

# Climate Change and Soil Quality

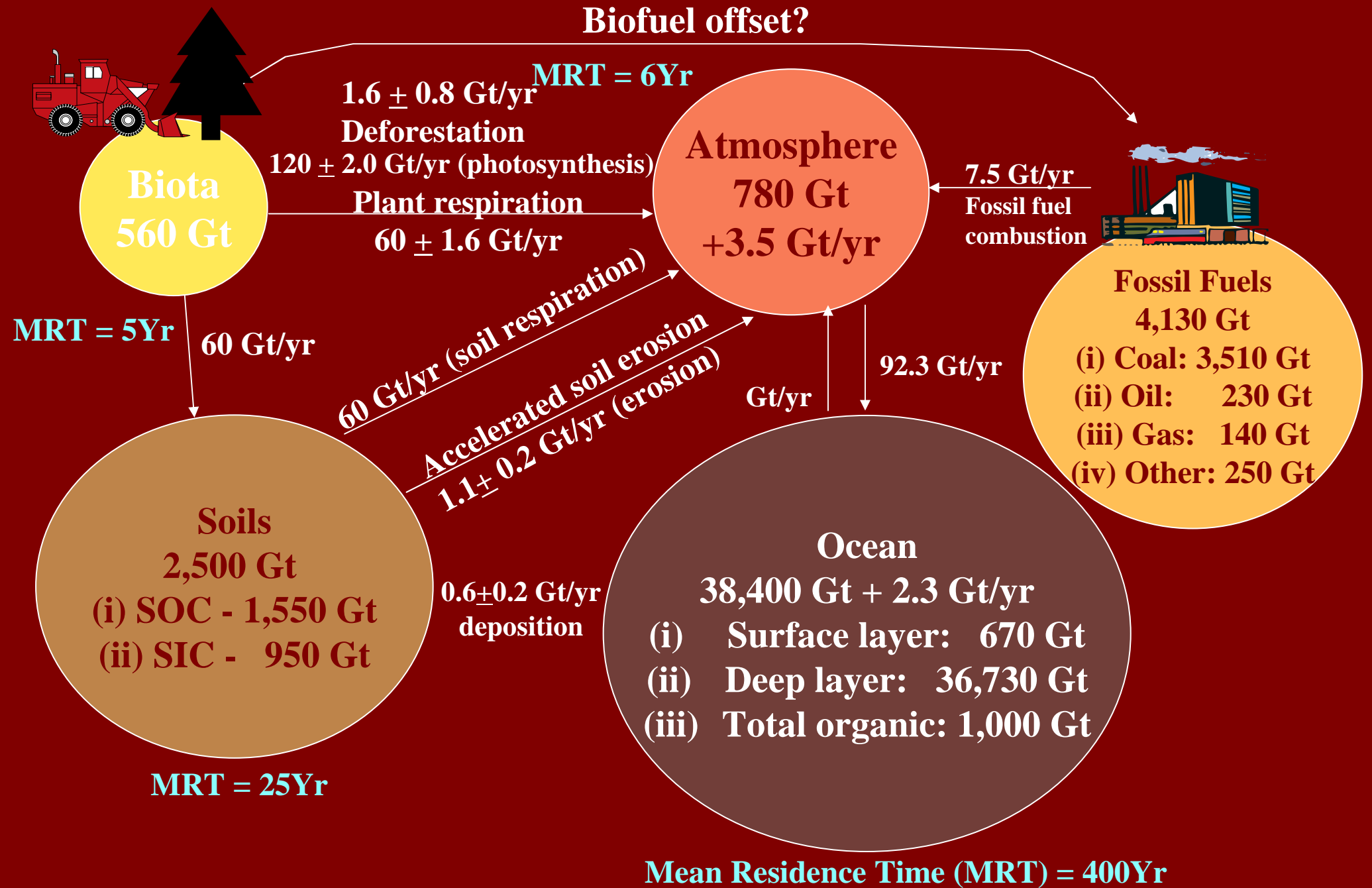
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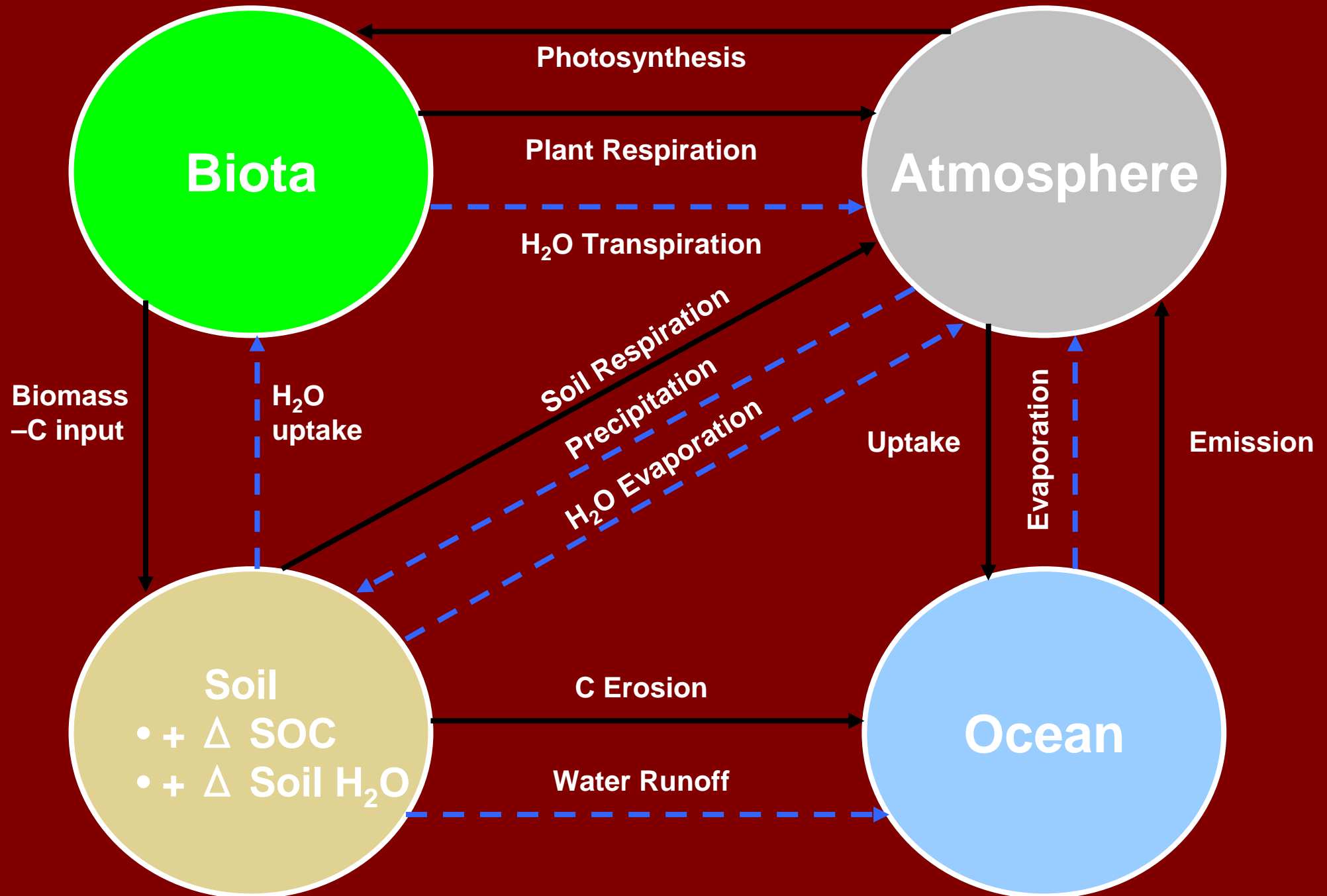
# Soil Quality

Capacity of a soil to perform ecosystem functions

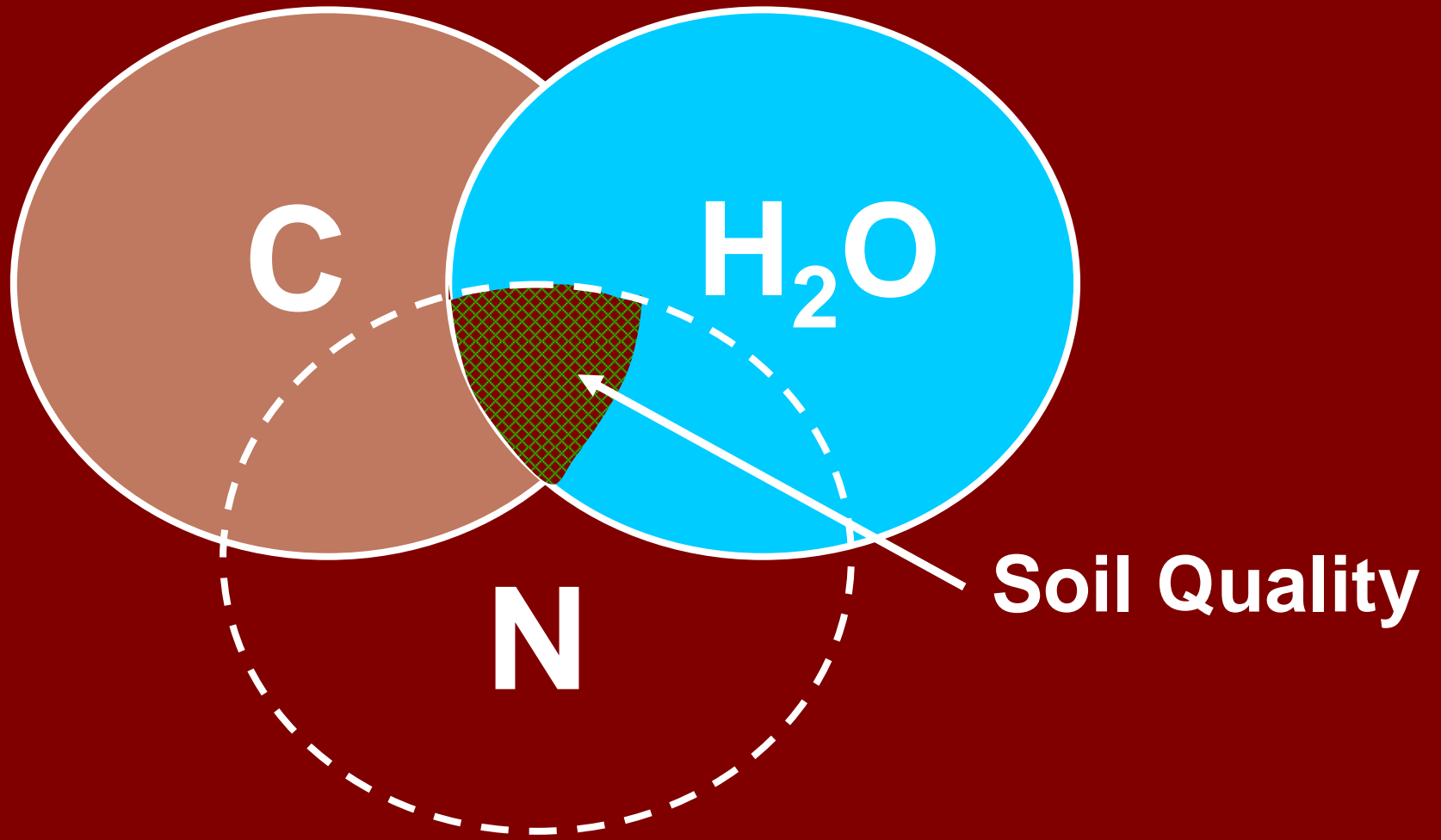
- Enhancing NPP
- Moderating climate
- Purifying water
- Cycling elements
- Increasing biodiversity
- Etc.



# Coupled Cycles of C and Water in Soil Ecosystem



# Coupled Cycling of C, N, H<sub>2</sub>O



# Mean Crop Yield in India, Kenya and Developed Countries (FAO, 2005)

Crop	Yield (kg/ha)	
	India	Developed Countries
Rice	3284	6810
Wheat	2601	3110
Maize	1907	8340
Sorghum	797	3910
Cowpea	332	1790
Chickpea	814	7980

# Climate Change

- Projected climate change may exacerbate the problem of desertification, drought and soil degradation.
- It is essential to identify and implement coping (mitigation) and adaptive strategies.

# Drought

It refers to a prolonged period during which the availability of fresh water supply is less than the demand, especially in arid and semi-arid regions.

# Types of Drought

## A. Climatic

1. Meteorological

When rainfall is deficient

2. Hydrological

When runoff in rivers declines

## B. Non-Climatic

3. Edaphic

When infiltration rate of soil decreases

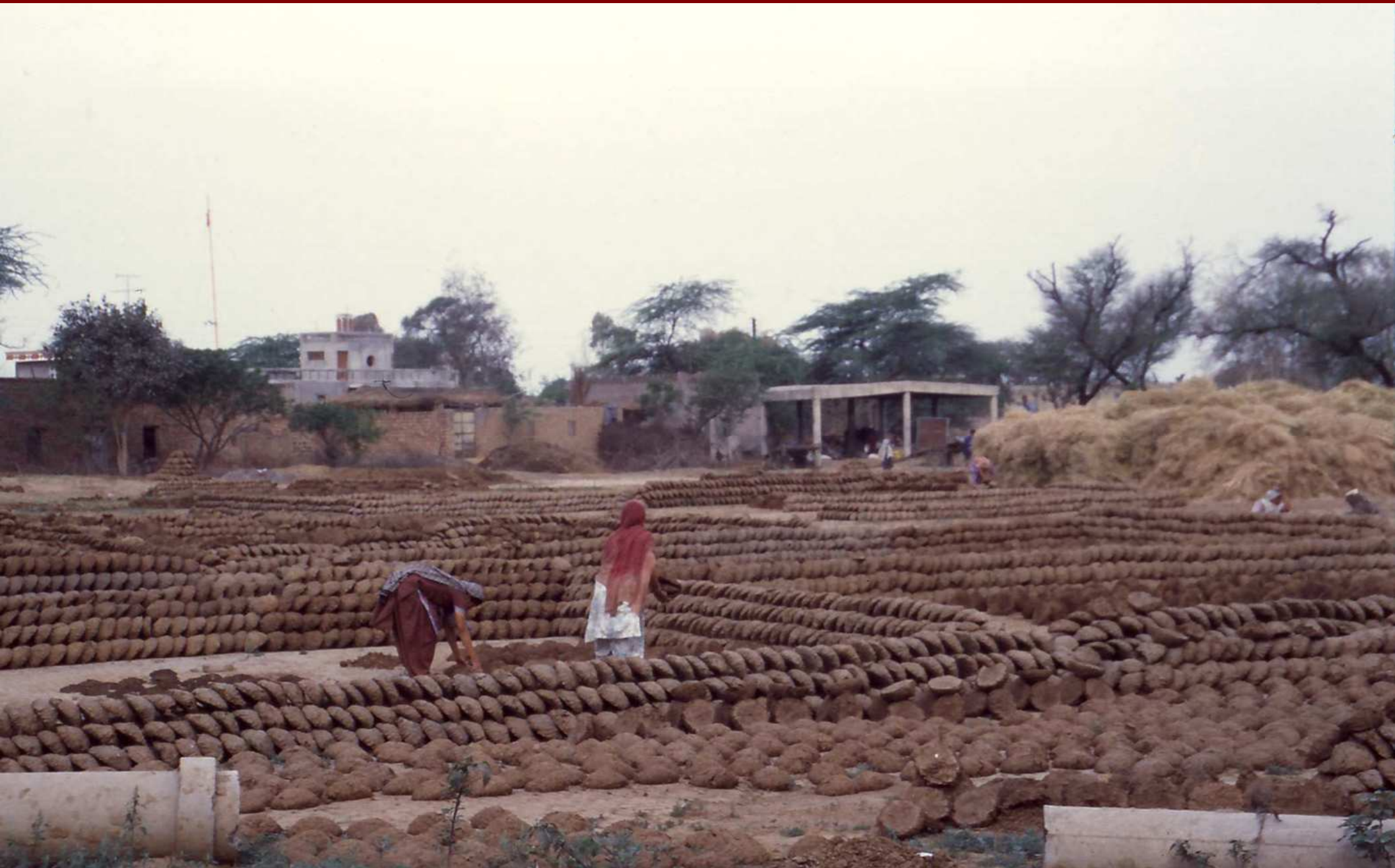
4. Agricultural

When available water is less than the need for agricultural use

# Other Soil Related Constraints In South Asia

- Low AWC in rainfed soils
- Poor quality soils
- Depleted of nutrients and SOC
- Extractive farming







# Agricultural Intensification

Cultivating the best soils with the best management practices to produce the optimum sustainable yield and save marginal lands for nature conservancy

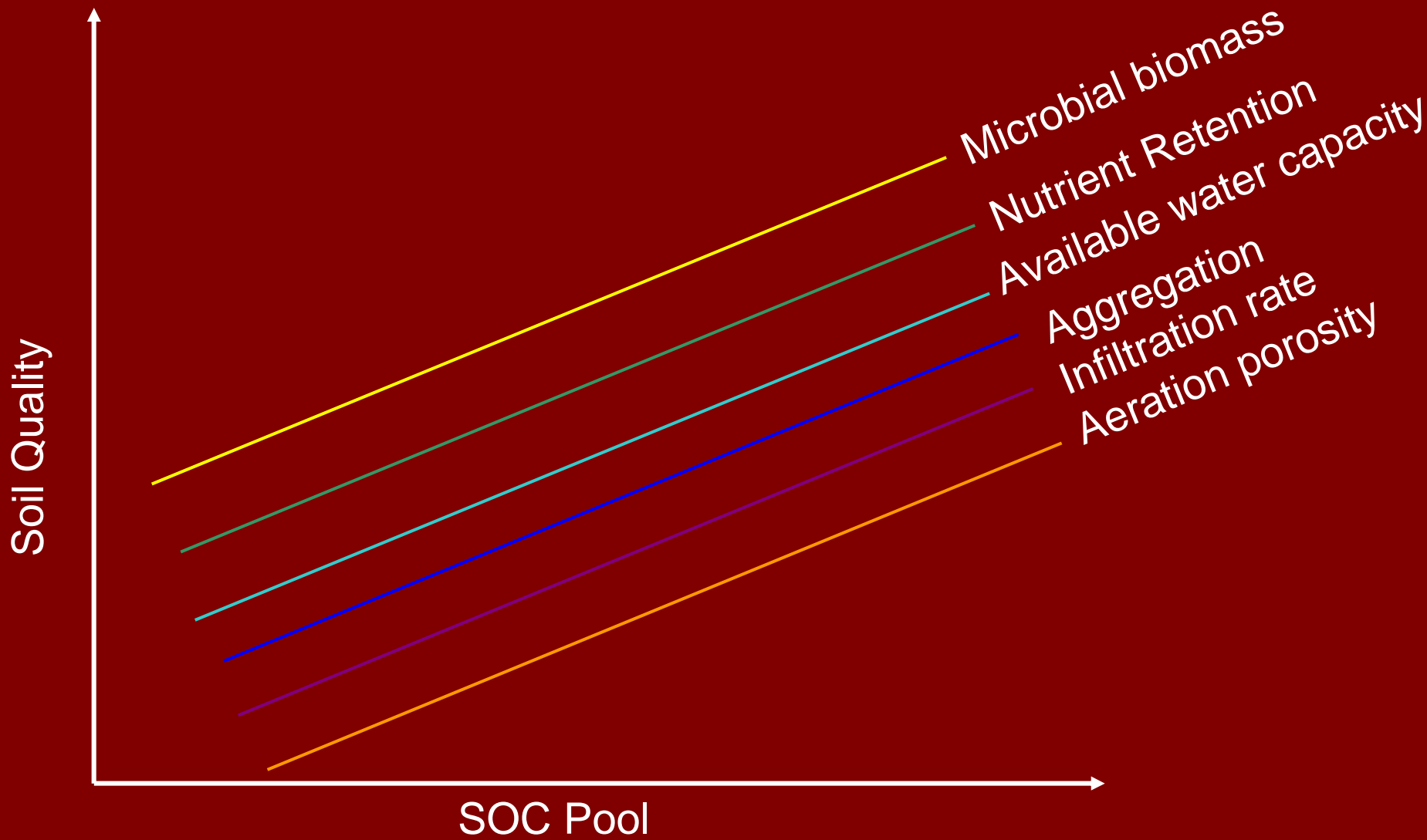
# Agricultural Intensification

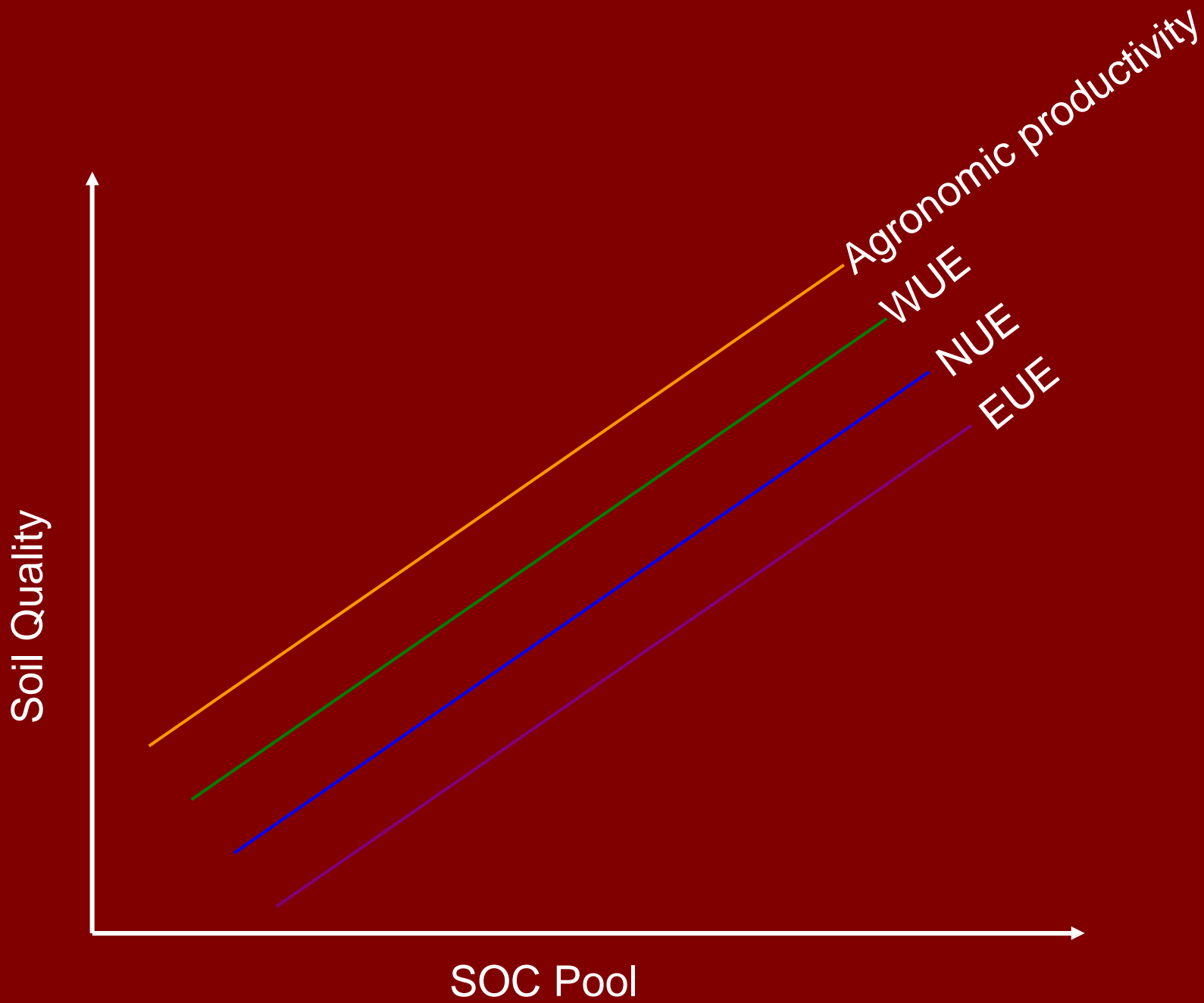


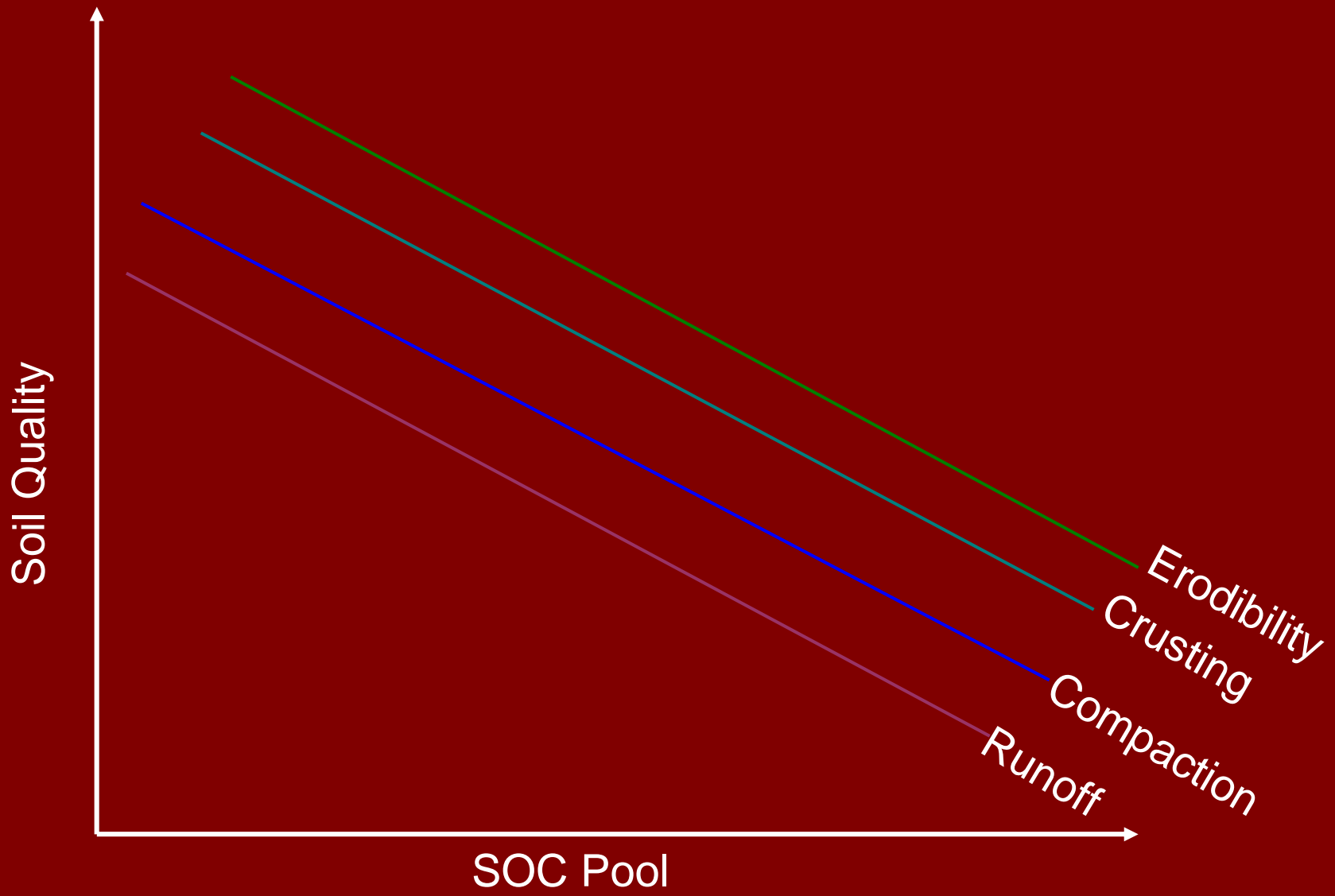
Delivering nutrients and water directly to roots of improved plants using nano-enhanced molecules

# Estimate of Increase in Food Production in LDCs by Increasing SOC Pool by 1 Mg C ha<sup>-1</sup> yr<sup>-1</sup>

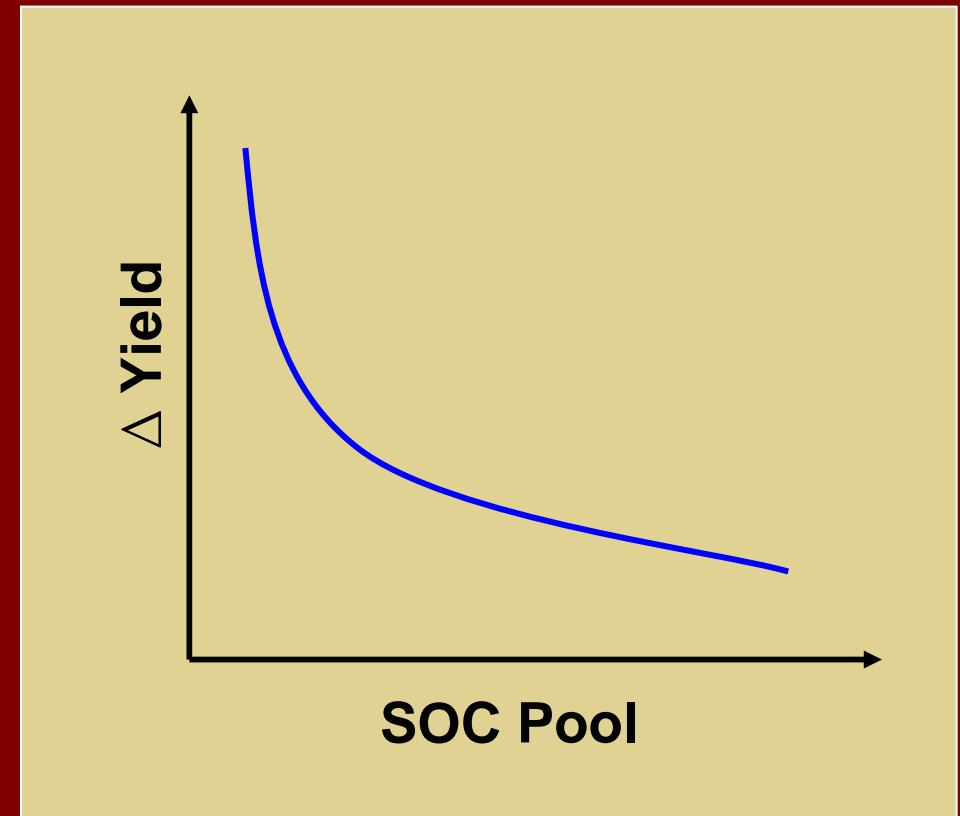
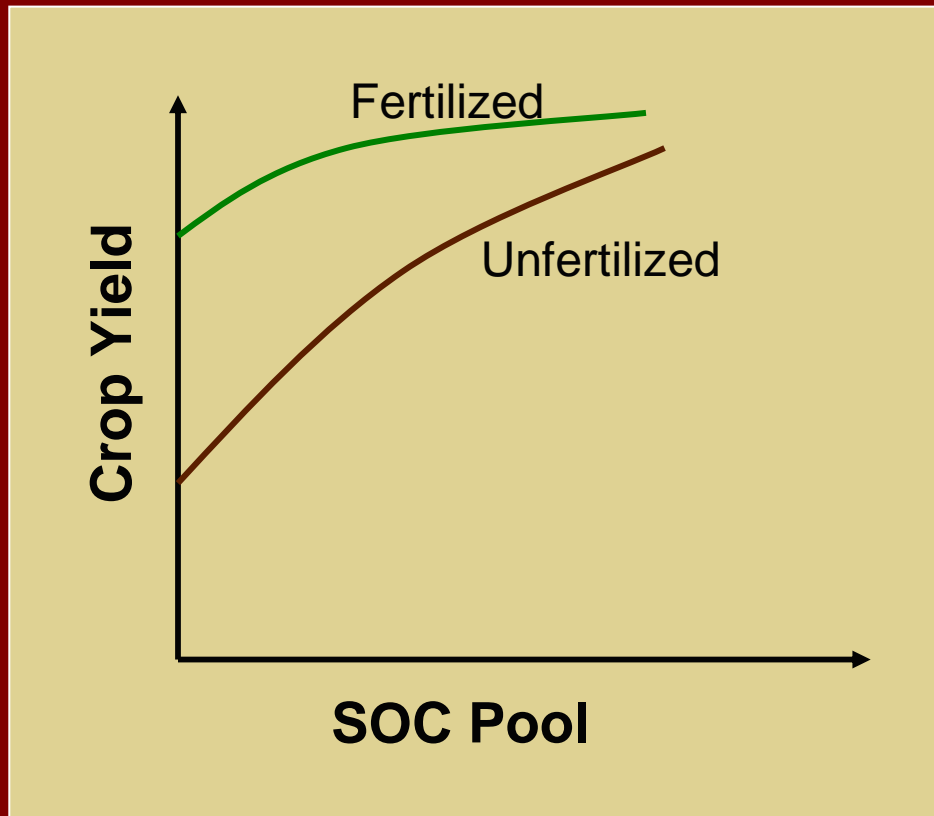
<b>Crop</b>	<b>Area (Mha)</b>	<b>Production Increase (10<sup>6</sup> Mg yr<sup>-1</sup>)</b>
<b>Cereals</b>	<b>430</b>	<b>21.8 – 36.3</b>
<b>Legumes</b>	<b>68</b>	<b>2.0 – 3.2</b>
<b>Tubers</b>	<b>34</b>	<b>6.6 – 11.3</b>
<b>Total</b>	<b>532</b>	<b>30.4 – 50.8</b>







# Crop yield and productivity effects of SOC pool



# Ten Tenets of Soil and Water Management

# Law #1

## Causes of Soil Degradation

The biophysical process of soil degradation is driven by economic, social and political forces.

# Law #2

## Soil Stewardship and Human Suffering

When people are poverty stricken, desperate and starving, they pass on their sufferings to the land.

## Law #3

# Nutrient, Carbon and Water Bank

It is not possible to take more out of a soil than what is put in it without degrading its quality.

# Law #4

## Marginality Principle

Marginal soils cultivated with marginal inputs produce marginal yields and support marginal living.

# Balancing Input and Output for Sustainability

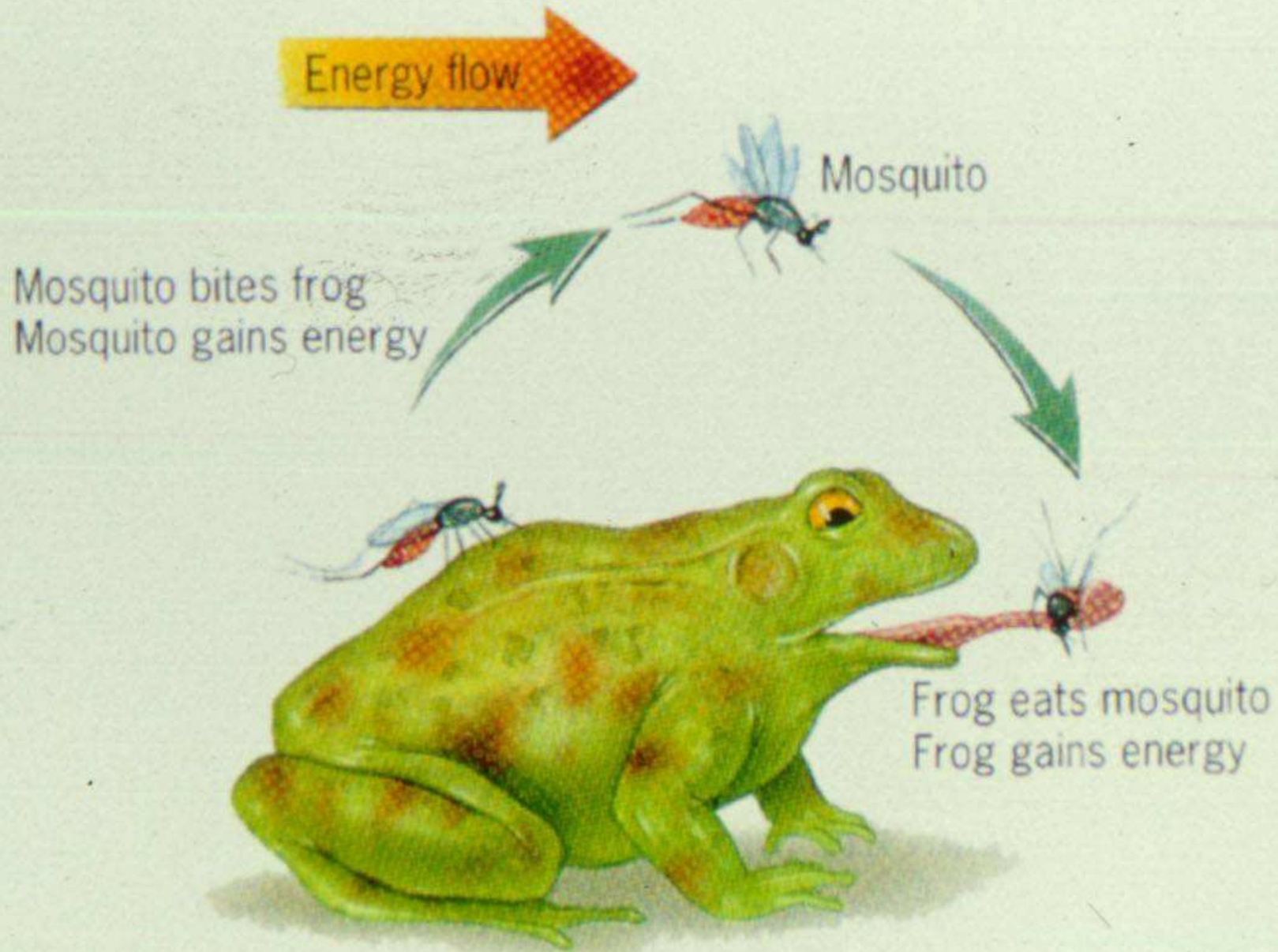


# **Law #5**

## **Organic Versus Inorganic Source** **of Nutrients**

Plants cannot differentiate the nutrients supplied through inorganic fertilizers or organic amendments.

# The Ultimate Recycling



**An Impossible Ecosystem**

## Law #6

### Soil Carbon and Greenhouse Effect

Mining C has the same effect on global warming whether it is through mineralization of soil organic matter and extractive farming or burning fossil fuels or draining peat soils.

# Law #7

## Soil Versus Germplasm

Even the elite varieties cannot extract water and nutrients from any soil where they do not exist.

## Law #8

### Soil As Sink For Atmospheric CO<sub>2</sub>

World soils can be a major sink for atmospheric CO<sub>2</sub> and CH<sub>4</sub> through conversion to a restorative land use adoption of recommended management practices. The C sink capacity of the pedosphere (~ 1 Pg C/yr) also has numerous ancillary benefits. It is essential to advancing global food security.

## **Law #9**

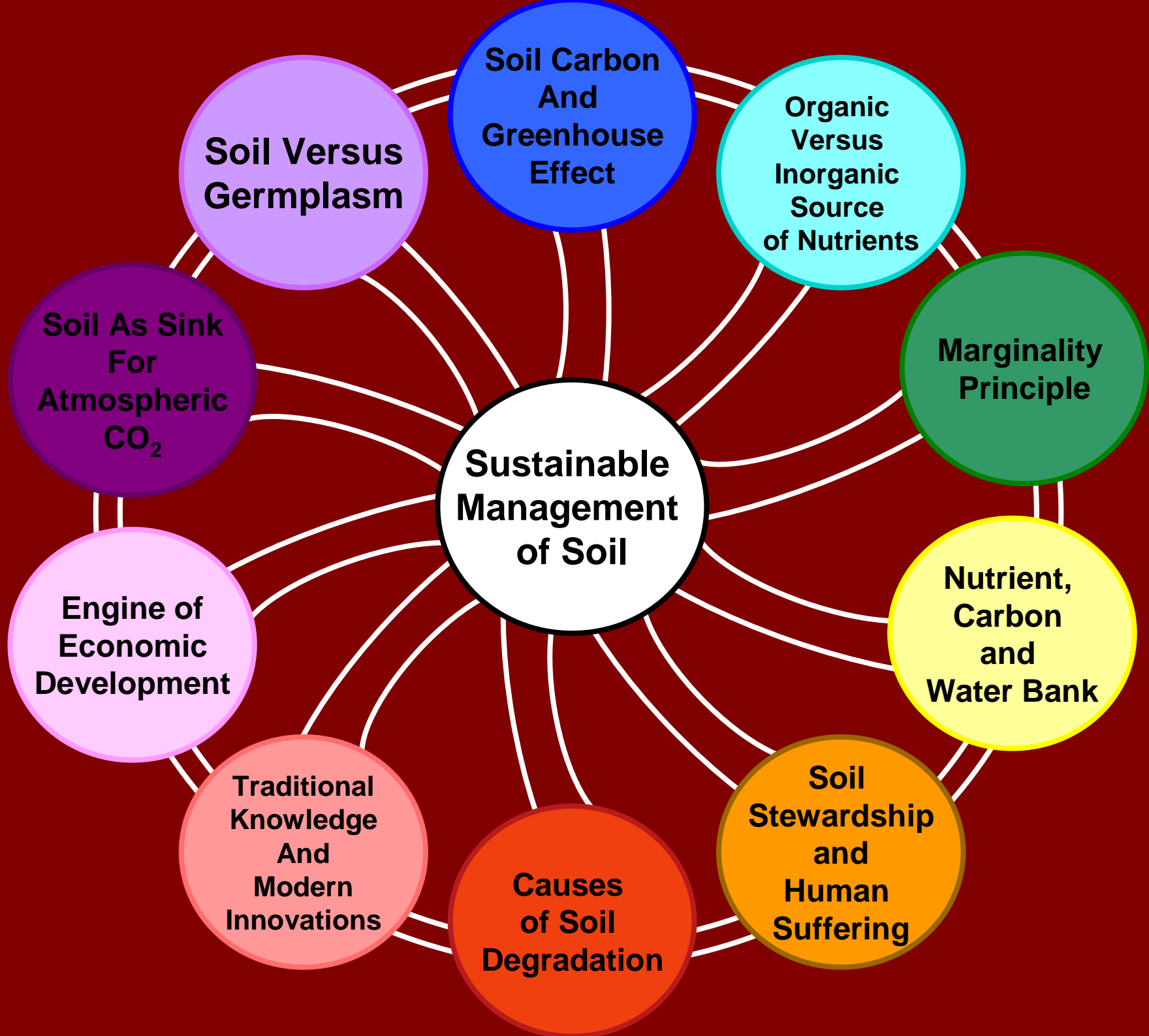
# **Engine of Economic Development**

Sustainable management of soils is the engine of economic development, political stability and transformation of rural communities in developing countries.

# Law #10

## Traditional Knowledge and Modern Innovations

- It is not an “either or” scenario.
- Modern science must synthesize the traditional knowledge.
- Those who refuse to use modern science to address urgent global issues must be prepared to endure more suffering.



# **Mother of the Necessity: The Soil**

**If soil and water resources are not restored or  
judiciously managed:**

- **Crops will fail even if rains do not**
- **Hunger will perpetuate even with emphasis on biotech and GM crops**
- **Civil strife and political instability will plague the world even with sermons and mantras on human rights and democratic ideals, and**
- **Humanity will suffer even with great scientific strides**

# Soil and Survival

“Upon this handful of soil our survival depends. Husband it and it will grow our food, our fuel, and our shelter and surround us with beauty. Abuse it and the soil will collapse and die, taking humanity with it.”

From Vedas

Sanskrit Scripture 1500 BC