SOIL AND FOOD SECURITY UNDER GLOBAL CHANGE

by

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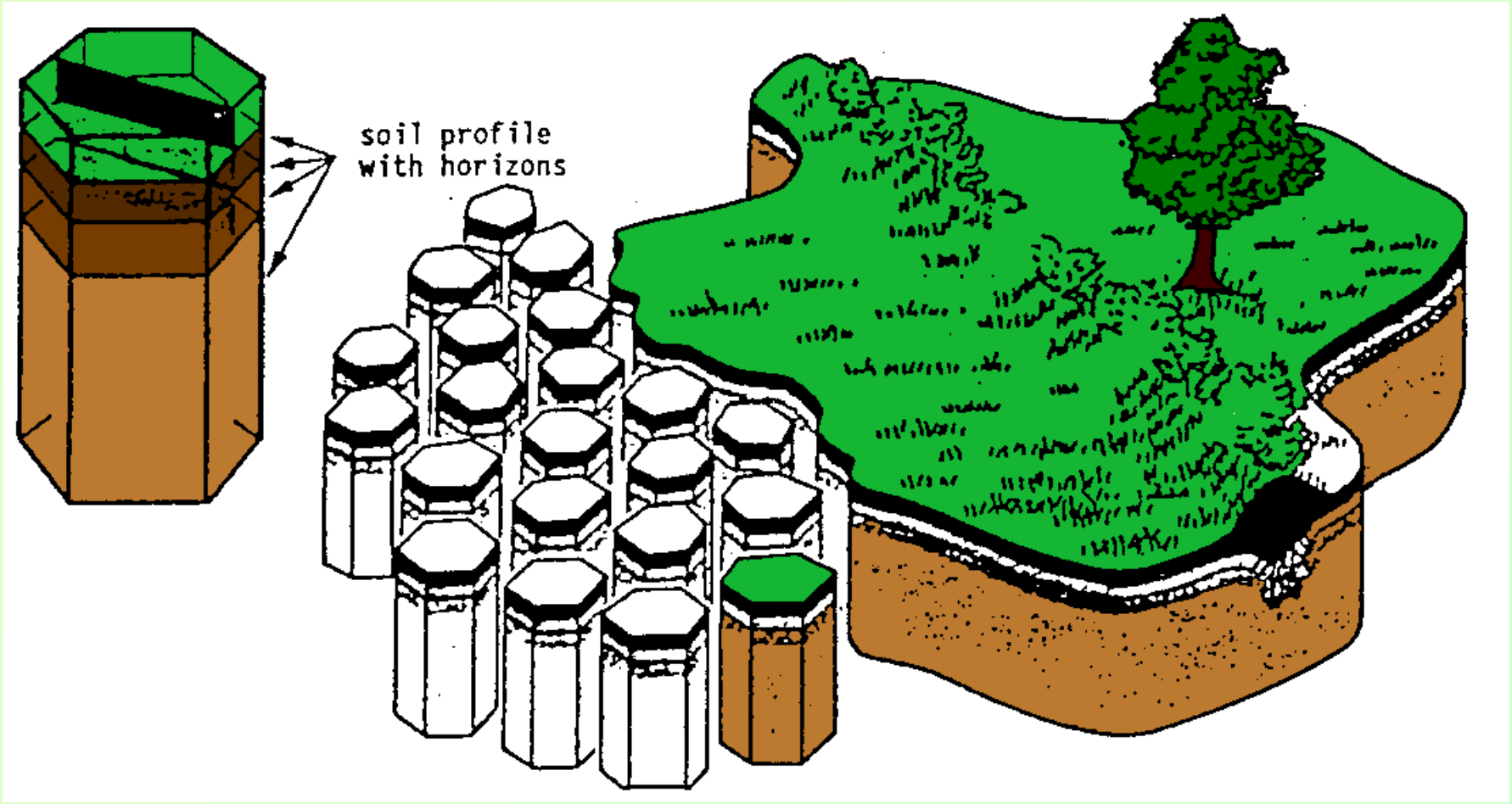
THE DIMENSIONS OF FOOD SECURITY

FOCUS AREA	TOPICS	SUBJECTS	SOCIAL AND POLITICAL DIMENSIONS
Availability/ Sustainability (production)	▪ Environmental opportunities/constraints ▪ Cultural, social and economic opportunities/ constraints ▪ Technological opportunities/constraints	Natural resources climate, land, soil, water Human resources religion, cultural assets Capital resources Farming systems Food policy systems Soil Water Plant/animal Food processing and conservation Agrochemicals	Food production Food technology
Accessibility	▪ Physical accessibility ▪ Cultural, social and economic accessibility ▪ Physiological accessibility	Storage Transport Conservation Market Quality/safety Religion, cultural assets Food habits Pricing system Policies Income generation Nutrition Health	Food markets and economy Food safety


soil profile
with horizons

WORLD SOIL SUITABILITY FOR SUSTAINING LIFE

~ 12 % of the land surface suitable for crop production;

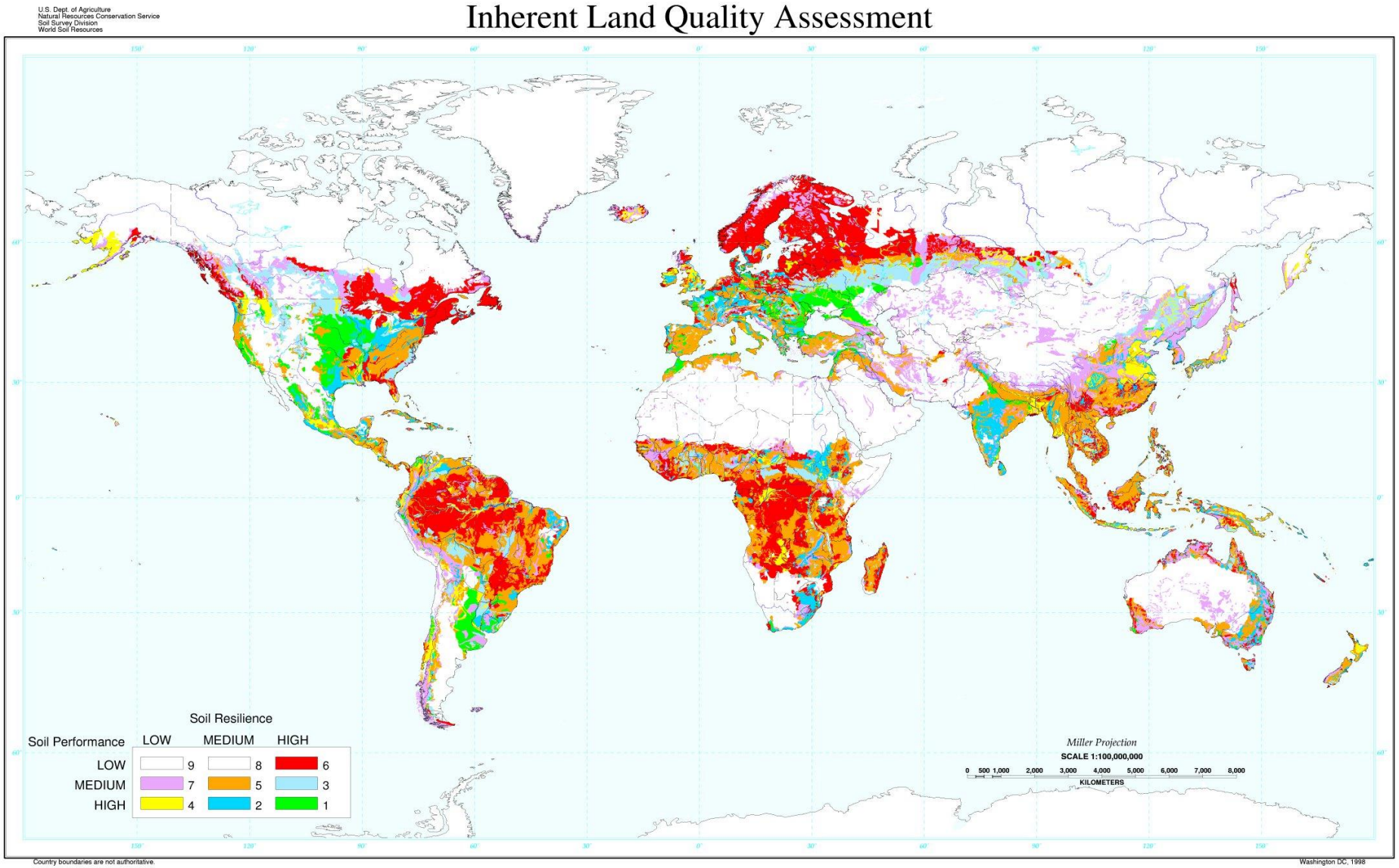
~ 24 % can be used for grazing

~ 31 % produce forests

~ 33 % unsuitable for any kind of sustainable use

(Buringh, 1998; FAO 1995)

Global map of land quality



Blum and Eswaran, 2004

GLOBAL LAND QUALITY WITH REGARD TO LAND SURFACE AND POPULATION DISTRIBUTION

Land Quality Class	Total Land Surface	World Population:
I	2,4 %	6,1 %
II, III	9,5 %	19,0 %
IV, V, VI	33,8 %	53,6 %
VII	9,0 %	11,5 %
VIII, IX	45,3 %	13,1 %

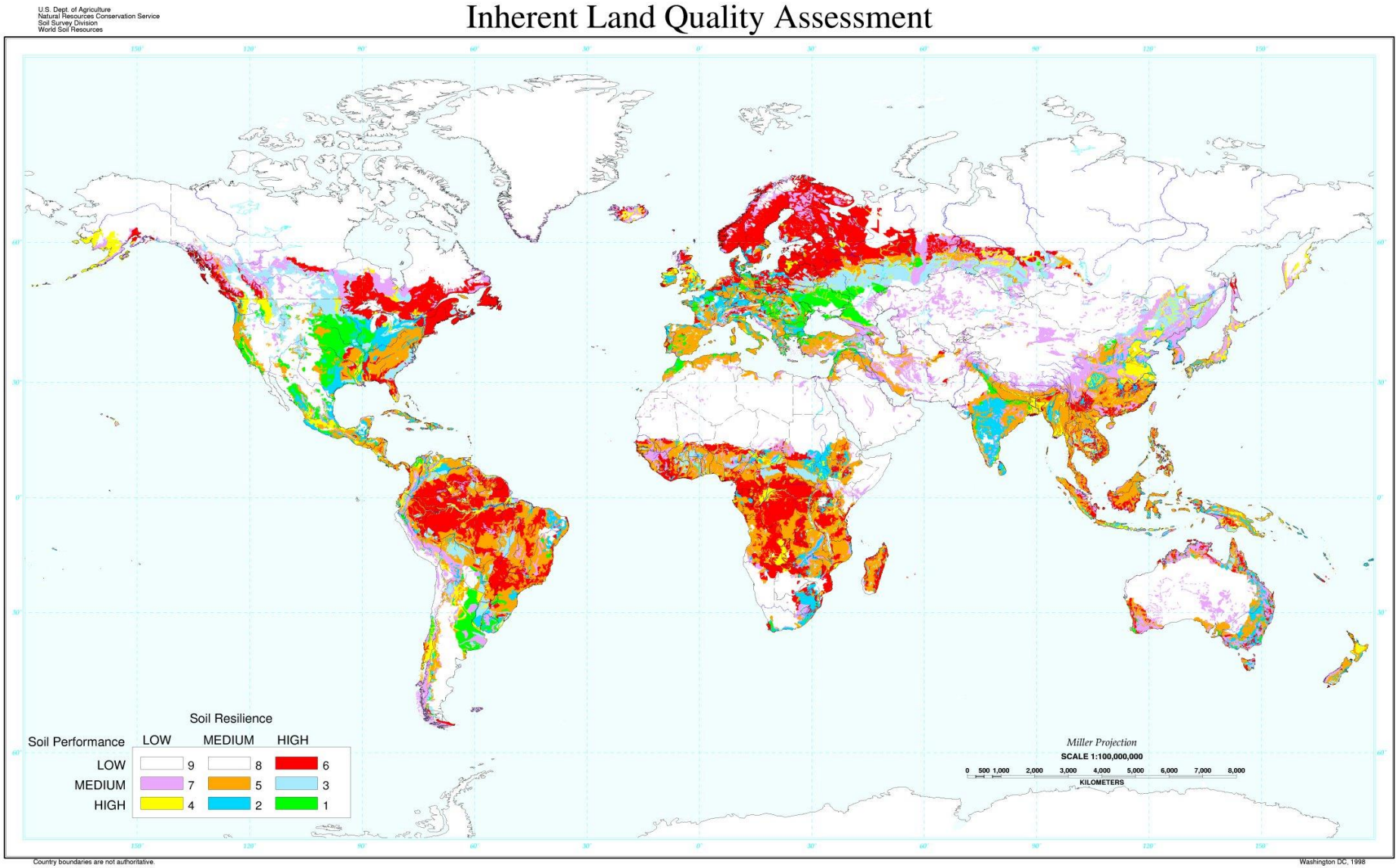
Blum and Eswaran, 2004

Percent of land area in major biomes as a function of land quality

BIOMES	LAND QUALITY CLASS (Percent of ice-free land surface)									
	I	II	III	IV	V	VI	VII	VIII	IX	Total
Tundra								15.62		15.62
Boreal			2.03	0.67	0.50	3.05	2.63	1.08	0.07	10.02
Temperate	2.14	2.55	0.70	1.31	4.76	1.66	2.01		0.15	15.29
Mediterranean			0.30	0.15	1.35	0.08	0.65		0.03	2.56
Desert							1.42		28.19	29.61
Tropical	0.25	2.43	1.51	1.83	9.90	8.53	2.31		0.16	26.90
Total	2.38	4.98	4.55	3.95	16.51	13.32	9.01	16.69	28.59	100.00

Blum and Eswaran, 2004

Global map of land quality



Blum and Eswaran, 2004

WHAT IS GLOBAL CHANGE?

SIX MAIN FORMS OF GLOBAL CHANGE THREATENING SOIL USE AND FOOD SECURITY:

1. increase in world population and change in spatial distribution;
2. loss of fertile soils through urbanisation, industrialisation and further human impacts;
3. changes in life style and demands for food;
4. increasing demands for bioenergy;
5. changes in world economy;
6. climate change.

1 Increase of world population and changes in its spatial distribution

- every year ~ 80-85 millions more = need for
  - more space;
  - more food;
  - more energy.

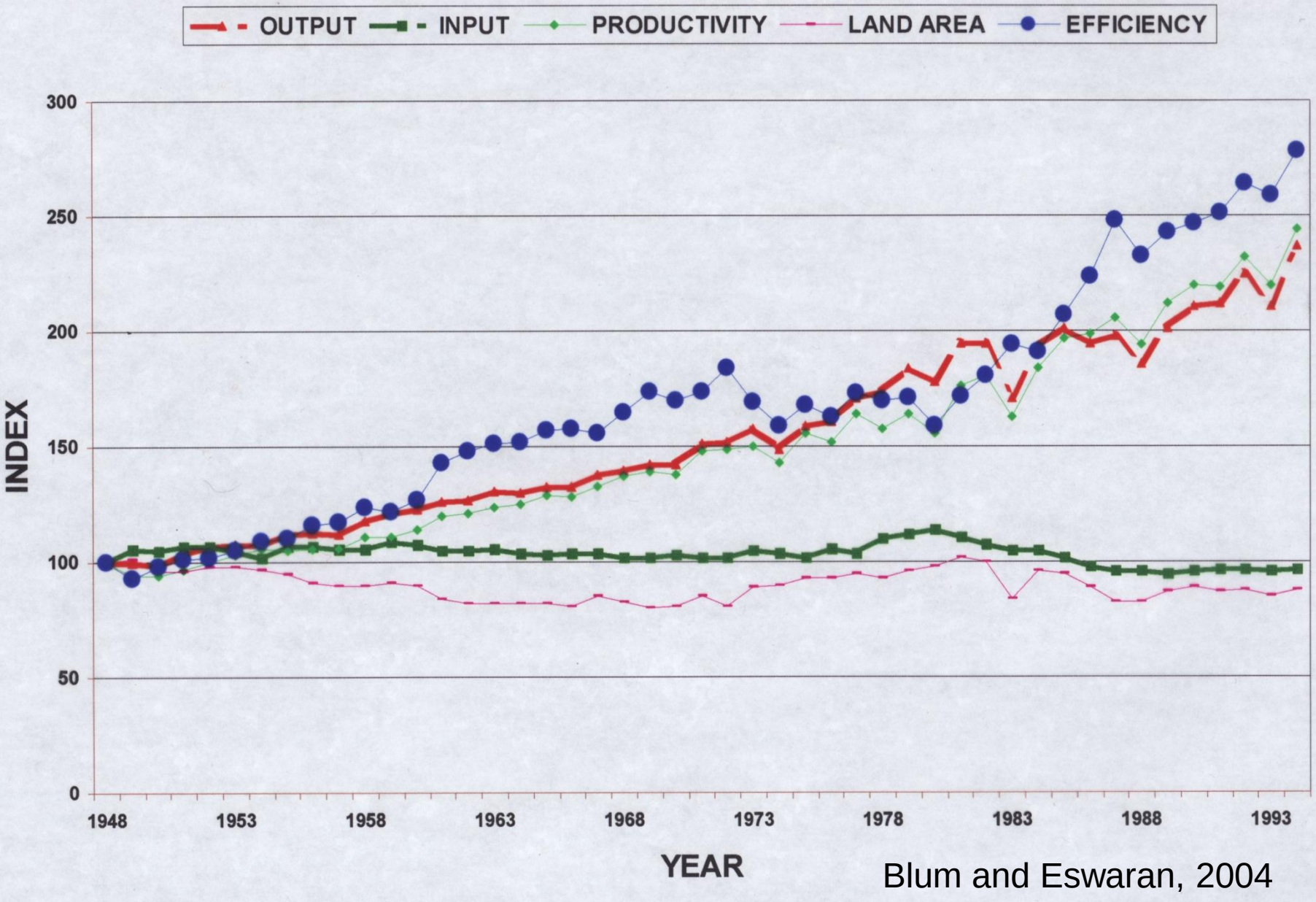
- every year 100-150 millions move from rural into urban areas or are born there:
  - loss of rural livelihoods (loss of subsistance farming);
  - increased pressure on the local, regional and world food markets

GROWTH OF WORLD POPULATION SINCE 8000 B.C. in mill.

year	world population	annual rate of growth in %
8000 B.C.	2 – 20	<0,1
1 A.D.	200 – 300	<0,1
1500	400 – 500	<0,1
1730	700	<0,1
1820	1000	0,2
1850	1200	0,5
1900	1600	0,6
1950	2500	0,8
1990	5300	1,8
2000	6000	1,5

(J.R. McNeill, 2003)

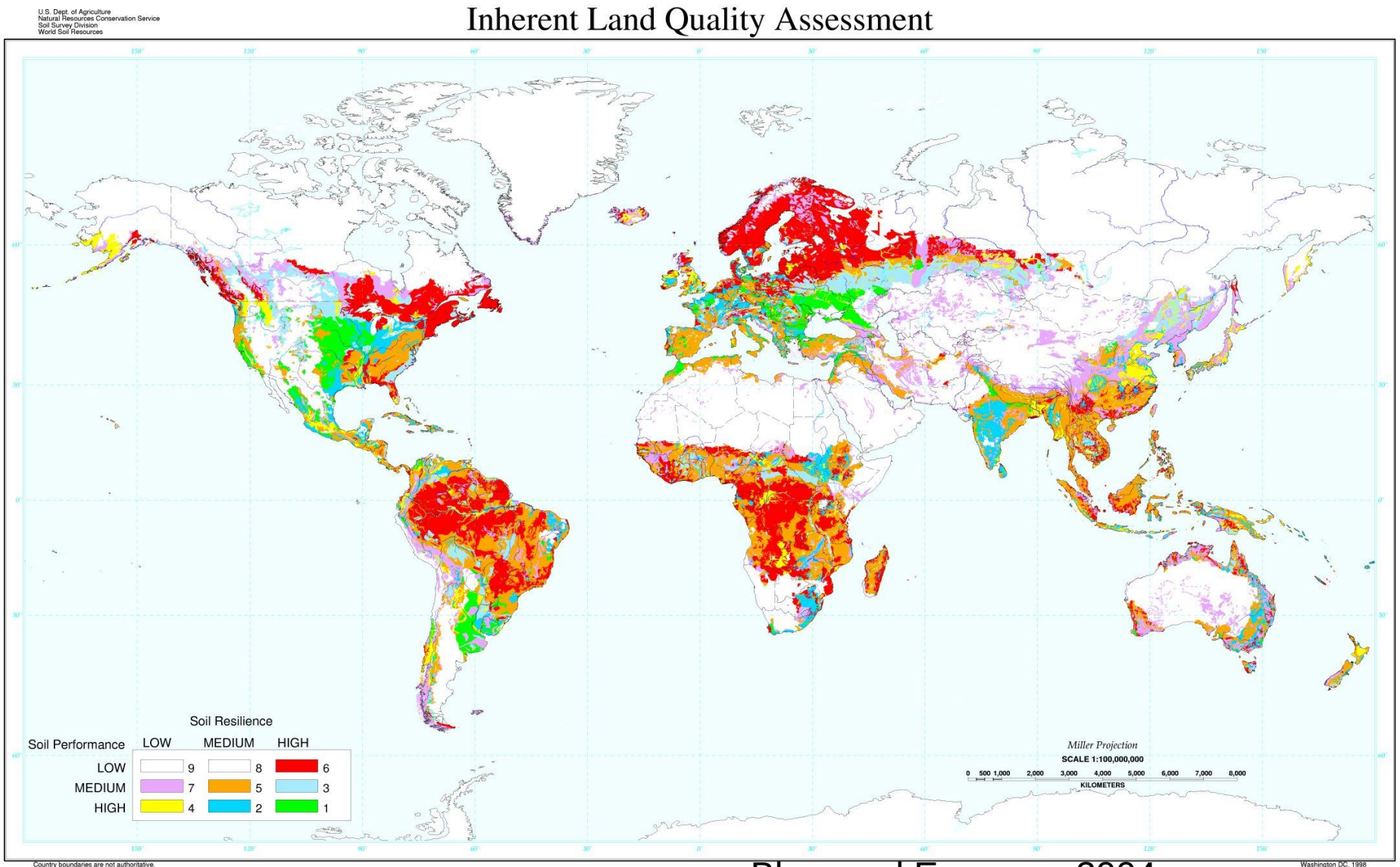
PRODUCTIVITY AND EFFICIENCY OF LAND USE



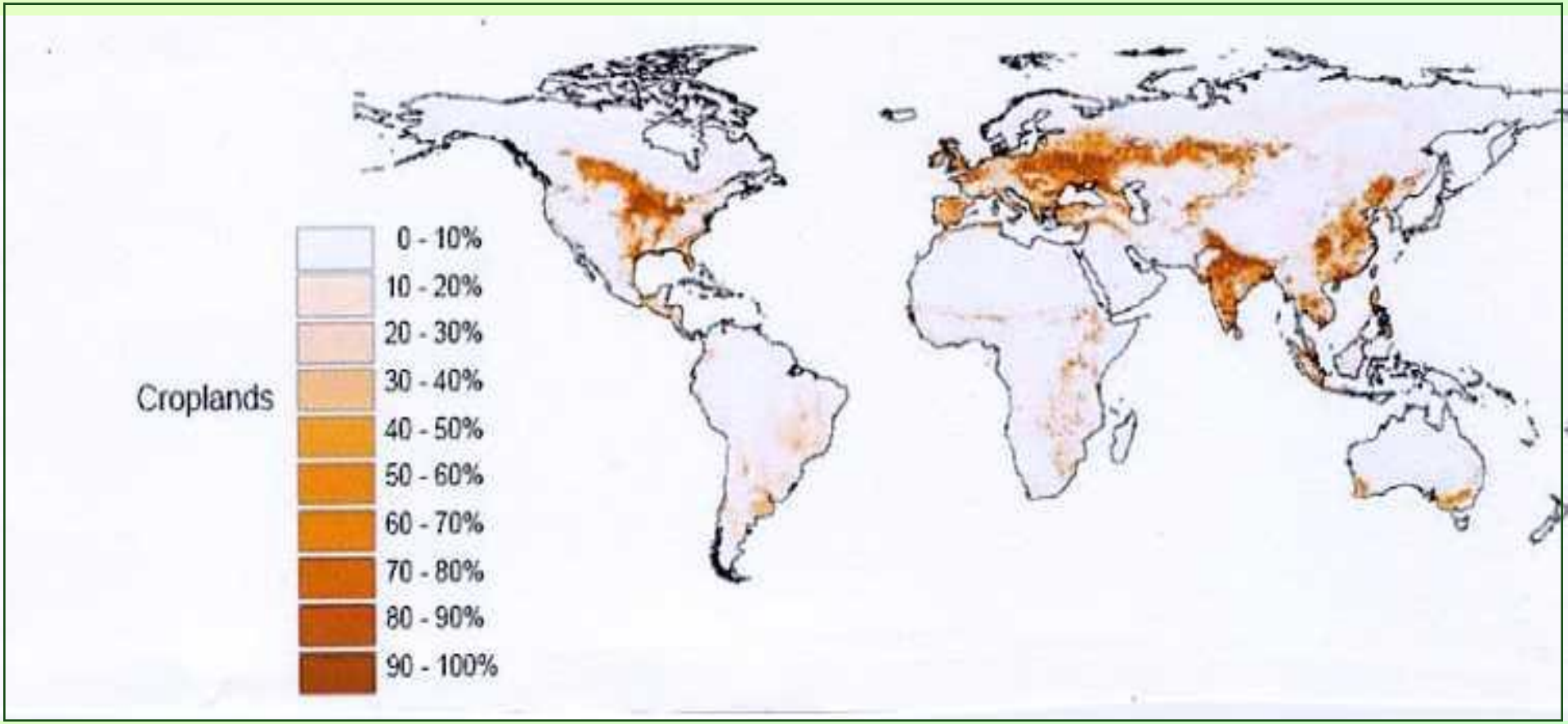
Blum and Eswaran, 2004

2 Losses of fertile soils through urbanization, industrialisation and further human impacts

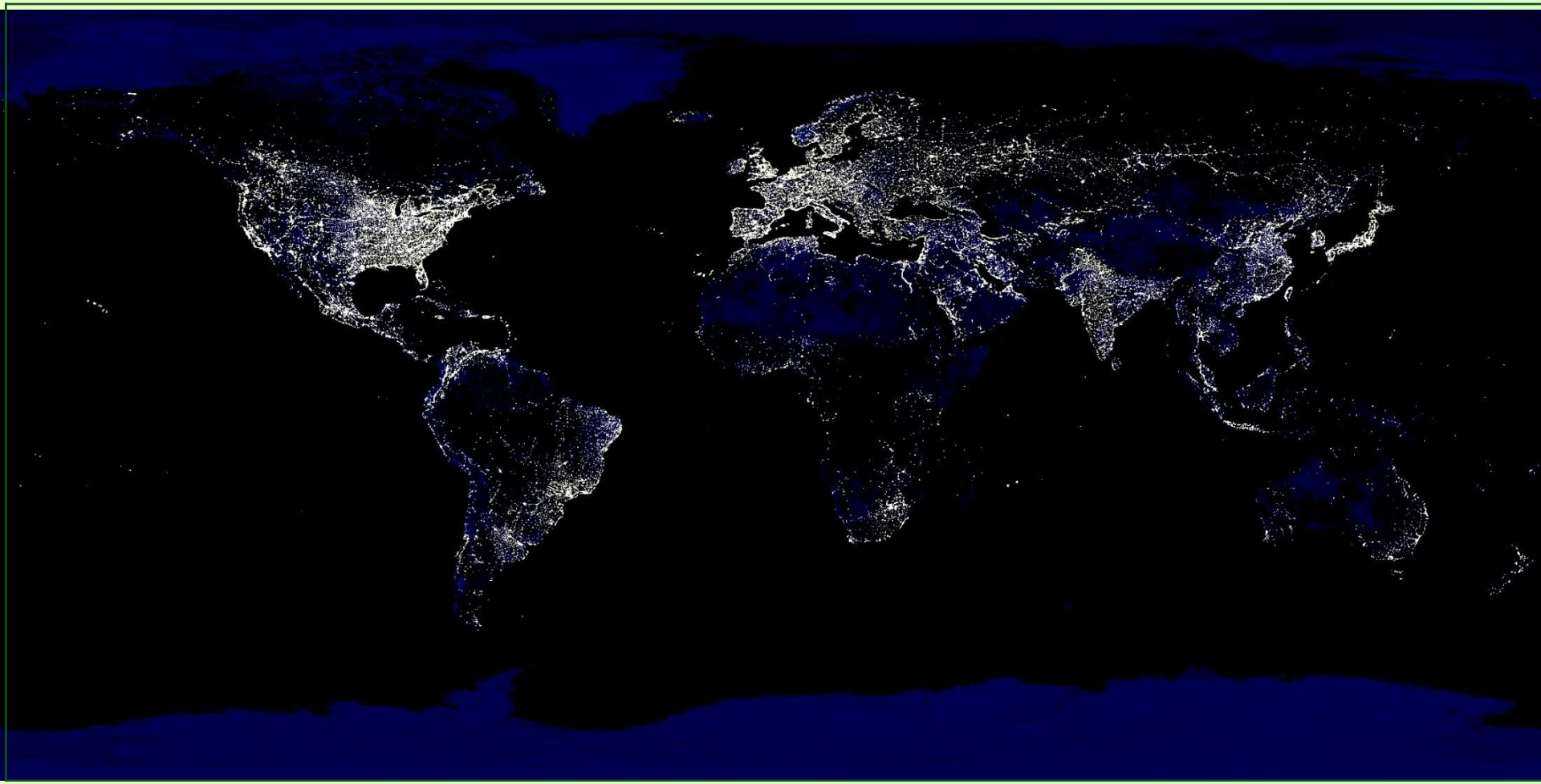
Global map of land quality

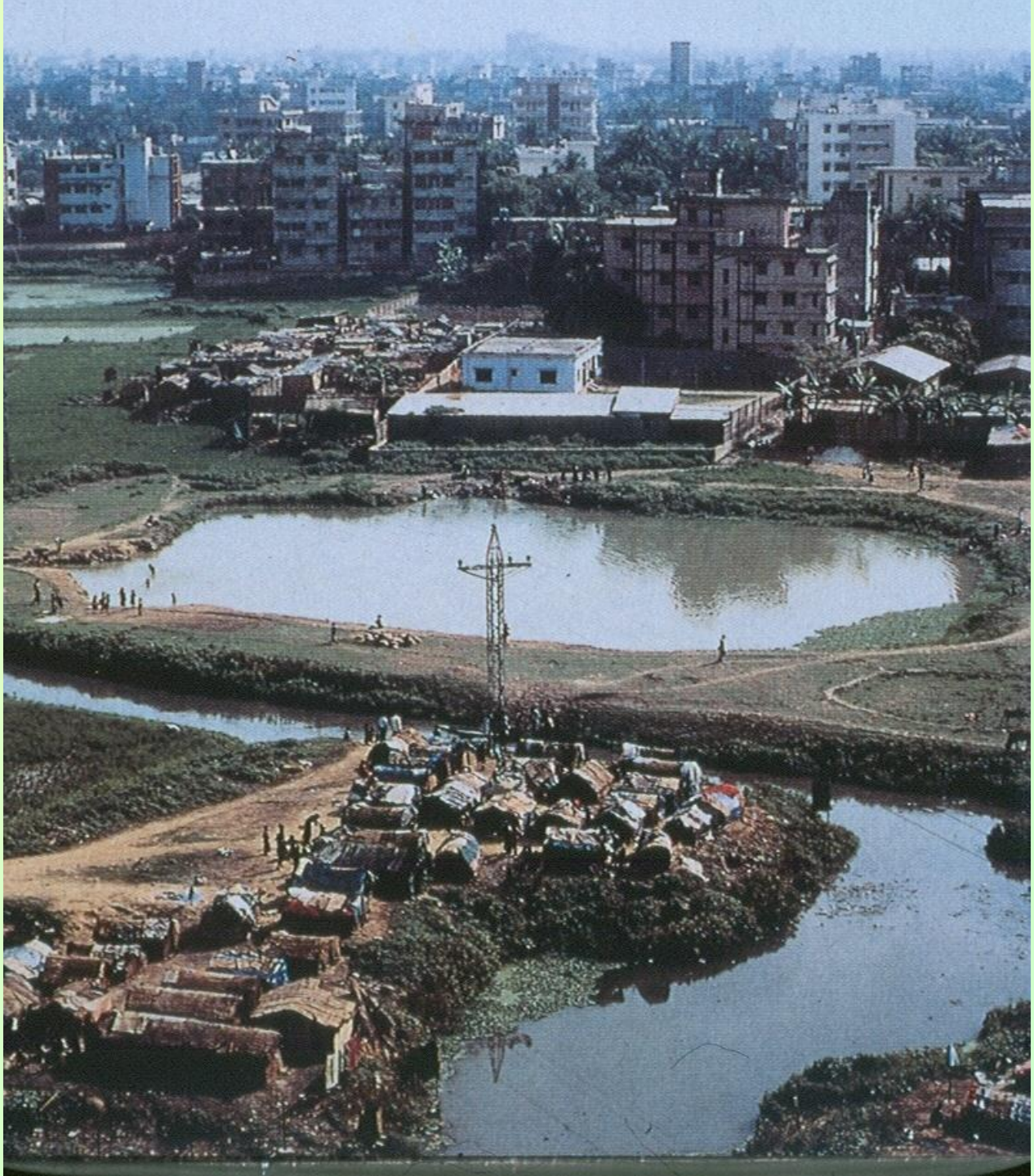


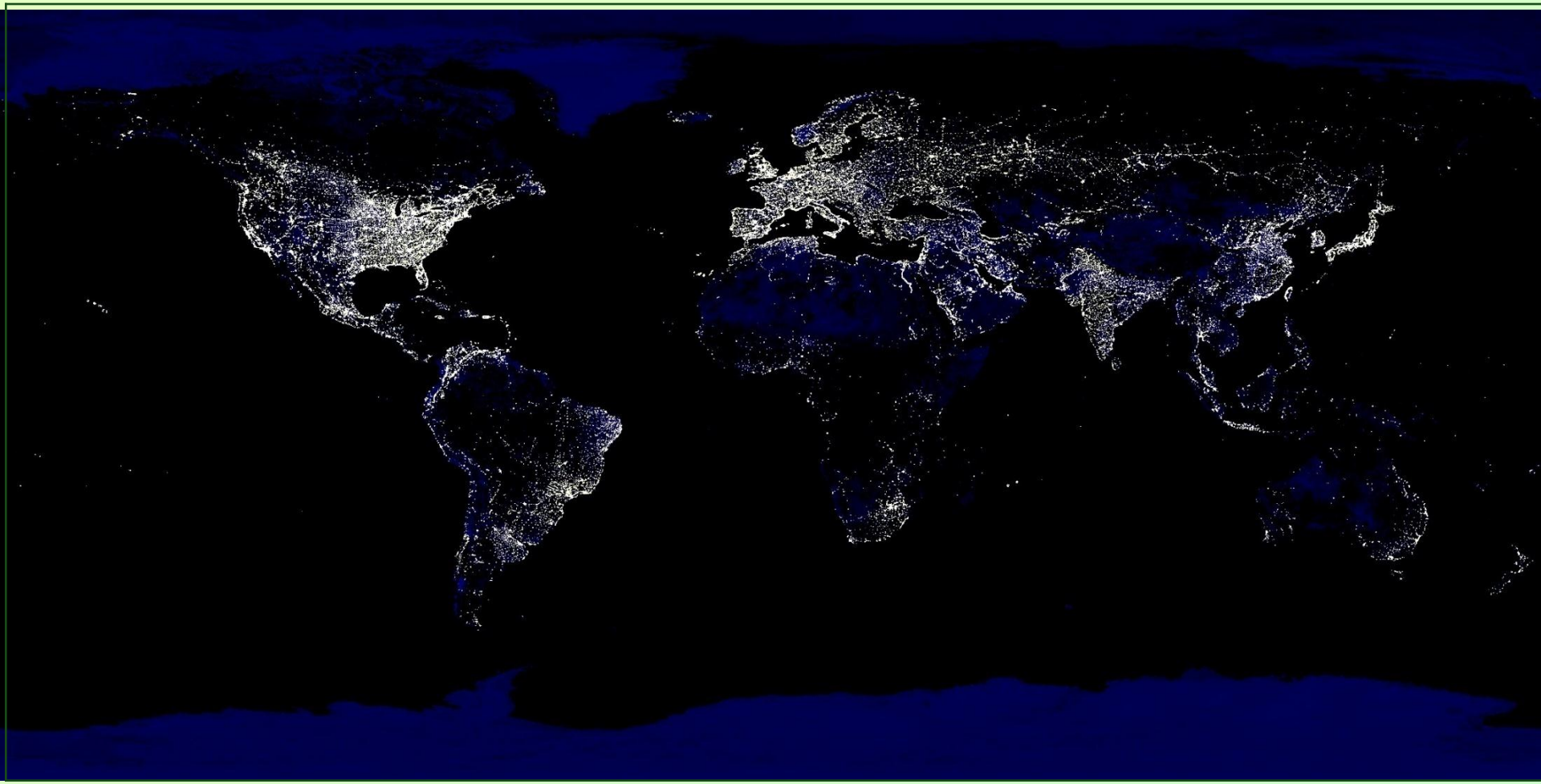
Blum and Eswaran, 2004



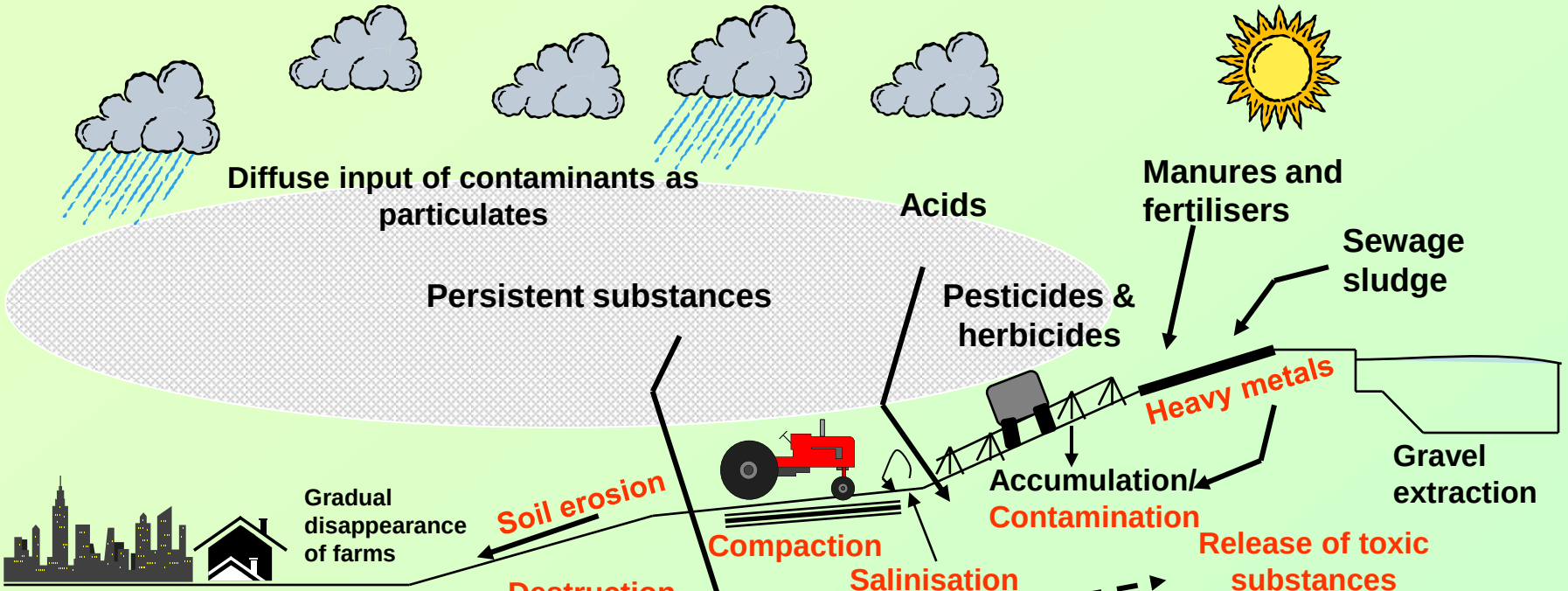
(Foley et al. 2005)







The impact of human activities on soil



EU-JRC-IES-Ispra/Italy

3 Changes in life style and demands for food

- demand for more individual living space = increase of urbanization;
- waste of food in industrialized countries and excessive food consumption, leading to obesity;
- need for more grain because of increasing consumption of animal protein/meat etc.)

Grain for the production of animal protein:

- for 1 kg of chicken meat ~ 2-3 kg of grain
- for 1 kg of pork ~ 4-5 kg of grain
- for 1 kg of beef ~ 7-10 kg of grain

In compensation of all these demands, the average yields of cereals should be raised from **2.64 Mg/ha in the year 2000**, to **3.60 Mg/ha in the year 2025**, and to **4.30 Mg/ha in the year 2050**, without taking into consideration other foodstuff (Lal, 2006).

4 Increasing demands for bioenergy [biogas, biofuel (biodiesel, ethanol), fiber]

BIOFUELS WORLDWIDE – PREVISION FOR 2012

(acc. to FAO/OECD)

13% of all grain } for ethanol
35 % of all sugar cane } production

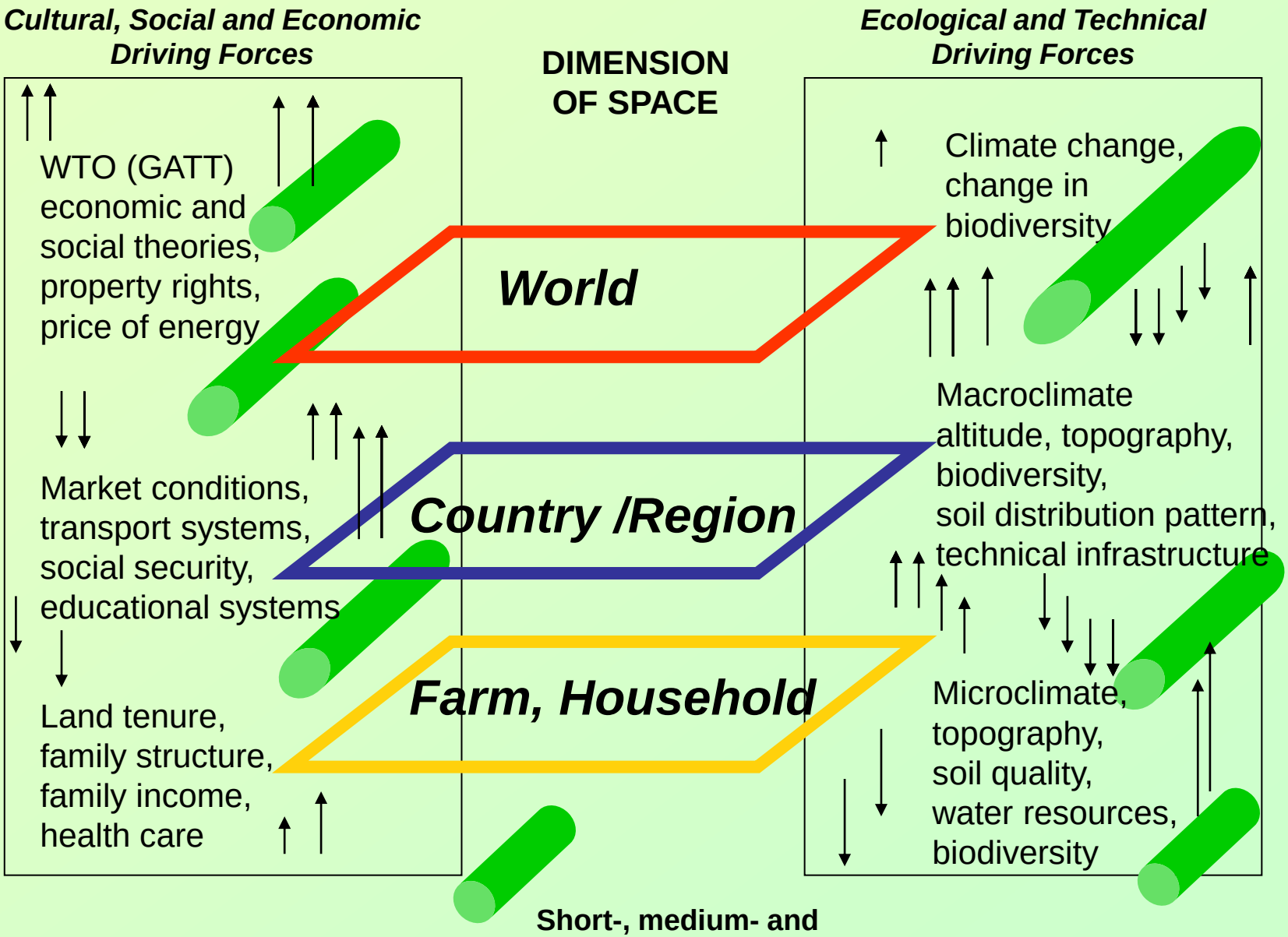
16% of all vegetable oil for biodiesel

Quotation: Pascal Lamy, Dir.Gen. WTO, Feb. 2011 in Berlin (Germany)

5 Changes in world economy and emerging economic trends in food production and marketing

- increasing costs for agricultural land;
- increasing production costs (energy, fertilizers, pesticides, agricultural machinery etc.;
- new financial instruments for agricultural production and marketing of agricultural products (speculative performances, e.g. hedging, derivates, causing volatilisation of prices, etc.;
- land take in foreign countries = „land grabbing“ for agricultural production.

DRIVING FORCES OF LAND AND SOIL DEGRADATION - DIMENSIONS OF SPACE AND TIME



6. Climate change

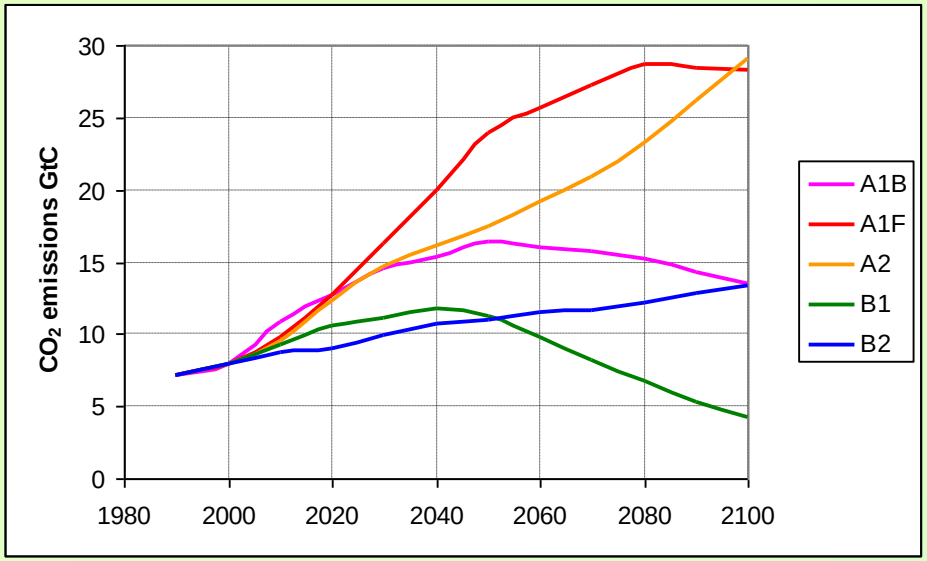
(temperature, precipitation, wind) and soil and land management

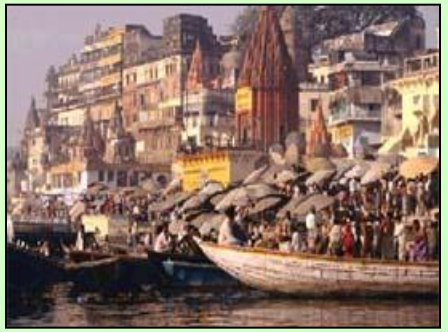
Climate change is causing

- global warming:
  - exceedence of temperature thresholds;
  - increased crop water requirements
  - increased incidence of pests and diseases, invasive plant and animal species;
- alteration in precipitation patterns, soil moisture conditions and surface runoff;
- increased occurrence of extreme weather events;
- increased climate variability

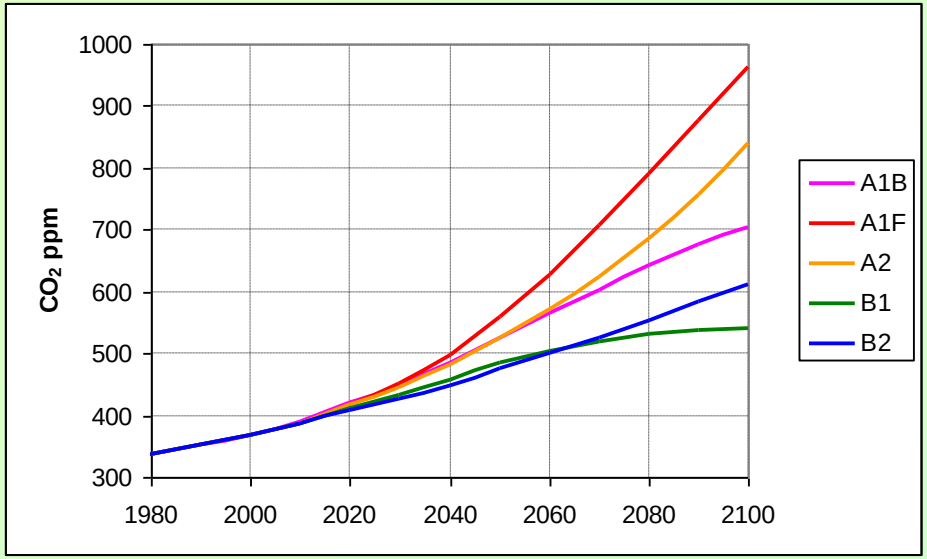
IPCC SRES Scenarios to 2100

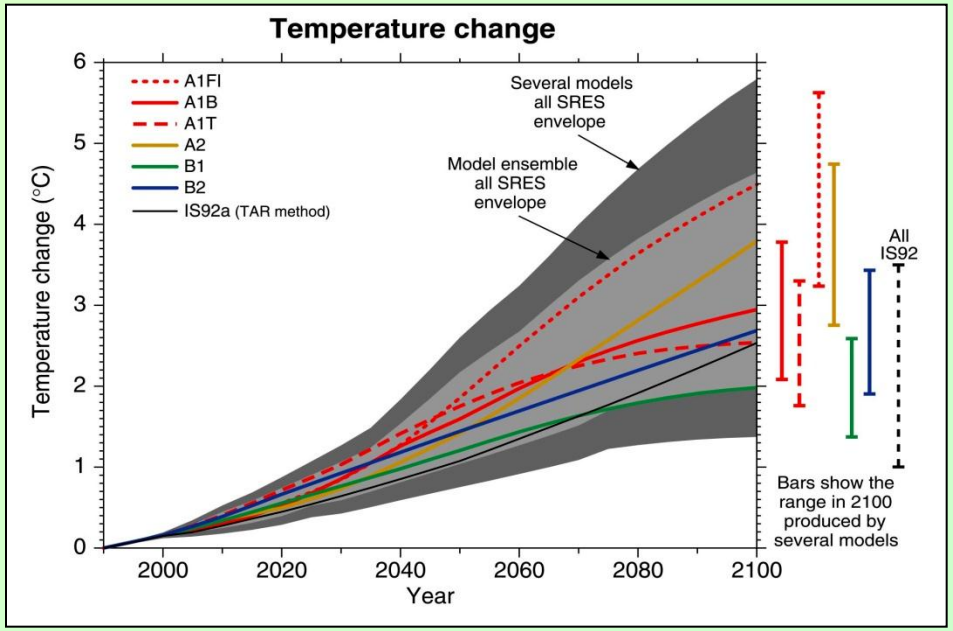
CO_2 emissions





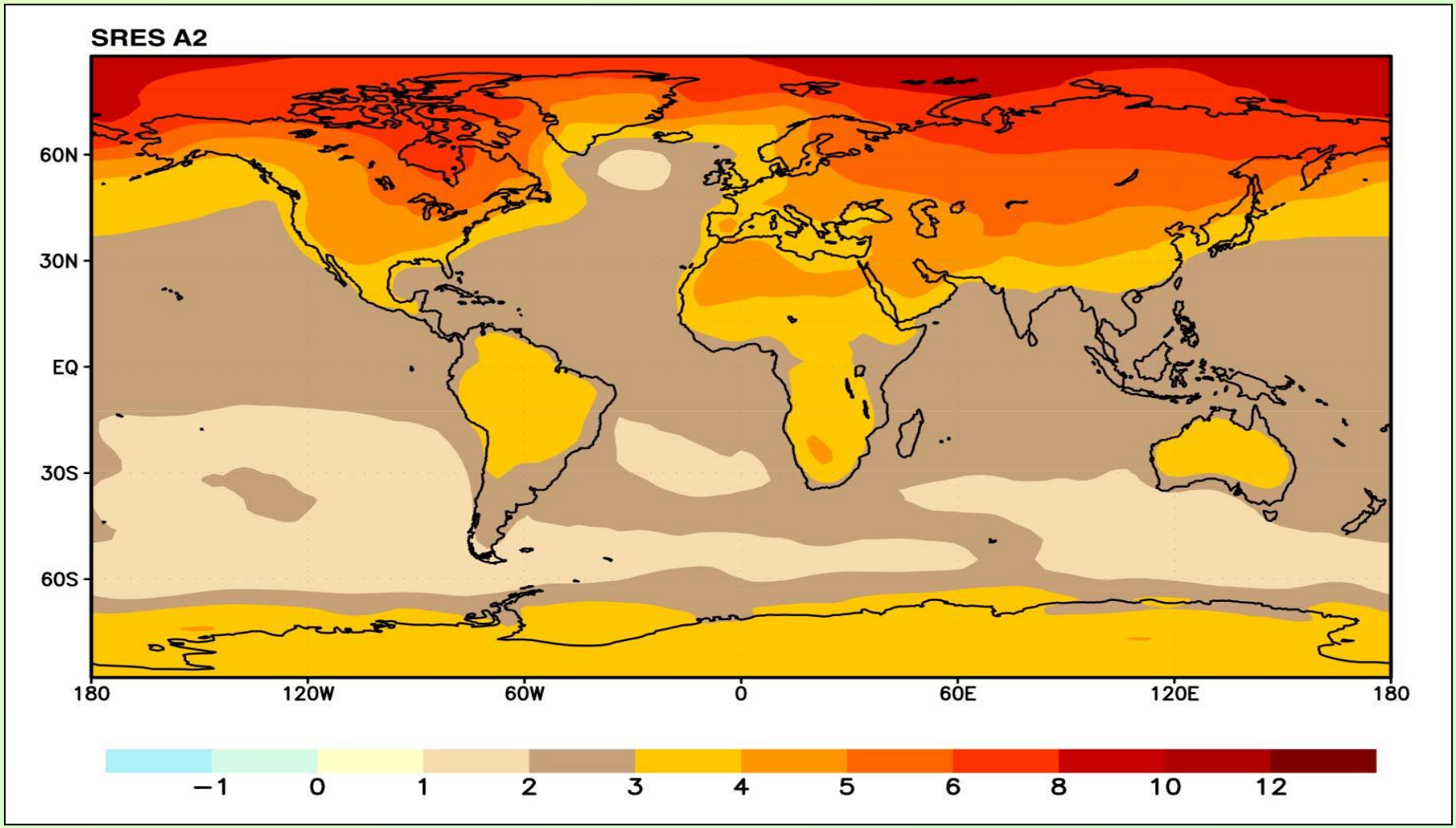
CO_2 abundance in the atmosphere





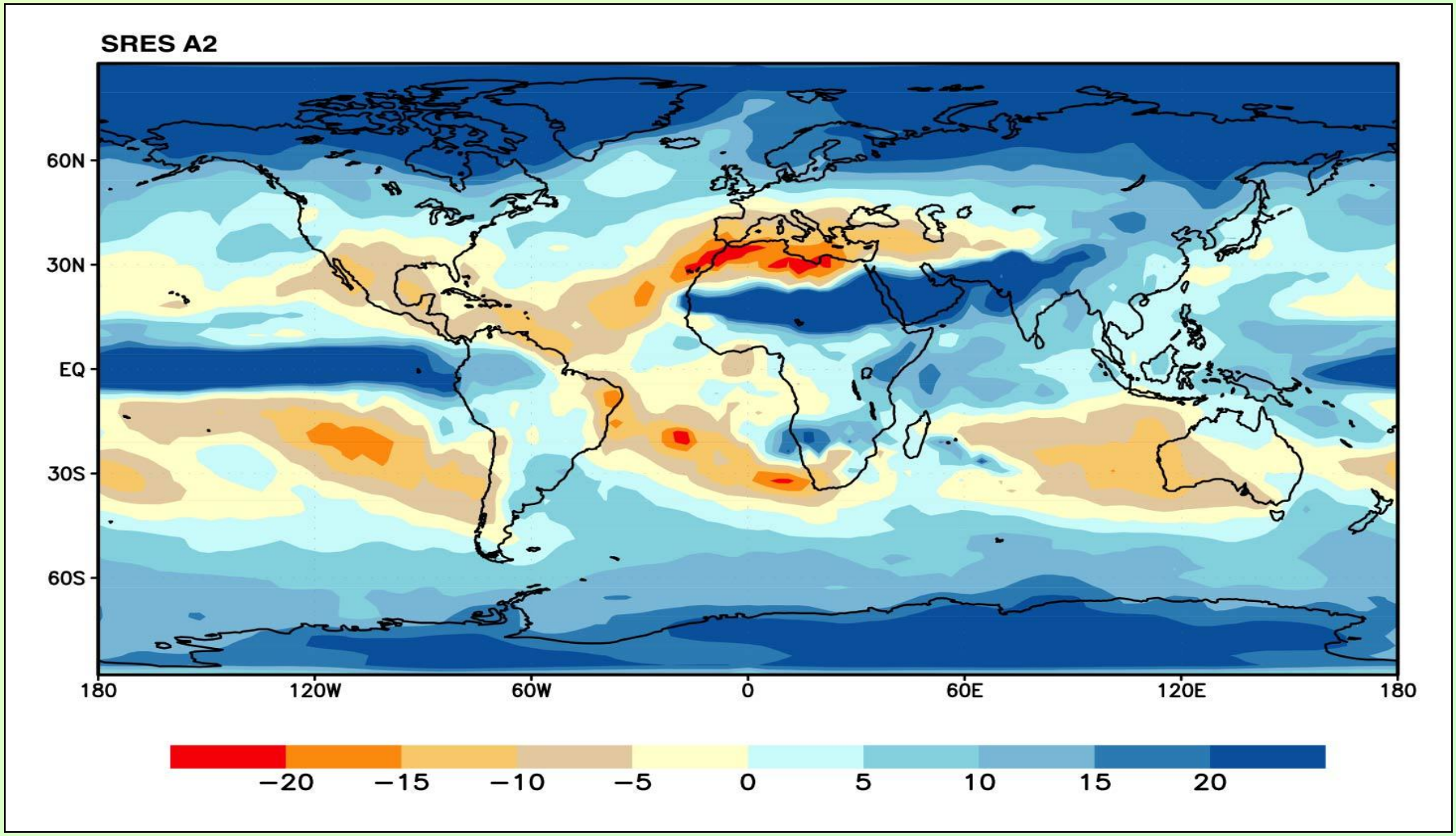
Source: IPCC, 2001

Annual mean temperature change: 2071 to 2100 relative to 1990



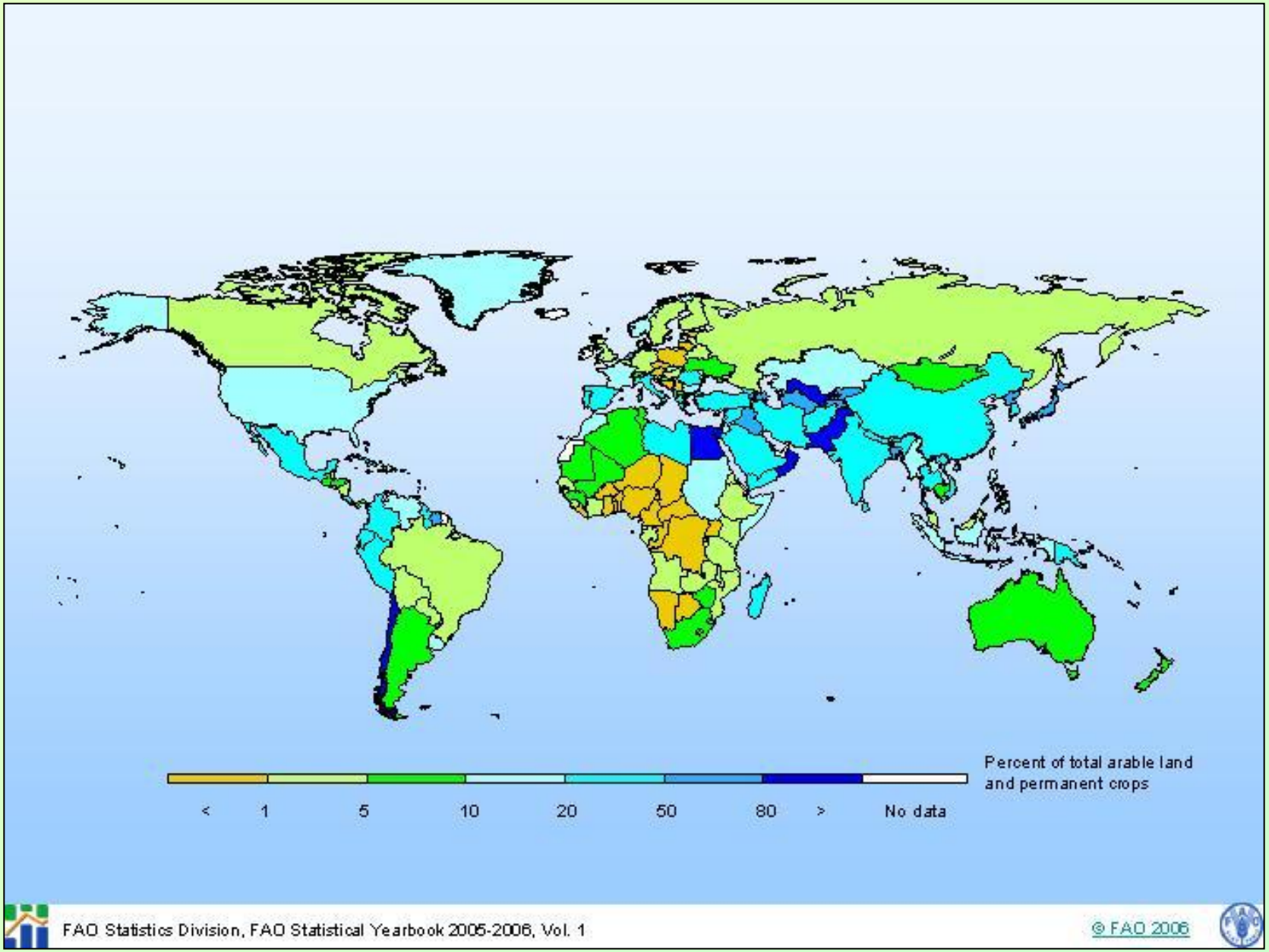
Source: IPCC, 2001.

Annual mean precipitation change: 2071 to 2100 relative to 1990 (Hadley Center)



Source: IPCC, 2001.

Share of Irrigated Land in Arable Land (2003)



SUMMARY AND CONCLUSIONS

1. Through global change, food security will be under threat;
2. These threats will be different for specific world regions and with predominantly negative consequences for many countries in development;
3. Adverse impacts on food production will be caused by:
   - further losses of productive agricultural land by sealing, erosion and other threats;
   - decrease of water resources;
   - increasing costs of energy and fertilizers;
   - severe changes in biodiversity (in and above soil).

4. Adverse impacts will also occur regarding:
   - human health and living conditions in specific world regions;
   - feedback processes between soil and the atmosphere, accelerating climate change.

5. Possible causes of global change derive from world views on the relationship humans-nature, questionable economic and social theories and the increasing globalization of decisions regarding the production and marketing of agricultural/biological commodities without considering regional/local ecological, social and economic conditions.

6. Any mitigation of global change and its impacts on food security must be based on a reorientation of world views and consequently adequate reactions by the world economy, by establishing new economic rules and steering operations.
7. Knowledge about soils will play an increasingly important role in mitigating adverse effects by furthering the sustainable production of food in the future.

THANK YOU!