Change and adaptation

New Zealand Farm Forestry Association Annual Conference – Trees in a political landscape

26th March 2021

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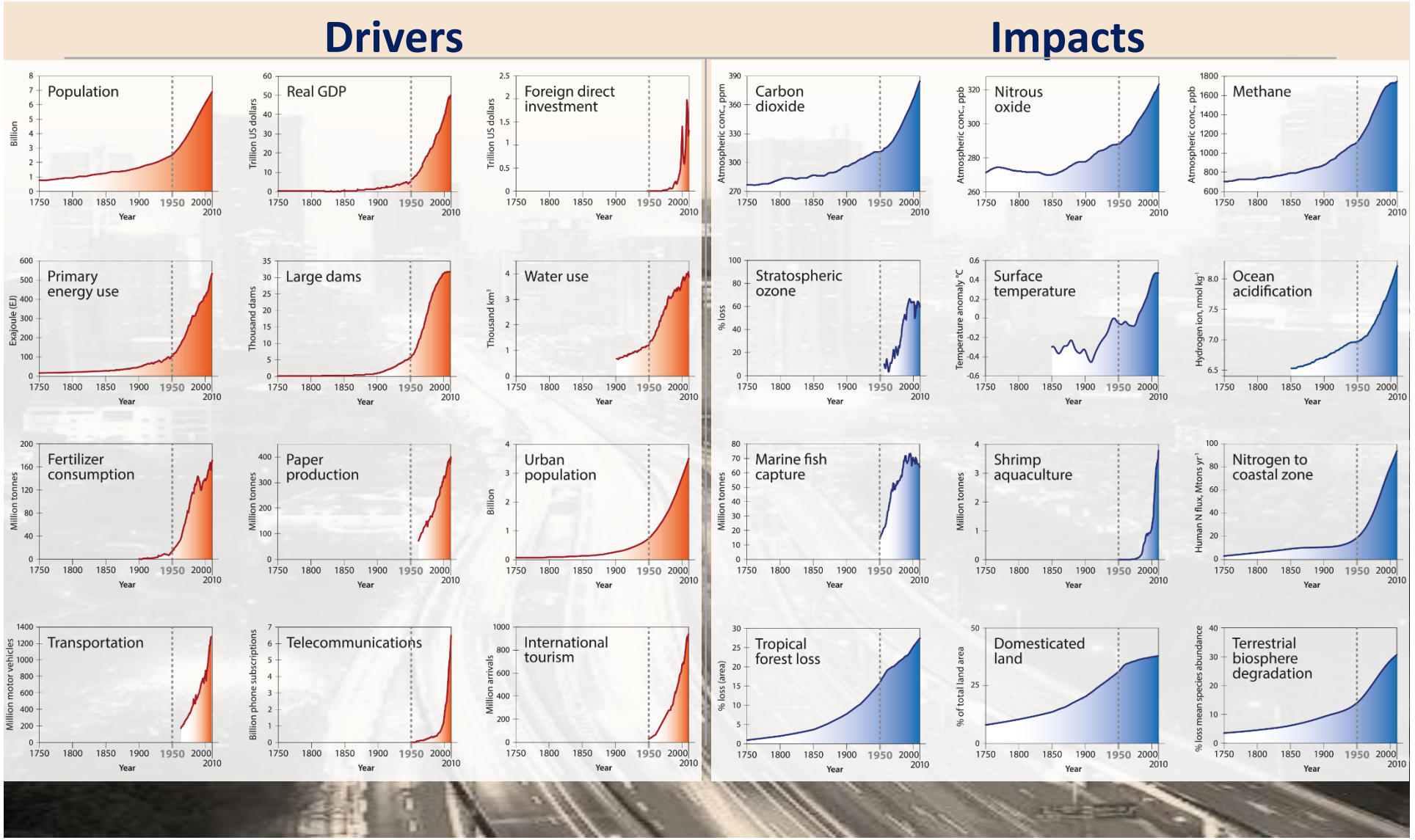
Outline

- Global Environment
- National Environment
  - Political landscape
  - Change and forests
- Adaptation approaches
  - Data driven and human approaches
  - Building resilience
  - Reimagining landscapes
- Challenges and enablers

GLOBAL ENVIRONMENT

The Great Acceleration – the Anthropocene epoch



Steffen, Broadgate, Deutsch, Gaffney, Ludwig (January 2015) Anthropocene Review

Forests planted in the next 50 years will be exposed to more climate change than many of the Earth's forests have experienced for thousands of generations during which time the world is projected to reach mean air temperatures not seen for 16 million years.

- IPCC. (2014). Climate Change 2014 Synthesis Report - Summary for Policymakers. https://www.ipcc.ch/site/assets/uploads/2018/02/AR5_SYR_FINAL_SPM.pdf
- Tripati, A.K., Roberts, C.D., & Eagle, R.A. (2009). Coupling of CO2 and ice sheet stability over major climate transitions of the last 20 million years. *Science* 326*(5958)*, pp. 1394-1397.
- Westerhold, T., Marwan, N., Drury, A.J., Liebrand, D., Agnini, C., Anagnostou, E., Barnet, J.S.K., Bohaty, S.M., De Vleeschouwer, D., & Florindo, F. (2020). 66 Million Years of Earth's Climate History Uncovered – Puts Current Changes in Context https://scitechdaily.com/66-million-yearsof-earths-climate-history-uncovered-puts-current-changes-in-context/#google_vignette.
- Westerhold, T., Marwan, N., Drury, A.J., Liebrand, D., Agnini, C., Anagnostou, E., Barnet, J.S.K.,Bohaty, S.M., De Vleeschouwer, D., & Florindo, F. (2020). An astronomically dated record of Earth's climate and its predictability over the last 66 million years. *Science* 369*(6509)*, pp. 1383-1387.

NATIONAL ENVIRONMENT

The New Zealand Political Landscape

- Environmental pollution
- Greenhouse Gas Emissions
- Urbanisation
- Export market fluctuations
- Covid-19 impacts
- Labour shortages
- Immigration
- Housing shortages
- Interest groups

- Treaty of Waitangi Settlements
- RMA reform
- NPS - Freshwater management
- NES - Plantation Forestry
- NPS - Indigenous biodiversity
- Zero Carbon Act
- Emissions trading scheme
- New Zealand Carbon budgets
- Farm Environment plans
- Trade Agreements

Climate change will affect planted forests in New Zealand

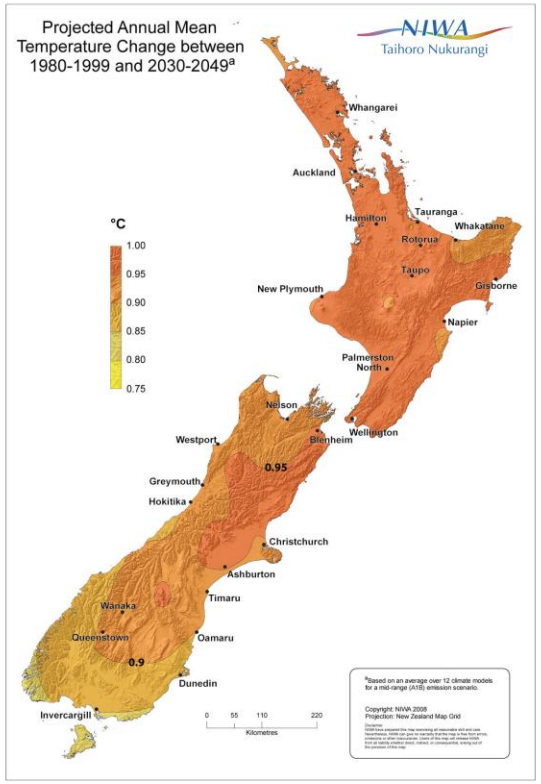
SCION
FORESTS ▪ PRODUCTS ▪ INNOVATION

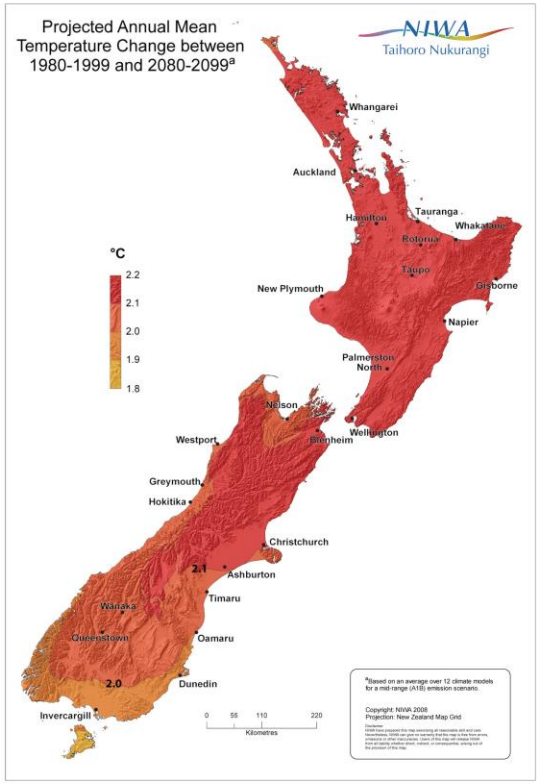
Projections of how climate will change:

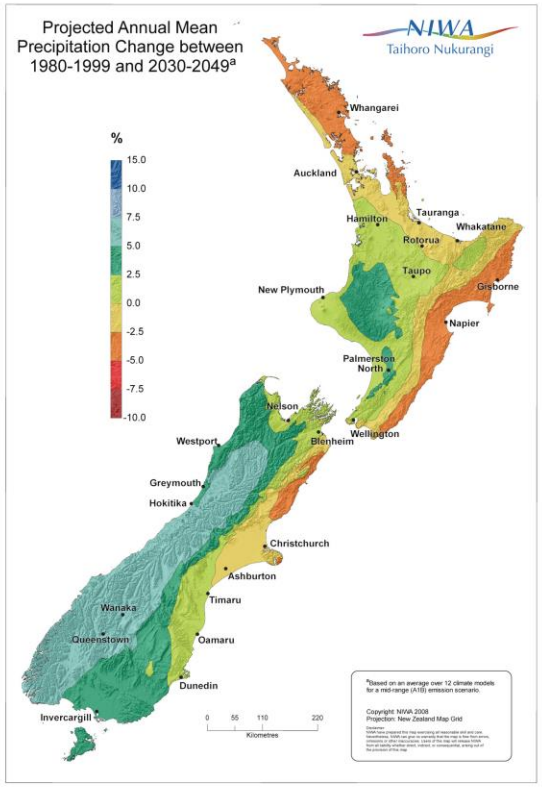
Over the next two or three forestry rotations, NIWA projects the following likely trends in New Zealand's future climate:
• Warmer by about 2.0°C* • Wetter in the west and drier in the east • More extreme weather events.

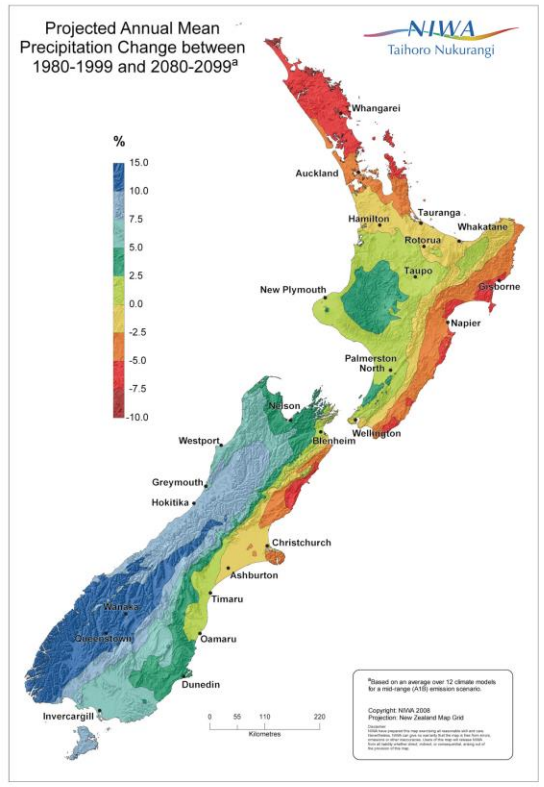
Some of these changes will create opportunities.

Others will require higher levels of risk management.



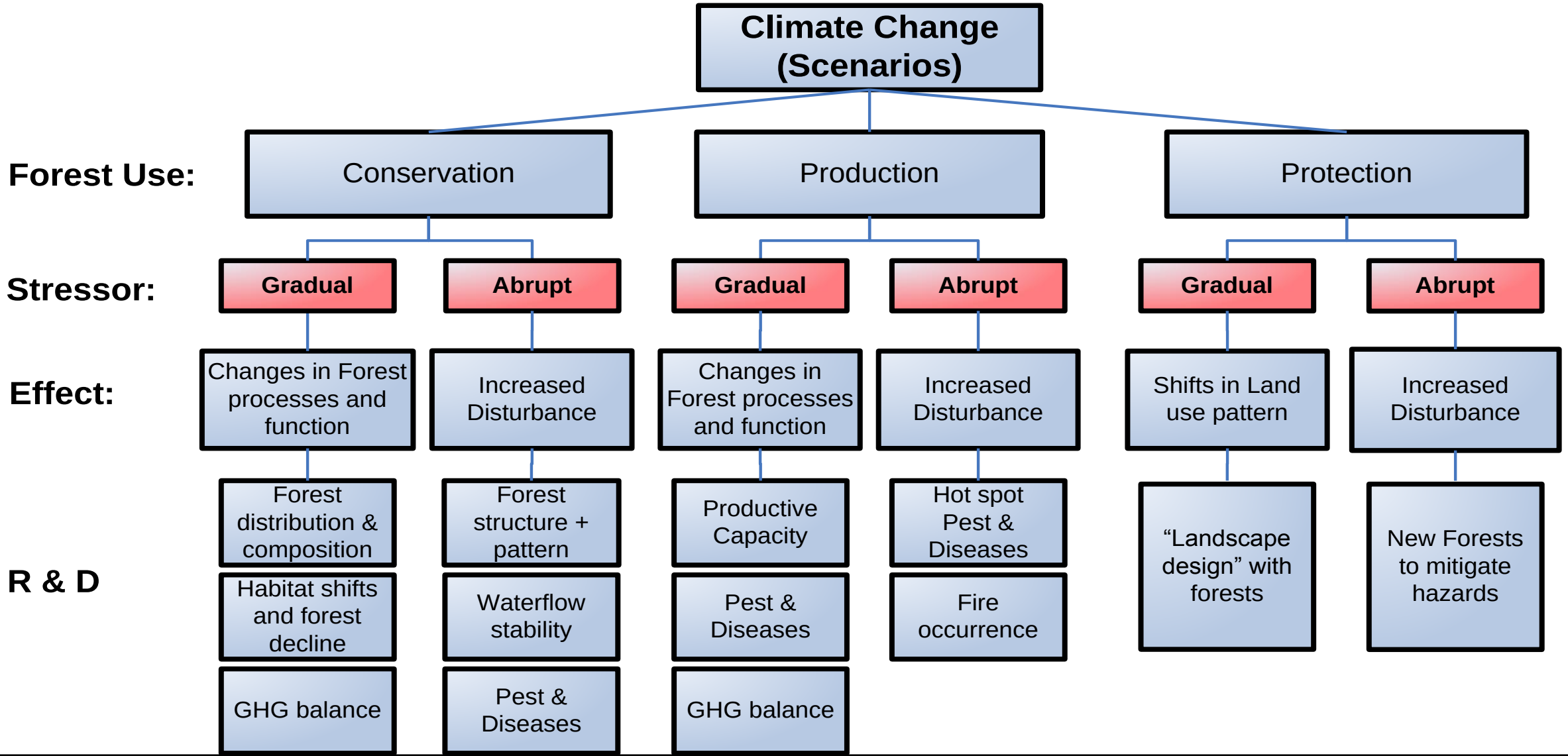






* Mid-range projection

Effects of Climate Change on NZ's forests



Extreme weather events – higher variability and uncertainty

The effects of extreme weather events are already being felt. Intense storms are difficult to predict and their impact on forests can be huge.

More high intensity rain

Photo supplied by BOP Regional Council

Higher temperatures mean more rain and severe storms

For forest growers, heavier rain means:

- ! *Higher risk of erosion and downstream impacts from sediment and debris flows.*

Higher winds

Winds may increase by up to 10%

For forest growers, higher winds mean:

- ! *More risk of toppling and breakage.*

Warmer temperatures, less frost

Fewer frost days in lower North and South Island

For forest growers, higher temperatues will mean:

- ✓ *Higher growth rates. Reduced risk of crop damage or loss from frost damage.*

Increased drought

Severe droughts (1 in 20 years) may double or quadruple

For forest growers, more droughts will mean:

- ✓ *Less fungal diseases.*
- ! *Slower growth rates. Increased fire danger.*

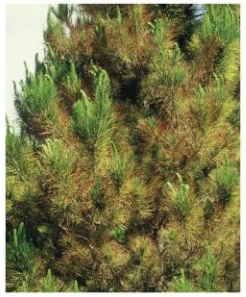
Impacts on forestry

Forest productivity

- ✓ *More rainfall and higher temperatures mean higher growth rates.*
- ✓ *Elevated CO_2 typically makes trees grow faster.*
- ! *Wood density decreases with temperature change.*
- ! *Increased risk of diseases, pests, weeds, wind and fire.*

Forest productivity is expected to increase

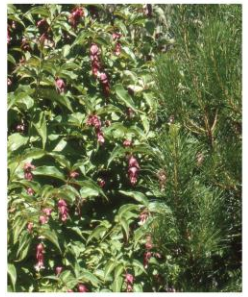
Pests and diseases



- ✓ *Less fungal disease in dry areas.*
- ! *Increased risk of new species from warm-temperate or subtropical regions.*
- ! *Warmer temperatures mean more insects (due to better survival over winter).*
- ! *Increased risk of Swiss needle cast in Douglas-fir.*

Species composition may change in response to pest and disease trends

Weeds



- ! *Weeds adapt to change more quickly than trees. Faster growing trees mean even faster growing weeds.*
- ! *Increased weed competition for water in dry regions.*
- ! *Species composition and distribution will change. Risks of new weeds will increase.*

Growth rates of weeds are expected to increase in most regions

Fire

- ! *Higher temperatures and more wind mean a longer fire season and bigger fires.*
- ! *Highly stocked stands have higher risk profile and insurance rates.*

Fire risk is likely to increase in many regions

Summary

✓ *Tree growth responds directly to changes in temperature, water availability and CO_2 concentration. In many regions, this could mean higher productivity and opportunities to establish faster-growing forests.*

✓ *Climate change issues are driving policy to offset CO_2 emissions.*
- *Carbon forestry offers increased revenue streams for growers*
- *Demand for sustainable wood products is expected to increase*

✓ *Climate change has highlighted the potential for using forests to protect soil and decrease risks of flooding.*

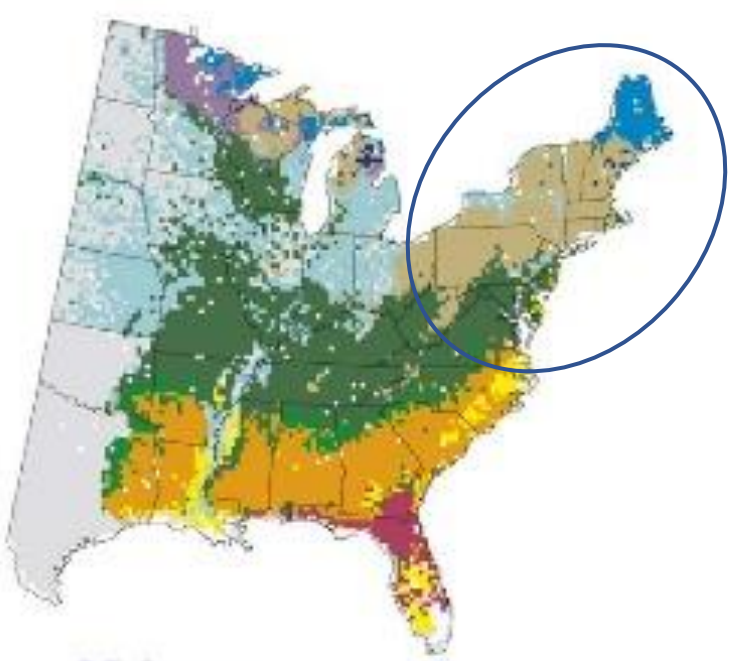
! *The impact of pests and diseases, weeds, fire, intense rainfall and high wind cause significant economic losses in planted forests. These risks are expected to increase with climate change.*

ADAPTATION APPROACHES

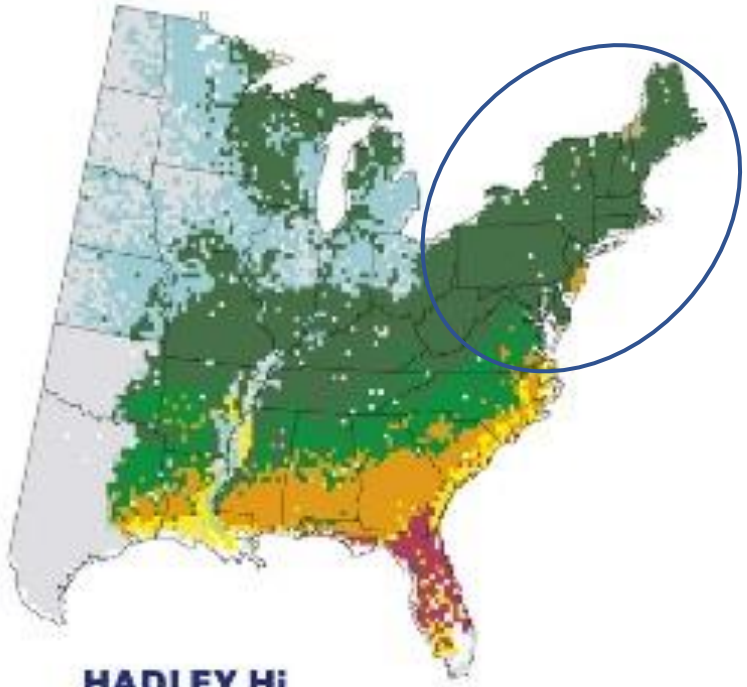
Species Range Shifts

Tree Atlas

Climate induced changes in biophysical conditions will likely lead to shifts in species range distributions



RF-Current



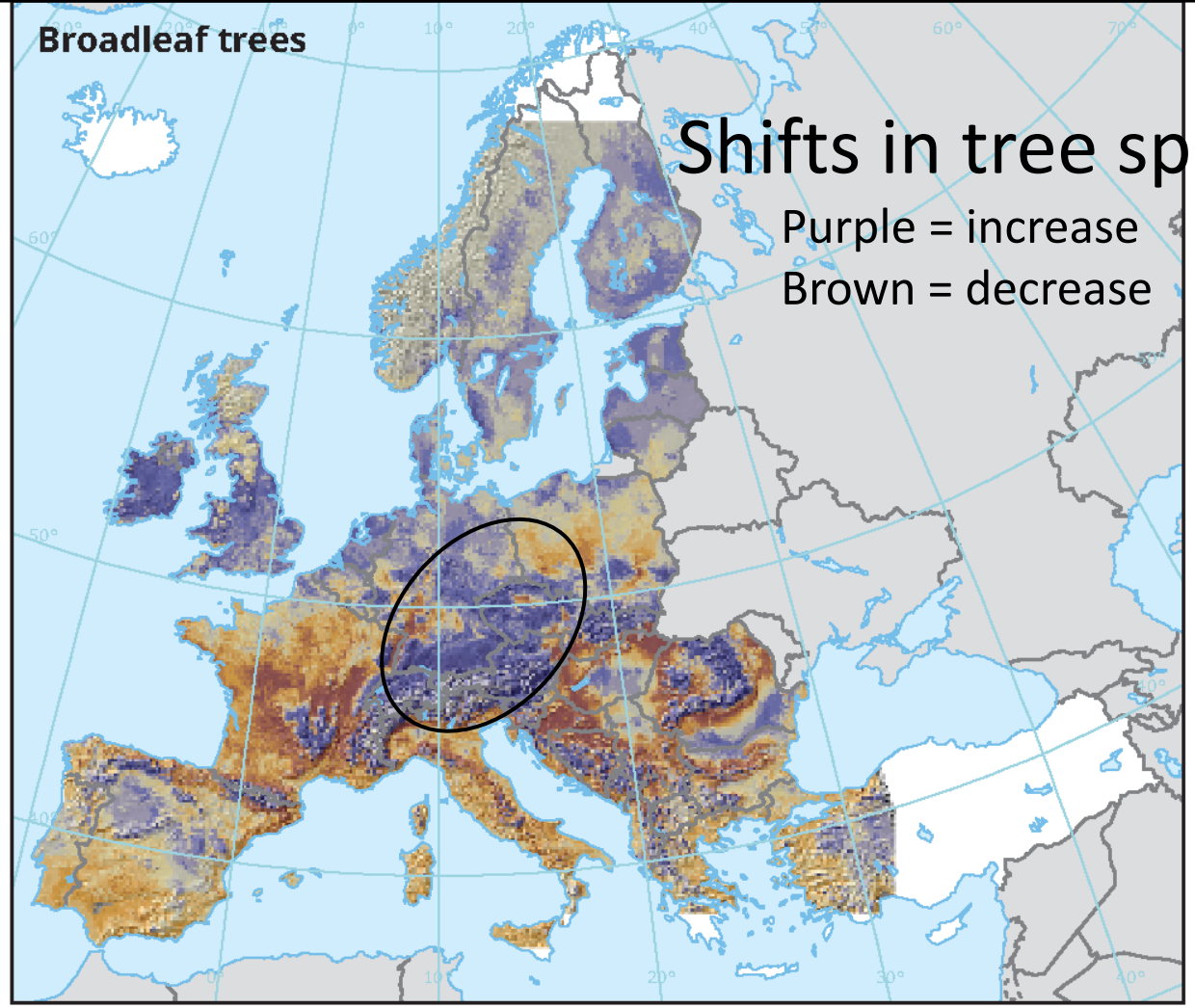
HADLEY Hi

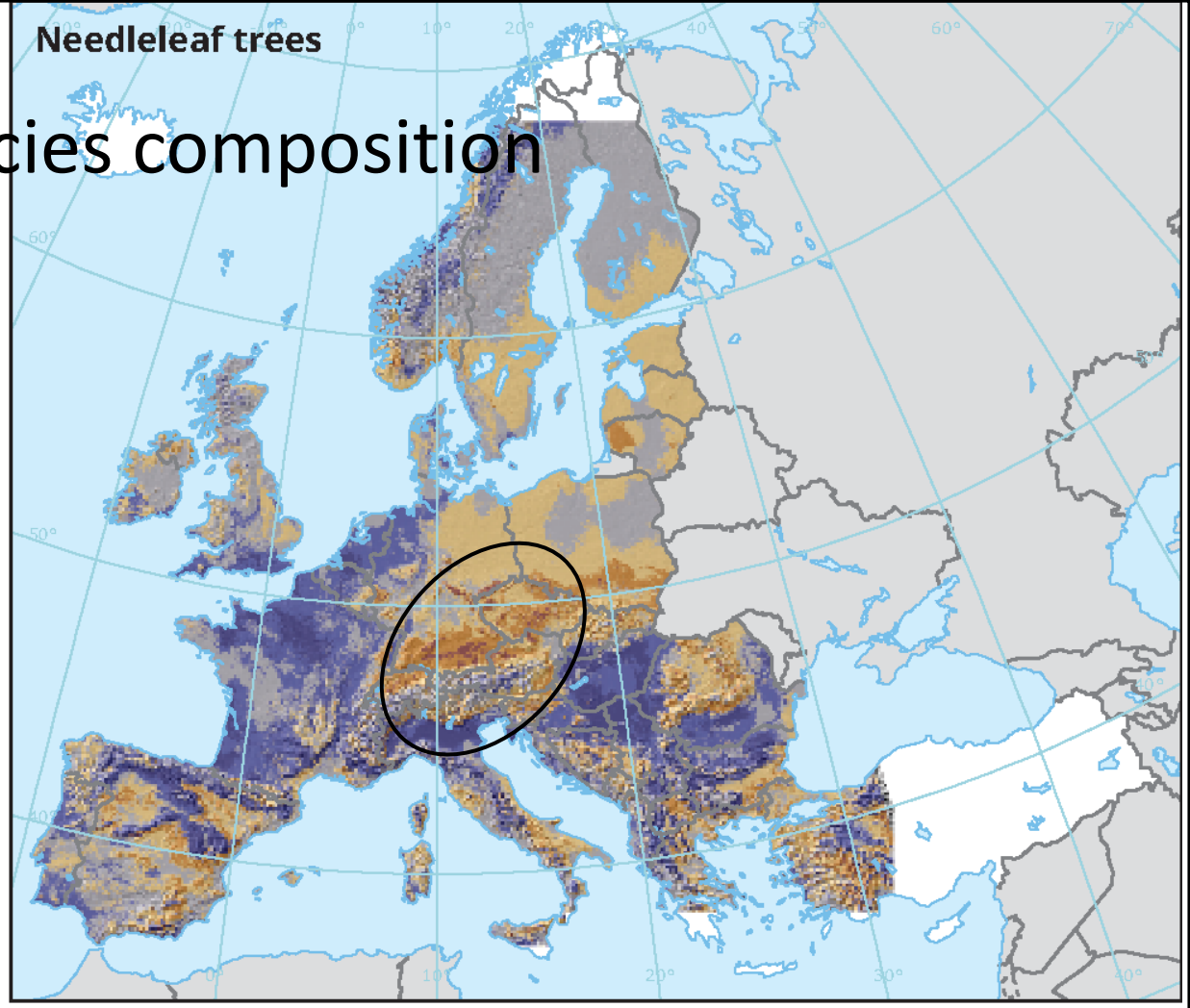
Iverson et al

Shifts in tree species composition

Purple = increase

Brown = decrease





Projected changes in broadleaf (left) and needleleaf (right) tree composition from species habitat suitability changes

High: 13

Low: – 13

No data

Outside coverage

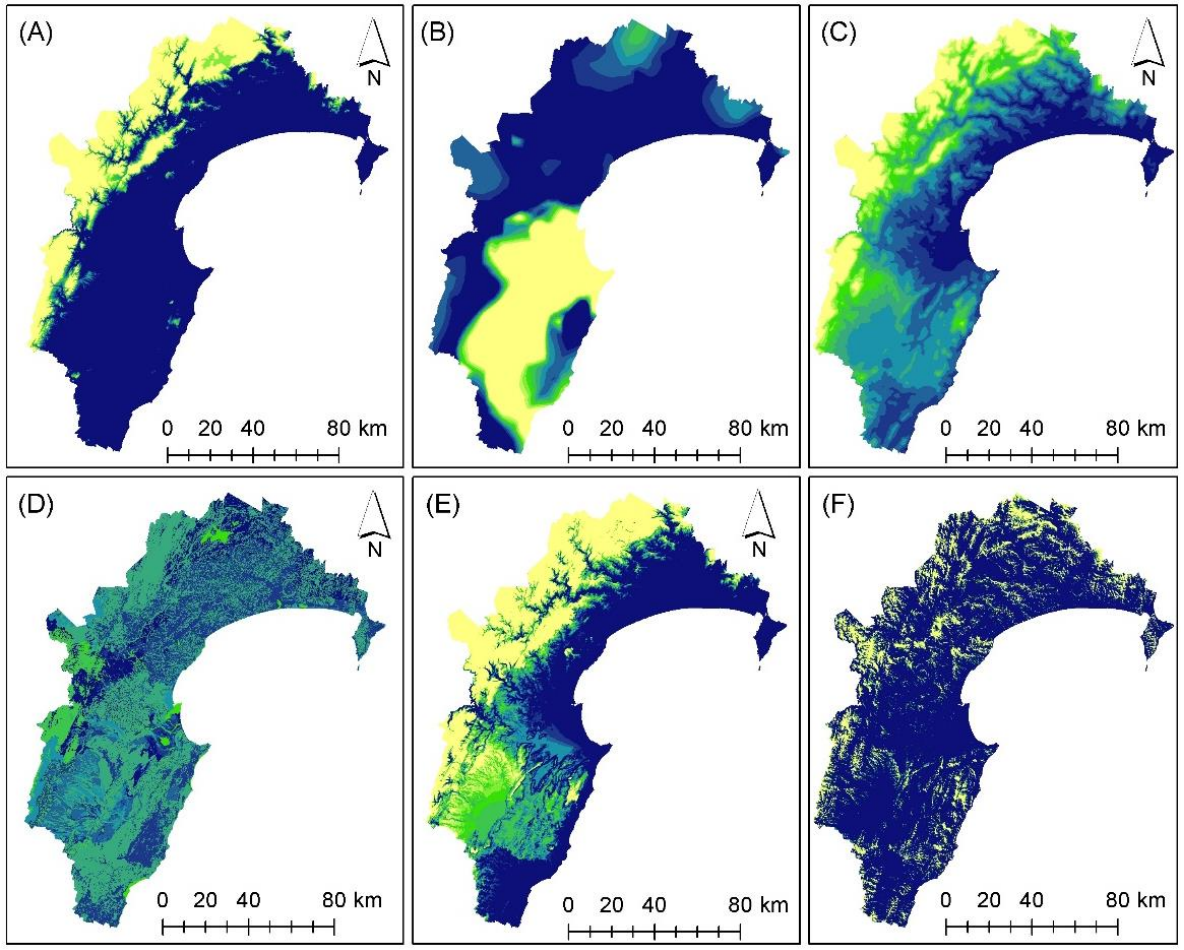
0 500 1 000 1 500 km

High: 4

Low: – 5

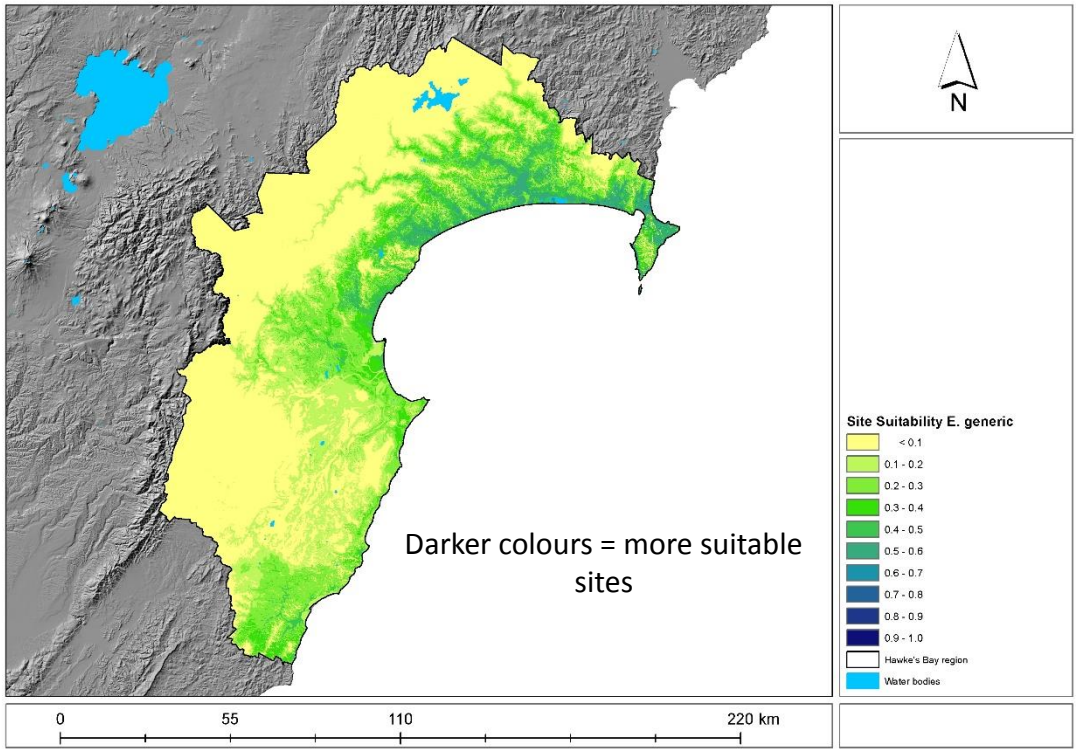
Tree Species Site Suitability – Hawkes Bay: Eucalyptus

Elevation (m) | Rainfall (mm) | Temperature (^{0}C)



Plant Available Water (mm) | Frost (days) | Wind exposure (unitless)

Eucalyptus generic scenario



Adaptation: Climate Smart Villages – learning from future climates

RESEARCH PROGRAM ON Climate Change, Agriculture and Food Security

CGIAR

CCAFS

WHAT DO WE WANT OUR FUTURE TO BE?

RESILIENT

Resilience is

- Bahrami, F. & Hemmati, M. (2020). Landscape resilience, an examination and evaluation of existing definitions in the field of landscape resilience, a brief review of literature. MANZAR
- Summer
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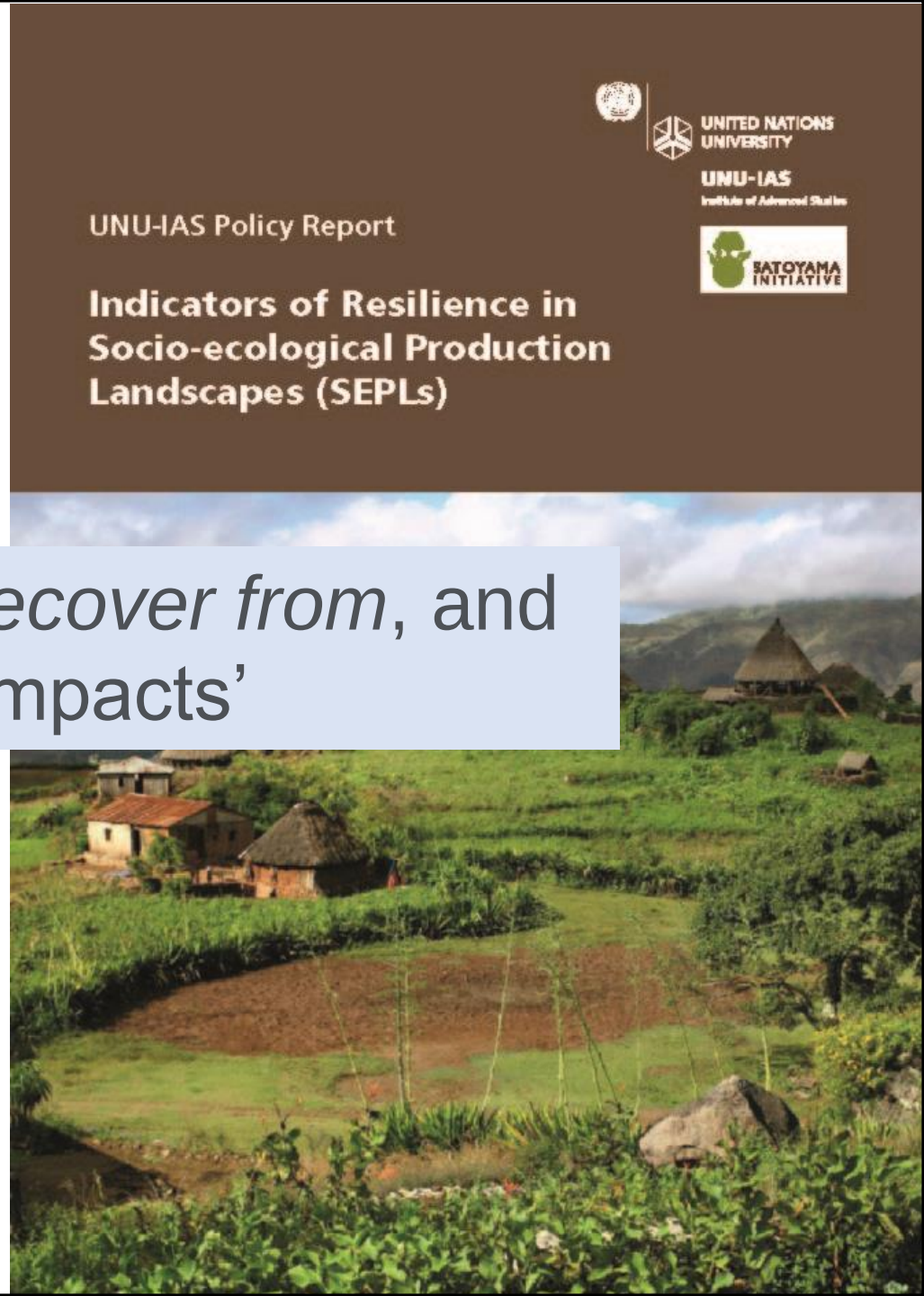
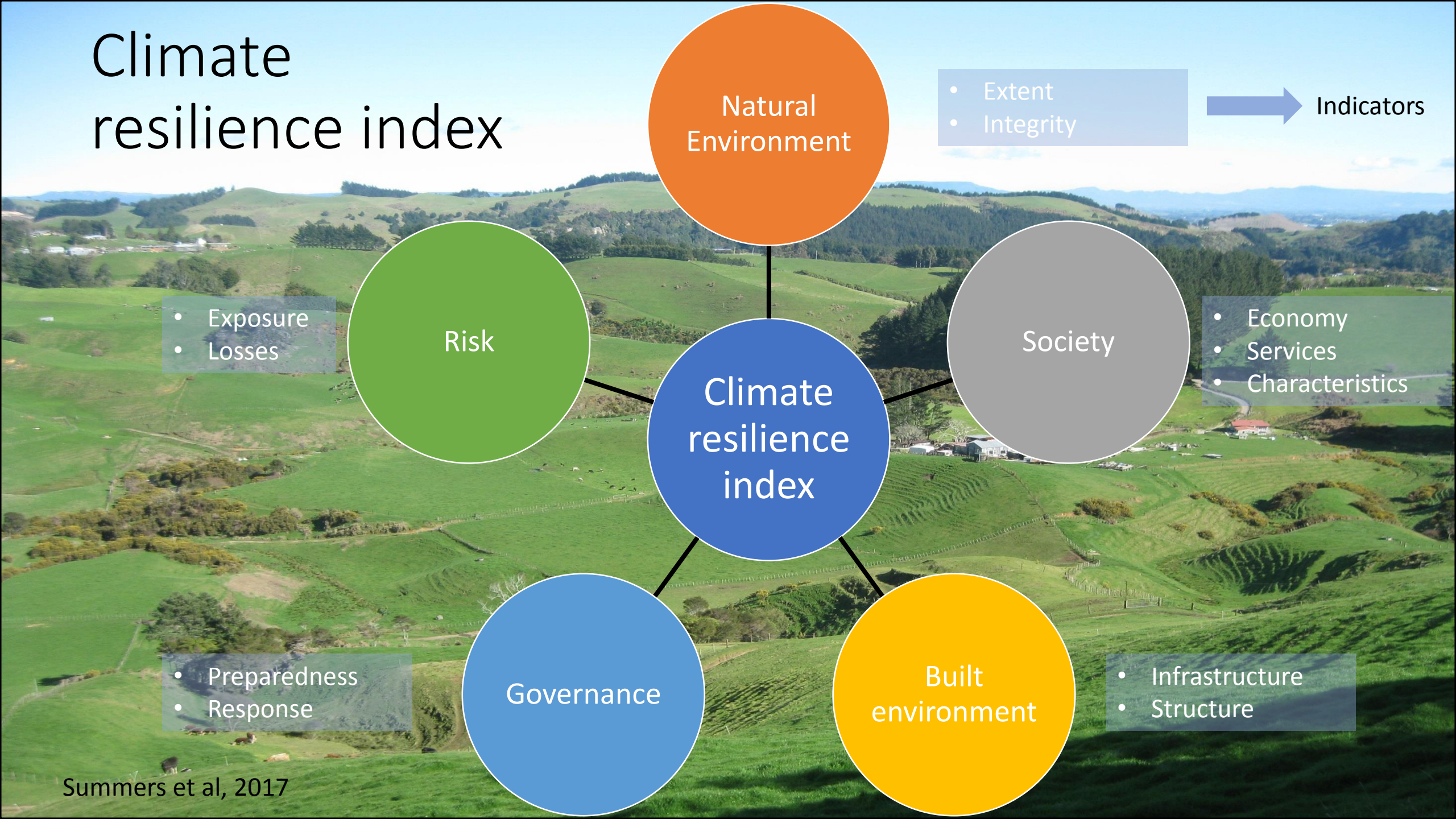
Foundation for a climate resilience screening index, GeoHealth, 1,151–164, doi:10.1002/2016GH000047
- United Nations Development Programme. 2018. Assessing Landscape Resilience: Best Practices and Lessons Learned from the COMDEKS Programme".

‘The ability to *prepare for*, *recover from*, and *adapt* to external impacts’



Climate resilience index

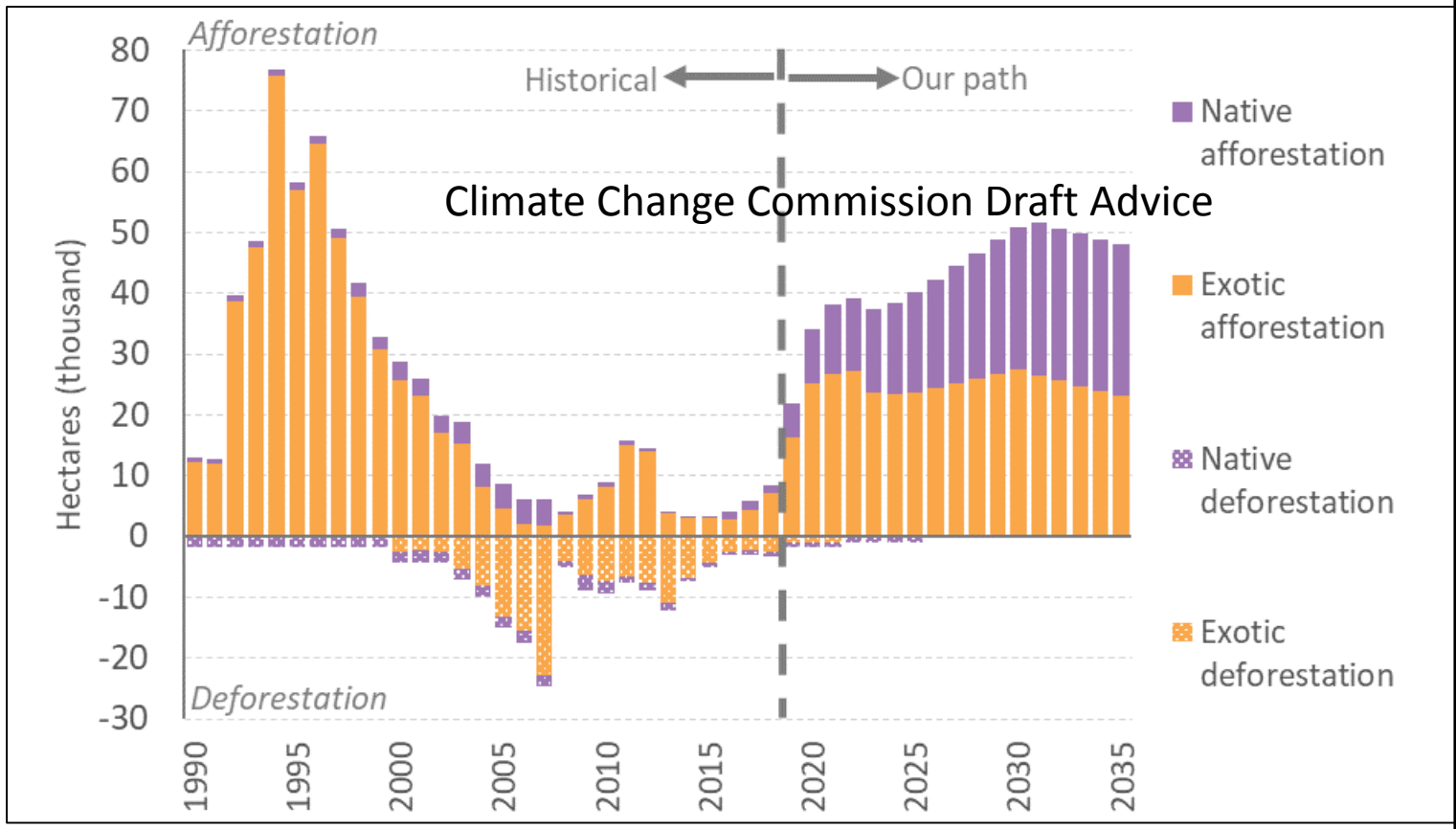


Summers et al, 2017


REIMAGINING LANDSCAPES

Trees and forests are a key component of NZ's climate response

- About 700,000 new hectares
- Mix of native and exotic species
- The questions are where, what and how
- New products, new regimes, new locations, new thinking

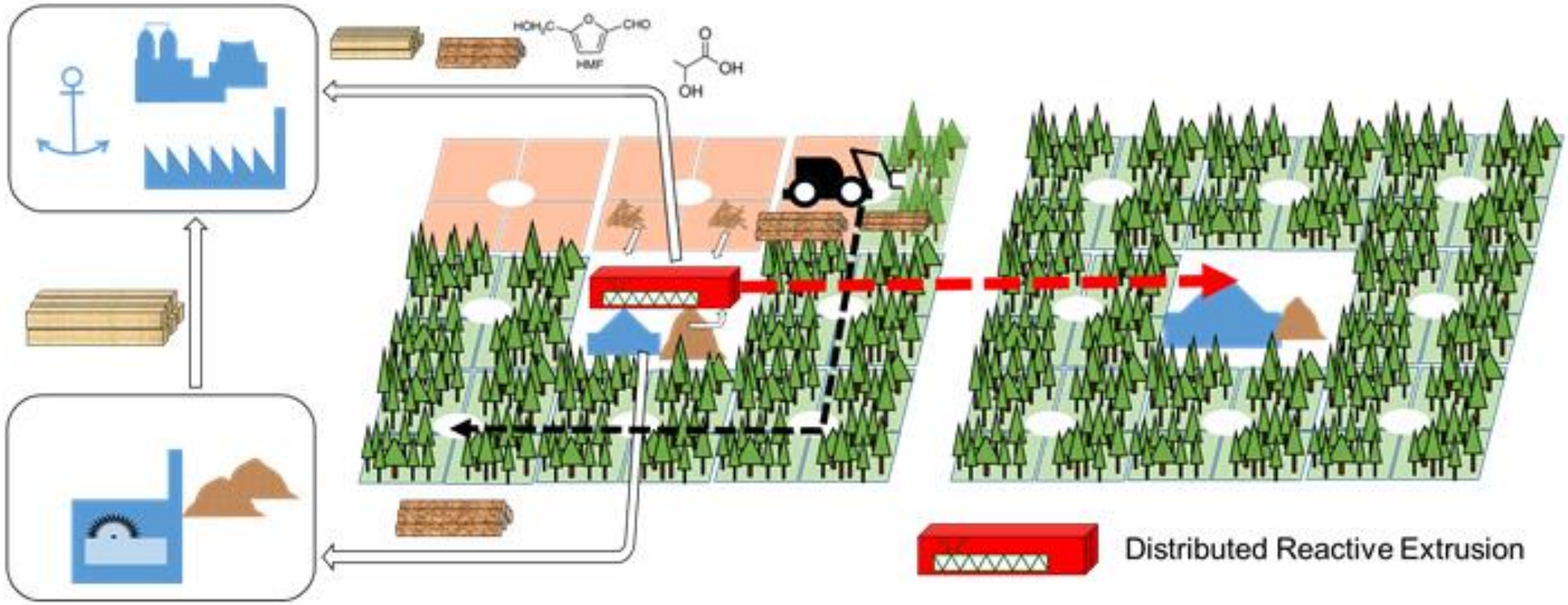


Trees and Agricultural interface: Trees Outside Forests

Everything that can be made with fossil-based materials today can be made from a tree tomorrow – Stora Enso
PLUS add in all those other ecosystem service benefits

Taking the processing to the trees – small scale distributed industries

Future: Super-skid scenario; Distributed REX unit processes post-harvest waste and saw dust to 5-HMF and LA close to feedstock source. Unit moves between forests.



Challenges to adaptation

- Lack of knowledge on …
- Risks around new land uses and value chains
- Behaviour change
- Policy settings
- Carbon budgets and targets
- Investment capital availability
- Public perceptions
- Markets……
- A multiplicity of goals and actors

Enablers of adaptation

- Government strategic investment
- National, regional and local coordination and collaboration
- Knowledge repositories, knowledge transfer systems
- Education and training
- Development of new forest based value chains
- Site species matching under climate scenarios
- Development of new agroforestry regimes
- Development of regional and local resilience models
- National network of demonstration farms

Key points

- We need to design our future
- We must to work within a resilience framework and take a systems approach
- We should explore new land use types and mixes
- Trees and forests need to be interwoven into the landscape
- Adaptation will need national coordination

Acknowledgements and useful references

- Tara Strand
- Peter Clinton
- David Palmer
- Andrew Dunningham
- Andrea Stocchero
- Marc Gaugler

- Michael S Watt, Miko U F Kirschbaum, John R Moore, H Grant Pearce, Lindsay S Bulman, Eckehard G Brockerhoff, Nathanael Melia; 2019. Assessment of multiple climate change effects on plantation forests in New Zealand, Forestry: *An International Journal of Forest Research*, cpy024, https://doi.org/10.1093/forestry/cpy024
- Dunningham, A.G., Kirschbaum M.U.F., Payn, T.W., Meason, D. 2012. Long-term adaptation of productive forests in a changing climatic environment. In: Impacts of Climate Change on Land-based Sectors and Adaptation Options. Clark, A.J.; Nottage, R.A.C.; Hansford, D. (eds). 2012 Stakeholder Report to the Sustainable Land Management and Climate Change Adaptation Technical Working Group, Ministry for Primary Industries. 68 p.
- Scion. Climate change will affect New Zealand's planted forests. Fact sheet. https://www.scionresearch.com/__data/assets/pdf_file/0003/60609/Climate-Change-Poster.pdf
- Ministry for Primary Industries. 2018. A review of climate change research in New Zealand focussing on forestry. MPI Technical Paper No. 2018/56. https://www.mpi.govt.nz/dmsdocument/31461/direct#:~:text=Forestry%20is%20New%20Zealand's%20third,other%20sources%20such%20as%20agriculture.

www.scionresearch.com

Prosperity from trees *Mai i te ngahere oranga*