ERASMUS-EDU-2023-CBHE
Project number: 101129032

Duration: 36 months
(01/01/2024 – 31/12/2026)

LESLIE
LAND MANAGEMENT
ENVIRONMENT &
SOLID-WASTE

Co-funded by
the European Union

BUKHARA STATE UNIVERSITY
1930

MICRO-CREDENTIAL

CLIMATE CHANGE FOR SUSTAINABLE LAND MANAGEMENT IN CENTRAL ASIA

3.- The Carbon Cycle, Land Use and SLM

Human Perturbation: Fossil Fuels, Deforestation and Agriculture

CC-W03-V10

Human Perturbation and the Carbon Cycle

Natural Carbon Balance



Human Perturbation

Fossil fuels
Deforestation
Agriculture

Human activities disrupt the balance between carbon sources and sinks

Co-funded by the European Union

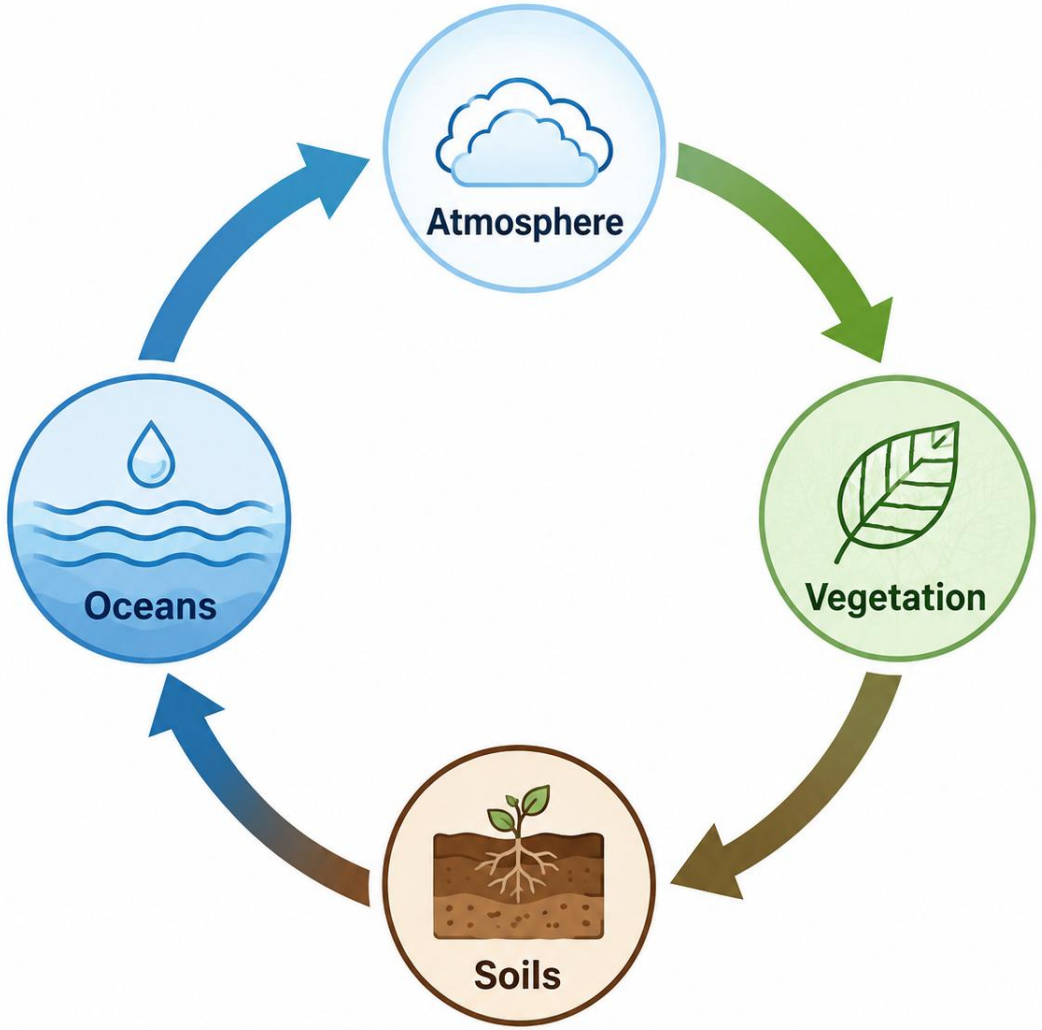
A Balanced Carbon Cycle

Vegetation absorbed atmospheric CO_2 through photosynthesis

Soils stored large amounts of carbon

Oceans continuously exchanged carbon with the atmosphere

Sources and sinks remained largely balanced before industrialization



Co-funded by the European Union

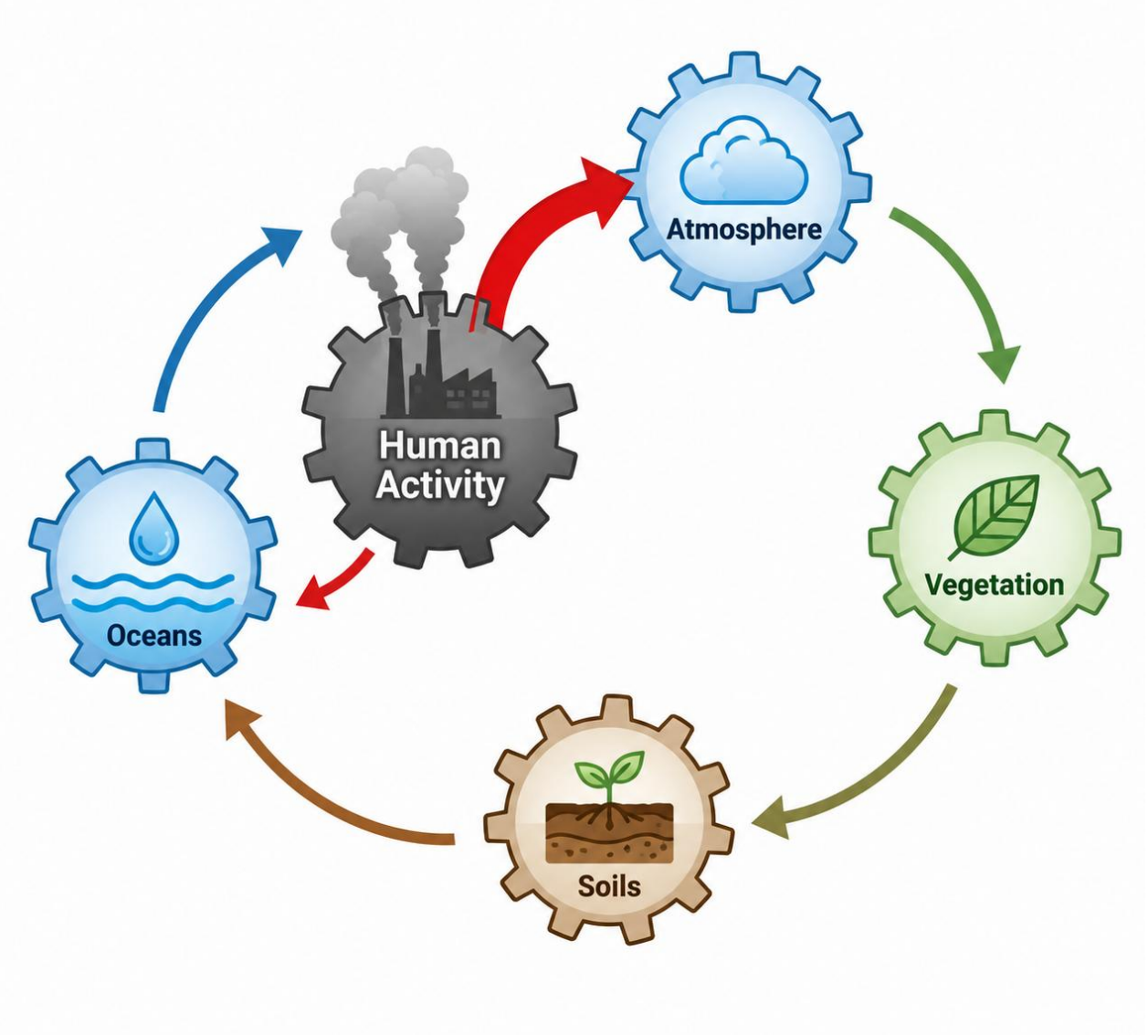
When Humans Changed the Balance

Industrialization increased greenhouse gas emissions

Natural sinks could not absorb carbon as fast as emissions increased

Carbon began accumulating in the atmosphere

Human activities created an imbalance between carbon sources and sinks



Co-funded by the European Union

Fossil Fuels: Carbon from the Geological Past



Fossil fuels contain ancient organic carbon stored underground

This carbon remained isolated from the atmosphere for million of years

Burning fossil fuels rapidly releases this stored carbon as CO_2

Burning fossil fuels rapidly unleashes millions of years of deeply stored ancient carbon directly into today's atmosphere

Co-funded by the European Union

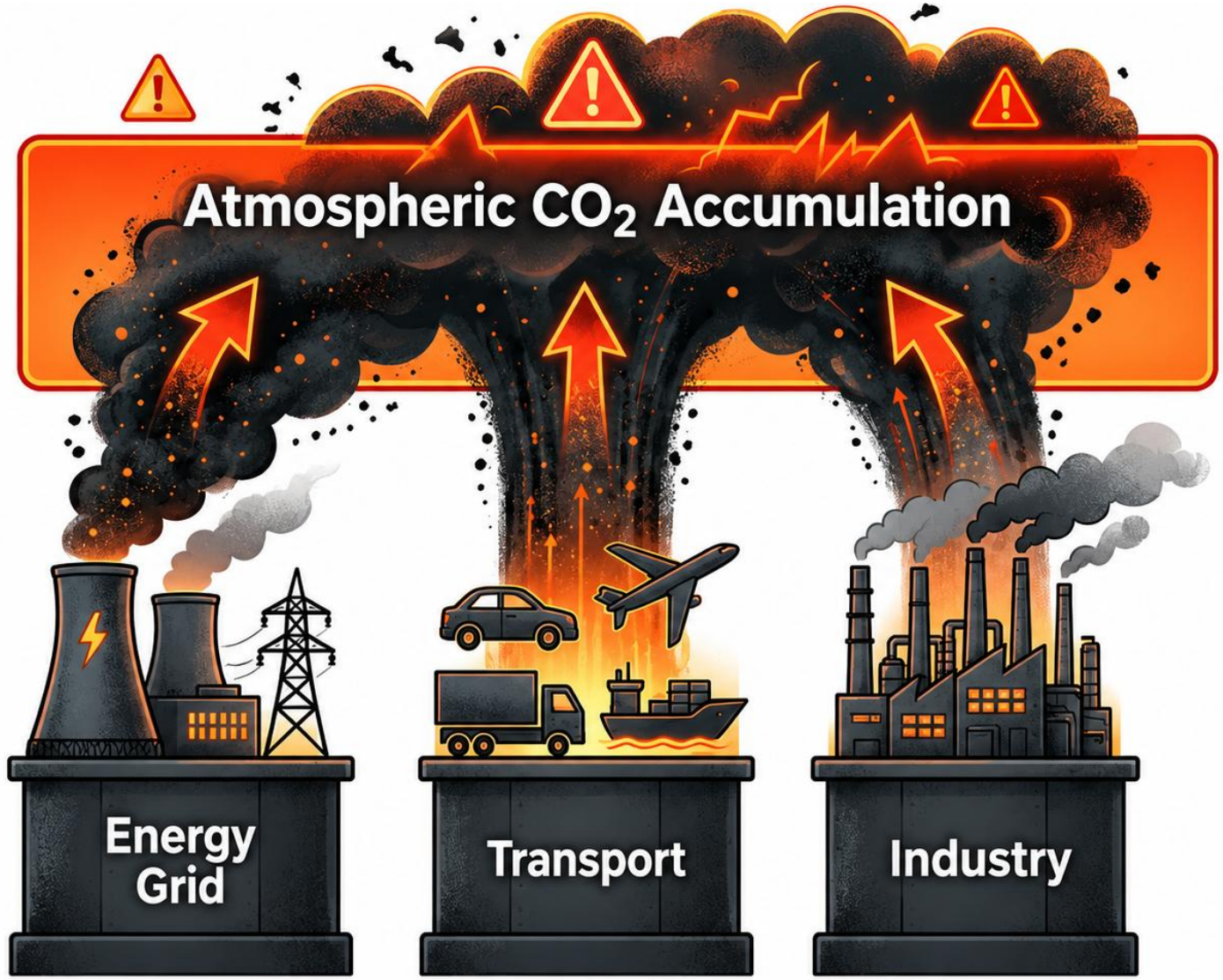
Fossil Fuel Emissions and Modern Climate Change

Energy production is the largest source of fossil fuel emissions

Transport and industry are also major contributors

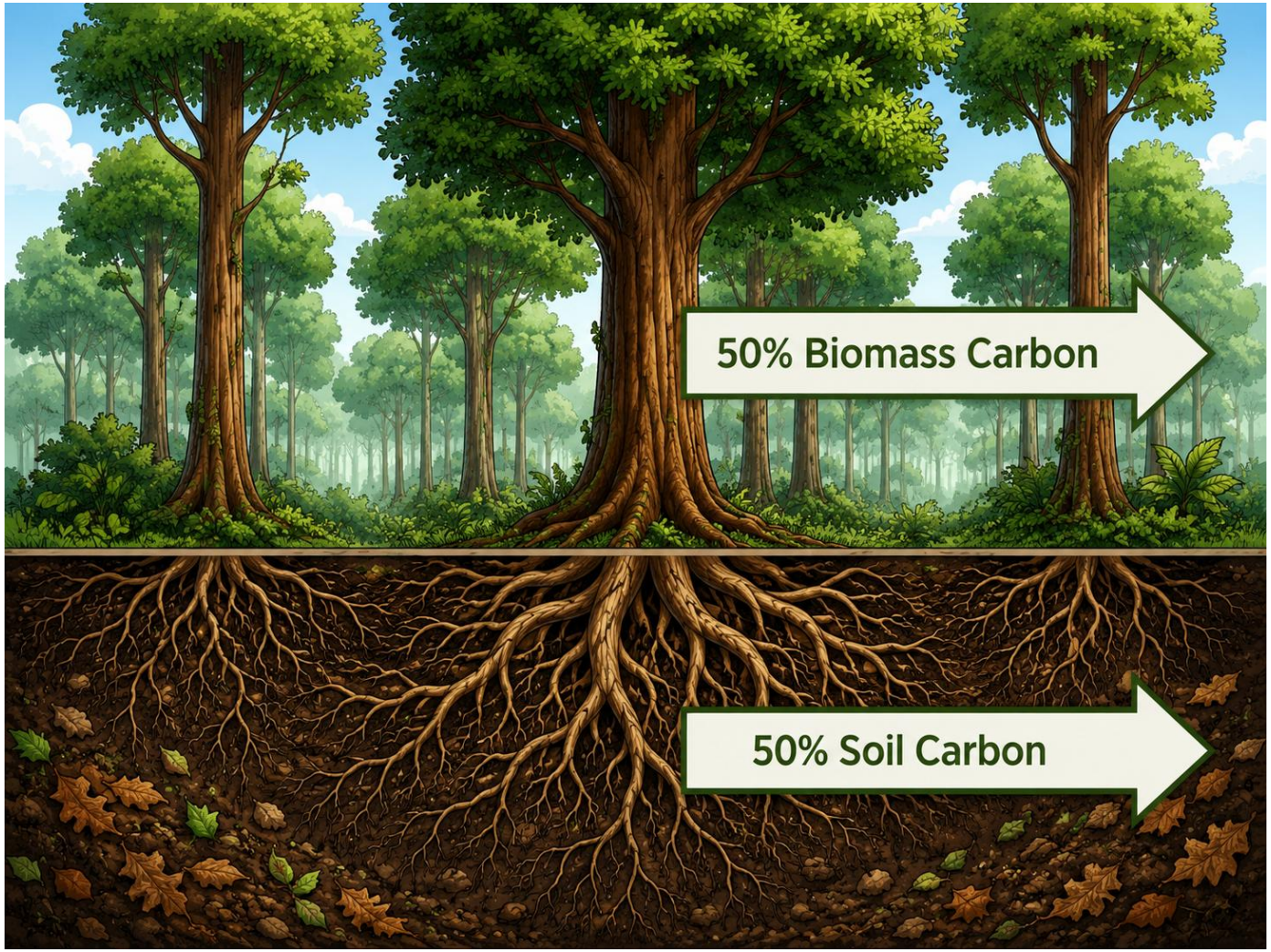
These emissions increase atmospheric CO_2 concentrations

Fossil fuel emissions are a major driver of modern climate change



Co-funded by the European Union

Forests: Nature’s Carbon Reservoirs



Forests store large amounts of carbon both above and below ground

Above ground: Carbon stored in vegetation and biomass

Below ground: Carbon stored in roots, organic matter and soils

Co-funded by the European Union

Deforestation: From Carbon Sink to Carbon Source

Carbon released from vegetation

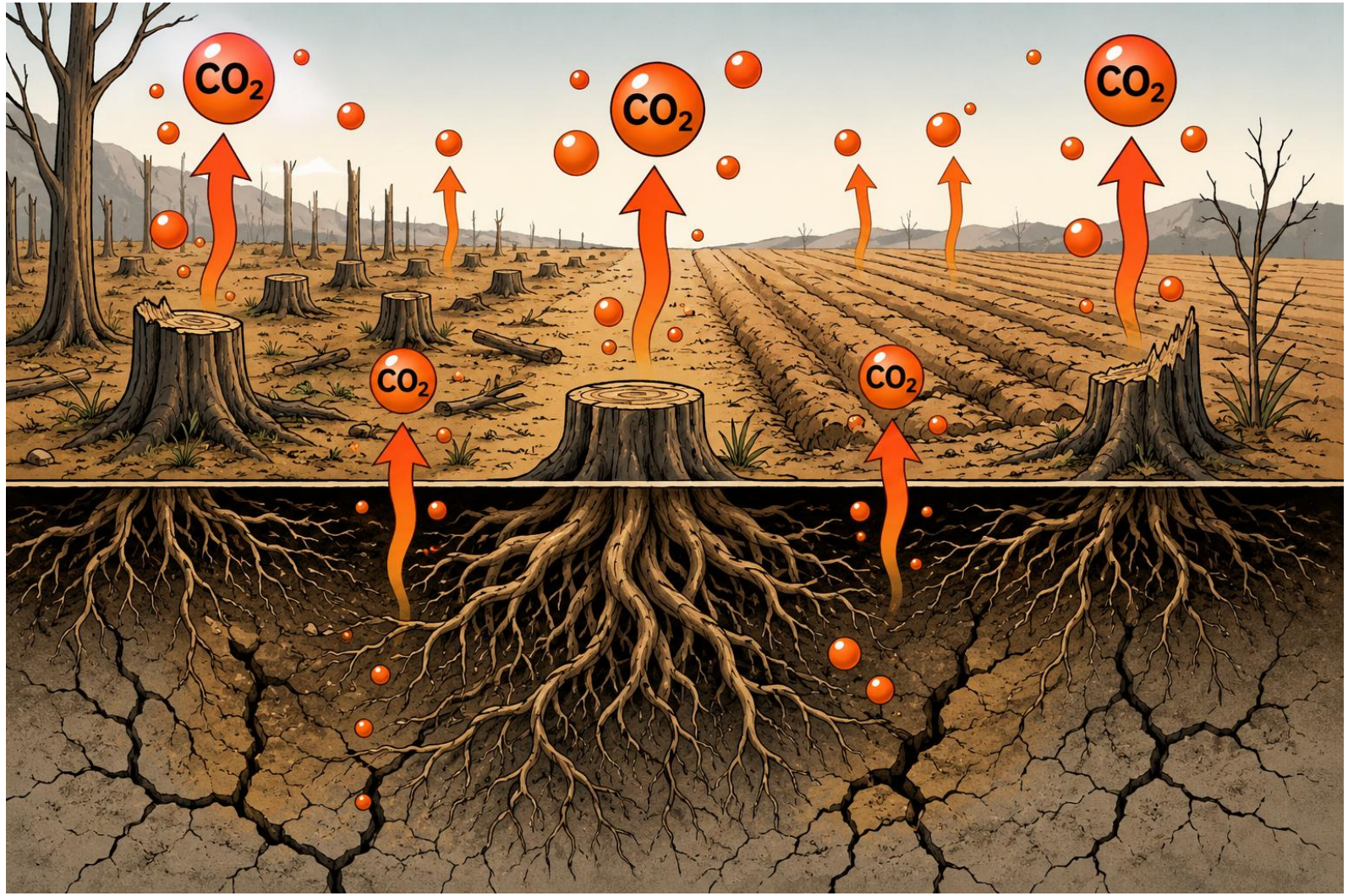
↓

Carbon released from soils

↓

Reduced carbon sequestration

Deforestation releases stored carbon and reduces future carbon sequestration



Co-funded by the European Union

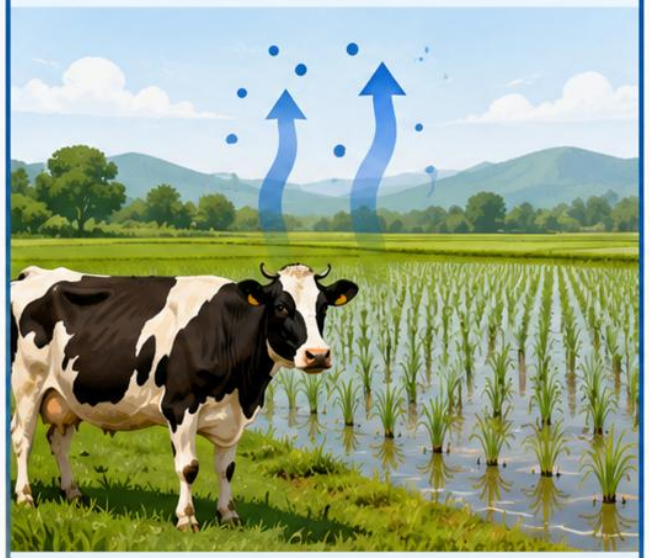
Agriculture and Greenhouse Gas Production

CO_2 Carbon Dioxide (CO_2)



- Land clearing and machinery

CH_4 Methane (CH_4)



- Livestock and rice cultivation

N_2O Nitrous Oxide (N_2O)

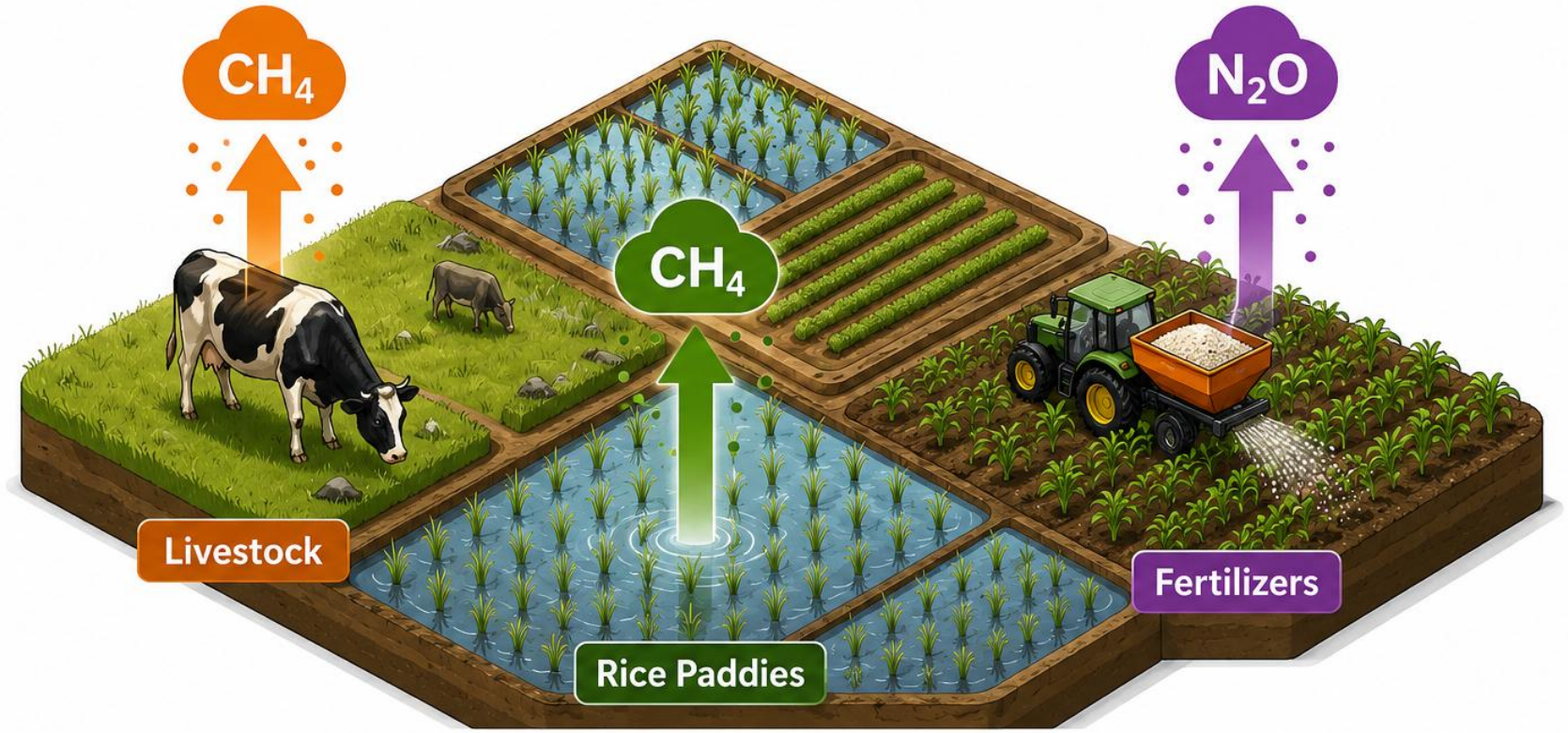


- Fertilizers and manure management

Agriculture contributes to climate change through multiple greenhouse gases

Co-funded by the European Union

Livestock, Rice Cultivation and Fertilizers



Livestock → CH_4

Rice paddies → CH_4

Fertilizers → N_2O

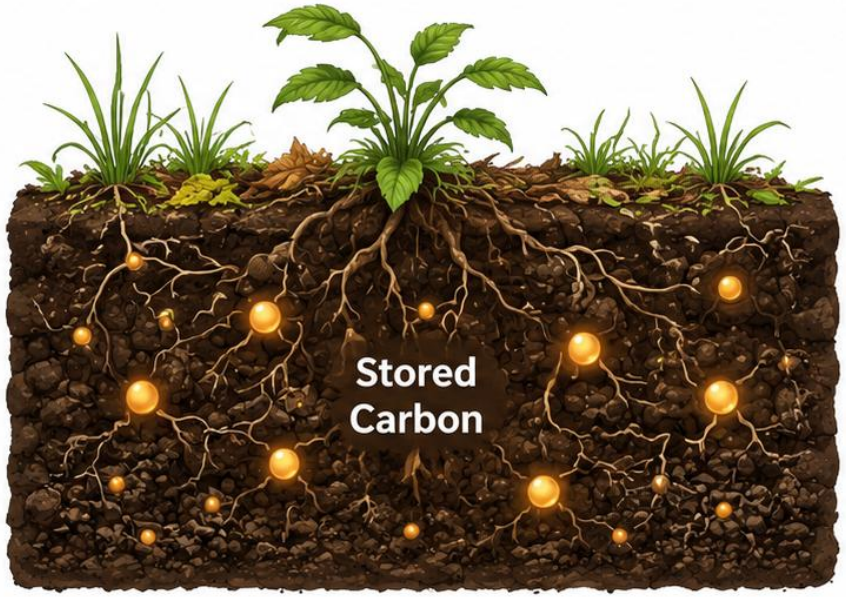
Livestock, rice cultivation and fertilizers are the main agricultural sources of methane and nitrous oxide.

Co-funded by the European Union

Soil Organic Carbon: The Hidden Carbon Pool

Healthy Soil

Carbon is stored in soil organic matter.



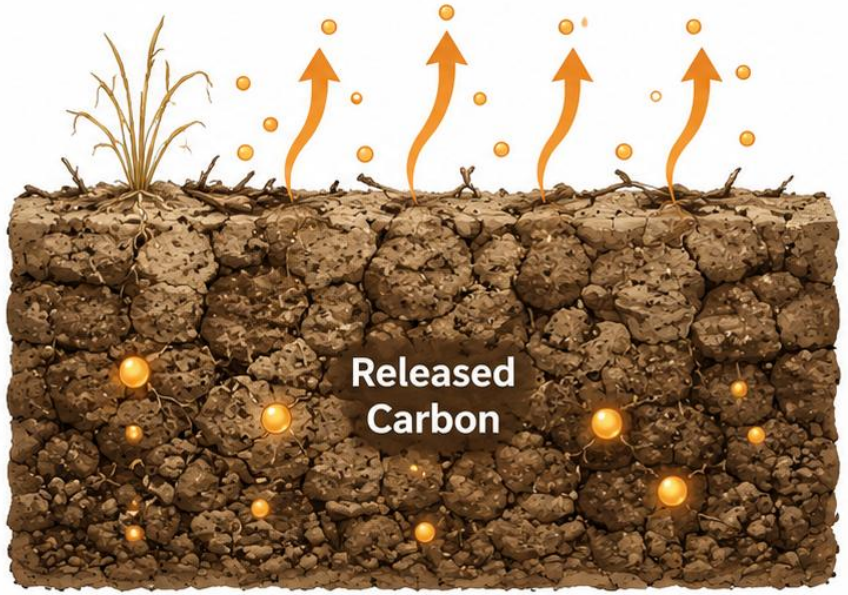
High organic matter

Good structure and fertility

Supports plant growth

Degraded Soil

Carbon is released into the atmosphere.



Low organic matter

Poor structure and erosion

Reduced fertility and productivity

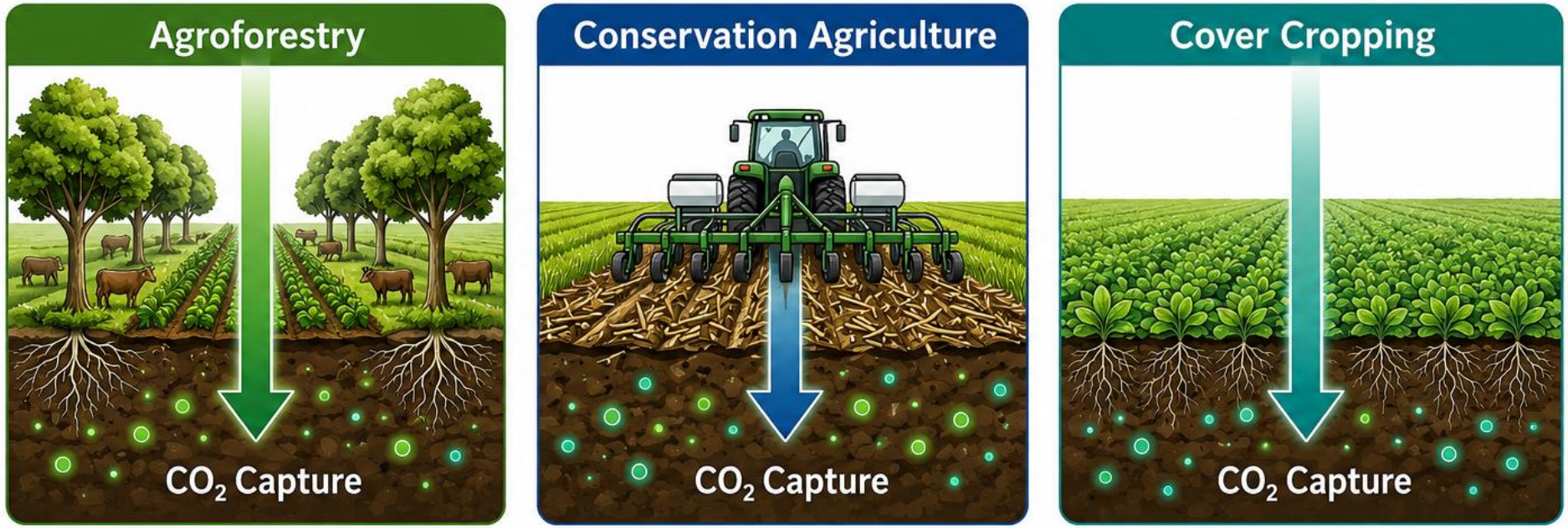
Healthy soils act as major carbon reservoirs,
while degraded soils become sources of carbon emissions.

Co-funded by the European Union

Restoring Carbon through Sustainable Land Management

Sustainable Land Management practices can restore carbon stocks in soils and biomass through:

- Agroforestry
- Conservation Agriculture
- Cover Cropping



Key Takeaway: Sustainable land management practices offer proven, nature-based solutions to sequester atmospheric carbon back into soils and biomass.

Co-funded by the European Union

Land-Based Mitigation Opportunities

Reduced Deforestation



- CO_2 Prevents the release of large amounts of stored carbon.
- Halting deforestation offers the largest immediate emissions reduction.
- Protects biodiversity and ecosystem services.

Improved Agriculture



- CH_4 Improving efficiency reduces methane (CH_4) emissions.
- N_2O Better nutrient management reduces nitrous oxide (N_2O).
- Sustainable productivity with lower greenhouse gas emissions.

Soil Carbon Sequestration



- CO_2 Restoring degraded soils increases carbon storage.
- Builds soil organic matter and improves soil health.
- Enhances water retention and resilience to climate impacts.

Reduced Emissions • Increased Carbon Storage • Climate Change Mitigation

Key Takeaway: Protecting forests, improving agriculture, and restoring soils collectively represent one of our largest and most cost-effective tools for climate mitigation.

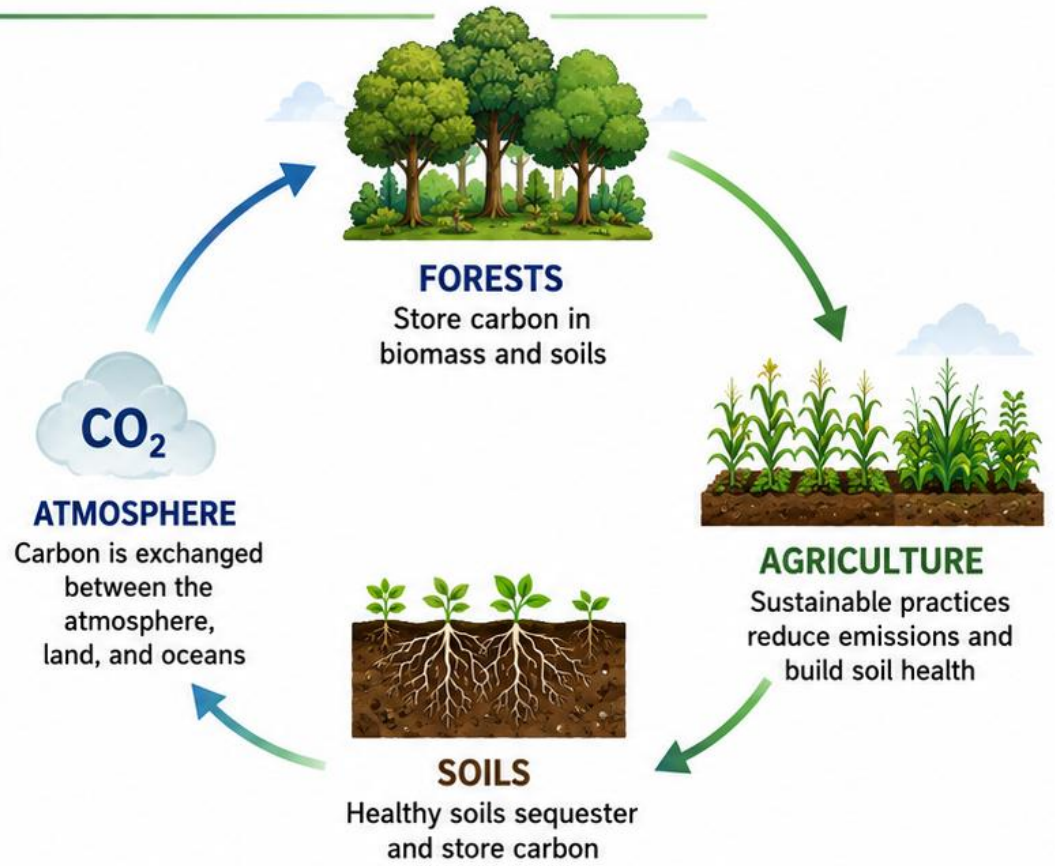
Co-funded by the European Union

Key Conclusions and Future Perspectives

Human activities have disrupted the natural carbon cycle.

Fossil fuels, deforestation, and agriculture are the main drivers of carbon emissions.

Sustainable Land Management can restore carbon stocks and support climate resilience.



Key Takeaway: Transitioning to Sustainable Land Management is critical to repairing the carbon cycle, securing our food systems, and stabilizing the global climate.

Co-funded by the European Union

ERASMUS-EDU-2023-CBHE
Project number: 101129032

Duration: 36 months
(01/01/2024 – 31/12/2026)

LESLIE
LAND MANAGEMENT
ENVIRONMENT &
SOLID-WASTE

Co-funded by
the European Union

BUKHARA STATE UNIVERSITY
1930

MICRO-CREDENTIAL

CLIMATE CHANGE FOR SUSTAINABLE LAND MANAGEMENT IN CENTRAL ASIA

3.- The Carbon Cycle, Land Use and SLM

Human Perturbation: Fossil Fuels, Deforestation and Agriculture

CC-W03-V10