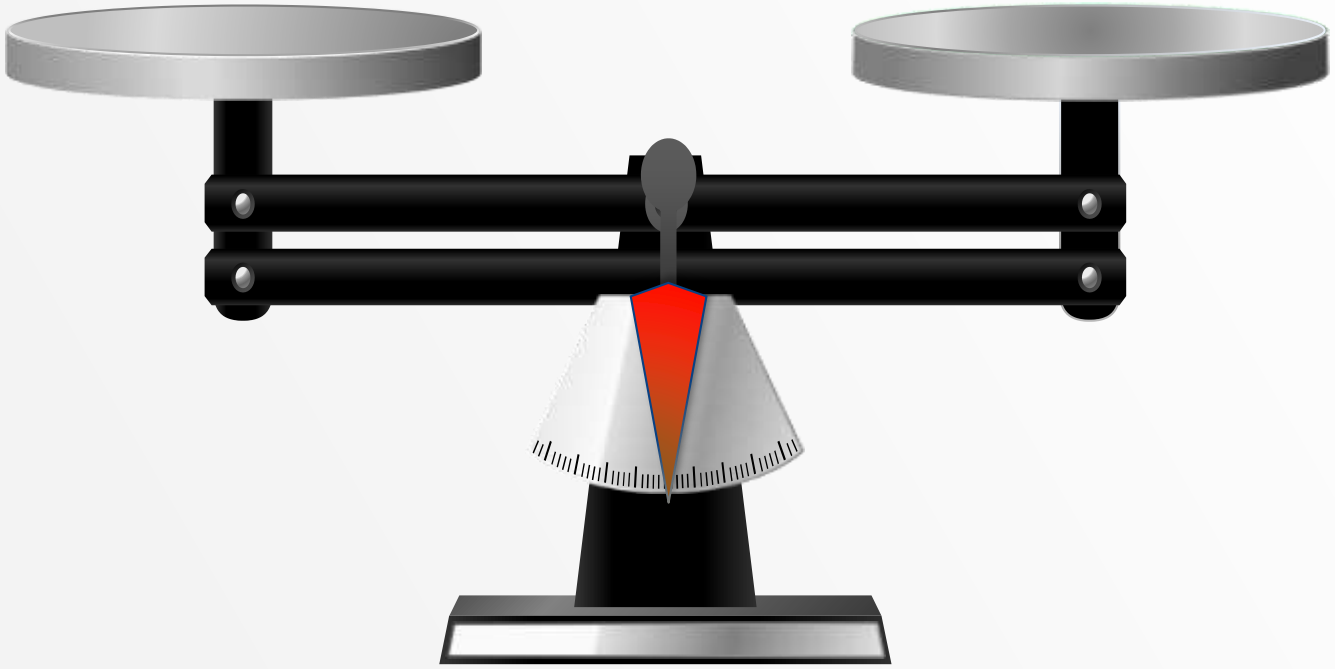
?

Regenerative Agriculture

Negative Emissions



It doesn't matter: just get involved

If you want to target regenerative agriculture: the bonus is negative emissions and negative emission agricultural products

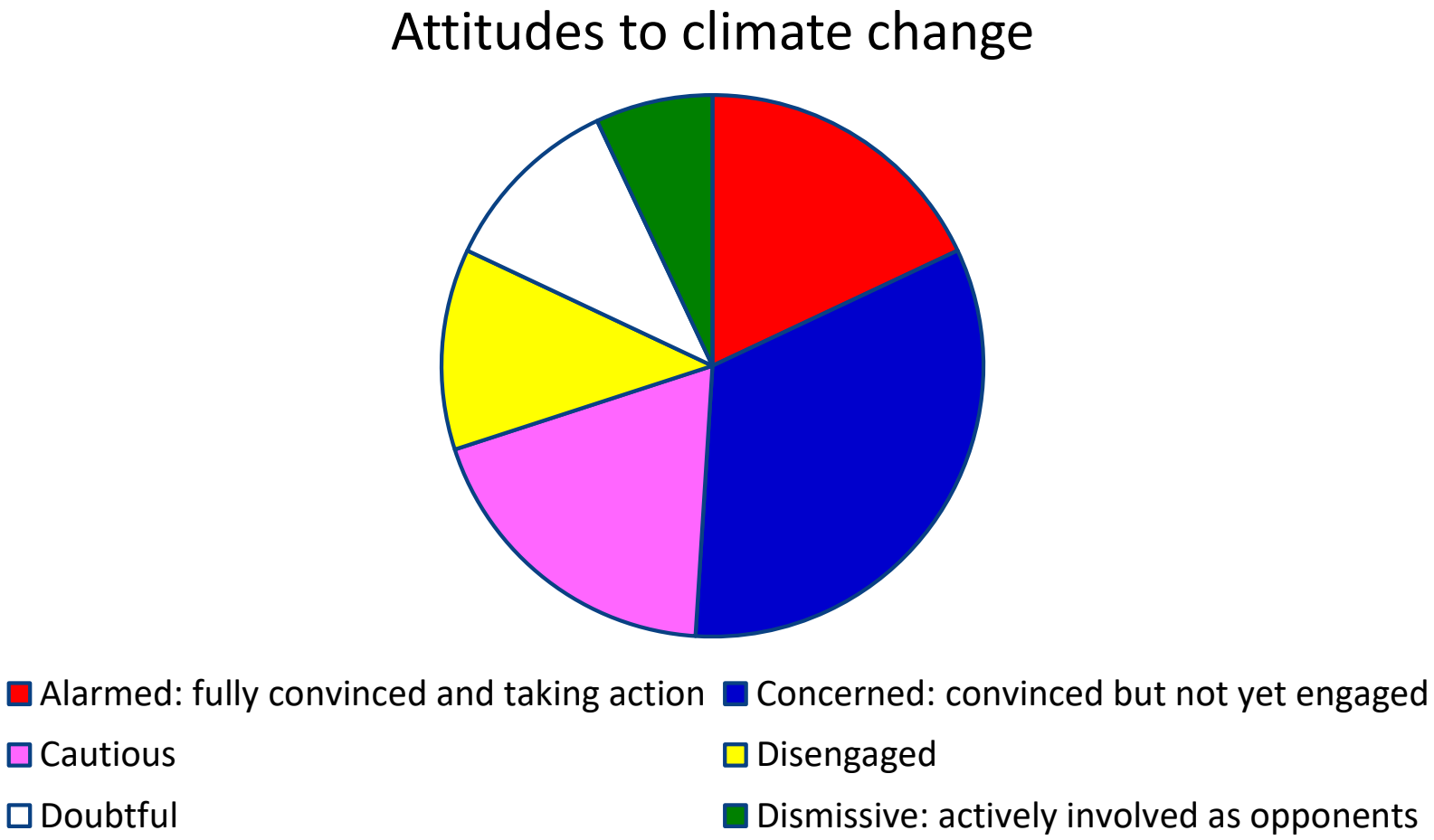
If you want to tackle negative emissions: the bonus is:

- Increased water holding capacity
- Drought resilience
- Less runoff and erosion
- Longer growing seasons
- As well as higher yields
- Big reduction in farm chemicals and fertilisers ($ 1-200bn/y for fertiliser alone)
- Increased animal health and well being
- Productivity increase, including ability to improve product quality and target higher value products

Get involved:

- Agitate for labelling of products
- Talk with anyone who will listen
  - Have you ever really won an argument?

Try to move those who aren't too far away



Source: Huntley, R. 2019, Renewing democracy in a time of environmental crisis, MSSI Oration Series Paper No. 3, Melbourne Sustainable Society Institute, The University of Melbourne.

THE UNIVERSITY OF MELBOURNE

Thank you

Professor Robin J Batterham, Kernot Professor of Engineering

THE UNIVERSITY OF MELBOURNE

Extra Slides

- Fertile soils teem with microorganisms, which directly contribute to the biological fertility of that soil.
- & Biological fertility is under-studied and our scientific knowledge of it is incomplete.
- & In addition to fertility, soil microorganisms also play essential roles in the nutrient.

  cycles that are fundamentally important to life on the planet.

- & In the past, agricultural practices have failed to promote healthy populations of microorganisms, limiting production yields and threatening sustainability.
- & Scientific research is exploring new and exciting possibilities for the restoration and promotion of healthy microbial populations in the soil.

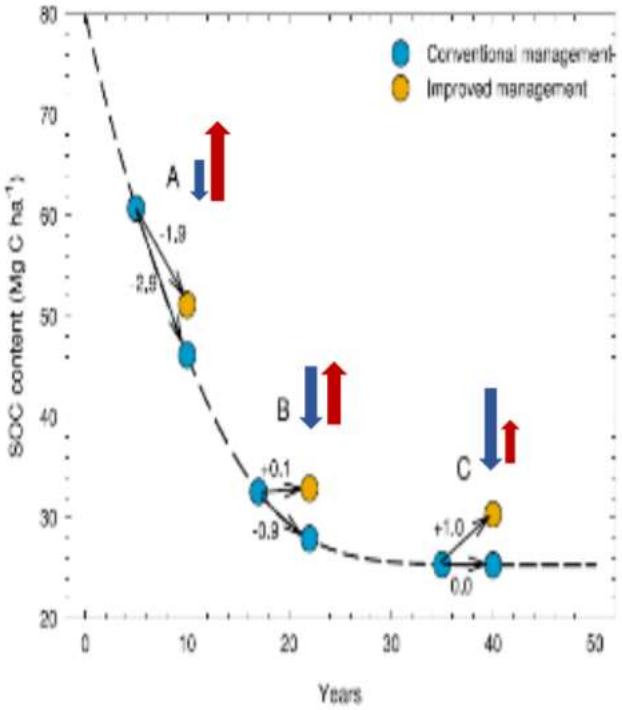
Source: C. Johns The role of microorganisms in soil health. Future Directions International 20 June 2017

The conversation between plants and soils

Plants release chemicals that ‘talk’ to the soil and, by joining the conversation, we could reduce our massive reliance on planet-harming artificial fertilisers

Source: D. Holland. Pursuit by the University of Melbourne 14 June 2017

Declining N fertility – need for legumes….



(Sanderman and Baldock 2010)

- Red Soil, GSR 300mm, 4t/ha @ 10.5% protein

Year	Soil N	Fert N	N Cost (% of GM)
2017	108	80	9.1
2037	54	134	14.6
2067	27	161	17.7

Source: https://www.crawfordfund.org/wp-content/uploads/2019/07/CF_REEVESTG_FARRER_ORATION_16Jul2019.pdf

Microbial spatial footprint as a driver of carbon stabilization

- Well-recognized approaches for soil C accretion include reducing soil disturbance, increasing plant biomass inputs, and enhancing plant diversity.
- we use a unique combination of X-ray micro-tomography and micro-scale enzyme mapping to demonstrate for the first time that plant-stimulated soil pore formation appears to be a major, hitherto unrecognized, determinant of whether new C inputs are stored or lost to the atmosphere.
- Unlike monocultures, diverse plant communities favor the development of 30–150 µm pores. Such pores are the micro-environments associated with higher enzyme activities, and greater abundance of such pores translates into a greater spatial footprint that microorganisms make on the soil and consequently soil C storage capacity.

Source: Kravchenko, A.N., Guber, A.K., Razavi, B.S. et al. Microbial spatial footprint as a driver of soil carbon stabilization. Nat Commun 10, 3121 (2019). https://doi.org/10.1038/s41467-019-11057-4

Microbiome-on-a- Chip: New Frontiers in Plant–Microbiota Research

An enigmatic concoction of inter- actions between microbes and hosts takes place below ground, yet the function(s) of the individual components in this complex play- ground are far from understood. This Forum article highlights how microfluidic – or 'Microbiome-on- a-Chip' – technology could help to shed light on such relationships, opening new frontiers in plant– microbiota research.

Source: Stanley, C.E. and van der Heijden, M.G., 2017. Microbiome-on-a-chip: new frontiers in plant–microbiota research. *Trends in microbiology*, 25(8), pp.610-613.

Microbiome-on-a-Chip

New frontiers in plant–microbiota research

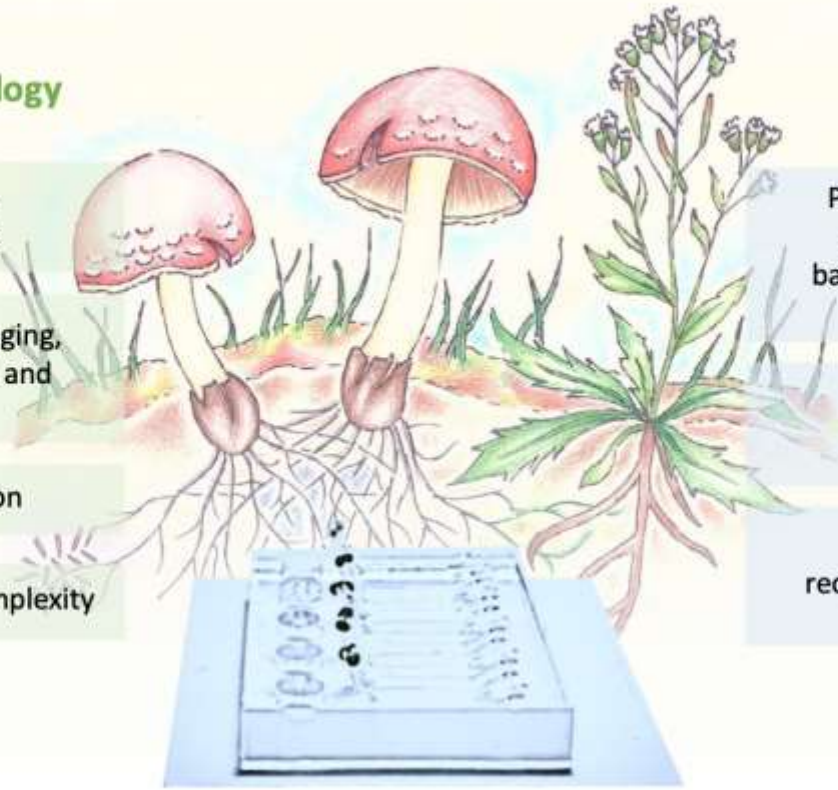
Microfluidic technology

Environmental control, e.g. chemotaxis studies

High-resolution dynamic imaging, e.g. single-organ, single-cell and subcellular studies

Quantitative information

Simulating environmental complexity



New frontiers ahead

Plant microbiome dynamics, e.g. probing interactions between bacteria and beneficial soil fungi or fungal pathogens

Hyphosphere profiling, e.g. visualising root microbiome dynamics

Influence of microbiota on recycling of key nutrients (N,P) and carbon in soil

Trends in Microbiology