ISRIC
World Soil Information

Sustainable Land Management (SLM)

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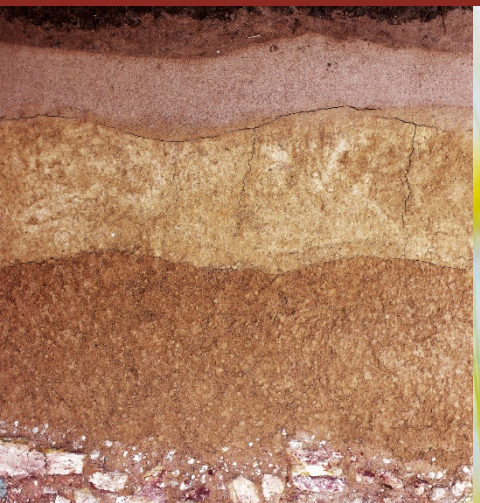
ISRIC Spring School
31-5-2018



source: FAO, http://www.fao.org/3/a-mn997e.pdf

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Land Degradation

alit ve
act
10 de
er ar
a single heavy rainstorm
centimeters (≈ centuries!) of soil

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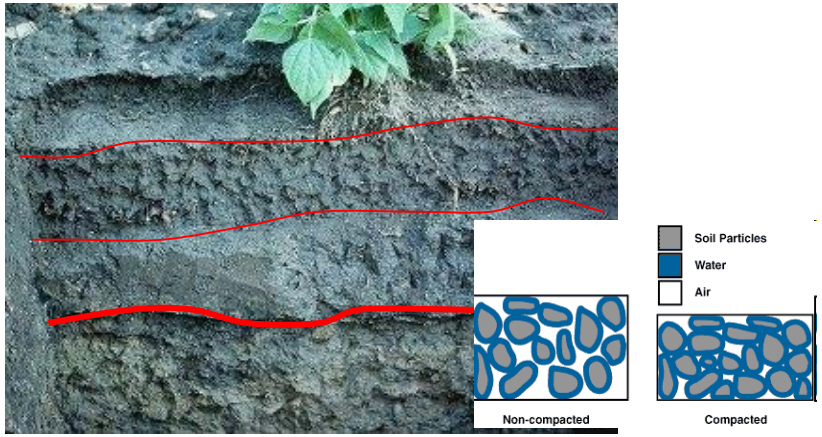
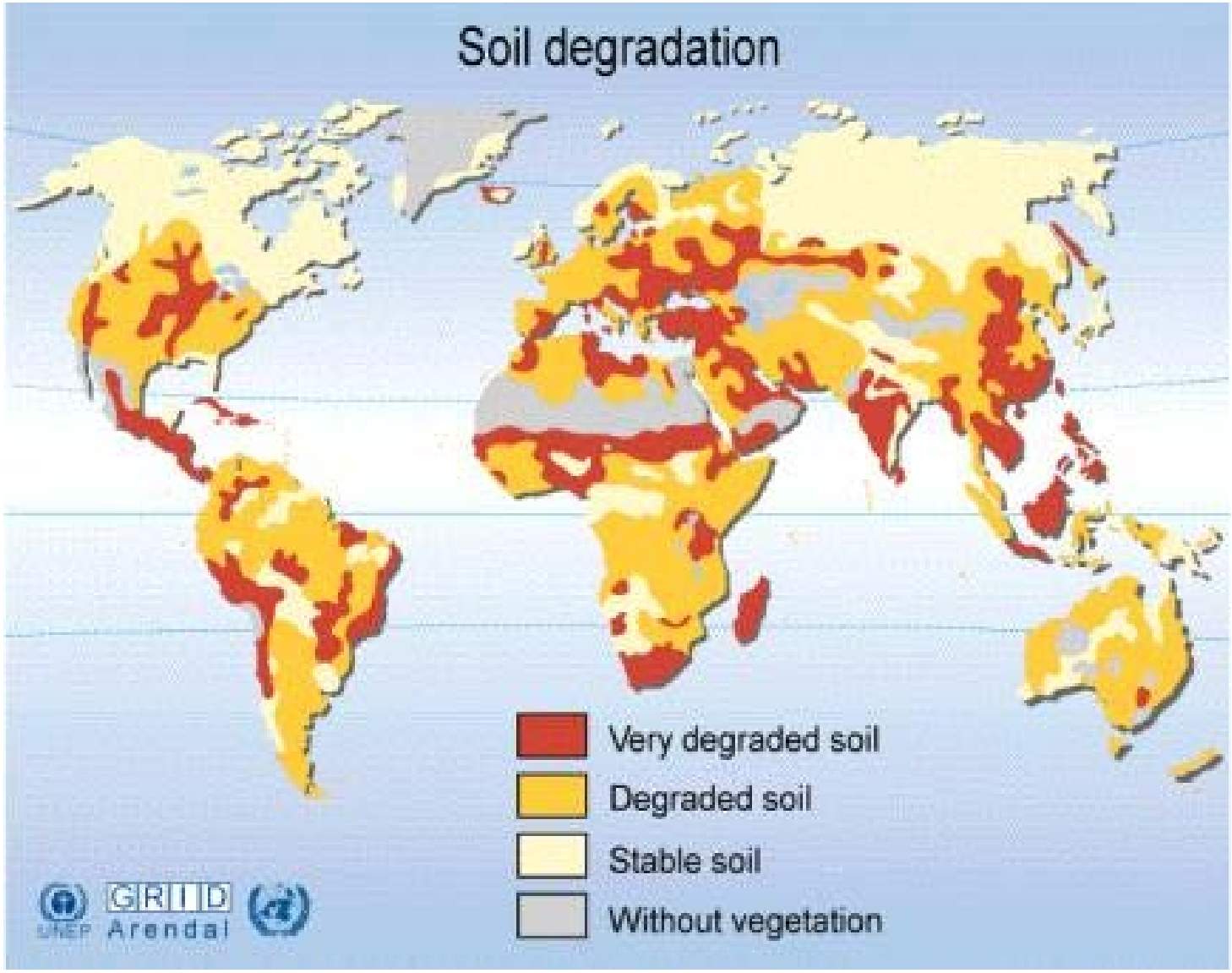
- Salinisation
- Urbanisation & infrastructure



Is land degradation a problem?

- Land degradation reduces productivity, biodiversity and affects various "ecosystem services"
- > 250 million people and 1/3 of the Earth's surface are already affected by degradation (especially in poorer countries);
- Land degradation leads to increasing migration: "ecological refugees";
- Land degradation is one of the major environmental problems, but also the least well-known.

Spatial variation on global scale



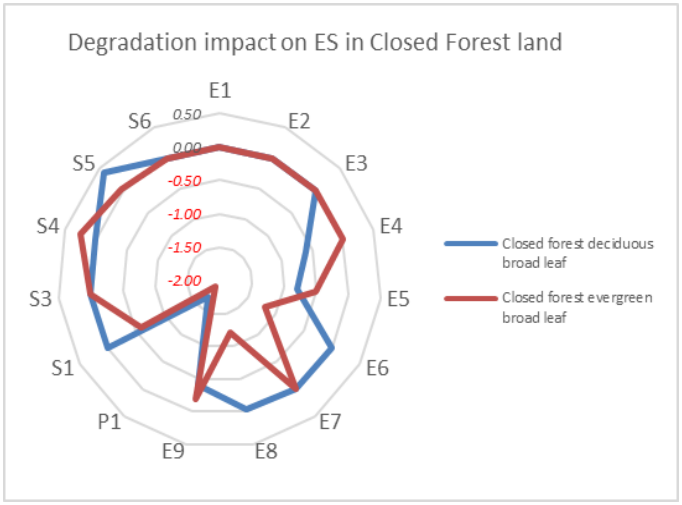
Types of land degradation

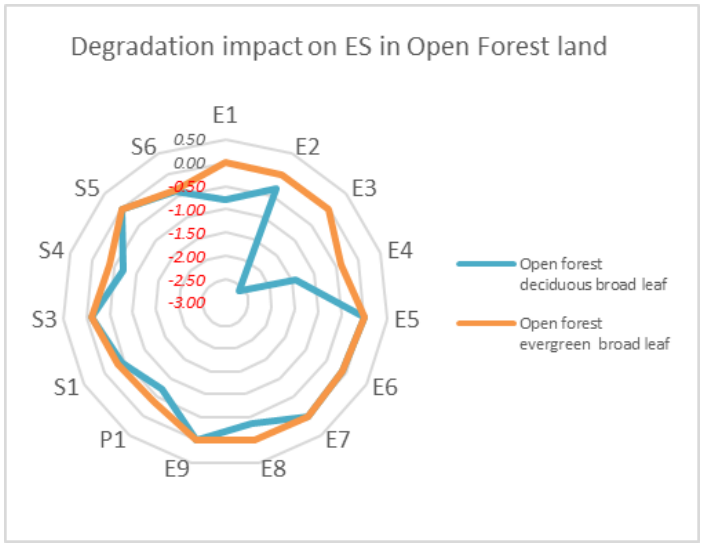
- Main types of land degradation:
  - Physical (e.g. erosion by water or wind)
  - Chemical (e.g. salinization)
  - Biological (e.g. reduced earthworm activity)
  - Hydrological (e.g. reduced water quality)

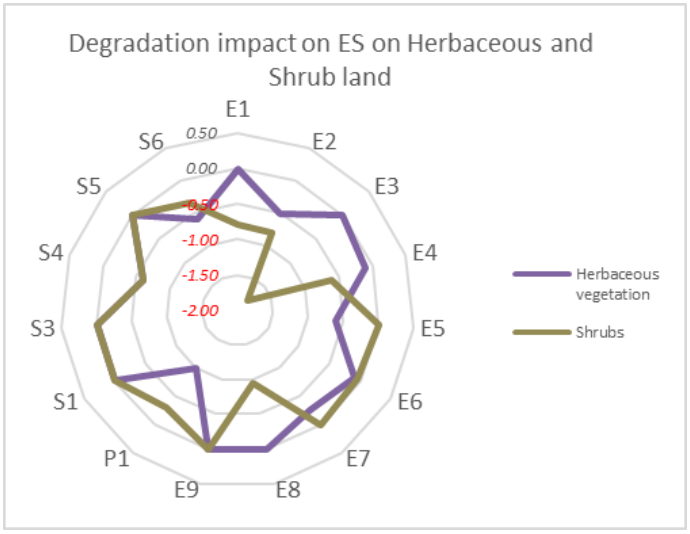
Impa

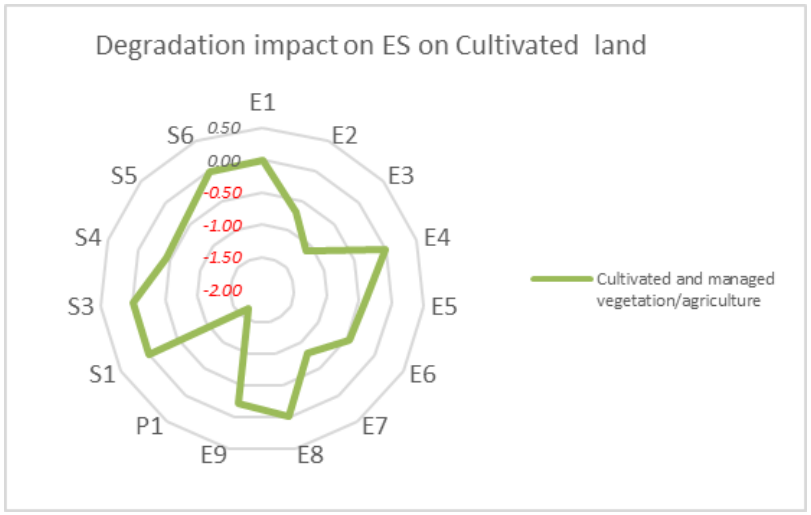
- > 3 Billion people in developing countries depend directly on the land,
- among them are 70% of the world's very poor – land degradation threatens their lives
- to feed the expected 9 Bn people by 2050 we need 70% more food and to protect the land through *Sustainable Land Management (SLM)*

Impact of degradation (example from Madagascar)









Sustainable Development Goals

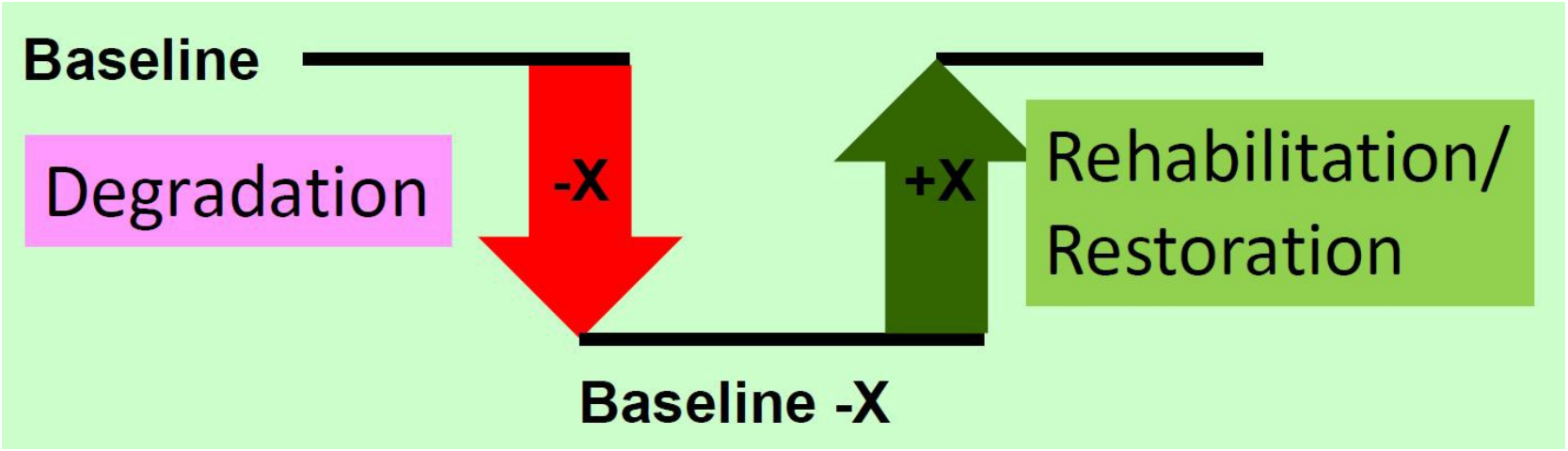
Land Degradation Neutrality

SDG 15 - urges countries to “Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and **halt and reverse land degradation** and halt biodiversity loss”

Target 15.3 - the target championed by UNCCD: “By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive **to achieve a land degradation- neutral world**”.

Land Degradation Neutrality

LDN = “a state whereby the **amount and quality** of land resources necessary to support ecosystem functions and services and enhance food security **remain stable or increase** within specified temporal and spatial scales and ecosystems”.



Land Degradation Neutrality

Suggested framework for monitoring and reporting:

Indicator 15.3.1
Proportion of land that is degraded over total land area

Sub -Indicators
UNCCD (CBD, UNFCCC)
Reporting Mechanisms

Data sources:

Official Statistics and Earth Observation

Remote sensing, e.g. MODIS NDVI → NPP,GlobeLand30m-2000

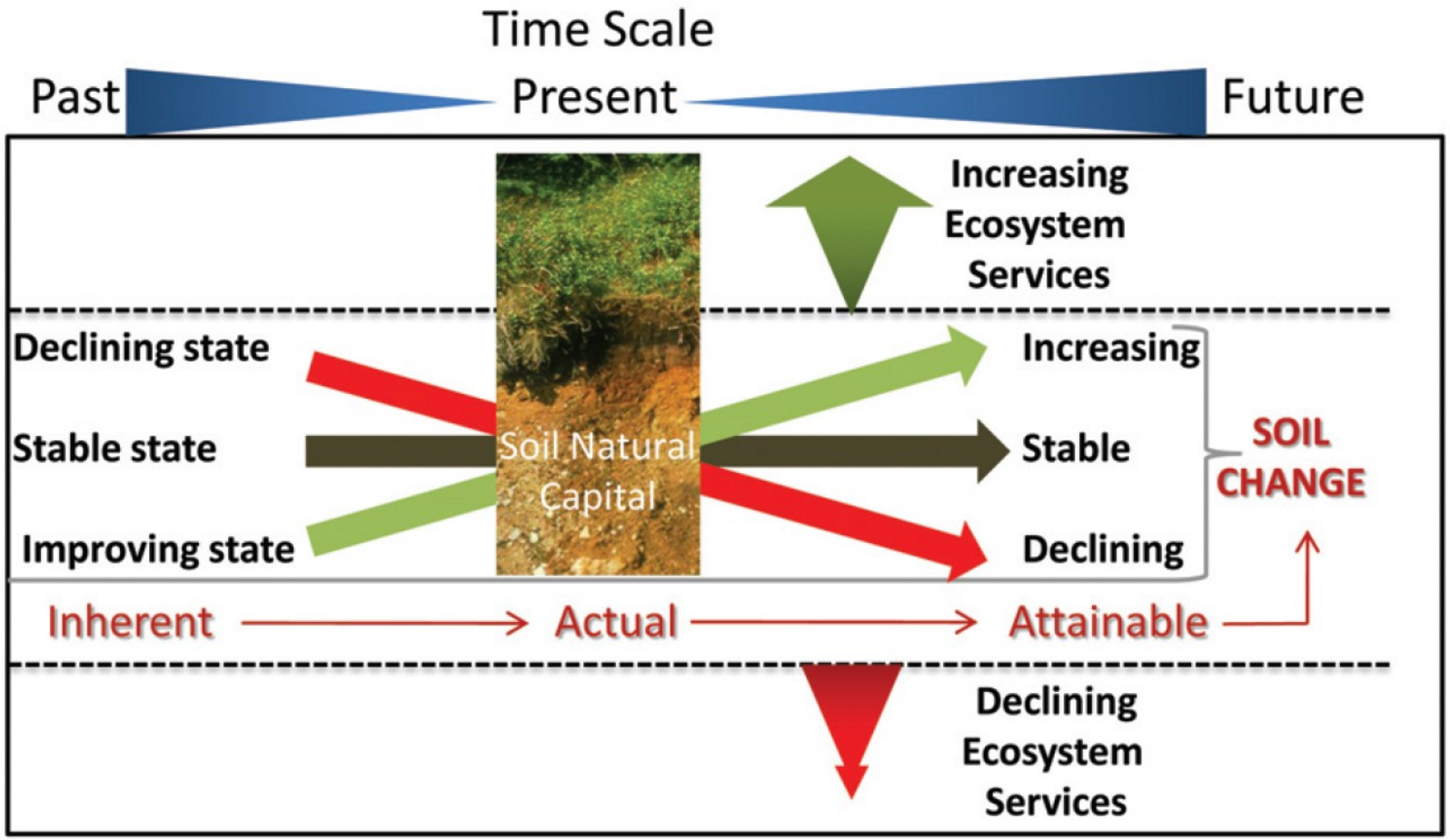
Land Use and Management Practices

e.g. WOCAT

Surveys, Sampling and Citizen Sourcing

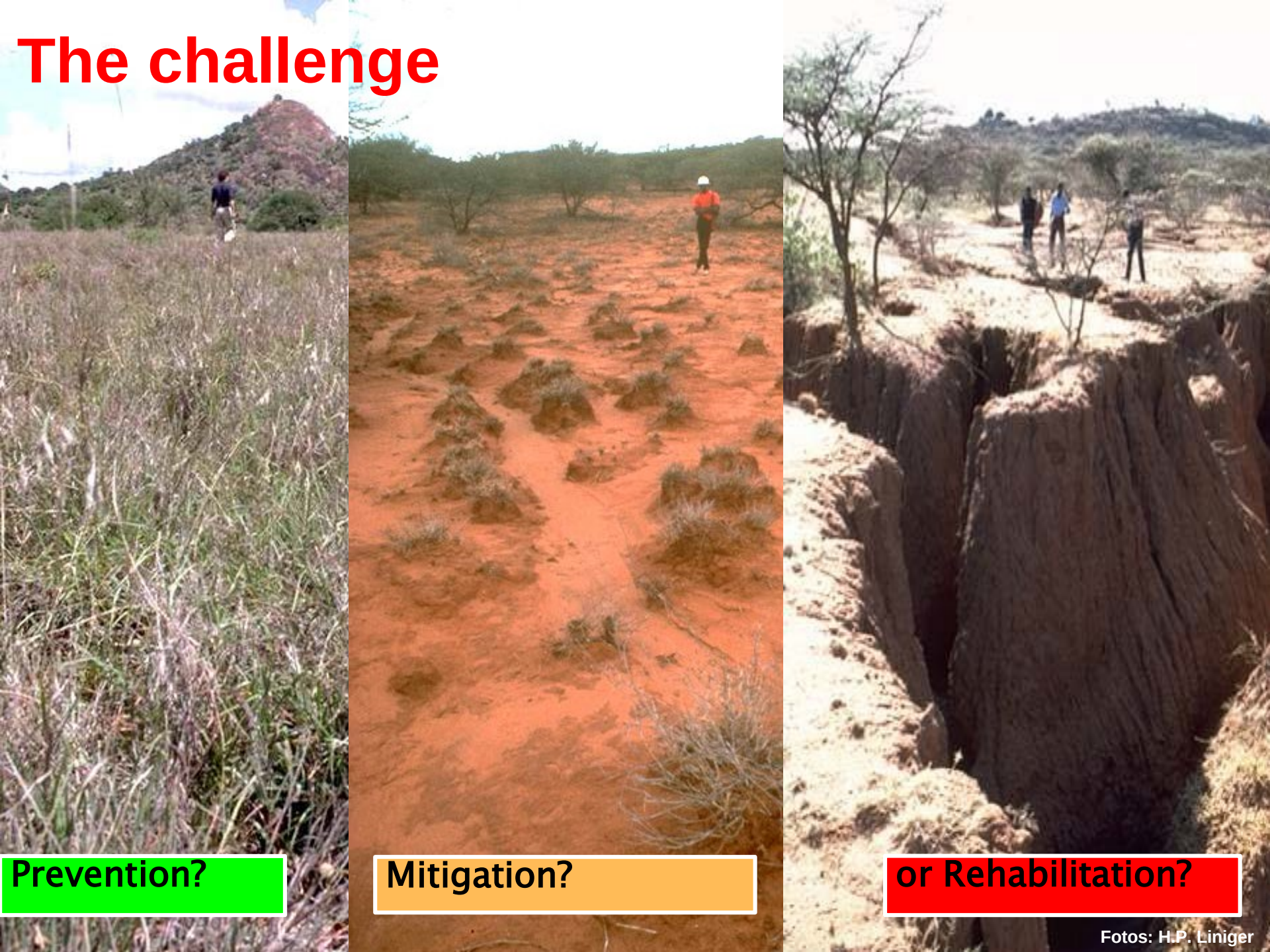
From local into (yourself!) to global info (e.g. ISRIC)

Sustainable land & soil management



source: Robinson et al. 2012 http://dx.doi.org/10.2136/vzj2011.0051

The challenge



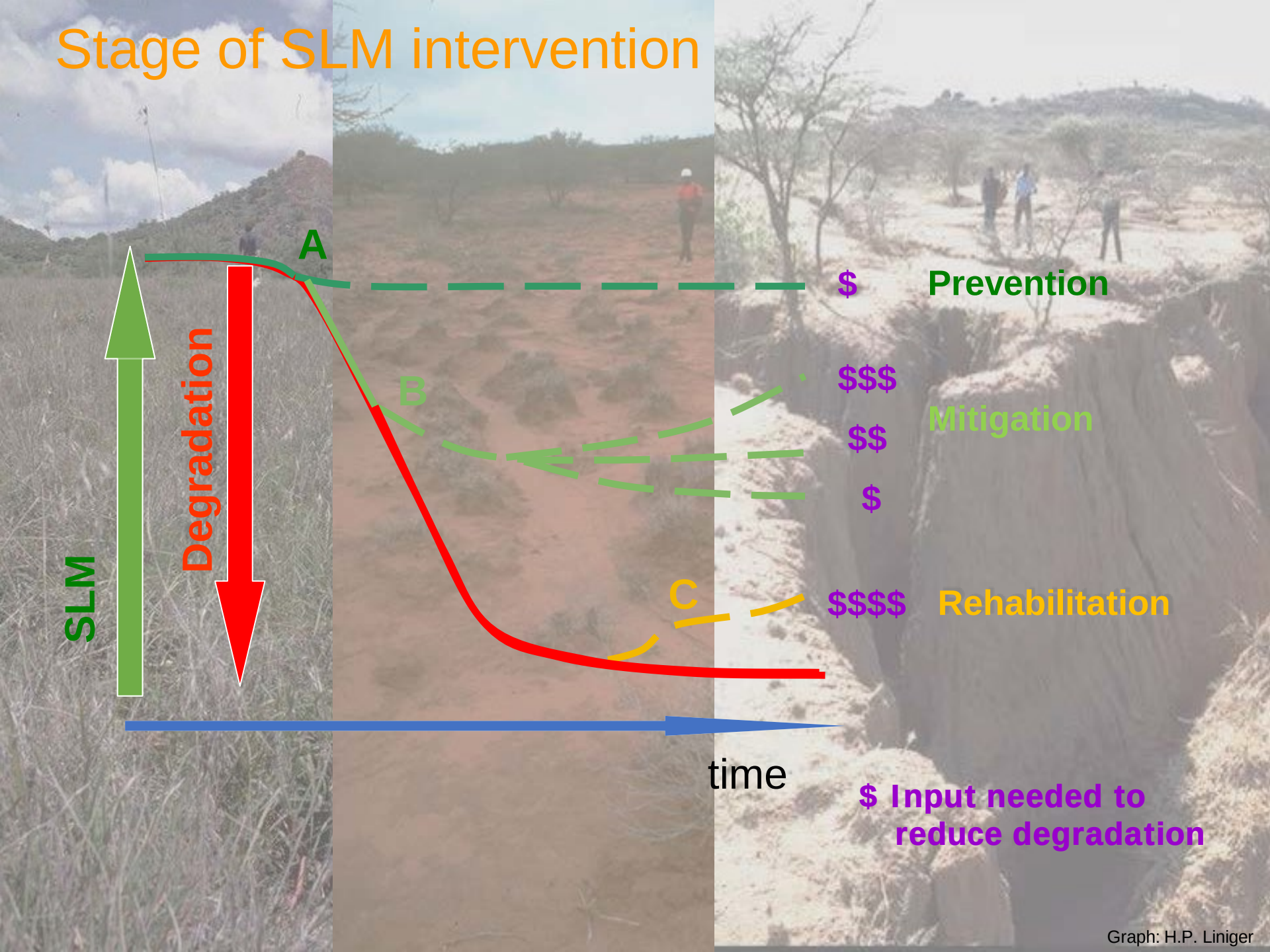
Prevention?

Mitigation?

or Rehabilitation?

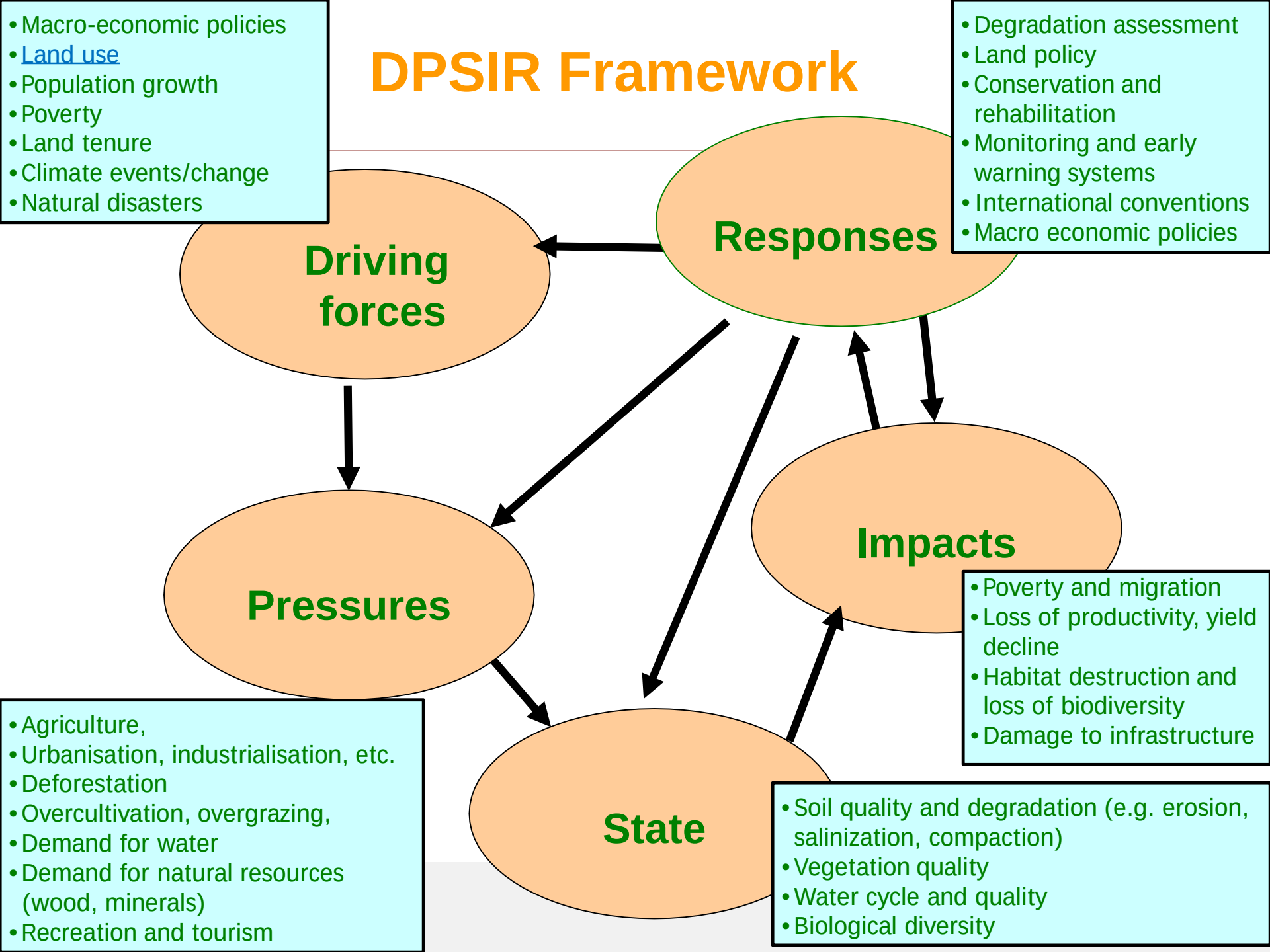
Fotos: H.P. Liniger

Stage of SLM intervention



Graph: H.P. Liniger

DPSIR Framework



- Macro-economic policies
- Land use
- Population growth
- Poverty
- Land tenure
- Climate events/change
- Natural disasters

- Degradation assessment
- Land policy
- Conservation and rehabilitation
- Monitoring and early warning systems
- International conventions
- Macro economic policies

- Agriculture,
- Urbanisation, industrialisation, etc.
- Deforestation
- Overcultivation, overgrazing,
- Demand for water
- Demand for natural resources (wood, minerals)
- Recreation and tourism

- Poverty and migration
- Loss of productivity, yield decline
- Habitat destruction and loss of biodiversity
- Damage to infrastructure

- Soil quality and degradation (e.g. erosion, salinization, compaction)
- Vegetation quality
- Water cycle and quality
- Biological diversity

There has always been (too?) much focus on degradation…

but too little attention for Sustainable Land Management (SLM)

SLM: definitions

*SLM is the **use of land resources**, including soil, water, animals and plants for the production of goods **to meet changing human needs**, while simultaneously **ensuring the long-term productive potential** of these resources and **ensuring their environmental functions*** (WOCAT, 2007)

***SLM** is land managed in such a way as to **maintain or improve ecosystem services for human well-being**, as negotiated by all stakeholders* (UNCCD, 2009)

Land degradation

“land losing its ability to perform its functions”

Sustainable land management

“ looking after the land ”

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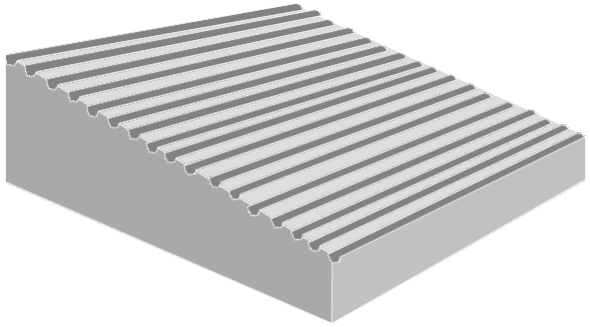
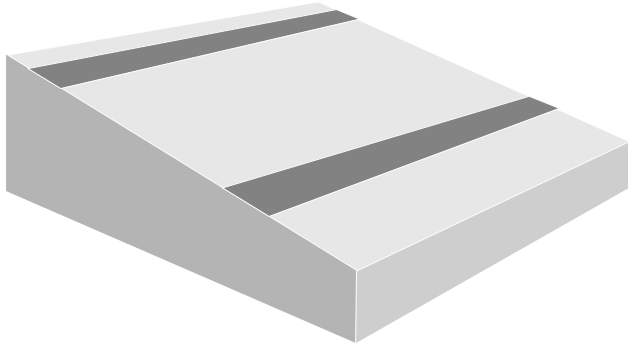
More definitions (as used in this presentation)

- **Technology (/practice/technique/intervention)**: what is implemented in the field to prevent or control degradation;
- **Measure**: part of a technology which may alone or together with other measures constitute a technology;
- **Approach (**strategy, ...): the “ways and means” to successfully implement a technology, “enabling environment”

Categorisation of SLM technologies

By technique used





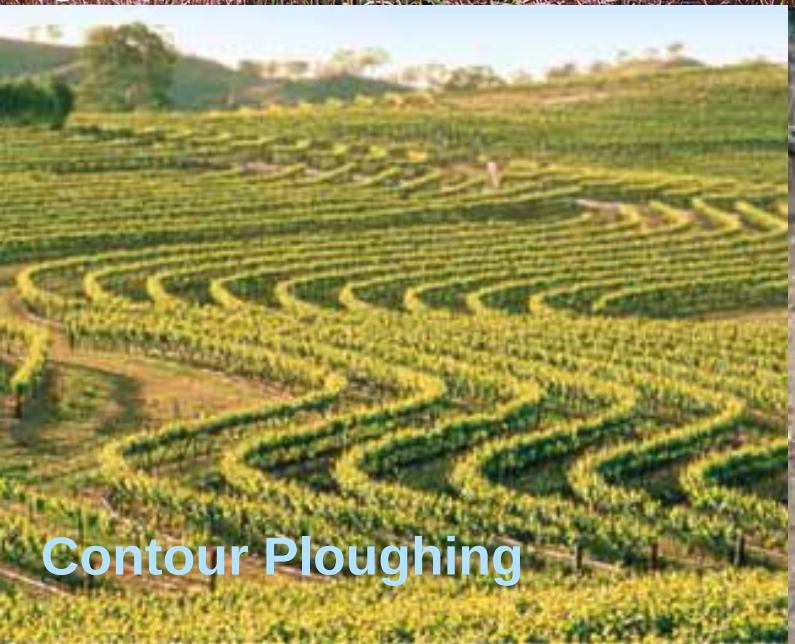
<u>Agronomic measures</u> such as mixed cropping, contour cultivation, mulching

- *are usually associated with annual crops*
- *are repeated routinely each season or in a rotational sequence*
- *are of short duration and not permanent*
- *do not lead to changes in slope profile*
- *are normally independent of slope*

<u>Vegetative measures</u> such as grass strips, hedge barriers, windbreaks, agroforestry

- *involve the use of perennial grasses, shrubs or trees*
- *are of long duration*
- *often lead to a change in slope profile*
- *are often aligned along the contour or against the prevailing wind direction*
- *are often spaced according to slope*

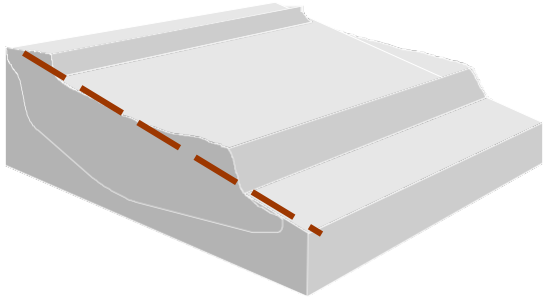
Examples of agronomic measures



Examples of vegetative measures

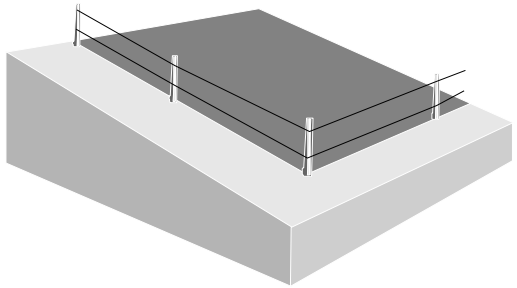
Categorisation of SLM technologies

By technique used



Structural measures such as terraces, banks, bunds, constructions

- *often lead to a change in slope profile*
- *are of long duration or permanent*
- *aim primarily to control runoff, wind velocity and erosion and harvest rainwater*
- *often require substantial inputs of labour or money when first installed*
- *are often zoned on the contour/against wind direction*
- *are often spaced according to slope*
- *involve major earth movements and / or construction with wood, stone, concrete, etc.*



Management measures such as land use change, area closure, rotational grazing

- *involve a fundamental change in land use*
- *involve no agronomic and structural measures*
- *often result in improved vegetative cover*
- *often reduce the intensity of use*

Examples of structural measures

Example of Management measures


Area closure / fencing


Controlled fire


Cut & Carry + Stall feedin


Rotational grazing/rangeland resting

Categorisation of SLM technologies

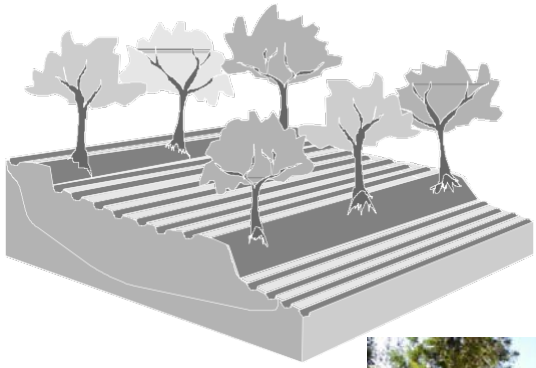
By technique used

The best of two (or more) worlds?

Combinations in conditions where different measures are complementary and thus enhance each other's effectiveness. Any combinations of the above measures are possible, e.g.

- *structural: terrace, with*
- *vegetative: grass and trees, with*
- *agronomic: ridges*

*Together such combinations constitute **one** technology!*



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Categorisation of SLM practices

By common denominators, e.g. type of degradation addressed

→ Conservation Groups[1]:

- **Terracing**: all technologies that aim to reduce the slope angle (and hence the speed of surface run-off);
- **Water harvesting**: all technologies that aim to collect water from rainfall and/or runoff for irrigation or domestic use;
- **Agroforestry**: combining (food) crops with trees;
- **Conservation Agriculture**: various technologies that have in common: permanent soil cover, crop rotation and minimum soil disturbance
- **Grazing land management**: technologies aimed to improve grazing land;

[1] *NB: Such groupings are arbitrary and other groups are possible, using different criteria!*

Failures up to 1980s (and sometimes persisting!)

(in summary)

- Top-down approach;
- Projects too short and too expensive;
- Too much engineering and wrong emphasis;
- Much research work irrelevant;
- Farmers seen as damaging and ignorant;
- Too much focus on degradation instead of conservation (SLM).

Documenting and Mapping SLM experiences

WOCAT

World **O**verview of **C**onservation **A**pproaches and **T**echnologies

Knowledge Management and Decision Support for Sustainable Land Management

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WOCAT tools and methods

- Standardized **questionnaires** for documentation and evaluation of SLM technologies and approaches and mapping
- A global **database** for storage, search and exchange of SLM technologies and approaches
- A **mapping tool** for local and regional assessment of degradation and SLM (area coverage, degree and impacts)
- A **decision support** tool for selection and up-scaling of identified best practices using a 3-step framework

Questionnaires / guidelines

Framework for:
documentation, monitoring, evaluation and
exchange of SLM practices

SLM Technologies
&
SLM Approaches

Local / field level
(Case studies)

SLM Map

Local, national, global;
scale independent
(spatial overview)

Documentation and evaluation of SLM practice

SLM specialists and land users document SLM practices in the field.

The collected information is entered in the WOCAT Database.

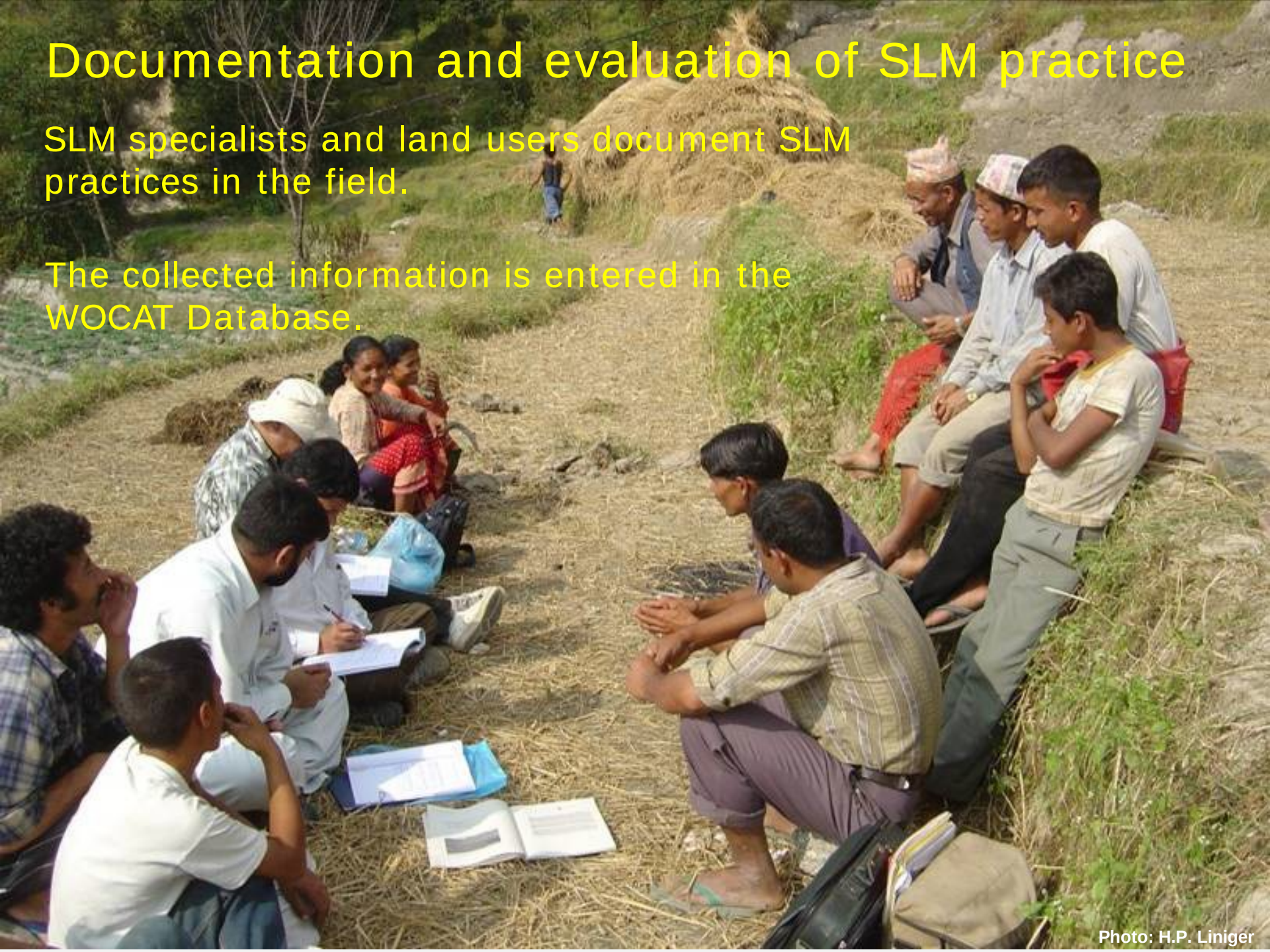
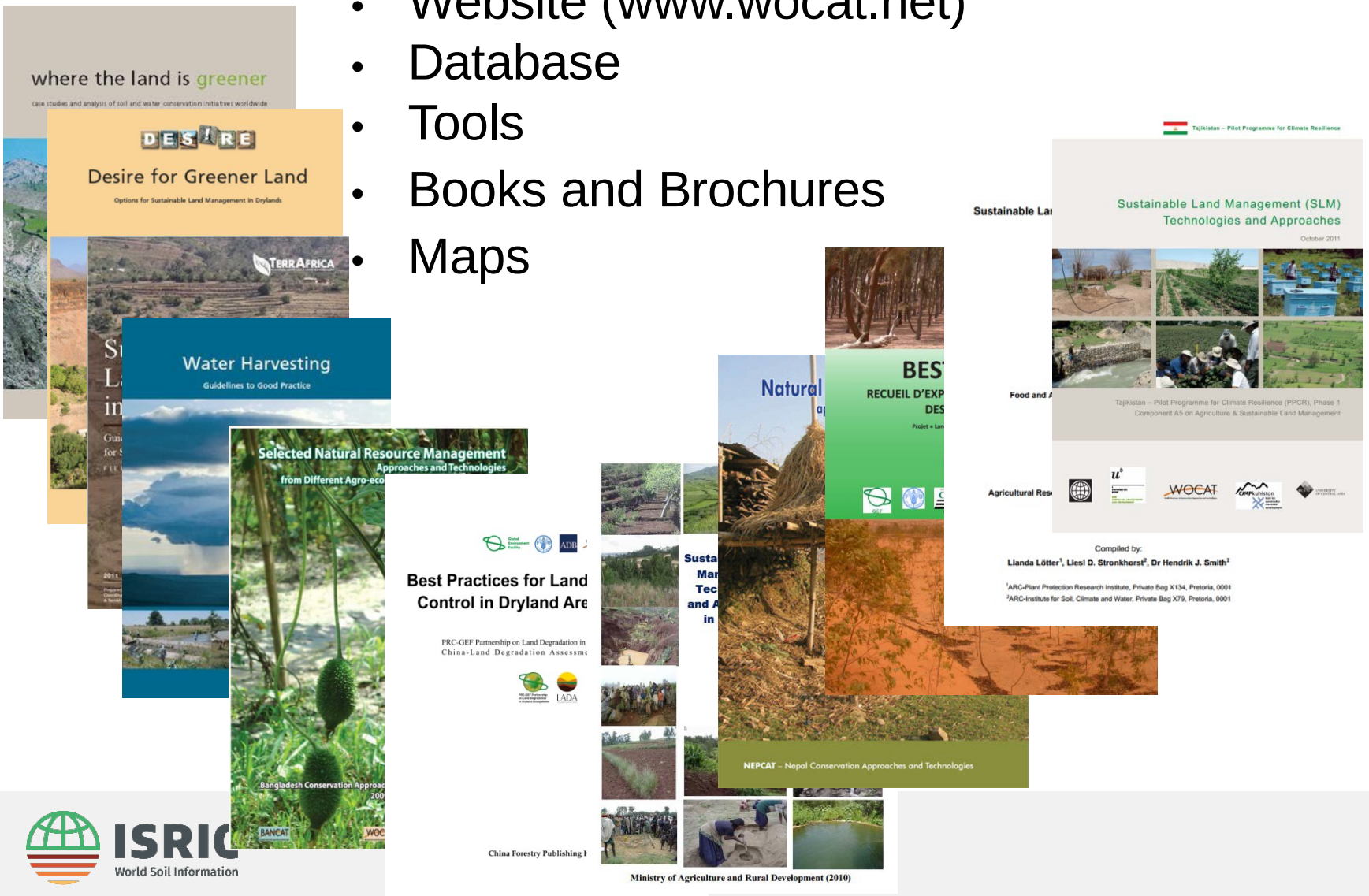


Photo: H.P. Liniger

Knowledge base – WOCAT outputs

- Website (www.wocat.net)
- Database
- Tools
- Books and Brochures
- Maps



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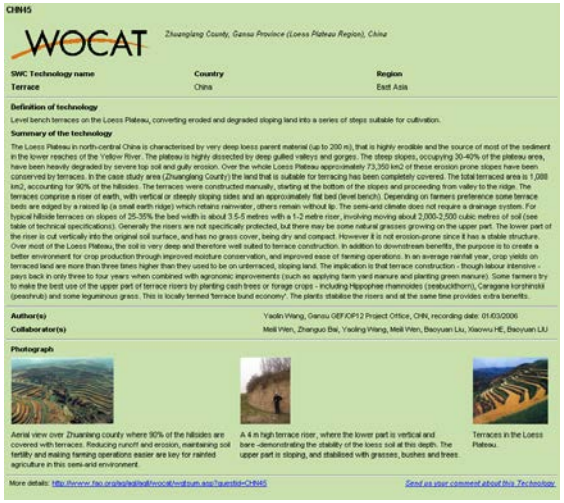
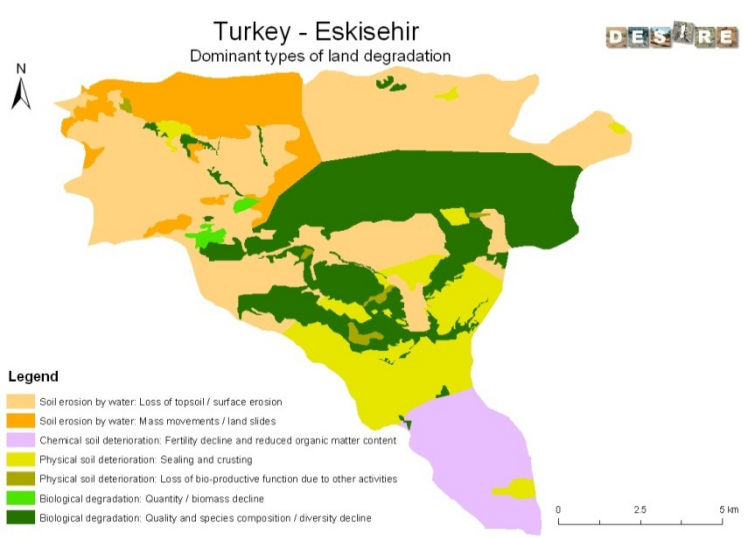
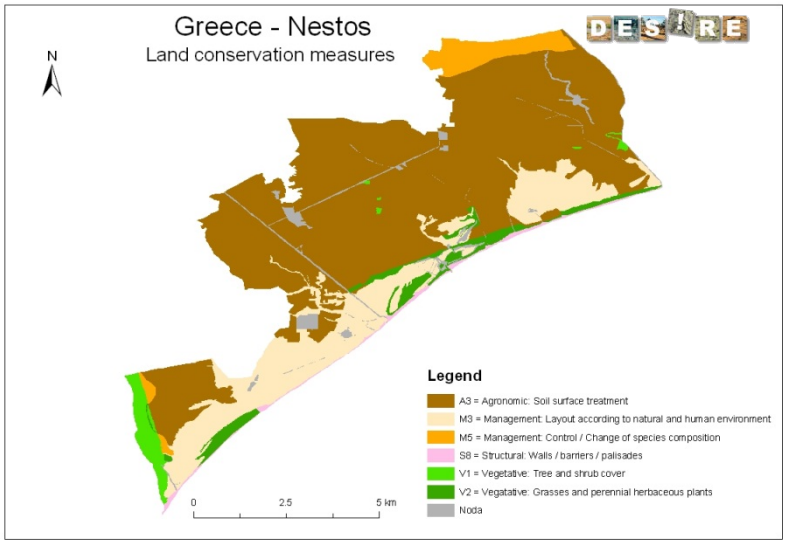
Global extent of SLM

- Google Earth

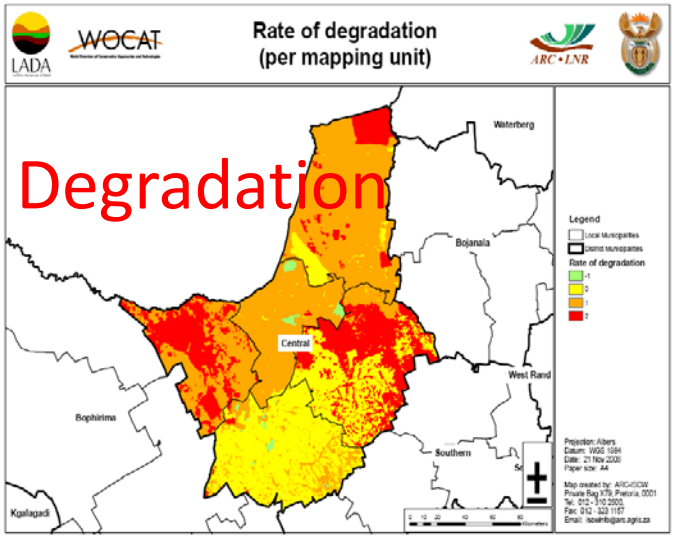


- National and regional maps of degradation and conservation

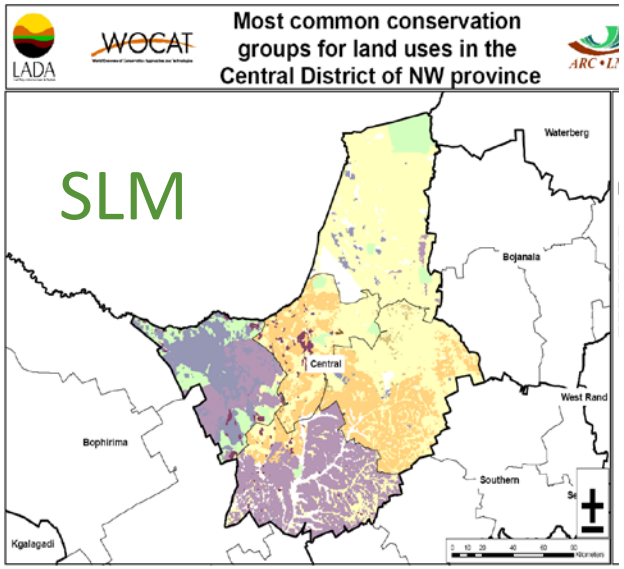




Mapping: Land Degradation/Conservation & impacts



Few maps about land degradation



No maps about SLM!

…and LD/SLM impacts!?

→ Where to invest?

→ Hot spots

→ Bright spots

WOCAT SLM DATABASE

Home | Search SLM Data | Add SLM data | My SLM Data | Login | English

the Global Database on Sustainable Land Management

is the primary recommended database by UNCCD

About the WOCAT SLM Database

Search SLM data | Add SLM data

Search SLM Data | All SLM Data | Search

SLM Technologies

An **SLM Technology** is a land management practice that controls land degradation and enhances productivity and/ or other ecosystem services.

View all

SLM Approaches

An **SLM Approach** defines the ways and means used to implement an SLM Technology, including the stakeholders involved and their roles.

View all

United Nations
Convention to Combat
Desertification

UNCCD Prais Practices

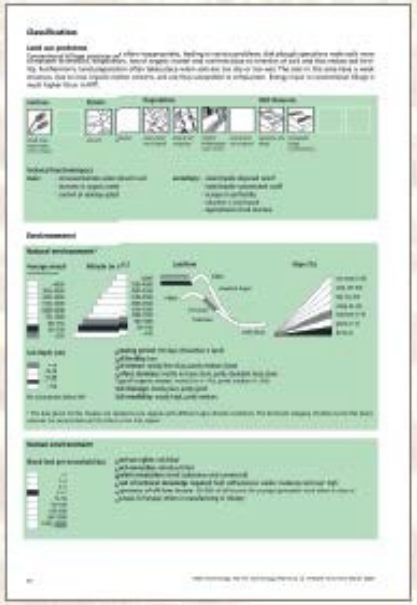
A UNCCD PRAIS Practice is a best practice in SLM, as previously shared through the UNCCD PRAIS system in the UNCCD reporting process.

View all

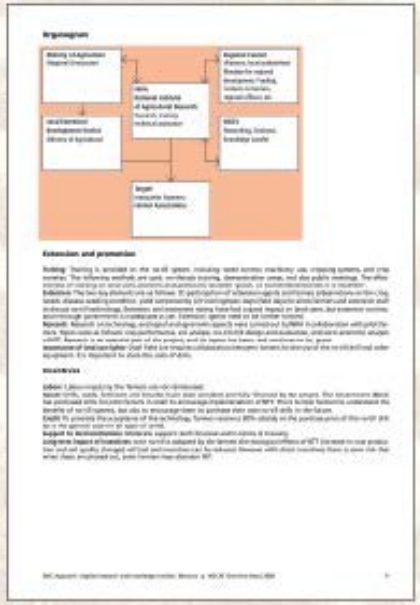
Key Numbers

- 1127 SLM Practices published from 119 countries by 210 users.
  - 657 SLM Technologies
  - 17 SLM Approaches
  - 453 UNCCD PRAIS Practices
- 235 new practices drafted in the past 90 days.
- 9643 visits from 150 different countries since launch in August 2016.

Technologies



Approaches



SLM Technologies

Natural vegetative strips

Philippines

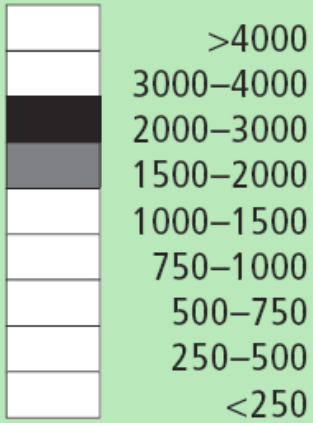
left: A two-year old, well established NVS on a 35% slope: the NVS here have developed into forward sloping terraces. Note that contour ploughing is practiced between the strips. (Agustin Mercado, Jr)
right: These recently established NVS are clearly laid out along the contour. (Bony de la Cruz)

Within individual cropland plots, strips of land are marked out on the contour and left unploughed in order to form permanent, cross-slope barriers of naturally established grasses and herbs.

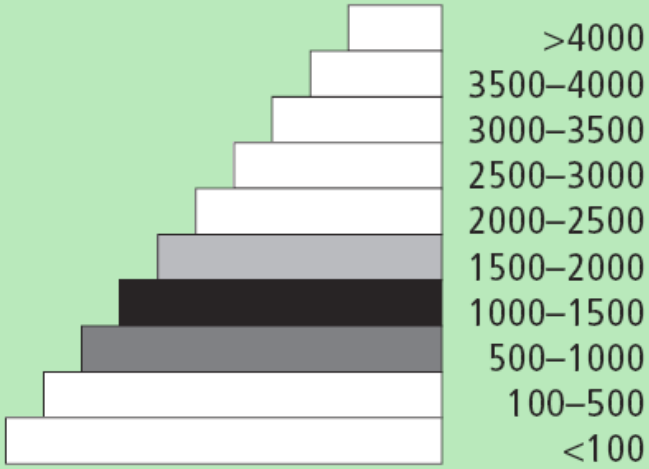
Natural and human environment

Natural environment

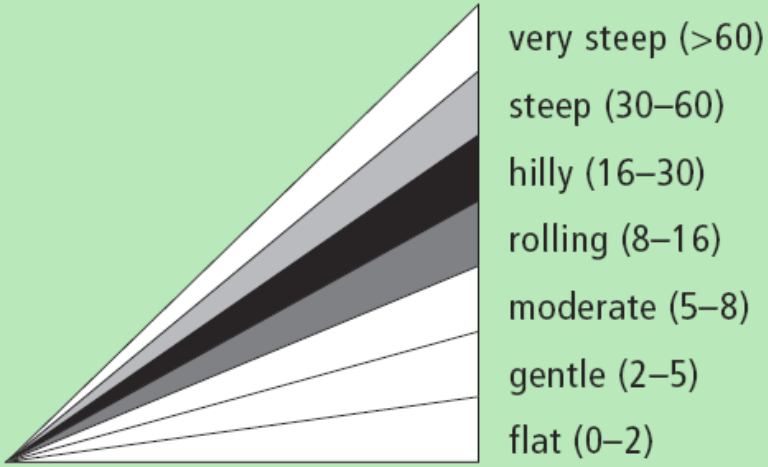
Average annual rainfall (mm)



Altitude (m a.s.l.)

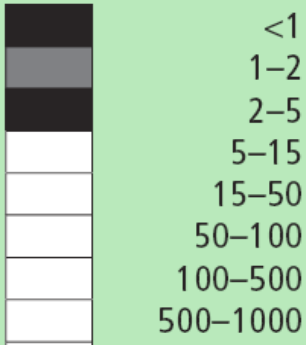


Slope (%)



Human environment

Cropland per household (ha)



Land use rights: mainly individual, partly leased
Land ownership: mainly individual titled, partly individual not titled
Market orientation: mixed (subsistence and commercial)
Level of technical knowledge required: field staff/extension worke
Importance of off-farm income: 10–50% of all income: carpentry, t
farms with intensive agricultural activities (eg vegetable production)

… Economics

Establishment inputs and costs per ha

Inputs	Costs (US$)	% met by land user
Labour (5 person days)	15	100%
Equipment		
- Animal traction (32 hours)	40	100%
- Tools (2): Plough and harrow	25	100%
- Stakes (pegs)	4	100%
TOTAL	**84**	**100%**

Benefits compared with costs	short-term:	long-term:
establishment	positive	very positive
maintenance/recurrent	positive	very positive

Impacts on Ecosystem Services (on- / offsite)

Production and socio-economic benefits	
+ + +	fodder production/quality increase (or biomass as mulch)
+ + +	very low inputs required
+ +	farm income increase
+	crop yield increase
Socio-cultural benefits	
+ + +	improved knowledge SWC/erosion
+ +	community institution strengthening
+ +	national institution strengthening (government line agencies and educational institutions)
Ecological benefits	
+ + +	soil cover improvement
+ + +	soil loss reduction
+ + +	soil structure improvement
+	increase in soil moisture
+	increase in soil fertility
+	biodiversity enhancement
Off-site benefits	

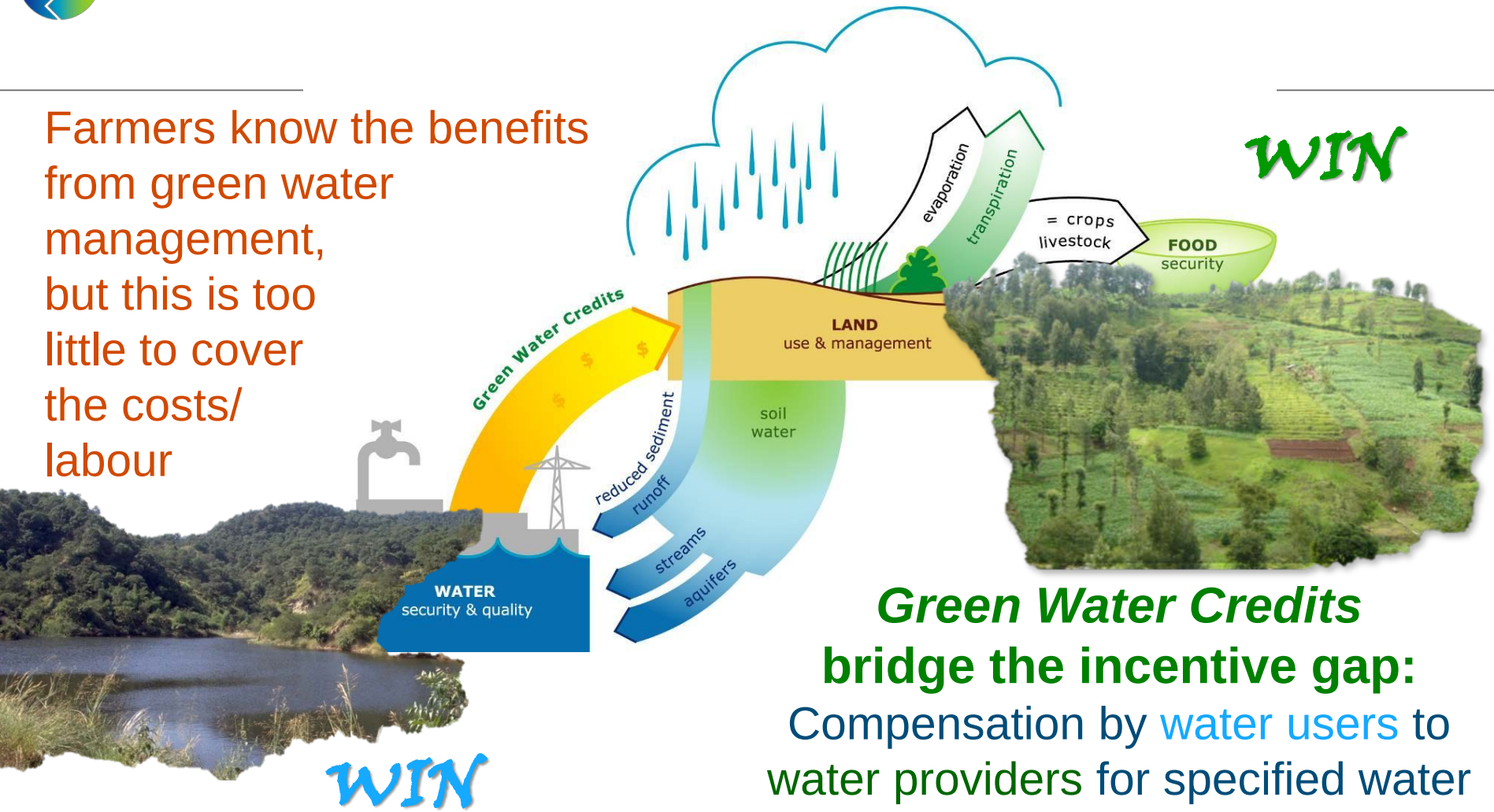
Strengths and weaknesses

Strengths and ➜ **how to sustain/improve**
Easy to establish and maintain ➜ Strengthen farmers associations. Intensify information and education campaign.
Little competition with crops for space, sunlight, moisture and nutrient ➜ Ensure continued regular trimming of vegetative strips and use of these as fodder or mulch.
Low requirement of labour and external inputs ➜ Use only naturally growing grass species.
Effective in reducing soil erosion (by up to 90%) ➜ Adopt other supportive technologies like mulching, zero tillage/minimum tillage, etc.

Weaknesses and ➜ **how to overcome**
Effect on yield and income is not readily felt, since reduced erosion is not easily translated into increased income or yield ➜ Farmers should have supplementary sources of income (eg livestock). Education about what long-term sustainability means.

Example of an “Approach”: Green Water Credits

Farmers know the benefits from green water management, but this is too little to cover the costs/ labour



WIN

WIN

Green Water Credits
bridge the incentive gap:
Compensation by water users to water providers for specified water management services

EXERCISE!

- Form groups (4-5 persons) with similar agro-ecological conditions;
- Each group pictures a land degradation situation recognisable to all group members and identifies a specific “soil threat” to address;
- Search the WOCAT database for technologies applied under similar conditions;
- Choose one technology which you deem most relevant for your situation;
- Describe this technology in brief in a **poster** and explain whether and where it needs some adaptation to your specific conditions;
- Present the poster to the group in max. 10 minutes.

ISRIC
World Soil Information

Thank you for your attention

Useful links:

www.isric.org

www.wocat.net

www.desire-project.eu

www.recare-project.eu

www.greenwatercredits.net