

Epistemology of desertification and the ecosystem service paradigm

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Epistemology of desertification

Epistemology, from Greek (*epistēmē*), meaning "knowledge, understanding", and (*logos*), meaning "study of" is concerned with the nature and scope (limitations) of knowledge.

- What is desertification and how to identify the affected areas on the basis of agreed definitions?
- Can we affirm our understanding of desertification is scientifically based?

What is desertification?

Many definitions exist but the one agreed by the United Nation Convention to Combat Desertification is:

"land degradation in arid, semi-arid and dry sub-humid regions resulting from various factors, including climatic variations and human activities."(UNCCD)

Land degradation

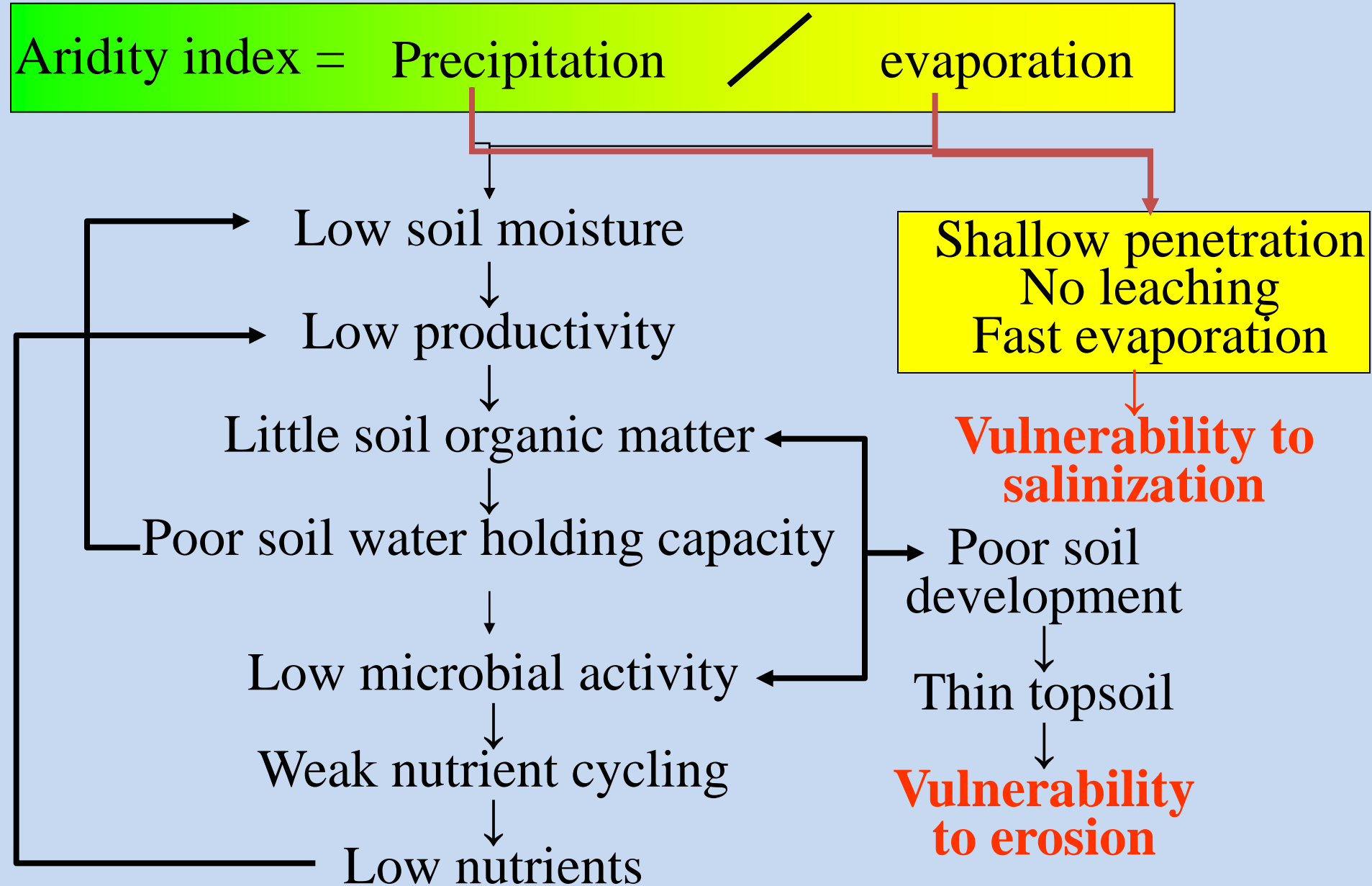
“means reduction or loss, in arid, semi-arid and dry sub-humid areas, of the **biological** or **economic** productivity and **complexity** of rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands...”(UNCCD)

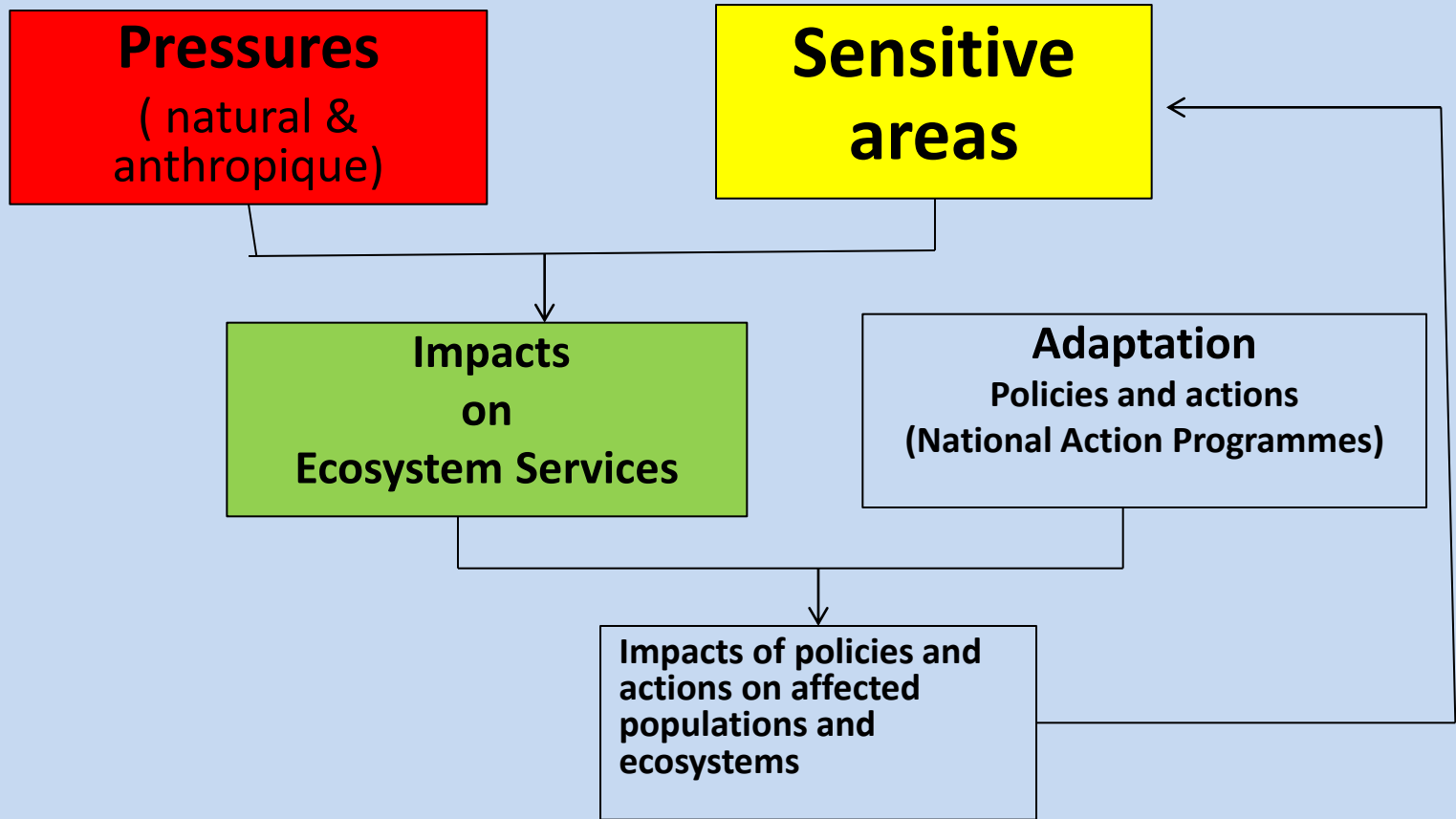
Drylands

(arid, semi-arid and dry sub-humid)

areas, other than polar and sub-polar regions, in which the ratio of annual precipitation to potential evapotranspiration falls within the range from 0.05 to 0.65

What is special about drylands?





Main pressures on land (I)

- 1. Climate: Increased aridity and drought frequencies,*
- 2. Vegetation: Loss of vegetative cover and primary production,*
- 3. Soil: erosion, fertility decline, salinization.*

Main pressures on land (II)

5. Changing population densities

6. Human movements and migration: Rural migration, urban sprawl, littoralization, land abandonment

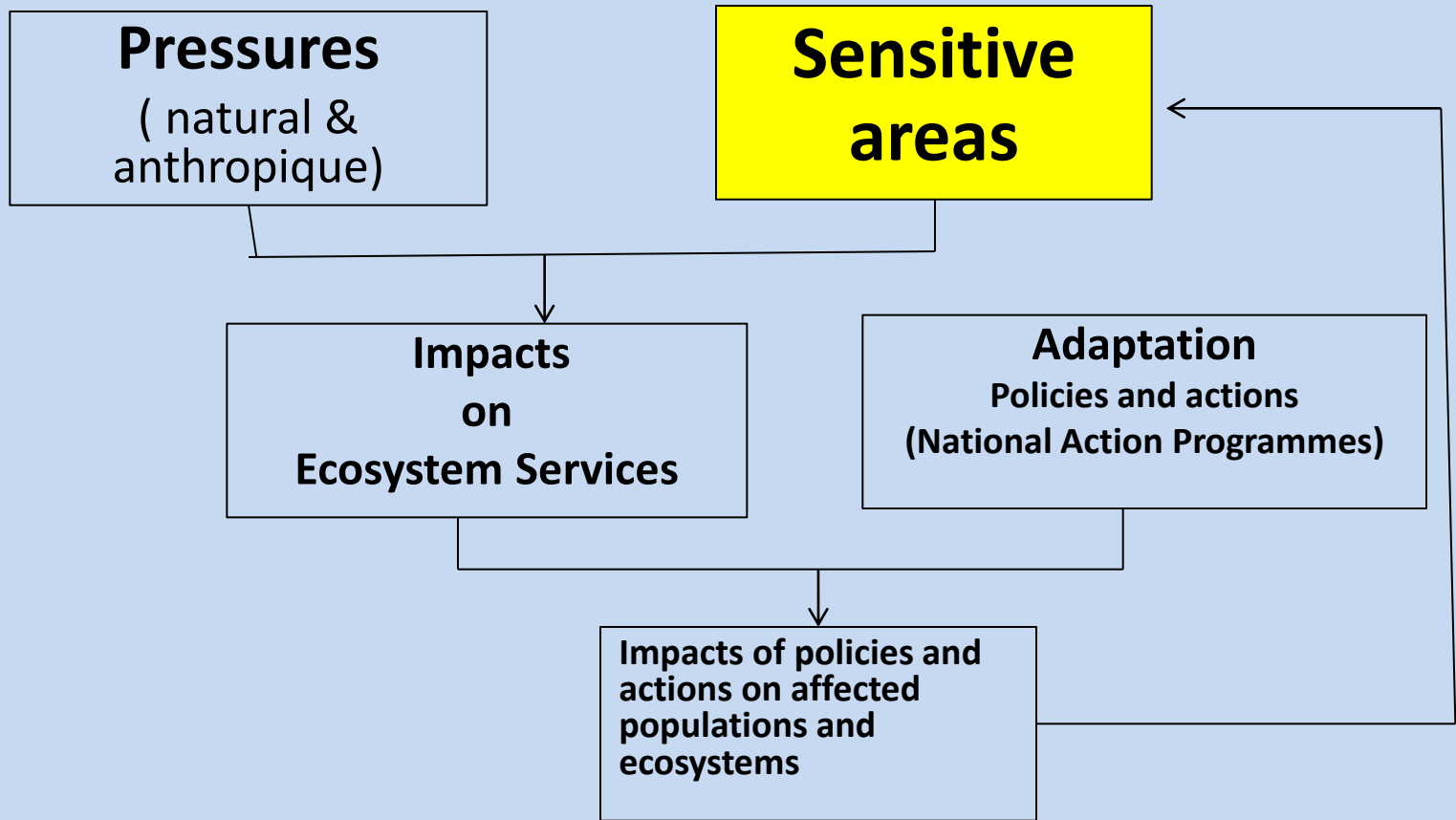
Main pressures on land (III)

7. Grazing mismanagement, decrease in primary production in rangelands

8. Deforestation, wild fires, forest fragmentation

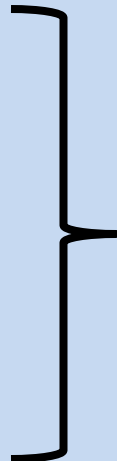
9. Inappropriate agricultural practices, agriculture expansion (livestock, crop production, irrigation)

10. Pollution due to mining or technology

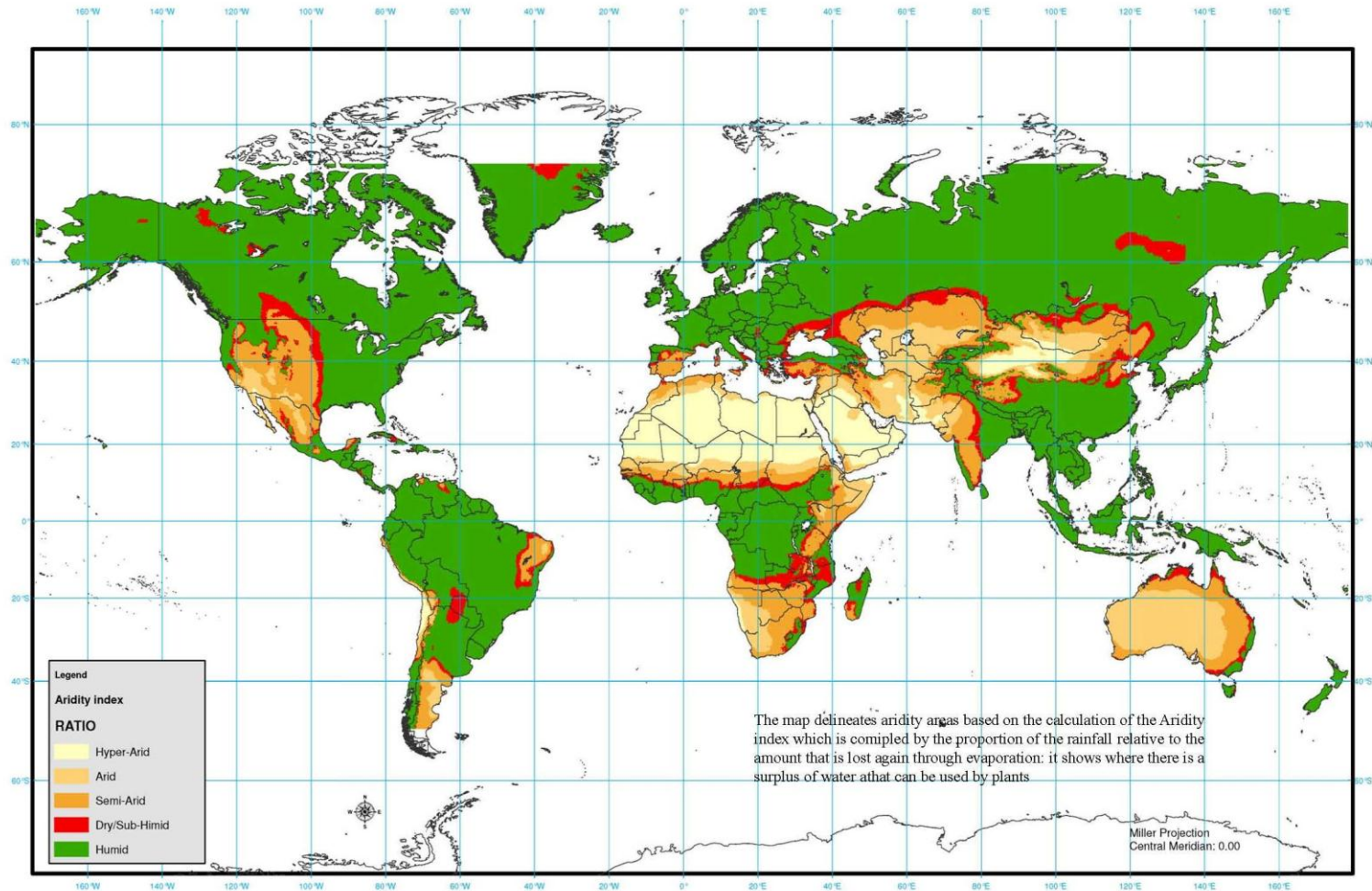


Sensitive areas=Affected areas

The areas threatened by desertification can be identified according to:

- Climate
 - Soil
 - Land/vegetation cover
 - Land management
- 
- Environmentally
Sensitive
Area Index
(ESA)

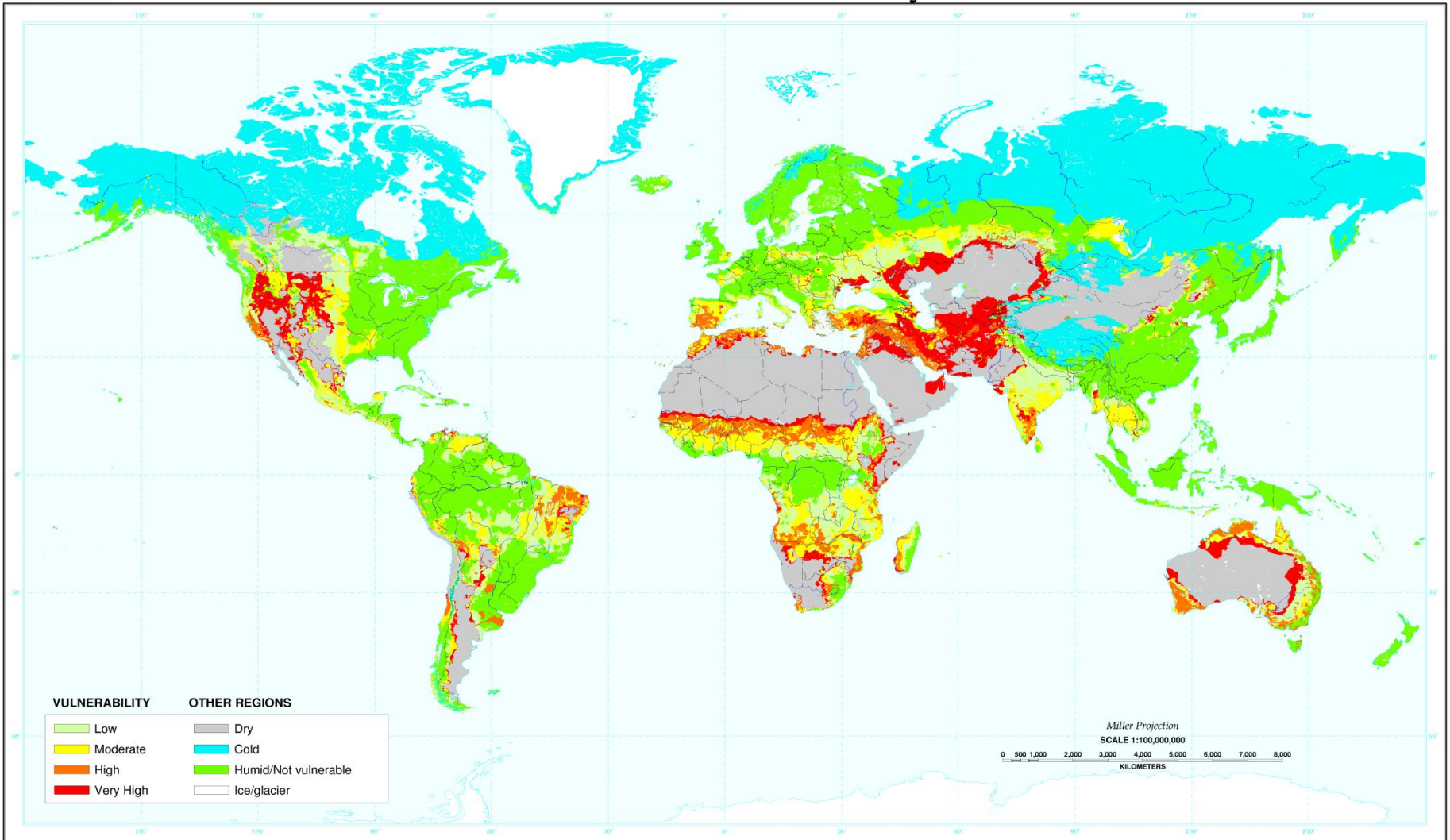
Affected areas (I): climate (JRC)



Rain/Eto ratio between 1989 to 2010

Affected areas: soil (II) (USDA)

U.S. Department of Agriculture
Natural Resources Conservation Service
Soil Survey Division
World Soil Resources



Vegetation cover



- Cultivated and Managed areas / Barbed cropland
- Past flooding or irrigated cropland
- Mosaic cropland (50-70%) / vegetation (grassland/shrubland/forest) (20-50%)
- Mosaic vegetation (grassland/shrubland/forest) (50-70%) / cropland (20-50%)
- Closed to open (>15%) broadleaved evergreen and/or semi-deciduous forest (>5m)
- Closed (<40%) broadleaved deciduous forest (>5m)
- Open (15-40%) broadleaved deciduous forest/woodland (>5m)
- Closed (<40%) needle-leaved evergreen forest (>5m)
- Closed (<40%) needle-leaved deciduous forest (>5m)
- Open (15-40%) needle-leaved deciduous or evergreen forest (>5m)
- Closed to open (>15%) mixed broadleaved and needleleaved forest
- Mosaic forest or shrubland (50-70%) and grassland (20-50%)
- Mosaic grassland (50-70%) and forest or shrubland (20-50%)
- Closed to open (>15%) shrubland (<5m)
- Closed to open (>15%) grassland
- Sparse (<15%) vegetation
- Closed (<40%) broadleaved forest regularly flooded, fresh water
- Closed (<40%) broadleaved semi-deciduous and/or evergreen forest regularly flooded, saline water
- Closed to open (>15%) grassland or shrubland or woody spt on regularly flooded or waterlogged soil, fresh, brackish or saline water
- Artificial surfaces and associated areas (Urban areas >50%)
- Tidal areas
- Water bodies
- Permanent Snow and ice
- No data

GlobCover Version 2 - 300m

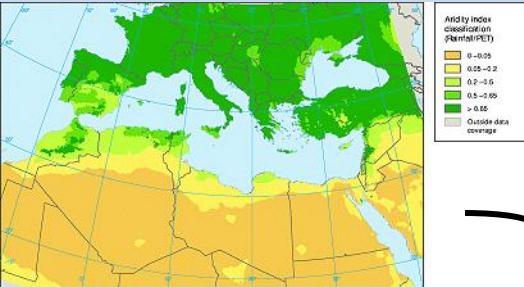
December 2004 / June 2006 [ENVISAT MERIS]

European Space Agency
Agence spatiale européenne

to access GlobCover data: <http://www.esa.int/dua/online/globcover>



Climate 1960-1990



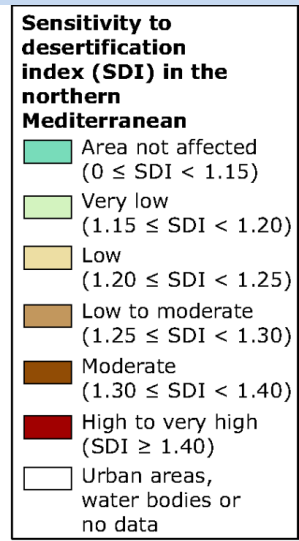
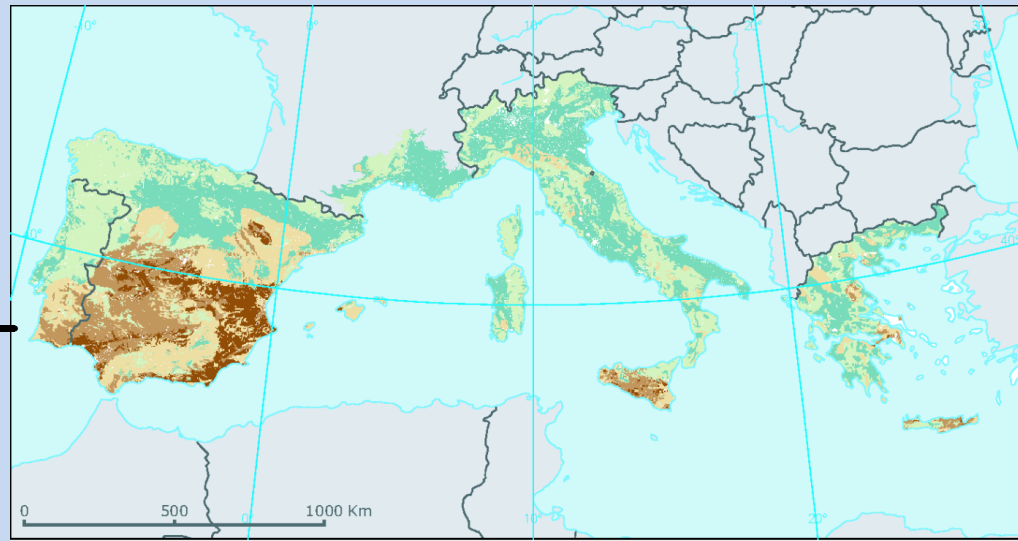
soil



vegetation



ESA Index



Scale 1:1.000.000

Source: European Environmental Agency, 2005

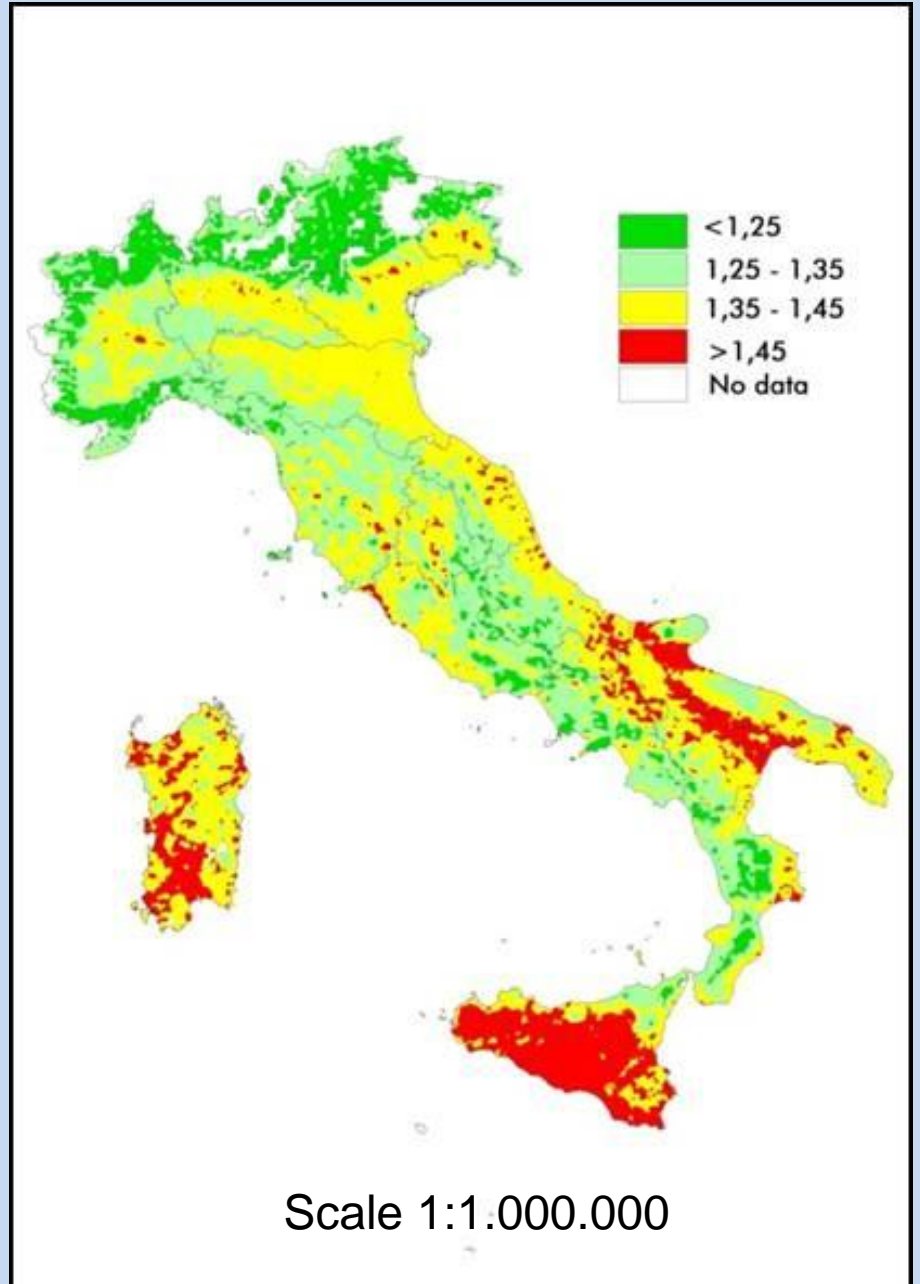
ESA Index

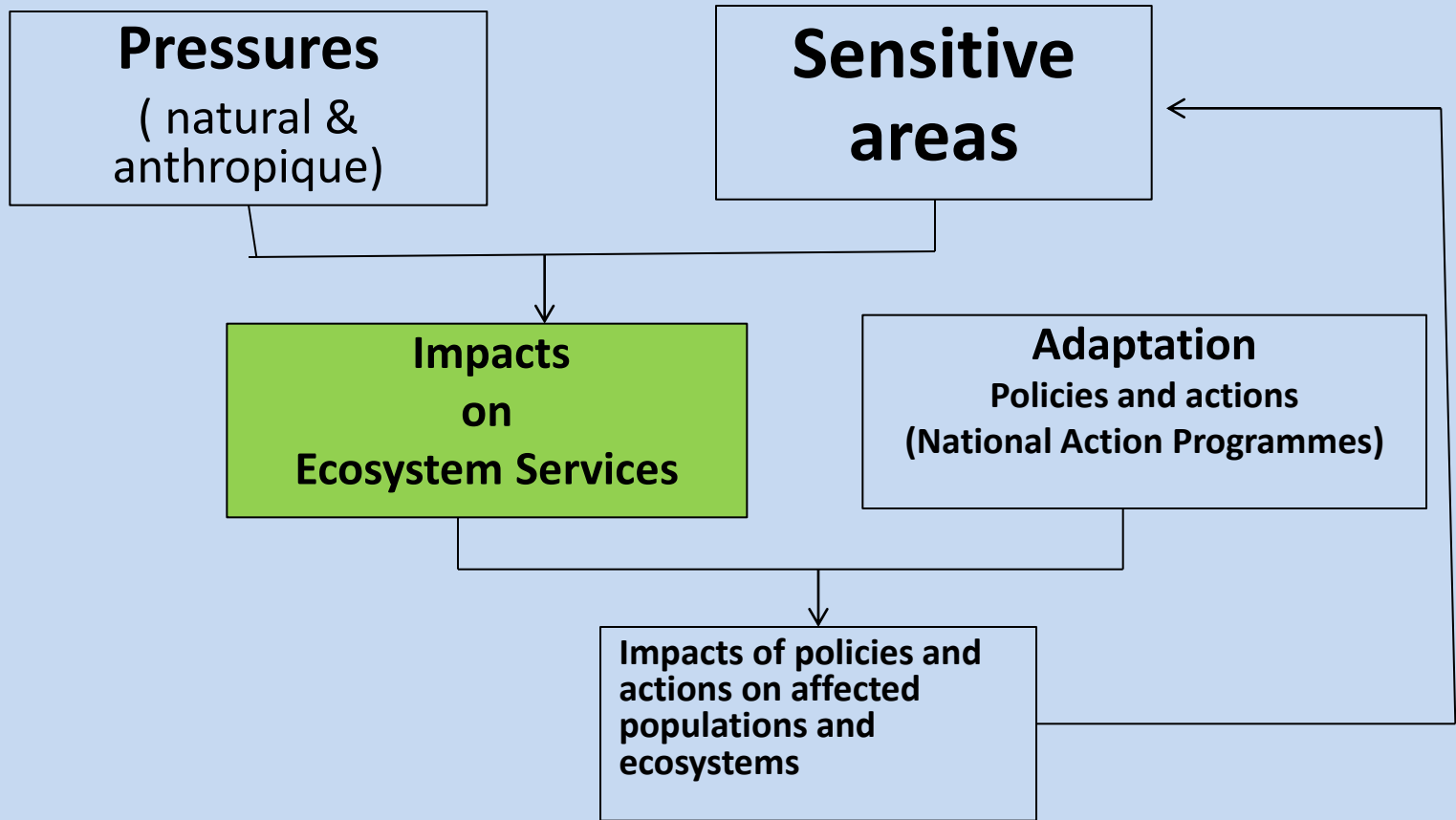
Climate (1970-2000)

Soil

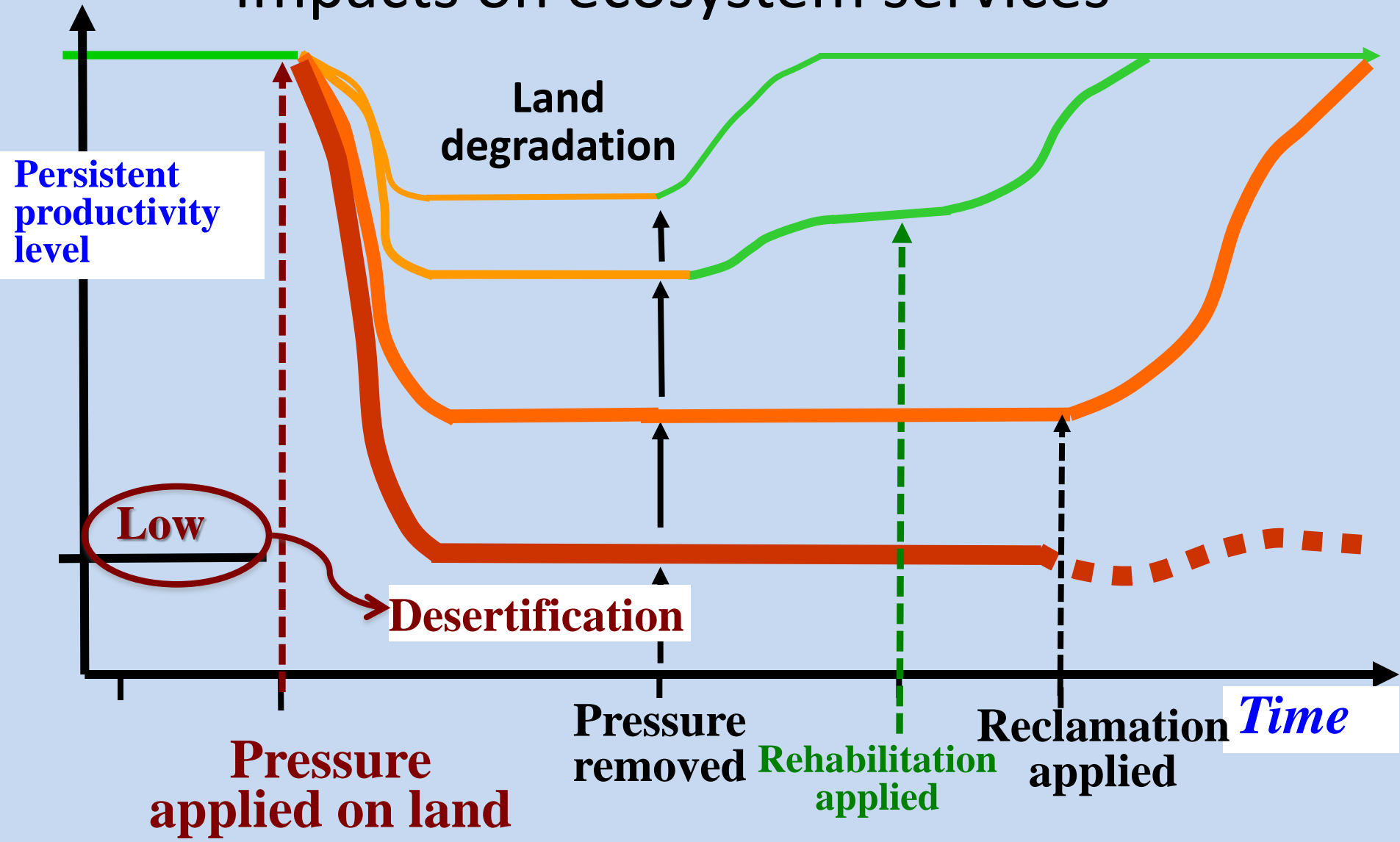
Vegetation

Management



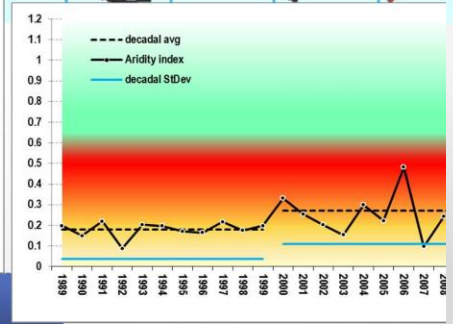
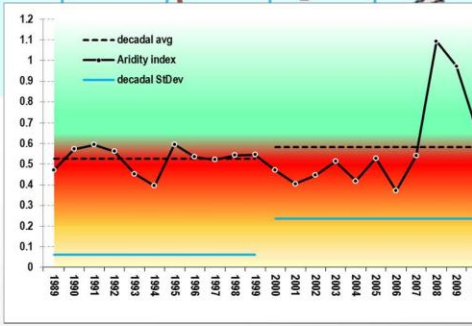
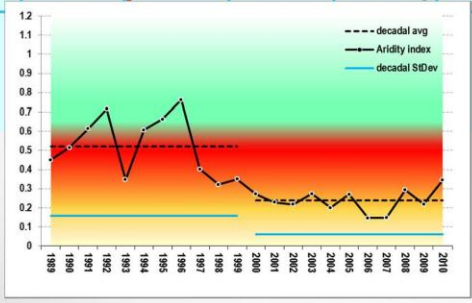
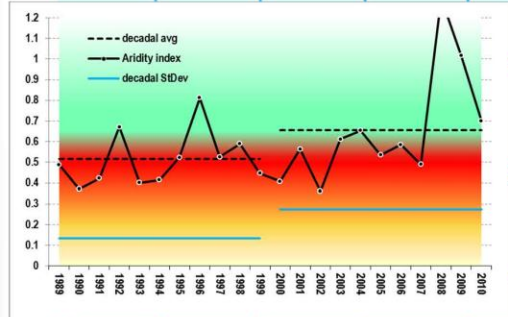
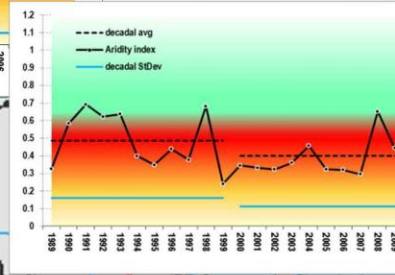
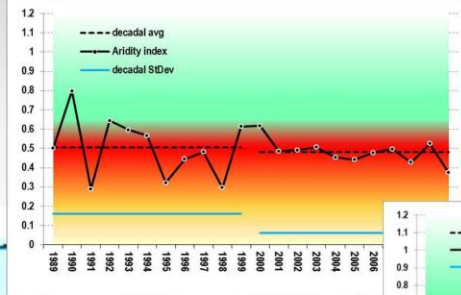
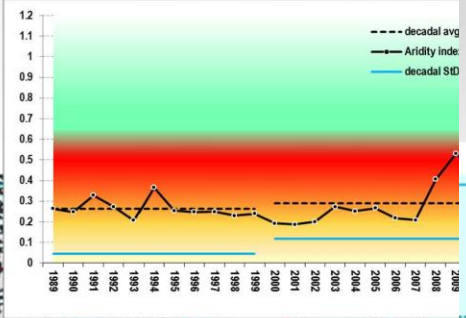
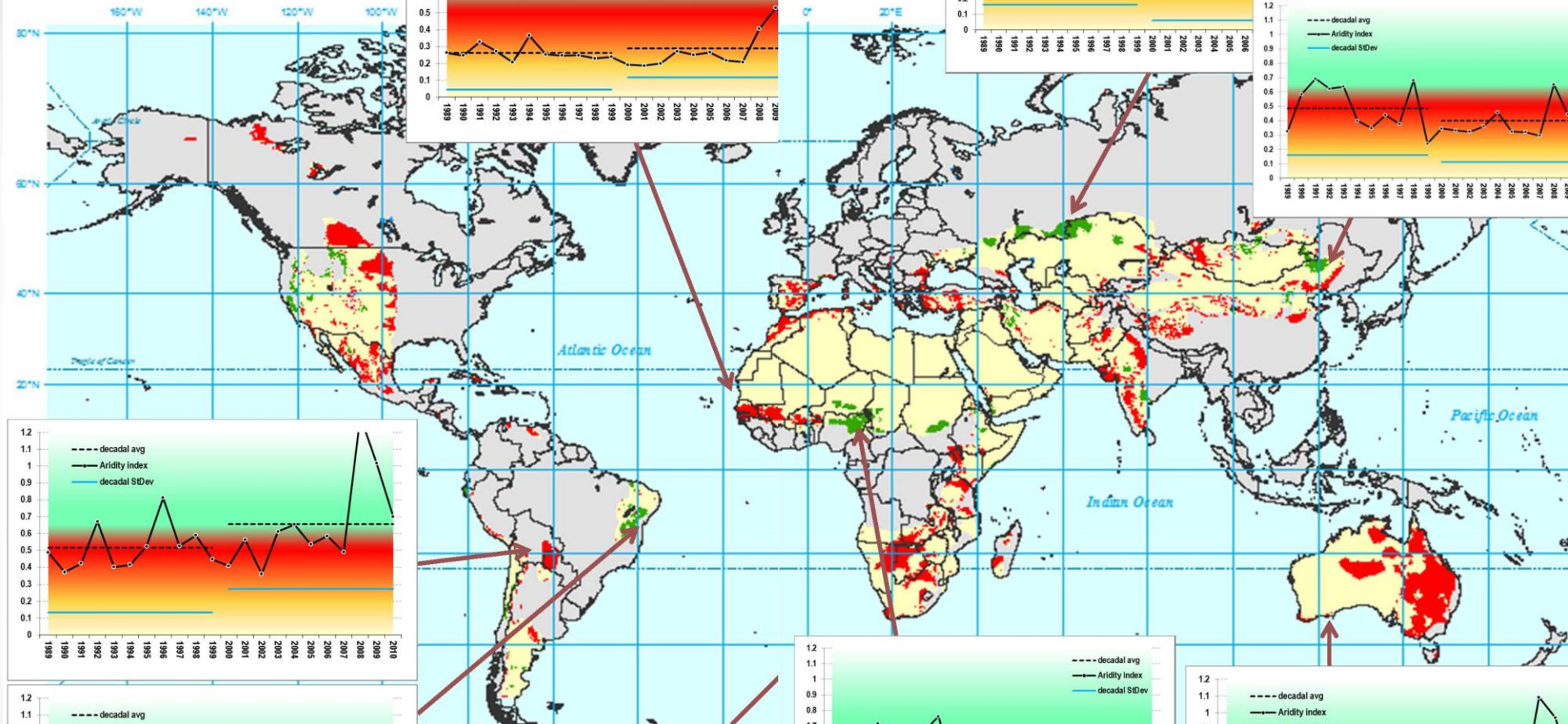


Impacts on ecosystem services



Variation of Aridity

1989-2010



The maps indicates areas where the aridity increased (green) and where the aridity decreased (red). Graphs, depict the same class colours as on map X and indicate the variability (value level of the blue line, e.g. standard deviation) of the aridity and aridity class changes.

Some areas changed from high variability to a more stable situation whether more dry or less dry; others remained variable but changed to more or less dry.

The ecosystem services paradigm

Humankind benefits from a multitude of resources and processes that are supplied by natural [ecosystems](#). Collectively, these benefits are known as **ecosystem services**. Ecosystem services were popularized and their definitions formalized by the United Nations 2005 [Millennium Ecosystem Assessment](#) (MEA).

MEA grouped ecosystem services into four broad categories: ***provisioning***, such as the production of food and water; *regulating*, such as the control of climate and disease; *supporting*, such as nutrient cycles and crop pollination; and *cultural*, such as spiritual and recreational benefits.

Desertification - Persistent reduction in the capacity of dryland ecosystems to provide

Ecosystem Services

- Cultivated
- Range
- Natural

Food Fiber

Forage

Fuelwood

Provisioning

Provisions derived from
Biological productivity

What are the quantifiable services that address

Regulating

Water regulation

Climate regulation

Pollination

Seed dispersal

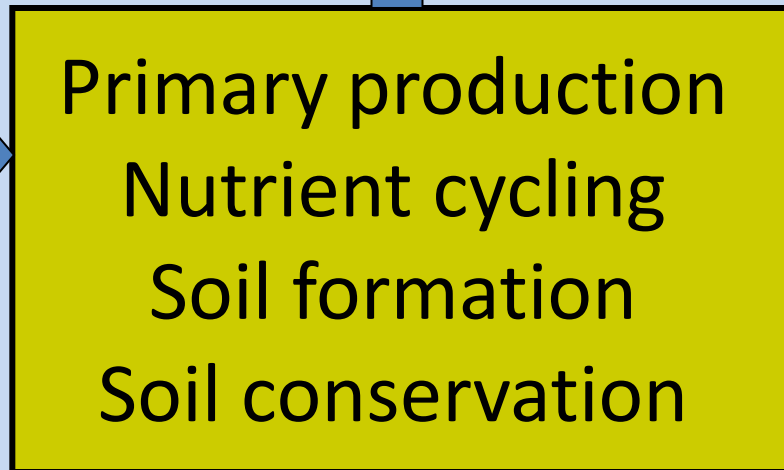
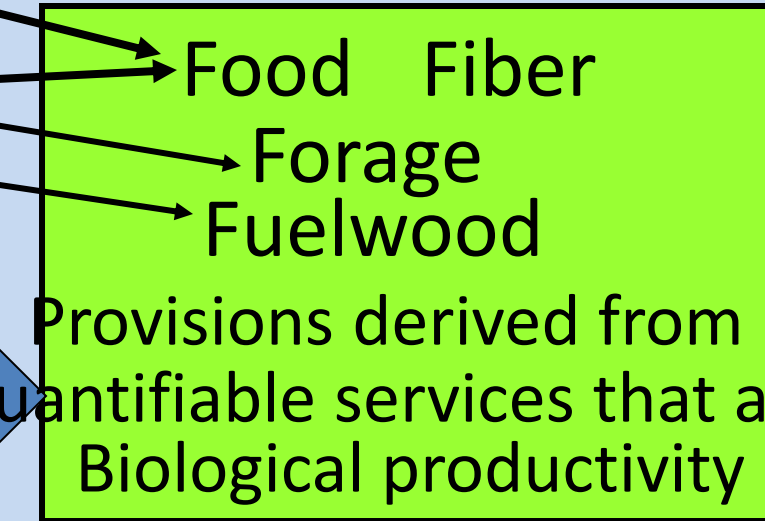
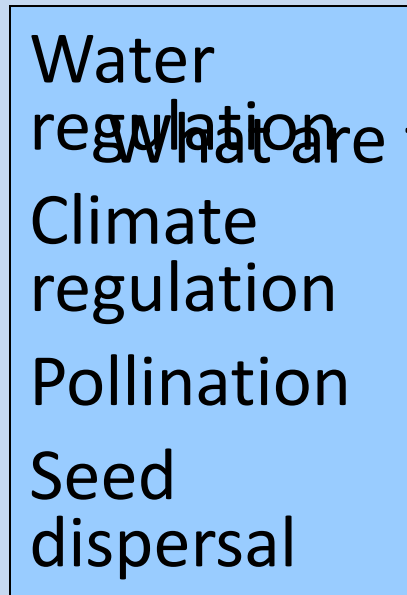
Primary production

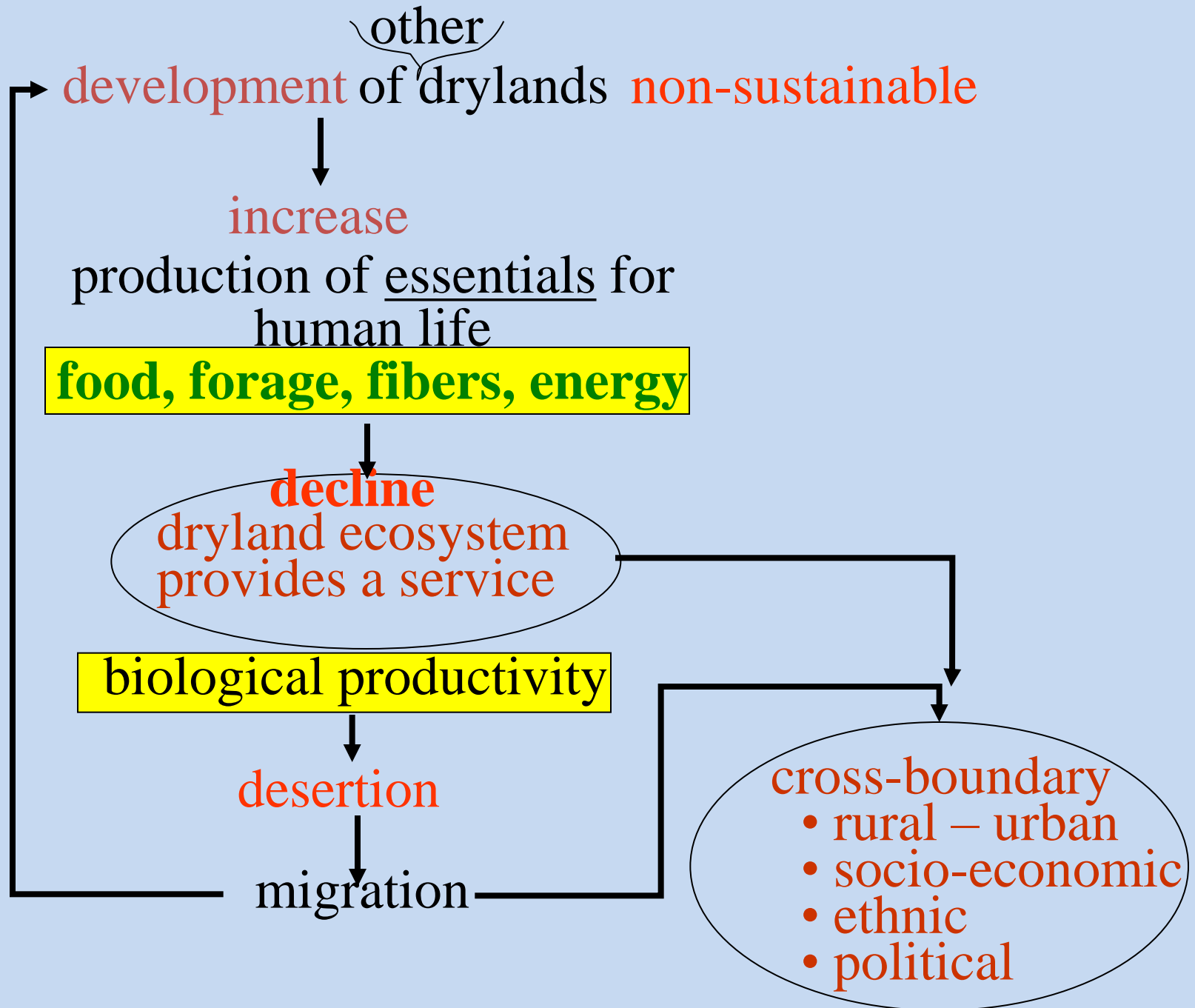
Nutrient cycling

Soil formation

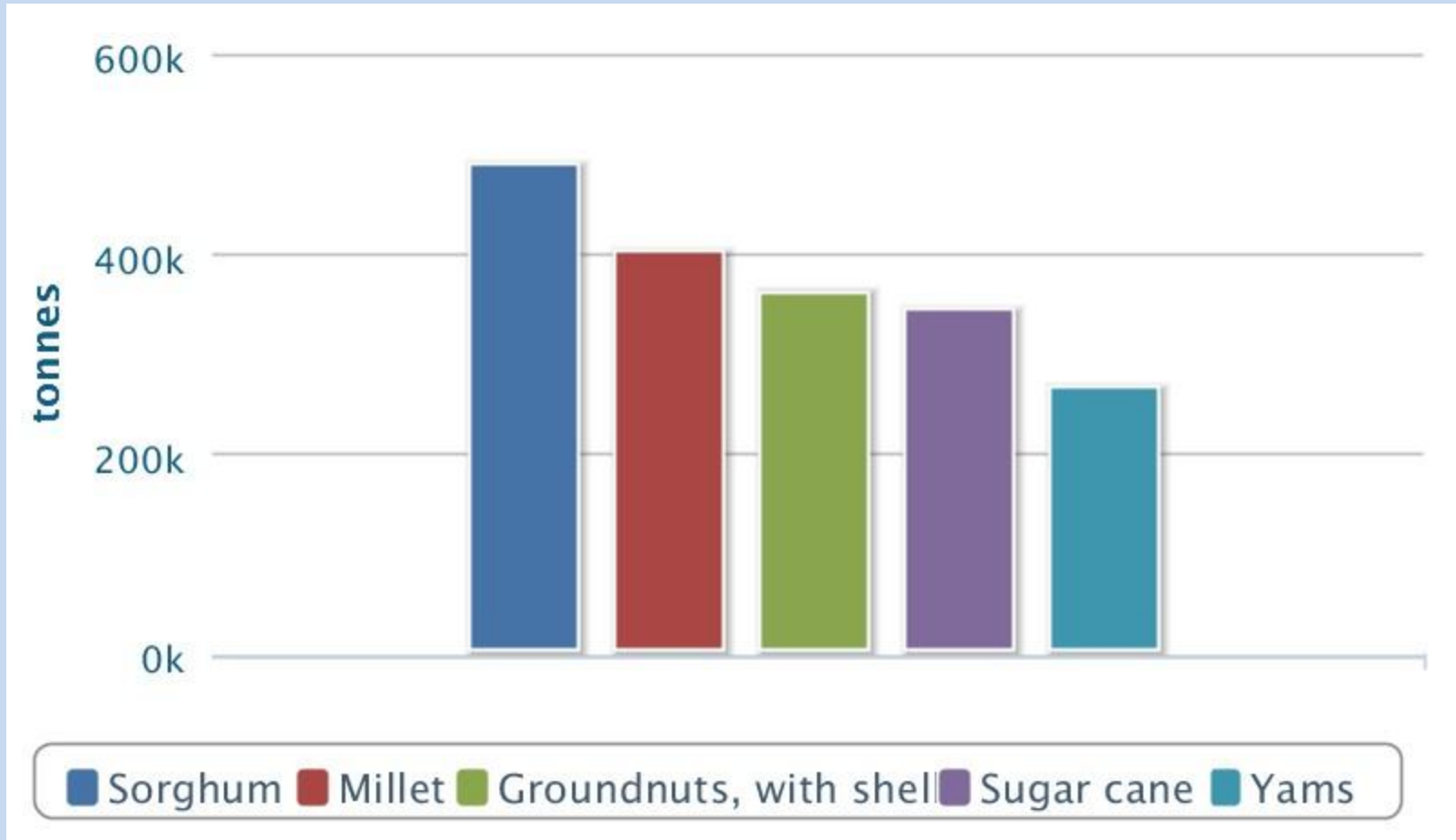
Soil conservation

Supporting





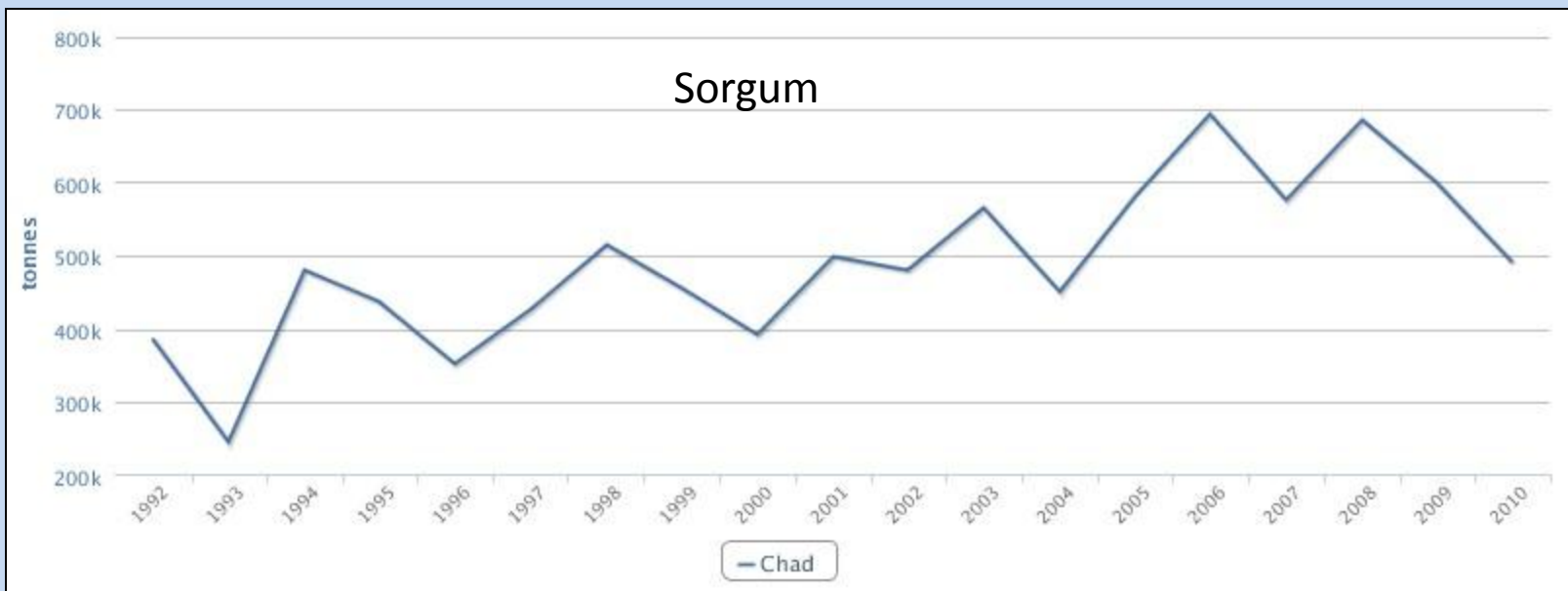
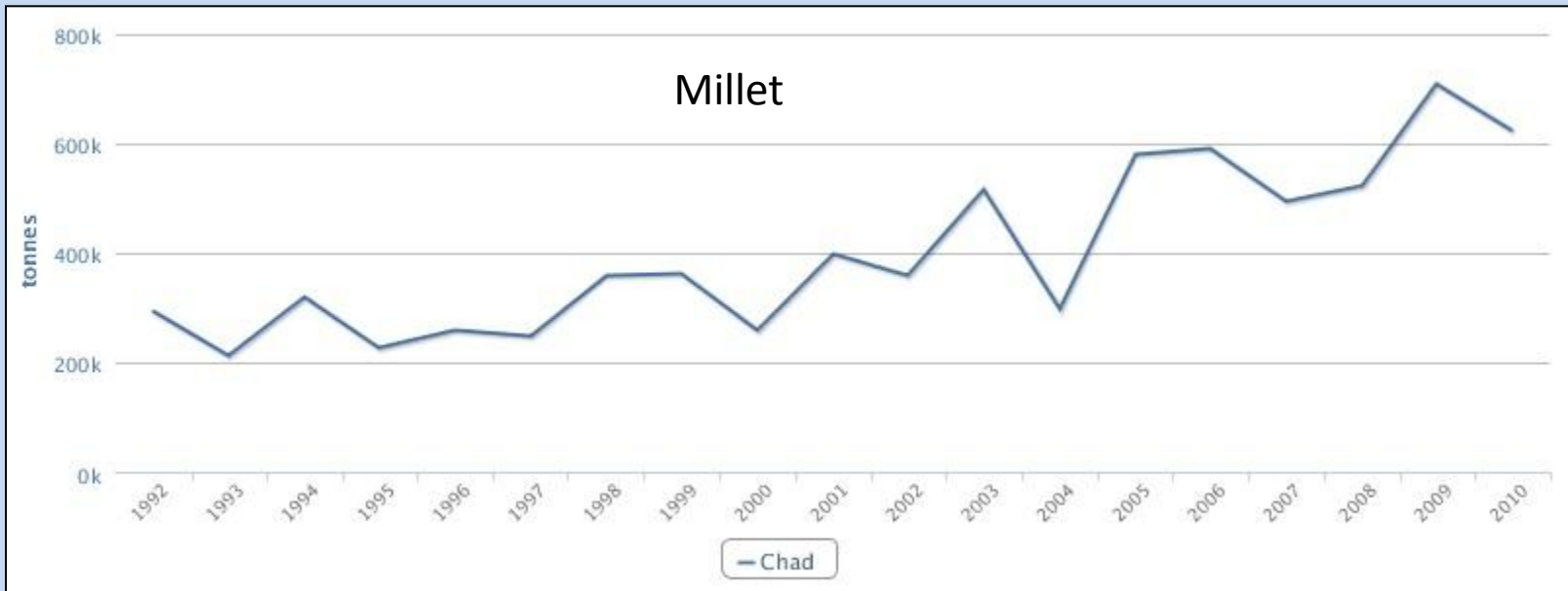
CHAD - AGRICULTURE PRODUCTION



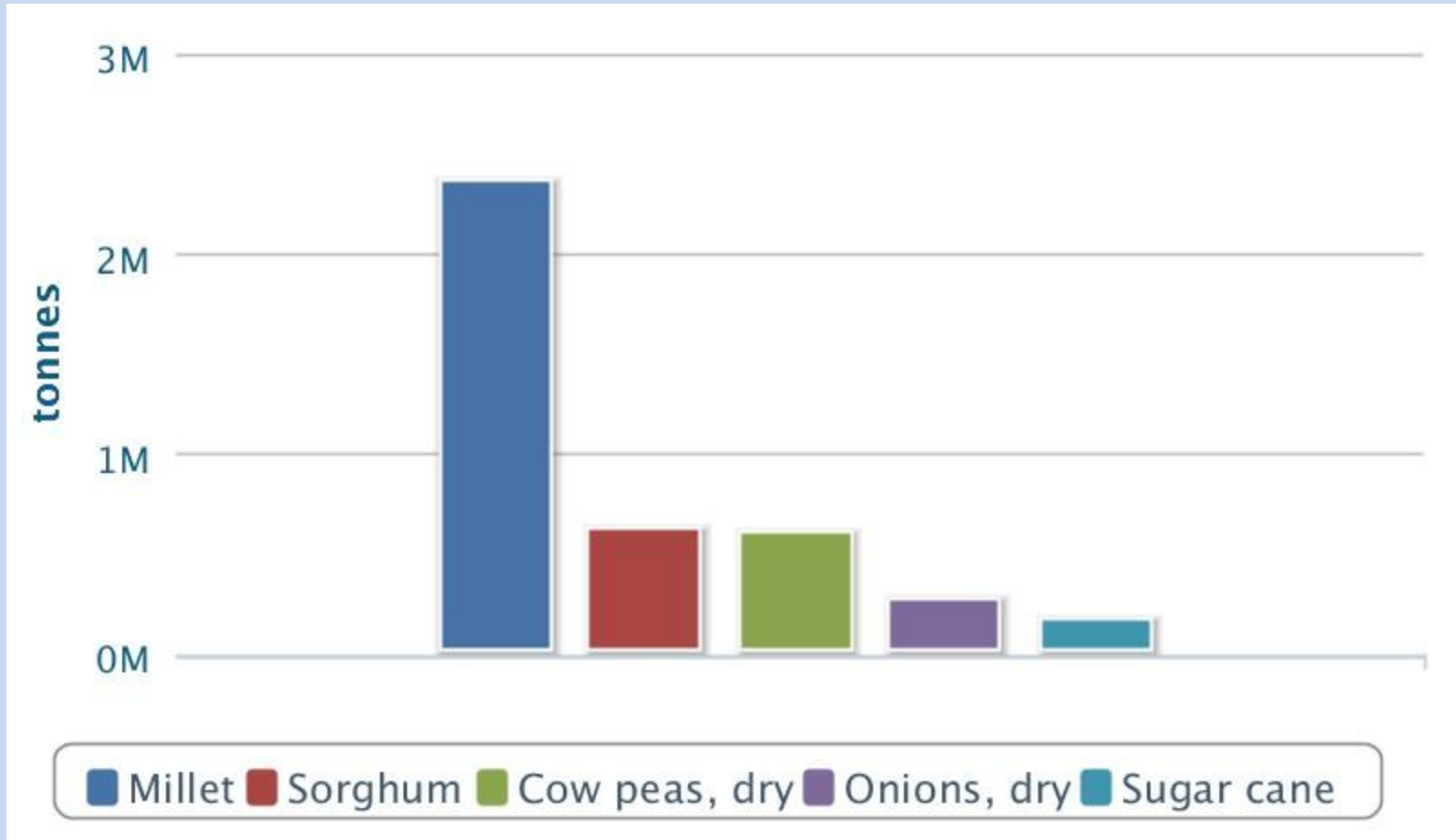
Annual precipitation anomaly

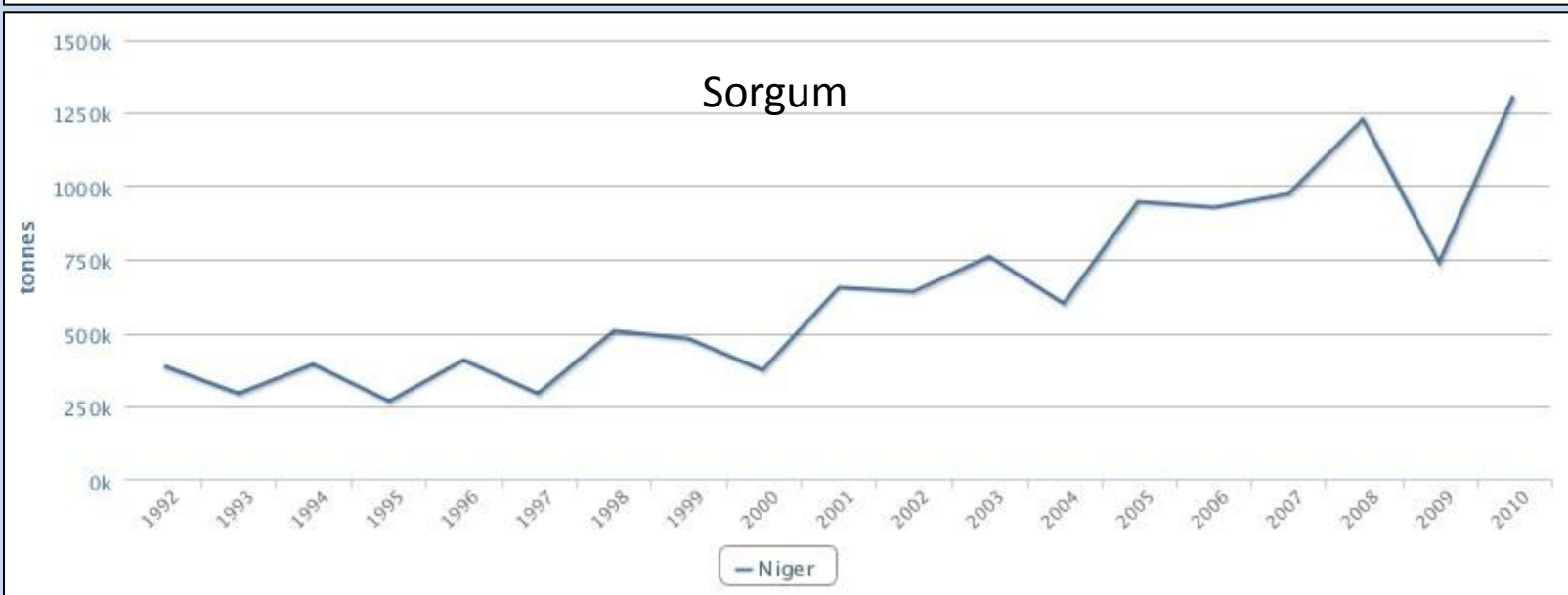
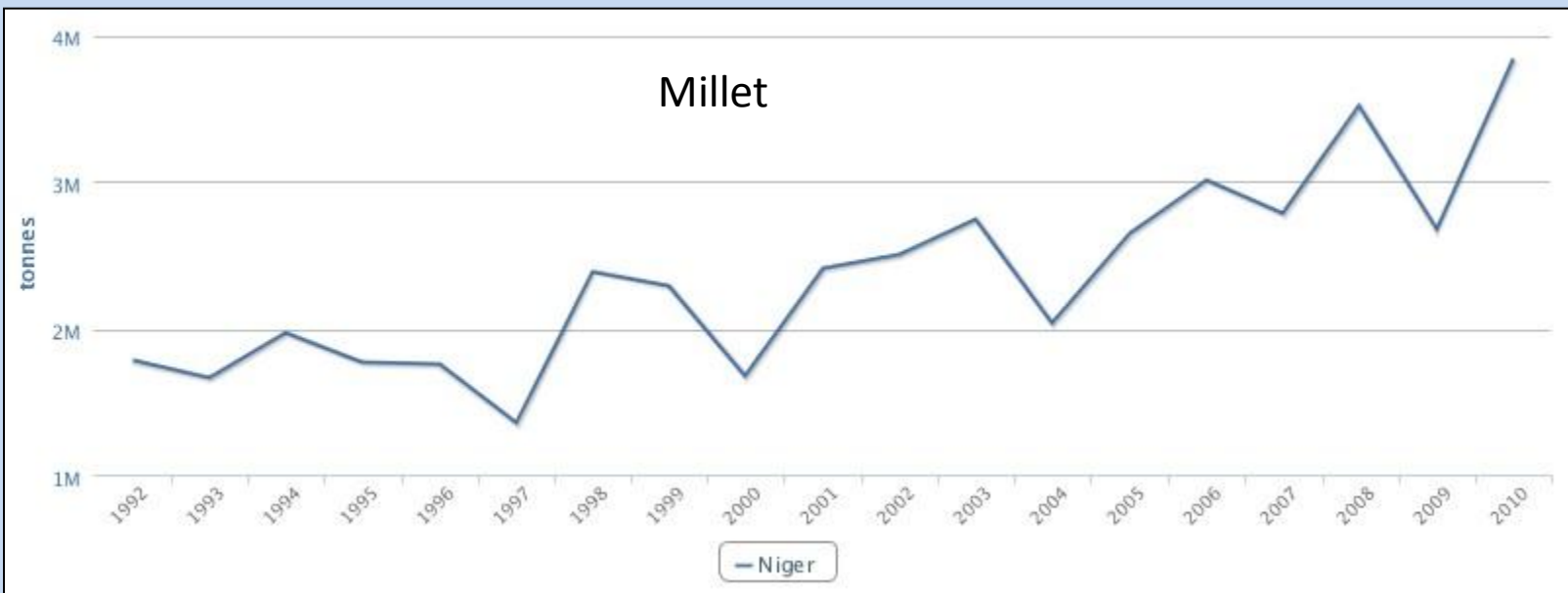
(in respect to 1970-2000 mean)

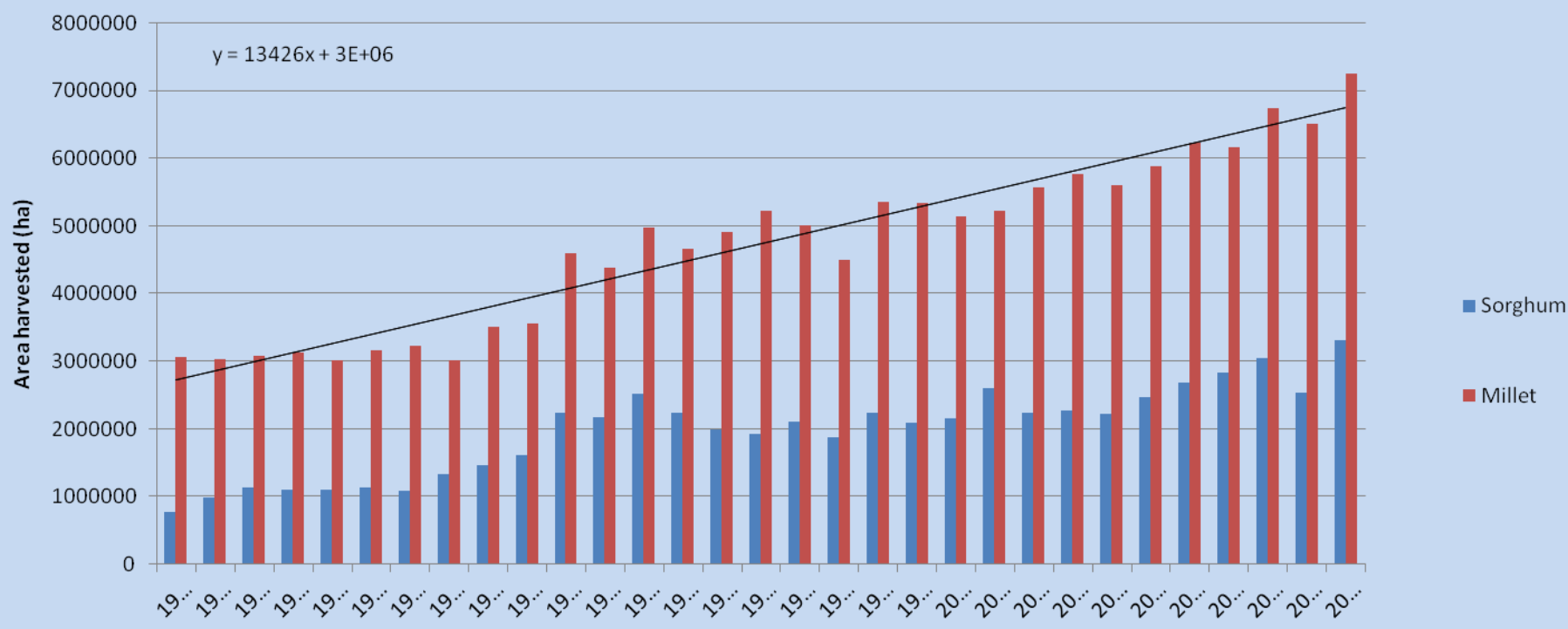
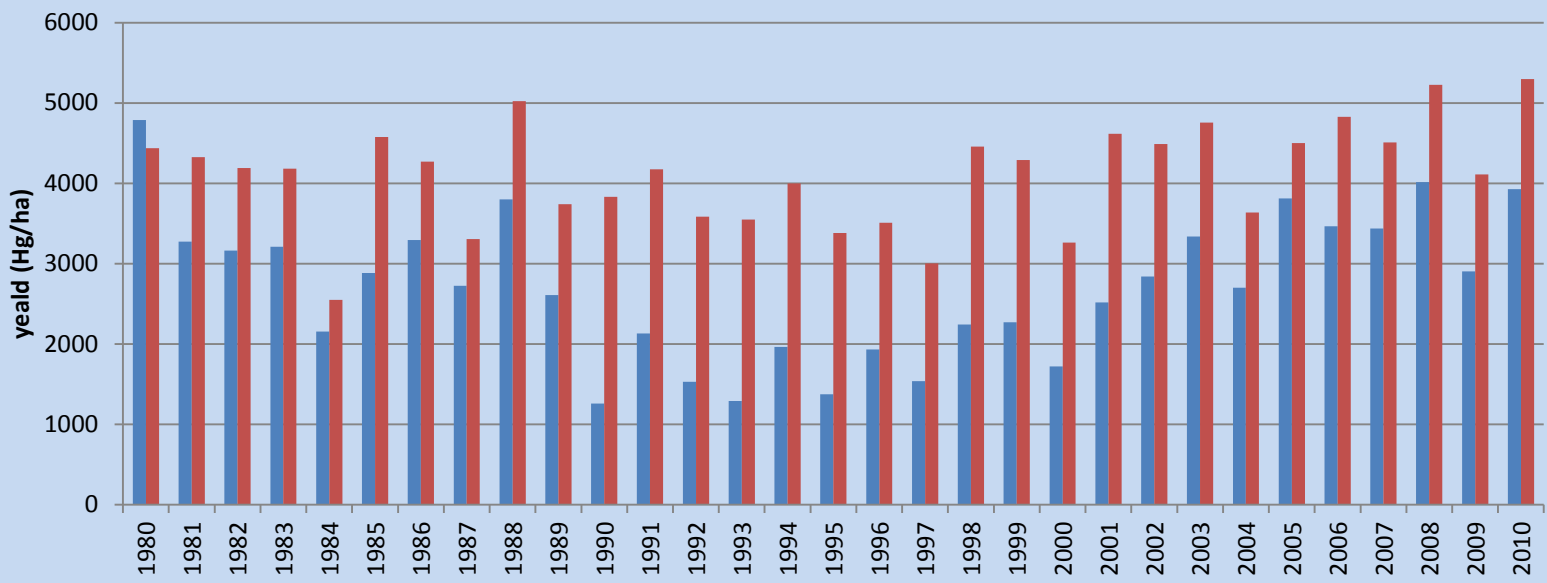




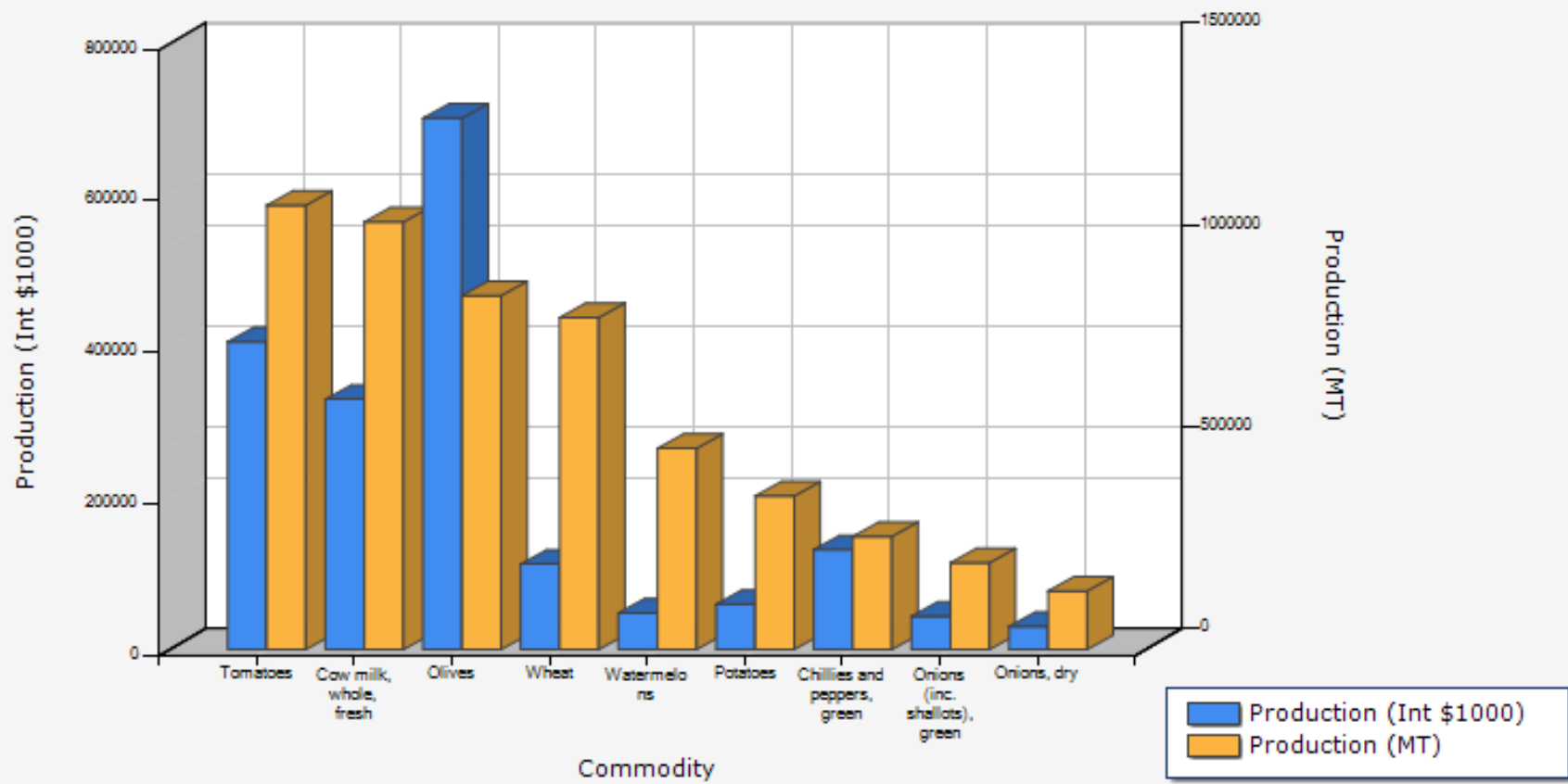
NIGER

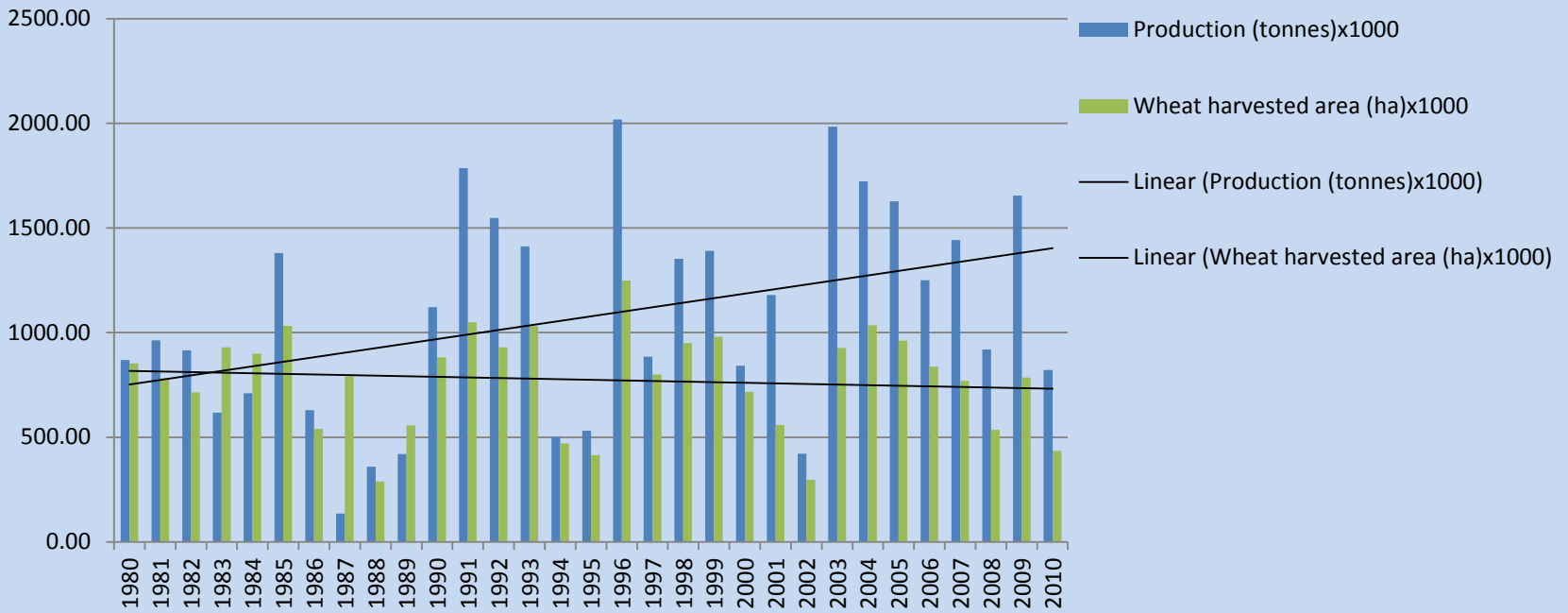




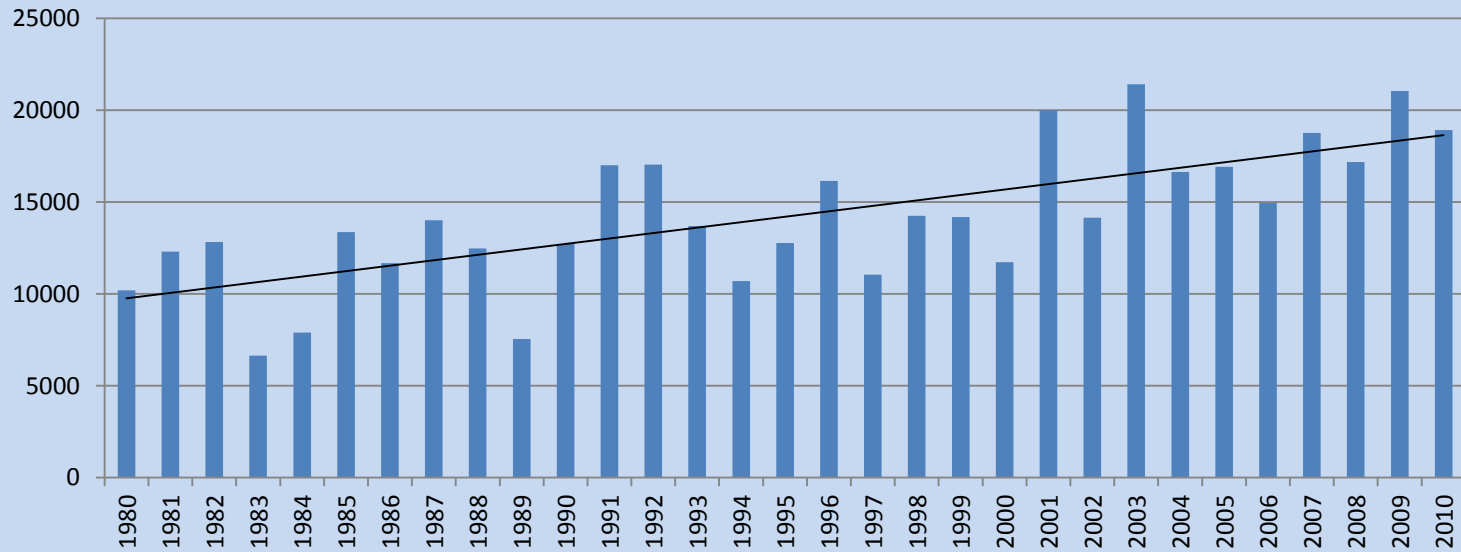


Top production - Tunisia - 2010



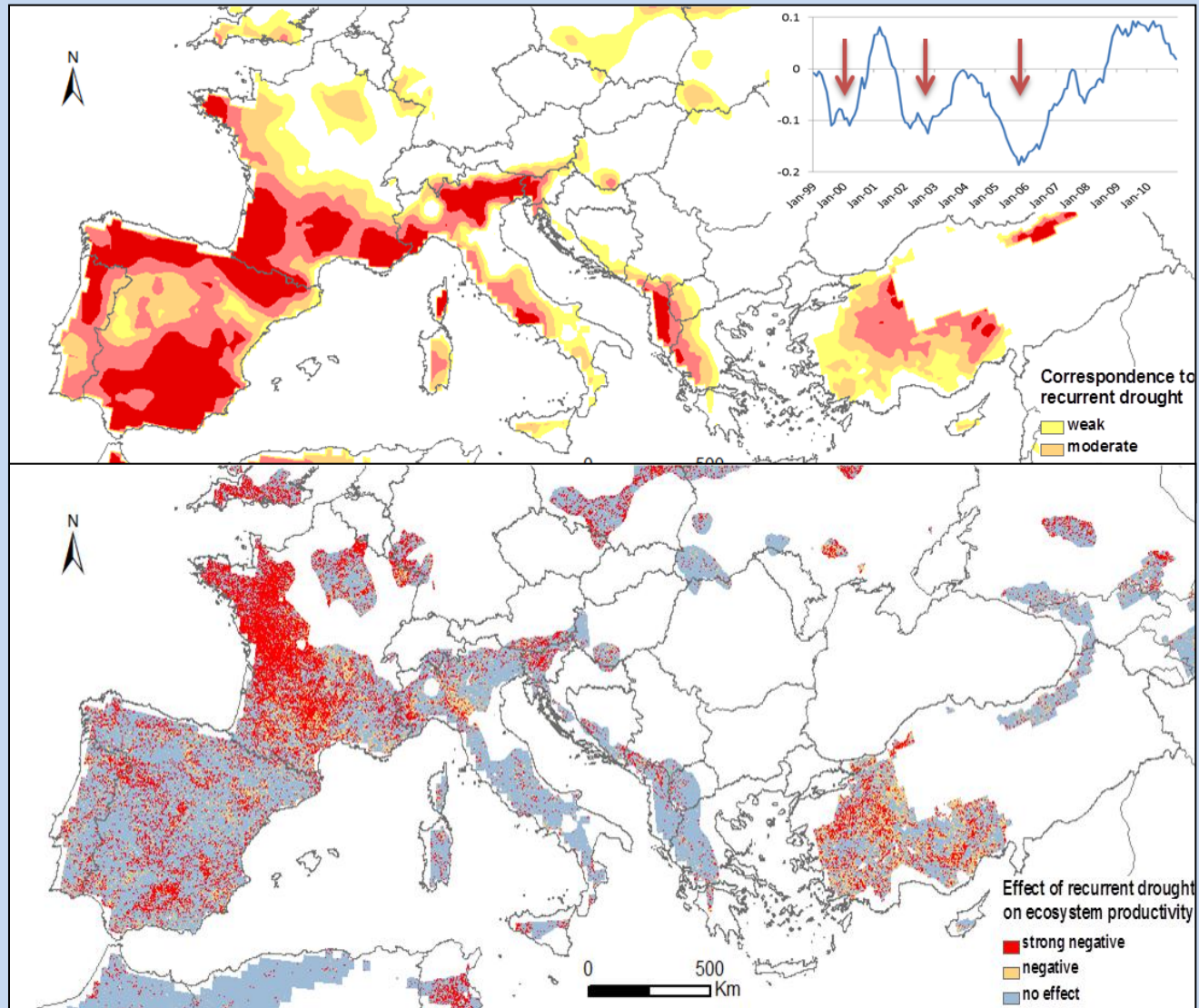


Wheat yeald (Hg/ha)



Drought and vegetation trend

1999-2010



Conclusions (I)

The main objective of combating desertification is the development of drylands but more efforts are needed to improve the understanding of bio-physical and socio-economic process and their interactions to identify reliable and meaningful indicators.

National reporting to UNCCD is an opportunity to improve the understanding of the evolution of desertification but it can hardly be accomplished with the available data and modelling tools.

Conclusions (II)

National institutions seem, for a lack of commitment and resources, unable to fulfill their obligation for the monitoring and reporting of desertification.

International institutions (FAO, JRC) are achieving new results based on the state of art of knowledge and technology.

The new born **Desert Net International** aims to support the desertification policy with improved scientific initiatives and understanding.

<http://www.european-desertnet.eu/>

Thank you