

Climate x Food & Biodiversity

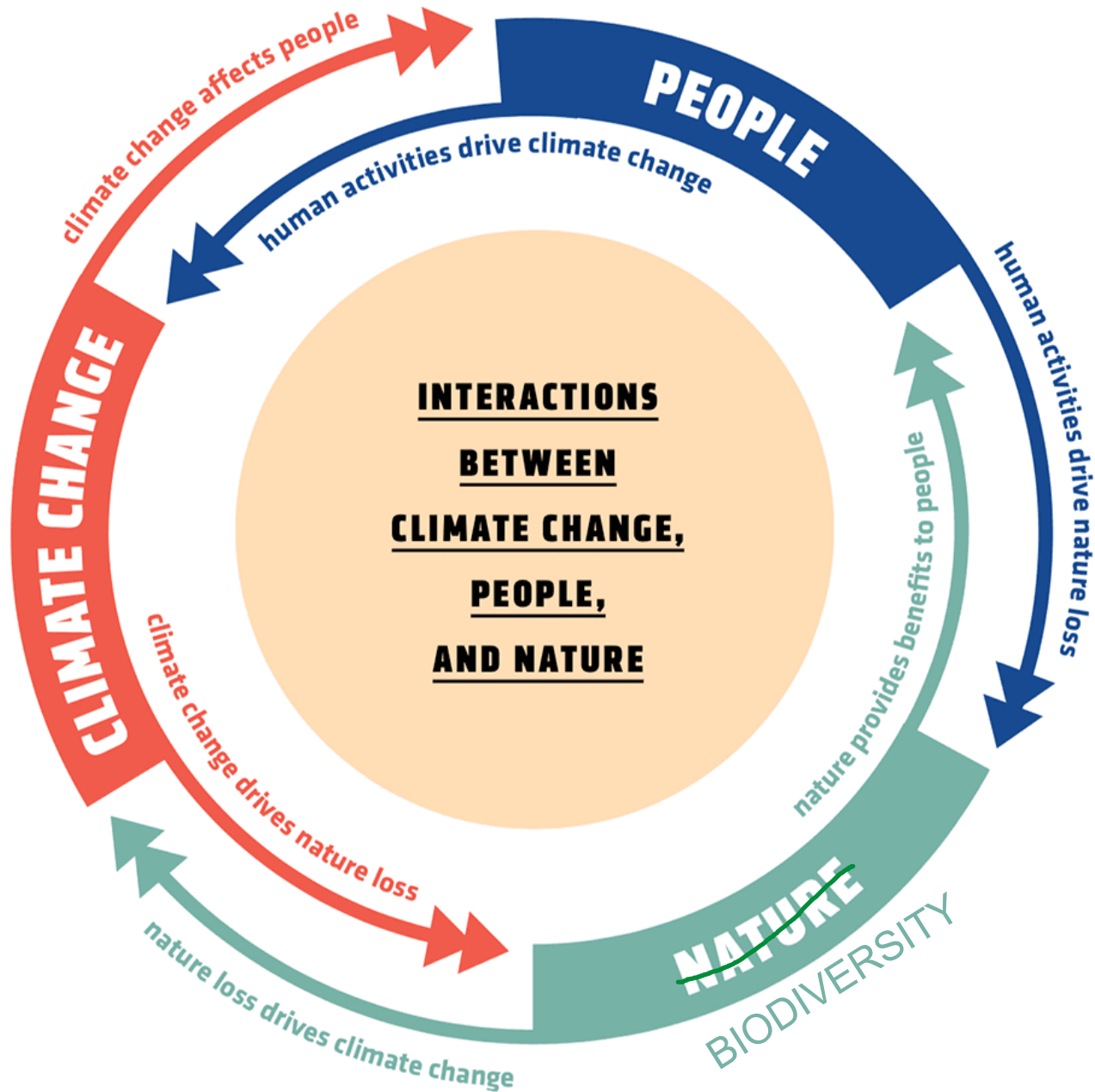
Jenna M. Lawrence, Ph.D.





Titi monkey
(*Plecturocebus toppini*)







BIODIVERSITY LOSS



ABILITY OF RURAL PEOPLE TO ADAPT TO CLIMATE CHANGE

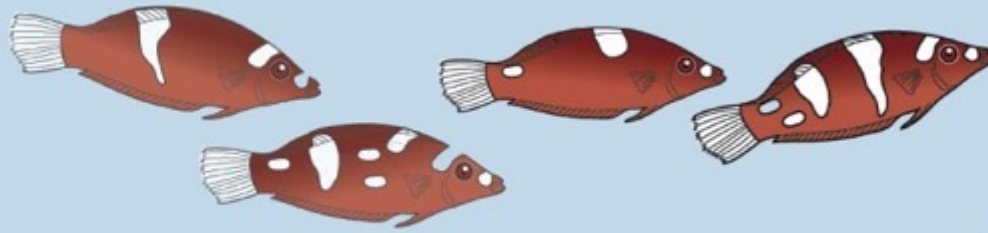
Resilience!

What is Biodiversity?

“Biodiversity is the variability among living organisms and the ecological complexes of which they are part.”

Millennium Ecosystem Assessment

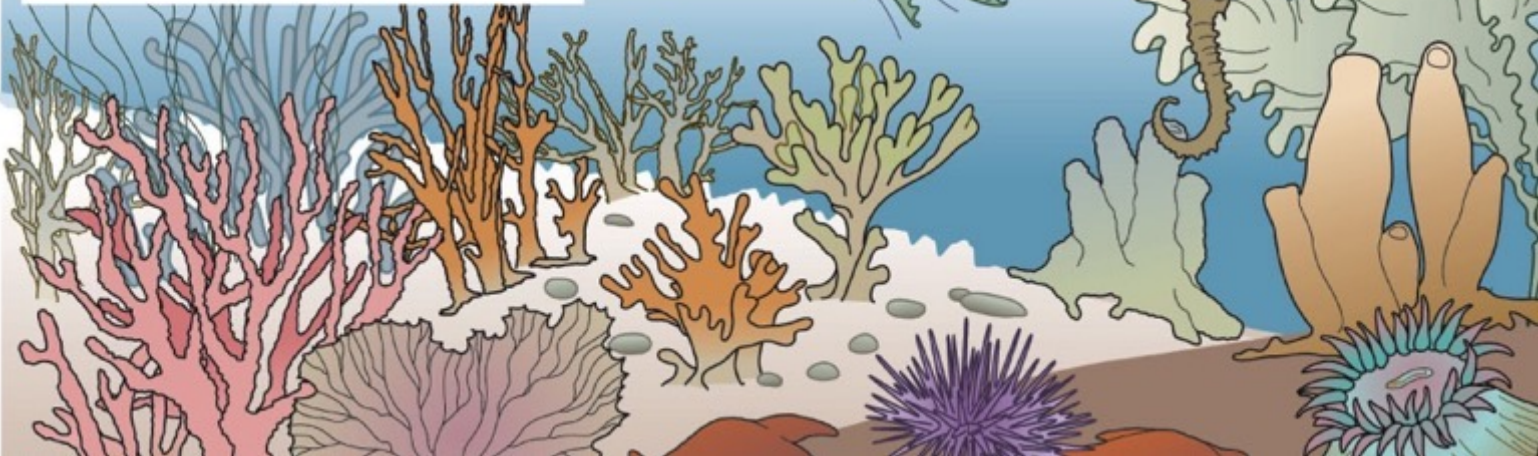
**Genetic
diversity**



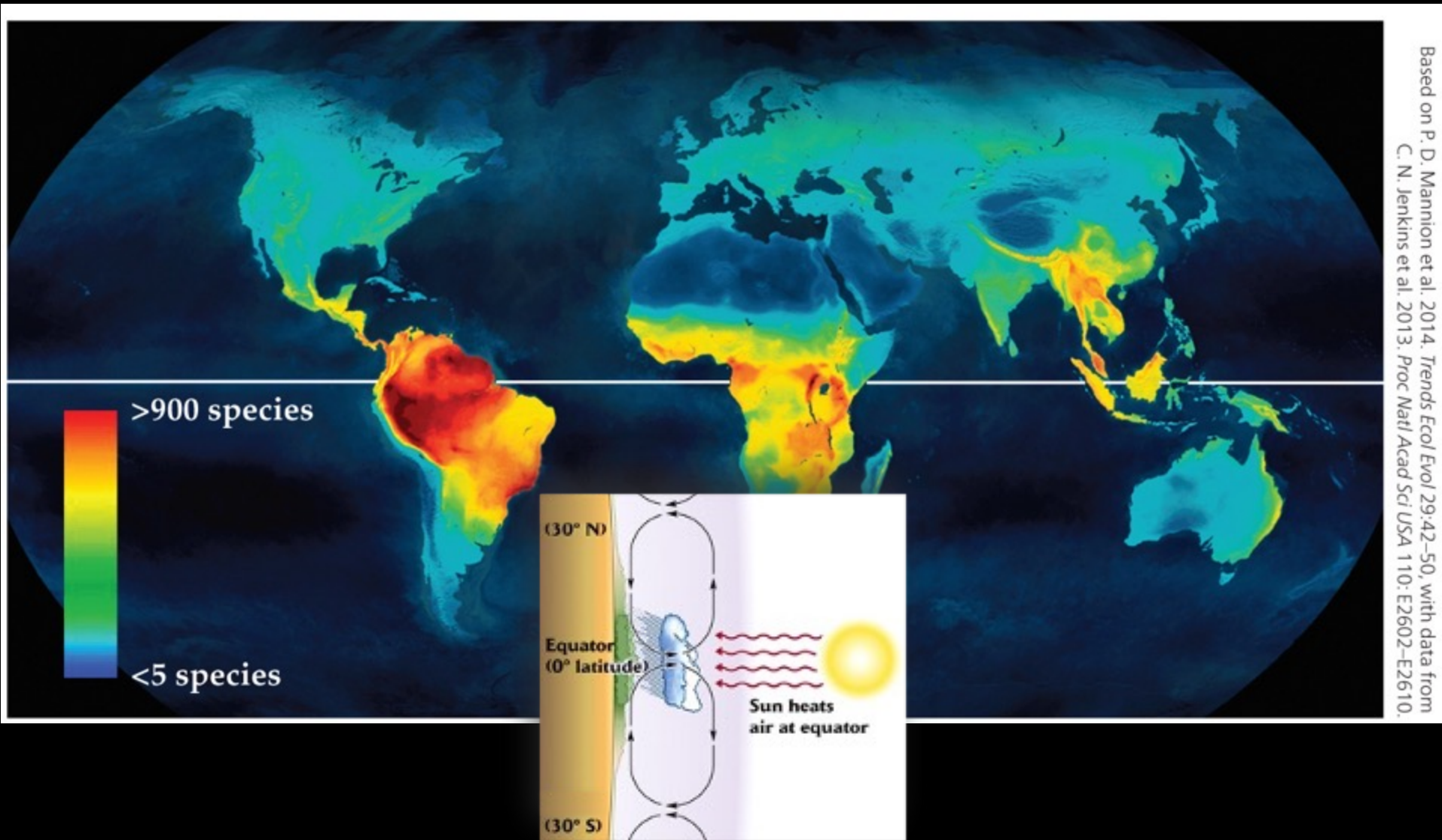
**Species
diversity**



**Community/ecosystem
diversity**

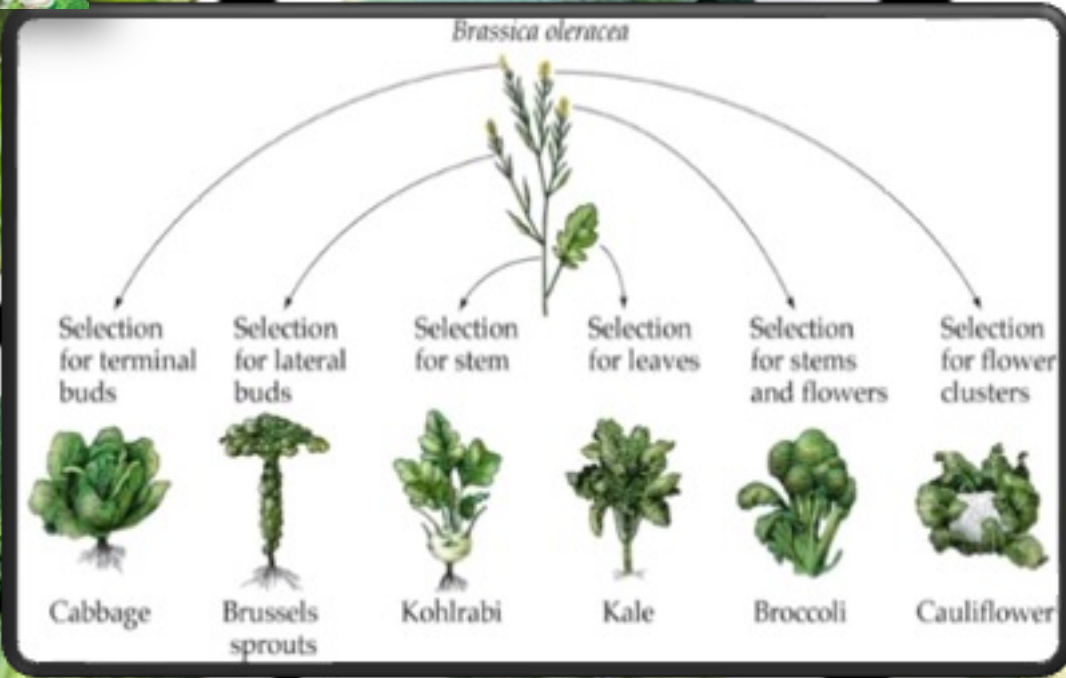


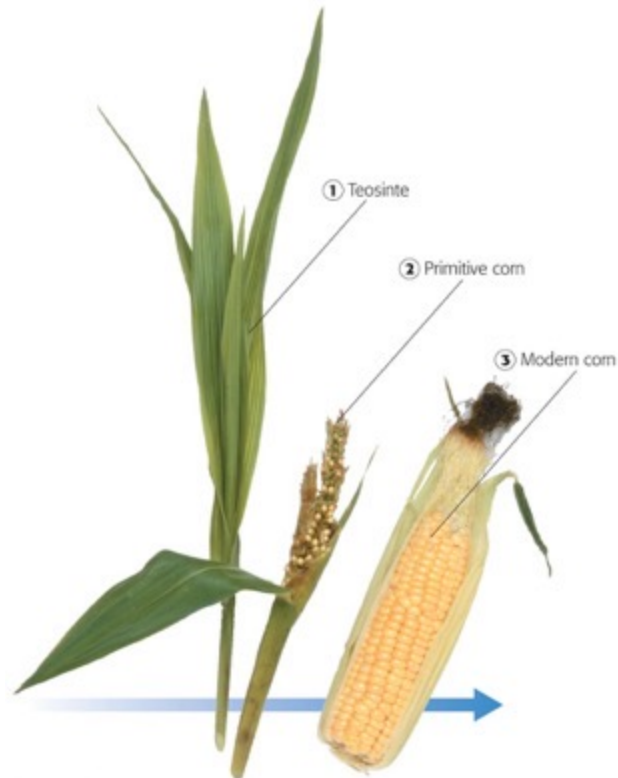
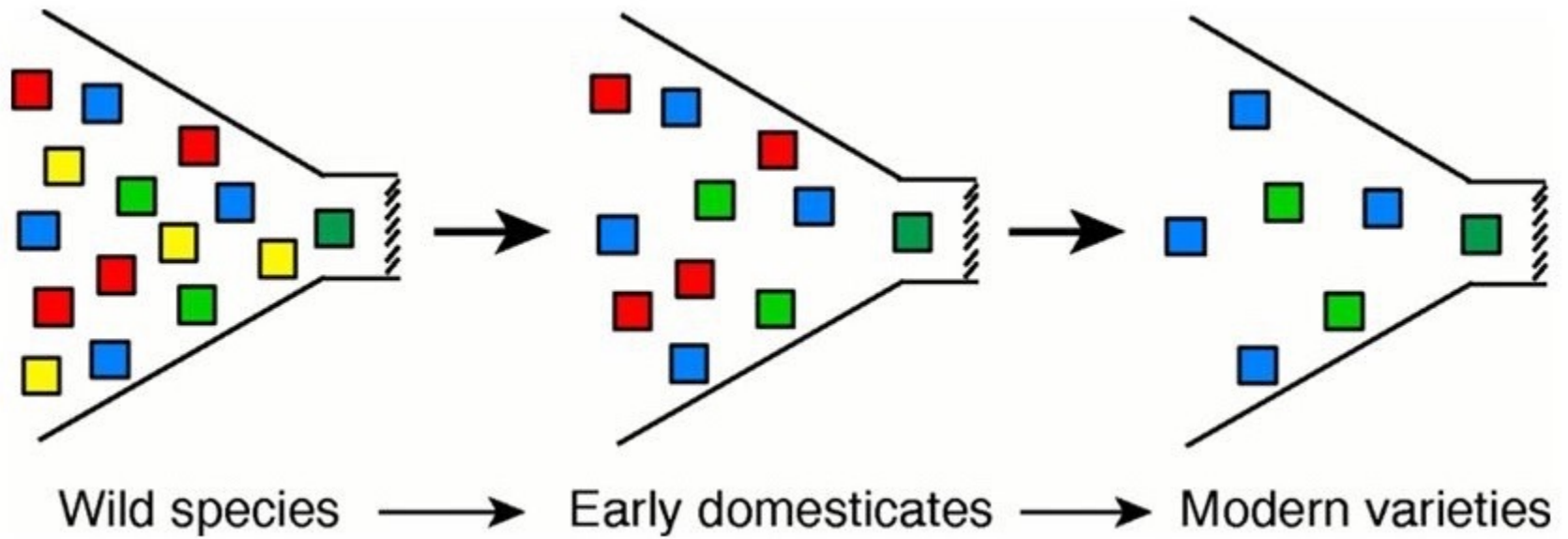
Terrestrial-vertebrate species diversity



How many species?

Brassica oleracea



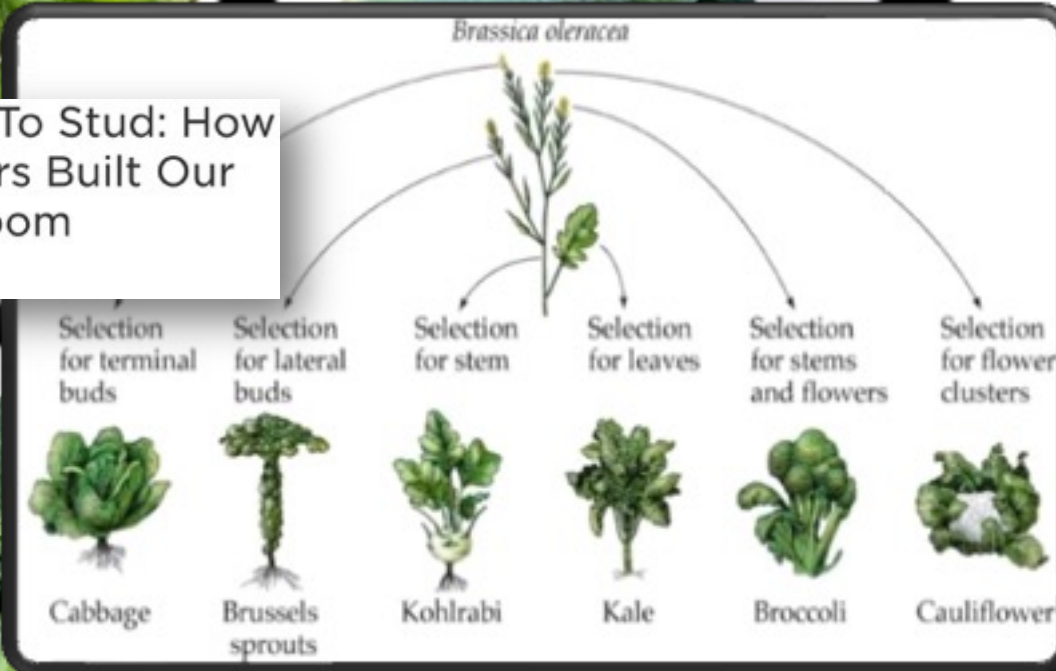


How many species?

Brassica oleracea

From Culinary Dud To Stud: How Dutch Plant Breeders Built Our Brussels Sprouts Boom

October 30, 2019 - 2:17 PM ET
Heard on All Things Considered





MUCH OF THE WORLD'S BANANAS ARE OF THE CAVENDISH VARIETY, WHICH IS ENDANGERED BY A STRAIN OF PANAMA DISEASE.

FRANK BIENEWALD—LIGHTROCKET VIA GETTY IMAGES

What We Can Learn From the Near-Death of the Banana

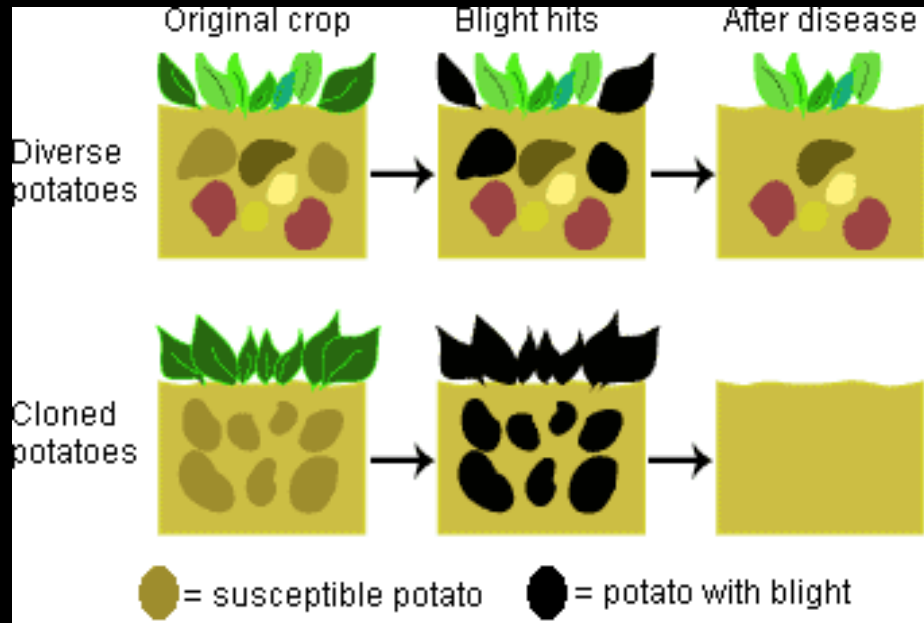
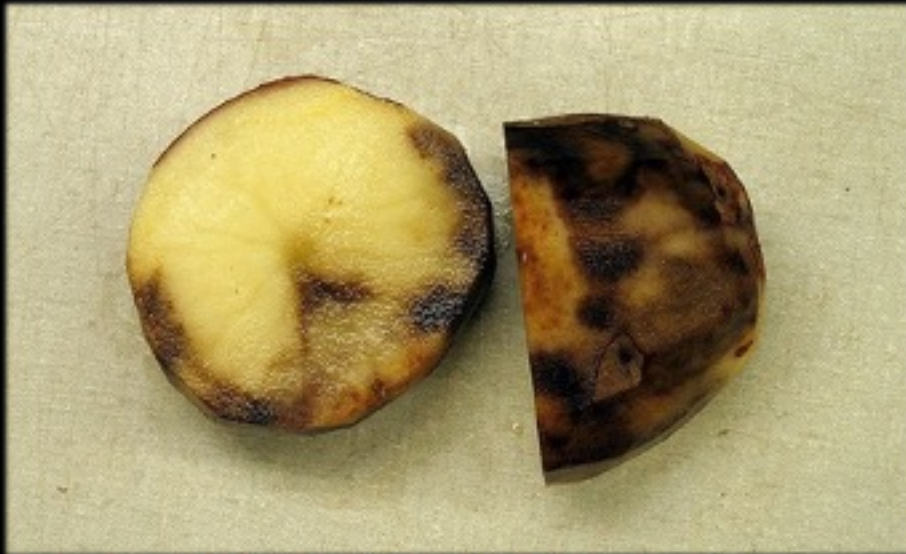
Monocultures, when only a single variety is cultivated, are foreboding for more than just bananas. Here's how computer scientists have learned from their dangers as well.

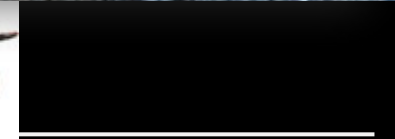
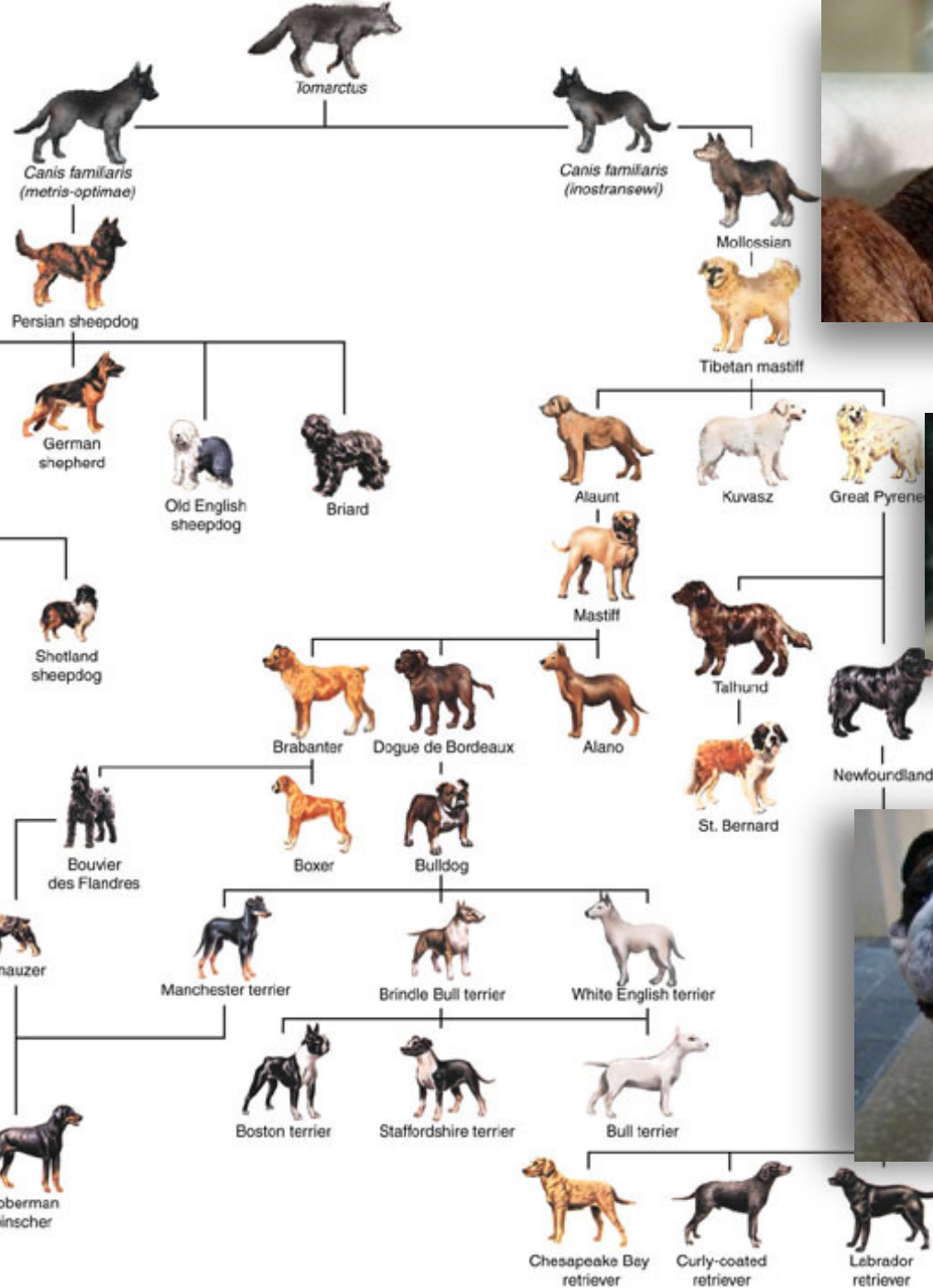
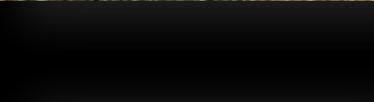
ANNA PURNA KAMBHAMPATY

NOV 18, 2019 12:29 PM PST

Time

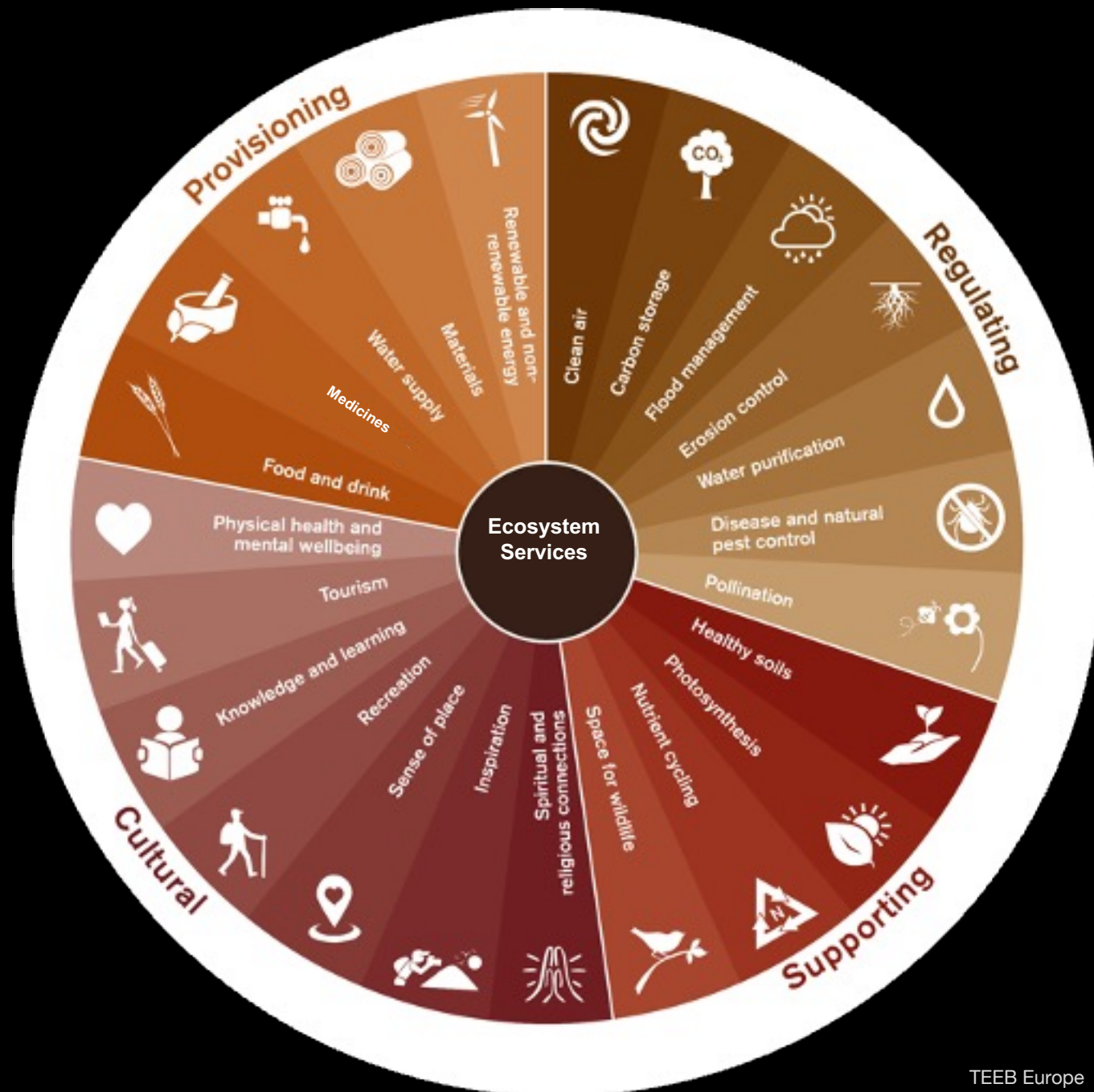
Resistance to disease depends on genetic diversity: The Irish Potato Famine of the 1840s

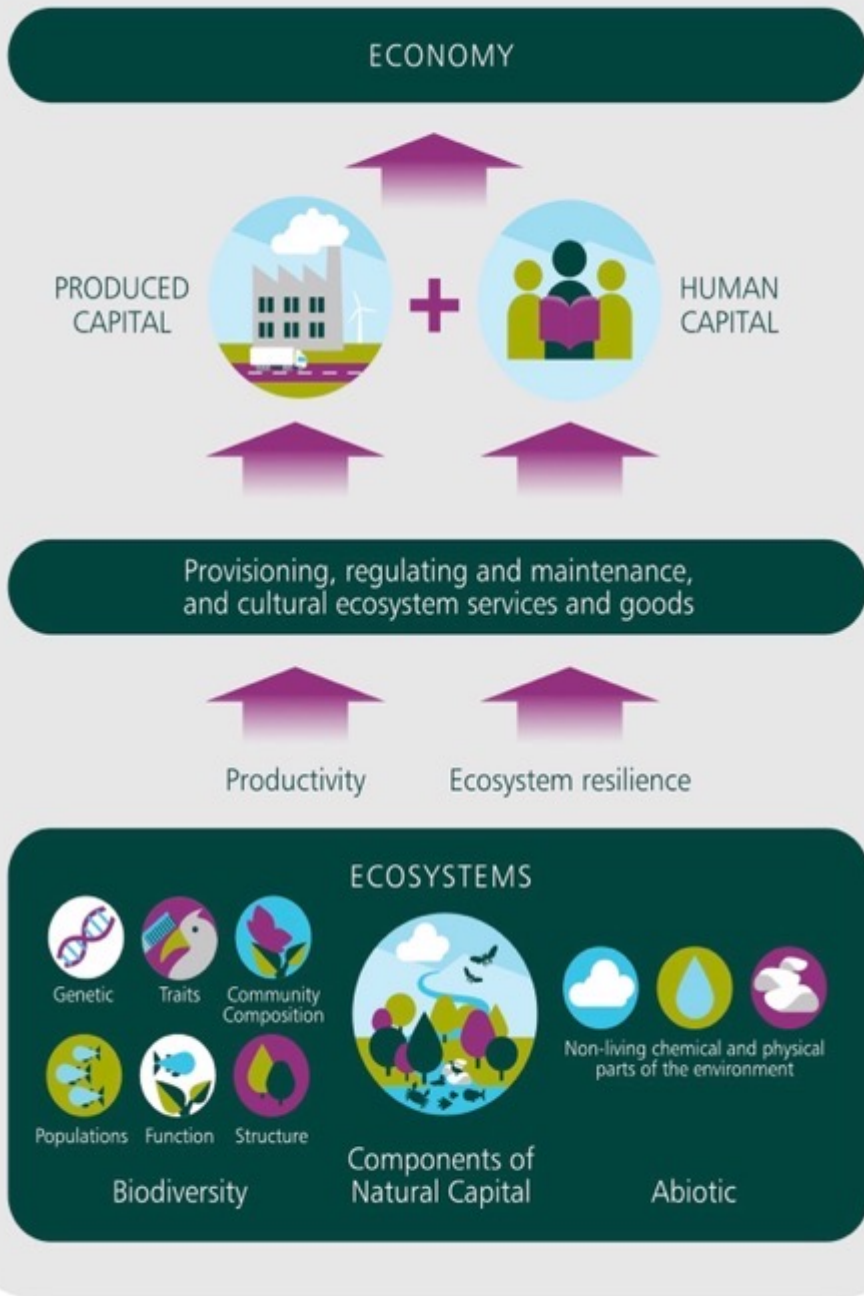




85% of the world's
largest companies
have a significant
dependency on
“nature”

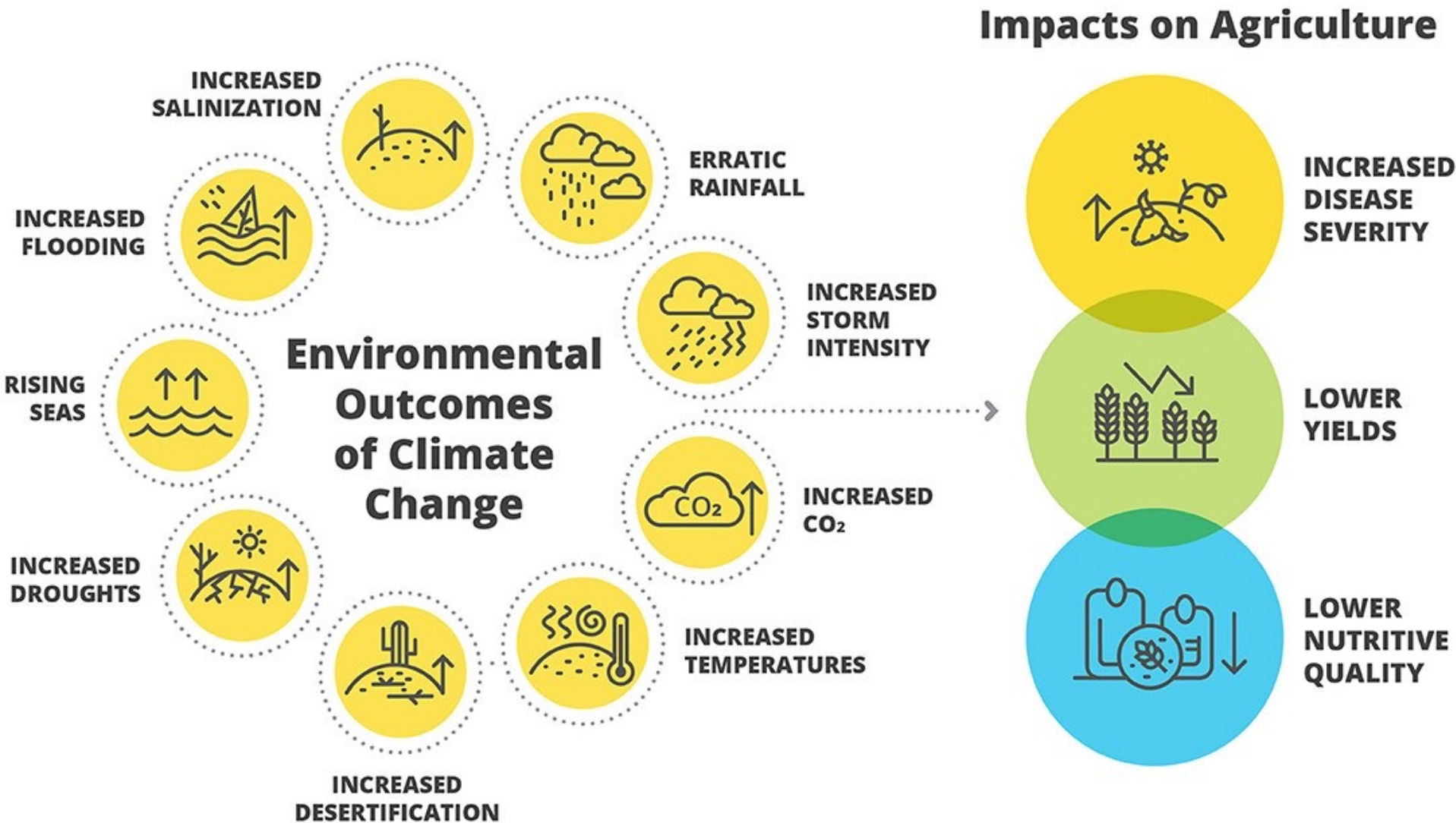
-S&P

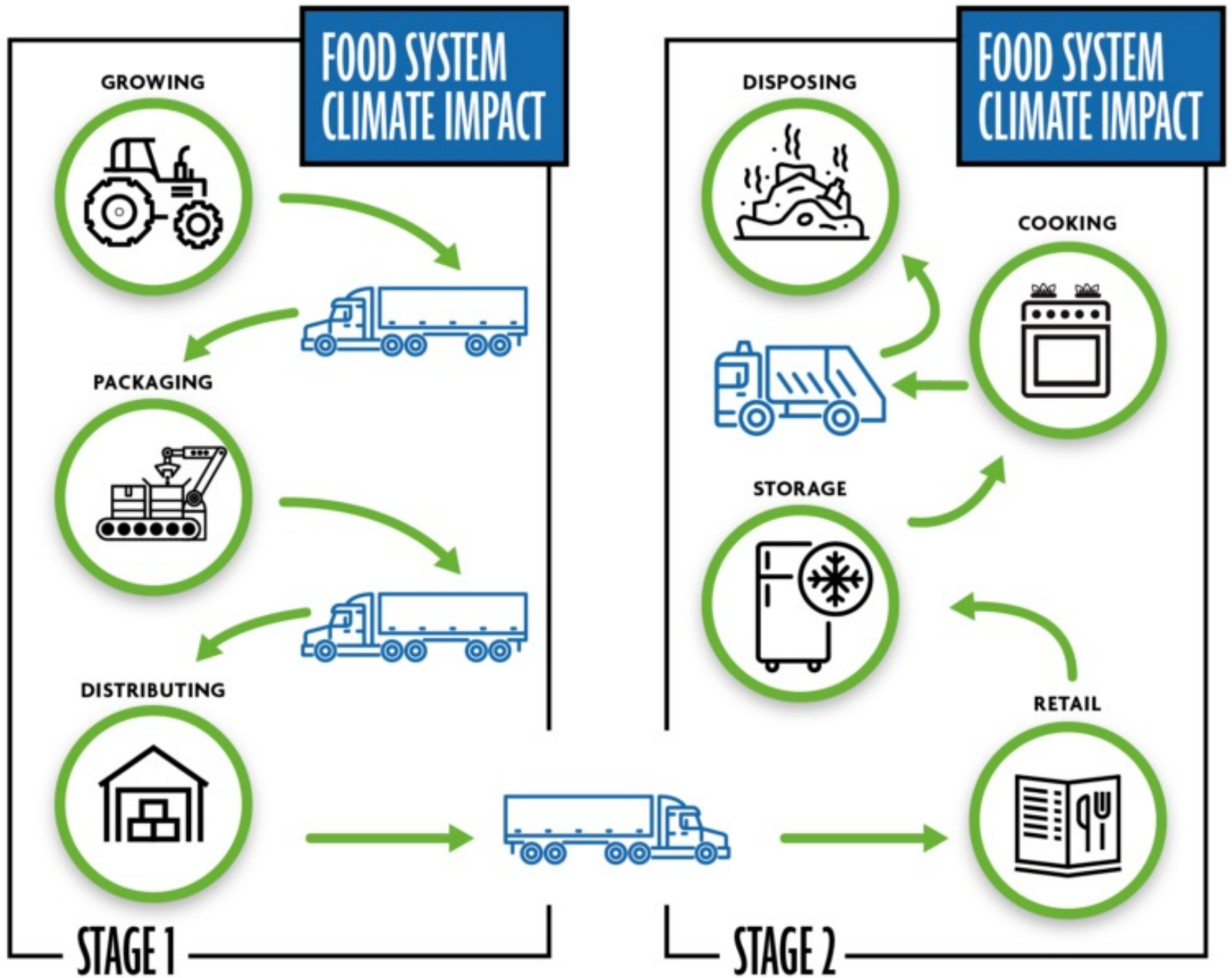




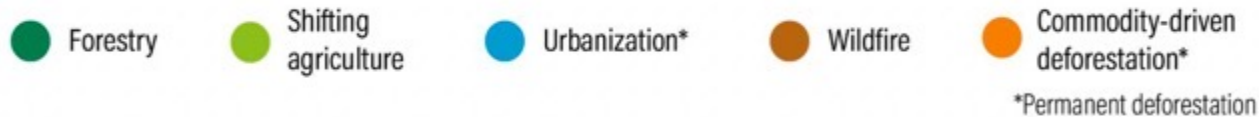
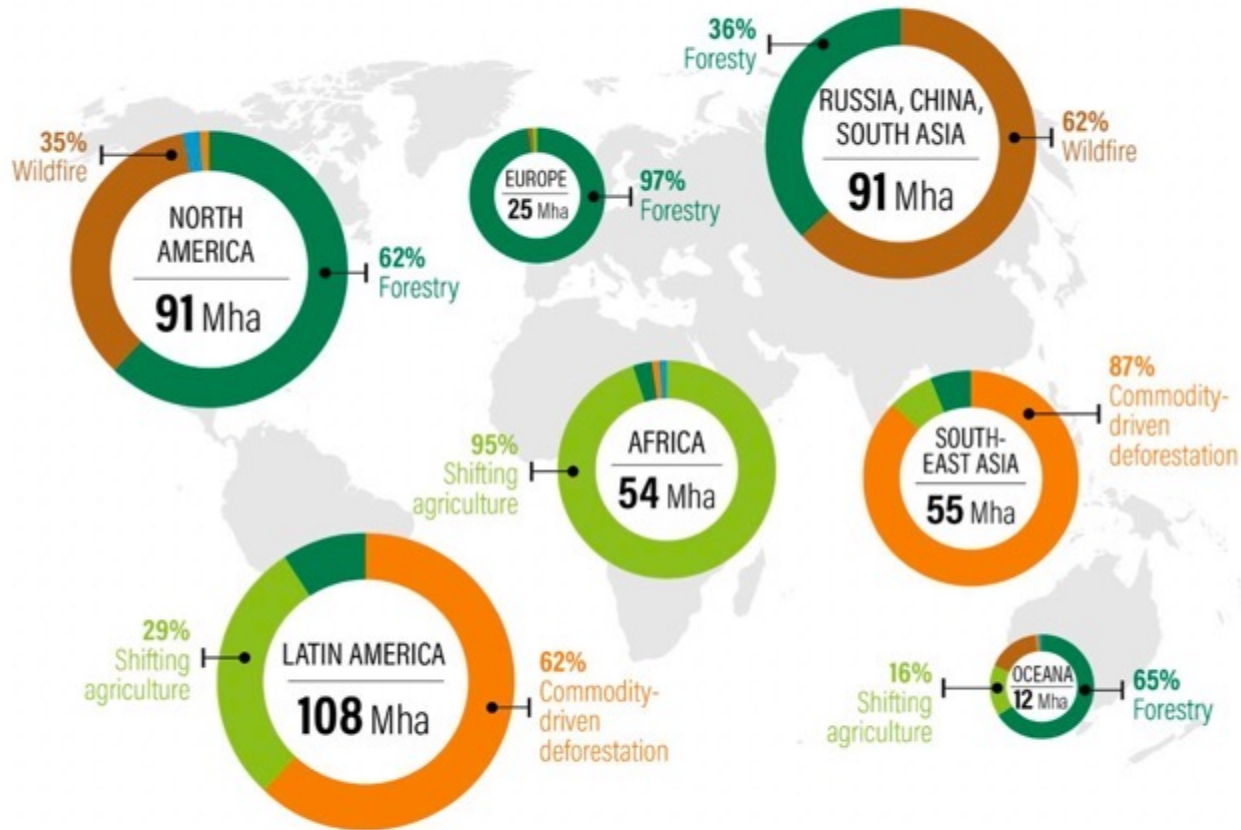
\$58 trillion (55% of global GDP) “moderately or highly reliant on nature”
(PwC 2023)

Climate Change Impacts on the Food System





DRIVERS OF TREE COVER LOSS BY REGION, 2001-2021

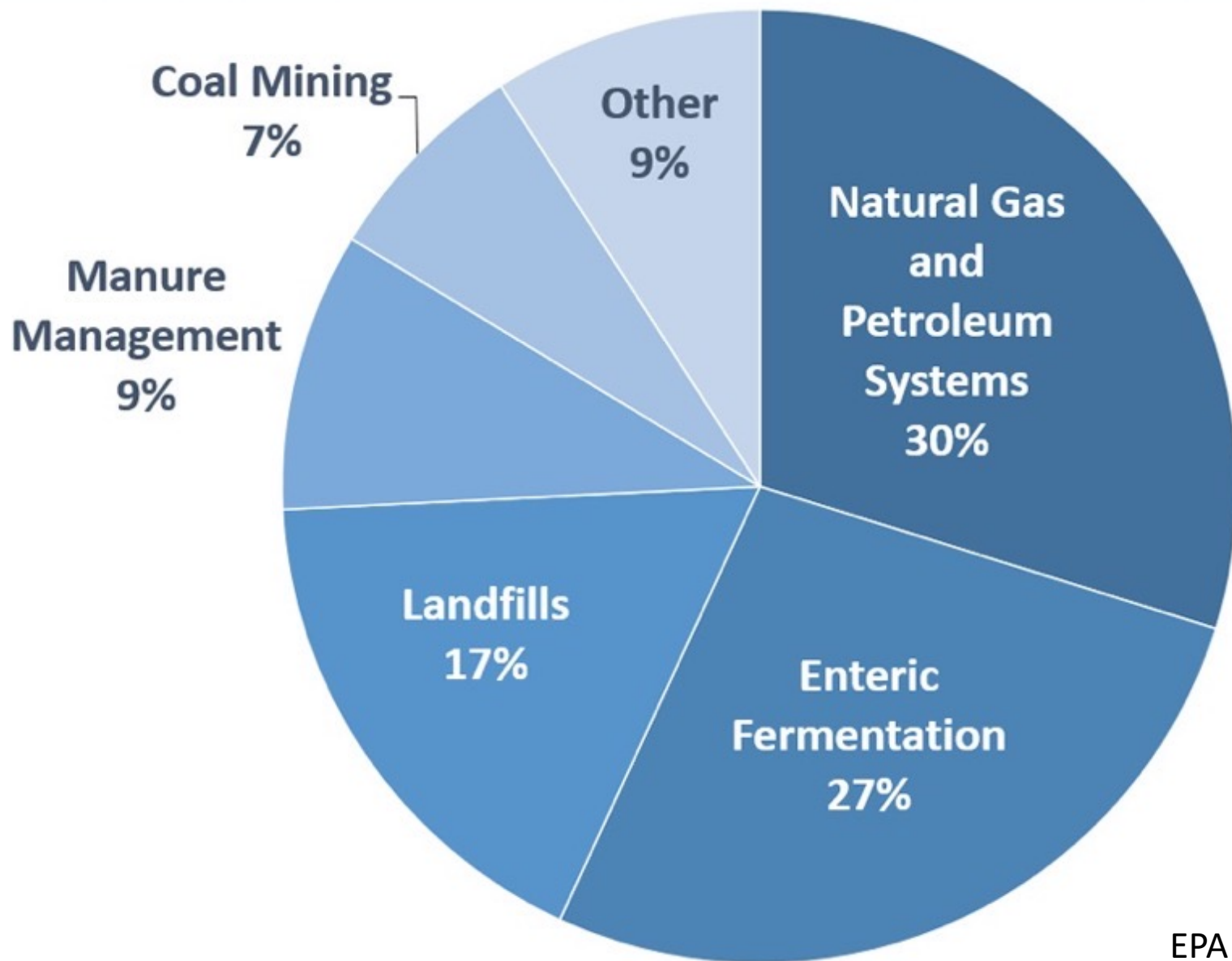


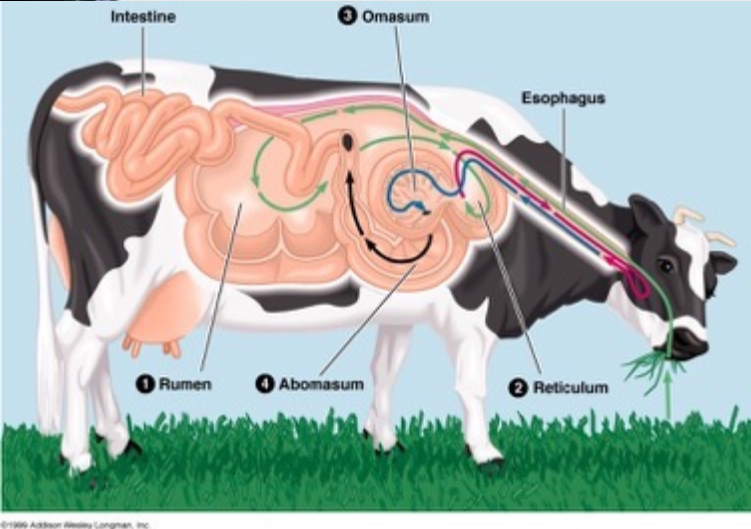
Source: Curtis et al. 2018, <https://doi.org/10.1126/science.aau3445>.



WORLD RESOURCES INSTITUTE

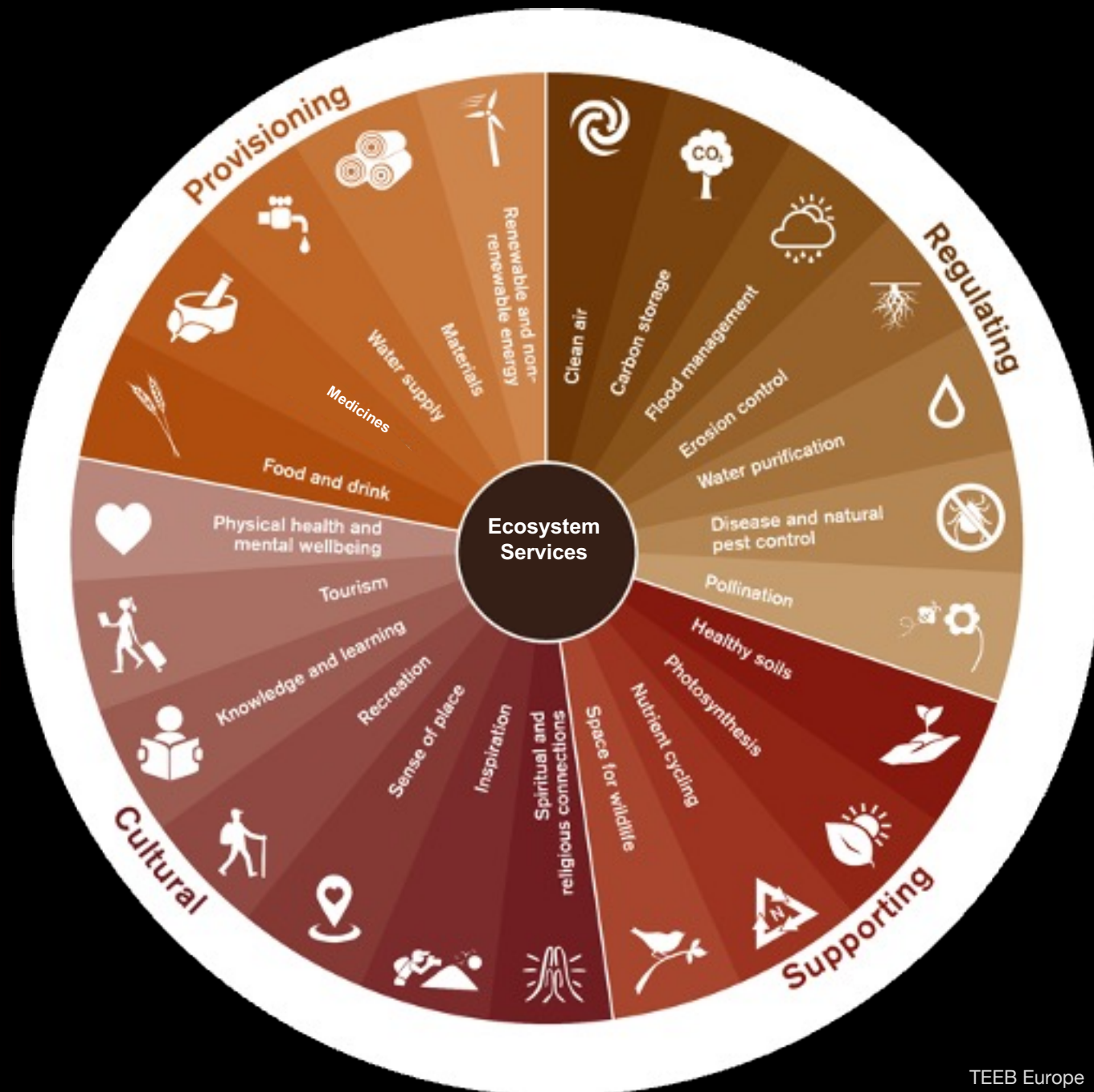
2019 U.S. Methane Emissions, By Source





85% of the world's
largest companies
have a significant
dependency on
“nature”

-S&P



Nutrient cycling



Pest control



Pollination

The insect apocalypse, and why it matters

Dave Goulson

Current Biology 29, R942–R995, October 7, 2019



Plum dung beetle

US honeybee deaths hit record high as scientists scramble to find main cause

Oliver Milman in New York

Tue 25 Mar 2025 06.00 EDT

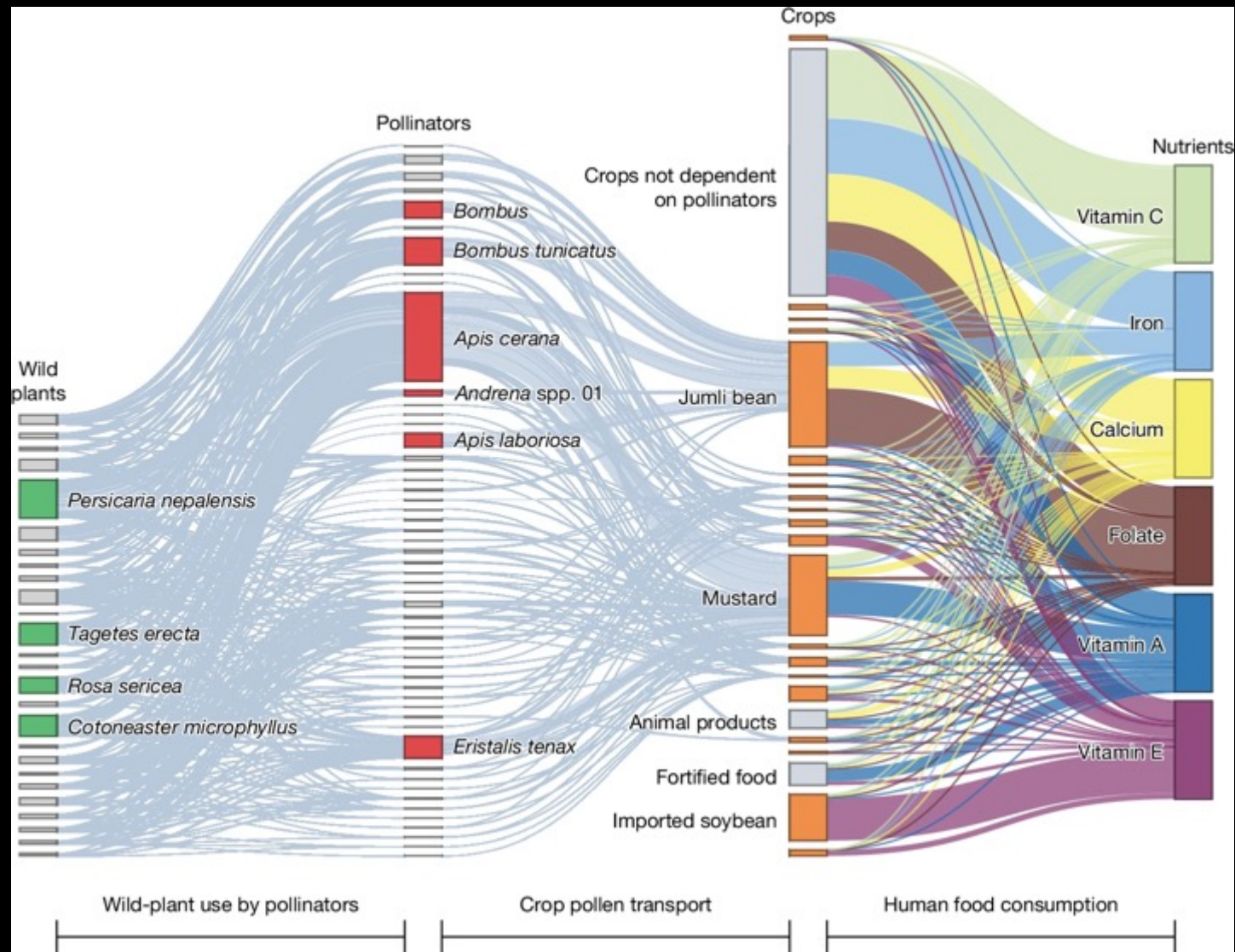
US Department of Agriculture calls in university to help study decline as Trump administration staff cuts sting

The Guardian US



24

Ecological interactions underpinning human nutrient-intake in Nepal



Timberlake *et al.* 2026. Pollinators support the nutrition and income of vulnerable communities. *Nature*



NPS

Why It's Important That Your Tequila Be Labeled "Bat Friendly"

Your agave depends on it, according to ecologist Rodrigo "Bat Man" Medellín



UNAM
Universidad Nacional
Autónoma de México

TEQUILA
INTERCHANGE
PROJECT



Ecologist Rodrigo Medellín says saving bats and saving agave go hand in hand



Kathy Adams Clark

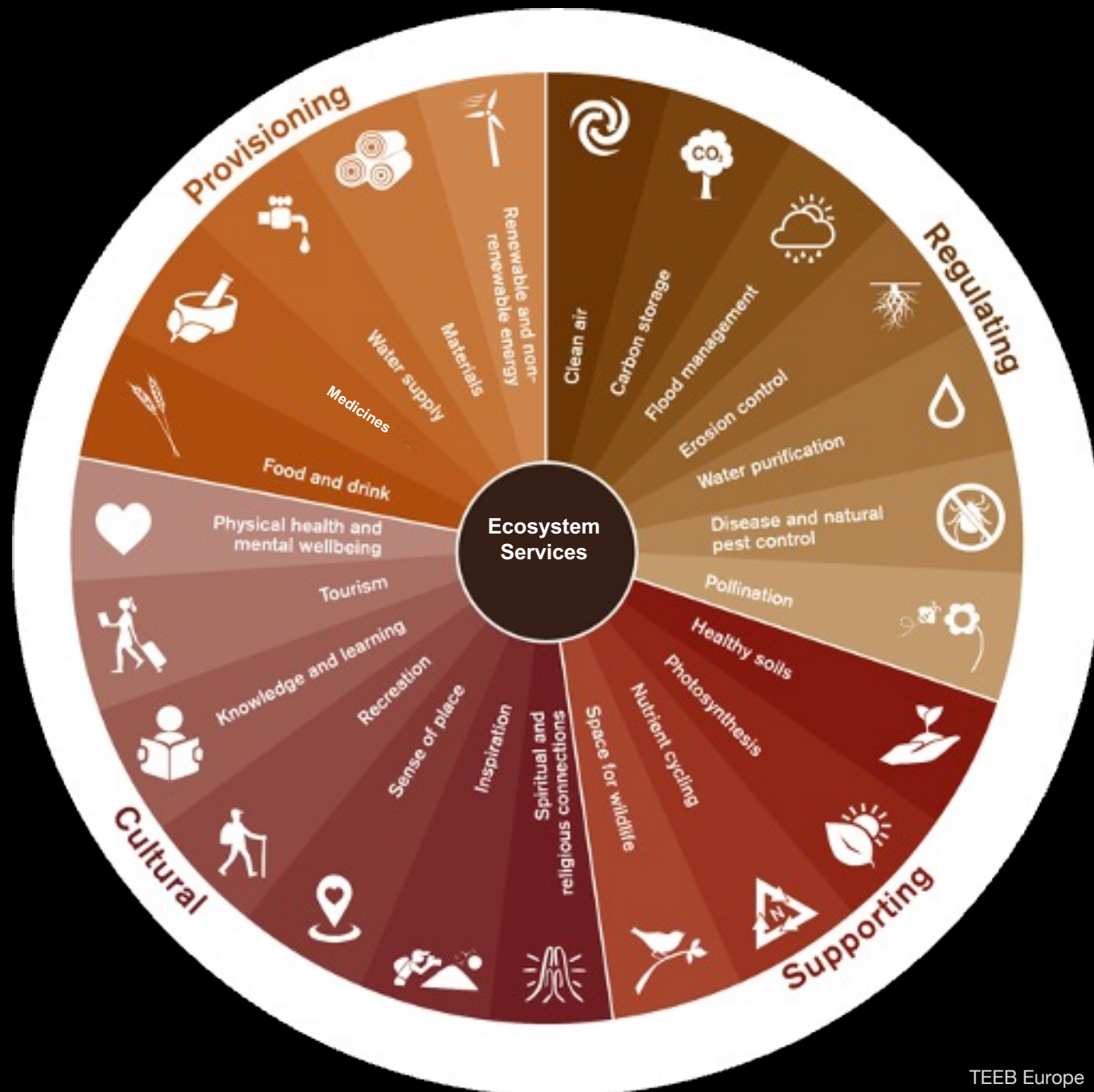
To pollinate half an acre:
20 humans, 10 hours

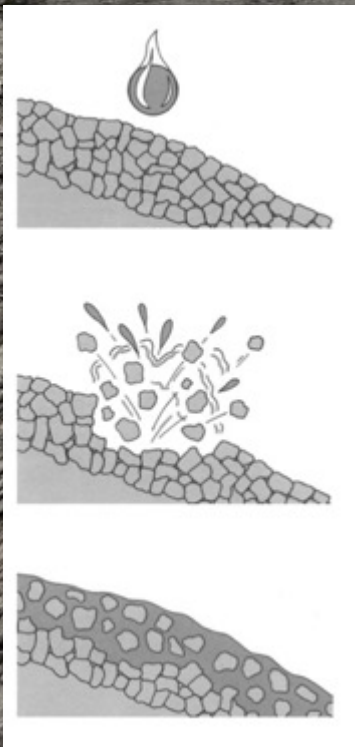


J. Li

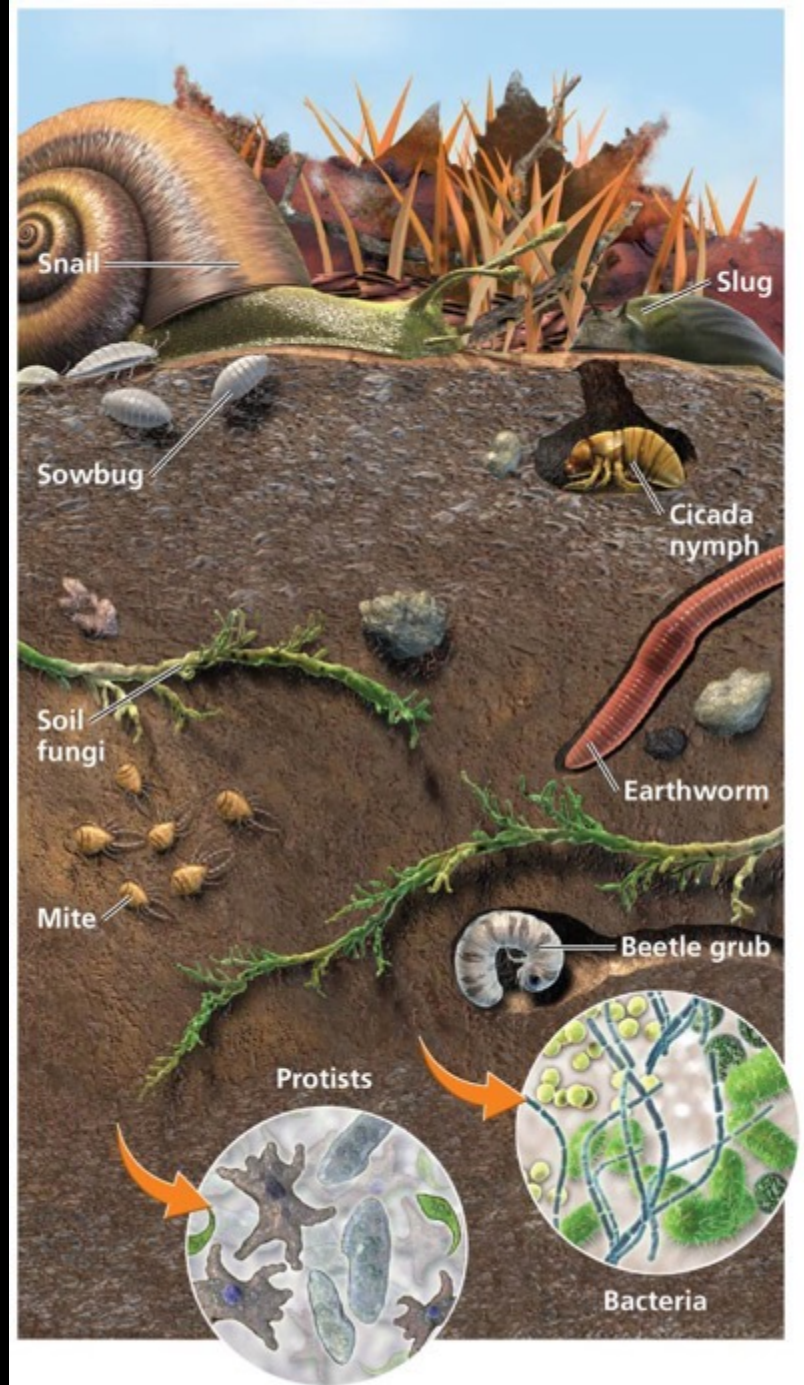
85% of the world's
largest companies
have a significant
dependency on
“nature”

-S&P

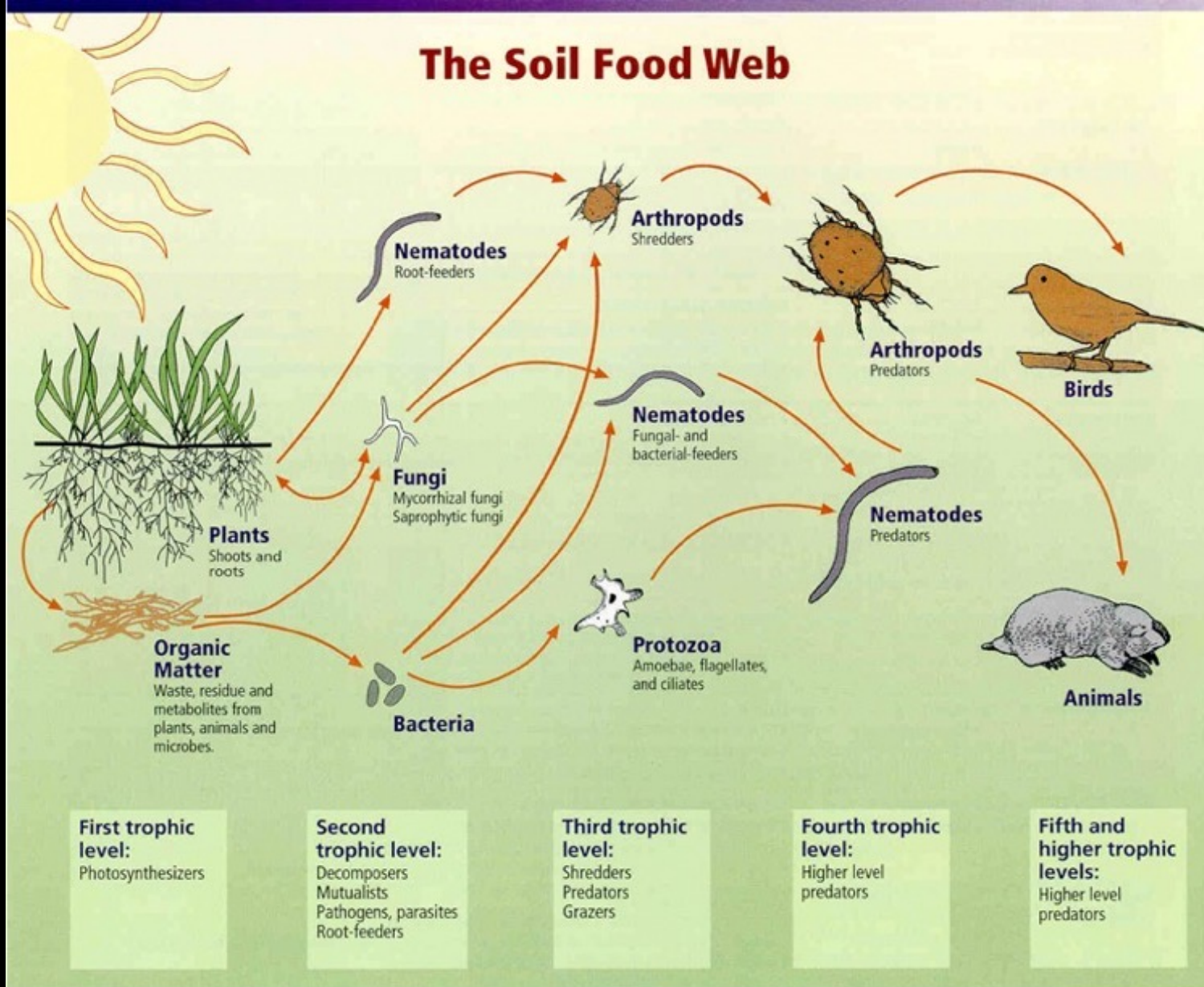




Soil = inorganic + organic!

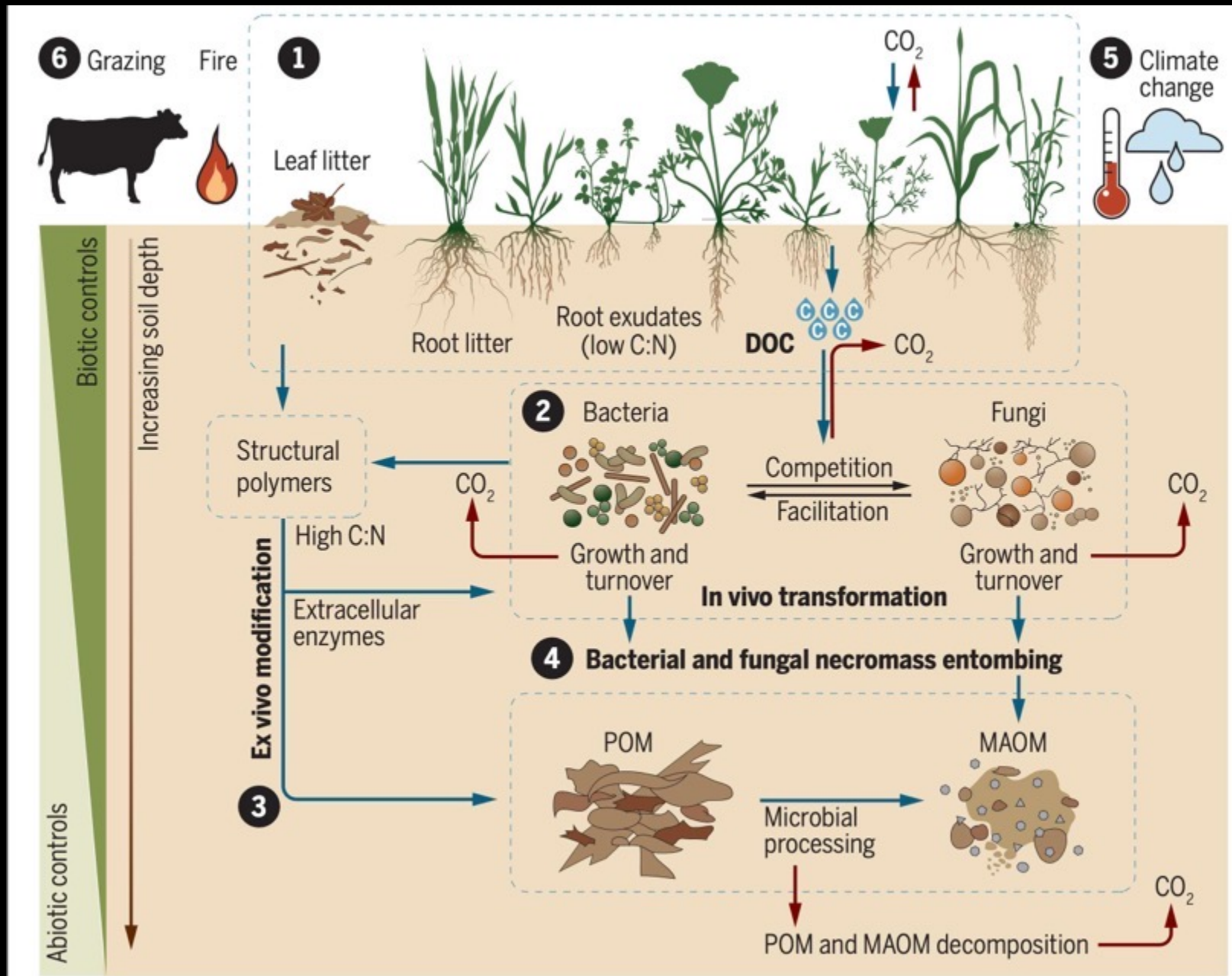


The Soil Food Web

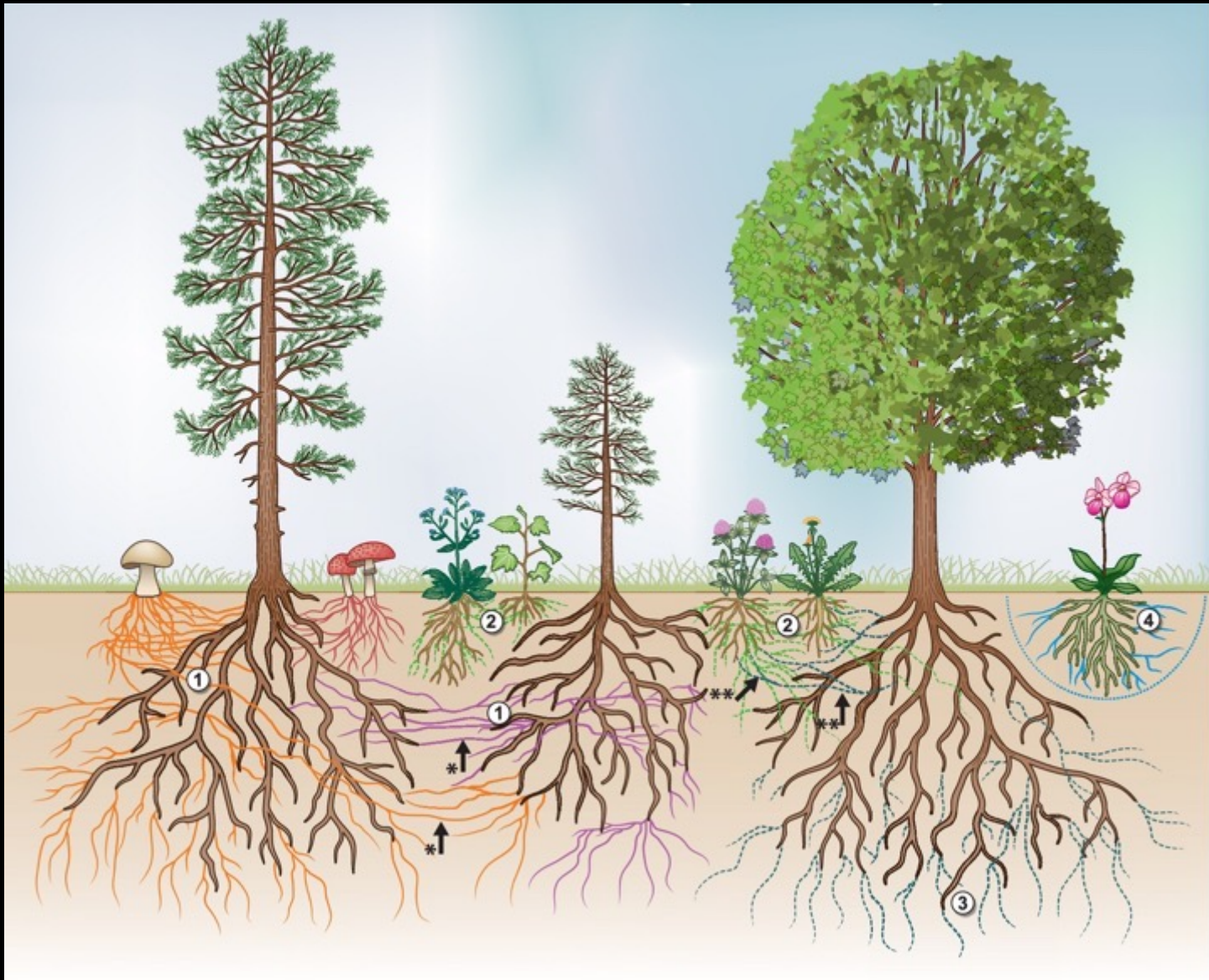


Relationships between soil food web, plants, organic matter, and birds and mammals
 Image courtesy of USDA Natural Resources Conservation Service
http://soils.usda.gov/sqi/soil_quality/soil_biology/soil_food_web.html.

Soil carbon sequestration: requires biodiversity!



Mycorrhizal fungi



The Invisible Force Keeping Carbon in The Ground

In climate-addled places, mats of mycelium may make all the difference for the trees they live alongside.

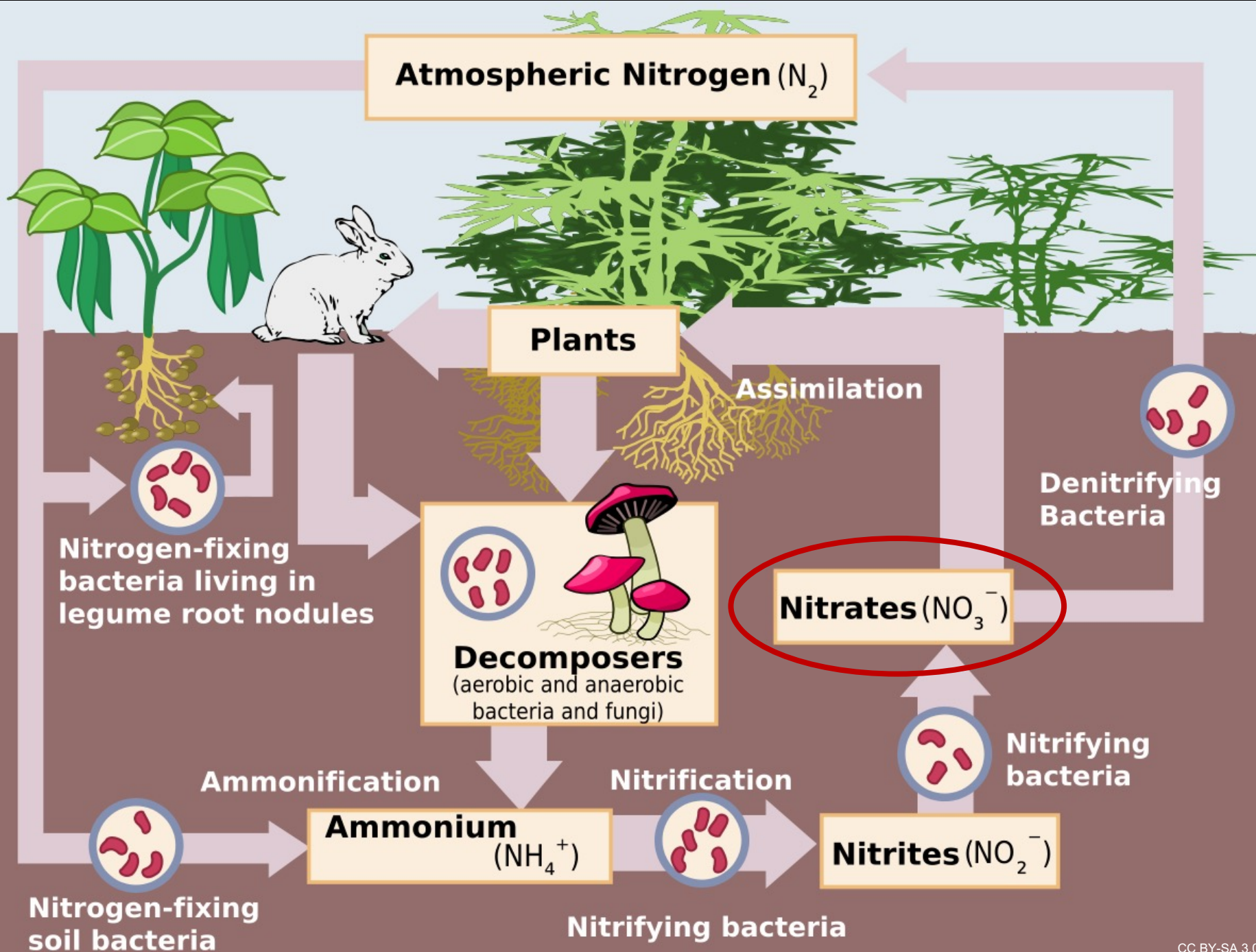
By Zoë Schlanger



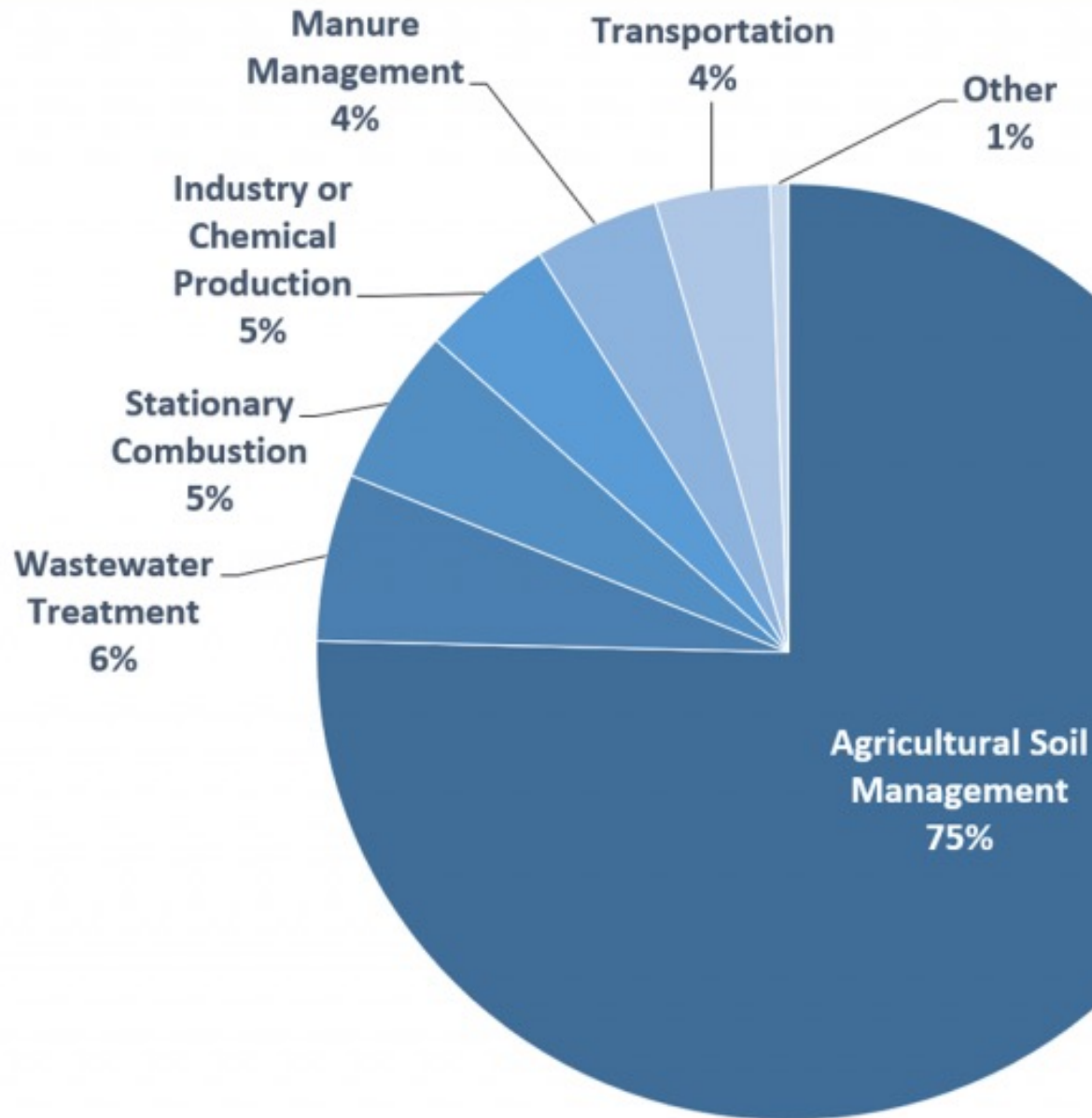
HHelene / Alamy

OCTOBER 23, 2023, 3:07 PM ET

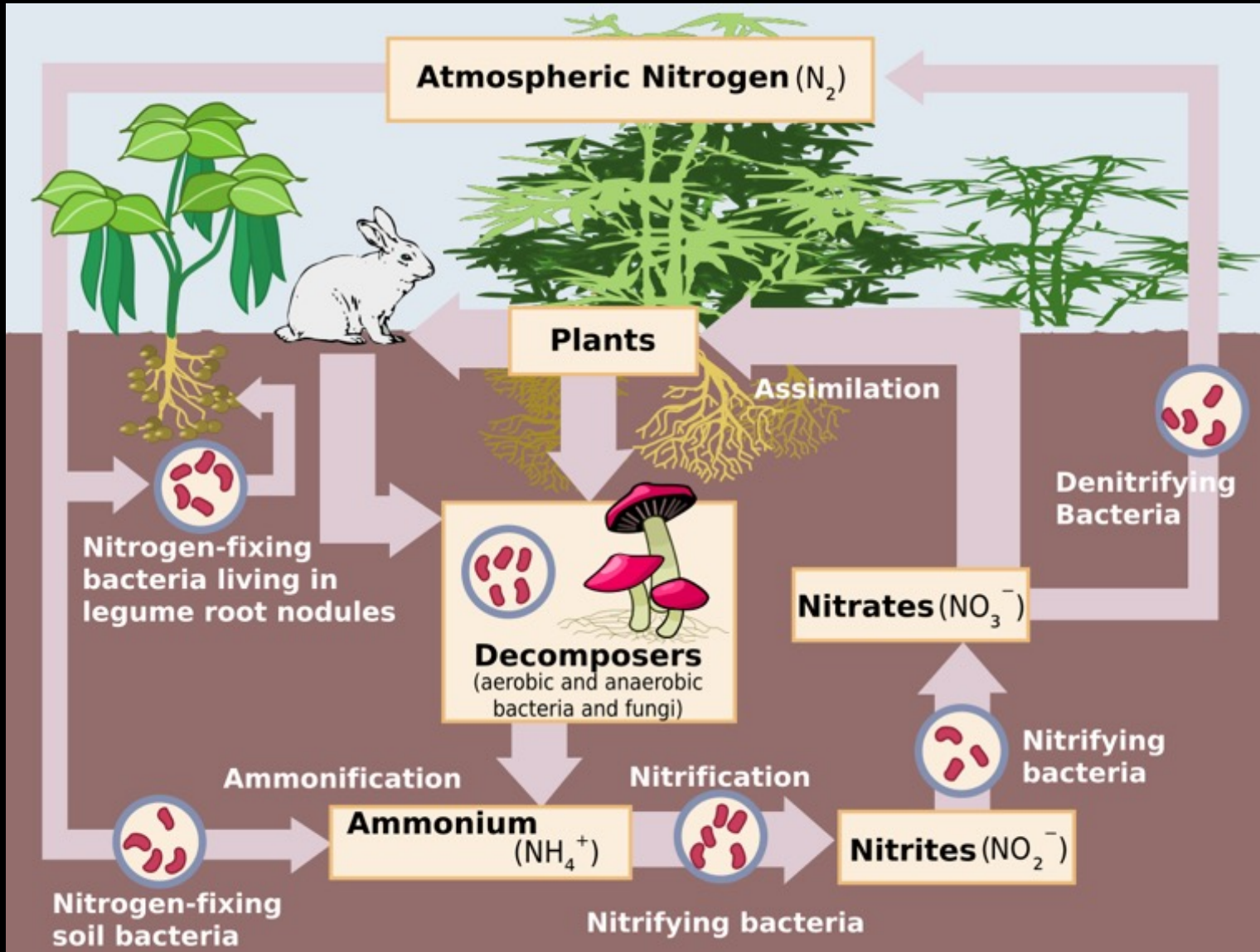
The Atlantic



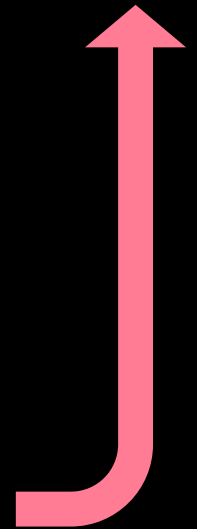
2019 U.S. Nitrous Oxide Emissions, By Source



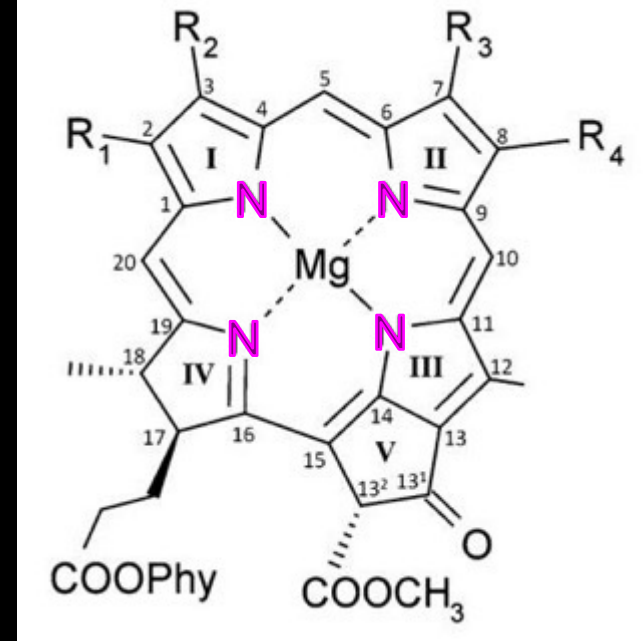
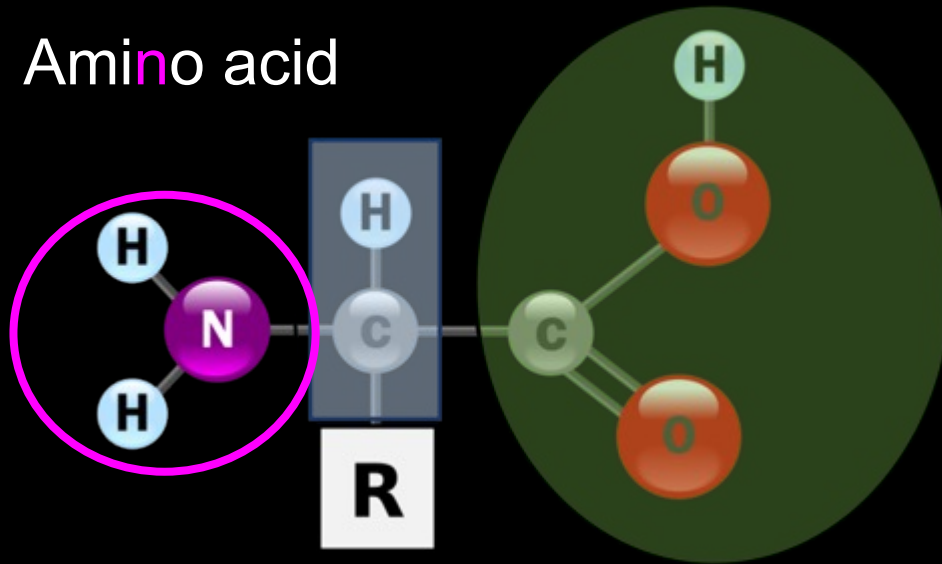
Nitrogen Cycle



N_2O
(Nitrous oxide)

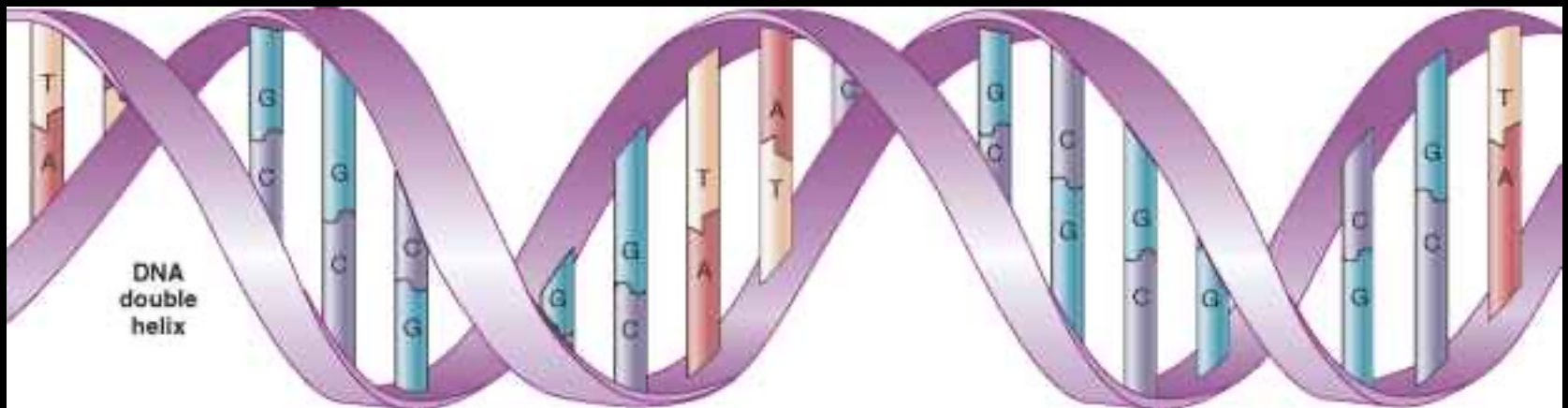


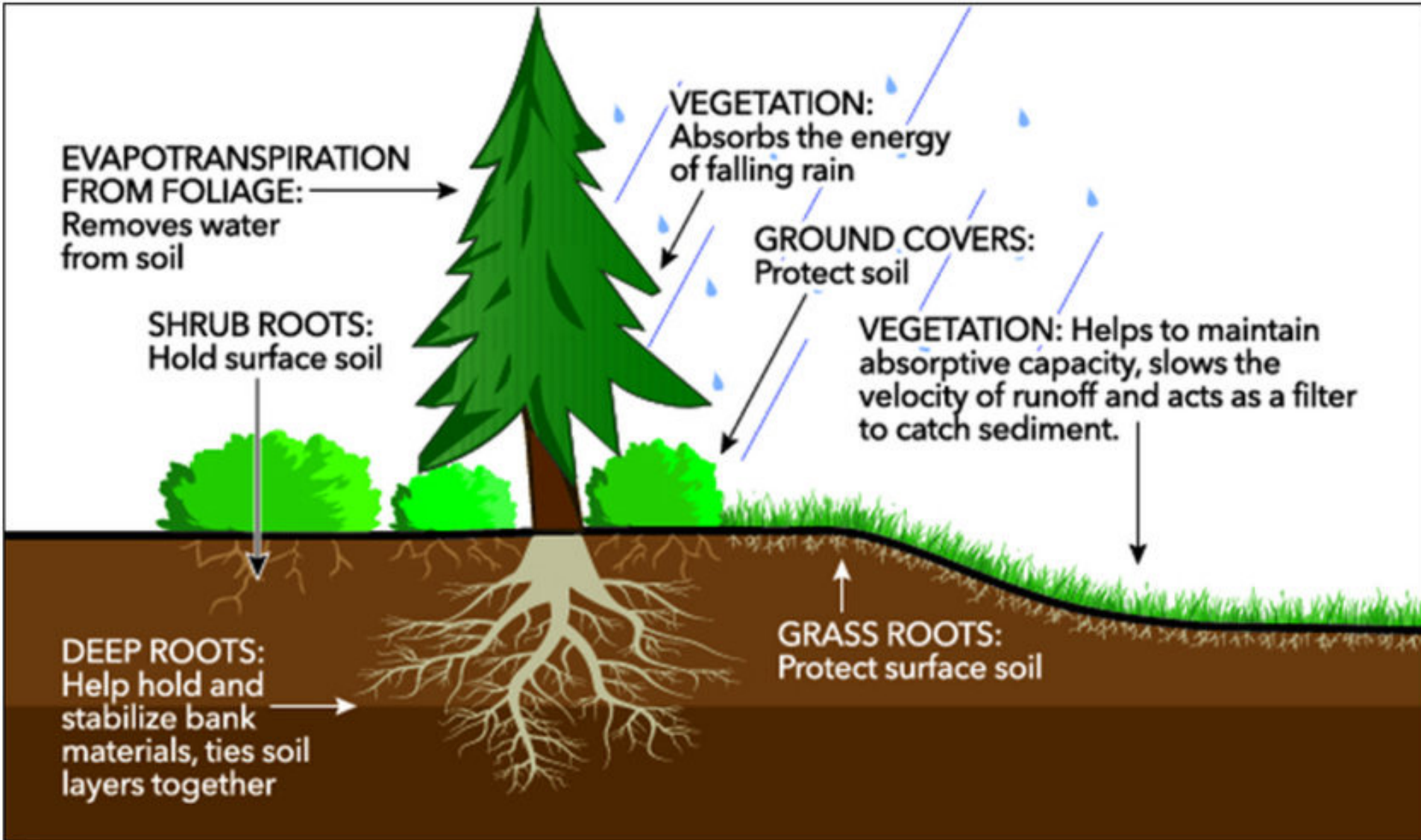
Amino acid



Chlorophyll
(for photosynthesis)

Nitrogenous bases





Stewards 2017

TEEB Europe





Amazonia

HydroSHEDS

Amazon Basin

River network derived
from SRTM elevation data
at 500 m resolution



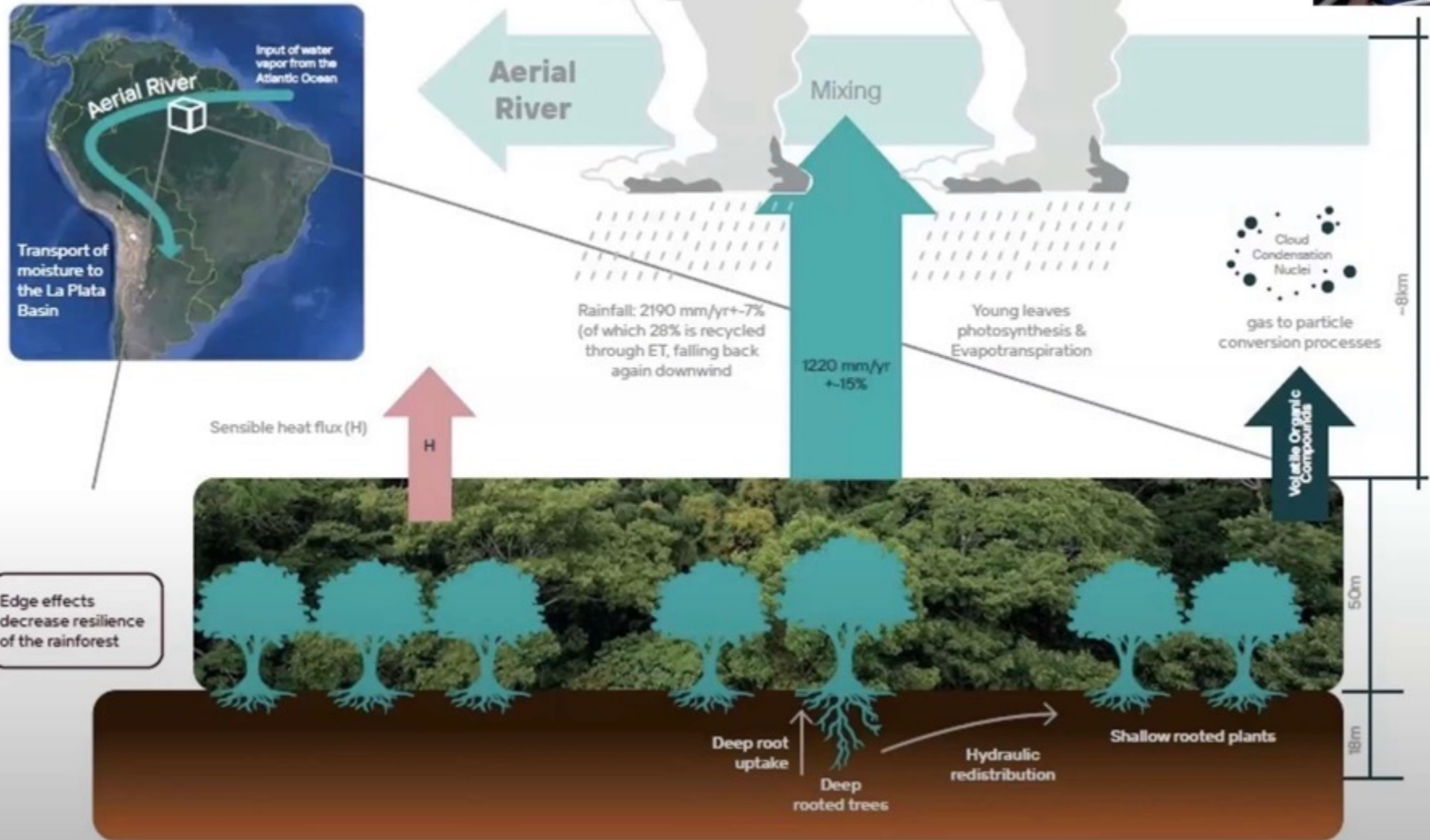
Only
major
rivers and
streams are
visualized

River line width
proportional to
upstream basin area

0 500 1000
Kilometers



Why the Amazon needs trees: water cycling!

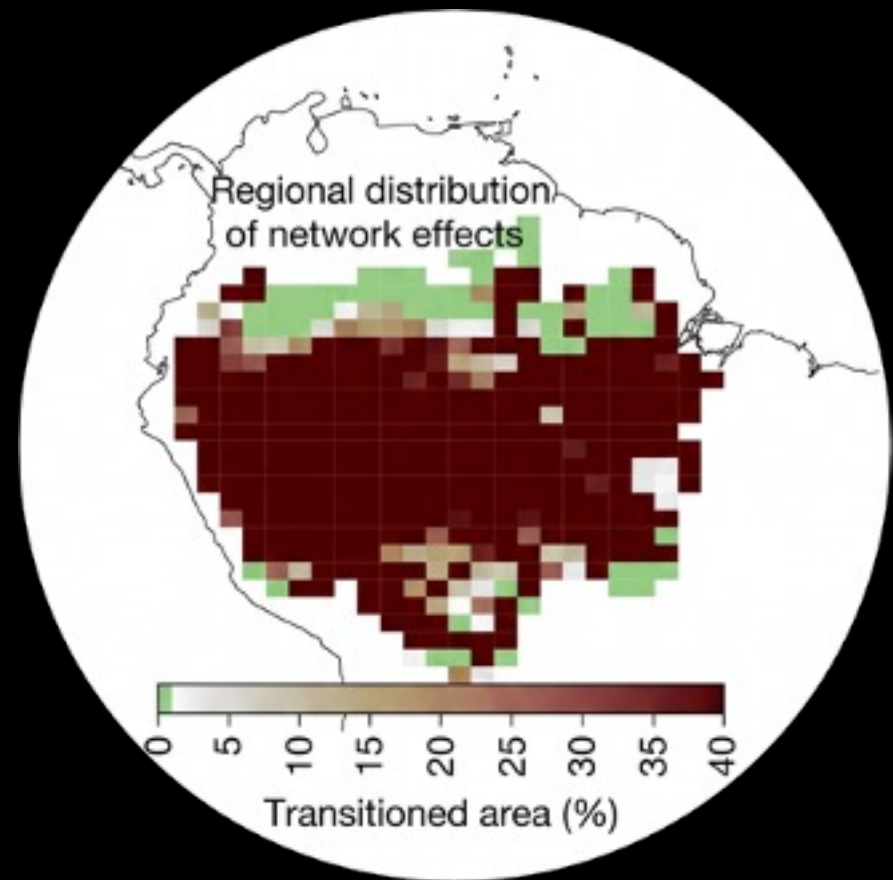
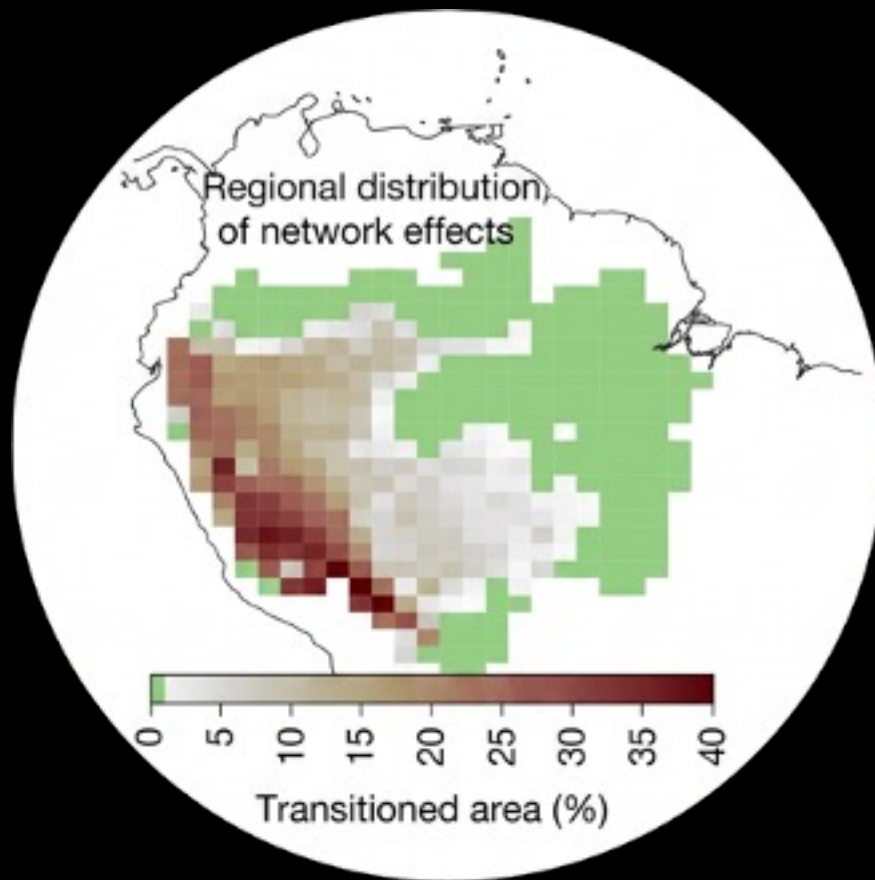


Deforestation-induced drying lowers Amazon climate threshold

<https://doi.org/10.1038/s41586-026-10456-0>

06 May 2026

Nico Wunderling^{1,2,3}✉, Boris Sakschewski², Johan Rockström^{2,4,5}, Bernardo M. Flores^{6,7}, Marina Hirota^{8,9,10} & Arie Staal¹¹✉



Cereal crops decimated by Europe's heatwave

By Grace Duncan | 20 July 2023



Source: Alamy

The 2023 European cereal harvest is set to be its lowest since 2007, some 9.5% lower than the five-year average

[thegrocer.com](https://www.thegrocer.com)

How a single aspect of climate change can make food less safe

Rising temperatures can affect food across the world by



Increasing the incidence of infections by food- and waterborne pathogens



Promoting higher uptake of toxic heavy metals in staple crops



Expanding harmful algal blooms and affecting seafood safety



Driving plant pests into new territories, potentially leading to overuse of pesticides



Making plants more susceptible to fungal infections and mycotoxins emerging in new regions



Climate impacts on global agriculture emerge earlier in new generation of climate and crop models

Jonas Jägermeyr^{1 2 3}, Christoph Müller⁴, Alex C Ruane⁵, Joshua Elliott⁶,
Juraj Balkovic^{7 8}, Oscar Castillo⁹, Babacar Faye¹⁰, Ian Foster¹¹, Christian Folberth⁷,
James A Franke^{6 12}, Kathrin Fuchs¹³, Jose R Guarin^{5 14}, Jens Heinke⁴,
Gerrit Hoogenboom^{9 15}, Toshichika Iizumi¹⁶, Atul K Jain¹⁷, David Kelly¹¹,
Nikolay Khabarov⁷, Stefan Lange⁴, Tzu-Shun Lin¹⁷, Wenfeng Liu¹⁸,
Oleksandr Mialyk¹⁹, Sara Minoli⁴, Elisabeth J Moyer^{6 12}, Masashi Okada²⁰,
Meridel Phillips^{5 14}, Cheryl Porter⁹, Sam S Rabin^{13 21}, Clemens Scheer¹³,
Julia M Schneider²², Joep F Schyns¹⁹, Rastislav Skalsky^{7 23}, Andrew Smerald¹³,
Tommaso Stella²⁴, Haynes Stephens^{6 12}, Heidi Webber²⁴, Florian Zabel²²,
Cynthia Rosenzweig⁵

Affiliations + expand

PMID: 37117503 DOI: [10.1038/s43016-021-00400-y](https://doi.org/10.1038/s43016-021-00400-y)

Abstract

Potential climate-related impacts on future crop yield are a major societal concern. Previous projections of the Agricultural Model Intercomparison and Improvement Project's Global Gridded Crop Model Intercomparison based on the Coupled Model Intercomparison Project Phase 5 identified substantial climate impacts on all major crops, but associated uncertainties were substantial. Here we report new twenty-first-century projections using ensembles of latest-generation crop and climate models. Results suggest markedly more pessimistic yield responses for maize, soybean and rice compared to the original ensemble. Mean end-of-century maize productivity is shifted from +5% to -6% (SSP126) and from +1% to -24% (SSP585)-explained by warmer climate projections and improved crop model sensitivities. In contrast, wheat shows stronger gains (+9% shifted to +18%, SSP585), linked to higher CO₂ concentrations and expanded high-latitude gains. The 'emergence' of climate impacts consistently occurs earlier in the new projections-before 2040 for several main producing regions. While future yield estimates remain uncertain, these results suggest that major breadbasket regions will face distinct anthropogenic climatic risks sooner than previously anticipated.

ARABICA



Sweeter & softer

0.8% - 1.5%

800-1200 m

70%

VS.

ROBUSTA



Taste

Caffeine

Altitude

Share in the worldtrade

Stronger & harsh

1.7% - 3.5%

0-900 m

30%

Coffee Production May Be Imperiled as Forests Are Destroyed for More Crops

A new report by an industry watchdog adds to growing scientific consensus that as forests are felled to make way for coffee farms, rainfall decreases and crops are more likely to fail.





Jenna M. Lawrence, Ph.D.

Agricultural animals



Heat Stress



- Behavior
- Health & Well-Being
- Productivity

Adaptation & Mitigation

- Genetics
- Nutrition
- Management

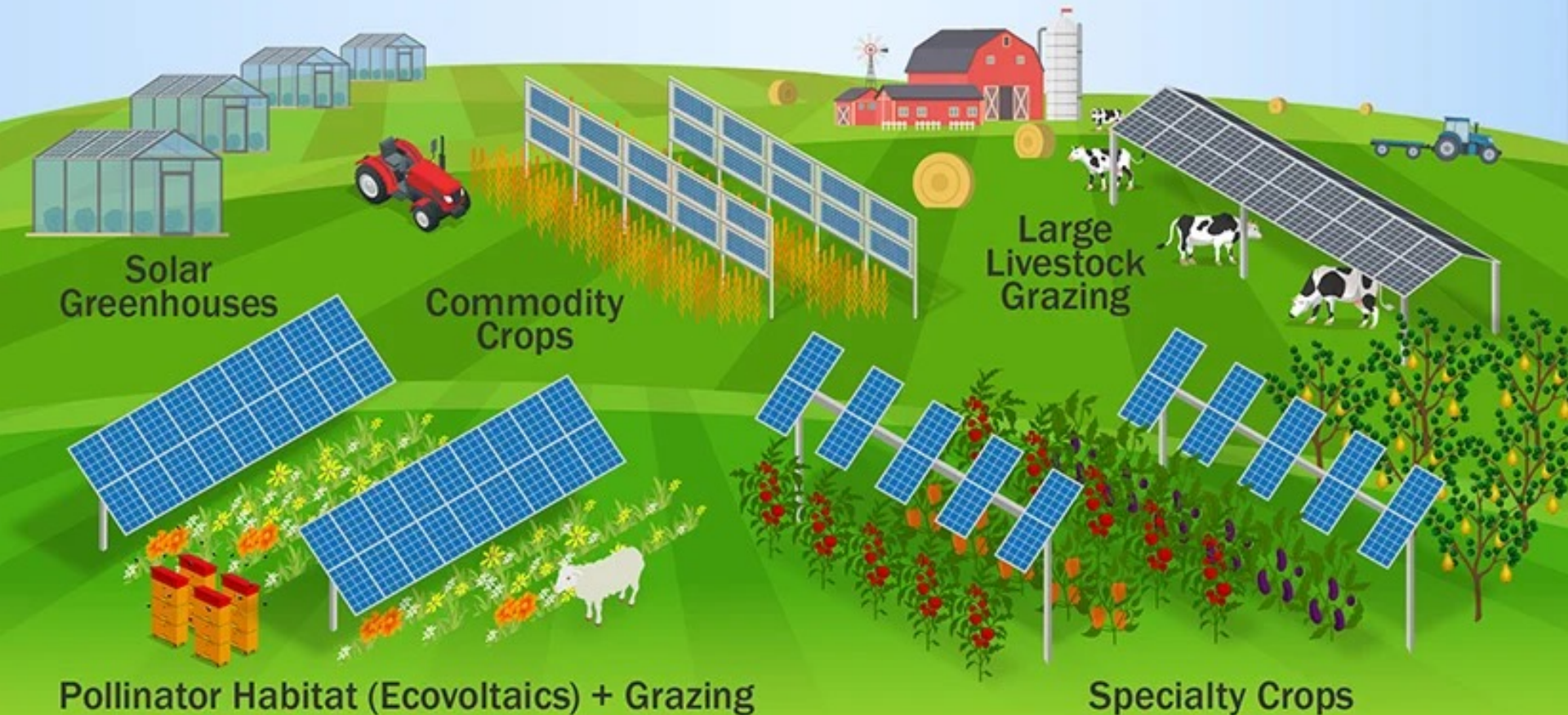
A black and white photograph of two sheep standing on a grassy cliff edge, looking out over a body of water. The sheep are in the foreground, with the ocean and a distant shoreline in the background. The sky is cloudy.

Since 2016 (IPBES):

- 559/6190 domesticated mammal breeds extinct
- >1000 threatened

The Growing Experiment Of Putting Solar Panels On Farmland

Agrivoltaics 101









Jenna M. Lawrence, Ph.D.



Agroecology

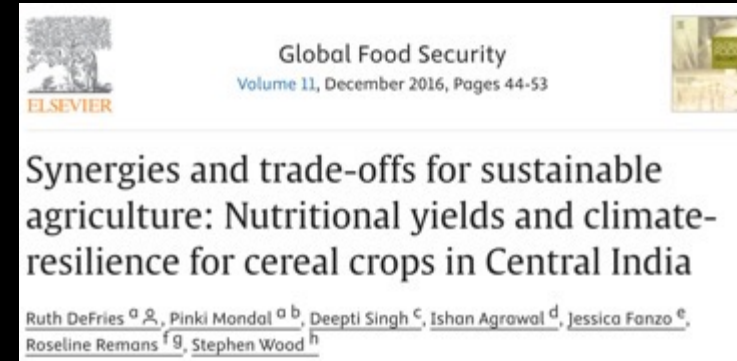
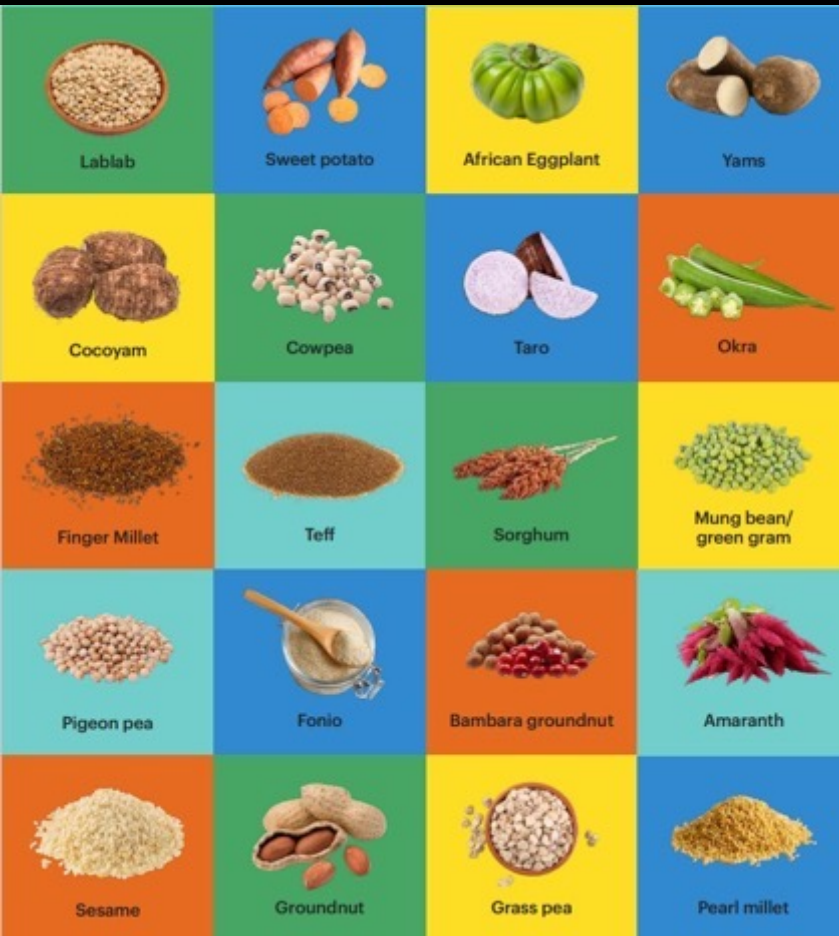




“Biodiversity: ancient tool for resilience”

-Alex McAlvay

Opportunity crops

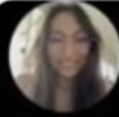


Diversity of sorghum and other millets



 **James Medlock**
@jdcmedlock

They're literally doing the meme



Amy · 16h
@lolennui.bsky.social

(me making fun of your crop rotation idea and thereby holding our people back another 5000 years) jeff thinks the beans have to take turns lmao



Office of Management and Budget   @WHOMB · 19h

Replying to @WHOMB

\$4 million for "legume systems research."



11:49 PM · Jun 3, 2025 · 1.9M Views

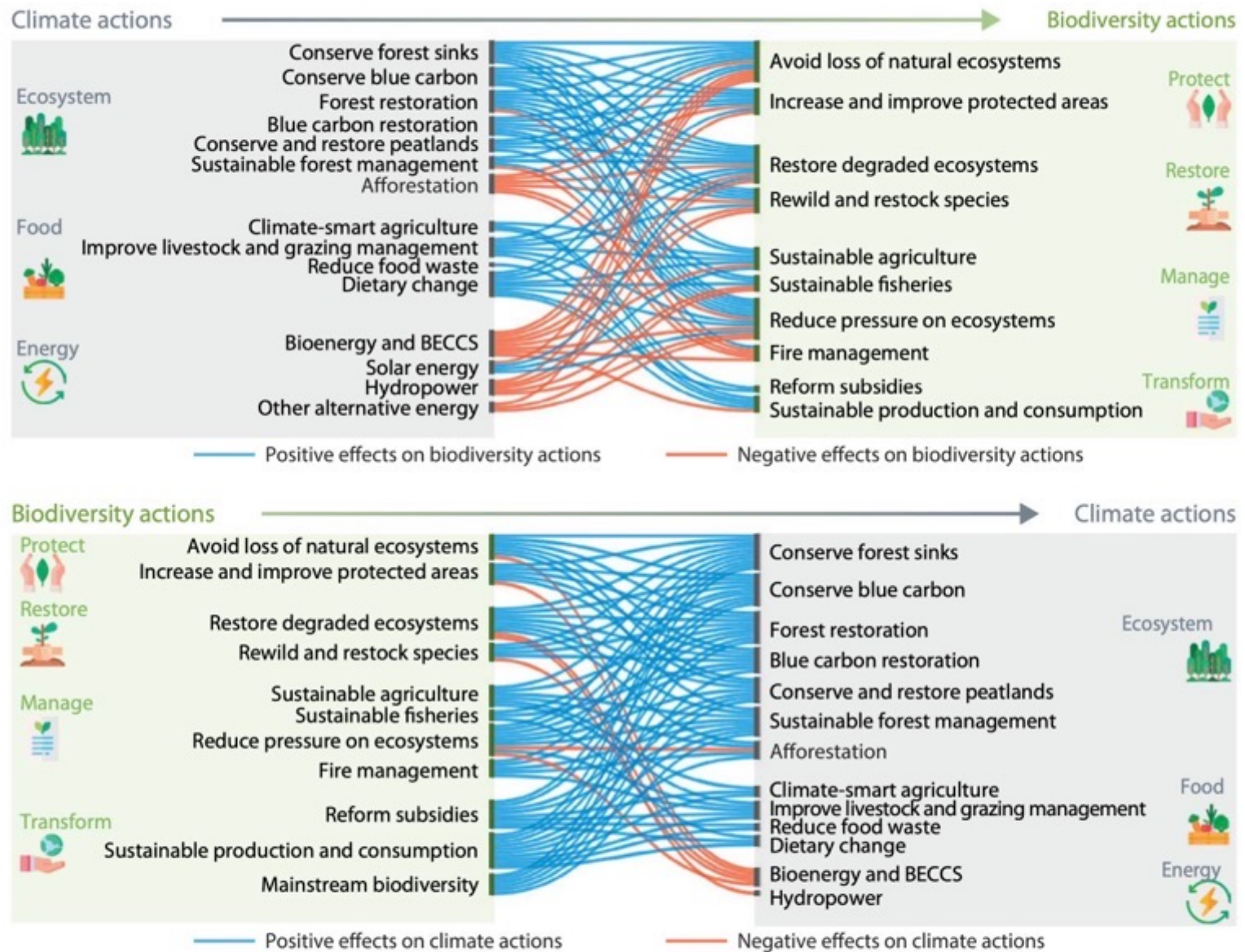


Fig. 3. Positive and negative effects (Top) of actions to mitigate climate change on actions to reduce biodiversity loss and (Bottom) of actions reducing biodiversity loss on those mitigating climate change. Orange lines indicate potential negative effects, and blue lines indicate potential positive effects. Interactions may shift over time and may surpass thresholds that trigger unforeseen consequences, positive or negative [after (18)].