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# SDG 15: combat desertification, and halt and reverse land degradation

Alan Belward, Cannobio, 2015

# 220,000,000 t/yr

MSG 6<sup>th</sup> March 2004 (Source copyright EUMETSAT) Sahara dust figures (Prof Andrew Goudie, Oxford)



# The future we want



We recognize the economic and social significance of good land management, including soil,

We stress that desertification, land degradation and drought are challenges of a global dimension and continue to pose serious challenges to the sustainable development of all countries,

We recognize the need for urgent action to reverse land degradation. In view of this, we will strive to achieve a landdegradation neutral world in the context of sustainable development.





# UN Convention to Combat Desertification (UNCCD) definition of 'land'

"the terrestrial bio-productive system that comprises soil, vegetation, other biota, and the ecological and hydrological processes that operate within the system"





### **UNCCD** definition of land degradation in drylands\*

Reduction or loss of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as:

(i) soil erosion caused by wind and/or water
(ii) deterioration of the physical, chemical and biological or economic properties of soil
(iii) long-term loss of natural vegetation







# UNCCD 2010 revision (proposal)

(a) Desertification is best to be treated as an extreme case of land degradation, which is expressed in a persistent reduction or loss of biological and economic productivity of lands that are under uses by people whose livelihoods depend on this productivity, yet the reduction or loss of this productivity is driven by that use.

(b) Combating desertification means addressing all stages of land degradation that precede the level of productivity loss specific to desertification, the one that reclamation, rather than rehabilitation measures are required for restoring the persistently lost productivity of the land.

(c) Land degradation and desertification, as described in (a) and (b), require attention in all lands, with special concern directed to all drylands, namely those of climate yielding an aridity index  $\leq$  0.65, whether based on 1950-1980 prevailing climate, and/or on more recent climate data.









## Land Improvement









#### **Harmonized World Soil Database**

http://www.iiasa.ac.at/Research/LUC/External-World-soil-database/HTML/index.html

![](_page_9_Picture_4.jpeg)

![](_page_10_Picture_0.jpeg)

earch

## Soil water erosion

![](_page_10_Figure_2.jpeg)

- Average EU-28: 2.46 t ha<sup>-1</sup> yr<sup>-1</sup> (in the erosive prone areas: 91% of EU)
- Total Soil loss: 970 Mt annually
- Spatial resolution: 100m
- Reference year: 2010
- 24% of EU lands have rates >2 t/ha
- 11% of total area contributes to almost 70% of total Soil Loss

"Between 2000 and 2010, intervention measures through the CAP have reduced the rate of soil erosion by an average of 20% for arable lands"

Panagos, Borrelli, Robinson, 2015. NATURE. Panagos et al (2015) – Environmental Science & Policy

![](_page_11_Picture_0.jpeg)

![](_page_12_Picture_0.jpeg)

![](_page_13_Picture_0.jpeg)

![](_page_14_Picture_0.jpeg)

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![](_page_18_Picture_0.jpeg)

![](_page_19_Picture_0.jpeg)

![](_page_20_Picture_0.jpeg)

![](_page_21_Picture_0.jpeg)

![](_page_22_Picture_0.jpeg)

http://www.satimagingcorp.com/satellite-sensors/spot-5.html

![](_page_23_Picture_1.jpeg)

Each 'pixel' integrates the surface reflectance from a square of 2,500 ha

![](_page_23_Picture_3.jpeg)

http://scrippsco2.ucsd.edu/

#### Monthly Carbon Dioxide Concentration

parts per million

![](_page_24_Figure_3.jpeg)

![](_page_25_Picture_0.jpeg)

![](_page_25_Figure_1.jpeg)

MA = Moving Average curve that defines the SBD (Season Begin Day) and SED (Season End Day) points on the NDVI curve.

![](_page_25_Picture_3.jpeg)

![](_page_26_Picture_0.jpeg)

![](_page_26_Figure_1.jpeg)

#### **Productivity parameters:**

MI=a+b+c+d+e+f+g (Minimum-Minimum Integral) Approximation of the Gross Primary Productivity. MPI=a+b+c (Minimum Permanent Integral) Area characterising the perennial vegetation component and depending on the vegetation index used may also contain somponents of soil substrate. SER=d+f (Season Exceeding Residual Integral) The amount of sensescnet vegetation outside of the growing season. May be more indicative to before/after harvest of agricultural areas. CF=g (Cyclic fraction) Thix parameter may be directly related to purely seasonal growth. PF=d+e+f (Permanent Fraction) The amount of vegetation that does not have a characteristic seasonal cycle within the growing season.

#### **Phenological parameters:**

SBD = Season Begin Day.

SL = Season Length.

MXV = Maximum Value of the vegetation index.

MXD = Maximum Day.

SBV = Season Begin Value of the vegetation index.

![](_page_27_Picture_0.jpeg)

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> Date: 27 October 2014 Ref.: KMST/FMI-031 cc: mbt/mnd/lb/mc/vc

Dear Mr. Šucha,

#### Subject: Collaboration between the JRC and the UNCCD secretariat in the provision of data for monitoring land degradation

You may recall that Parties to the United Nations Convention to Combat Desertification (UNCCD) have recently adopted a new framework to monitor progress in the implementation of the Convention.

The monitoring framework is now based on a core set of progress indicators and the use of readily available global data sources. Such an approach, which will be applied for the first time during the 2016 reporting and review cycle, aims at effectively assess status and trends of land degradation worldwide, while limiting data collection efforts at national level and putting greater emphasis on data quality improvement and interpretation.

As part of the new monitoring framework, the secretariat has been mandated to identify suitable global datasets, to extract national estimates of each adopted progress indicator and to make these data available to country Parties. In order to successfully deliver this new task, we are looking forward to establishing solid partnerships with institutions that have the technical capacity and expertise to assist the secretariat in this regard.

In our views, the Joint Research Centre (JRC) of the European Commission would be the most natural and appropriate partner for providing scientific backstopping in the field of processing and handling global datasets. Beyond the relevant expertise, allow me to recall that the JRC has been already identified by the Conference of the Parties (COP) as the source of a robust, scientifically proven methodology for land productivity data and has already invested considerable efforts to produce a global dataset of land productivity dynamics in the framework of the World Atlas of Desertification initiative.

## United Nations Convention

While objectives and deliverables of this cooperation could be better defined in a joint work programme, I would like to propose that a first concrete step could be the provision of national estimates of land productivity dynamics to the countries participating in the Land Degradation Neutrality (LDN) Project recently launched by the secretariat. The project aims at testing the extent to which the current monitoring framework can support setting national LDN targets, which we expect to guide the implementation of the Convention after the adoption of the Sustainable Development Goals later in 2015.

I recognize that the relation of the European Commission to the UNCCD is led by DG Environment along with the science and technology support from JRC and reckon therefore that this collaboration will open the way to future cooperation between the UNCCD and JRC with particular regard to monitoring the implementation of the Convention and assessing its impact on the ground. From our side, we will be pleased to share with JRC a solid and long-lasting network of relationships with the 195 Parties of the Convention, which will continue providing key information on land degradation at national, subregional and regional levels.

I sincerely hope that your organization is ready to take up this exciting and important opportunity and look forward to your kind feedback.

![](_page_27_Picture_13.jpeg)

Mr. Vladimír Šucha Director-General Joint Research Centre European Commission

cc: Mr. Timo Makela DG Environment Director - DG ENV E - Global and Regional Challenges

> Ms. Maria Betti DG JRC Director - Institute for Environment and Sustainability Fax: +39 (0)332 78 9001

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![](_page_27_Picture_18.jpeg)

![](_page_27_Picture_19.jpeg)

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![](_page_28_Picture_0.jpeg)

## Increasing land-productivity

![](_page_28_Figure_2.jpeg)

esearch

![](_page_29_Picture_0.jpeg)

Joint Research Centre

arch

![](_page_30_Picture_0.jpeg)

![](_page_30_Picture_1.jpeg)

Joint Research Centre

![](_page_31_Picture_0.jpeg)

![](_page_32_Picture_0.jpeg)

50 km

Al Jouf Saudi Arabia 2000 Landsat imagery courtesy USGS/NASA <u>50 km</u>

Al Jouf Saudi Arabia 2003 Landsat imagery courtesy USGS/NASA <u>50 km</u>

Al Jouf Saudi Arabia 2015 Landsat imagery courtesy USGS/NASA <u>50 km</u>

![](_page_36_Figure_0.jpeg)

#### at least 2,500 fields

European Commission

![](_page_36_Picture_3.jpeg)

![](_page_36_Picture_4.jpeg)

At least 40,000 showers/field/day

![](_page_36_Picture_6.jpeg)

![](_page_36_Picture_7.jpeg)

Photo credits Al Jouf Gallery http://www.aljouf.com.sa

![](_page_37_Picture_0.jpeg)

## **Measuring Land degradation is a challenge**

## ① Declining land-productivity ≠ Land degradation

e.g. less intensive agriculture may decrease yields in the short-term, but improve environmental quality in the long-term

## ② Increasing land-productivity ≠ Land improvement

e.g. intensive agriculture may increase yields in the short-term, but reduce environmental quality in the long-term

### 3 Land degradation = Declining land-productivity degraded land will always perform worse than its unaffected counterpart

![](_page_37_Picture_7.jpeg)

![](_page_38_Picture_0.jpeg)

# **Discussion points**

- 1 Land and soil degradation are complex and we don't have agreed measurement protocols / indicators today
- 2 Land-productivity dynamics are a proxy for land degradation, not a measure of land degradation
- 3 Long-term satellite-based observations offer considerable potential as a source of information on land-productivity dynamics – but remember that satellites observe above-ground biomass
- 4 Complex social, economic and biophysical processes drive both positive and negative changes in land-productivity dynamics
- 5 Systematic validation is needed, including further analysis of the causes, statistics and economics behind the observed changes

![](_page_38_Picture_7.jpeg)

#### World Atlas of Desertification 3<sup>rd</sup> Edition

#### **Converging evidence** A growing global population has led to an increase in the practices) and consequences (e.g., soil erosion, changes in productivity, loss of biodiversity) [32,33]; hence, land demand for food, fibre and fuel. This has a significant impact on limited land resources, which often leads degradation is not a phenomenon that can be modelled to land degradation. However, at any given place on at a global scale. To acknowledge and accommodate Earth, complex human-environment interactions are at these complex local interactions and dynamics, the new play, which include differing rates and magnitudes of World Atlas of Desertification relies on a "convergence of drivers (e.g., overgrazing, climate change, agricultural evidence" in global datasets. Decreasing Increasing UNSUSTAINABLE WATER USE FOR AGRICULTURE EXPANSION AND Land productivity is an essential concept for monitoring YIELD GAPS AND RESOURCE EXHAUSTION DUE TO NUTRIENT land degradation. Various approaches to map land HIGH POPULATION PRESSURE IN LOW RESILIENCE AREAS. productivity provide consistent and repeatable views regarding what areas of concern or improvement to highlight. The map shown here is based on 15 years of satellite observations at ten-day intervals [34,35]. While not an absolute measure of land productivity, it depicts long-term seasonal dynamics and departures that may relate to productivity change. The "convergence of evidence" in regional productivity trends illustrated here as well as in other global data sets - provides insights for further examination of more local data to understand the underlying causes and consequences of observed trends [36].

Source Joint Research Centre (JRC) and UNEP 2016

![](_page_40_Picture_0.jpeg)

#### "World Atlas of Desertification - WAD mapping land degradation and sustainable management solutions"

- 62% of total crop production is for direct human consumption, 35% for animal feed
- In 24% of the global cropland area, 60% of applied nitrogen is in excess
- More than 75% of the land is used by humans while more people live in cities since 2007
- 28% of 1692 cities (>300K habitants) are under very high water stress

WAD documents global trends and where stress situations coincide leading to land degradation

![](_page_40_Picture_7.jpeg)

![](_page_40_Picture_8.jpeg)