Future Farming Vision

Agrosylviculture
A solution to the perfect storm?

Dr Charles ‘Merf’ Merfield

The BHU Future Farming Centre

Permanent Agriculture and Horticulture: Science and Extension

www.bhu.org.nz/future-farming-centre

My Background

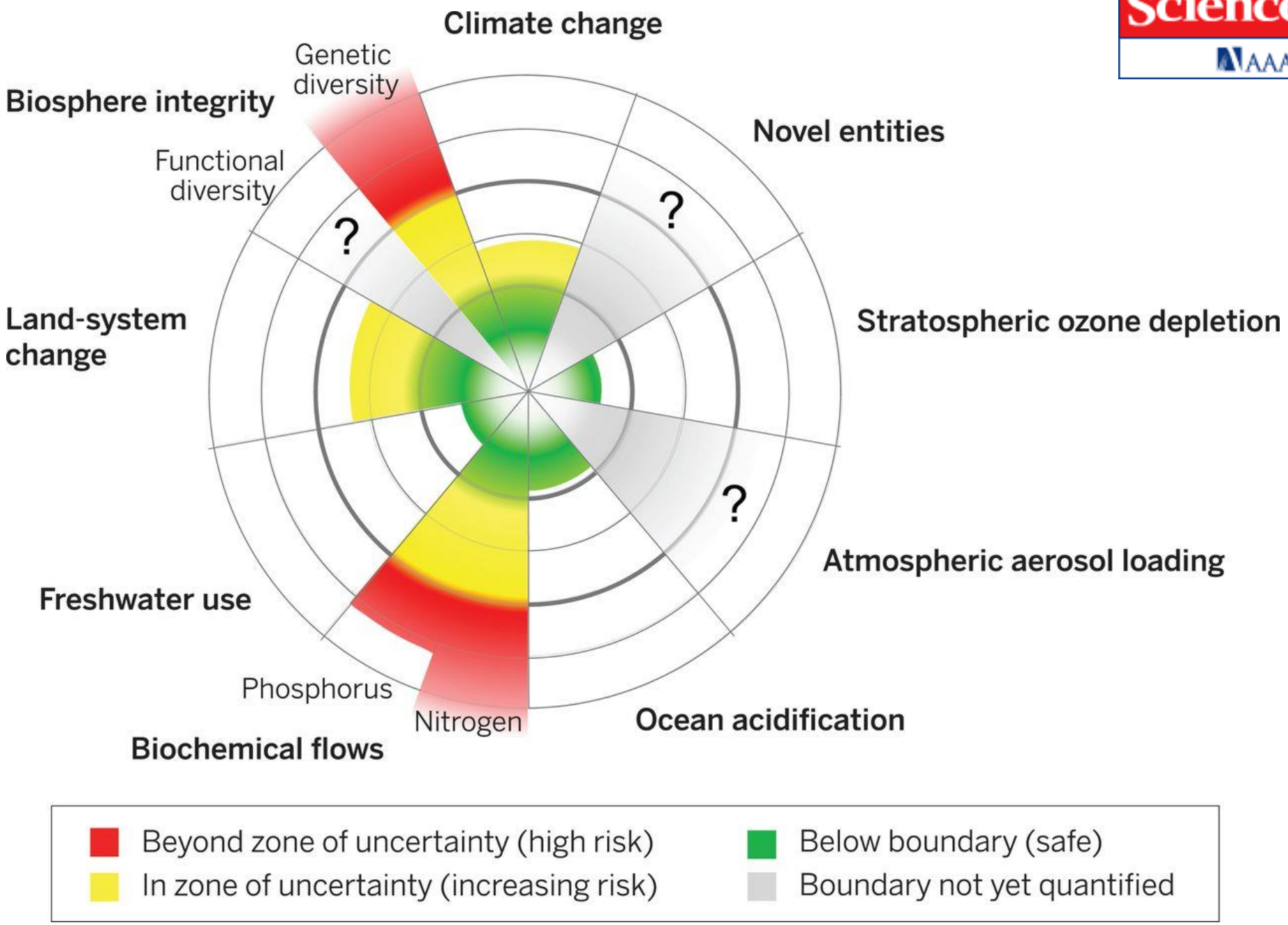
- Commercial Hort Higher National Diploma - UK
- Managed vegetable farms in UK and NZ for 7 years
- Moved into science / research mid 1990s
- Experience in UK, Ireland, USA, Uruguay, Australia and NZ
- Continue to work with farmers and growers

The Future Farming Centre

- Not for profit - charitable trust
- Old-school ag and hort research coupled to extension / tech transfer and consulting
- A quarterly **free** newsletter - FFC Bulletin
- Just handing out knowledge:
  - No preaching
  - No politics
- www.bhu.org.nz/future-farming-centre

The perfect storm

- There is an intrinsic link between the challenge we face to ensure **food security** through the 21st century and other global issues, most notably **climate change**, **population growth** and the need to sustainably manage the world's rapidly growing demand for **energy and water**.
- Beddington J. 2009. Food, energy, water and the climate: **a perfect storm of global events**? Sustainable Development UK Annual Conf., London, 19 March 2009



The deafening call for change

- Millennium Ecosystem Assessment. 2005.
- The State of Food and Agriculture: Paying Farmers for Environmental Services. FAO, 2007.
- International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD), 2008
- Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. IPBES. 2010.
- The Economics of Ecosystems and Biodiversity (TEEB). 2010.
- Food and Ecological Security: Identifying synergy and trade-offs. UNEP, 2011.
- Avoiding Future Famines: Strengthening the Ecological Foundation of Food Security through Sustainable Food Systems. UNEP, 2012.
- The State of Food Insecurity in the World 2013. The multiple dimensions of food security. FAO, 2013.
- Food Security and Biodiversity: Challenges, Conflicts and Options. UNEP, 2014.
- Olivier De Schutter, the UN Special Rapporteur on the Right to Food. 2008-14, multiple reports.

In New Zealand

- Ecan's Land and Water Plan, Horizon's One Plan….

Photo: www.oceanservice.noaa.gov

Photo: www.biol.canterbury.ac.nz

The solution? Agrosylviculture

- Agrosylviculture
  - Silvopastoral: stock & pasture and trees
  - Silvocropping: crops and trees
    - Silvoarable
    - Silvohorticulture
- Back to the future - a very old, and well proven technique, to address modern problems
- Vs. unproven, high tech/cost solutions

The Spanish Dehesa which covers 3.5 million ha, nearly 3% of the land area

Practical innovation in agro-ecology 2013 Stephen Briggs


24m

Photo: Dr. Jim McAdam at The Irish Scientist

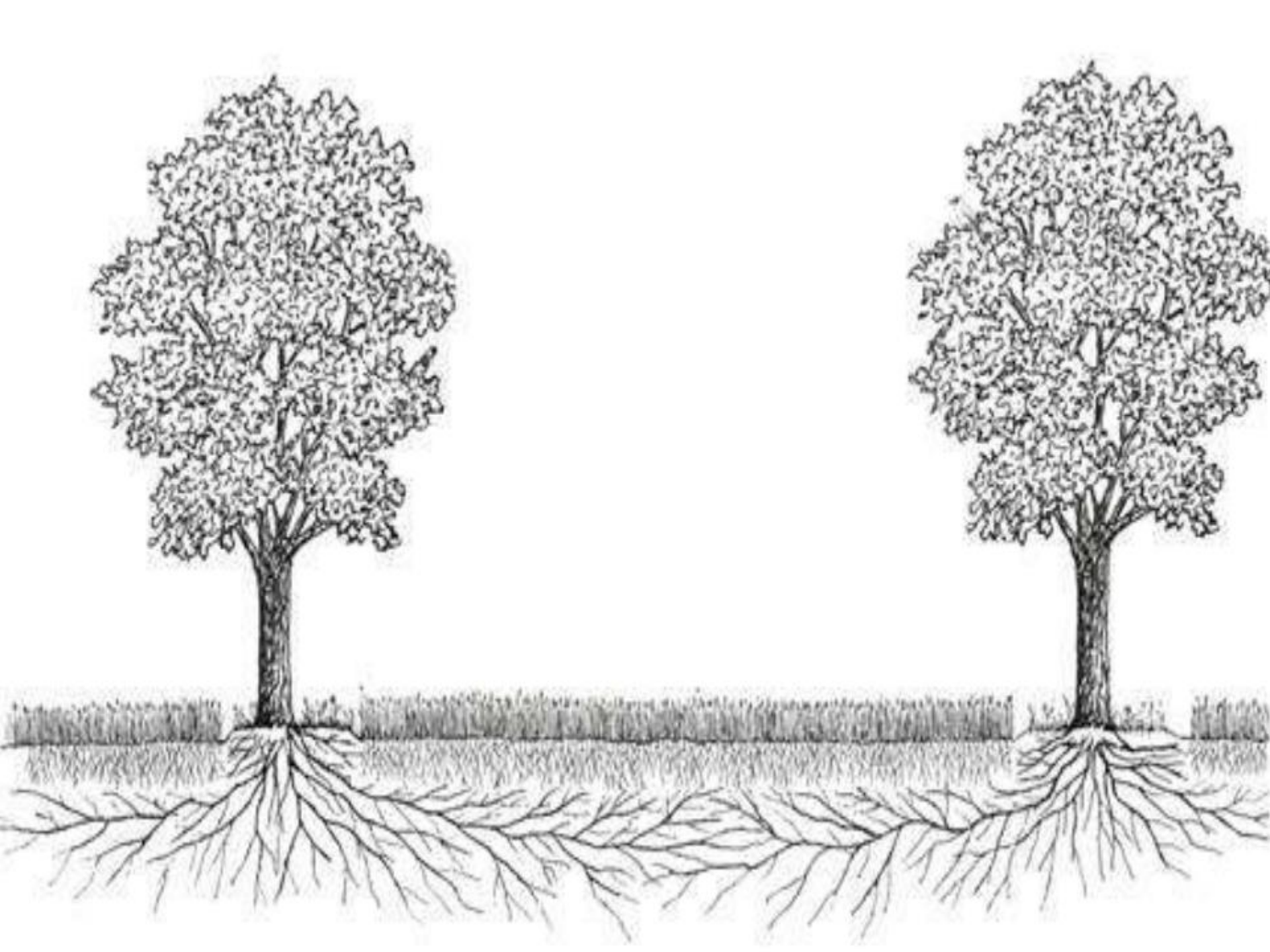
Photo: Rodrigo Olave

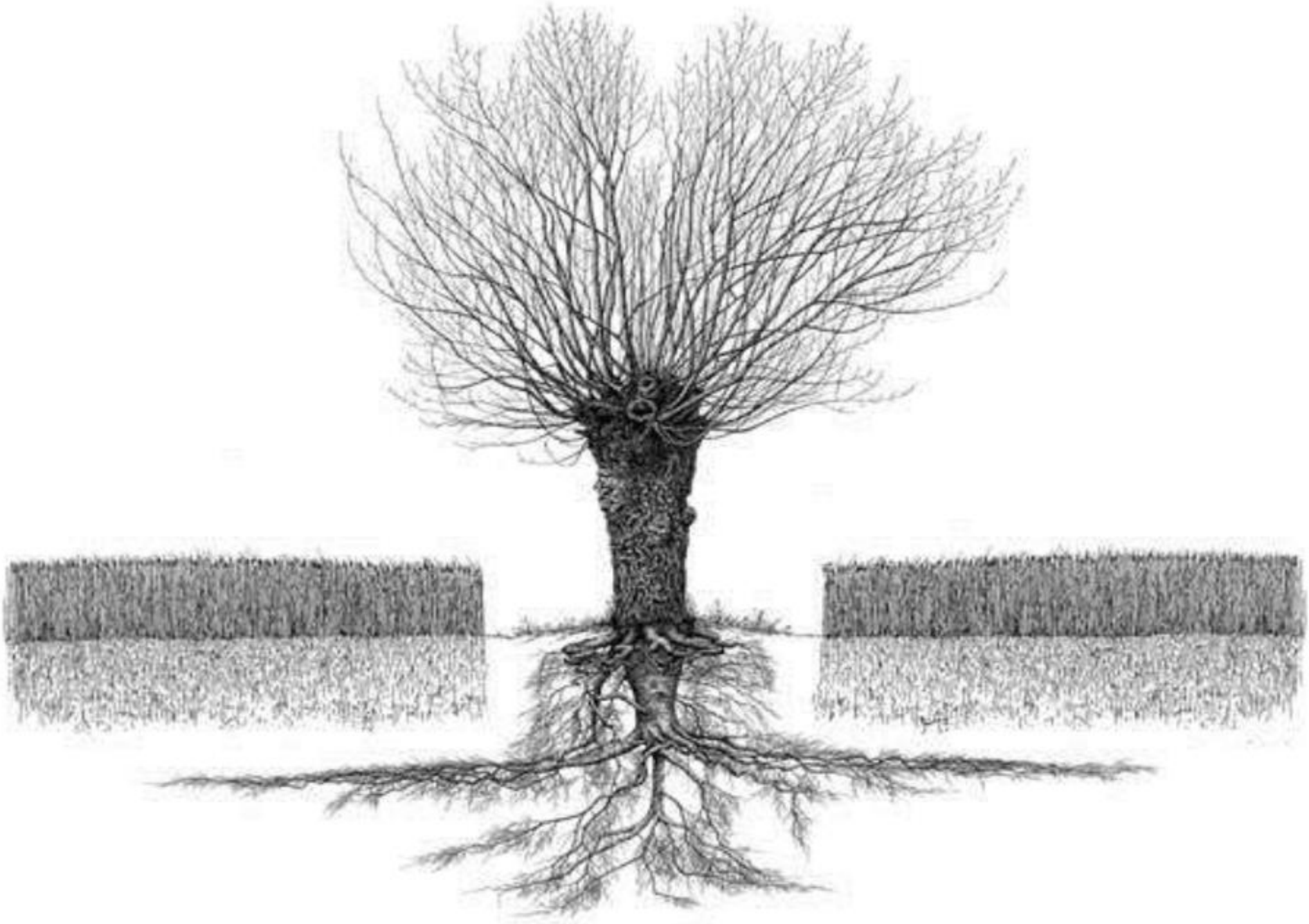
Photo: USDA FS

Photo: nac.unl.edu

Nutrients, nutrients, nutrients

- Pasture and crop roots + tillage force tree feeder roots deeper in the soil profile - under the surface crops
- Trees are forced to get more of their nutrients from depth
- Trees can therefore **capture nutrients** lost beyond the surface crop zone

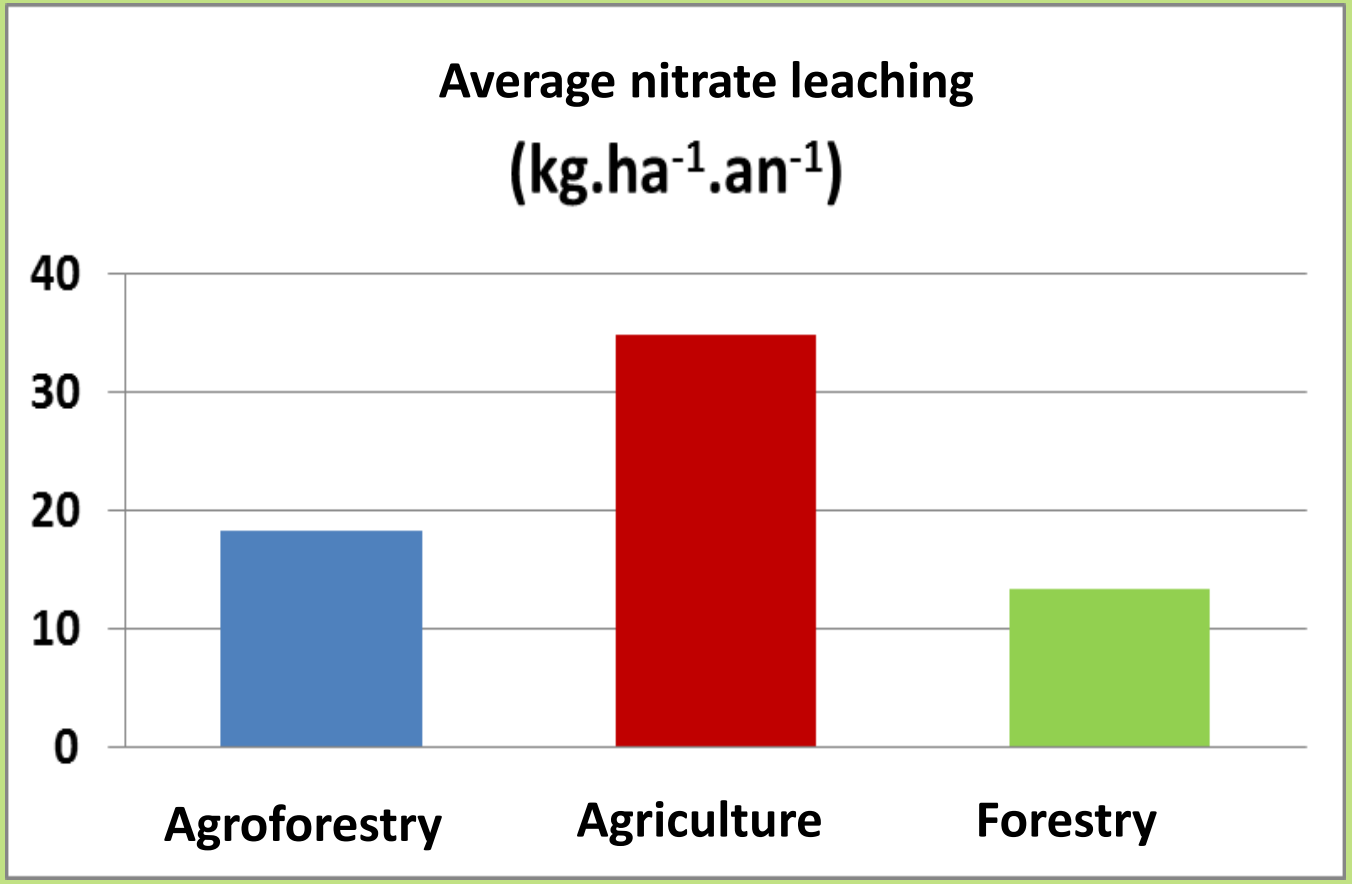




Agrosylviculture poplar tree roots deeper rooting

Forestry plantation poplar tree roots shallower rooting

Possible N leaching reductions



~ 50% less nitrogen lost under agrosylviculture than arable

Source: INRA Restinclières, France

Phosphorous & soil loss

- Main P loss route is with soil loss via overland flow
- Main method of keeping P out of water is riparian planting
- Agrosylviculture, esp. contour plantings, can act as multiple ‘riparian plantings’ across the field reducing soil and P losses

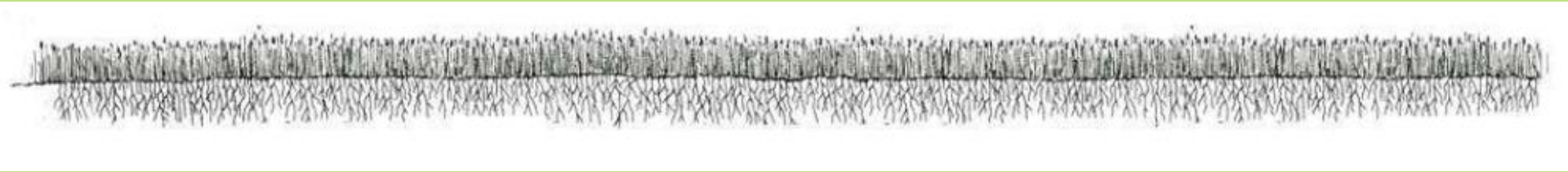
Phosphorous & soil loss

- Treatments reduced total phosphorous loss by 8% on contour strip and 17% on agrosylviculture watersheds
  - Udawatta, R. P., Krstansky, J. J., Henderson, G. S. & Garrett, H. E. (2002). Agroforestry Practices, Runoff, and Nutrient Loss. Journal of Environmental Quality, 31(4), 1214-1225.

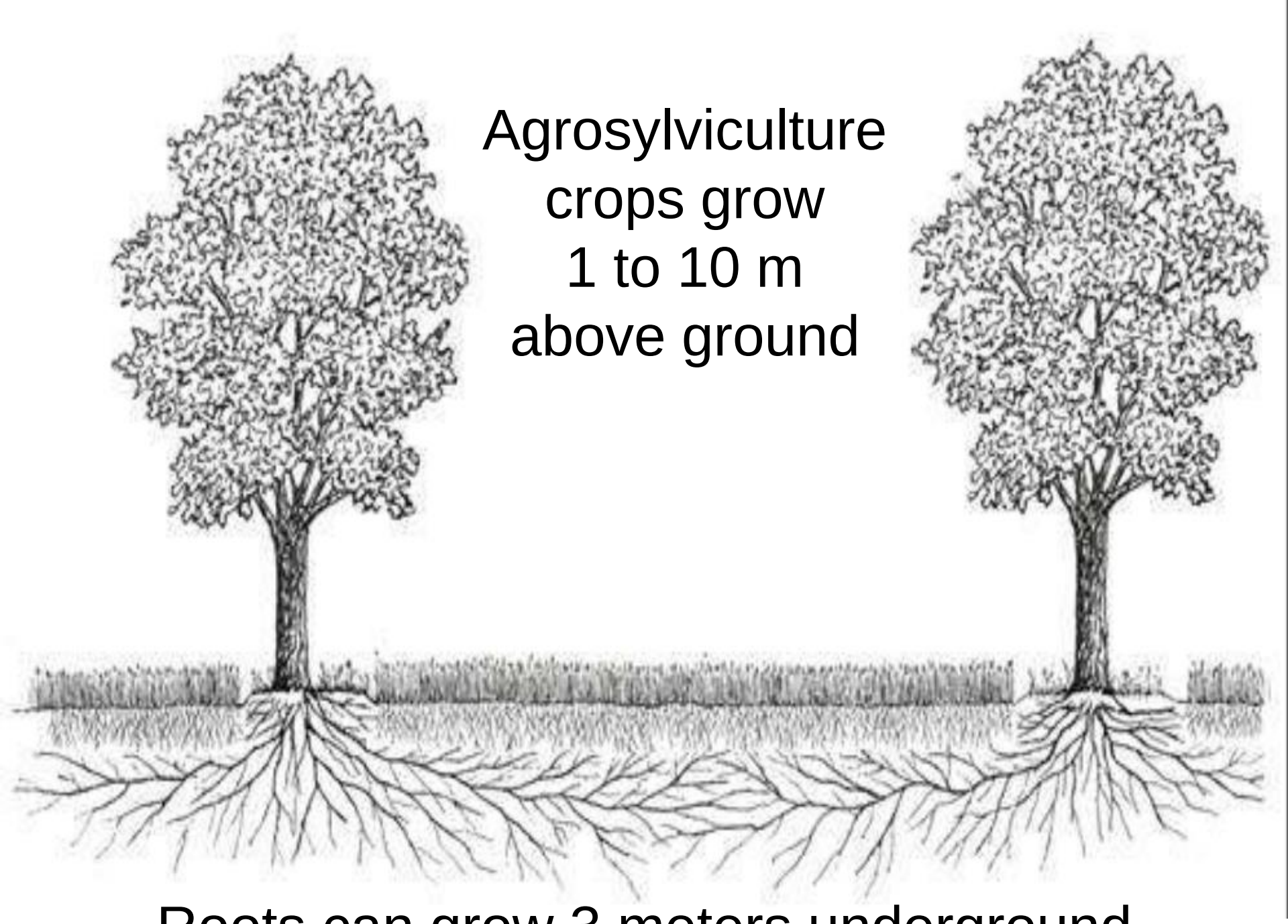
Much better than monoculture

- Farming the “third dimension”

Monoculture - crops typically grow upto 1 m above ground only



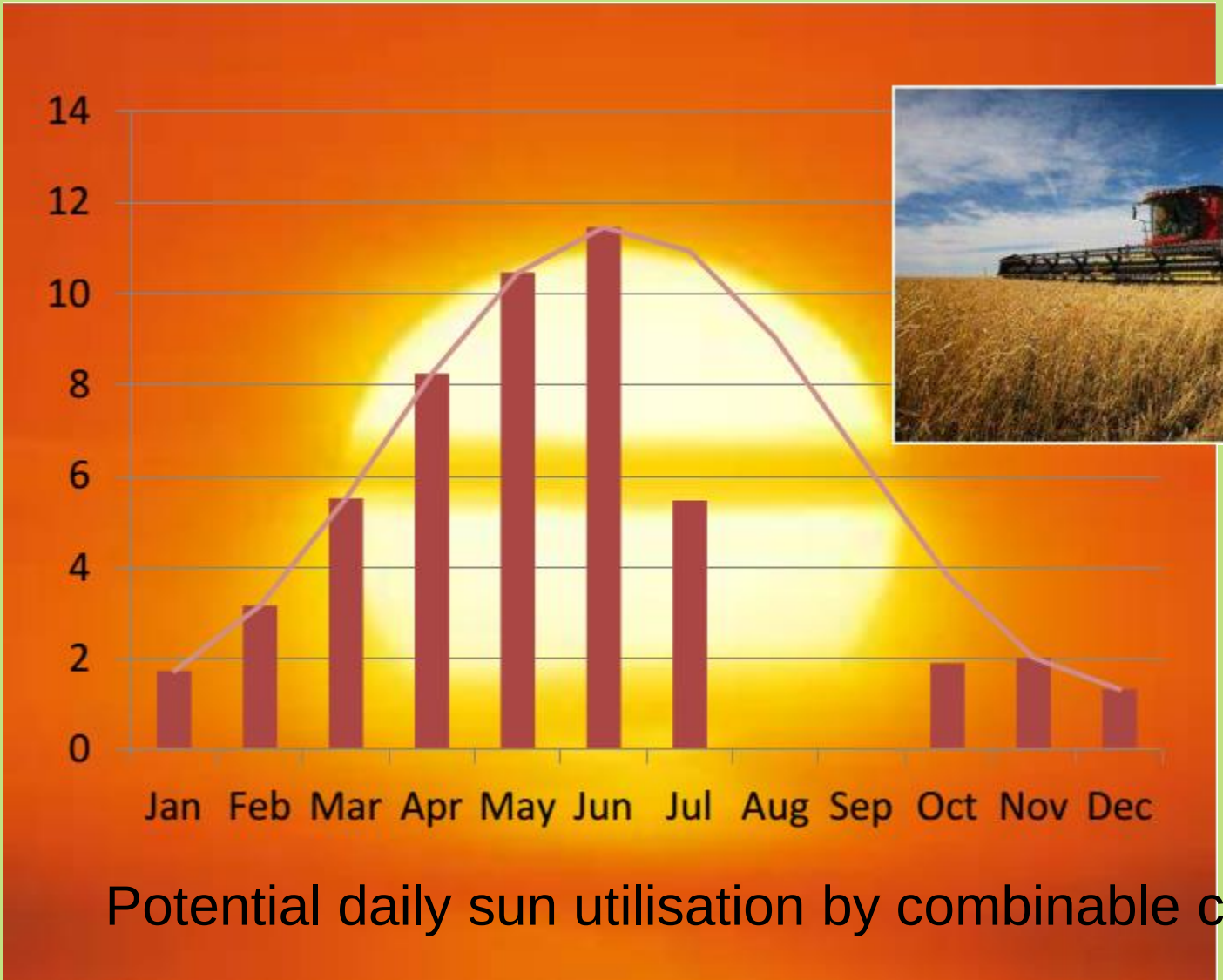
Monoculture - roots typically grow 1 m below ground


Agrosylviculture
crops grow
1 to 10 m
above ground
Roots can grow 3 meters underground

Capturing the sun

After Stephen Briggs

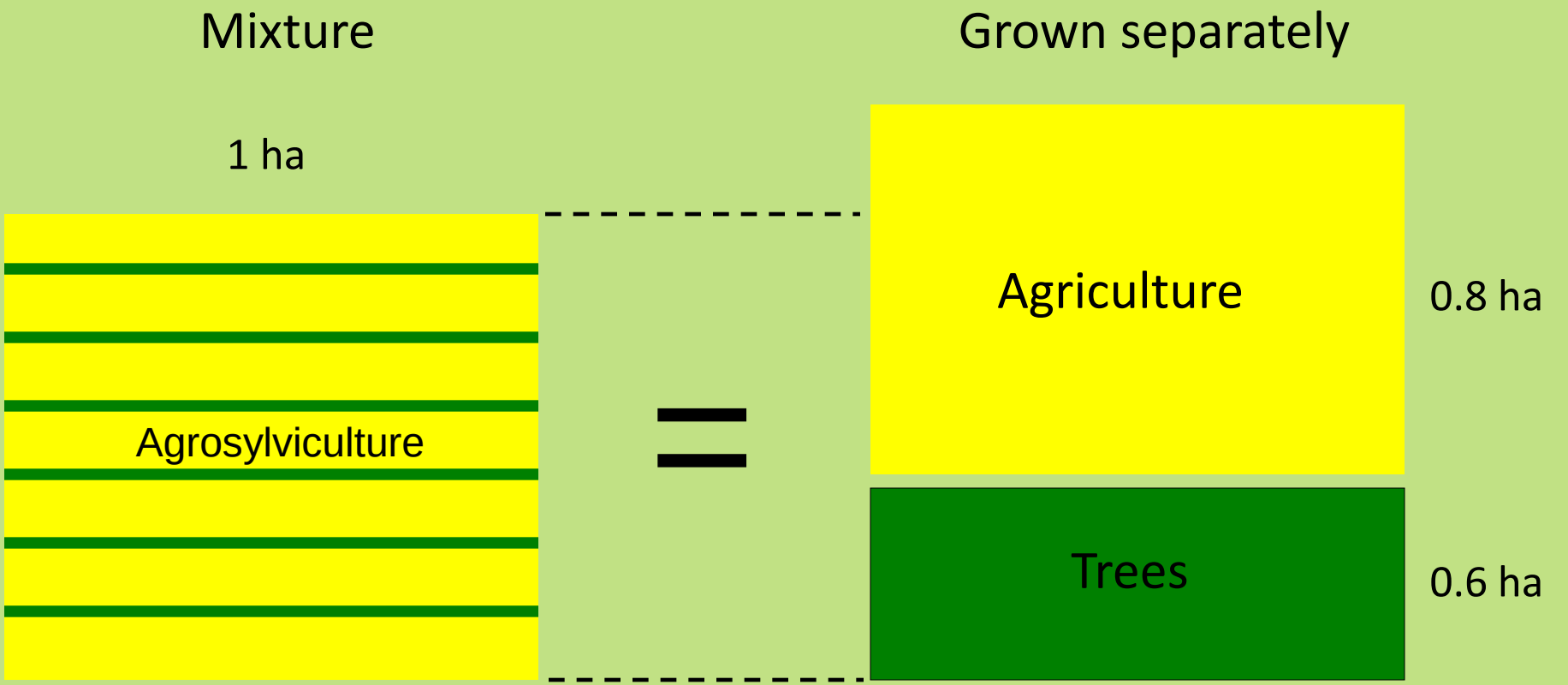
Capturing the sun



Potential daily sun utilisation by combinable crops

After Stephen Briggs

Land equivalent ratio (LER)



Land equivalent ratio LER = 1.4

After Stephen Briggs

The BHU Future Farming Centre
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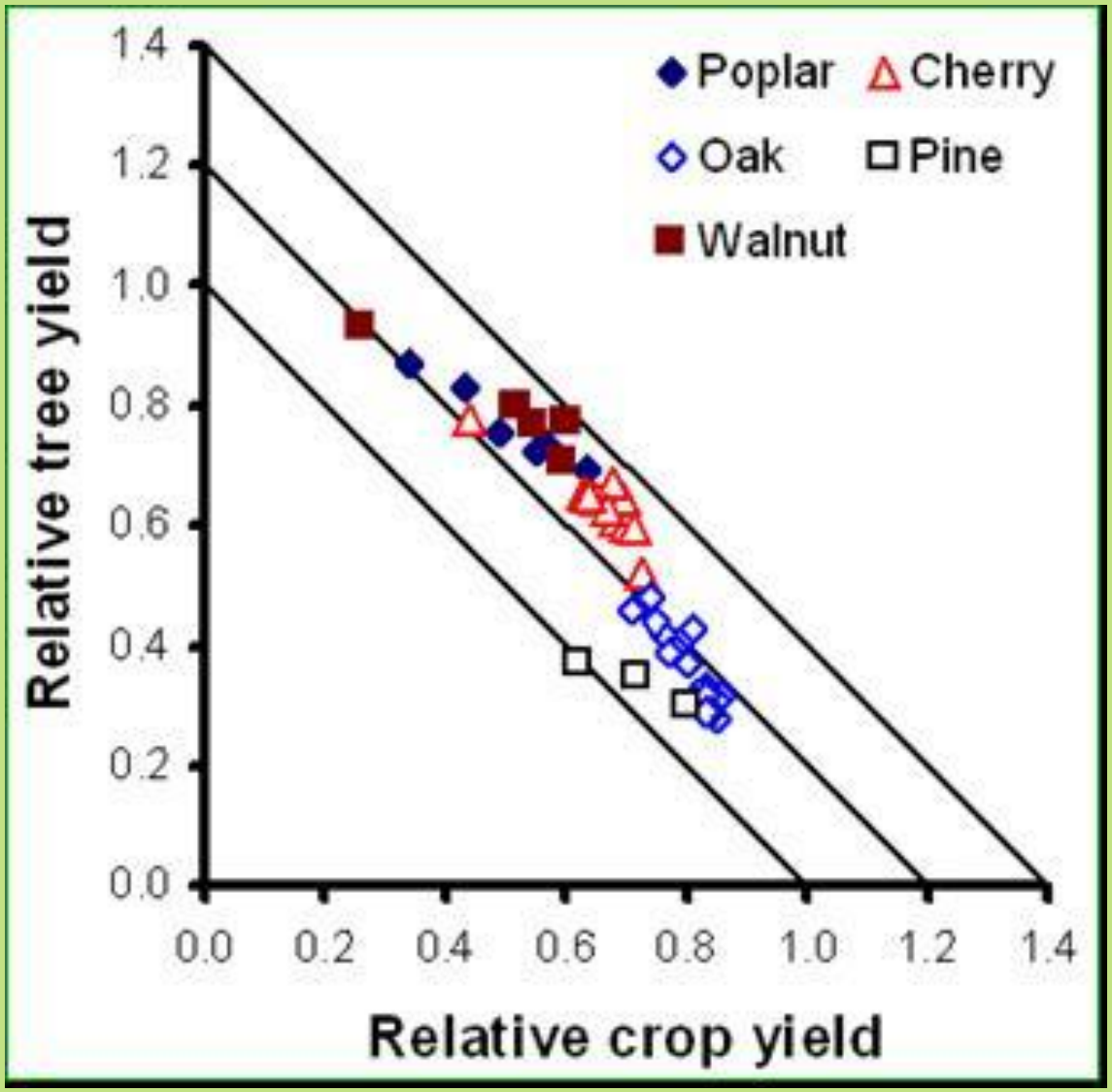
Tree and crop yields for 42 tree-crop combinations



EU research

LER's

1.1 to 1.4

http://www.cranfield.ac.uk/sas/naturalresources/research/projects/safe.jsp

Climate change - mitigation

- Much more than carbon in trees
- Soil carbon - esp. deep soil carbon due to deeper rooting
- Reducing need for N ferts - one of the top agricultural causes of climate change
- Reducing nitrous oxides emissions from soil (lower nitrate N and less waterlogging)

Climate change - adaptation

- Protecting soil loss from storm events
- Diversification - annual and perennial crops - LER stability
- Reducing evapotranspiration - accessing deeper water, humidification and lowering local temperatures in hot weather (and increasing temps in cold weather)

Biodiversity

- A “doubling” of biodiversity going from mono to biculture
- The presence of trees (perennials) provides habitat for a very large extra number of species, both big and pretty (birds) to small and invisible (soil organisms)
- Biodiversity loss is one of the boundaries the Stockholm Resilience Centre’s say we have passed

Shelter - stock

IMPACT OF SHADE TREES ON ANGUS COW BEHAVIOUR AND PHYSIOLOGY IN SUMMER DRY HILL COUNTRY: GRAZING ACTIVITY, SKIN TEMPERATURE AND NUTRIENT TRANSFER ISSUES

Keith Betteridge[1], Des Costall[1], Sam Martin[2], Brenden Reidy[3], Angela Stead[4], Ian Millner[4]

Shade cows grazed for 30-40 minutes longer than no shade cows.

Shade reduced maximum ambient temperature by 10˚C. Average temperature on the cows back at 2 PM was 40.8˚C for *No shade* and 36.8˚C for cows with S*hade*.

Shelter - crops

- Primary driver - reducing wind speed
- Lower wind speed = lower evapotranspiration
- Transpiration from trees also increases RH
- Crops less stressed so yield increases
- INRA microclimatic studies show a a 30% reduction in evapotranspiration from agrosylviculture compared to monoculture.
- Protection from drought and reducing irrigation

Conclusions

- The list of positives is very great
  - Nutrient (N&P) retention / reducing losses
  - More productive than monoculture (>1 LERs)
  - Reducing soil erosion + improved soil health
  - Climate change: mitigation and adaptation
  - Increasing biodiversity
  - Crop and stock shelter → improved performance
  - Flood and drought protection and buffering
  - Etc.

Conclusions

- Agrosylviculture is extensively proven over centuries, and many different climates, soils, and farming systems
- Action is required now - not 10-20 years time
- Agrosylviculture can be used today to address all these problems - well before many single focus, high tech, expensive, approaches come to market.

Two easy to read primers

- Agroforestry a new approach to increasing farm production 2012 Stephen Briggs
- http://www.nuffieldinternational.org/rep_pdf/1341272658Stephen-Briggs-2011-report.pdf

- http://www.bhu.org.nz/future-farming-centre/information/bulletin/2013-v2/farming-the-third-dimension

Making it happen

- Looking for partners to develop AS:
  - Demonstration sites
  - Develop extension / information materials
  - Generally promote AS in NZ
- Putting a AS bid into the 'Next Foundation'
- Other research / extension funds? - collaborators needed.