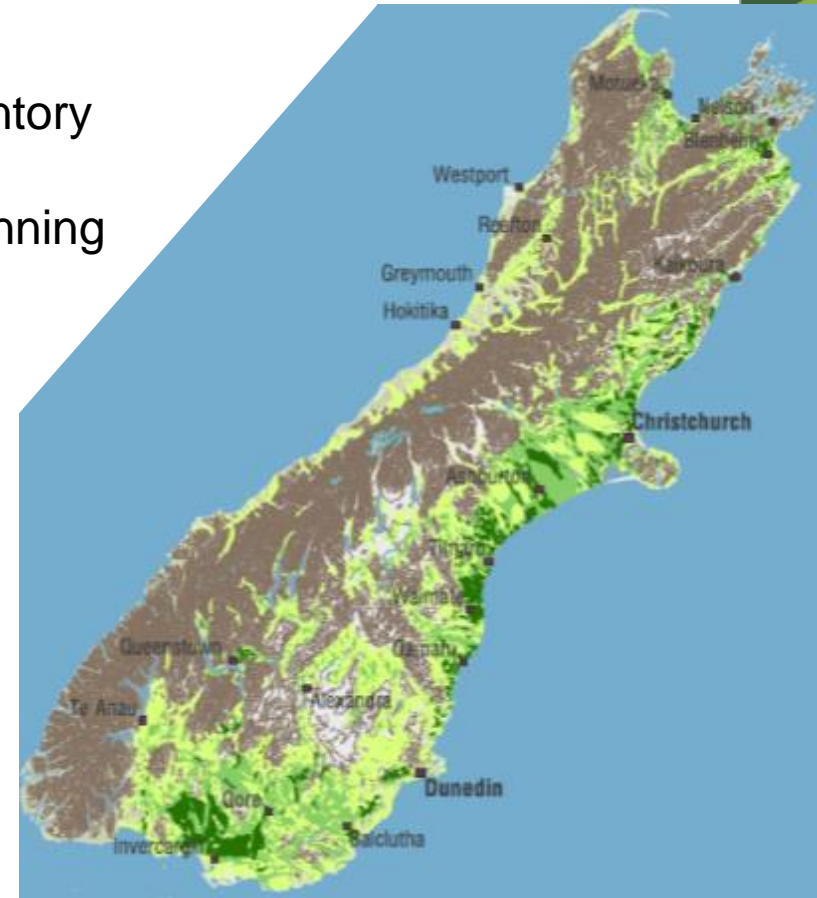
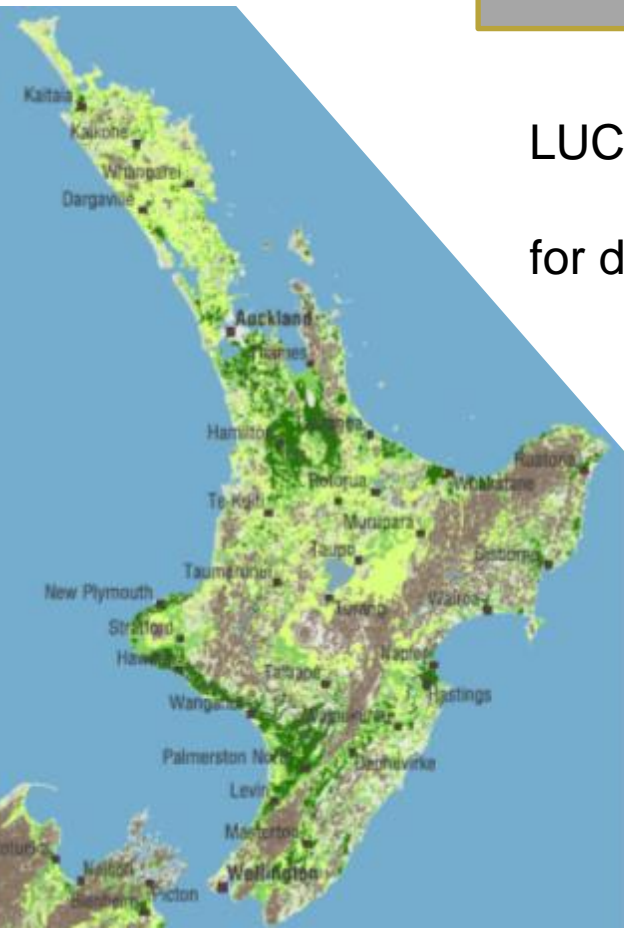


# 1. Land use capability

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

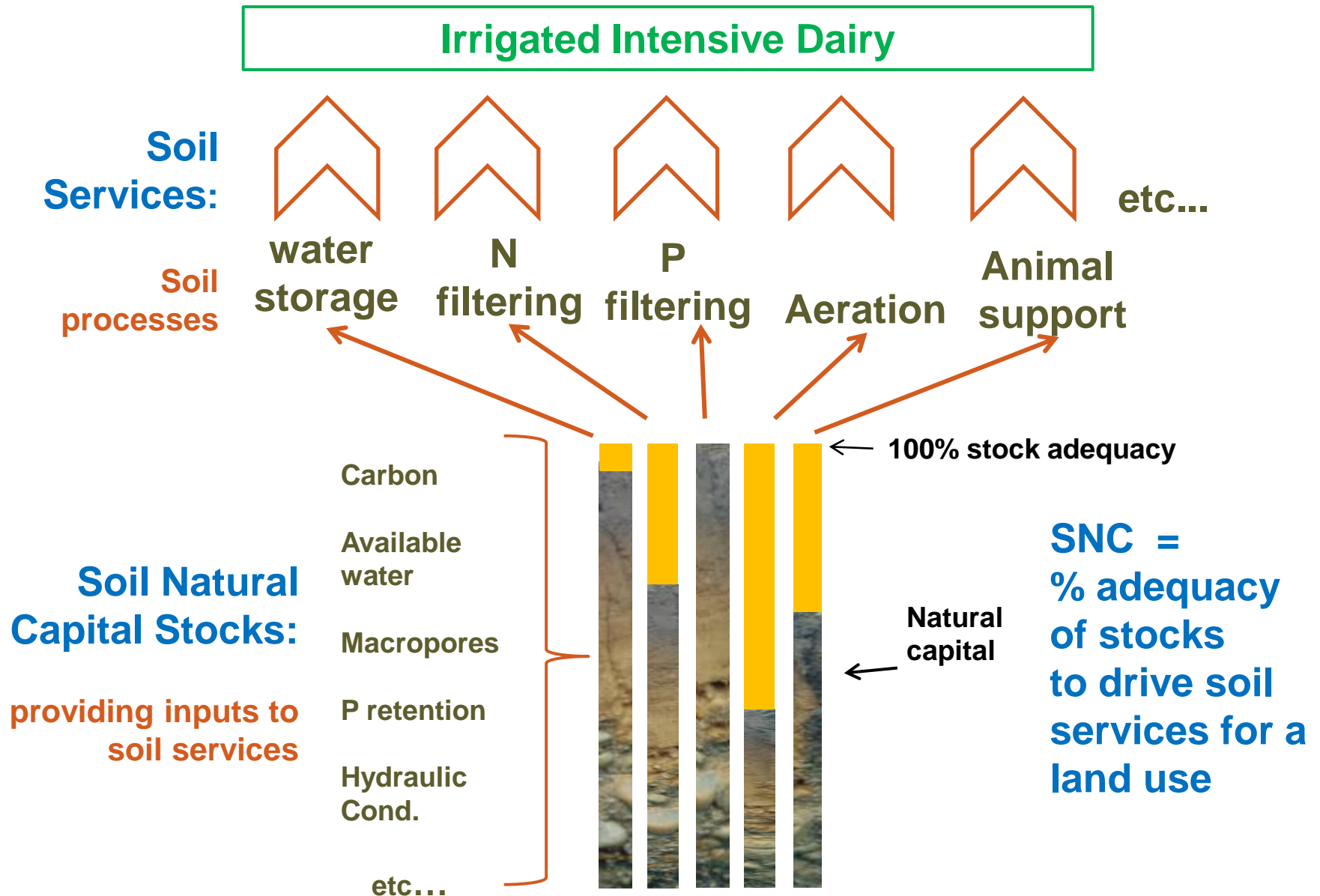
By **“soil natural capital”** we recognise that  
soils are one of these natural capital stocks  
that can be valued for the services they provide  
e.g. filtering of contaminants, or nutrient supply to plants

**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 |



Wet

Loamy

Gravel

# 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         |
| <b>Average</b>      | <b>73</b> | <b>61</b> | <b>47</b> | <b>23</b> | <b>10</b> |

= Summary of soil asset

Flaxton



Waimakariri



Barrhill



Eyre



Rangitata



**Three applications of SNC  
stock adequacy %  
- Proposed -**

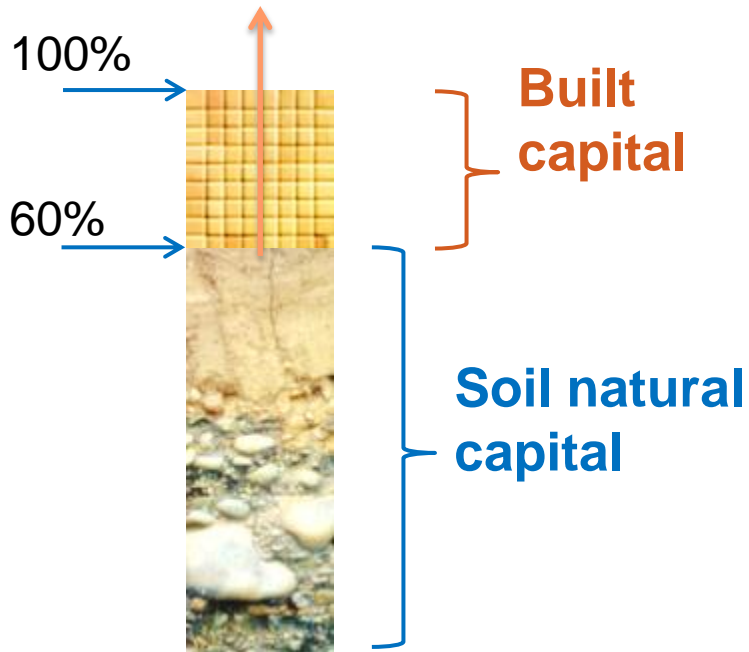
**Quantitative basis for understanding the  
relationship: soil resource – land use**



# 1. Indicator of built capital

## Irrigated dairying

water  
storage

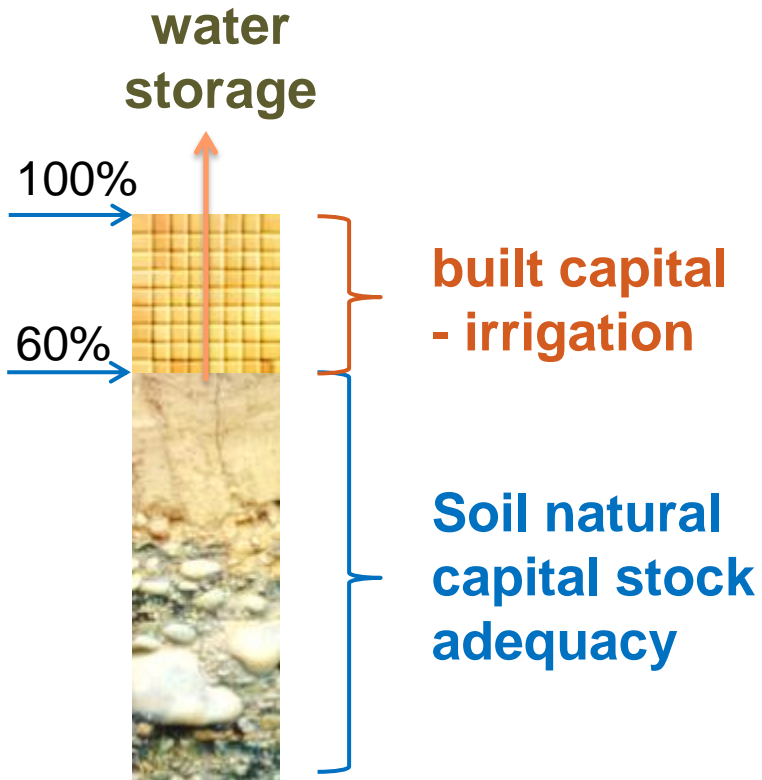


For best soil performance  
we need 100% water storage

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.

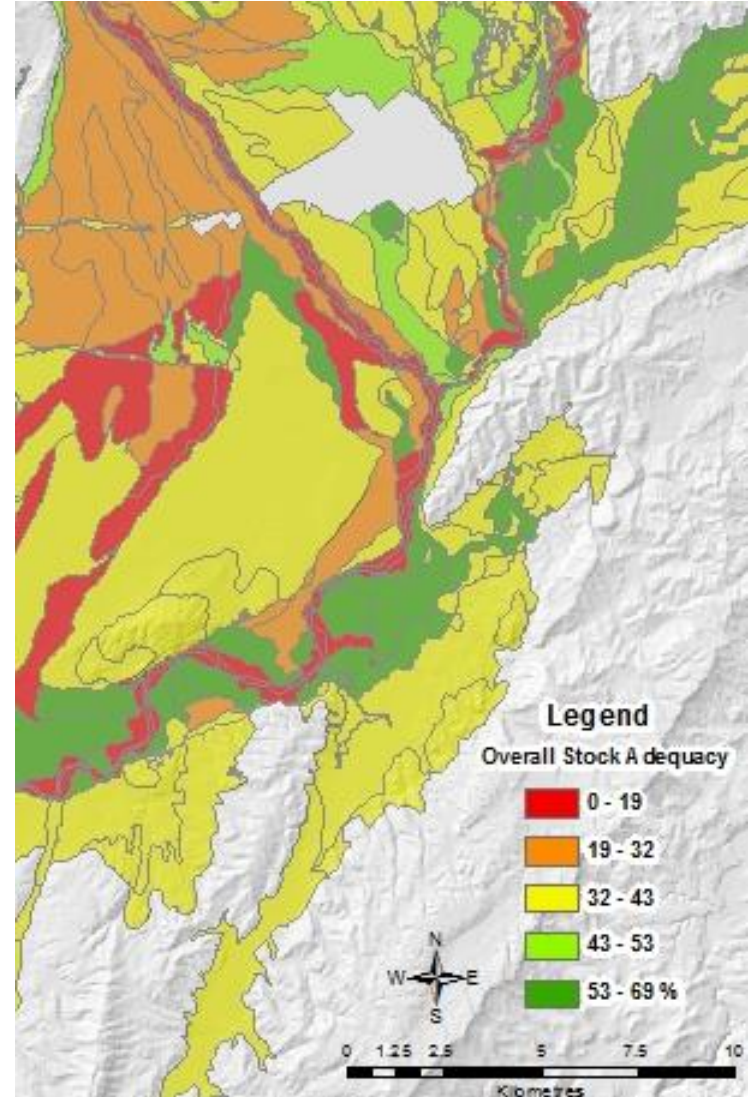
## At regional scale

- 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:

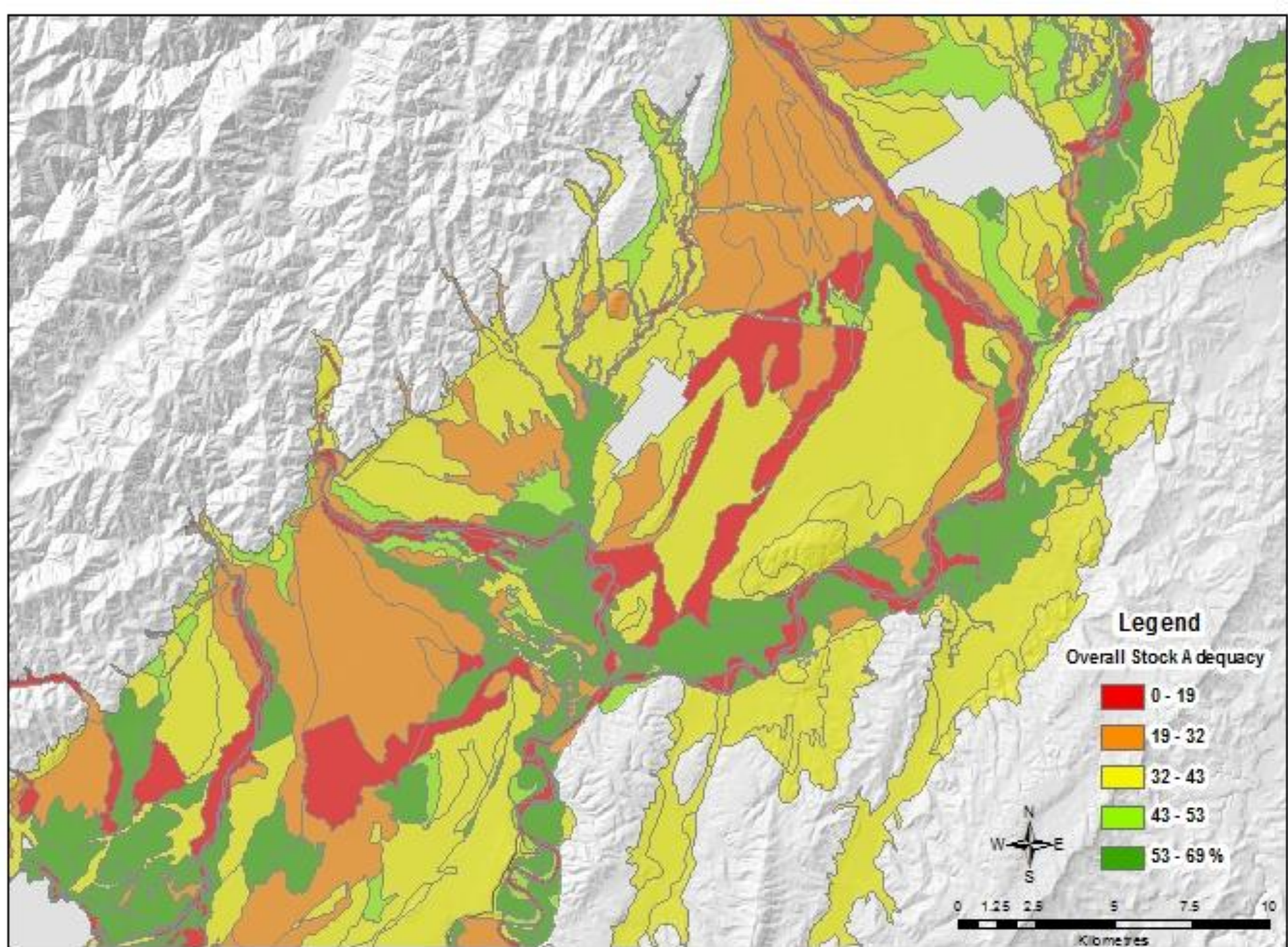
Loss of agricultural land by; desertification, erosion, population pressure, etc... with consequent risks of diminished food supply

**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...