



International Union of Soil Sciences

# Land degradation and the importance of soil care and conservation

Consiglio Nazionale delle Ricerche  
Istituto per la BioEconomia

**Edoardo A.C. Costantini**

*International Union of Soil Sciences, President-elect  
CNR-IBE, Institute of Bioeconomy,  
Sesto Fiorentino, (FI), Italy [eac.costantini@gmail.com](mailto:eac.costantini@gmail.com)*

Photo: E. Costantini



# Land degradation and soil conservation in the International Union of Soil Sciences

[www.iuss.org](http://www.iuss.org)

Division 3 – Soil Use and Management

COMMISSION 3.2 – Soil and water conservation

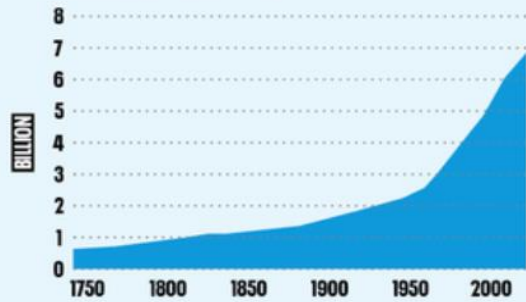
Chair: Lillian Øygarden / Norway

COMMISSION 3.5 – Soil degradation control, remediation and reclamation.

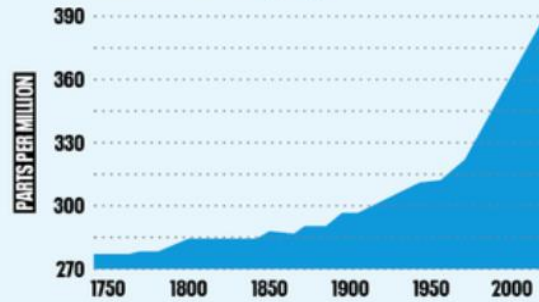
Chair: Stefan Norra / German

# HUMAN FOOTPRINT

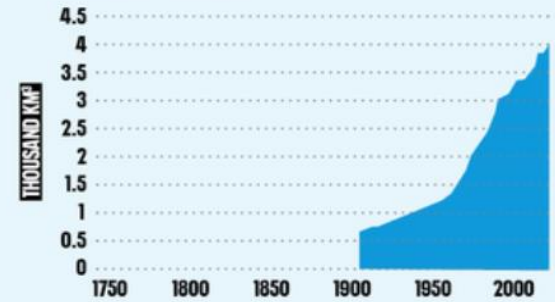
## WORLD POPULATION



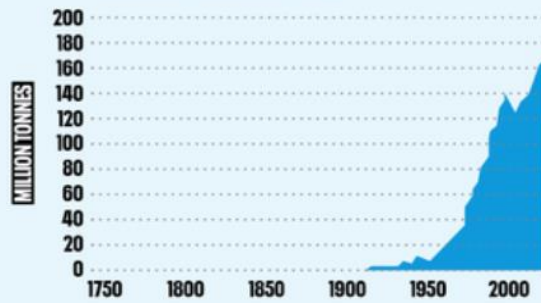
## CARBON DIOXIDE (CO<sub>2</sub>)



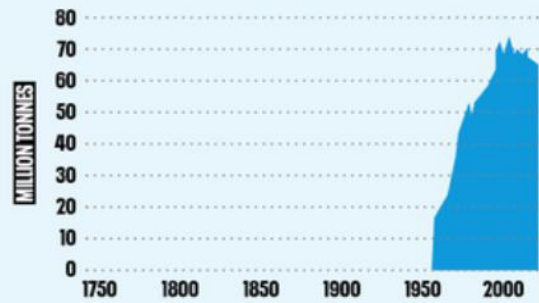
## FRESHWATER USE



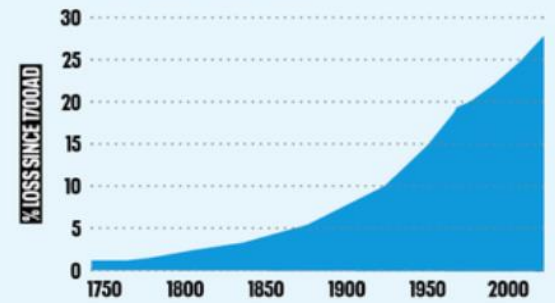
## FERTILIZER CONSUMPTION



## MARINE FISH CAPTURE

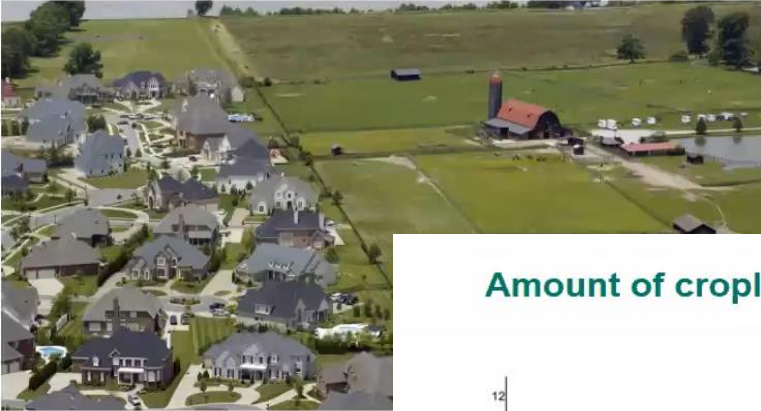


## TROPICAL FOREST LOSS



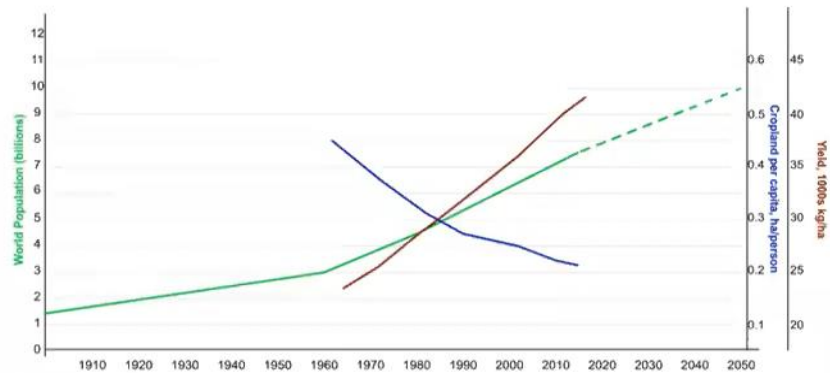


## Farmland is being consumed by urban development



# Increasing pressure on soil resources

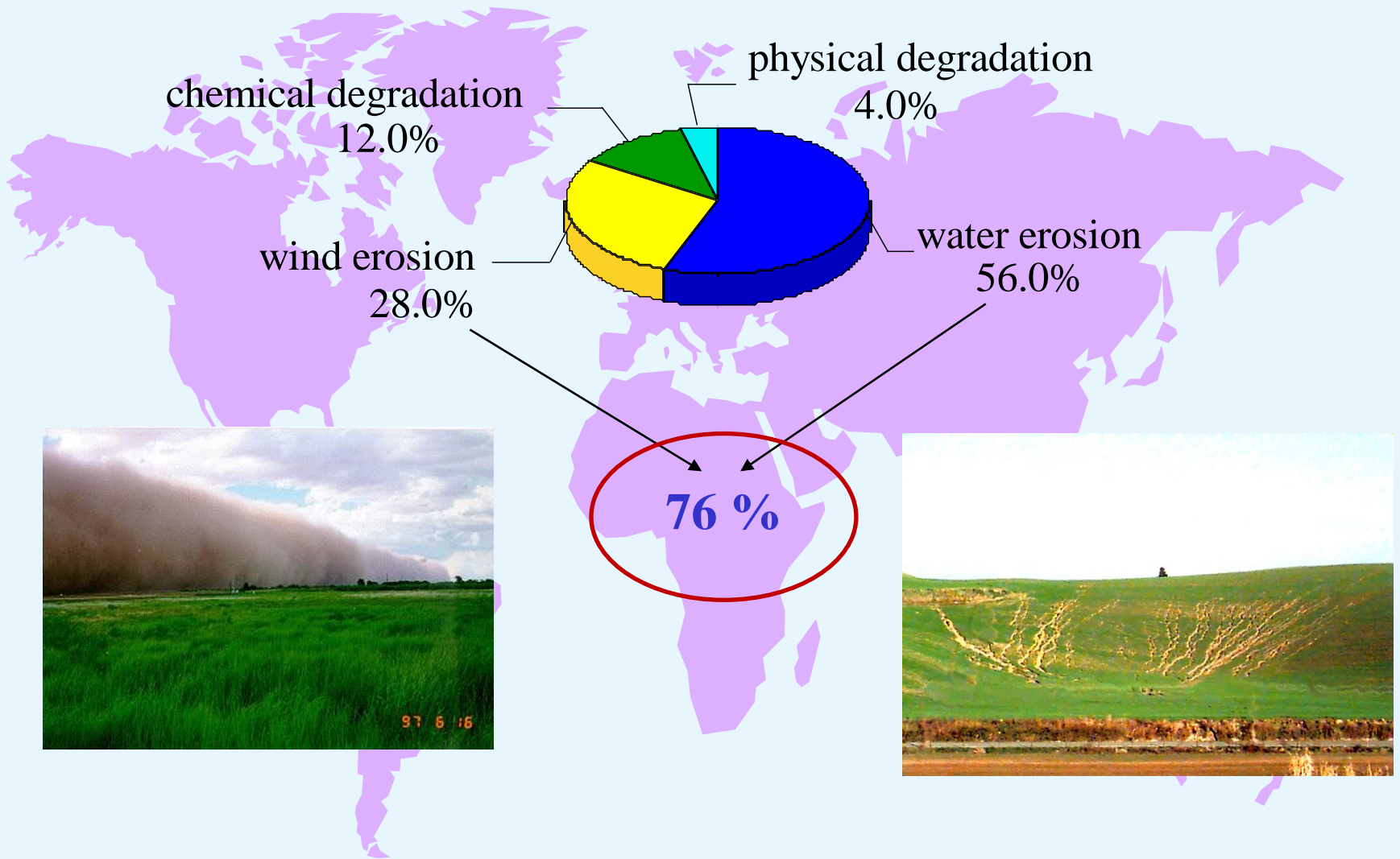
## Amount of cropland per capita has declined



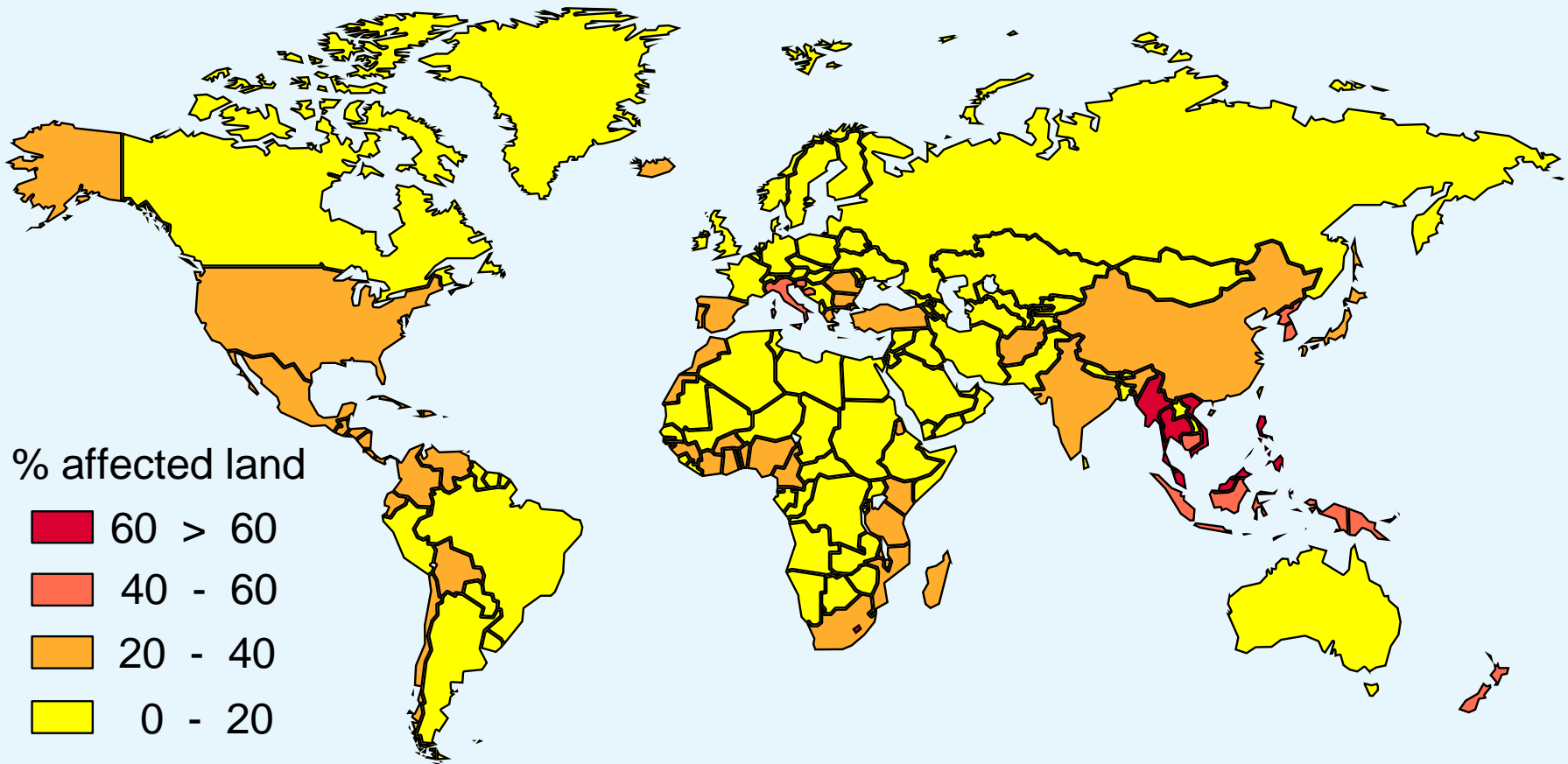
Amount of cropland, in hectares per person, plotted against yield in 1,000s of kilograms and world population (projected population dashed line.) Data from FAO 2019; FAO 2020.



# Soil degradation in the world (FAO)

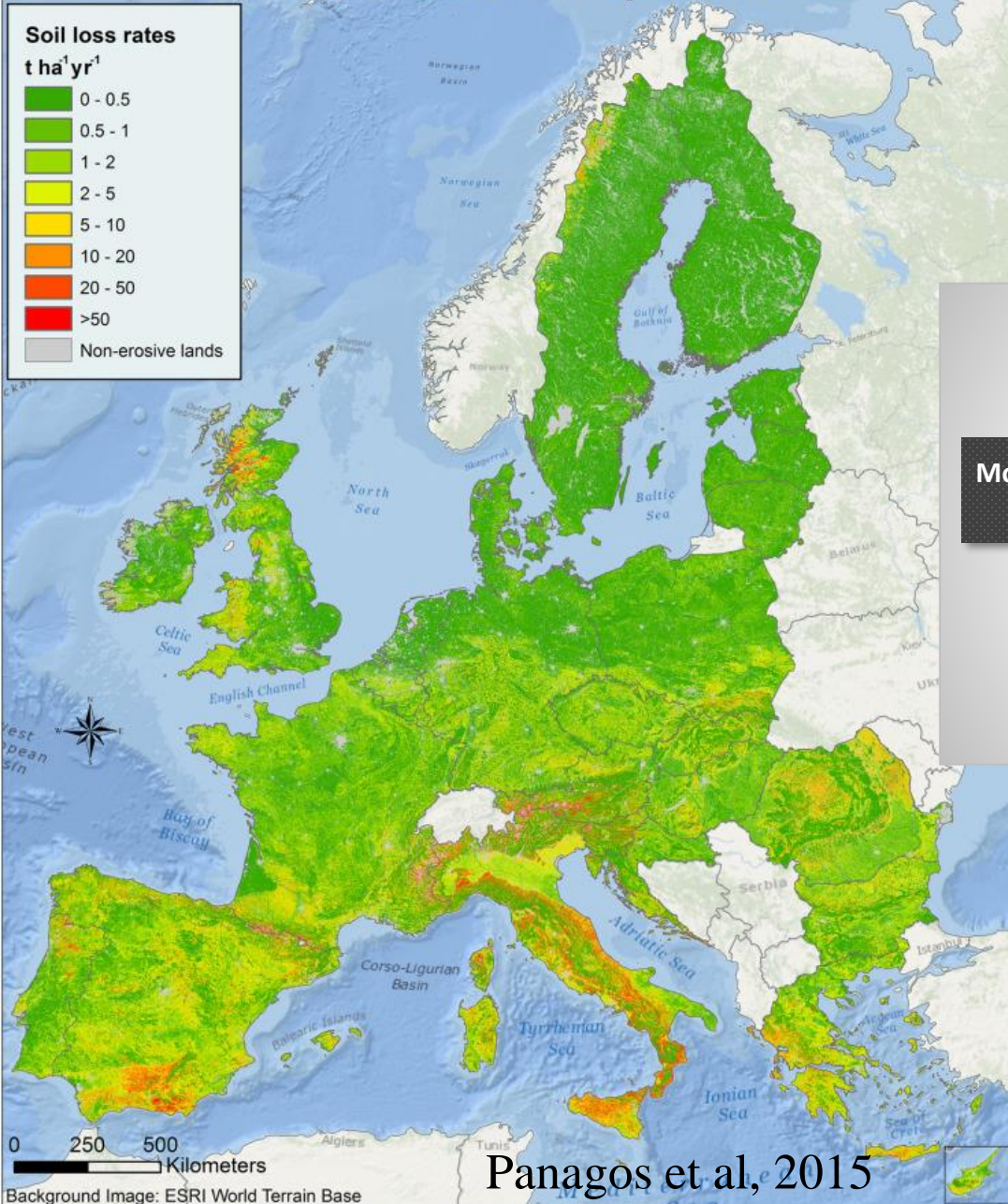


# Water soil erosion risk in the world (FAO)

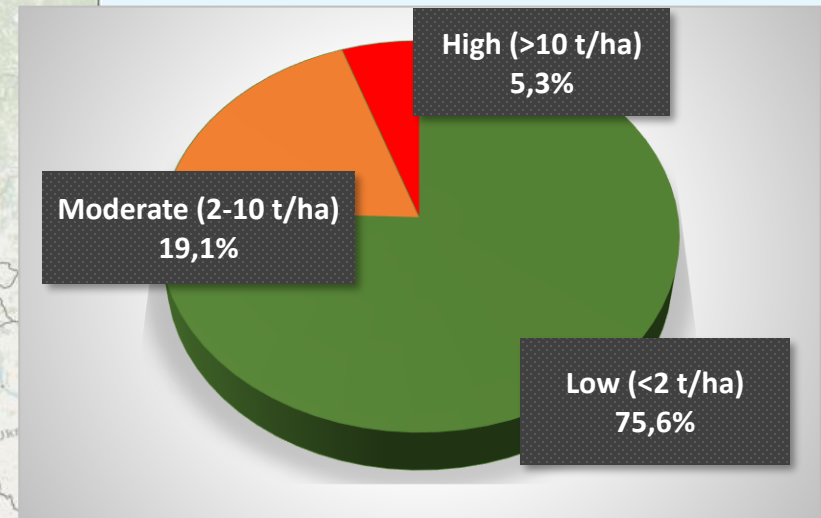




# Soil loss in the European Union



## Water soil erosion in Europe



# Effects of soil erosion on ecosystem services



**Loss of yield and food quality**

**Loss of soil heritage**

**Loss of SOM and biodiversity**

**Decay of landscape beauty**

**GHG emissions**

**Loss of bearing capacity**

**Loss of stored water**

**Loss of groundwater recharge**

**Contamination and salinization**

**Landslides and floods**



# Typologies of soil erosion process

**Natural or geologic erosion**

**Anthropogenic erosion**

**Natural erosion processes not affected by human activities**  
(natural and semi-natural habitats)

**When human activities influence natural erosion processes**  
(accelerated soil erosion)

**When human activities create non-natural erosion processes**



Photos: S. Pellegrini

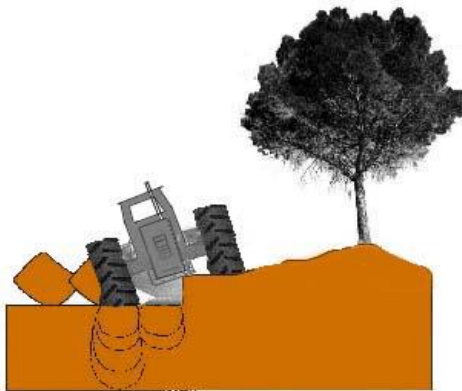
# Different forms of non-natural soil erosion induced by intensive mechanization

**TILLAGE  
TRANSLOCATION**  
(erosion-accumulation)

**PLOUGHED ORIENTED  
EROSION**

**SOIL FLUXES ON  
COMPACTED SUBSOIL  
LAYERS**

**MECHANICAL  
MASS MOVEMENTS  
(BULLDOZER  
EROSION)**



Photos: P. Bazzoffi



# Mechanical mass movements (bulldozer erosion)

## land levelling and scraping

Before new plantations

To remove natural vegetation or old plantations (about every 25 years or less)



Extension: at least 500,000 ha, only for vineyards (Italy) (Bazzoffi et al., 2006)

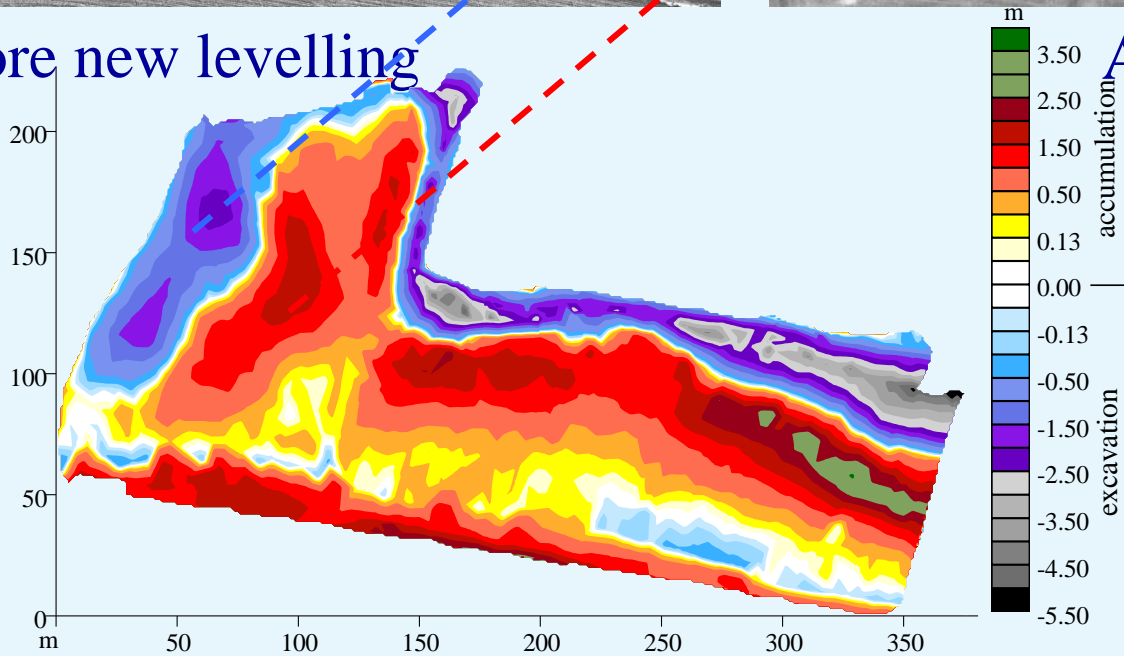
Photo: E. Costantini



# Land levelling impact



Before new levelling

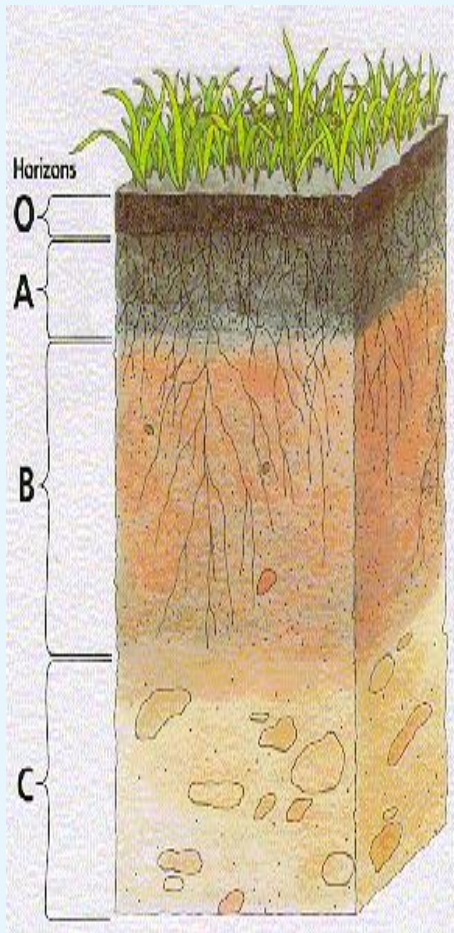


After new levelling

From: Bazzoffi et al., 2006

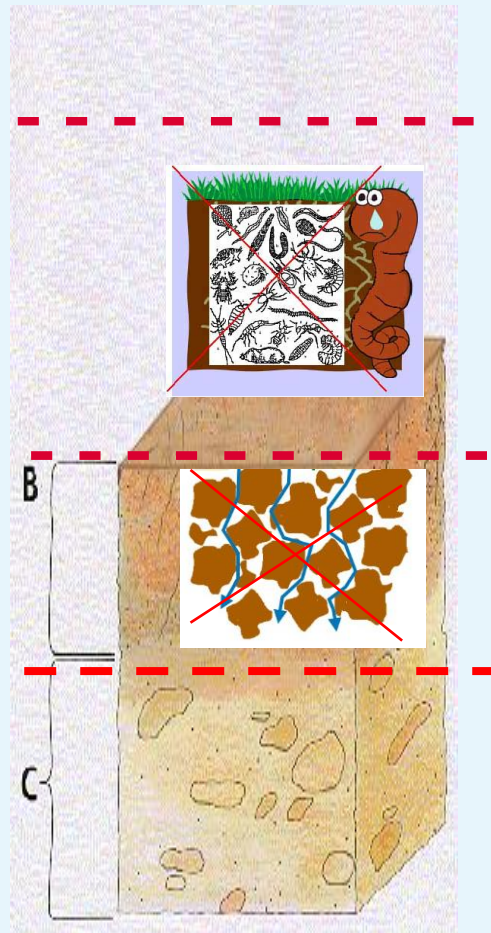
# The impacts of land levelling on soil profile

Original soil profile



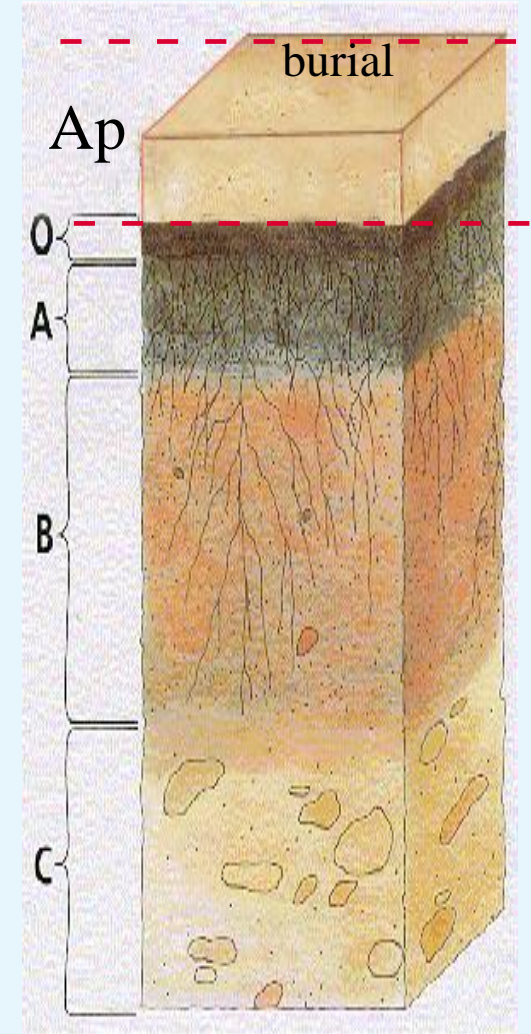
Scalped areas

Profile  
truncation



Accumulation areas

Profile





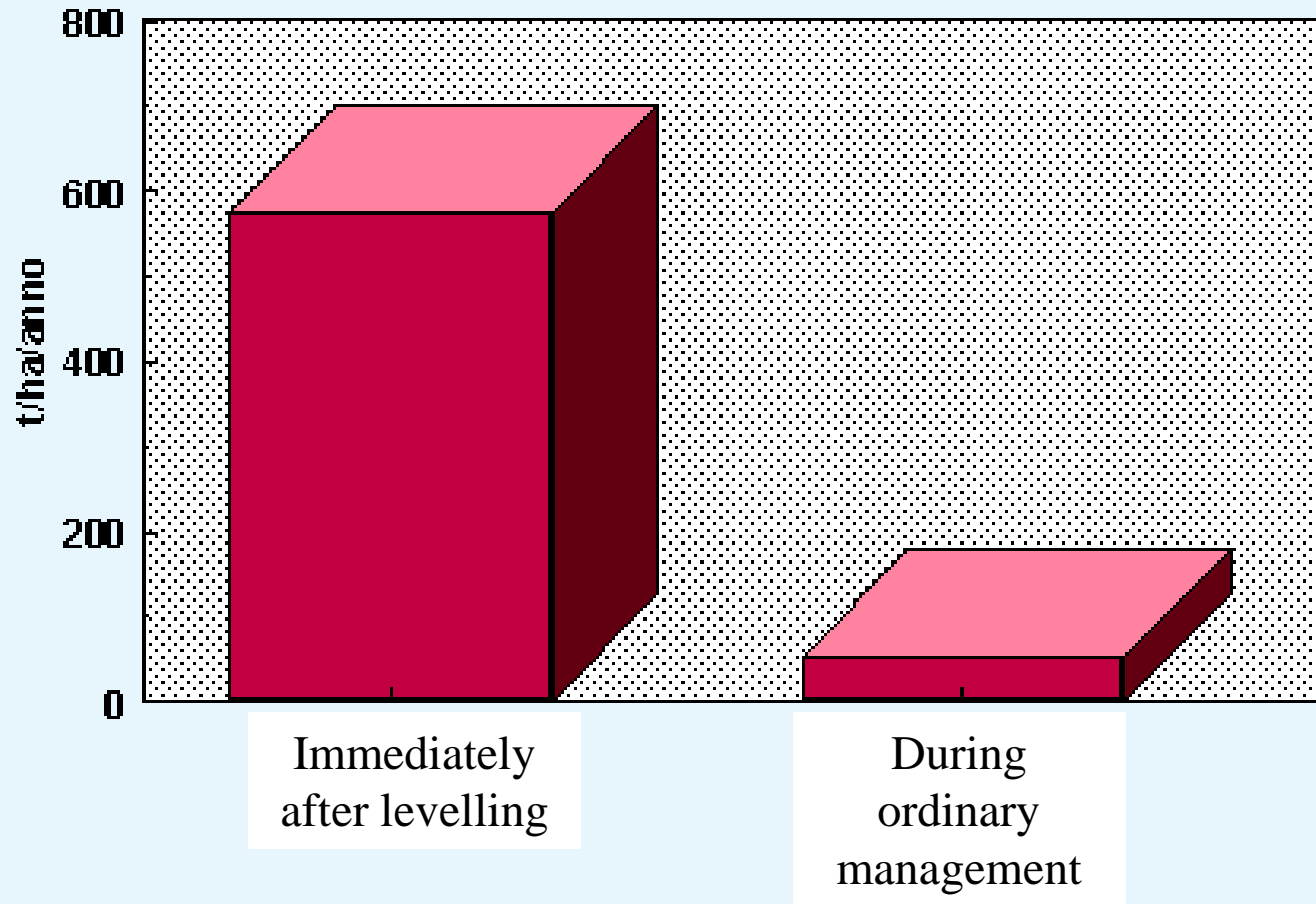
## Long and uniform slopes but...



- C horizon exposed.
- no surface hydrological set-up



## MEASURED SOIL EROSION (Bazzoffi et al., 2006)



# There are many soil care solutions

WOCAT-conservation  
practices

Regenerative  
agriculture

Conservation  
agriculture

Sustainable  
intensification

Organic farming

Agroecology

Agroforestry



Selective silviculture

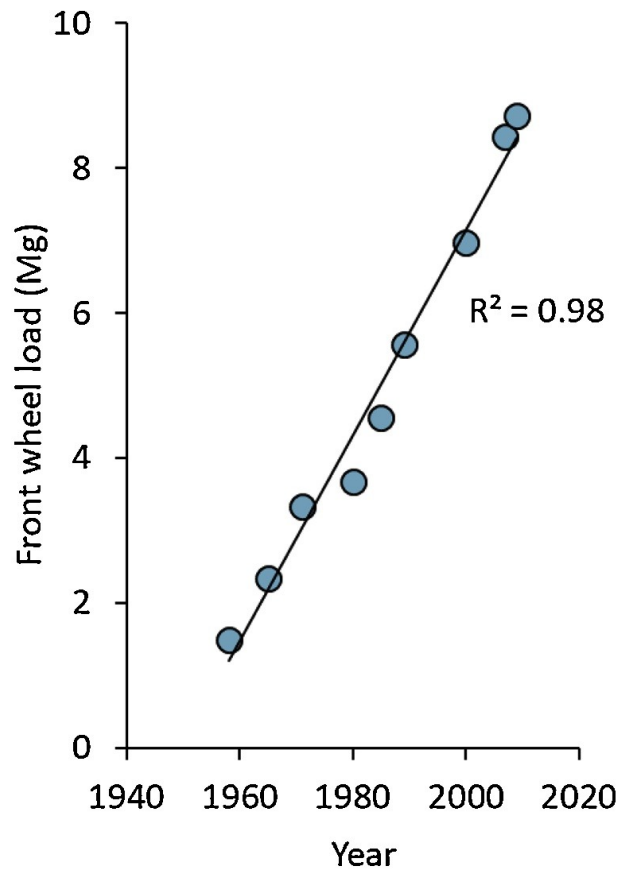
Integrated soil  
fertility management

Crop diversification

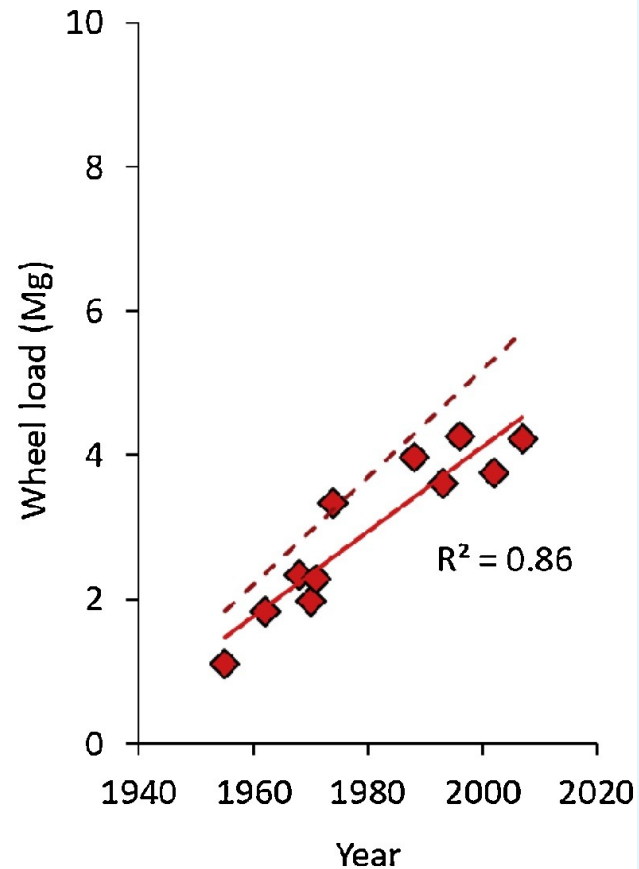
# ...but...historical increase in agricultural machinery weights

Keller et al.,

(a) 2019



(b)



a) front wheel loads of combine harvesters, b) rear wheel loads of tractors (USA). The dashed line in b) represents the 25% increase in load of the rear furrow wheel during conventional ploughing.



**Most important soil conservation measures on slopes:**  
**i) creating an efficient hydrological set-up, ii) reducing the weight of machinery, iii) reducing tillage disturbance, iv) maximizing soil armor**



**NO!**





**Soil care and conservation make landscape beautiful!**

**Any question?**

