Sustainable Land Management and Its Relation to Climate Change – Michael Stocking

Sustainable Land Management and Its Relation to Climate Change

Michael Stocking
Vice-Chair, GEF-STAP
Professor, University of East Anglia, Norwich, UK

UNCCD

UEA NORWICH

UNEP GEF STAP

Two Sides of the Same Coin

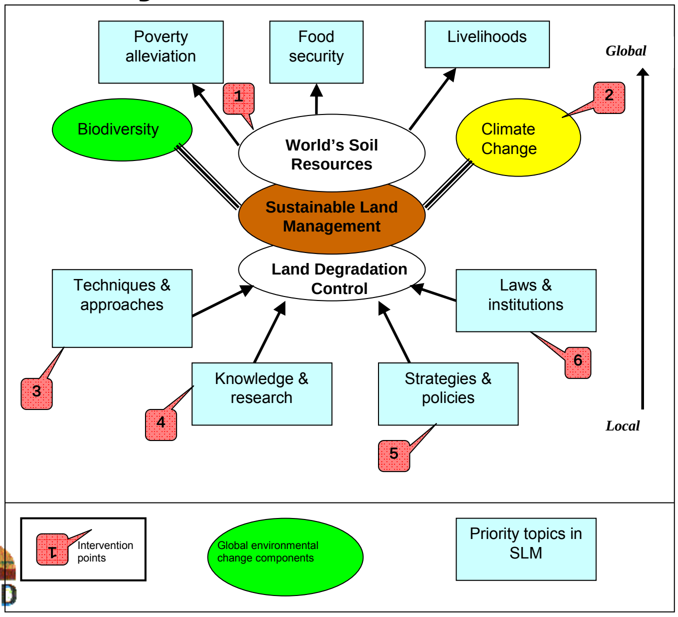
Land degradation

UNCCD

Sustainable Land Management

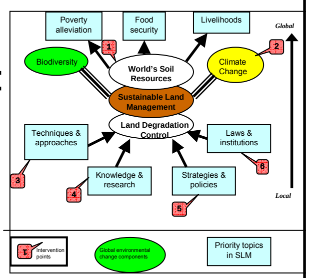
Global Environment Facility

A systems view of SLM



Three ways to achieve systems approach in SLM

- Find **synergies** with other focal areas
  - Biodiversity
  - Climate change (Intervention 1)
  - International waters
- Relate SLM to global **development** agendas (2):
  - Poverty alleviation
  - Food security
  - Livelihoods
- Identify practical **interventions** in:
  - Techniques and approaches (3)
  - Knowledge and research (4)
  - Strategies and policies (5)
  - Laws and institutions (6)



Sustainable Land Management and Its Relation to Climate Change – Michael Stocking

Key Principle – *Synergy*

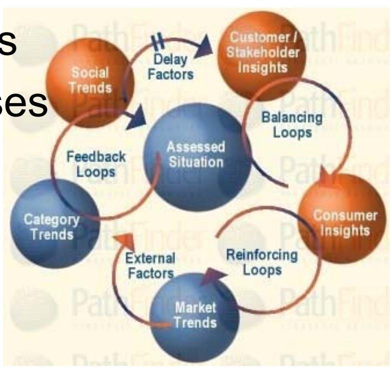
"The interaction of two or more agents or forces so that their combined effect is greater than the sum of their individual effects."

Global Synergy Database:
http://csrp.com.au/database/index.html
- most examples are about achieving additional benefits beyond the immediate purpose

UNCCD

To exploit the synergies …….

A systems approach is needed to:
- Harness benefits for development and environment
- Capture 'feedback' loops
- Avoid simplistic responses
- Mimic the real world



UNCCD

Sustainable Land Management and Its Relation to Climate Change – Michael Stocking

Ecosystem services

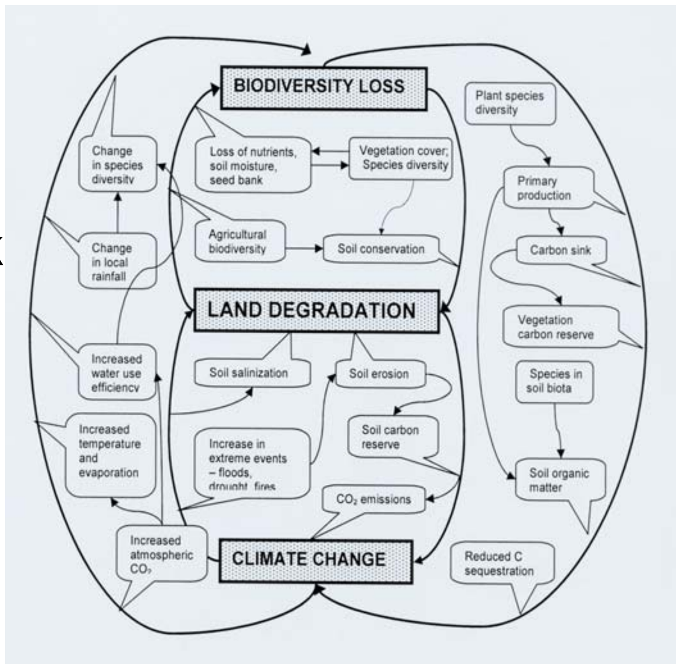
•Provisioning

•Regulating

•Cultural

UNCCD

The MA Model – Feedback Loops in Global Change



Source: MA, 2004; Gisladottir & Stocking, 2005

UNCCD

A simple impact matrix

…on….	LD	CC	BD
LD	√√√	√√	√√
CC	√	√√	√
BD	√√√	√	√√

Green: Major and best-recognised linkages

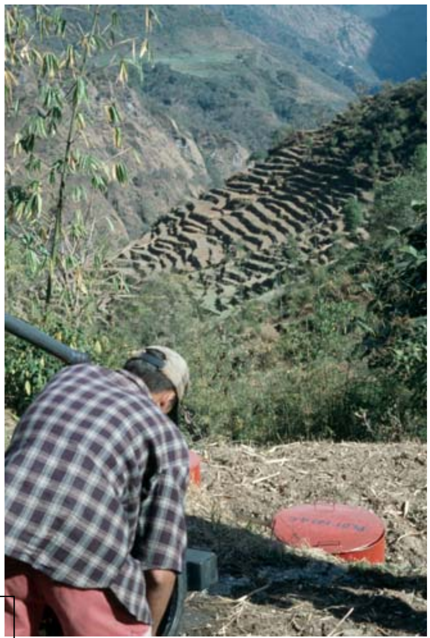
Purple: Important positive (reinforcing) feedback loops

UNCCD

Example of land-based synergies

Mid-hills of W. Nepal:

- Water conservation
- Carbon fixed
- Nutrients retained & used
- Pressure off woodland



Plots near Landruk, W. Nepal

UNCCD

Sustainable Land Management and Its Relation to Climate Change – Michael Stocking

Yams within an agroforestry system at Adwenso, southern Ghana

UNCCD

Sustainable Land Management

Definition: The use of renewable land resources (soils, water, plants, and animals) for production and services while protecting the long-term productive potential of these resources.

Mandate: To coexist with nature so that the productive, physiological, cultural and ecological functions of natural resources are maintained for the benefit of society.

Challenge: To harmonise the complementary but often conflicting goals of production and environmental protection.

UNCCD

Sustainable Land Management and Its Relation to Climate Change – Michael Stocking

LD is…….. a worldwide problem

And society deals with it…..

UNCCD

Sustainable Land Management and Its Relation to Climate Change – Michael Stocking

How much does land degradation cost?

Monetary value of **lost production** about $65 billion annually, consisting of:

- ➢$35 billion from **rangeland**, primarily in arid and semi-arid zones
- ➢$12 billion from **rainfed cropland**, much of this under subsistence farming
- ➢$17 billion from **irrigated lands**, through salinisation and groundwater pollution

How much Carbon goes with soil erosion?

Soil organic C pool is 40 – 100 t//ha

= c. 5% total soil is org C in top 10 cm

- ➢Organic C is selectively eroded [ER≥2]
- ➢On **well-managed** soils, loss=0.4 tC/ha/yr
- ➢On typical **rainfed cropland**, 2.5 tC/ha/yr
- ➢On **steep slopes**, no conservation, 10tC/ha/yr

Sustainable Land Management and Its Relation to Climate Change – Michael Stocking

What and who is affected?

Land out of production because of land degradation – estimated at **5 to 7 million hectares a year**

Proportion of earth's land surface affected seriously **- 33%**

Population affected by serious degradation in drylands alone – estimated at **2.6 billion** people in more than **100 countries**

UNCCD

Linking SLM and CC

1. Agriculture's ambivalent role
2. Opportunities in land use (LULUCF)
   - Soil management – soil biodiversity
   - Changing land use
   - Encouraging 'agrodiversity'
   - Reducing emissions (REDD)
3. Carbon sequestration

UNCCD

1. Agriculture's ambivalent role

- Agriculture contributes *directly* to CC via emissions of methane and nitrous oxides
- It contributes *indirectly* via demand for fertilizer, other chemicals and fuel
- Climate change, in turn, will change agricultural production dramatically
- Agriculture is *currently* a net contributor to climate change

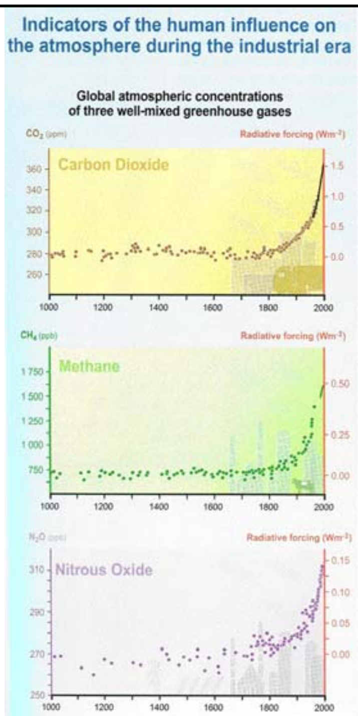
UNCCD

Agriculture's contribution

GHG	% total emissions	From agriculture & land-use change
CO_2	72	Mineralization OM, fuel, fire, de-vegetation (5% agric; 12% LUC)
CH_4	20	Livestock grazing (10% agric; 1% LUC)
N_2O	7	Arable soils, livestock waste (5% agric; 1% LUC)

About 31% of all GHGs arise from the 'food chain' [Source: European Commission Technical Report EUR 22284, May 2006]

UNCCD



2. Opportunities in land use (LULUCF)

"Activities in the LULUCF sector can provide a relatively cost-effective way of offsetting emissions, either by increasing the removals of greenhouse gases from the atmosphere (e.g. by planting trees or managing forests), or by reducing emissions (e.g. by curbing deforestation)"

"But greenhouse gases may be unintentionally released into the atmosphere if a sink is damaged or destroyed through a forest fire or disease."

UNCCD

[Source: UNFCCC http://unfccc.int/methods_and_science/lulucf/items/3060.php]

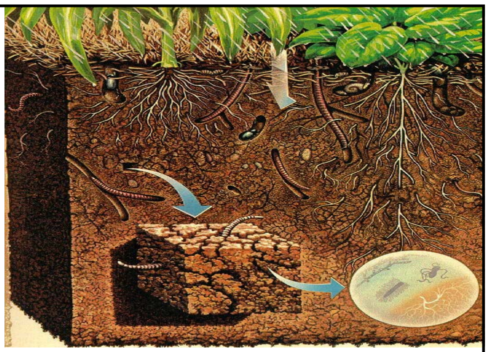
Practical examples of SLM with benefits for CC

- ✓Encouraging soil biodiversity
- ✓Focus on 'agrodiversity'

UNCCD

Sustainable Land Management and Its Relation to Climate Change – Michael Stocking

Soil Biodiversity: Provider of essential ecosystem goods and services



- Nutrient cycling
- Regulation of dynamics of soil organic matter
- Soil C sequestration and reduced GHG emissions
- Modification of soil physical structure and maintain water regimes
- Assistance to plant nutrient acquisition
- Enhancement of plant health...

UNCCD

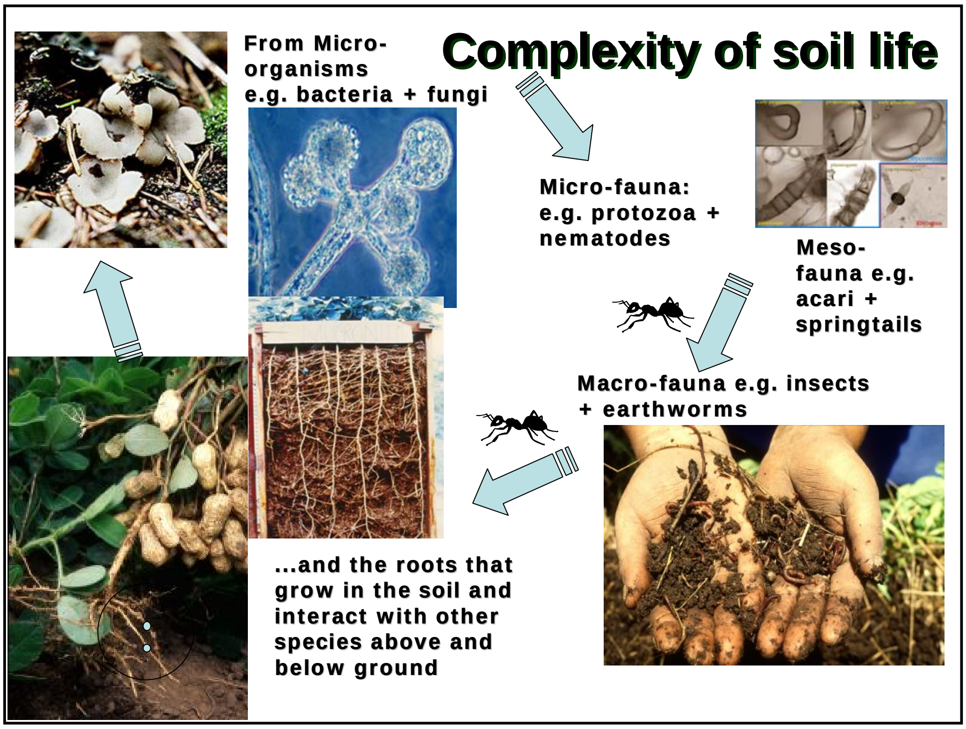
Soil Biodiversity is vast….and largely uncharted

Soils may contain:

- several vertebrates and earthworms
- 20-30 species of mites
- 50-100 species of insects
- tens of species of nematodes
- hundreds of species of fungi
- thousands of species of bacter

UNCCD

Sustainable Land Management and Its Relation to Climate Change – Michael Stocking



Soil biodiversity particularly important to poor farmers

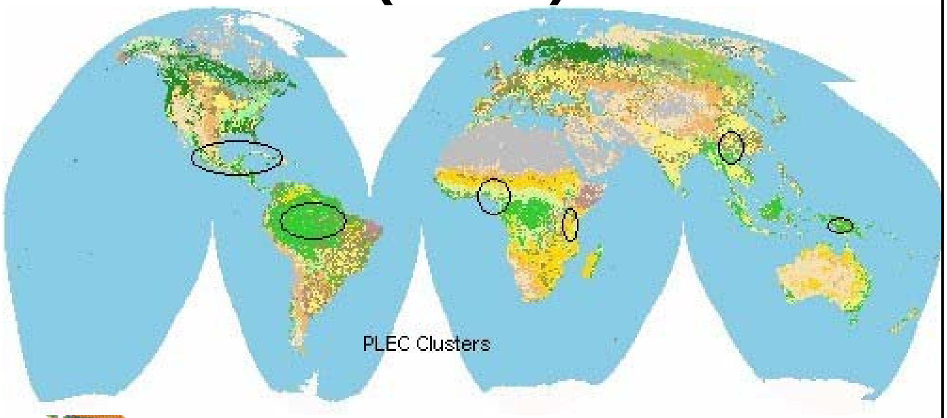
The goods and services provided by diverse soil organisms and their interactions are of particular significance.

- Maintaining soil productivity free
- Reducing need for mineral fertilizers
- Increasing efficiency of use of inputs
- Making soil easier to manage

UNCCD

Sustainable Land Management and Its Relation to Climate Change – Michael Stocking

People, Land Management and Environmental Change (PLEC)



UNCCD

Agrodiversity - a good news story

UNCCD

PLEC verified complex stories in complex landscapes

Upper-slope sediment, nutrient and water sources

Rice paddies harvesting sediment

Highly productive Kandy home gardens

UNCCD

Agrodiversity link to livelihoods

- Different farmers have different opportunities
- sloping land affords different challenges
- poorer farmers have steepest land, but often the greatest agrodiversity

UNCCD

Sustainable Land Management and Its Relation to Climate Change – Michael Stocking

Working with farmers

PLEC-Papua New Guinea

UNCCD

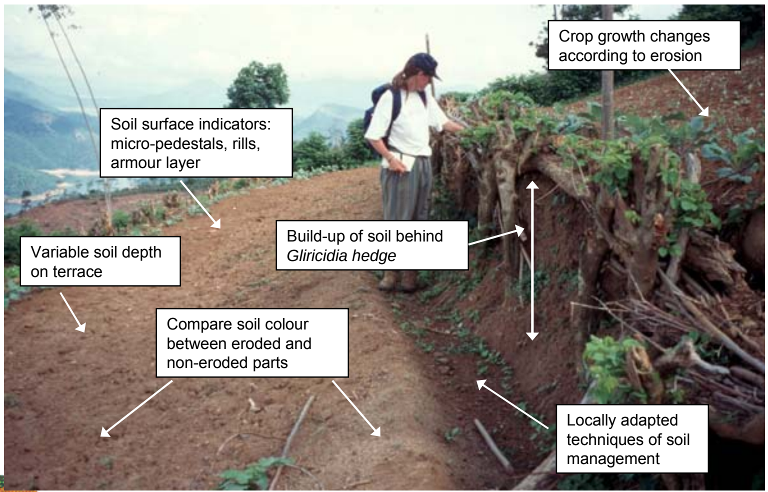
Field Indicators for SLM & agrodiversity

PLEC-Uganda

UNCCD

Sustainable Land Management and Its Relation to Climate Change – Michael Stocking

Soil indicators - Sri Lanka Hill Lands



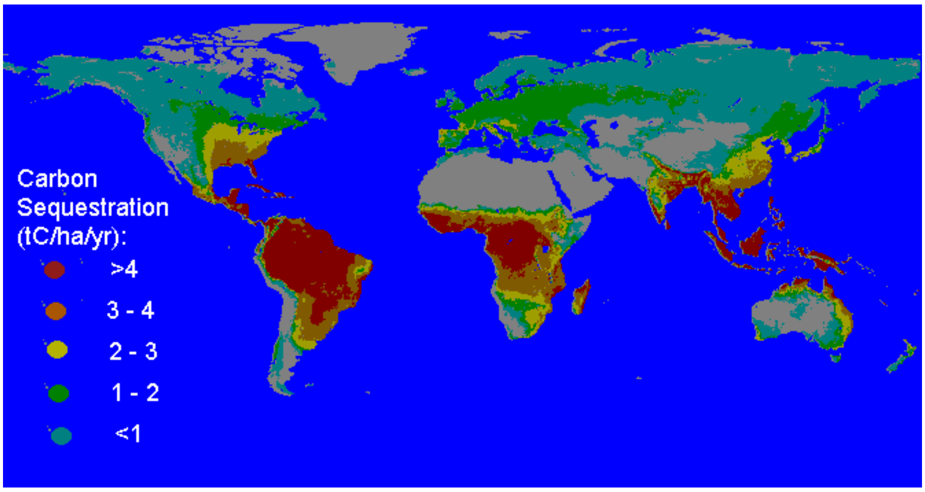
UNCCD

These are the sort of benefits that farmers have told us they appreciate

UNCCD

Sustainable Land Management and Its Relation to Climate Change – Michael Stocking

Potential Role of Forests



Potential rate of carbon sequestration in period 2008-2012 that might be induced by an afforestation project carried out in 2000; simulated with a model of forest carbon cycle for average climate. [Source: Center for Global Environment Research, Japan]

UNCCD

3. Carbon Sequestration

Atmospheric levels of CO_2 have risen from preindustrial levels of 280 parts per million (ppm) to present levels of 375 ppm.

Carbon sequestration refers to the provision of long-term storage of carbon in the terrestrial biosphere, underground, or the oceans so that the build-up of carbon dioxide (the principal greenhouse gas) concentration in the atmosphere will reduce or slow.

UNCCD

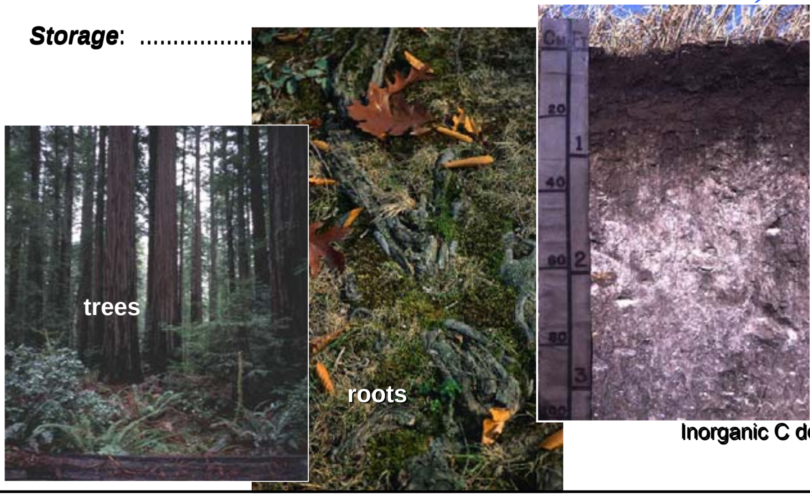
Sustainable Land Management and Its Relation to Climate Change – Michael Stocking

Terrestrial Carbon sequestration

Definition: The net removal of CO_2 from atmosphere into terrestrial pools of C

Process: Photosynthesis

Storage: ....



Soil carbon - the major part of the global C pool

Pool	Amount of carbon (Gigatons – 10^9 t)
Atmosphere	750
Soil (organic)	1400
Soil (inorganic)	930
Living vegetation	760

- ✓ Soil C > 3 times Atmos. C
- ✓ Soil C > 3 times C in all vegetation
- ✓ 60% of all global C is in the soil
- ✓ But organic soil C is transient and volatile

NB – the oceans have 38,000 Gigatons – 10 times all terrestrial & atmos. C

UNCCD

Sustainable Land Management and Its Relation to Climate Change – Michael Stocking

Agricultural C-sequestration

- ✓ Develop diversified annual cropping systems to replace monoculture
- ✓ Add organic matter amendments
- ✓ Practices that minimize soil disturbance
- ✓ Retain residues

Tillage

No-Till

Sustainable Land Management and Its Relation to Climate Change – Michael Stocking

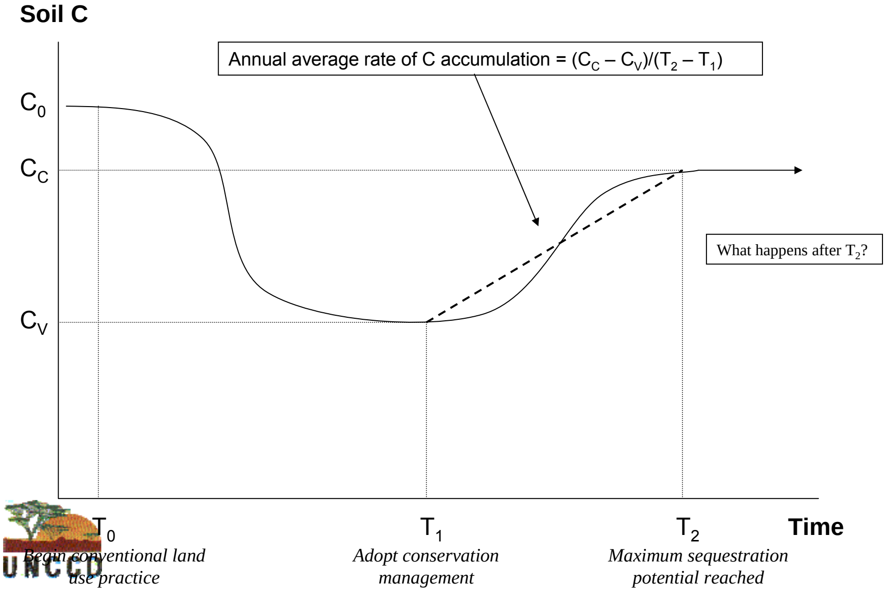
Terracing and agro-forestry

Practices that maintain and restore soil organic matter

Sustainable Land Management and Its Relation to Climate Change – Michael Stocking

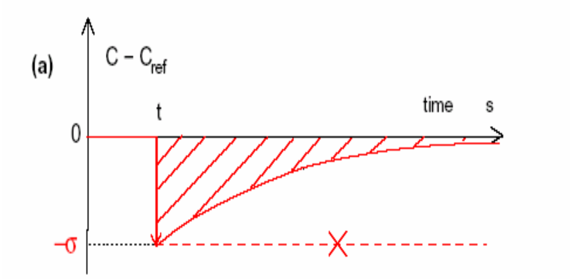
Issue 1 - Technical Potential

Changing land management practices can restore soil C



Issue 2 - Saturation

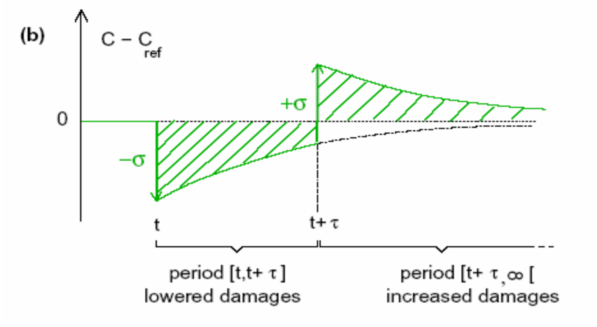
Gitz et al 2004



- ✓ Sequestration accumulates C until absorptive capacity is used up
- ✓ 10-15 years for tillage [Source: West & Post]
- ✓ 30-70 years for forest carbon. [Source: Birdsey]
- ✓ Majority of gains occur in first years

Sustainable Land Management and Its Relation to Climate Change – Michael Stocking

Issue 3 - Volatility



Gitz et al 2004

✓ When practice is discontinued, most C released quickly
✓ Essential to encourage and maintain sustainable land management

UNCCD

Conclusion

- Linking SLM and CC technically possible
- Many opportunities exist, but
  - Exploit the synergies
  - Beware the complex processes
  - Calculate the cost
  - Utilise local knowledge
- Suitable policies and strategies needed to create an enabling environment ….

UNCCD