

Conserving and regenerating forests and soils to mitigate climate change

Anne-Marie Codur
GDAE Research Fellow

GDAE Brown bag lunch series,
December 6, 2017





Global Development and Environment Institute
Tufts University



Hope Below Our Feet

Soil as a Climate Solution

by Anne-Marie Codur, Seth Itzkan, William Moomaw, Karl
Thidemann, and Jonathan Harris*

Climate
Policy Brief
No. 4
April 2017

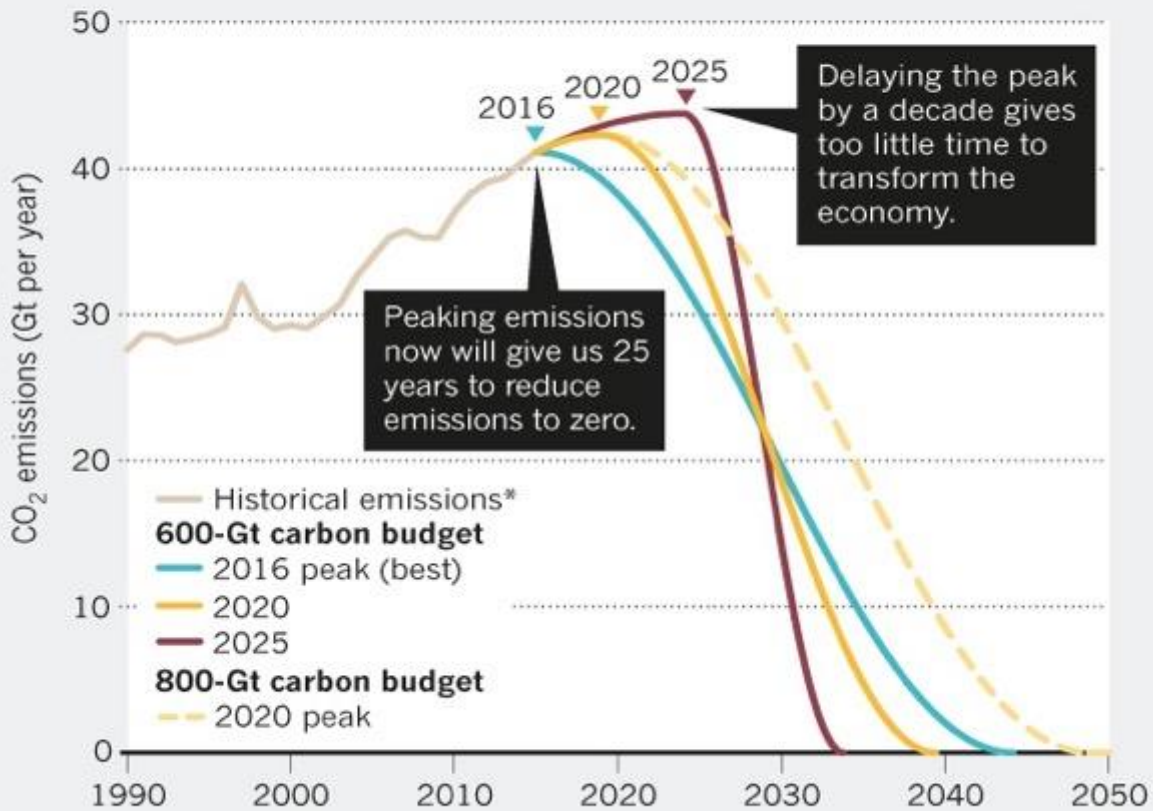
<http://www.ase.tufts.edu/gdae/Pubs/climate/ClimatePolicyBrief4.pdf>



The Urgent decarbonization transition

CARBON CRUNCH

There is a mean budget of around 600 gigatonnes (Gt) of carbon dioxide left to emit before the planet warms dangerously, by more than 1.5–2°C. Stretching the budget to 800 Gt buys another 10 years, but at a greater risk of exceeding the temperature limit.

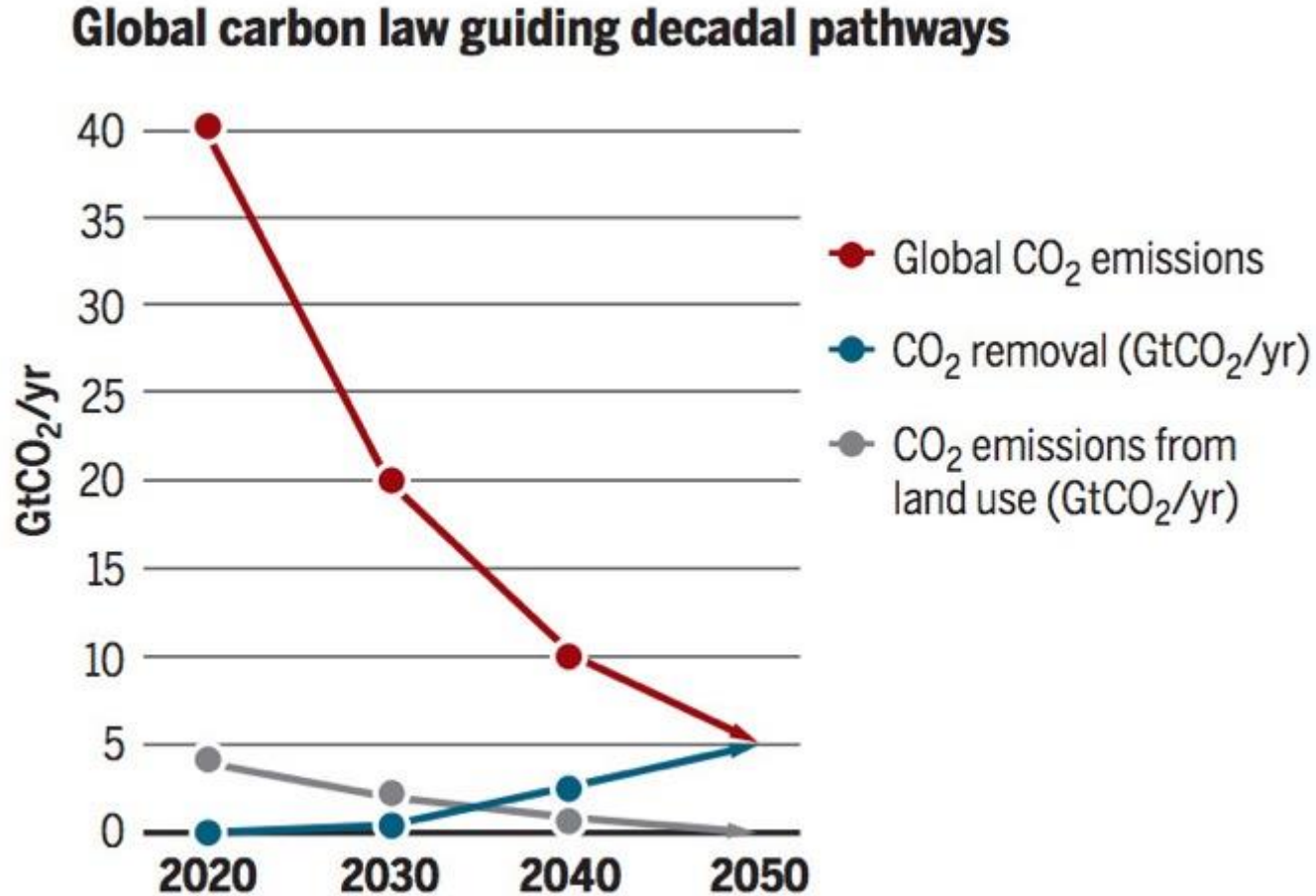


©nature

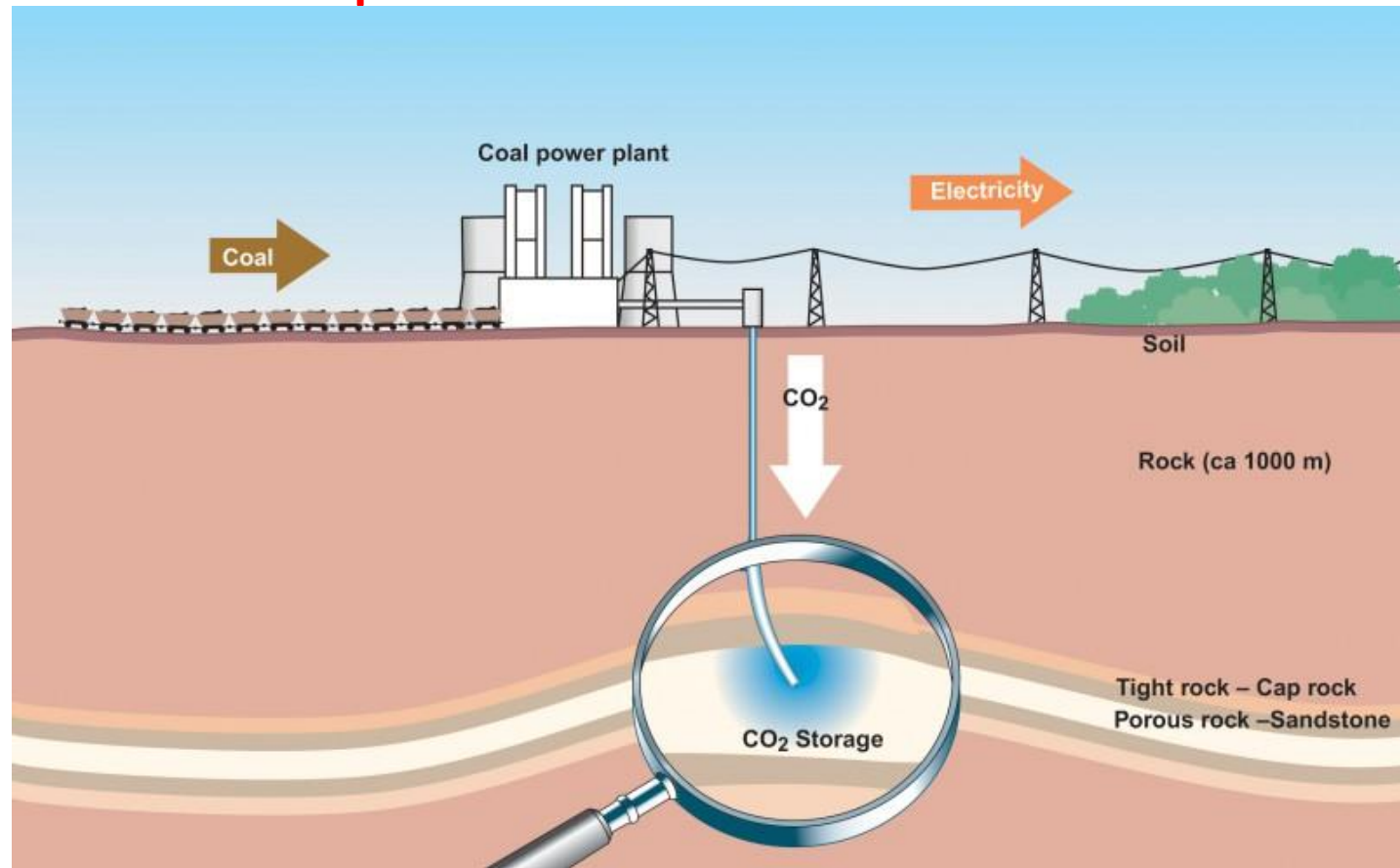
*Data from The Global Carbon Project.

Carbon budget:
600Gt CO₂
=
160Gt Carbon

“Herculean efforts” On the emission side:

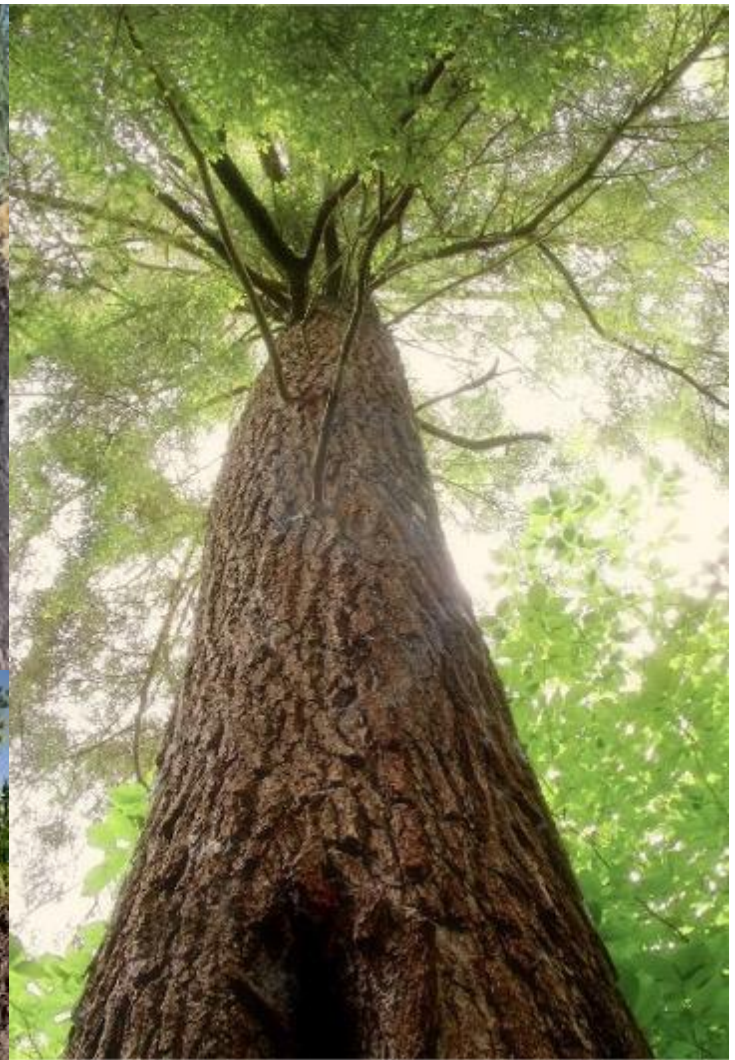


On the “Negative Emissions” side: Carbon capture, storage, sequestration Carbon capture and storage (CCS) technologies are still speculative and cost ineffective



“Carbon capture flops in California despite millions in investment”

Planet Earth does it best (and for free)!

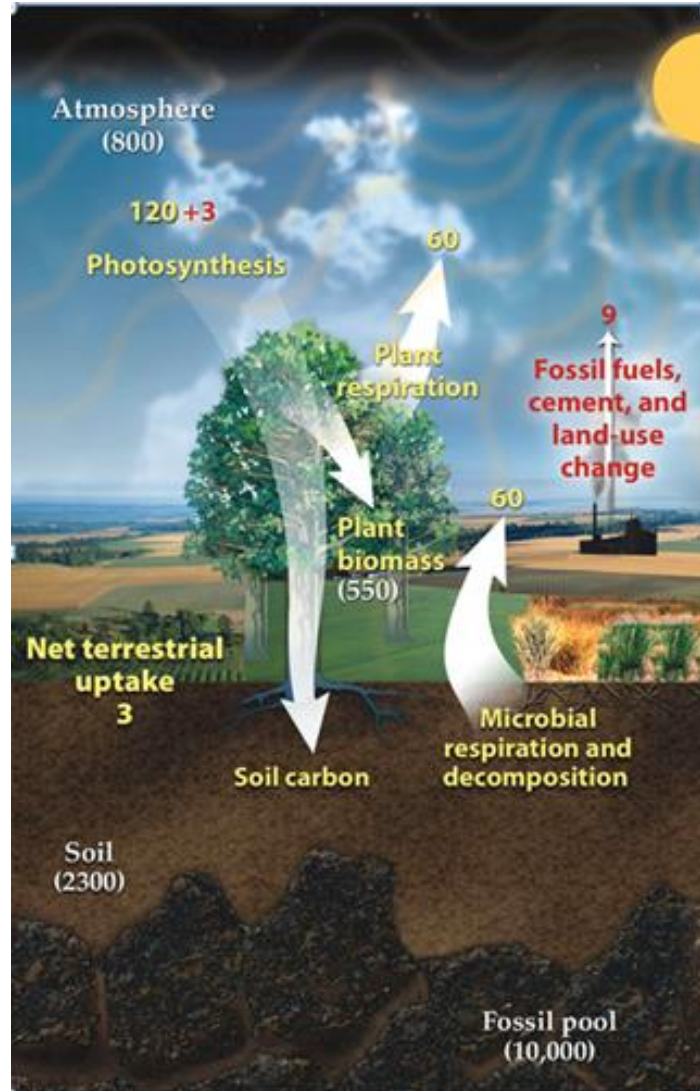


Carbon is a building bloc of life, cycling through:

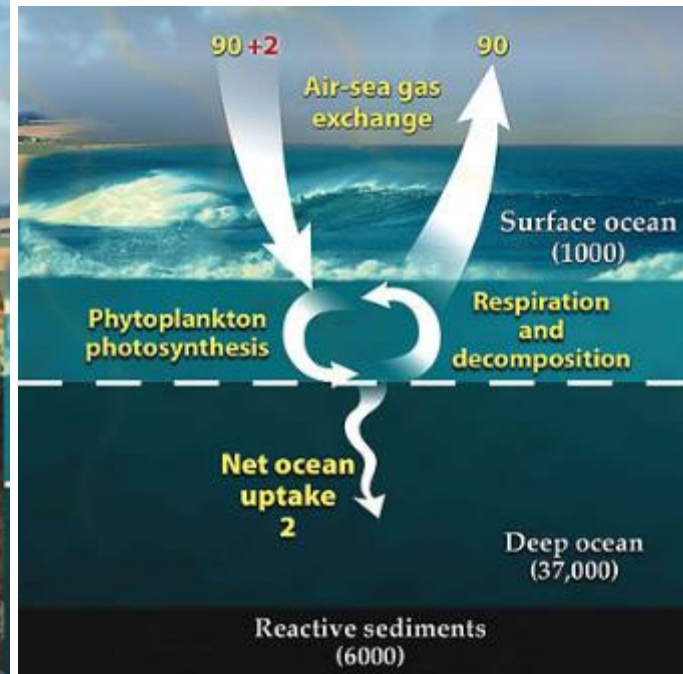
The Atmosphere:
860 Gigatons
(Carbon budget left = **160Gt!**)

Plant biomass:
550 Gt

Soils:
2300 Gigatons



The Oceans: net ocean uptake = 2Gt per year
-> **acidification**

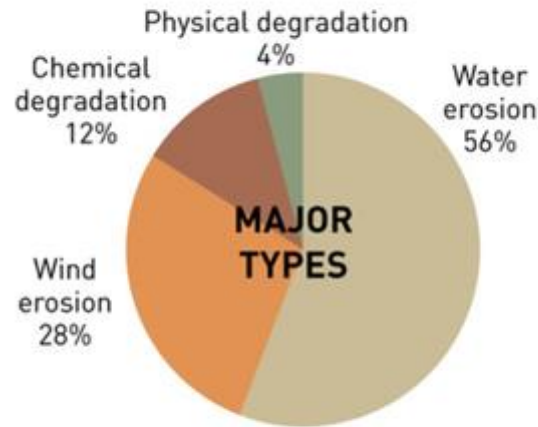


Note: data in this figure is from 2011, when Carbon concentration in atmosphere was 800 Gt

Soils have been losing their organic carbon since the dawn of agriculture

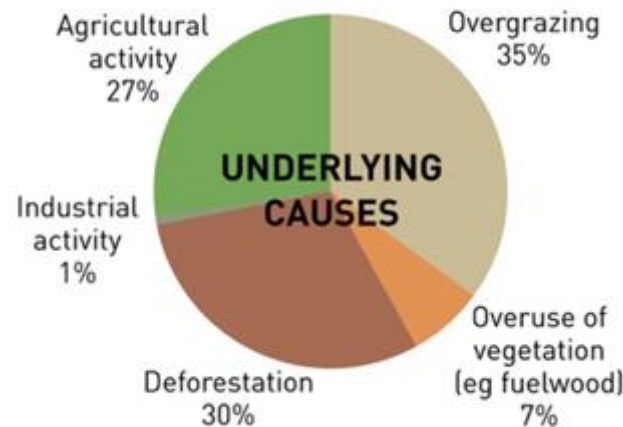
Major types and causes of soil degradation

Cultivated soils have lost 50 to 70% of their original organic carbon (Rattan Lal)



Fall of civilizations: The fertile crescent (Mesopotamia) is now a desert

Today, soils are being eroded 10 to 40 times faster than they can be replenished



Source: FAO/UNEP

One civilization knew how to make its soil more fertile: The Amazonians



2 meters deep
(6.6 feet):
Thousands of
years of
anthropogenic
soils

Fungi and micro-organisms attach to the biochar which retains nutrients forever: thousands of years later, terra preta is still extremely fertile

See Robert Tindall, Frédérique Apffel-Marglin and David Shearer, *Sacred Soil: Biochar and the Regeneration of the Earth*, 2017.

Instead, today's slash and burn agriculture



Clearing in the forest, fallen trees are burned to give some fertilizing phosphate to the clayish Amazonian soil, allows crops to be grown from 1 to 4 years maximum, then needs to slash and burn further... 3rd leading cause of CO₂ emissions in Latin America

Industrial agriculture mines and exhausts the soils



Soil erosion, loss of fertility

Soil erosion made worse by industrial agriculture

- 10 million hectares of cropland lost each year
- 80% of global agric land – moderate-severe erosion
- Eroding 10-40 times faster than we can replenish it
- Industrial ag – to create 1 inch topsoil: *200 years!*

Reliance on synthetic fertilizer can weaken soil fertility

- *50-60% not taken up by target crops*
- Acidification – especially with soil compaction
- Reduces organic matter, soil microbial diversity, functions
- Denitrification – leaching, runoff, N₂O emissions

Vicious cycle replaces nitrogen cycle –

- more fertilizer needed to get same yield, with more damage to soil fertility and environment.

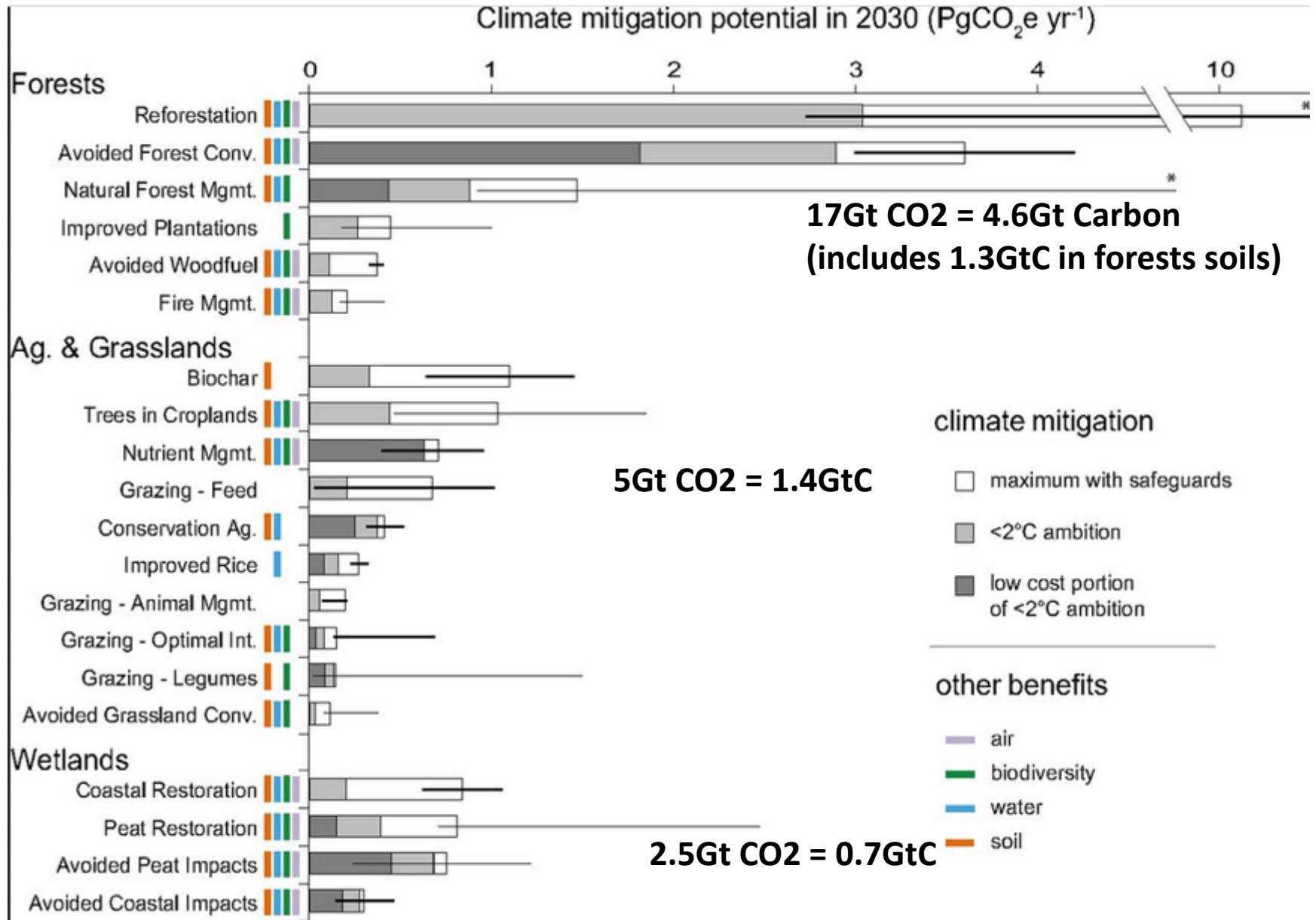
SCIENTIFIC
AMERICAN®

Only 60 Years of Farming Left If Soil Degradation Continues

Generating three centimeters of top soil takes 1,000 years, and if current rates of degradation continue all of the world's top soil could be gone within 60 years, a senior UN official said

**WE CAN SOLVE BOTH
THE SOIL CRISIS AND THE CLIMATE CRISIS:
recapture the Carbon from the atmosphere to
store it in soils and ecosystems**

Climate Mitigation Potential of 20 natural pathways



Reforestation

“Standing forests are the only proven system that can remove and store vast amounts of carbon dioxide from the atmosphere at the scale necessary to keep global temperature rise below 1.5 degrees Celsius this century.”

- Bill Moomaw

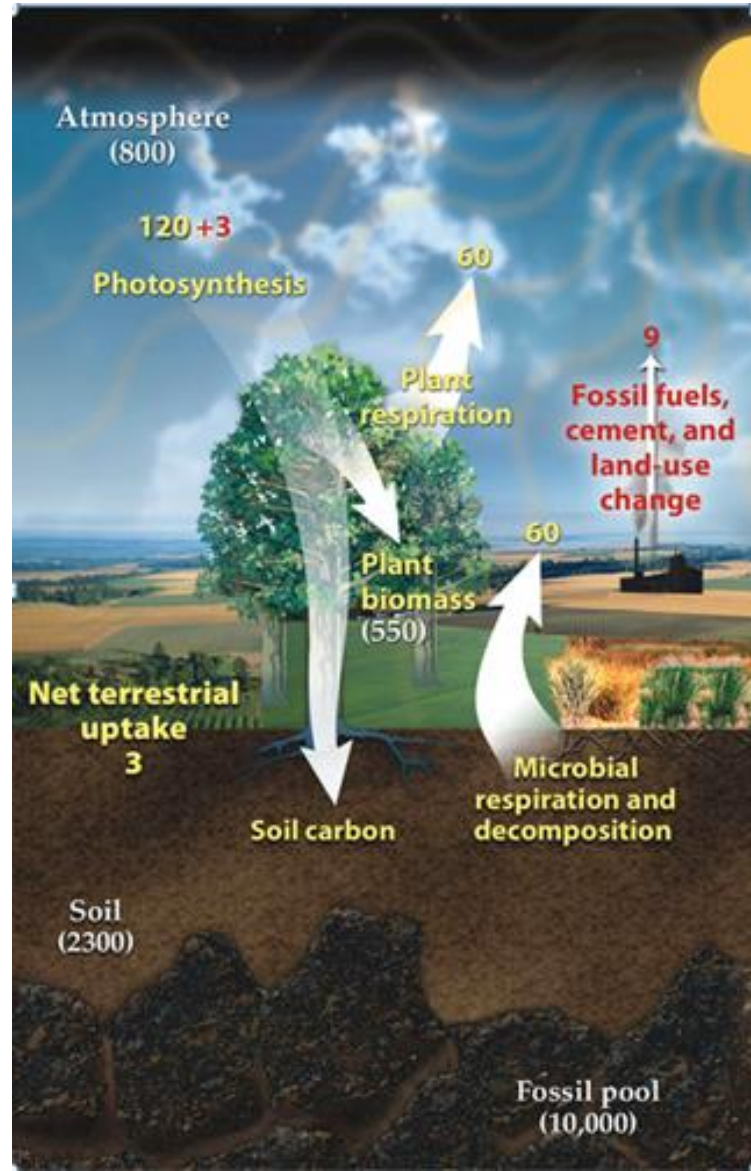
- Halt deforestation 1.1 GtC/y
 - Remove CO₂ by restoring forest capacity over next 50 years at average rates of
 - Allow current second growth forests to reach maturity 2 GtC/y
 - Restore degraded forests 1 GtC/y
 - Reforest recently deforested lands 1 GtC/y
- TOTAL = 5GtC/y**

Technical potential for regenerating Soils and increasing their carbon intake

- – **Agricultural soils: 1.4 GtC/year**
- – **Forests soils and agroforestry soils: 1.3 GtC/year**
- – **Salt affected and desertified soils: 0.5-1.4 GtC/yr**

Total estimated to 3.4 Gt per year

Adding 3.4Gt of Carbon per year in soils worldwide



Carbon in topsoil
(40cm = 16 inches):
860 Gigatons

Adding an extra 3.4Gt of
Carbon in topsoils per
year:

$$3.4/860 = 0.004$$

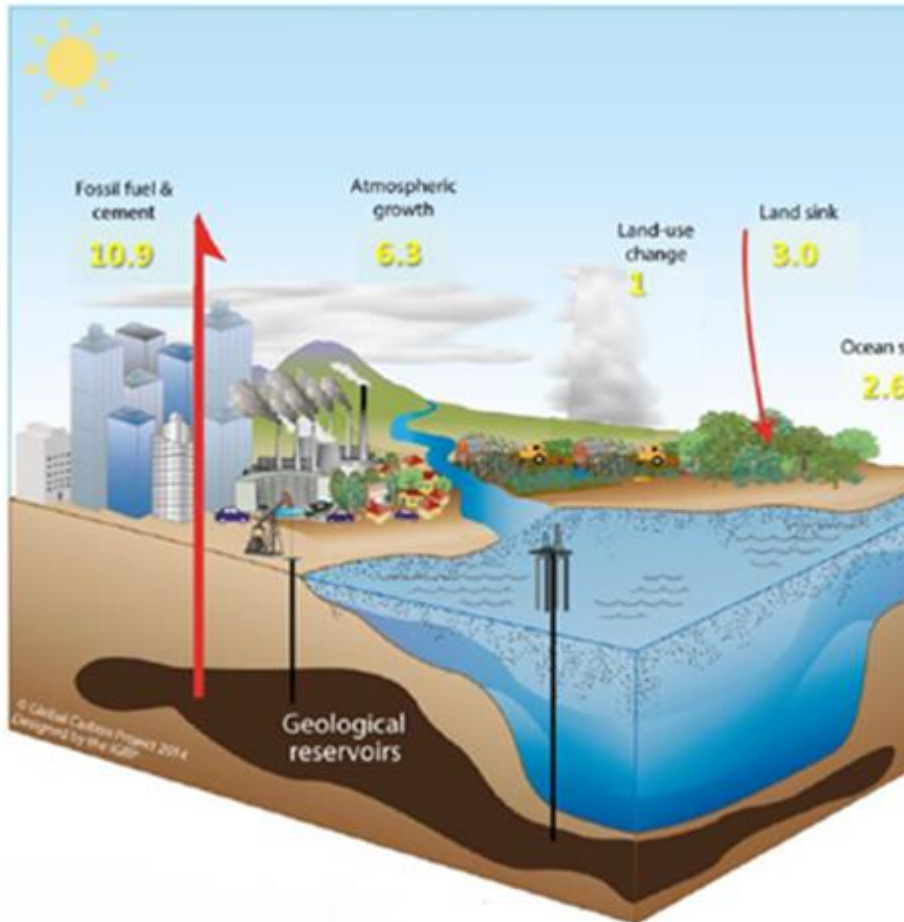
= 4 per 1000

Paris, December 2015, French Ministry
of Agriculture launches:

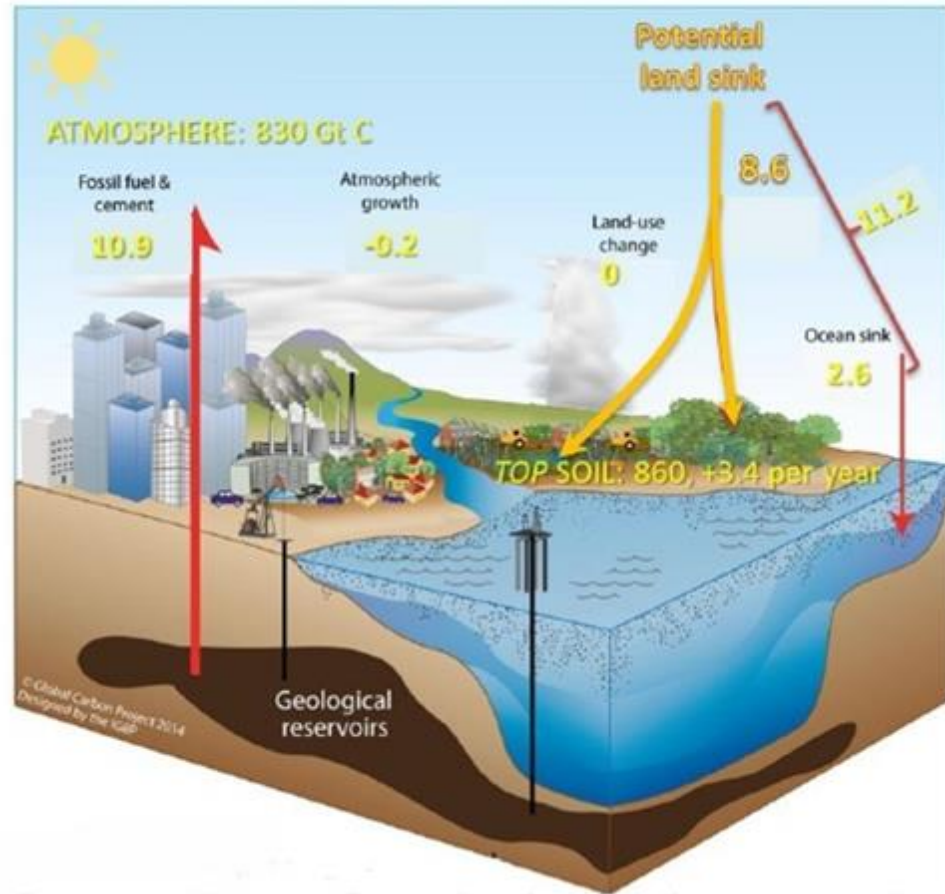


⇒ To increase carbon concentration in soils by 4 per 1000 per year
= 0.4% per year

Horizon 2030 – with and without a Forests&Soils regeneration



without Forests&Soils regeneration



with full implementation of Forests&Soils regeneration

Policy instruments and implementation?

FORESTS

In the language of the Climate Negotiations since Kyoto (1997): REDD

Since 2013: called REDD+



Reducing
Emissions from
Deforestation and forest
Degradation
+ Conservation and Sustainable Development



FIP Forest Investment Program

- \$775 million funding mechanism of the Climate Investment Fund, to “provide indispensable direct investments to benefit forests, development and the climate.”
- FIP grants and low-interest loans, channeled through partner multilateral development banks (MDBs)

-> incentives for industrial tree plantations: teak, pine, eucalyptus, palm trees (oil), ...

monoculture plantation: is this reforestation?

- suck up much of the water in an area
- “green desert” in terms of biodiversity
- increase erosion and compaction of the soil
- reduce soil fertility
- increase the risk of fire:

Portugal’s “killer forests”



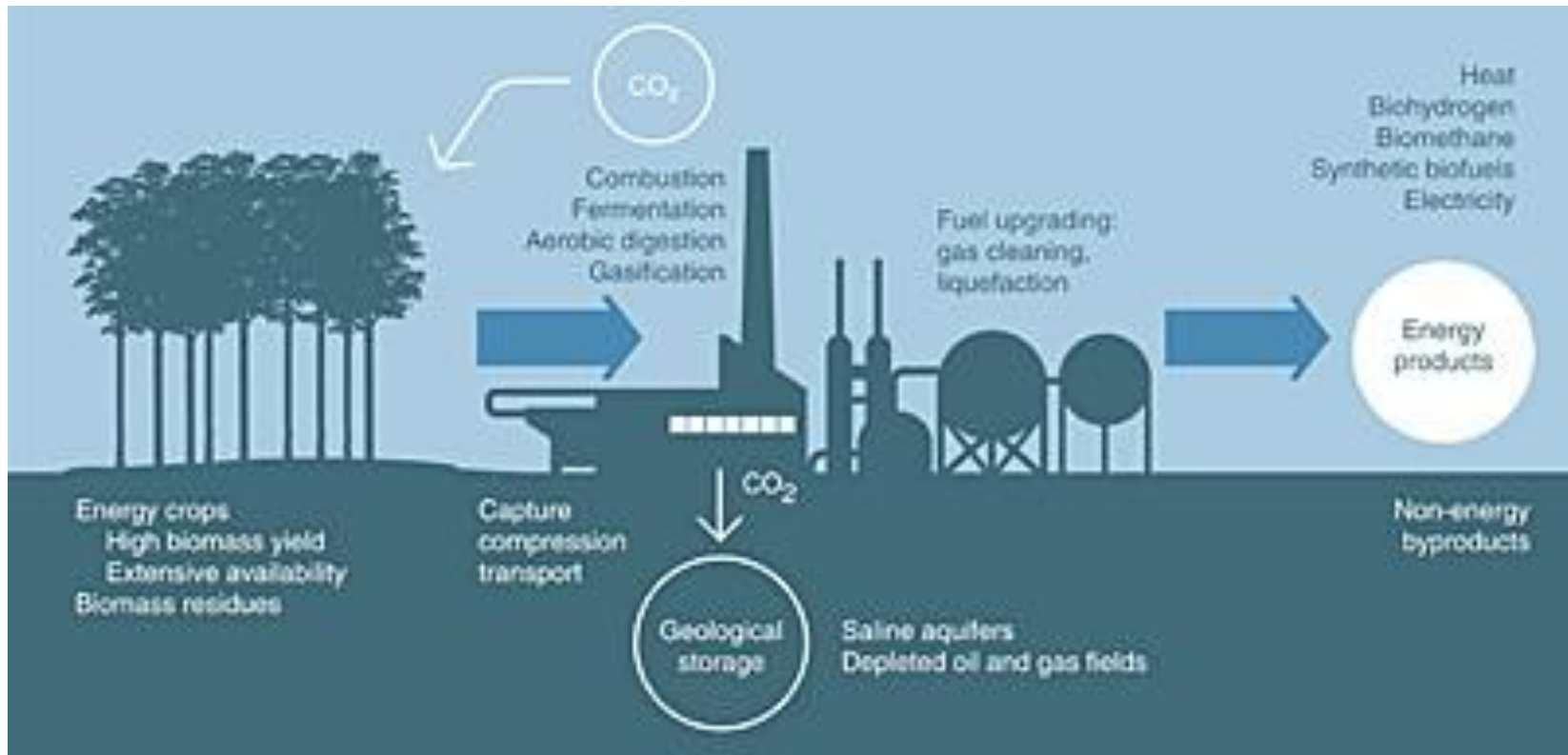
900,000 hectares of eucalyptus forests



Mozambique: 1.85\$million FIP funding to plant 200,000 ha of eucalyptus

Paraguay: PROEZA project 32,500 ha of eucalyptus to produce bioenergy for the soy sector (proposed by FAO to Green Climate Fund)rejected under pressure of Global Forest Coalition

Bioenergy with Carbon Capture and Storage (BECCS): **perverse effects**



biomass produced from fast-growing trees, switchgrass, agriculture waste, is

1) turned into pellets for burning in power plants

Or 2) refined into liquid fuels such as ethanol.

Resulting carbon emissions are supposed to be captured and geologically stored...

North Carolina's deforestation to fuel UK's power plants

global demand for wood pellets is estimated to grow at a rate of about 15 percent annually for the next five years before stabilizing at 27.5 million metric tons. This estimate is based on power plants converting from coal to biomass. 73% of the demand comes from the EU. The UK is the first importer.



“The U.K. offers \$1 billion a year in subsidies. Without those, it would be far more expensive to use wood pellets for energy.” – Bill Moomaw

<https://www.coastalreview.org/2017/10/wood-pellet-demand-opposition-growing/>

“THE DOUBLE STANDARD:

When someone burns wood to cook in a developing country it is considered a climate problem but when a developed country burns trees to generate electricity it is deemed a climate solution.”

- Bill Moomaw



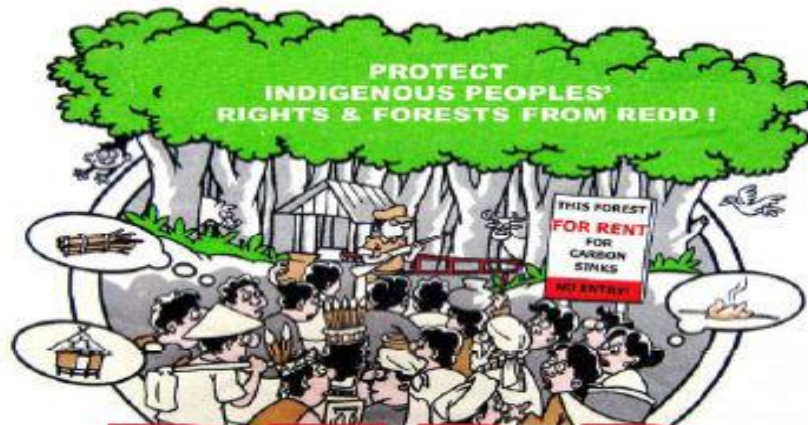
Bill Moomaw and Dana Smith, “The Great American Stand: US Forest and the Climate Emergency” <https://www.dogwoodalliance.org/wp-content/uploads/2017/03/The-Great-American-Stand-Report.pdf>

Farmer's land rights and indigenous rights' violations



Pine tree plantation in Uganda (Swedish Energy Agency's Carbon offsets)

The Ugandan state provides large land leases to companies
Uganda does not recognize indigenous peoples' right to land and their right to give free and informed consent to decide on the go ahead of a project.



REDD

A FALSE SOLUTION TO CLIMATE CHANGE

“could unleash a devastating wave of further forest loss, land grabbing, corruption, cultural destruction and conflict.” Indigenous Peoples “risk displacement, violence and loss of livelihoods.”¹⁸



Community-based forest management in Nepal: a success story

- 35% of forest land under community based forest management: manage their own forests for timber and non-timber products -> significantly contributes to ecosystems restoration, reduction of soil erosion, landslides and floods (UNEP, Nepal Ministry of Forests and Soils).



Members of a community forest user group managing their community forest in Nawalparasi district, Nepal. Nawalparasi/FECOFUN

Community members assessing the threats to community conservation during a community assessment. Dil Raj Khana/FECOFUN



Women members of a community forest user group in Morang district, Nepal. FECOFUN



REDD+ success is a matter of governance: local populations are part of the solution

Preamble to the Paris Agreement

- *Acknowledging* that climate change is a common concern of humankind, Parties should, when taking action to address climate change, respect, promote and consider their respective obligations on human rights, the right to health, the rights of indigenous peoples, local communities, migrants, children, persons with disabilities and people in vulnerable situations and the right to development, as well as gender equality, empowerment of women and intergenerational equity,

Policy instruments: SOILS as Climate Solution

- Not included in the negotiation framework of UNFCCC
- 2015: soils and agriculture only as a side event: 4per1000 initiative launched by French Ministry of Agriculture
- 2017: COP23 in Bonn: Soils and Agriculture become a priority

International Soil Carbon Initiatives

Policy Title	Focus	Agency(ies)
4 per 1000: Soils for Food Security and Climate ²⁸	Efforts and commitments to increase soil organic carbon by four parts per thousand (0.4%) per year	French Ministry of Agriculture and other international partners
Regenerative Development to Reverse Climate Change ²⁹	Funding to support regenerative agriculture programs in 52 member nations in The Commonwealth of Nations (the former British Empire)	The Commonwealth of Nations
Land Degradation Neutrality Fund (LDNF) ³⁰	Innovative financial market for investing in profit-generating sustainable land management and restoration projects globally in support of the UN Sustainable Development Goal 15 assuring land degradation neutrality.	UNCCD, UNEP, Mirova
Climate Smart Agriculture (CSA) ³¹	Goal of food security and development, by enhancing agricultural productivity, and climate adaptation, and mitigation	FAO, World Bank, Dutch Government

Some proposed methods:

HOW CAN SOILS STORE MORE CARBON?

The more soil is covered, the richer it will be in organic material and therefore in carbon. Until now, the combat against global warming has largely focused on the protection and restoration of forests. In addition to forests, we must encourage more plant cover in all its forms.



Never leave soil bare and work it less, for example by using no-till methods



Introduce more intermediate crops, more row intercropping and more grass strips



Add to the hedges at field boundaries and develop agroforestry



Optimize pasture management – with longer grazing periods, for example



Restore land in poor condition e.g. the world's arid and semi-arid regions

- **biochar**
- bolstering soil microbiology
- root, or mycorrhizal fungi and microorganisms
- agroforestry programs
- Terracing in mountainous terrains
- Etc...



Biochar

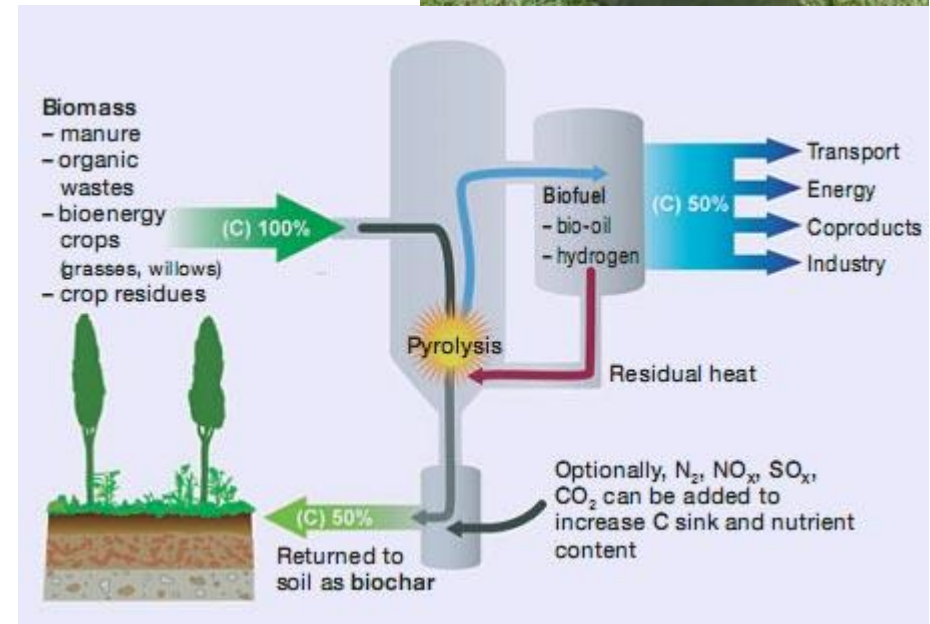
Heating biomass in oxygen-free oven (pyrolysis) at temperatures above 250°C produces **biochar**

porous: offers habitat for micro-organisms, retains water and nutrients

Experiments to scale up biochar use



Corn Field Trial, Virginia Tech University



Grazing to restore grassland

- Holistic management of livestock (Allan Savory) to combat desertification



2 polar opposite models in agriculture

- Large scale agro-business: 1 farmer per 1000 to 10,000 acres
- Small-scale agriculture: 1 family of farmers per 1 to 20 acres

Small-scale agriculture produces 70% of total global food production

-> Soil Climate solutions will look very different

When “Climate Smart Agriculture” is just another version of “agriculture business as usual”



From Tim Wise, “Strengthening smallholder farmers’ resilience to climate change: beyond Climate Smart Agriculture”, October 2017

Large-scale agriculture only uses a few of the methods of CSA – more beneficial practices are not adopted because they threaten agribusiness profits

What is practiced? Bias of large farms

Use of improved crop varieties	Use of manure for fertilizer	Information utilization
No-till/reduced till	Incorporation of residue	Weather tracking
Improved crop/fallow rotations	Live barriers or fences	Crop insurance
Use of legumes in crop rotations	Drip irrigation	Precision agriculture
Use of cover crops	Bunds/Zai	Livestock integration
Increased efficiency of Nitrogen fertilizer	Agroforestry	
	Terraces	
	Use of perennials	

© Global Development and Environment Institute, Tufts University

From Tim Wise, “Strengthening smallholder farmers’ resilience to climate change: beyond Climate Smart Agriculture”, October 2017

Agroecology is a subset of CSA would be the most adapted to small-scale agriculture in the developing world



Use of improved crop varieties	Use of manure for fertilizer	Information utilization
No-till/reduced till	Incorporation of residue	Weather tracking
Improved crop/fallow rotations	Live barriers or fences	Crop insurance
Use of legumes in crop rotations	Drip irrigation	Precision agriculture
Use of cover crops	Bunds/Zai	Livestock integration
Increased efficiency of Nitrogen fertilizer	Agroforestry	
	Terraces	
	Use of perennials	

From Tim Wise, “Strengthening smallholder farmers’ resilience to climate change: beyond Climate Smart Agriculture”, October 2017

Towards a real paradigm shift in Agriculture?

From extractive to regenerative

- Agroecology/Agroforestry/Permaculture: mimicking ecosystems
 - rotational grazing and grassland management: mimicking wild herds in the savanna
- Take nature as a model
- Looking at soils in systemic ways: Not only contributes to store carbon, but also plays other ecological roles: as a buffer to flooding, restores water resources, restores and enhances biodiversity, etc...

Issue of Governance in CSA: not at the detriment of rural communities and indigenous people

- Plea from dozens of INGOs (OXFAM, CARE, Alliance for Food Sovereignty in Africa,...) representing thousands of local communities and indigenous rights groups:

“We are deeply concerned that **a narrow focus on carbon** may lead to unintended negative consequences such as fostering a profit-driven economy around the commodification of soil, incentivizing industrial agriculture through **carbon markets, promoting land grabbing, increasing corporate control over land and other resources, and repeating failed schemes like REDD+ schemes** and carbon markets, which have benefitted carbon traders and large scale agriculture operations at the expense of our communities.”

Proposal: refocus the attention to an holistic approach

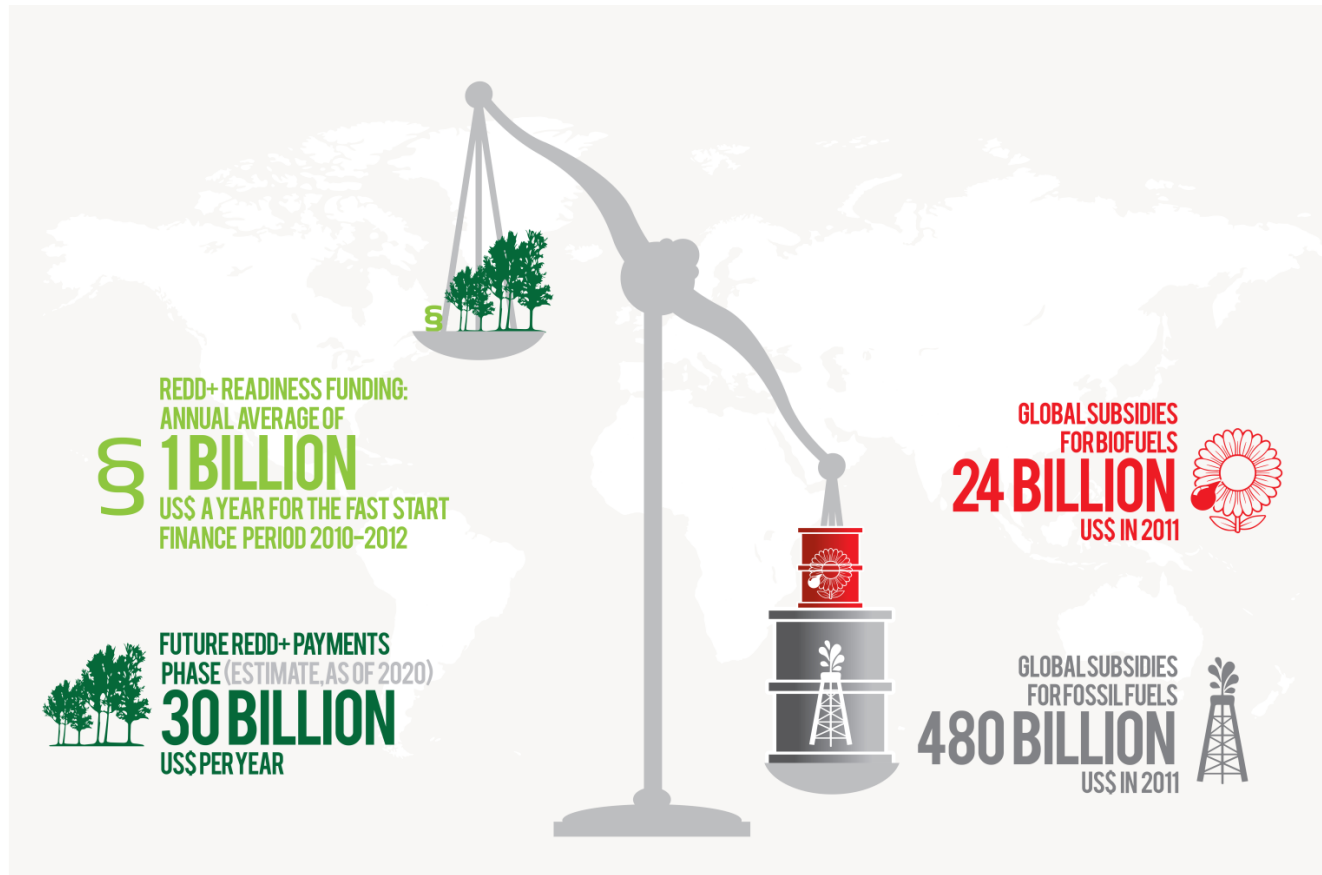
“We propose to reframe the emphasis of the conference around the much-needed transformation of conventional food and farming systems and their root causes through the holistic approach of **agroecology**. This transformation centers the improvement of smallholders’ and indigenous communities livelihoods as a key strategy to achieve food sovereignty, equity and resilience.”

Recommendations at COP23 (from the Climate, Land, Ambition and Rights Alliance - a group of 30 NGOs)

- Land use action in agriculture must be clearly framed with social and environmental priorities to prevent false solutions, and **must be left out of offset and carbon market**
- NDCs must include information on how countries will ensure that cross-cutting principles and obligations in the Paris Agreement (**food security, human rights and ecosystem integrity**) are to be ensured in implementation, particularly in the land sector
- Reporting must be **transparent** and CO2 removals in the land sector (often non-permanent) must be reported and accounted separately from permanent reductions in industrial emissions.
- Rules should be developed to address **bioenergy emissions as current “LULUCF loopholes” fail to account for emissions from burning biomass.**

C.L.A.R.A includes ActionAid, Biofuelwatch, Global Forest Coalition, Greenpeace, Oxfam, Friends of the Earth, Rainforest Foundation Norway, Caritas,...

Funding? The unbalance of power



Same unbalance exists for Agricultural subsidies:
500 \$billion subsidies for industrial agriculture

<http://forests4climate.org/unep-releases-report-on-intergrating-redd-into-green-economy-approaches/>

Redirecting Agriculture Subsidies towards a Truly Climate Smart Agriculture?

Storing an additional ton of carbon in soils costs:

- \$70 to \$140 per year, for croplands soils
- \$180 to \$280 per year, for grasslands and forests

Mostly labor costs => more jobs in rural areas (reduce the exodus of rural poor to urban slums)

⇒ Total cost of sequestering 3.5Gt C per year = **\$500billions**

3 billion rural poor => \$160 per person per year

Redirect current agricultural subsidies towards subsidies which benefit small scale subsistence farmers to restore their ecosystems, increase food production, enhance food sovereignty, and store carbon in the soils and forests.

First steps to a paradigm shift...

- 4per1000 governance is horizontal: a consortium including civil society actors and policy-makers: scientists and experts, officials from ministries of agriculture, experts from international organizations, farmers associations, NGOs in an open-forum where best practices and failures are shared, discussed, disseminated
- Even the FAO is changing its approach: not “top-down” as in the past but including “bottom-up” input from rural local communities.
- Increased recognition that “silo thinking and policy-making” does not work: ministries of agriculture, ministries of environment, and other experts need to work together in a multidisciplinary way
- Systemic and holistic approaches are increasingly prevailing in international discussions



California Healthy Soils Initiative

a collaboration of state agencies and departments, led by the California Department of Food and Agriculture, to promote the development of healthy soils.

-> main incentive: scarce water resources

+1% organic matter in soils = +25,000 gallons of available soil water per acre

-> budget of \$7.5million in 2017

22 healthy soils programs demonstration projects have been selected and funded for 2018

In the USA:

States programs on soils and carbon

State	Title	Number
California	Healthy Soils Initiative:	S.B. 32
	Water Conservation in Landscaping Act:	S.B. 780
Connecticut	An Act Concerning the Labeling of Topsoil Sold to Customers and the Carbon Content of Soil Sold in the State and Used for Regenerative Farming Purposes ³⁷	H.B. 6976
Maryland	Maryland Healthy Soils Program	H.B. 1068
New York	Carbon Farming Tax Credit	A3281
Oklahoma	Carbon Sequestration Enhancement Act	27A-3-4-101
Utah	Concurrent Resolution on Carbon Sequestration on Rangelands	H.C.R.8
Vermont	Regenerative Soils Program	S.B. 43
	Regenerative Agriculture Program	H.B. 430

The New York Times

Sunday Review | [Environment](#)

Soil Power! The Dirty Way to a Green Planet

By JACQUES LESLIE DEC. 2, 2017

