

Carbon Farming:

Perennial Crops and Agroforestry for Carbon Sequestration & More



Climate Change



What Must Be Done?

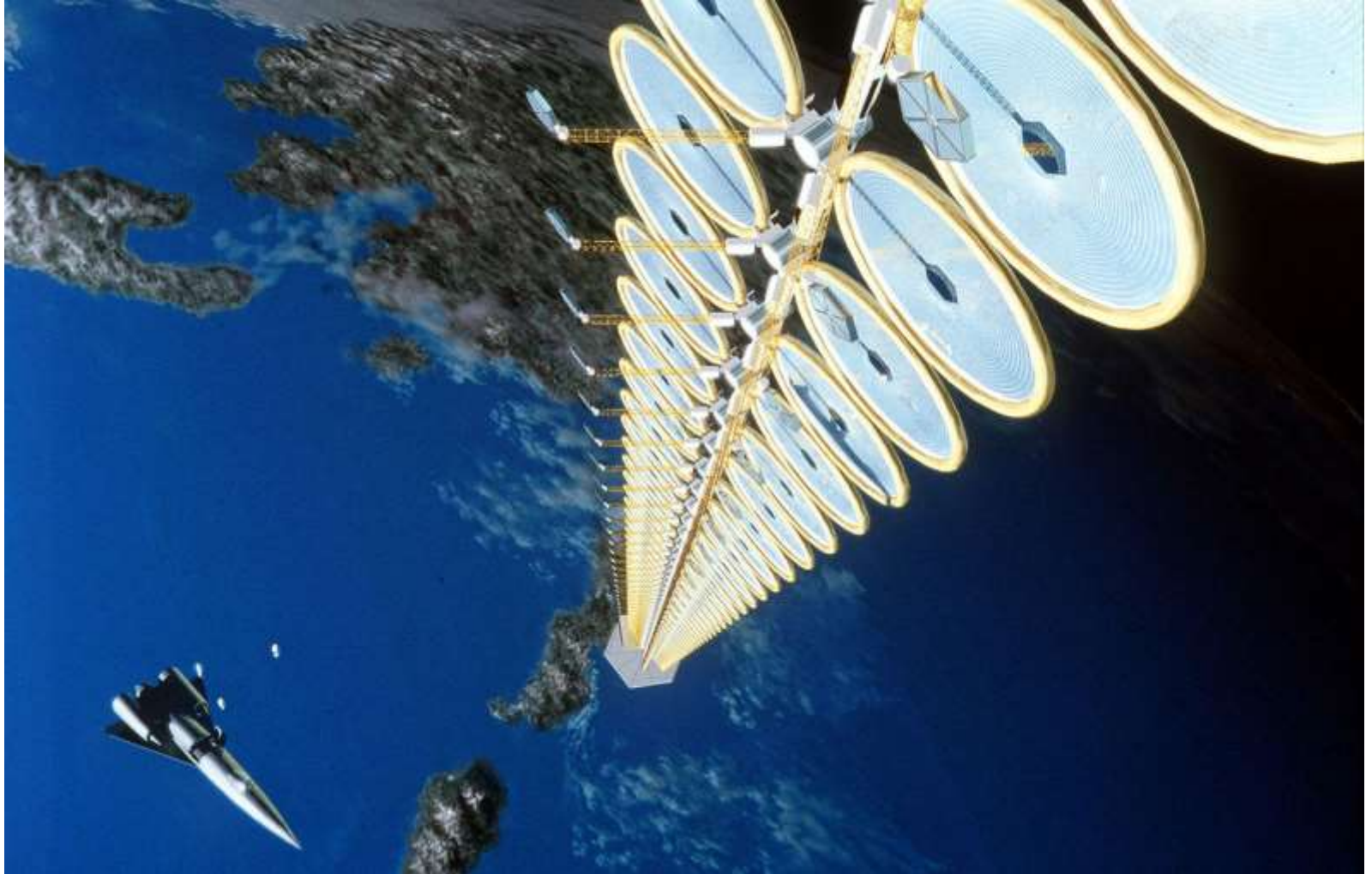
- Back to 300-350ppm CO₂
- Pull 200-250 GT carbon from atmosphere
- Reduce emissions DRASTICALLY
- Sequester gigatons of carbon
- Complete society-wide transformation



1 GT = 1 billion tons

Source: 350.org

Geoengineering?



Public domain



Climate Justice

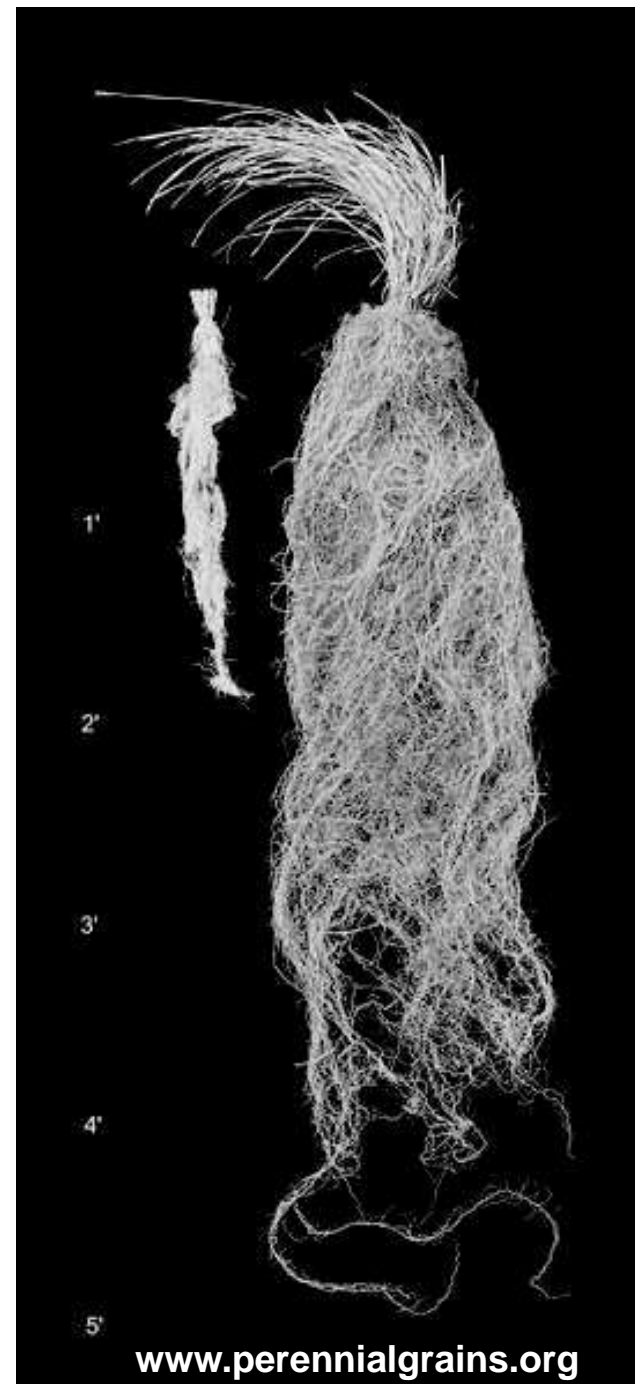
- Who causes climate change?
- Who suffers?
- What mitigation, adaptation, and development (MAD) strategies address this?

Carbon Sequestration


“The process of removing C from the atmosphere and depositing it in a reservoir... It entails the transfer of atmospheric CO₂ and its secure storage in long-lived pools.”



Perennials Sequester Carbon



Where the Carbon Goes

CARBON SINK		NOTES
Above Ground Biomass 1/3		50% or less of AGB is carbon
Below Ground 2/3		Mostly in soil aggregates; roots equal 20-40% of aboveground biomass

- Some C losses in both cases
- Challenging, non-standardized measurement

P.K. Nair, "Methodological Challenges in Estimating Carbon Sequestration Potential of Agroforestry Systems" in *Carbon Sequestration Potential of Agroforestry Systems*

Agroforestry can *equal or beat* adjacent forests

- In long-lived, densely-treed systems



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Enormous Potential

- IPCC notes 630,000,000 ha expansion possible
 - an area twice the size of India
- At 30-300 T/ha lifetime in soil
- 18.9-189 GT over 20+ years
 - Of 200-250 GT needed



Multiple Benefits

- Avoided deforestation (5-20 ha/ha)
- Reducing emissions
- Ecosystem services
- Soil improvement, erosion control
- Restore degraded land
- Food and fodder in hungry seasons
- Increased yields
- Food security

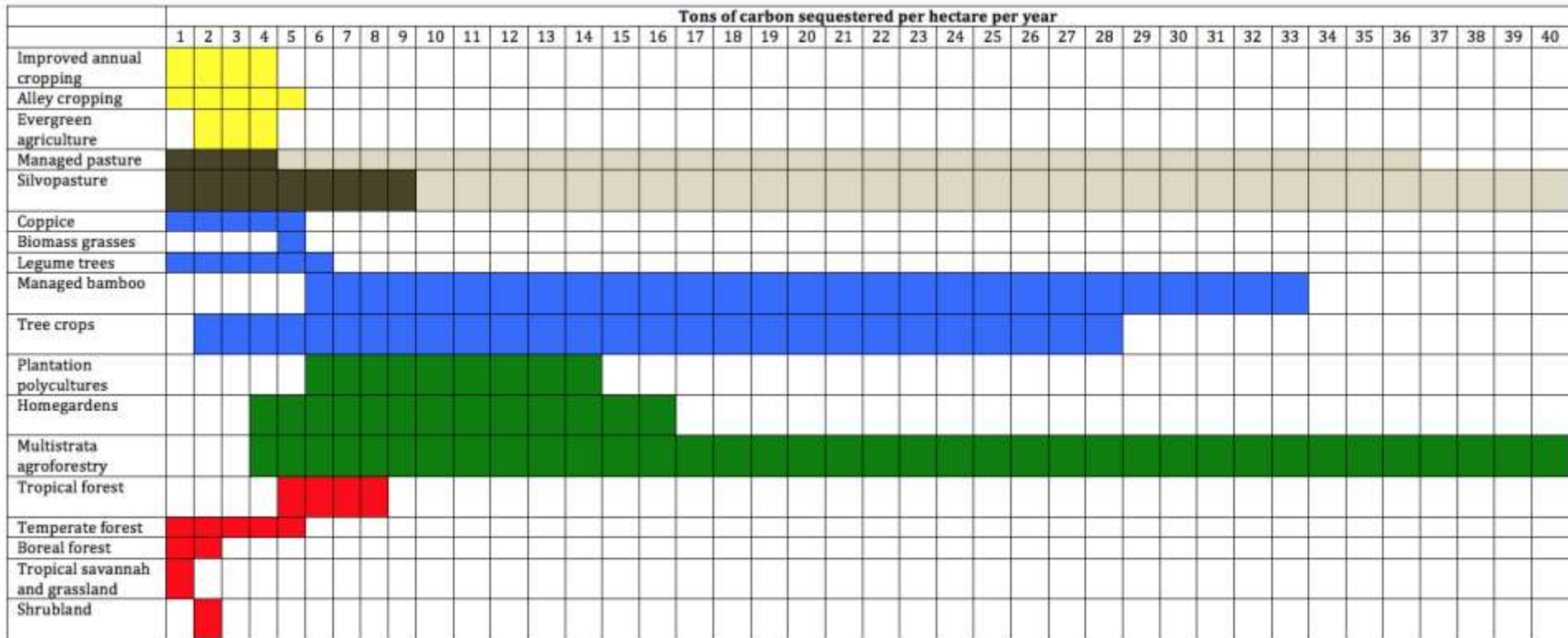


Drawbacks

- Some crops and practices lower yields
 - Especially in colder and drier climates
 - Balance vs. intensive annuals on less land
- Other emissions
 - Methane, nitrous oxide
- Water competition
- Invasive species
- Lure of “easy fixes”
- Monoculture and land grabs
- Financial hurdles for farmers
- Change in diet



Carbon Sequestration Rates



Improved Annual Systems

- Low carbon sequestration
- Familiar crops
 - Harvest
 - Process
 - Eat
- Some already widespread



Improved Annual Systems



No-Till



SRI



Rotation & Cover Crops



Mulching

Annual-Perennial Systems

- Low to medium carbon sequestration
- Familiar crops



Irregular Intercropping



Pinus koraensis, N. Korea



Faidherbida albida, Africa

Strip Intercropping



Alternate Rows



Alley Cropping



Contour Hedgerows

FMNR & Evergreen Agriculture



Farmer-Managed Natural Regeneration



Evergreen Agriculture with
Faidherbia albida

Windbreaks and Living Fences



Windbreak



Living fenceposts



Living fence

Livestock Systems

- Carbon sequestration low to medium
 - Rare instances high
- Livestock eat perennials, we eat them
- Methane offgassing
- 67% of world farmland is pasture



Managed Grazing



Silvopasture



Creative Commons 3.0

Intensive Silvopasture



Photo: UQ Collection ©

Fodder Trees



Fodder pods and fruits



Fodder bank

Fully Perennial Systems

- Carbon sequestration medium to high
- New and different crops
- Some undomesticated or hypothetical



Orchards and Plantations



Bamboo, Coppice, and Biomass



willow
short rotation coppice



chestnut coppice



*Dendrocalamus
asper*



*Gynerium
sagittatum*

Multistrata Systems



homegardens
Sago Festival
Saint Martin



multistrata
agroforestry
Veracruz



plantation polycultures
shade coffee under *Inga*



Aquaforestry



Fig. 94.—Mulberry orchard to which a heavy dressing of canal mud had been applied. A family of mulberry leaf pickers were living in the boat anchored in the canal.

Dyke-pond systems: China

Farmers of Forty Centuries



Chinampas
Xochimilco

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Perennial Grain Systems



- Monocultures
- Polycultures
- Pasture cropping
- Grain-grazing



Other Tools

- Carbon sequestration variable
- Biophysical techniques
- Increase carbon sequestration by plants



Rainwater Harvest & Drip Irrigation



Other Tools



Keyline



Biochar

TOOLKIT: CROPS



Non-Destructively Harvested Perennial Crops

- Perennial
- No-till
- Not destroyed by harvesting
- Many crops types
 - Food
 - Industrial
 - Agroforestry



Perennial Staple Crops

- Protein
- Carbohydrates
- Fats



Industrial Crops

- Materials
- Chemicals
- Energy



Opportunity

- Steer carbon funds to regions in need



ARLOMOM, Senegal