

West Africa's savannahs under change (WASAC): integrated view on variable effects of agriculture and land cover changes on carbon cycling

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Outline

- **Scientific objectives and approach;**
- **Influence of precipitation on net primary production;**
- **Influence of precipitation on soil organic matter content;**
- **Relationship between clay content and SOC;**
- **Improved management for soil organic carbon storage in West Africa;**
- **Conclusion and perspectives**

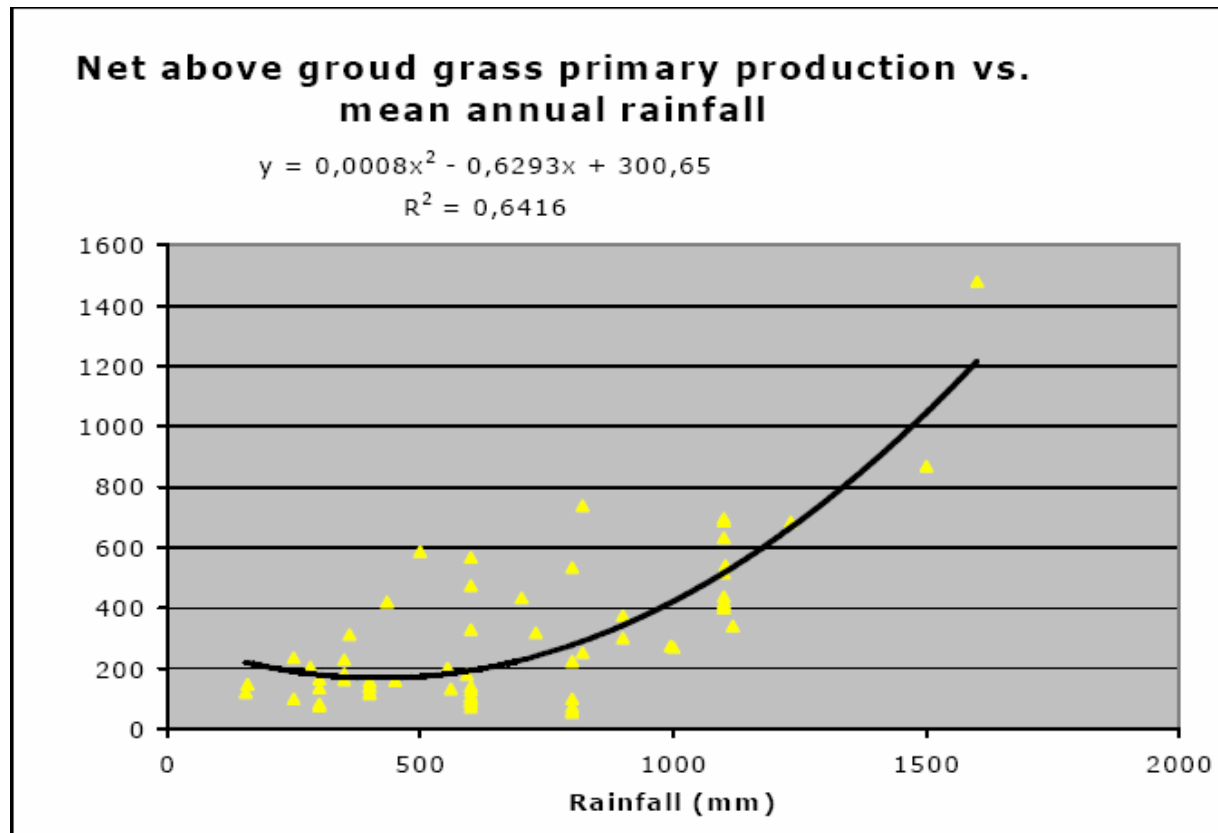
Scientific objectives and approach

- Provide a holistic synthesis considering the short, mid and long term effects of West African agriculture and land cover changes on carbon cycling;
- Collect and analyze available data on carbon accumulation in soils from natural savannah and forest, grazing land, fallows and crop fields;
- Main end product: a book synthesizing existing results (The tropical savannah).

Key questions

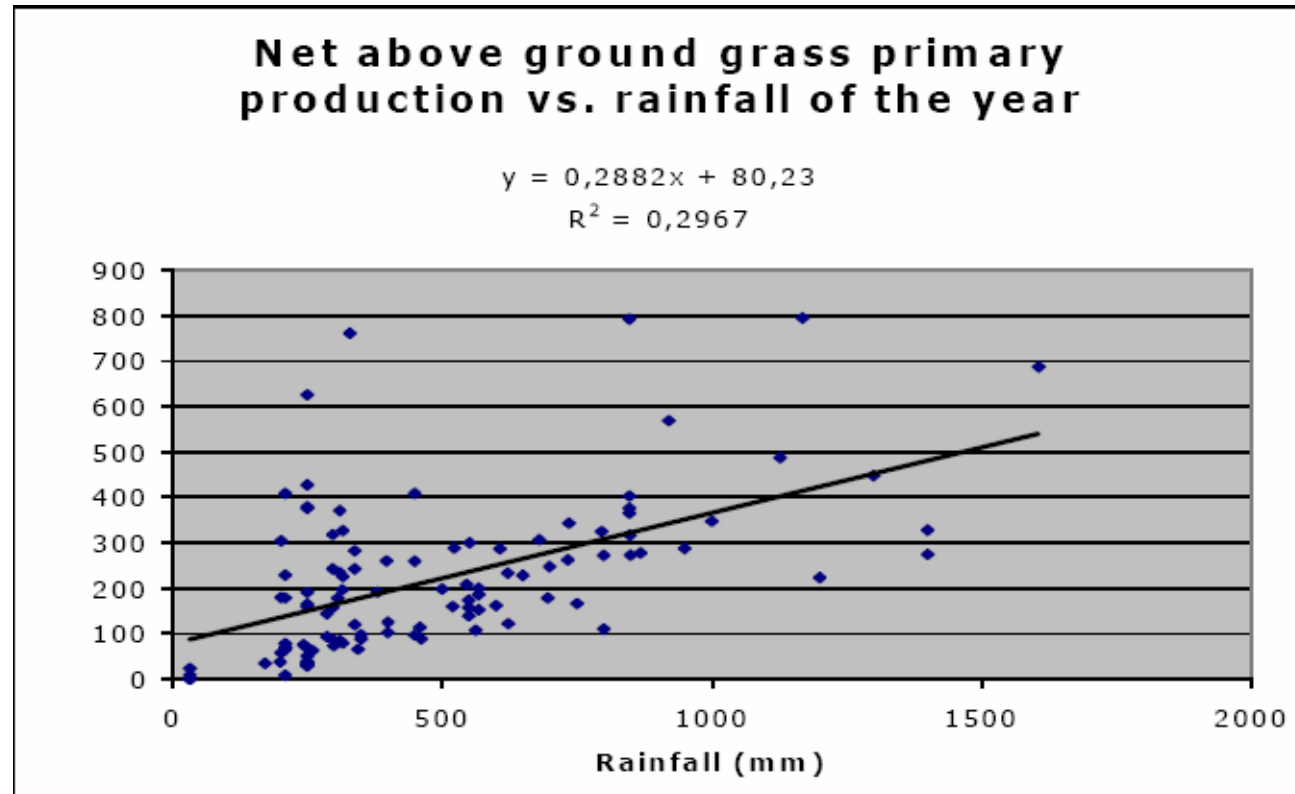
- Is there a solid relationship between soil carbon pools and flows of carbon?
- Is there a clear relation between soil carbon content and mineral content (fertility!) – or may such a relationship be established for soil types or for regions?;
- Are there effects of changing fire regimes on soil and productivity?
- What are the effects of changing rainfall patterns ?

Net primary production in West African savannahs



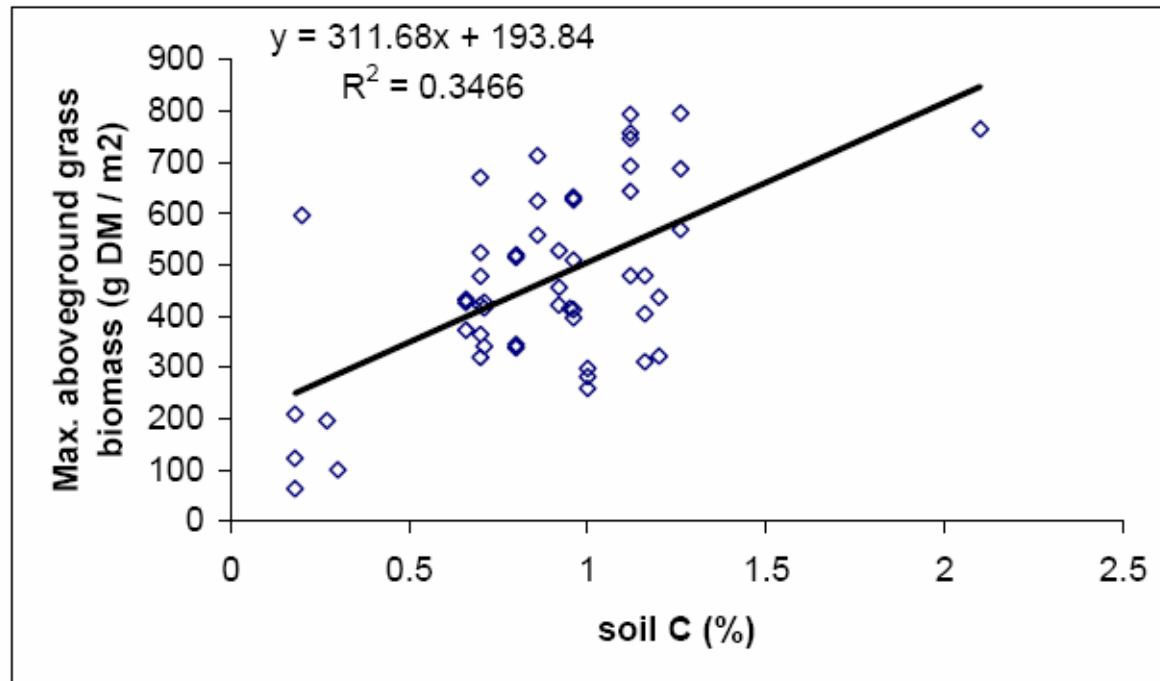
1. Mean annual precipitation explained 64% of the variation in maximum aboveground grass biomass (MAGB)

Net primary production in West African savannahs



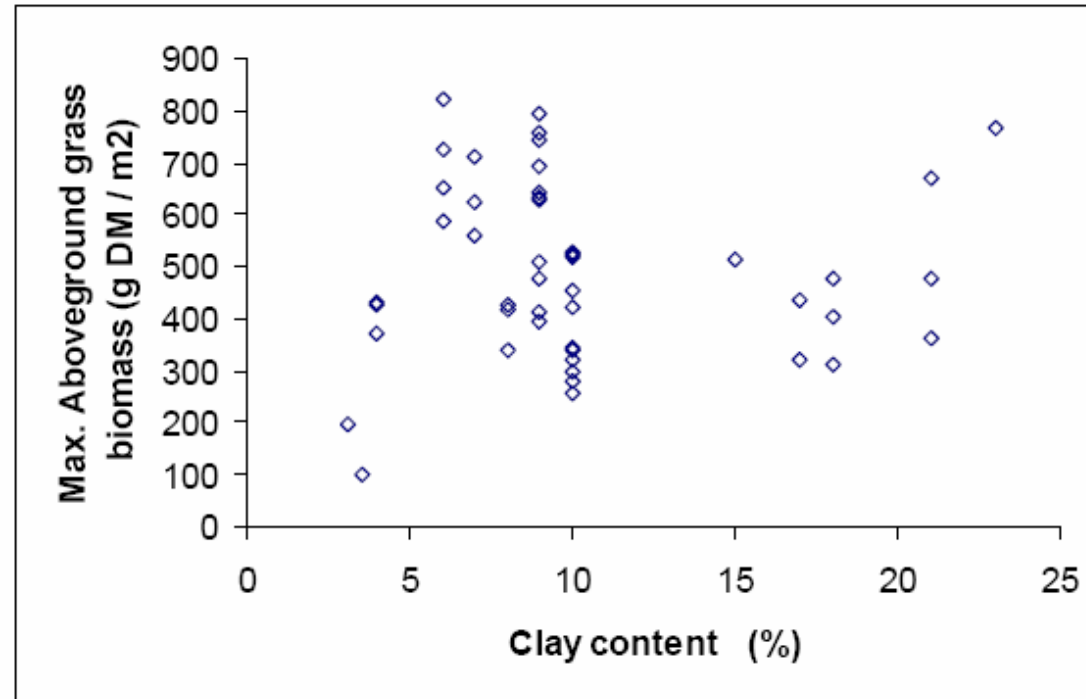
2. Only 30% of the variation in MAGB was explained by the annual precipitation measured same year as determination of NPP

Net primary production in West African savannahs



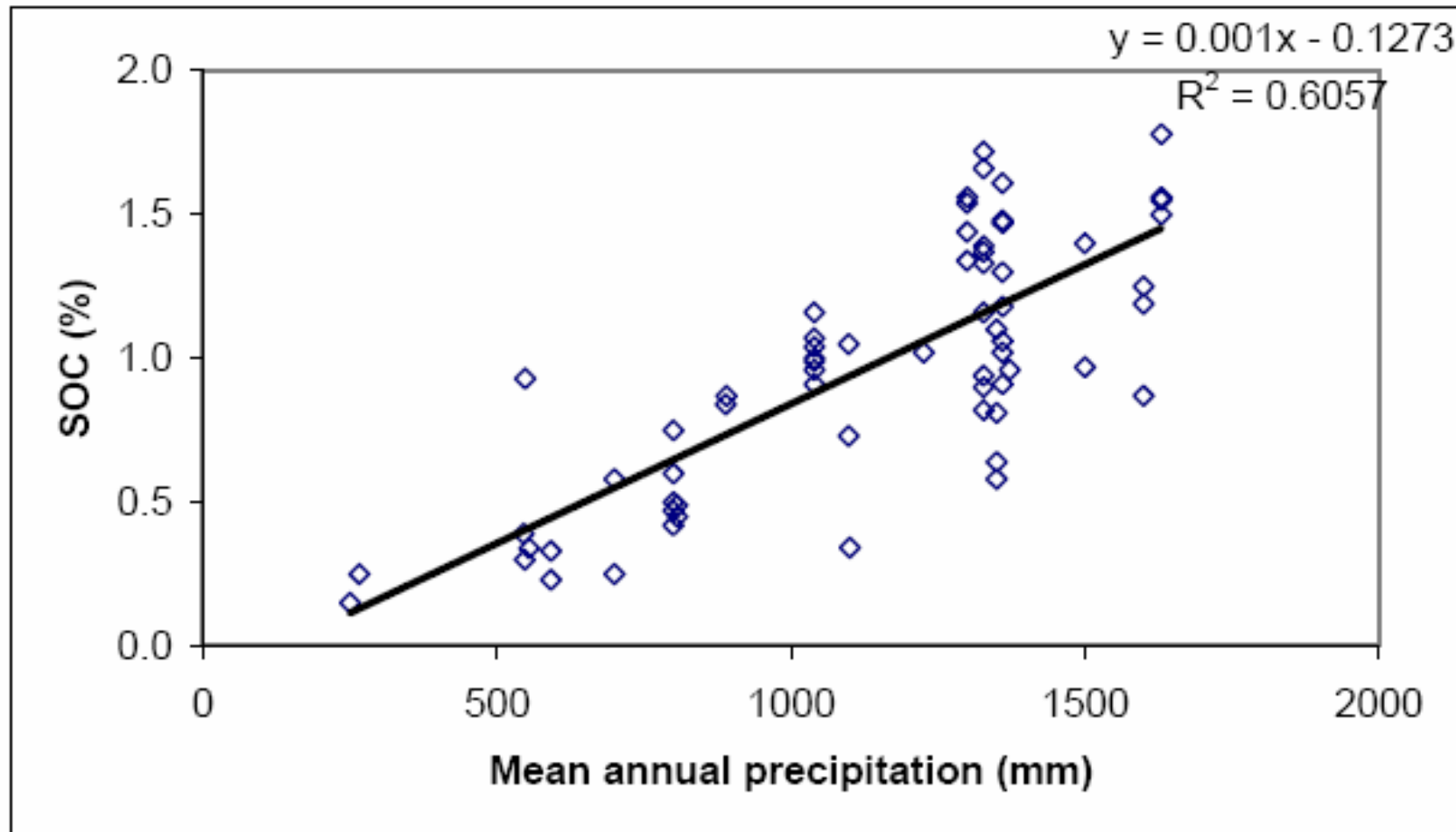
3. A certain relationship between biomass and soil carbon (SOC) was found ($R^2 \sim 35\%$)

Net primary production in West African savannahs



4. No relationship was found between clay content and MAGB

Influence of precipitation on soil organic matter content



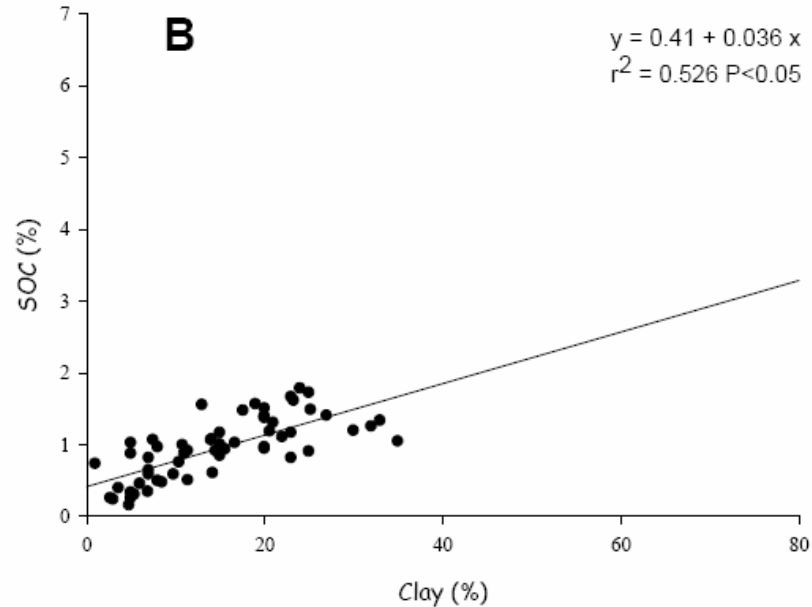
Relationship between C content and precipitation (Pmm), temperature, and clay + fine silt content of a tropical ferruginous top soil (0–20 cm). Coefficient of regression is shown (Feller 1994).

	mg C g ⁻¹ soil	Clay + FS* %	Pmm
Mg C g ⁻¹ soil	1.00		
Clay + FS %	0.870	1.00	
Pmm	0.770	0.841	1.00
T°C	-0.670	-0.709	-0.522

*: FS, fine silt

SOC increases with increasing rainfall: 77% of the variation in soil carbon content may be explained by precipitation differences.

Relationship between clay and SOC



- West African savannah soils are sandy: low capacity to retain nutrients
- pH values near neutrality compensates the low clay and SOM contents to sustain moderate levels of CEC;
- Recovery of natural vegetation: unique way to restore soil fertility.

Improved management for soil organic carbon storage

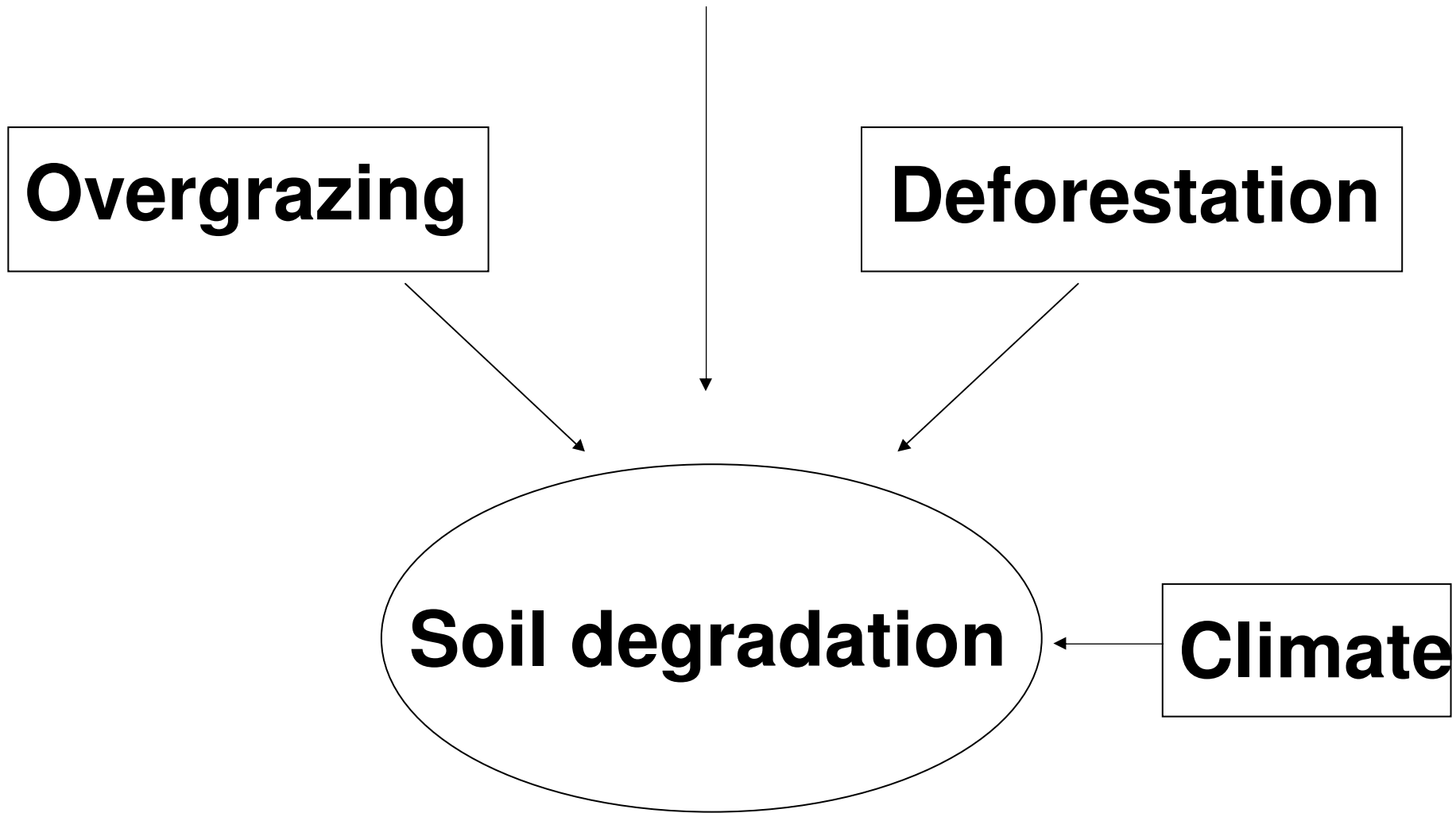
Expansion of agricultural lands

Overgrazing

Deforestation

Soil degradation

Climate



Factors driving the build-up of SOC

- **Type of system;**
- **Amounts of organic inputs;**
- **Quality of organic material;**
- **Soil type**
- **Management type**
- **Age of the system.**

Improved management for soil organic carbon storage

- **Crop residues and compost;**
- **Cover crops;**
- **Agroforestry;**
- **Fallow;**
- **Fertilization patterns (Manure, chemical fertilizers, green manures);**
- **Soil and water conservation.**

Conclusion and perspective

- **The WASAC project has created a database as tool for the analyses of carbon storage in different natural and cultivated ecosystems of the savannah zone;**
- **Model analysis by use of the CENTURY models shows predictions of a moderate loss of soil carbon in different Global Change scenarios like increasing temperatures.**

The contribution of managed systems to SOC storage has only been little investigated. The general observation is that except for Senegal where some studies on carbon sequestration in soil and the standing biomass have been undertaken, little if nothing has been or is being done regarding the crucial issue of mitigating atmospheric CO₂ by sequestering carbon in the soil.

In the perspective of carbon market opening:

- **identify potential sources of CO₂ emissions and sink for C sequestration in various man-induced changes in West African ecosystems;**
- **analyse the contribution of improved managements implemented for food production and carbon sequestration in the context of trading with CO₂;**

- **socio-economic options for all stakeholders included in the Kyoto protocol to fight against environmental degradation, climate change, food insecurity and poverty;**
- **implementation of large scale projects on carbon sequestration at national and regional level to increase the option for West African countries to take advantage of the "carbon market".**

Thank you for your attention