SOIL CARBON

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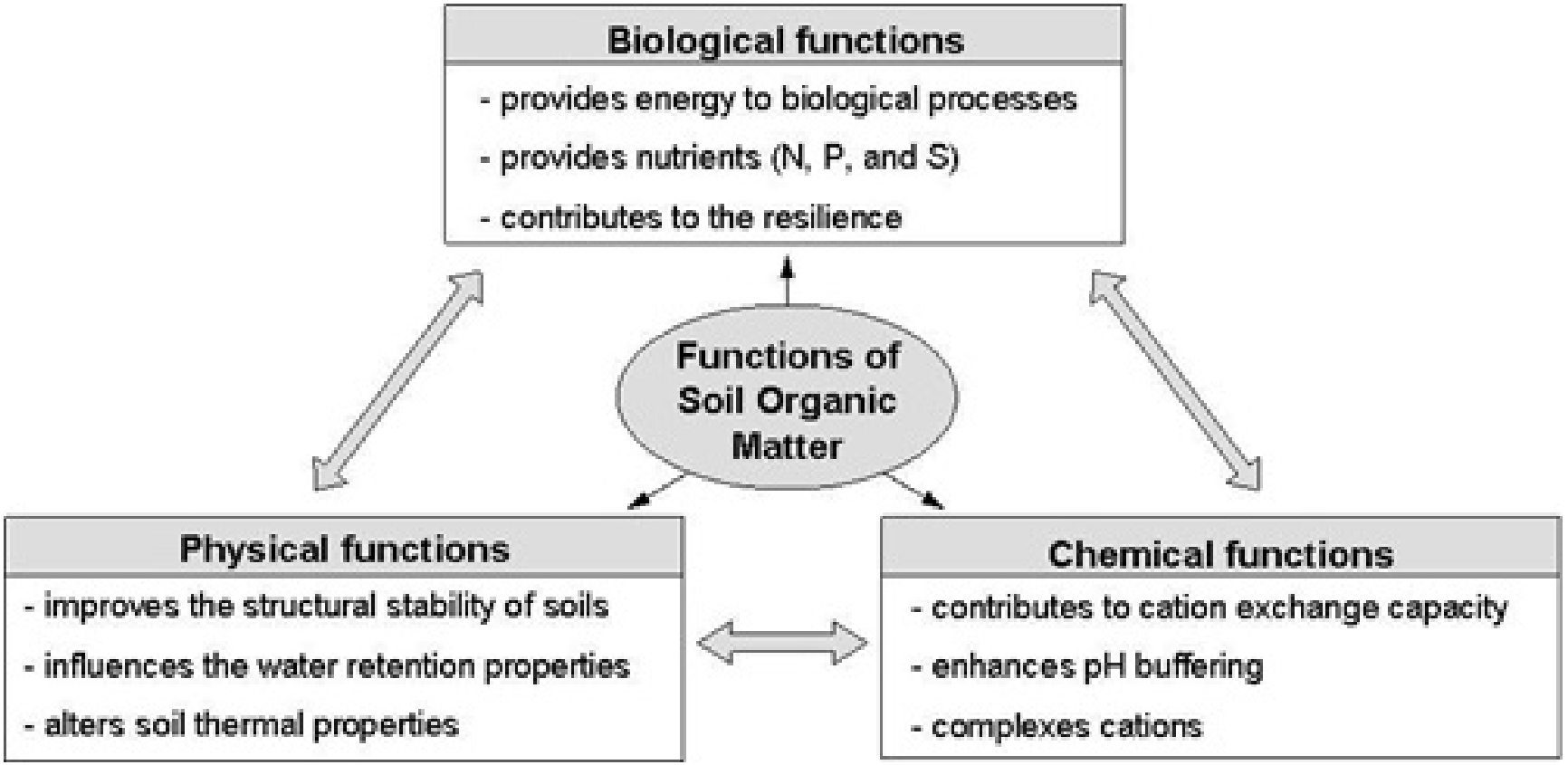
LINKING SOIL OM TO CARBON

Soil organic matter (SOM) is ~ 50% carbon

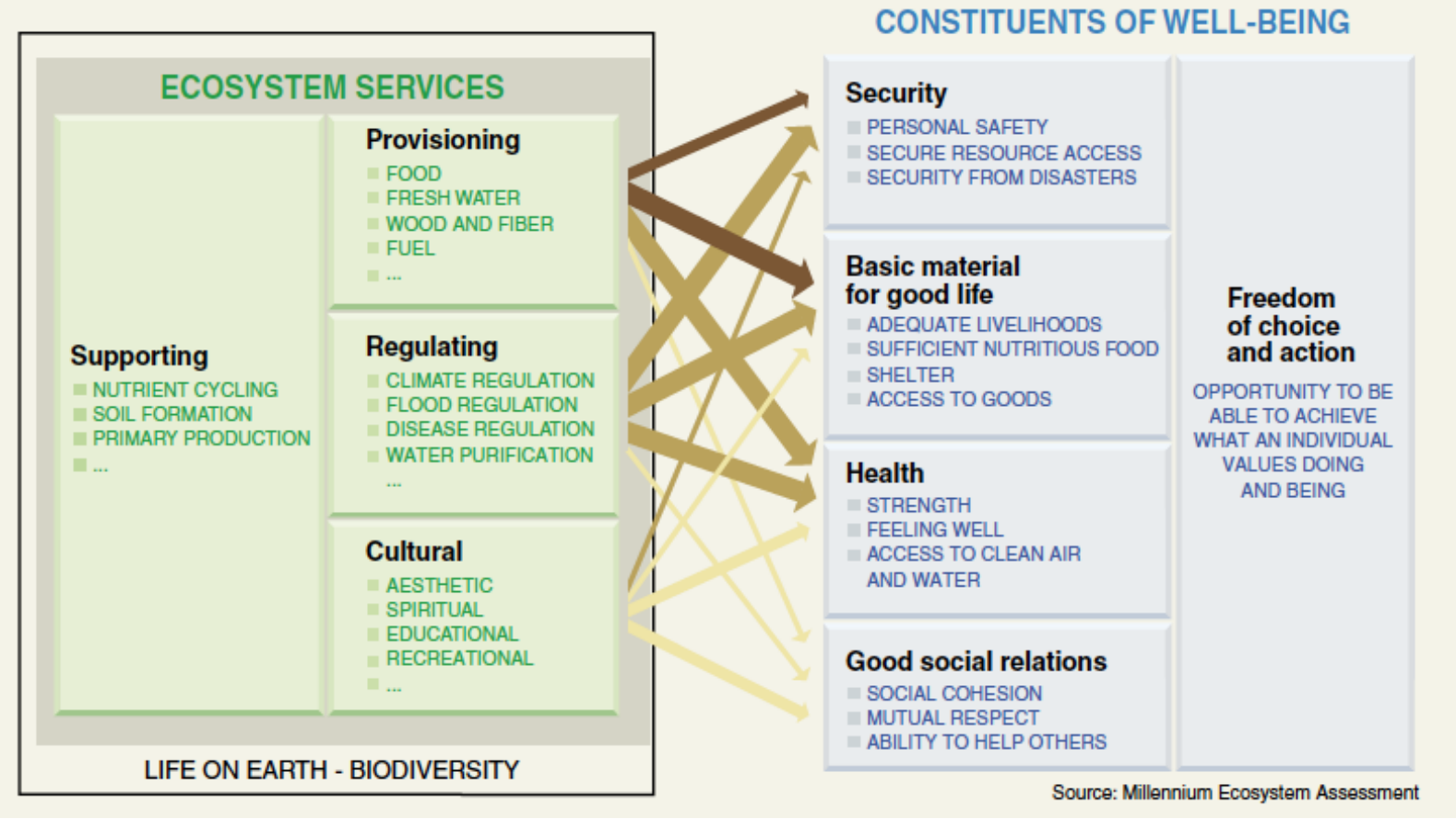
SOIL FUNCTION, SOIL HEALTH

Soil OM is the central component of soil quality.



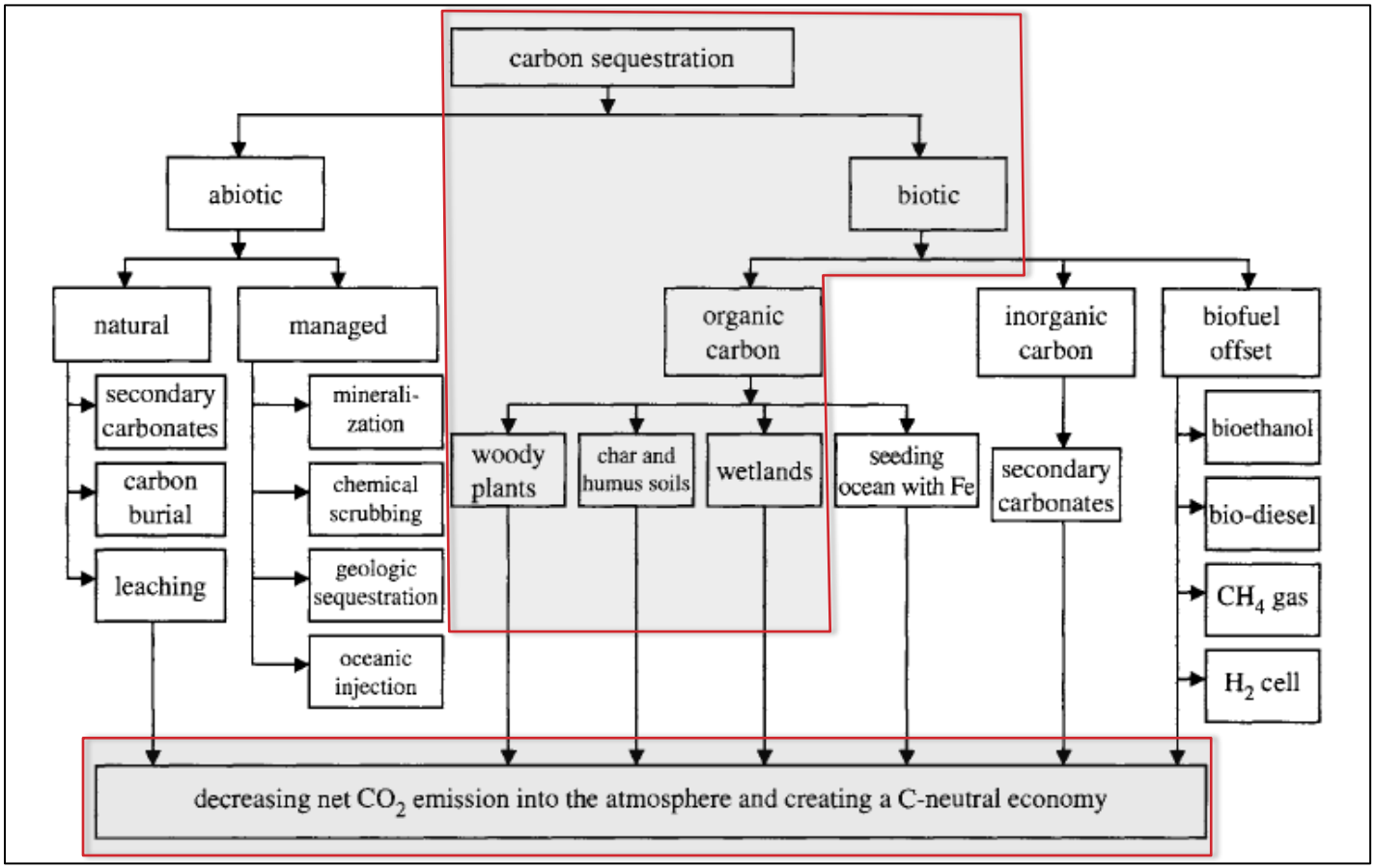
SOIL ECOSYSTEM SERVICES

<u>Soil functions</u>, and their related soil processes, are the foundation of soil-related ecosystem services.



CLIMATE CHANGE MITIGATION

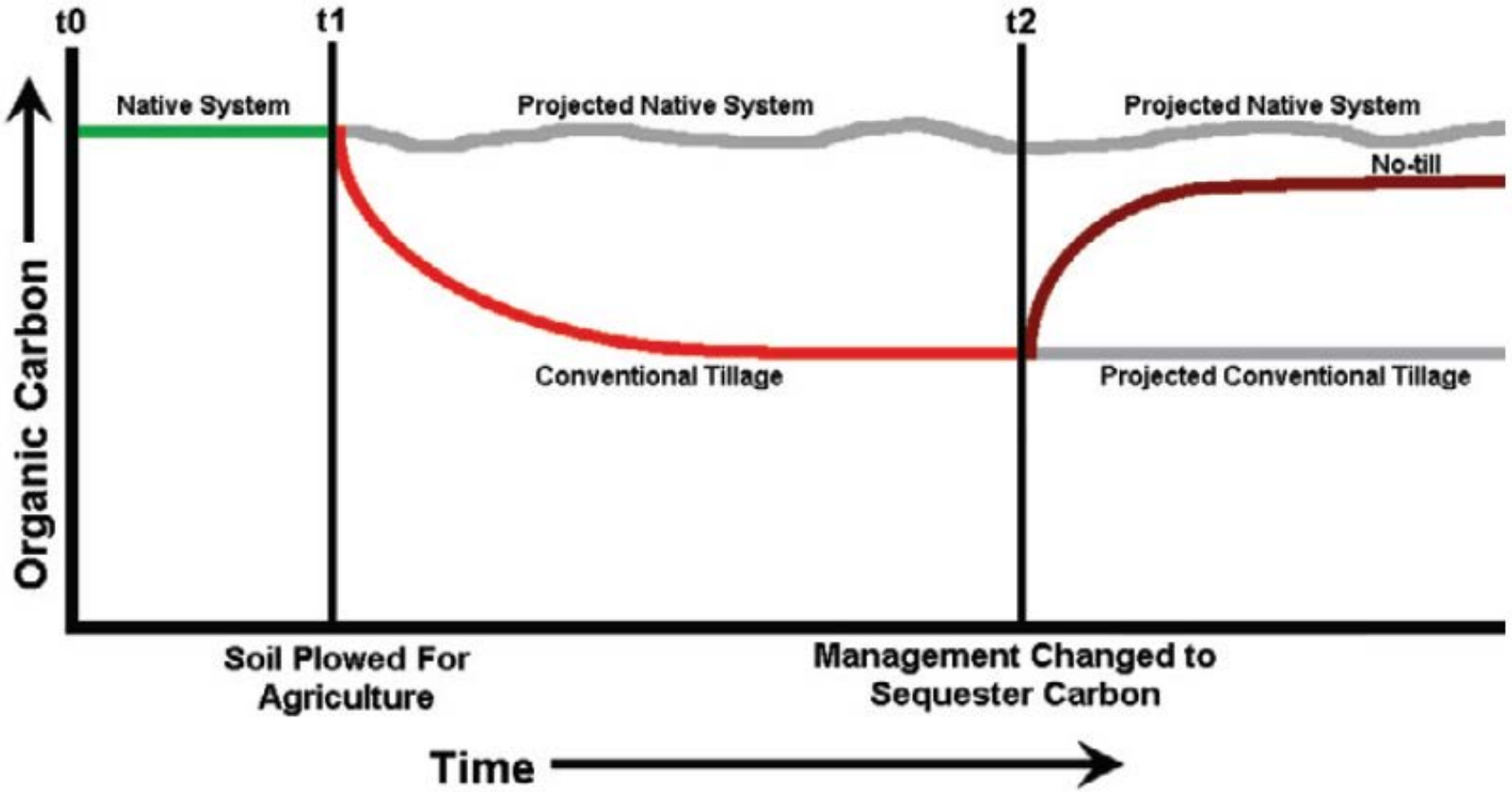
A soil carbon-specific ecosystem service <u>is climate change mitigation</u>.



Lal (2008)

LAND USE CHANGE

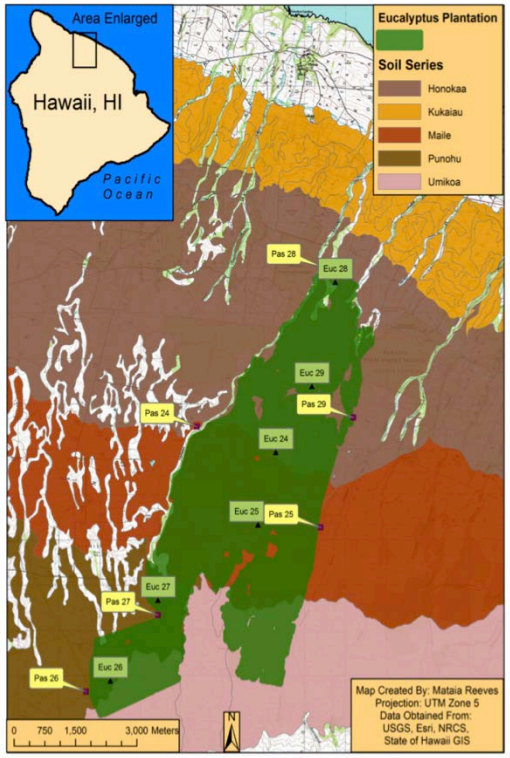
Land use change often results in soil carbon loss, management can stop or reverse the loss.



Brevik (2012)

DIRECT LAND USE CHANGE EFFECTS

How did soil carbon stock change as a direct effect of the conversion of pasture to managed eucalyptus plantation on the Hamakua coast of Hawaii?



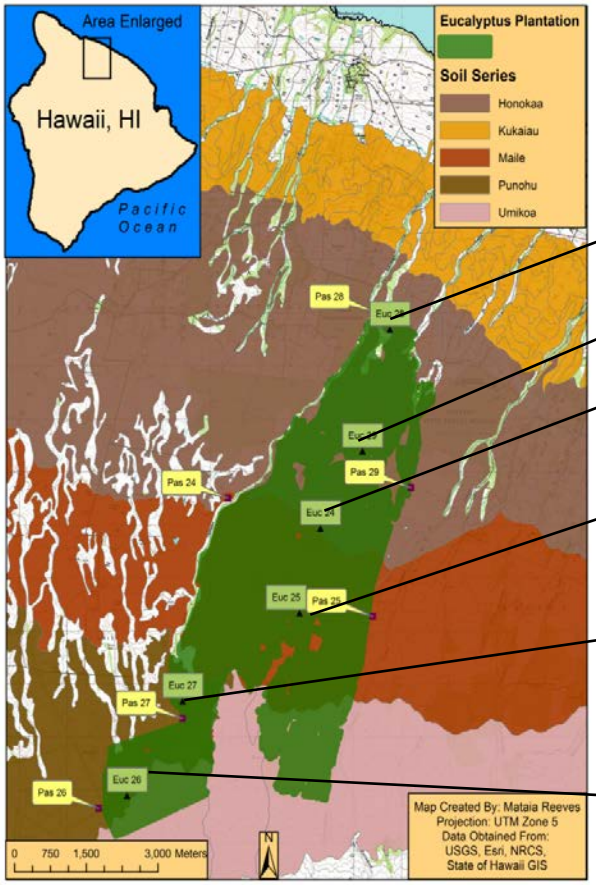
Land conversion from nearly 100 years of grazing pasture to *Eucalyptus* 7-10 years ago.

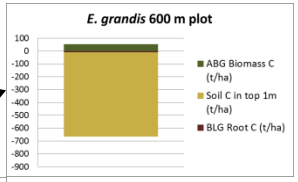
- 6 permanent plot pairs, Forest Solutions, (Nick Koch)
  - Paired with adjacent plots still under pasture
  - Covers a range of elevation, precipitation, biomass

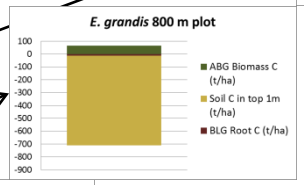
Crow et al. (in review)

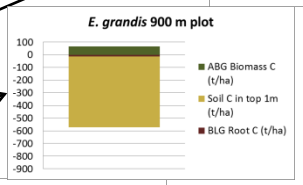
TOTAL CARBON INVENTORY

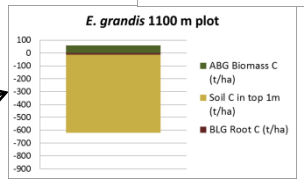
Soil carbon stock was nearly 10x that in aboveground biomass and roots

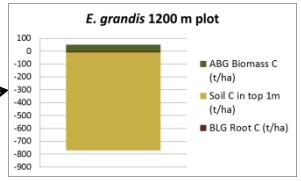


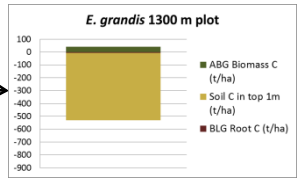


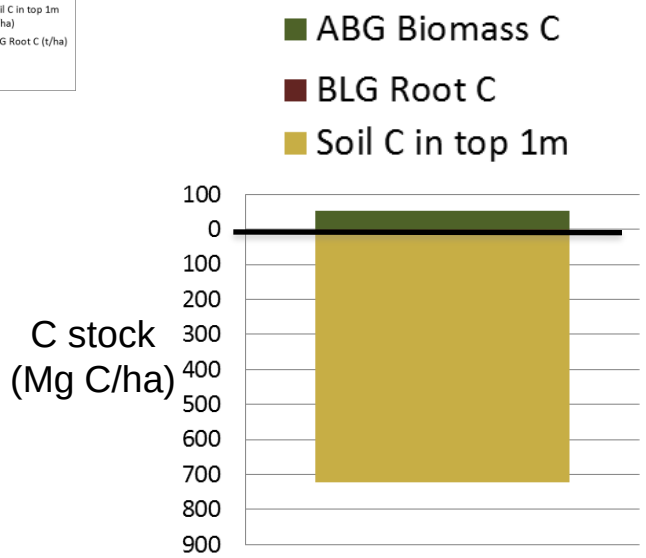










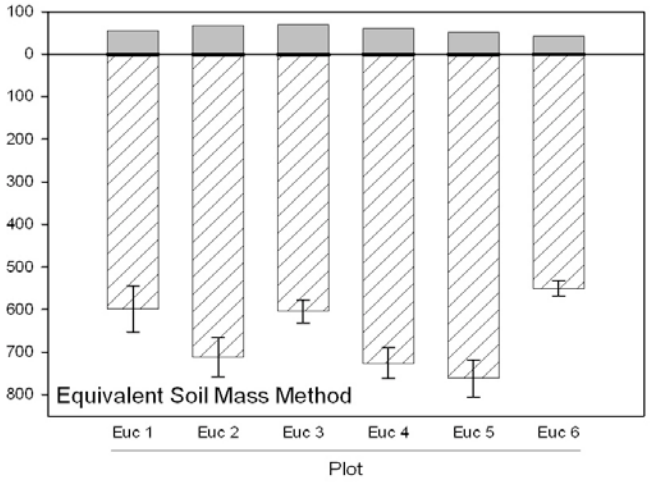


Mataia Reeves

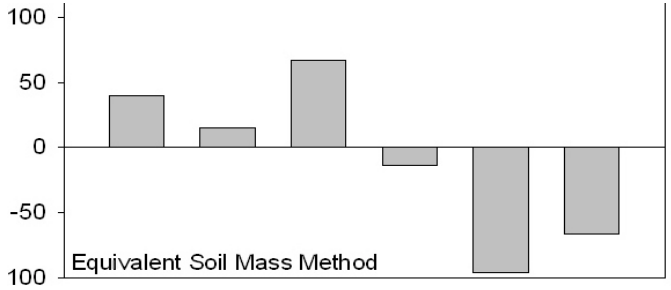
SOIL CARBON CHANGE

The change in soil carbon stock during conversion from pasture to eucalyptus plantation was variable and ~ zero.

Total Carbon
(T ha^{-1})



Δ Carbon
(T ha^{-1})

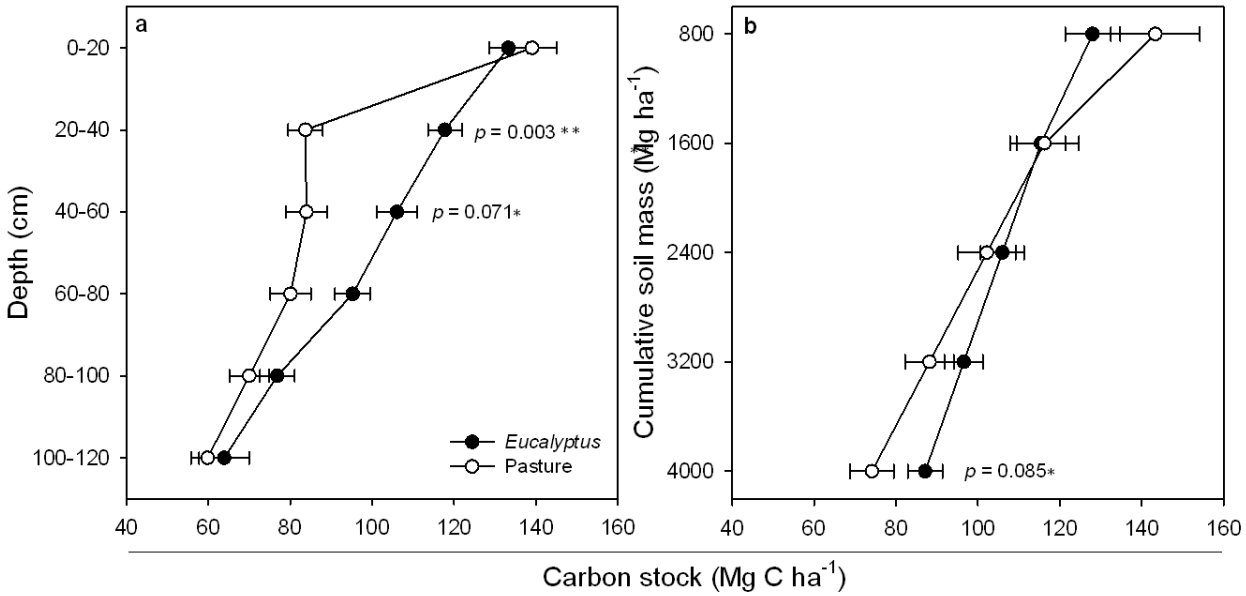


Mean 2.6% gain

Mataia Reeves and Olivia Schubert

CARBON STOCK METHOD MATTERS

Whether you use bulk density method or equivalent soil mass to determine soil carbon change matter, a lot.

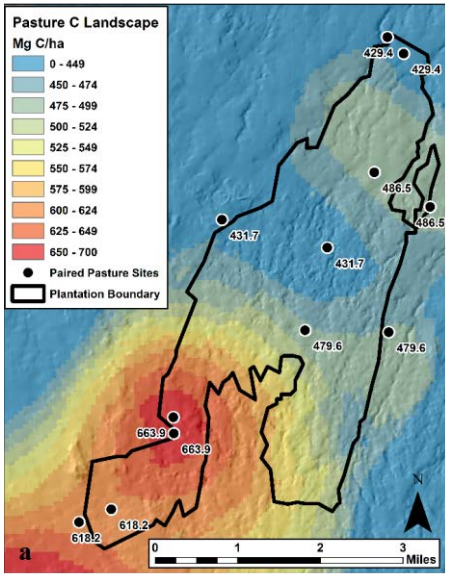


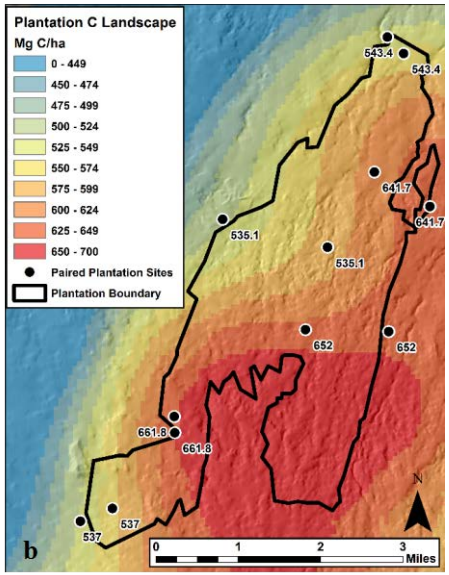
+17.5%	+2.6%	Soil carbon change

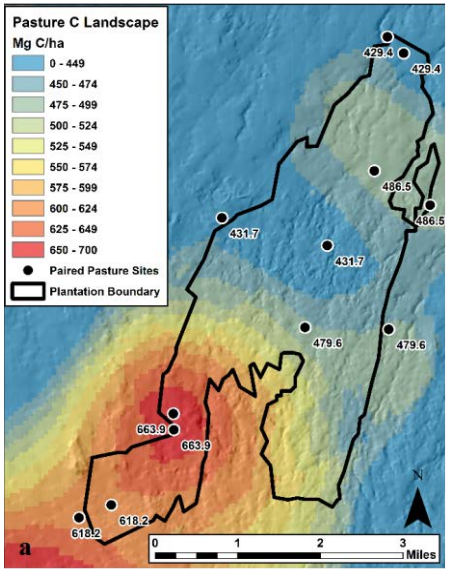
Crow et al. (in review)

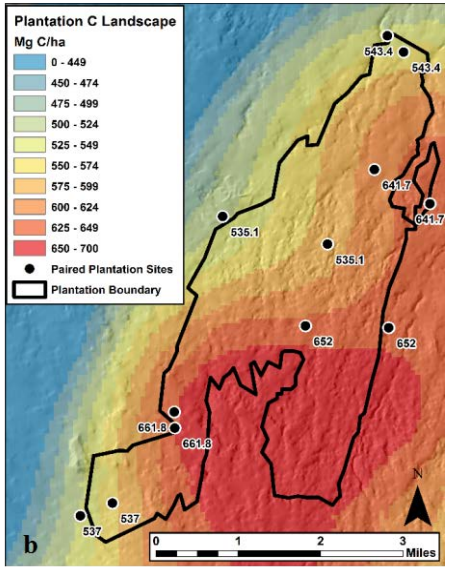
LANDSCAPE CARBON

Average values are nice, but landscape is more meaningful to land managers making decisions about land use.







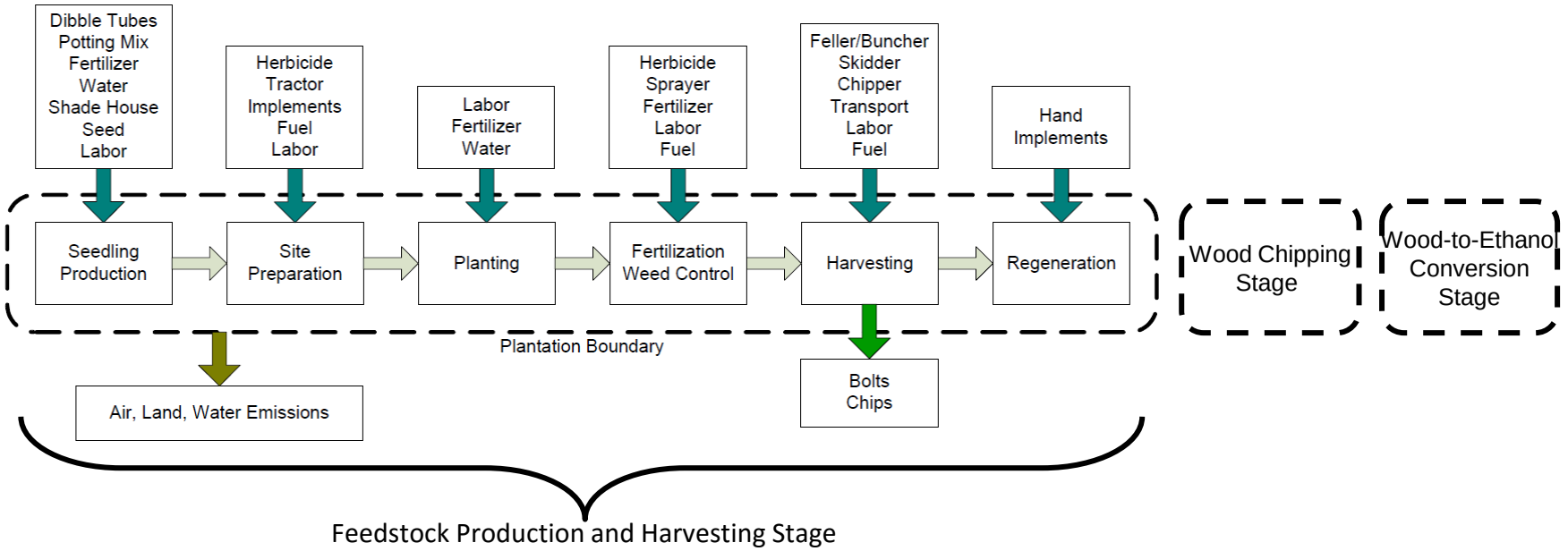


Pasture Eucalyptus Difference Proposed

Tomoaki Miura and Michelle Lazaro

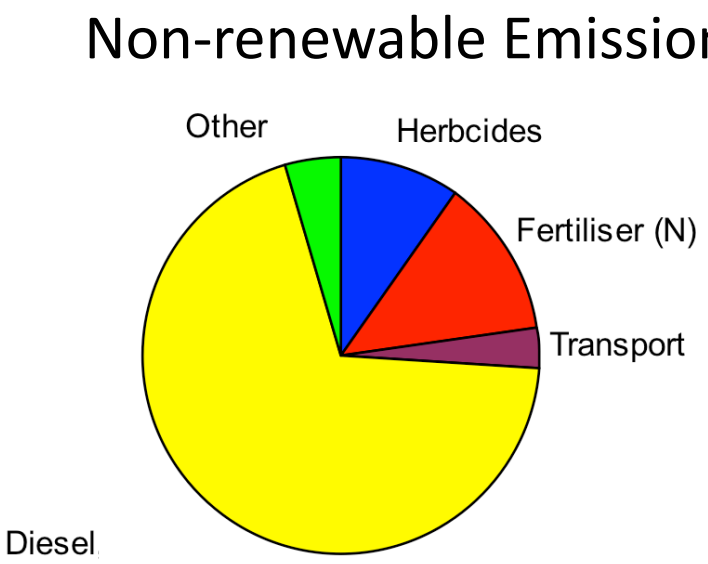
NON-RENEWABLE EMISSIONS

Define the boundaries of the system: determine the inputs and associated economic, energetic, and carbon costs.



NON-RENEWABLE EMISSIONS

In the proposed carbon landscape management scheme, the soil carbon gain in one rotation offsets non-renewable emissions for the next >100 rotations.

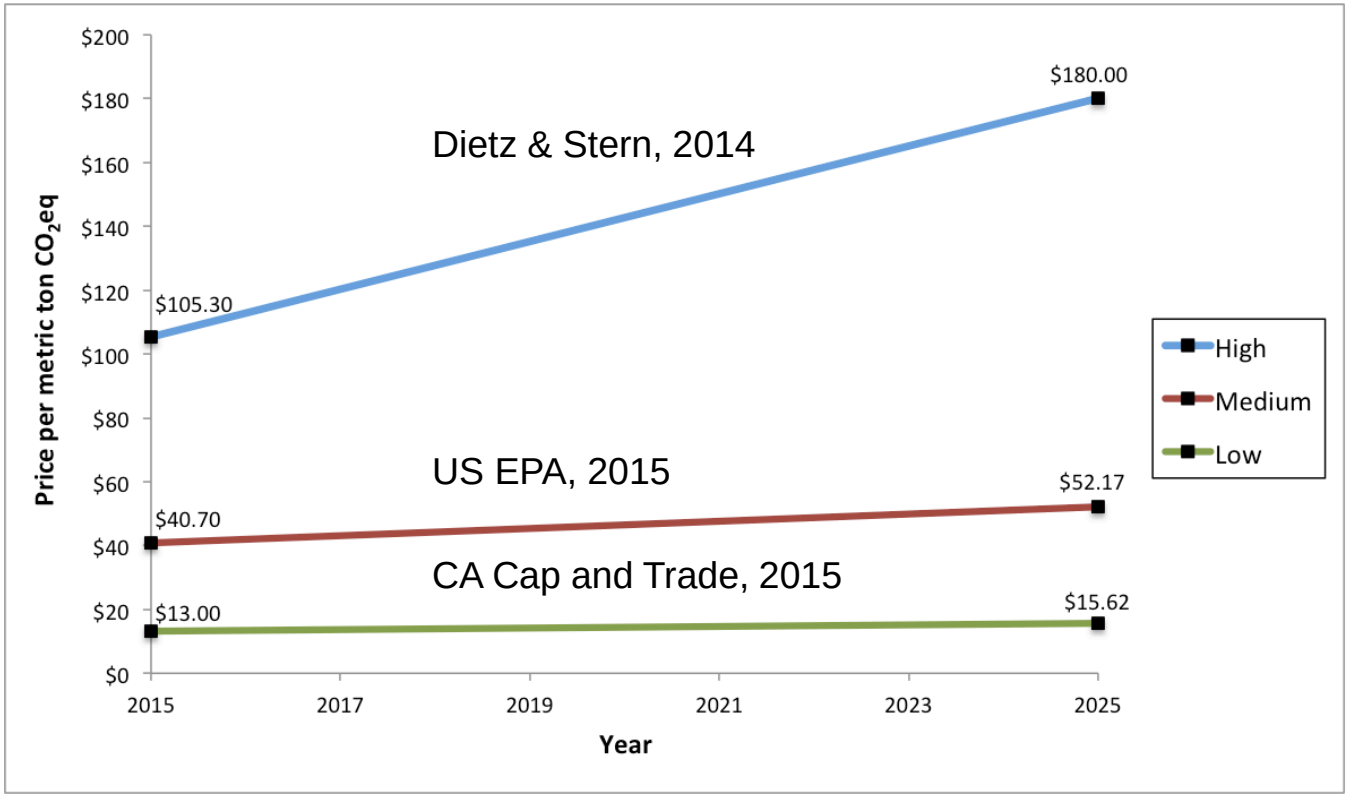


GHG Emission result		
$CO2_{Net}$		
Woody Crop at Plantation Boundary Includes Harvesting (7 Year Cycle).		
Eucalyptus	~3,500	kg CO_2 per ha
Wood Chip		
Eucalyptus	~5,000	kg CO_2 per ha
Ethanol from Woody Crop		
Eucalyptus	~17,000	kg CO_2 per ha

An alternative plantation boundary, drawn at the no-change perimeter, could maximize landscape-level soil C and optimize the sustainability of the plantation system from a global warming mitigation perspective by providing a soil C increase during the initial plantation that is great enough to offset the non-renewable emissions associated with 123 seven-year rotations.

CARBON MARKETS

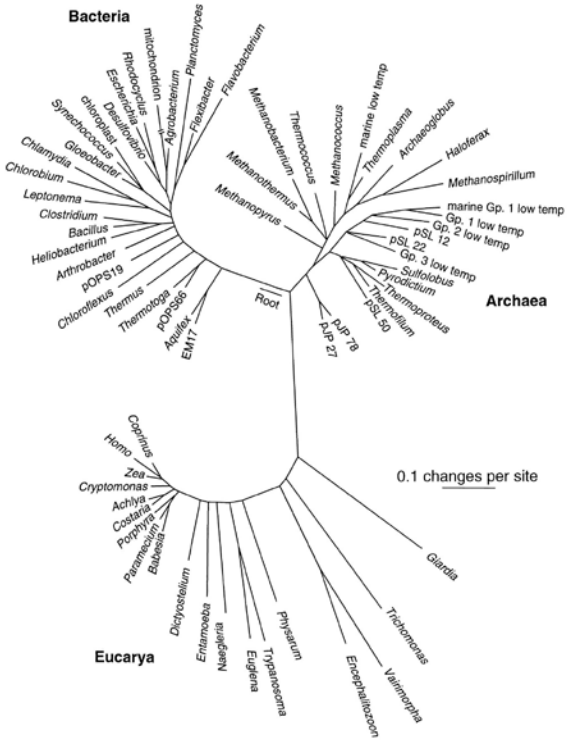
The economics and business model matter.



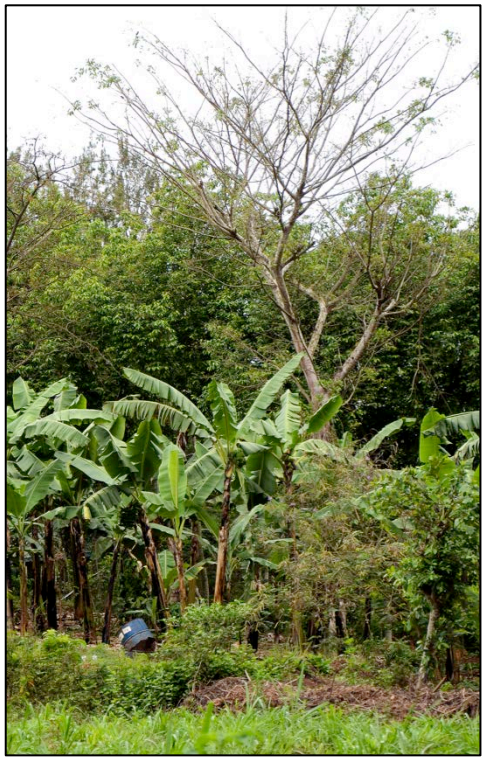
Three GWP valuation price scenarios in real dollars.

CONCLUSION

Diversity, diversity, diversity. And, soil C sequestration can be a major beneficial component of the net GHG balance of a system.



microbial



cropping system

landscape

SOIL CARBON CONUNDRUM

Balancing act: SOM simultaneously decomposes and accumulates, the balance is the soil carbon stock

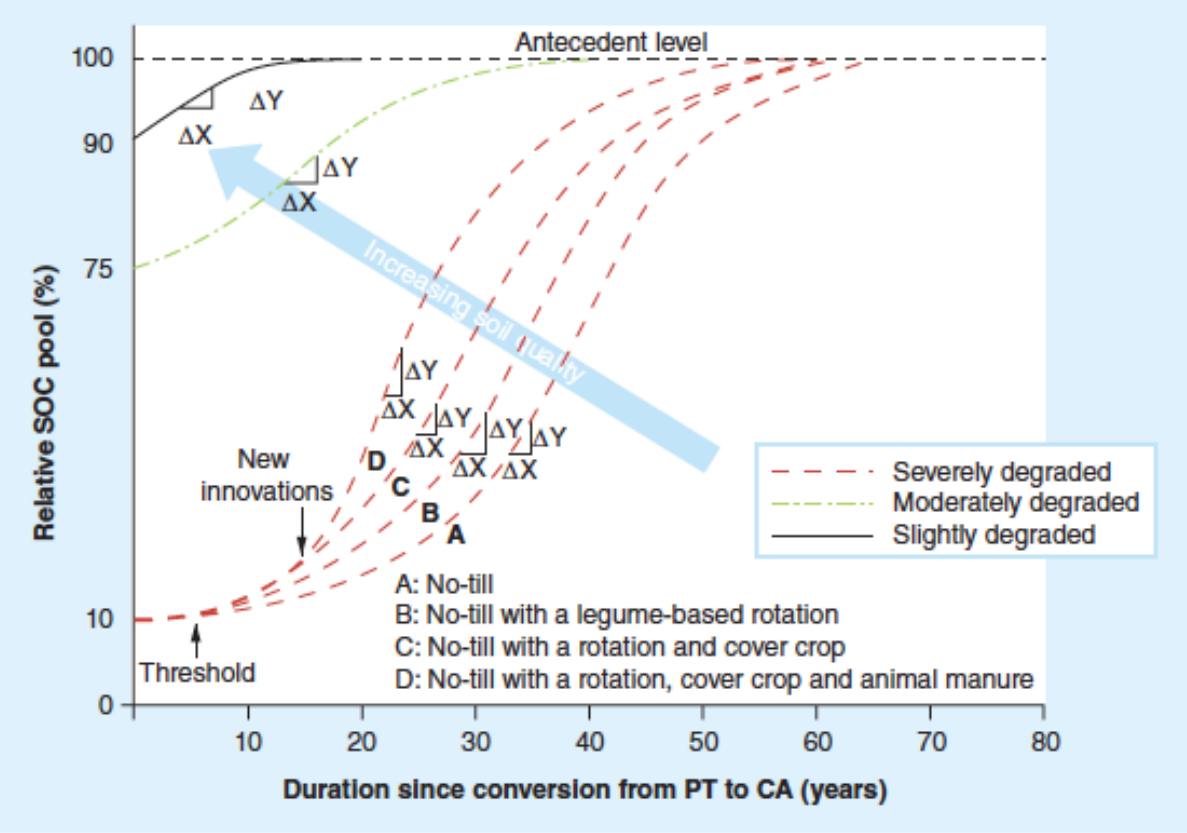
Factors Affecting the Balance Between Gains and Losses or Organic Matter in Soils	
Factors promoting gains	**Factors promoting losses**
Green manures or cover crops	Erosion
Conservation tillage	Intensive tillage
Return of plant residues	Whole plant removal
Low temperatures and shading	High temperatures and exposure to sun
Controlled grazing	Overgrazing
High soil moisture	Low soil moisture
Surface mulches	Fire
Application of compost and manures	Application of only inorganic materials
Appropriate nitrogen levels	Excessive mineral nitrogen
High plant productivity	Low plant productivity
High plant root:shoot ratio	Low plant root:shoot ratio

SOIL HEALTH, SOIL QUALITY

Soil quality refers to soil function (what does the soil do?), soil health is a set of measureable indices of soil quality.

MANAGEMENT CHOICE

Management options can conserve (maintain) or restore (accumulate) soil C stocks.



PT = plow tillage
CA = Conservation agriculture

Lal et al. (2014)