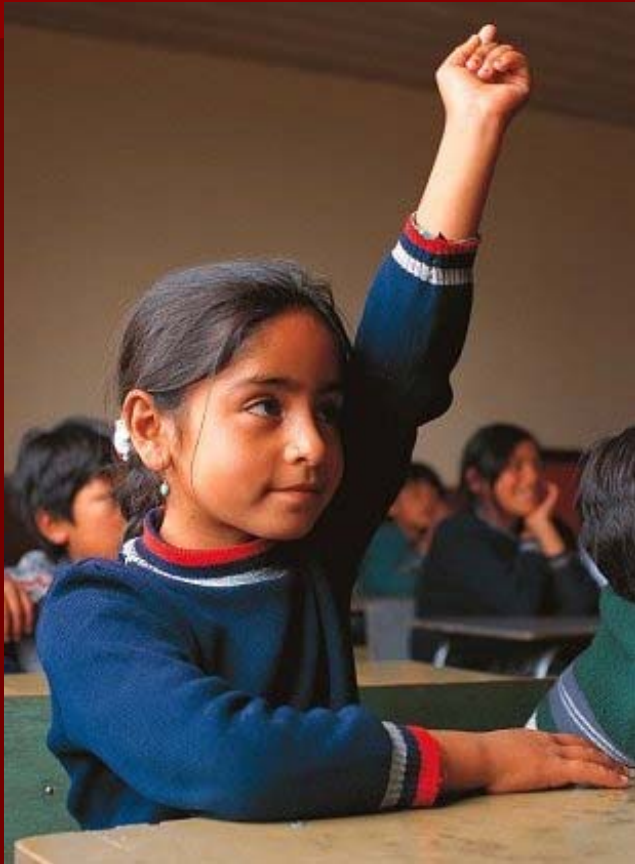


Food Security, Health and Environmental Change The Challenges in the 21st Century

**Mahendra Shah
IIASA, Laxenburg, Austria**

**Consilium Conferentiarum Episcoporum Europae
Under the Patronage of the president of the Italian Republic
50th Anniversary of the Rome Treaties
A New Humanism for Europe
Rome, 21-24th June 2007**

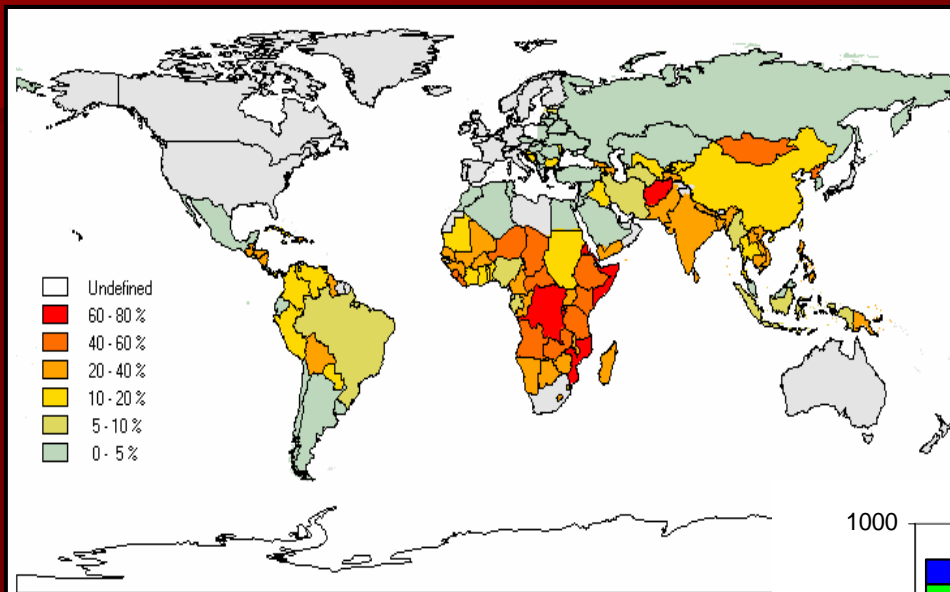
Universal Human Rights



Food
Water
Health
Education
Social Security
Clean/Safe Environment
Freedom from Harassment
Freedom from Discrimination
Opportunities for Participation

Human Rights + 30 years International Promises

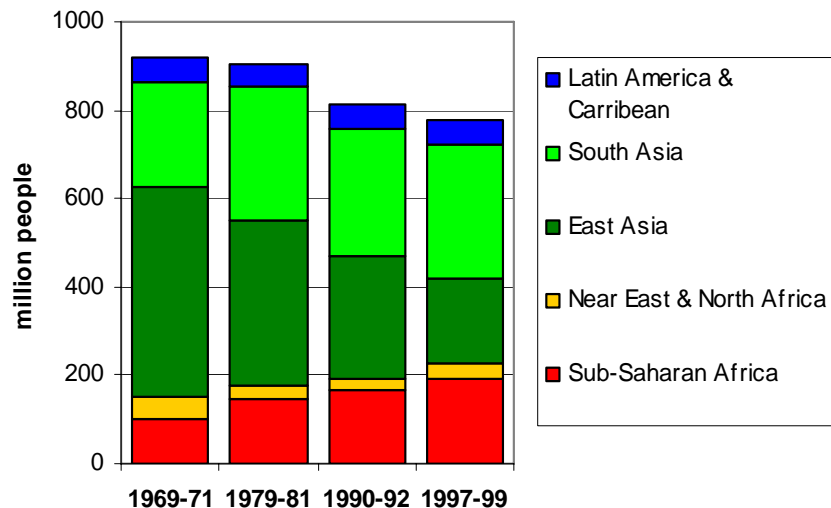
Hunger in a World of Plenty



World Food Summits
1974, 1996, 2002

MDGs 2000

33 Years of Failure to Deliver



The Gebremehdin Family: Pain of Hunger



World Food “Aid” ?

Esposito in Rio de Janeiro: Security of Growing Up ?



Food Crime ?



**Fatima yearning for a
secured future
BUT**

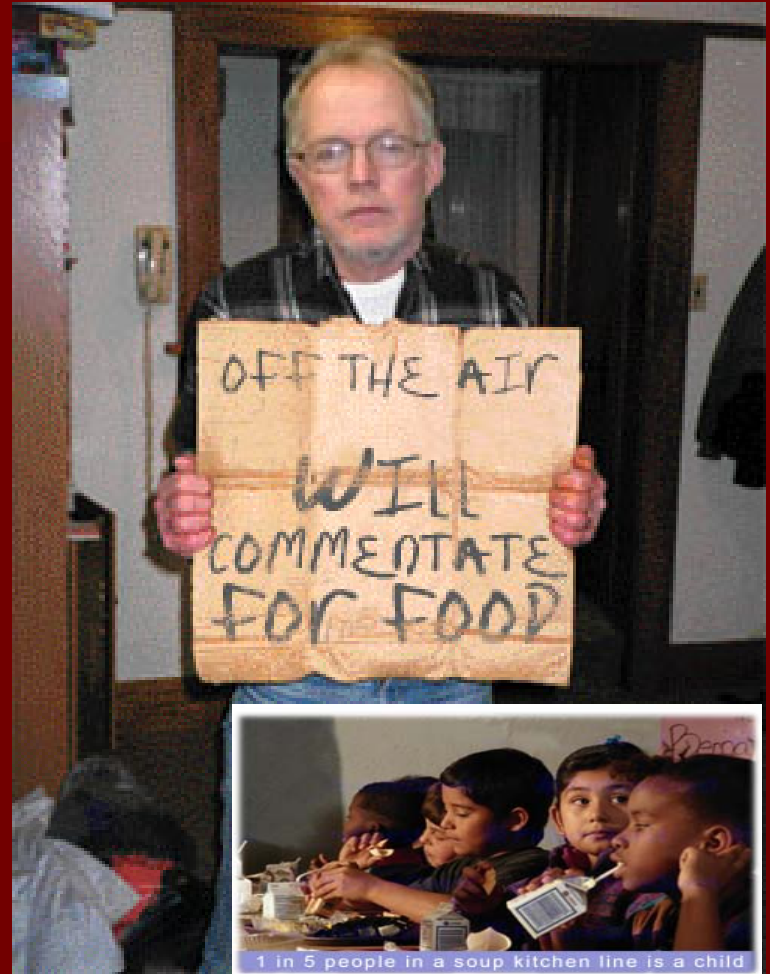
**No one cares for her
and it is her country?**

AP



Tatiana in Moscow

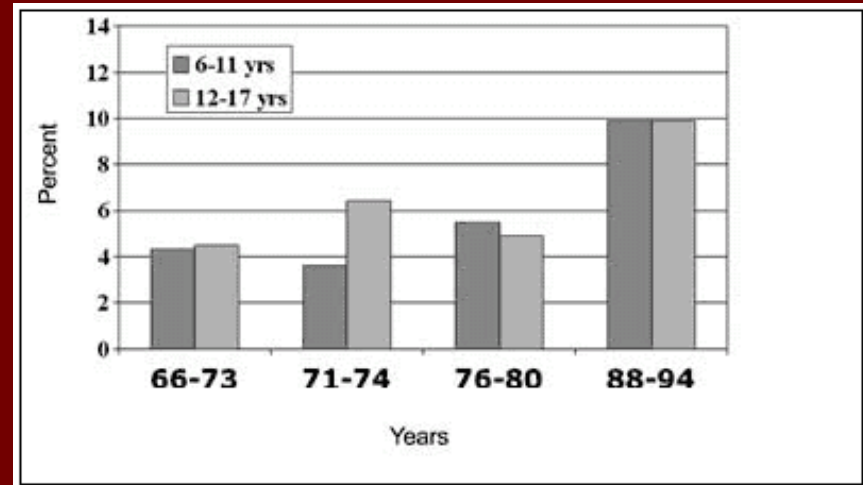
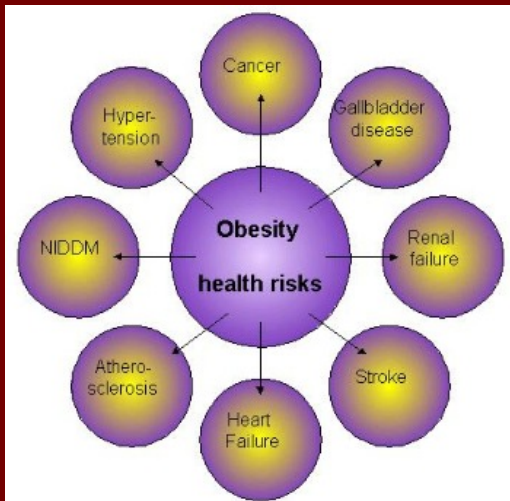
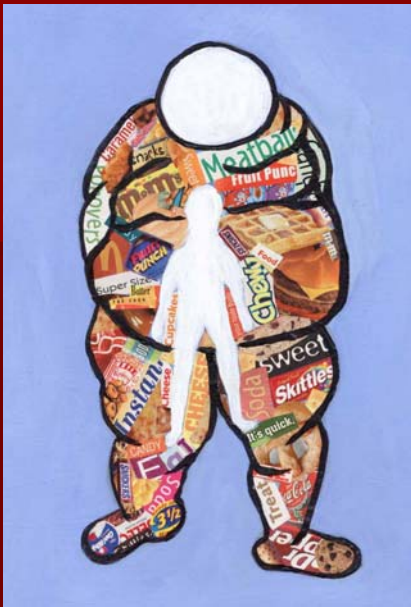
Hunger in Russia : + 6 Million



George in Washington DC

**5.4% of USA Population
on Food Stamps**

And the consequences of much too much food and lifestyles



EDUCATION

Food and Nutrition

Let food be thy medicine, Let thy medicine be food.....Hippocrates



Infectious Diseases, AIDS, Neurodegenerative disorders, Ageing.....

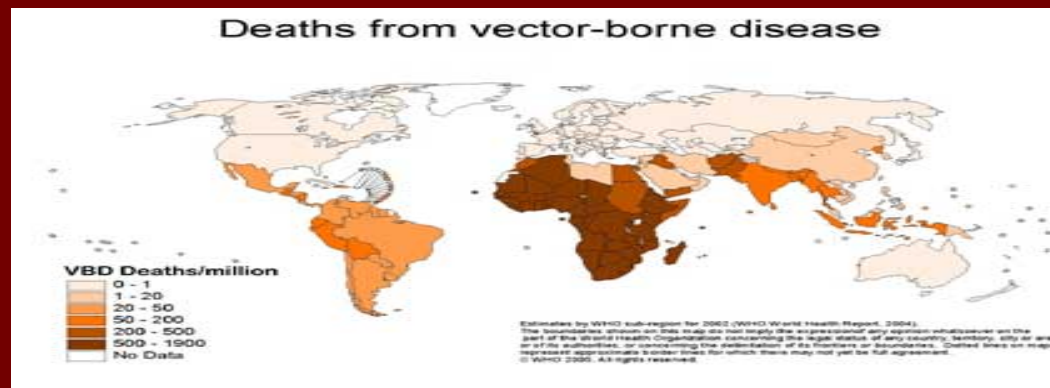
Changing Lifestyles: Major Causes of Mortality

Death Rate per 100,000

Heart disease.....	232
Cancer.....	190
Cerebrovascular disease.....	54
Chronic lung disease.....	43
Injuries.....	37
Diabetes.....	25
Influenza and pneumonia.....	22
Suicide.....	11
Chronic liver disease/cirrhosis.....	9
Homicide.....	6

Vector-borne Infectious Diseases

	At risk mill pop.	Affected mill/yr	DALY mill
■ Malaria	2400	273	42
■ Schistosomiasis	600	120	2
■ Filariasis	1000	120	6
■ Trypanosomiasis	55	0.5	2
■ Leishmaniasis	350	2	2
■ Onchoceciasis	120	18	1
■ Chagas Disease	100	18	1
■ Dengue Fever	3000	50	1
■ Yellow Fever	470	0.2	n.a
■ J. Encephalihs	300	0.1	1



Emerging / re-emerging infectious diseases, 1997-2007

Legionnaire's Disease

Cryptosporidiosis

Human Monkeypox

Lyme Borreliosis

Venezuelan Equine Encephalitis

Dengue haemorrhagic fever

Avian Influenza
Cholera
High mortality respiratory infection
Guinea
H7N2 influenza
Imported poliomyelitis
Kyasanur Fever
Cholera
Nipah haemorrhagic fever
Lassa Fever
High mortality measles
H7 influenza
Menigococcal meningitis
West Nile
Ebola

Vietnam
South Africa
Papua New

United States
Sudan
India
Somalia
Bangladesh
Sierra Leone
Nigeria
Canada
Nigeria
United States
Gabon

157

Respirator
(ARS)

us
us

s River
S

Drivers of Human Health

Natural Resources and Environment

- Land, Water and Biodiversity Degradation and Depletion
- Atmospheric Pollution
- Land Contamination
- Water Contamination
- Biodiversity Extinction

Societal Environment

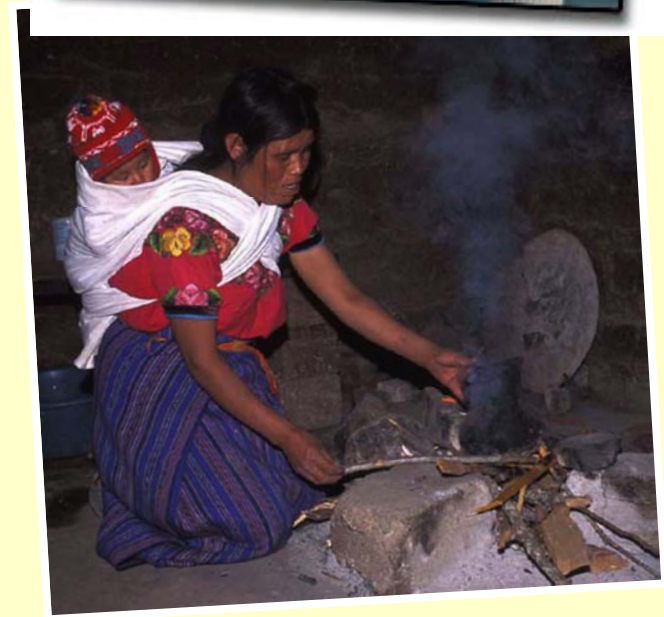
- Lifestyles: Rich, Poor
- Nutrition and diets
- Stress at work and home
- Fear in the city and human security
- Drugs, alcohol, unsafe sex
- Relationships and loneliness
- Waste and Industrial Chemicals

Healthcare

- Rural Public Health Systems
- Urban Public Health Systems
- Private Health Systems
- Science and IPRs
- Integrating Modern Medicare & Traditional Healthcare Systems

HEALTH for ALL in the 21st CENTURY?

Air Pollution and Health



Respiratory Diseases on the increase

Water Pollution and Health



80% of all illnesses in developing world caused by water-borne diseases

Land Contamination and Health



Agricultural Chemicals and Food Poisoning

Biodiversity Loss and Health



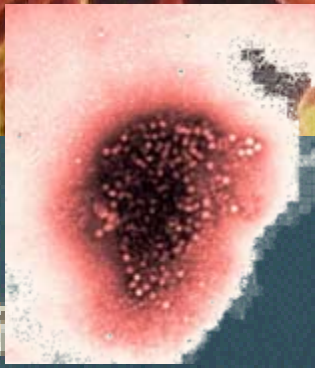
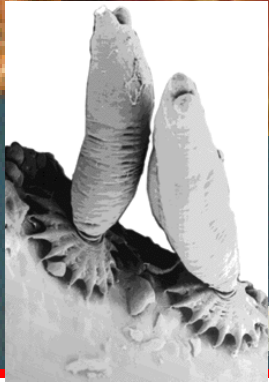
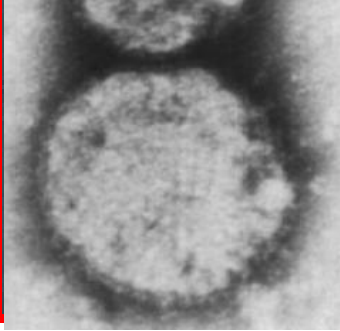
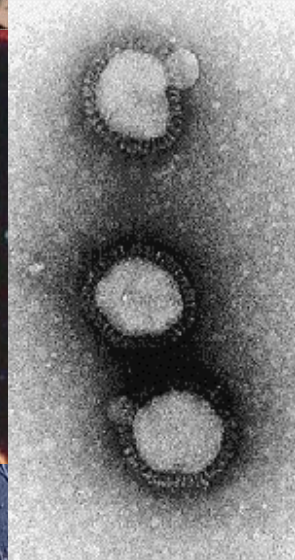
Biodiversity forms a major buffer against vector transmitted diseases

Industrial Chemicals and Health

- **Metals**
- **Tobacco (cotinine)**
- **PAHs**
- **Dioxins, Dibenzofurans**
- **PCBs**
- **Phthalates**
- **Phytoestrogens**
- **Organochlorine & Organophosphate pesticides**
- **Herbicides**
- **Other pesticides and insecticides**

Environmental Change

*Microbes are on the move
and
finding more & more breeding sites
genetic and hereditary changes*



What health consequences for future generations ?

Ecology and Ecosystems

World-wide Spatial Food Security & Infectious Diseases

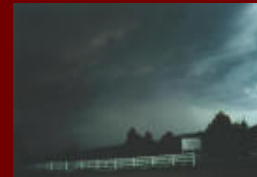
- **Food Security : Production, Trade and Consumption**
- **Microbes: Climate, vegetation, plant-animal biodiversity, human population, hosts..**
- **Latitudnal species diversity gradient..**
- **Variables – climate, energy, habitat diversity..**



**Integrated ecological - social – economic assessment
of world food security and disease threats
The risks of Climate Change**

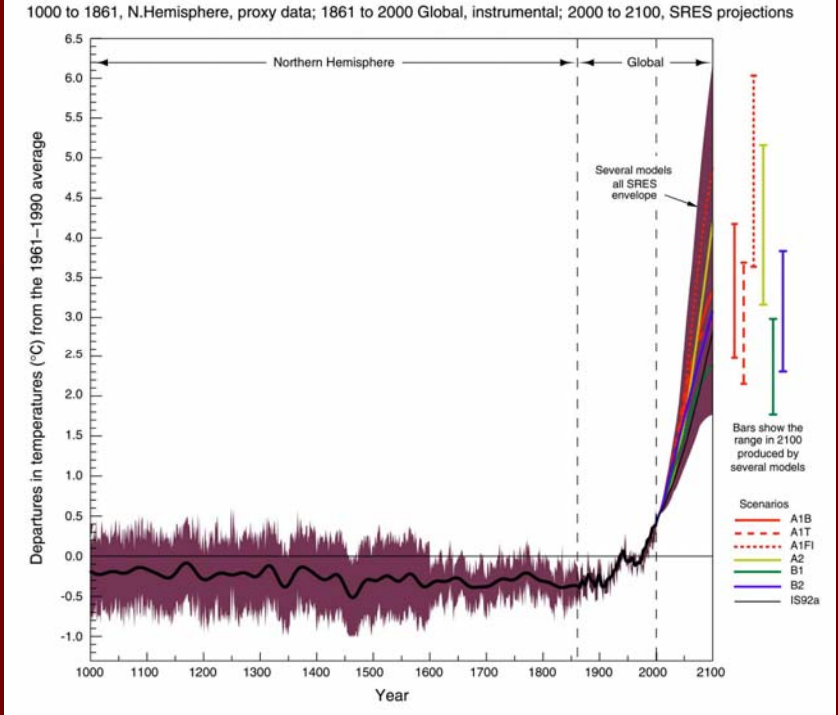
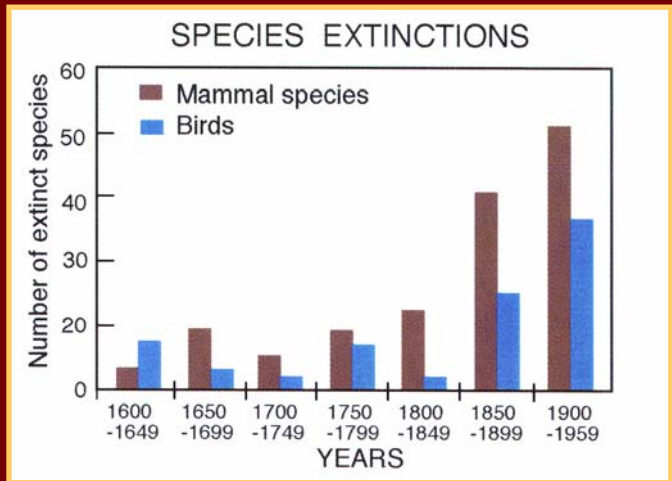
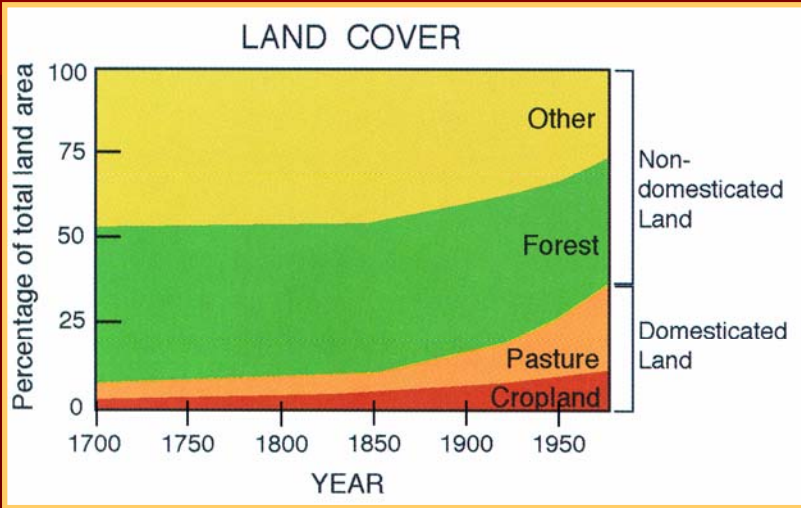
A global AEZ methodology and results

Climate Change

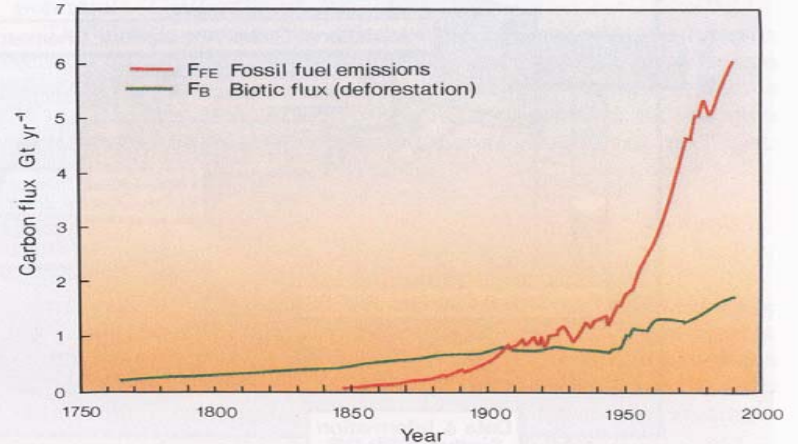


**Climate Change will exacerbate & accelerate
Environmental Change and Emergence of Diseases**

Global Change



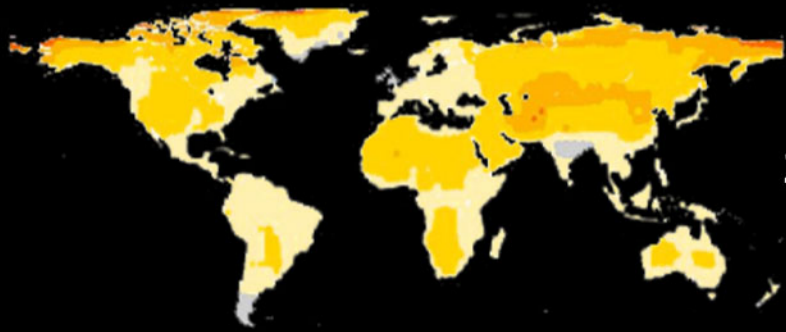
FOSSIL FUEL AND BIOTIC



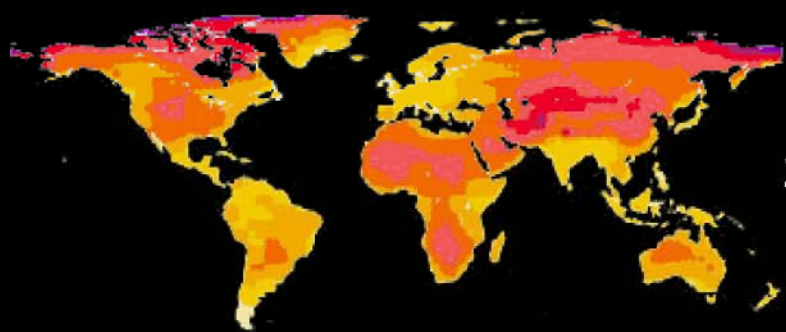
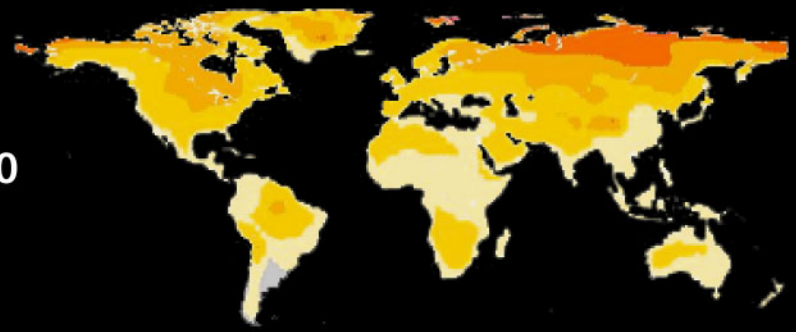
DELTA TEMPERATURE CHANGES

CGCM1

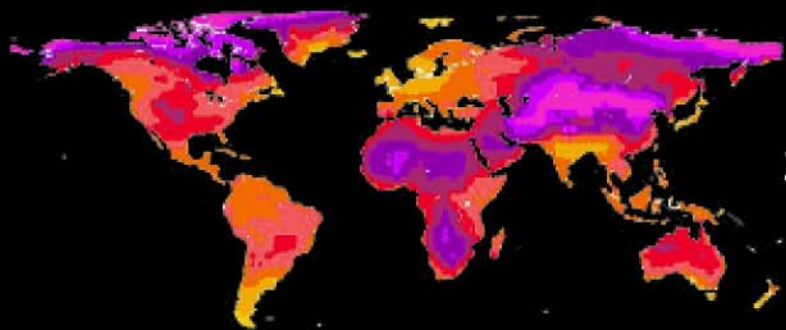
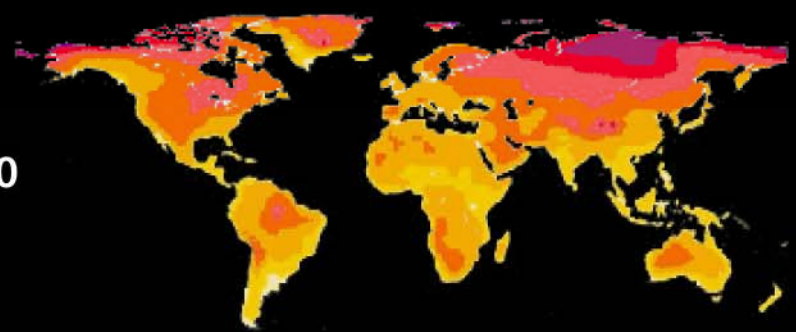
ECHAM



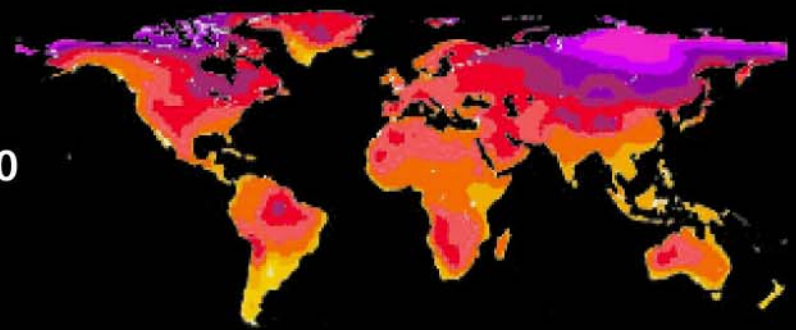
2020



2050



2080



DELTA PERCIPITATION CHANGES

CGCM1

ECHAM

2020

2050

2080

mm



HEALTH EFFECTS OF CLIMATE CHANGE

CLIMATE CHANGE

*Temperature Rise*¹

*Sea level Rise*²

Hydrologic Extremes

¹ 3°C by yr. 2100

² 40 cm " "

IPCC estimates

Global Warming Effect

→
**Heat Stress
Cardiorespiratory
failure**

Air Pollution

→
**Respiratory diseases,
e.g., COPD & Asthma**

Vector-borne Diseases

→
**Malaria
Dengue
Encephalitis
Hantavirus
Rift Valley Fever**

Water-borne Diseases

→
**Cholera
Cyclospora
Cryptosporidiosis
Campylobacter
Leptospirosis**

**Water resources & food
supply**

→
**Malnutrition
Diarrhea
Toxic Red Tides**

**Environmental
Refugees**

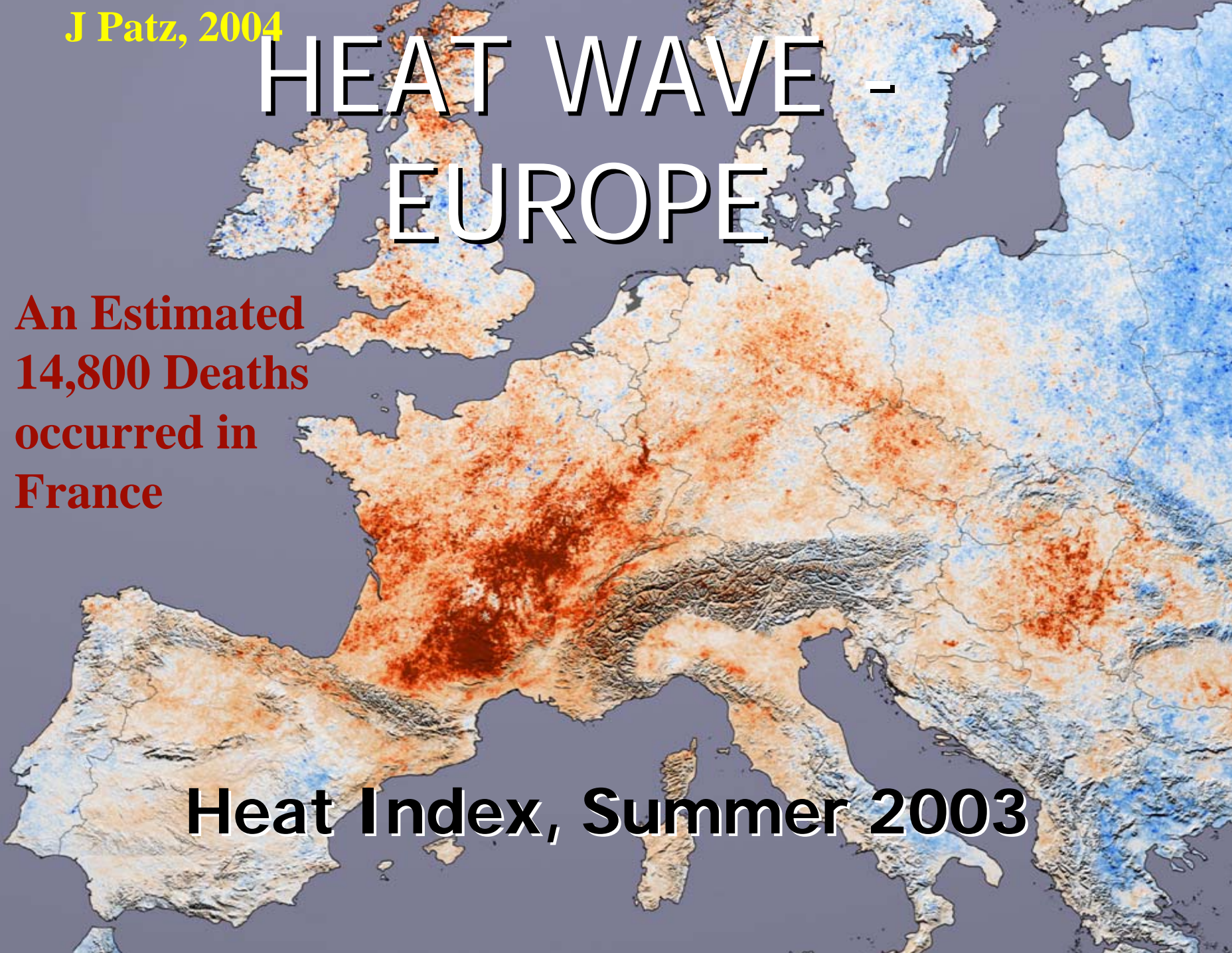
→
**Forced Migration
Overcrowding
Infectious diseases
Human Conflicts**

J Patz, 2004

HEAT WAVE - EUROPE

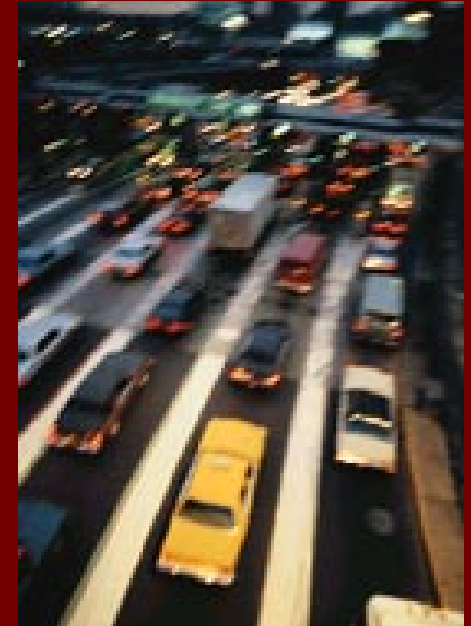
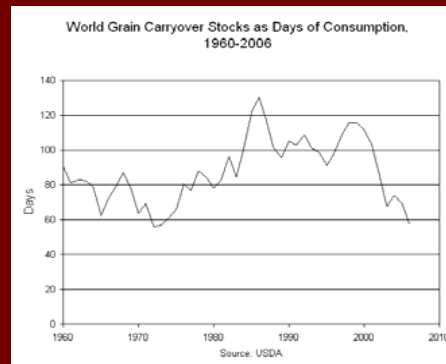
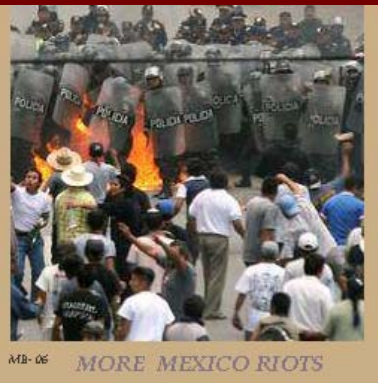
An Estimated
14,800 Deaths
occurred in
France

Heat Index, Summer 2003



Biofuels or Bloodfuels

- Corn - tortilla Price Riots in Mexico
- Land for Palm Oil and farmer's deaths in Colombia
- Doubling of corn prices and export cutbacks in USA
- World Food Stocks Lowest in History



USA and EU Biofuel Targets 10 to 20% of Transport Fuel From Food crops for Livestock to Food crops for Cars

Food Security in the 21st Century Prospects, Opportunities and Risks

Population and Demography

Ecosystems Vulnerability and Sustainability

Natural Resources: Land, Water, Agro-biodiversity

Climate Change and Variability

21st Century Policy Issues

Environmental Constraints and Focus on Agricultural research

Hunger: Estimated Populations at Risk

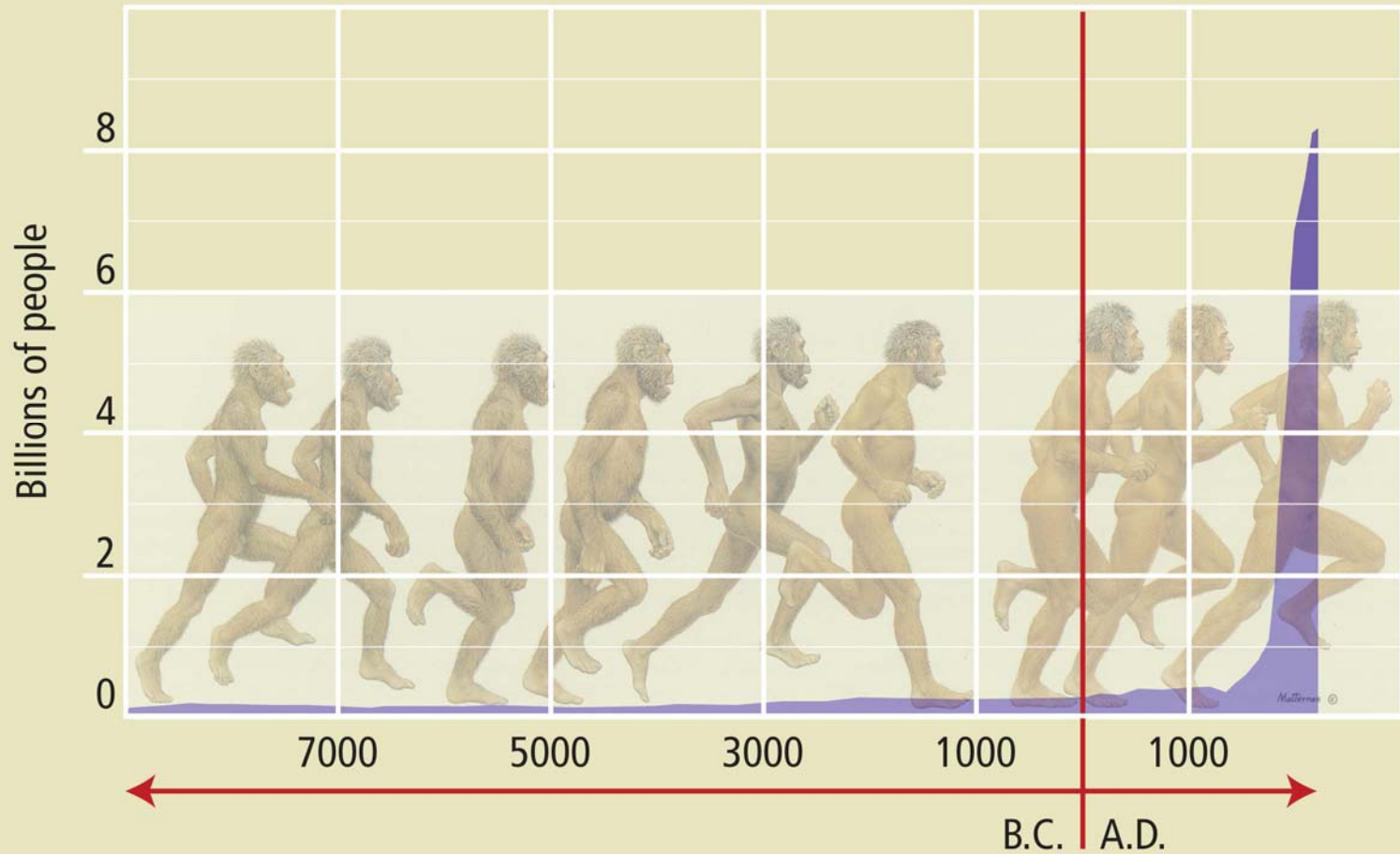
International Food Trade

Fairness and Justice: Climate Change

World Food Security

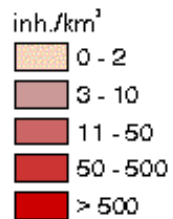
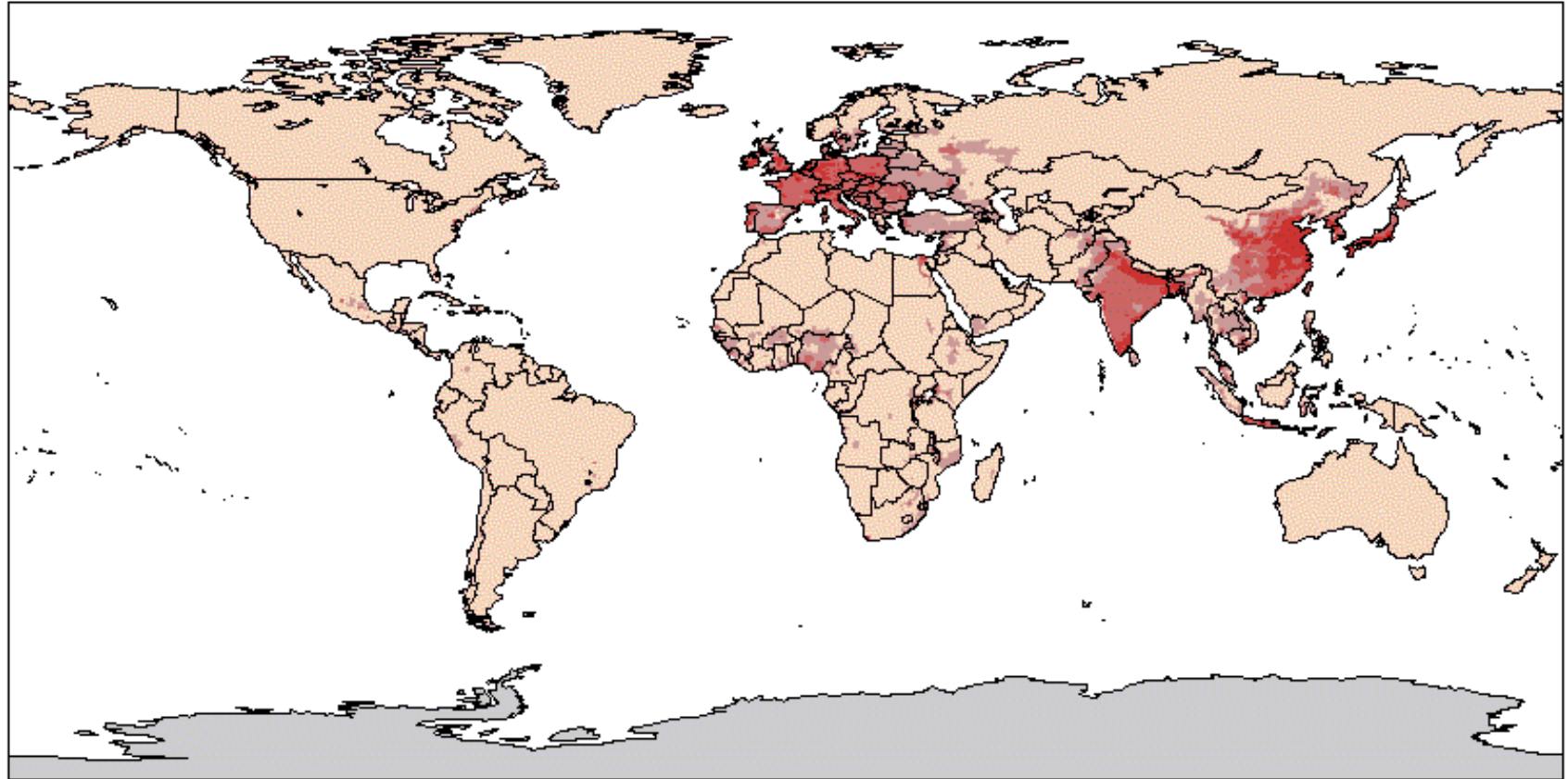
....

Human Population



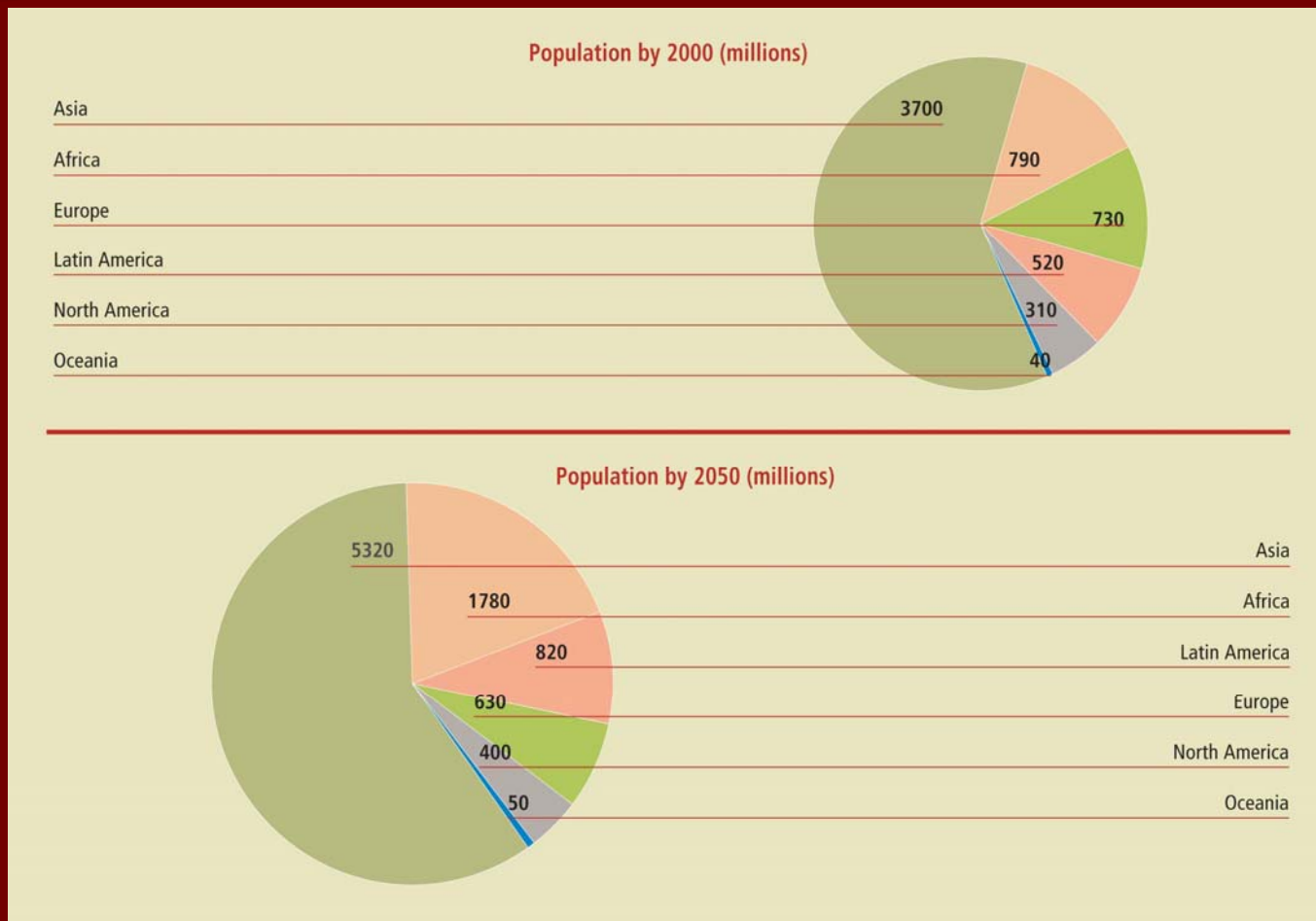
Regional Diversity and Demography, 1700 – 1990

year 1700



Demographic Transition 2000-2050

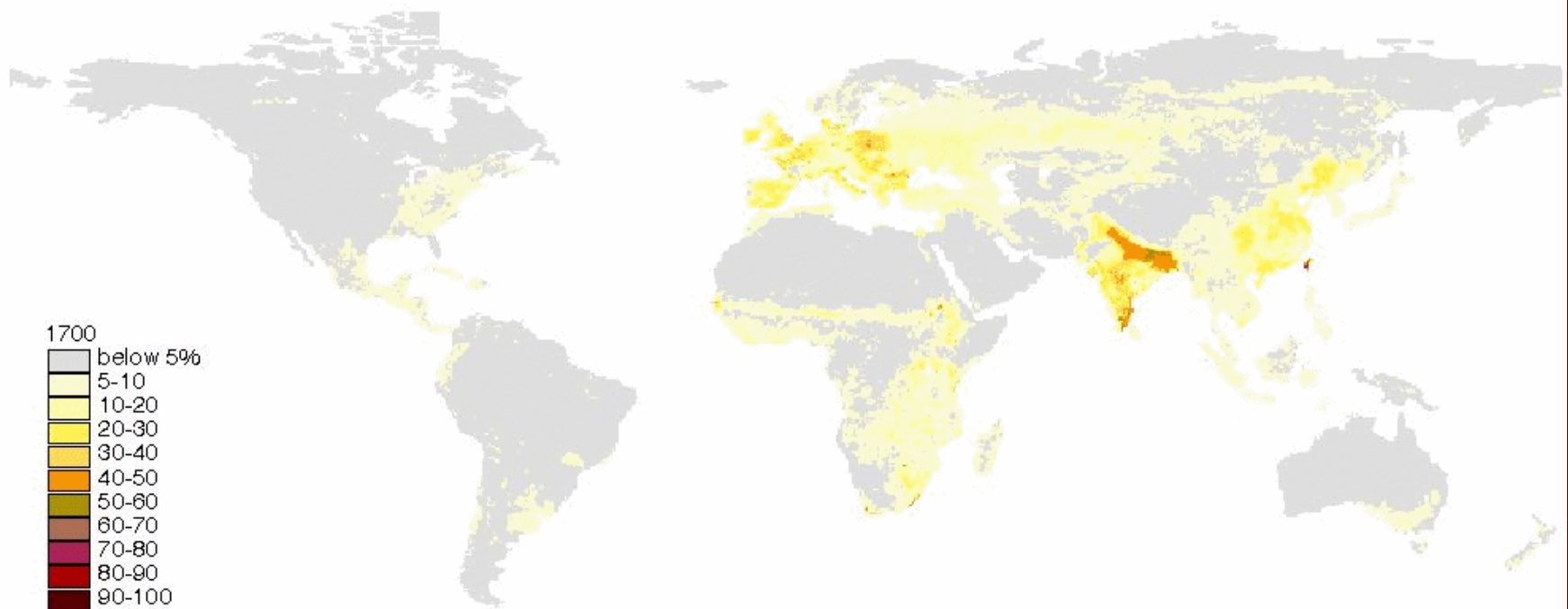
Population 2000, 2050 regional distribution



Expanding Cropland 1700-1990

Fraction of grid cell in croplands

Cropland 1700



Millennium Ecosystem Assessment Conceptual Framework



Ecosystems Provisioning Services

Goods produced or provided by ecosystems

■ Food

- Crops
- Livestock
- Capture Fisheries
- Aquaculture
- Wild Foods

■ Fiber

- Timber
- Cotton, hemp, silk
- Wood Fuel

■ Genetic resources

■ Biochemicals

■ Freshwater



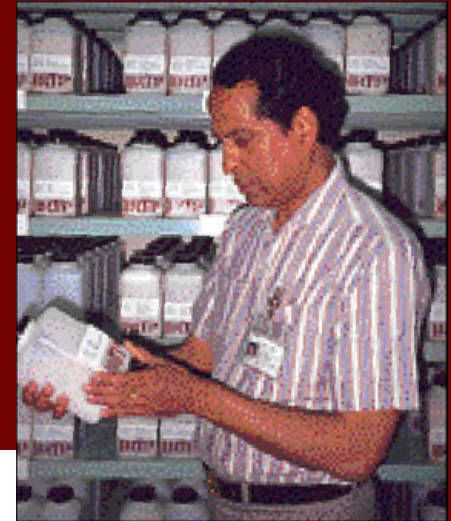
Ecosystems Regulating Services

Benefits obtained from regulation of ecosystem processes

- Air Quality Regulation
- Climate Regulation
 - Global (CO₂ sequestration)
 - Regional and local
- Erosion regulation
- Water purification
- Disease regulation
- Pest & Pathogens regulation
- Pollination
- Natural Hazard regulation



Intensive Mono Cropping



Agro-chemical Hazards and Biodiversity Loss

Intensive Meat and Fish Production



Valued at \$75 million, catfish production is a key industry for the Black Belt.



Aquaculture in the Tam Giang lagoon



Intensive Feeding : BSE, CJD, Bird Flue

Water Resources and Agriculture A Dysfunctional Relationship

Kg of water per Daily Food Diet

USA 5000

W Europe 4500

Asia 2100

Africa 1700

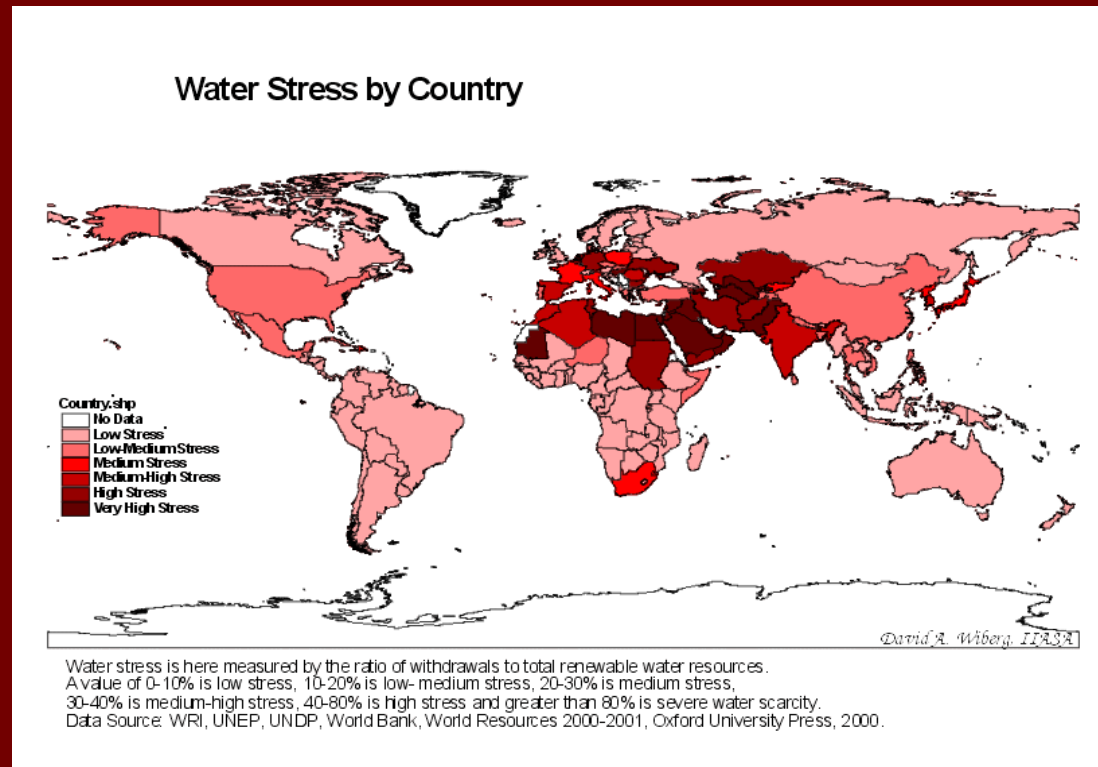
1 Kg of Rice 1900-4000 kg of water

1 Kg of Wheat 900-2000

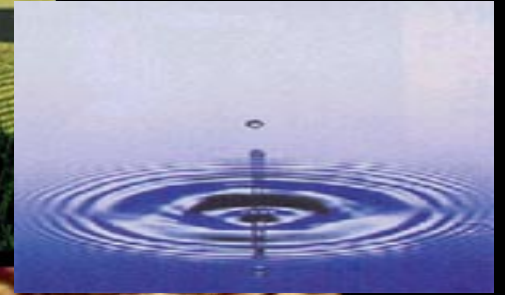
1 Kg of Potato 500-1500

1 Kg of Chicken 3500-5700

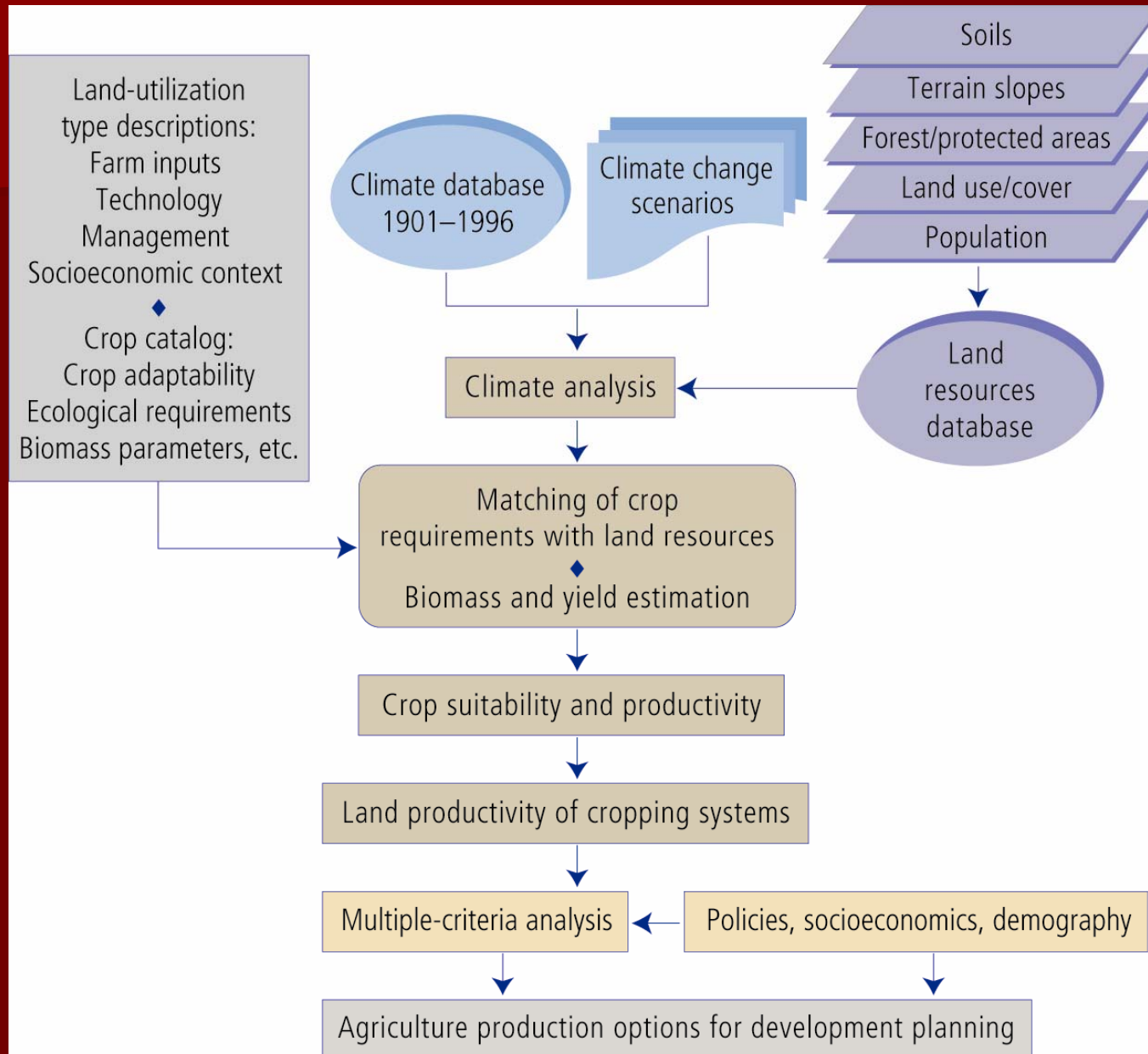
1 Kg of Beef 15000-70000



Food and Agricultural Sustainability

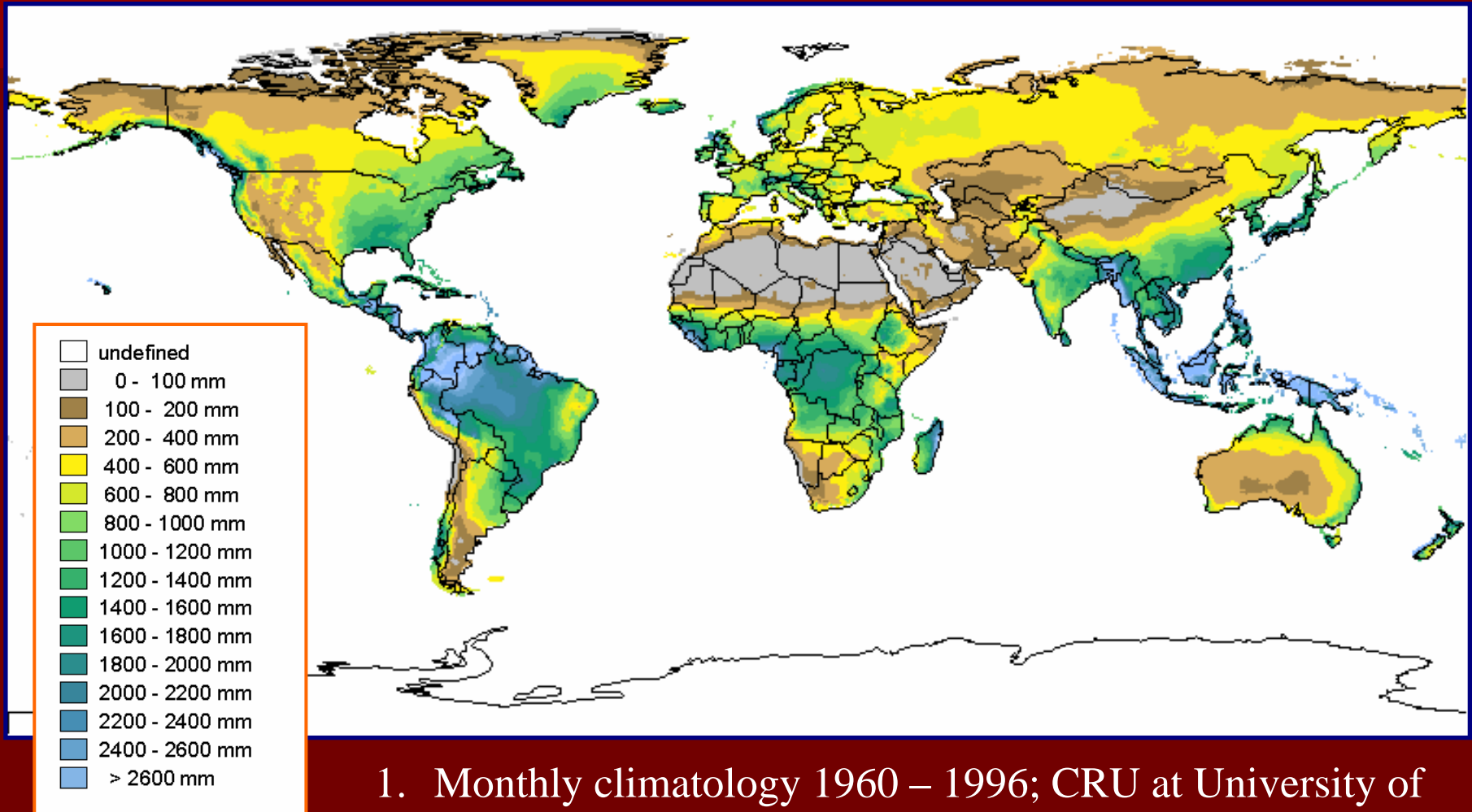


FAO-IIASA Global Agro-ecological Zones Methodology



Agro-ecological Zones Methodology

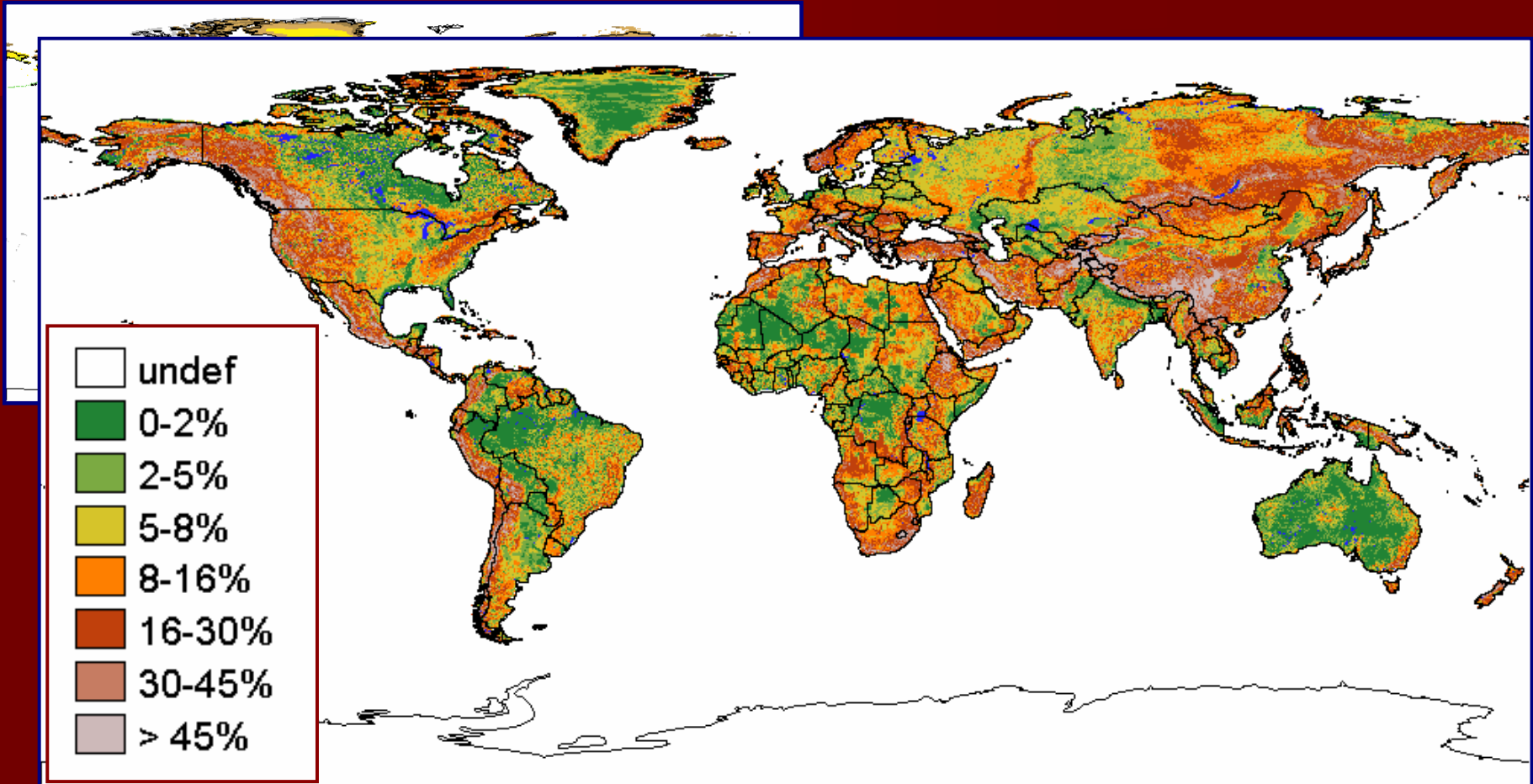
Geographical Data Layers



1. Monthly climatology 1960 – 1996; CRU at University of East Anglia; at 0.5 deg. latitude/longitude

Agro-ecological Zones Methodology

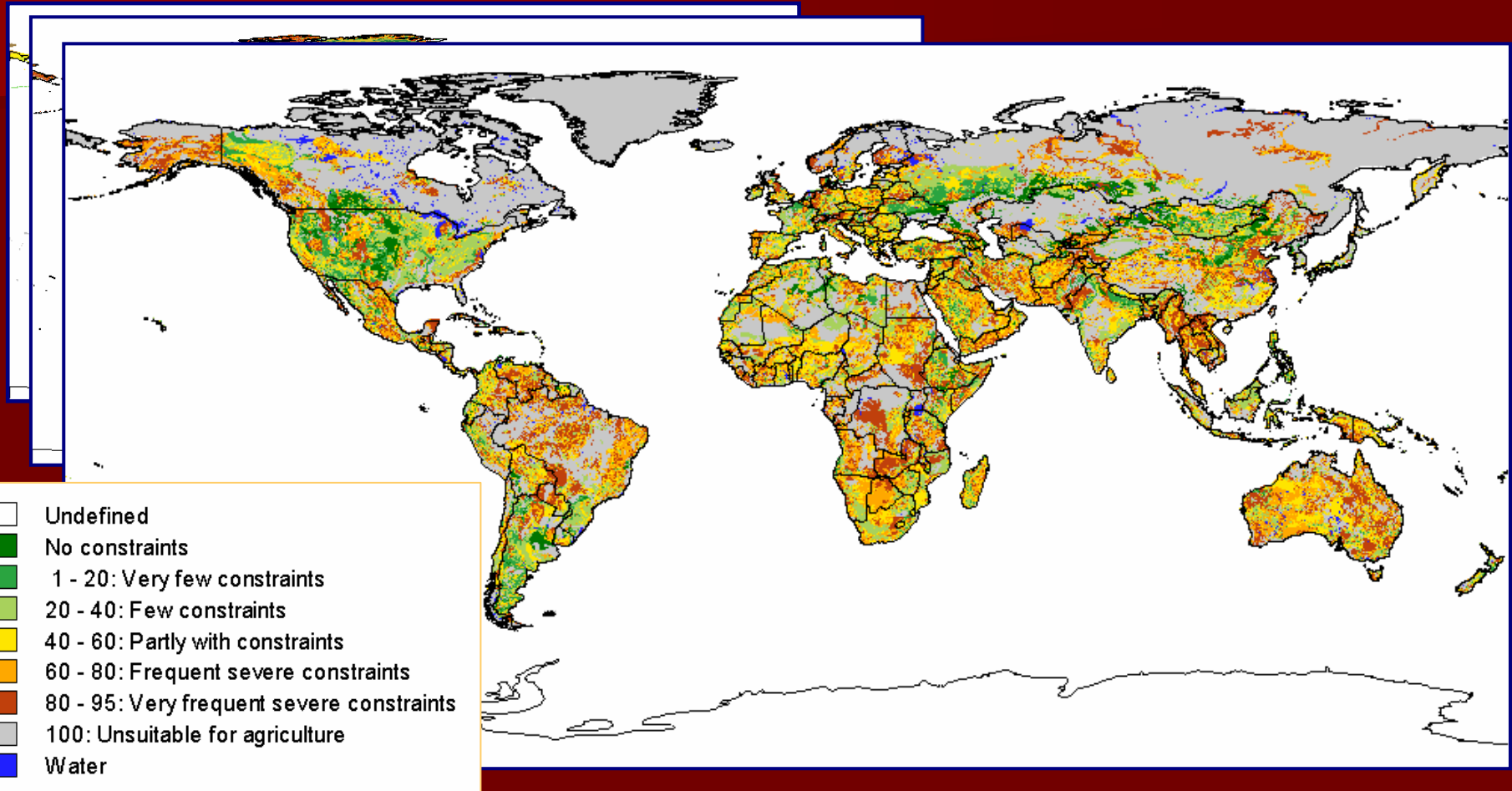
Geographical Data Layers



2. Terrain slope database; USGS Eros Data Center; digital elevation at 30 arc-seconds latitude/longitude

Agro-ecological Zones Methodology

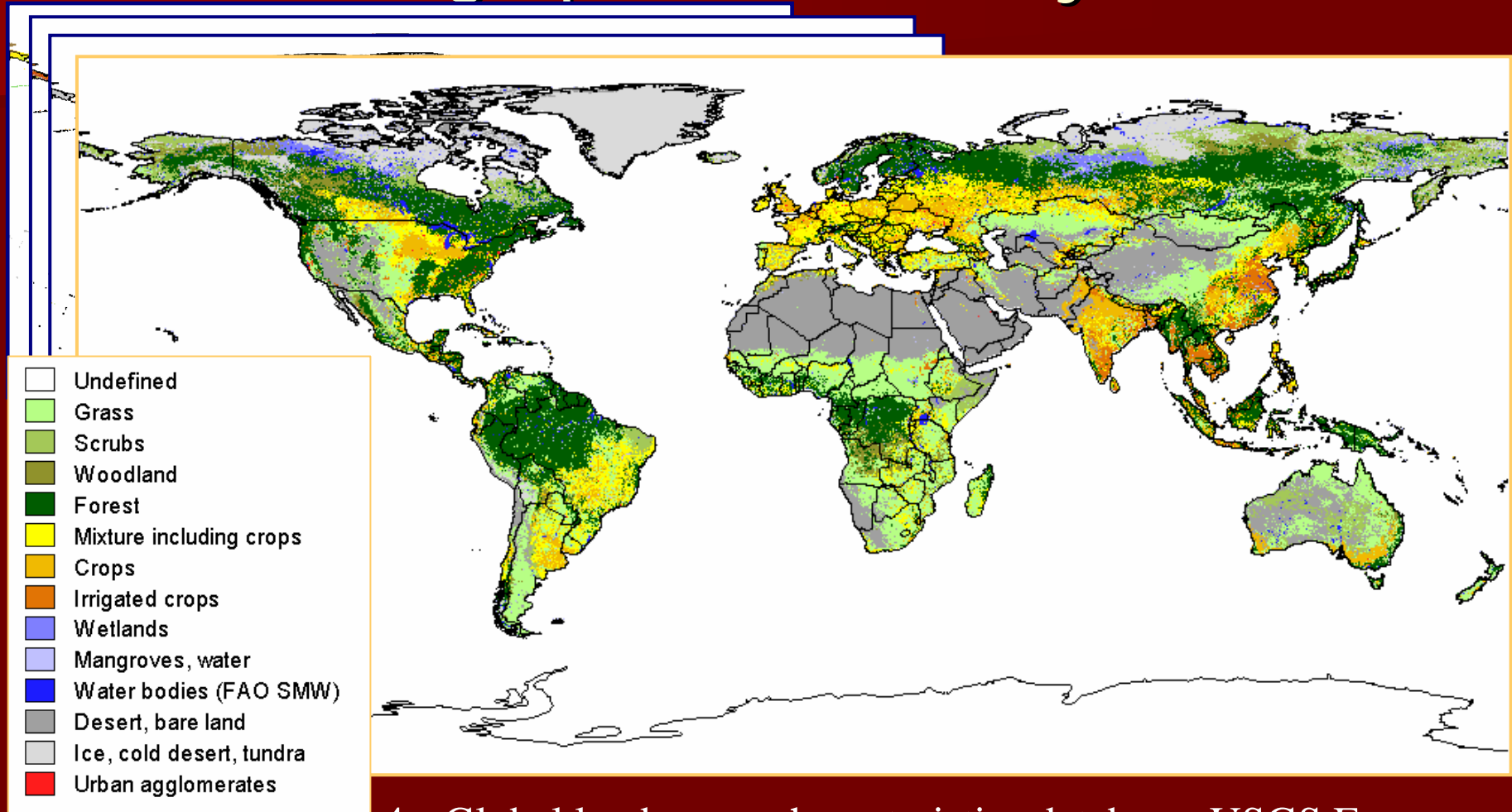
Geographical Data Layers



3. FAO/Unesco digital Soil Map of the World; UN Food and Agriculture Organization; at 5 arc-min. latitude/longitude

Agro-ecological Zones Methodology

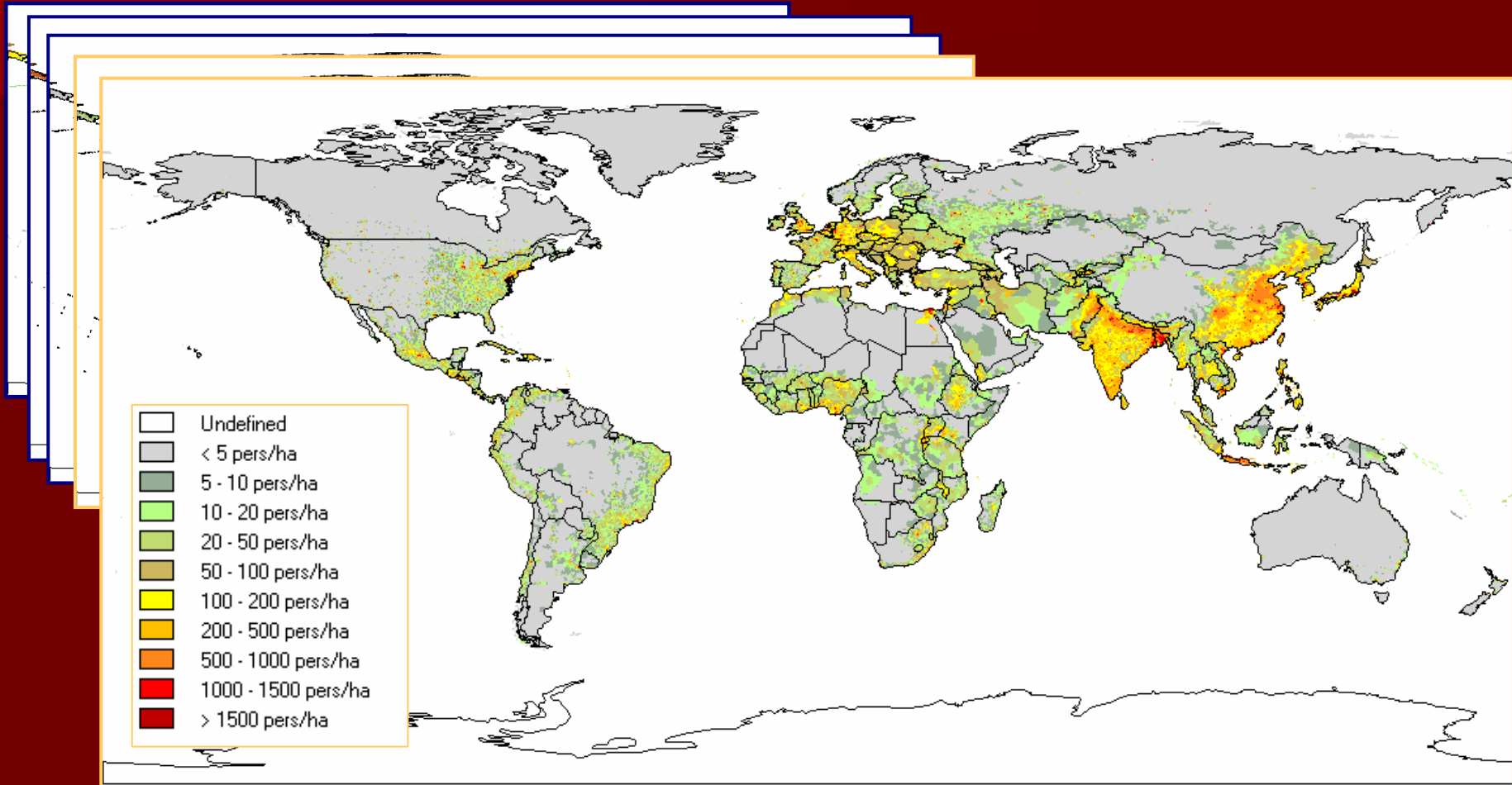
Geographical Data Layers



4. Global land cover characteristics database; USGS Eros Data Center; at 1 km resolution.

Agro-ecological Zones Methodology

Geographical Data Layers

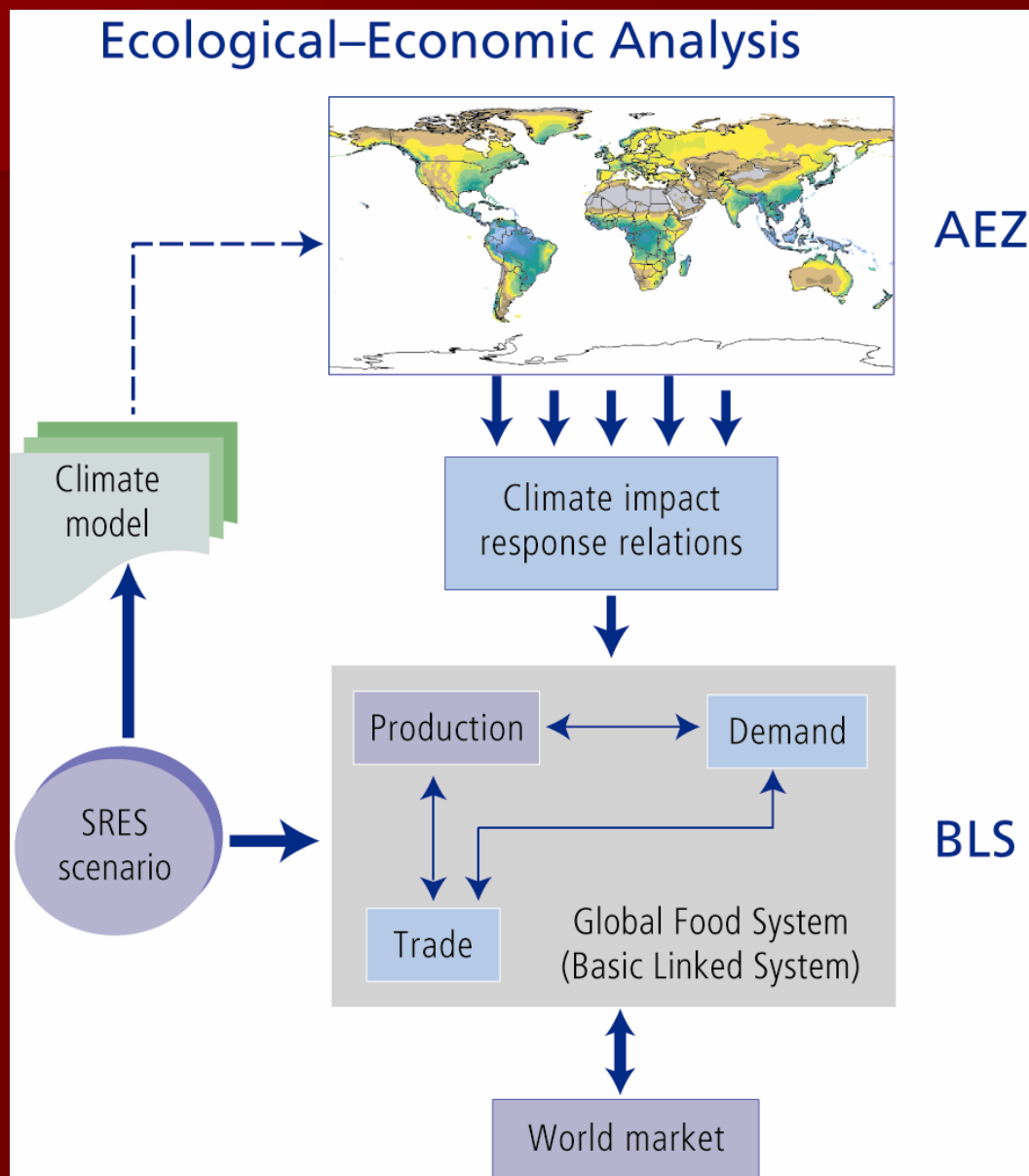


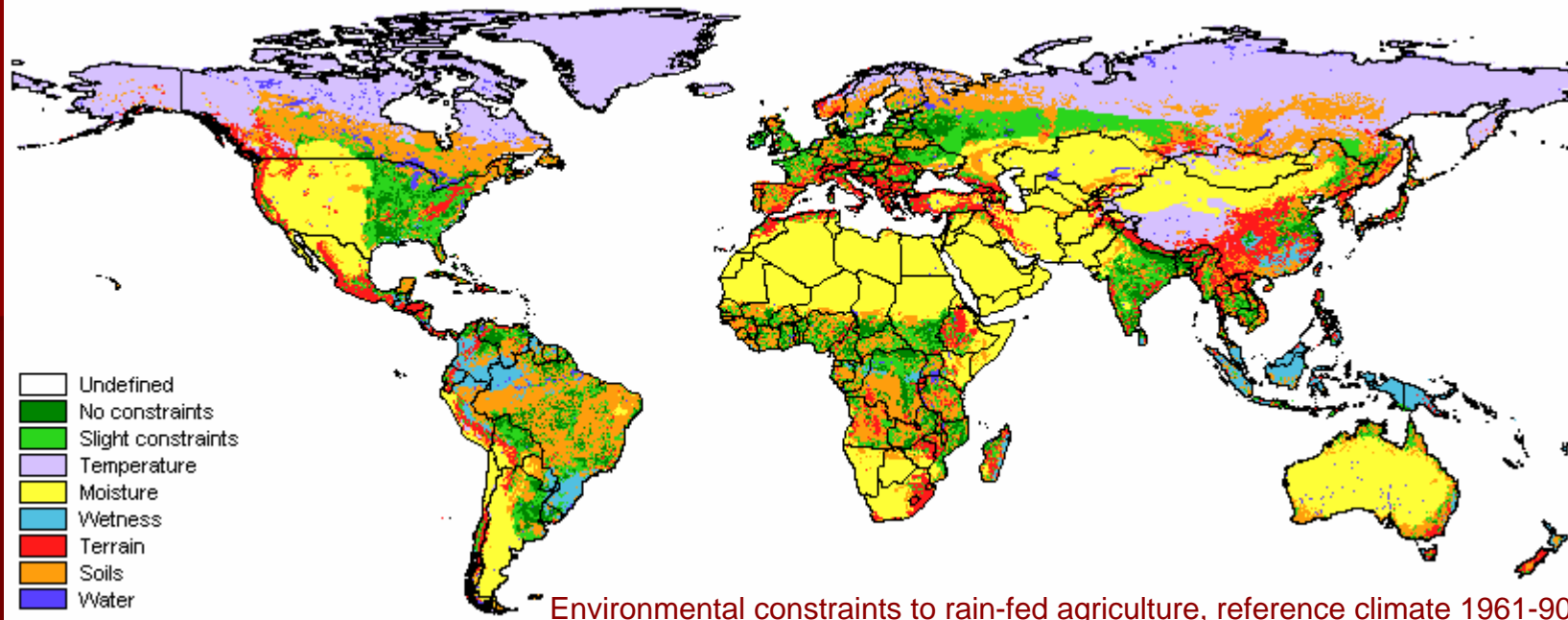
5. Global gridded population distribution data of 1995; CIESIN; at 2.5 arc-min. latitude/longitude resolution.

Global Agro-ecological Zones

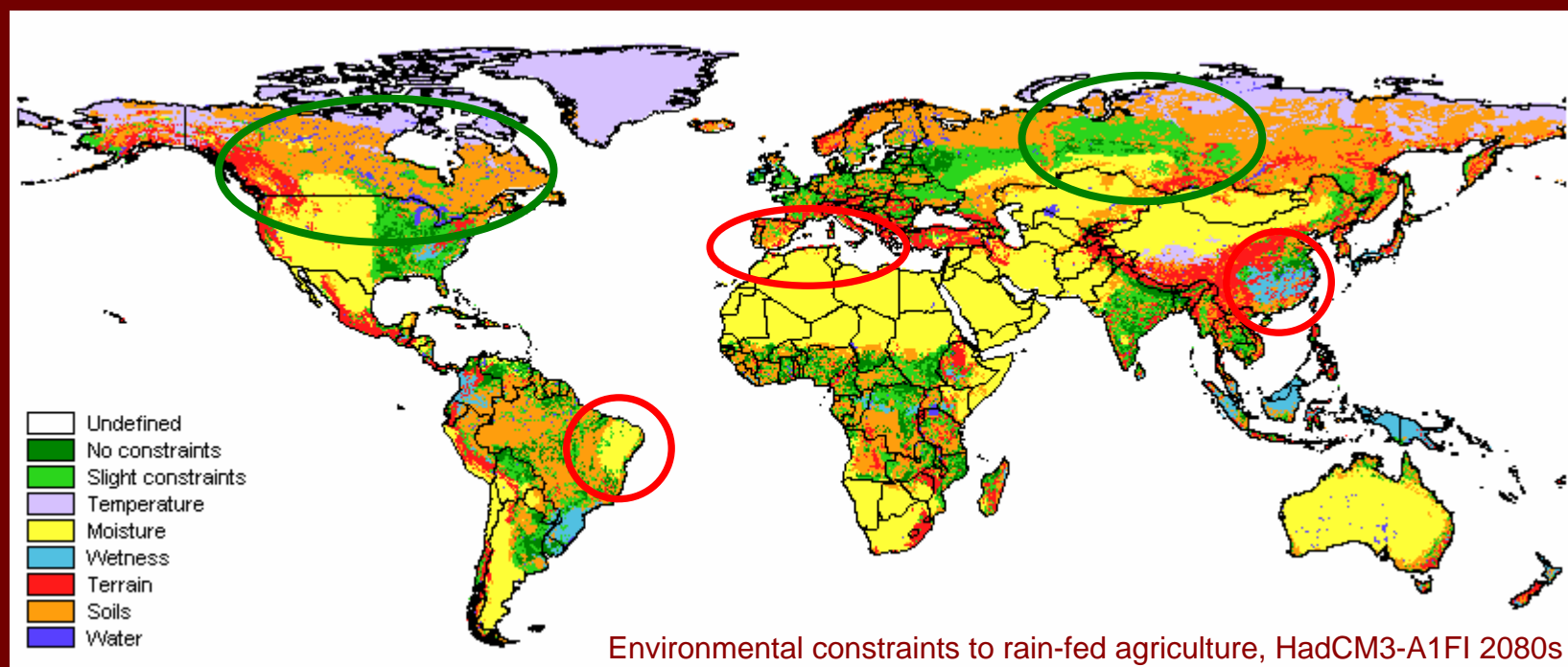
Environmental resources database
including climate, soil, terrain, and land cover
comprising 2.2 million grid cells,
assessing the agricultural potential
of food and fiber crops, pastures, trees etc
at three levels of farming technology.

Integrated ecological-economic Analysis of the Impact of Climate Change on Food and Agriculture Systems





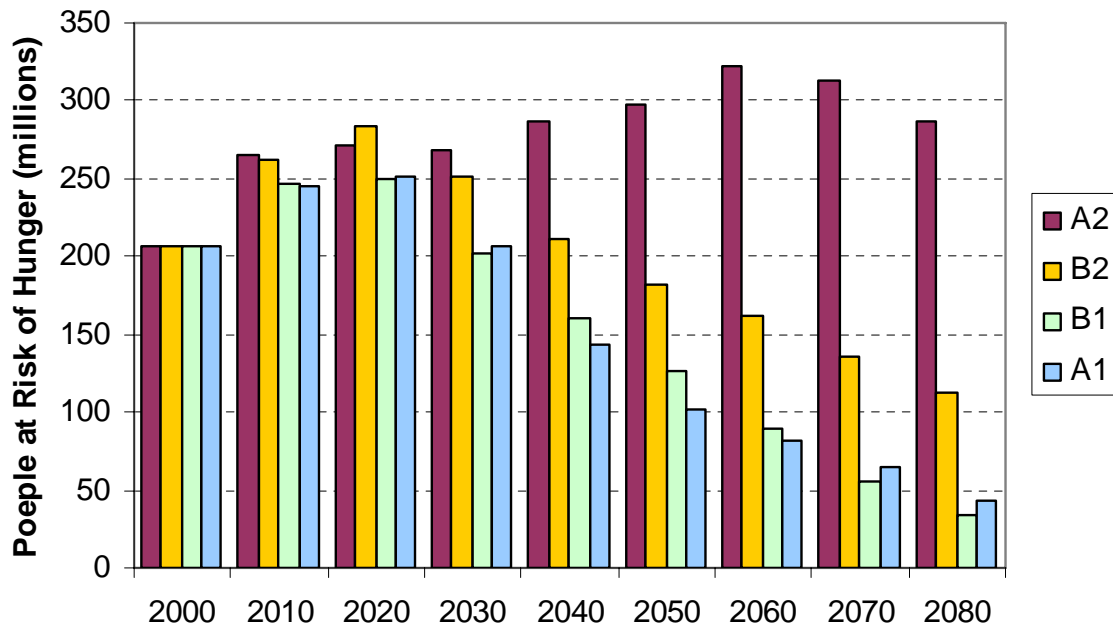
3.7



3.8

Number of People at Risk of Hunger

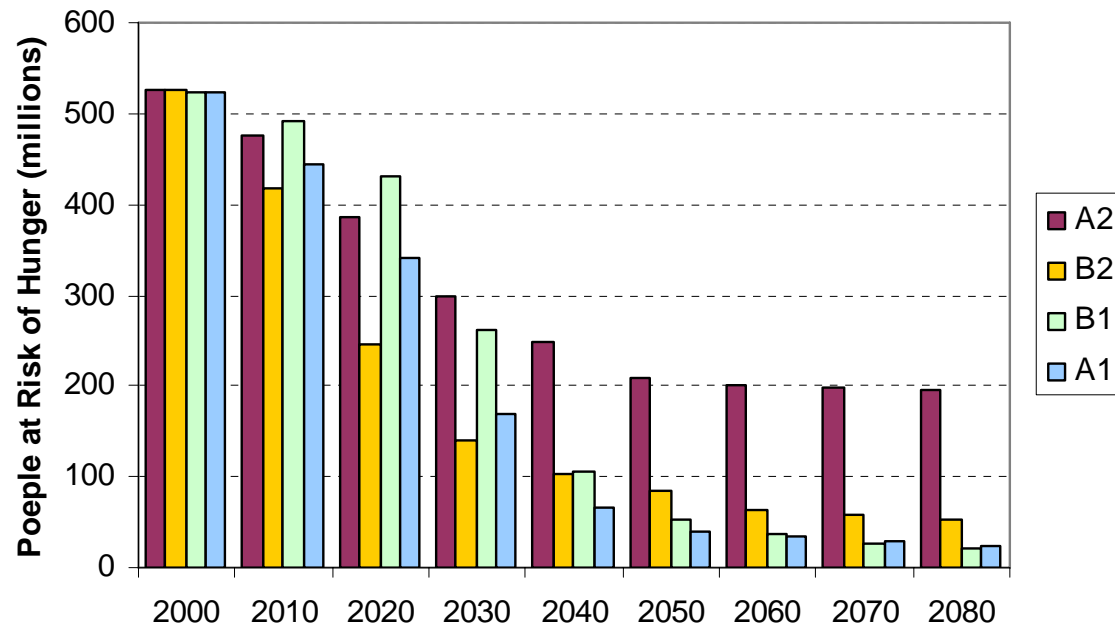
projected for different IPCC economic development paths



AFRICA

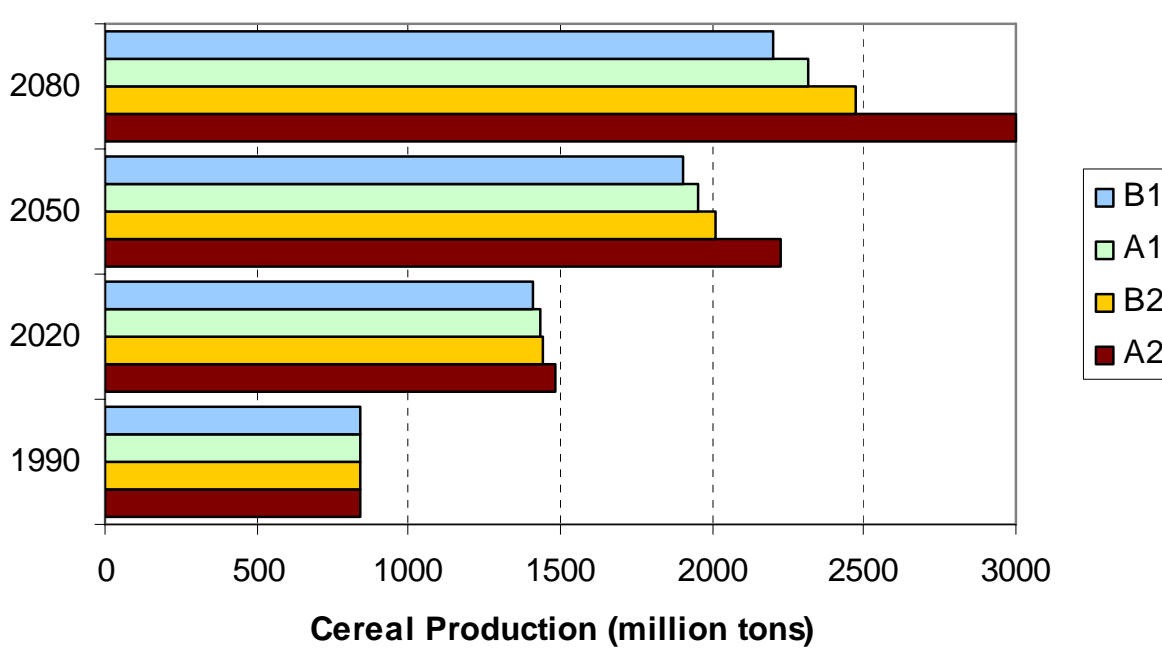
Source: Fischer et al., 2002

**SOUTH,
SOUTHEAST
and EAST
ASIA**



Cereal Production, Net Imports of Developing Countries

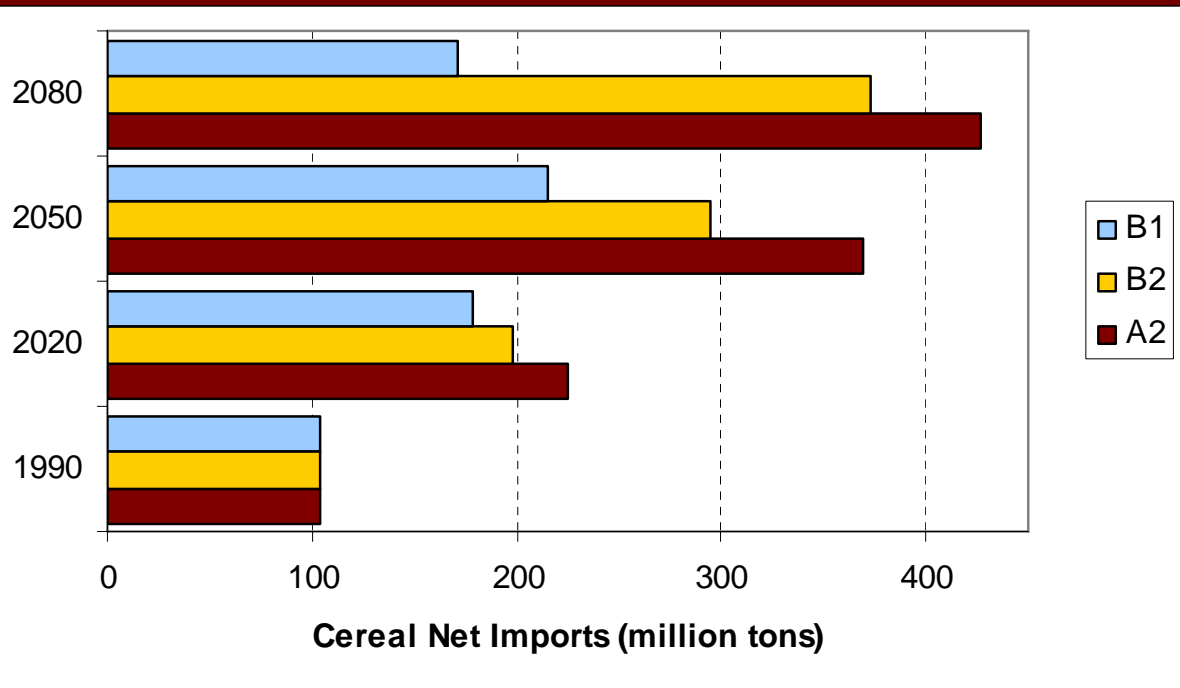
projected for different IPCC economic development paths



PRODUCTION

Source: Fischer et al., 2002

NET IMPORTS, CEREALS



Economic Impacts of Climate Change

Hadley A1F1 Scenario 2080

	% Ag GDP	% Cereal Production
World	-1.5	-1.4
Developed	-0.5	2.8
North America	7.5	1.3
Europe	-14.7	-3.4
Developing	-1.9	-3.9
Africa	-4.9	-0.6
Latin america	3.7	15.9
Asia	-4.3	-8.6

World Market prices(% change from Ref Scenario)

Cereals 19.5%

All crops 10.5%

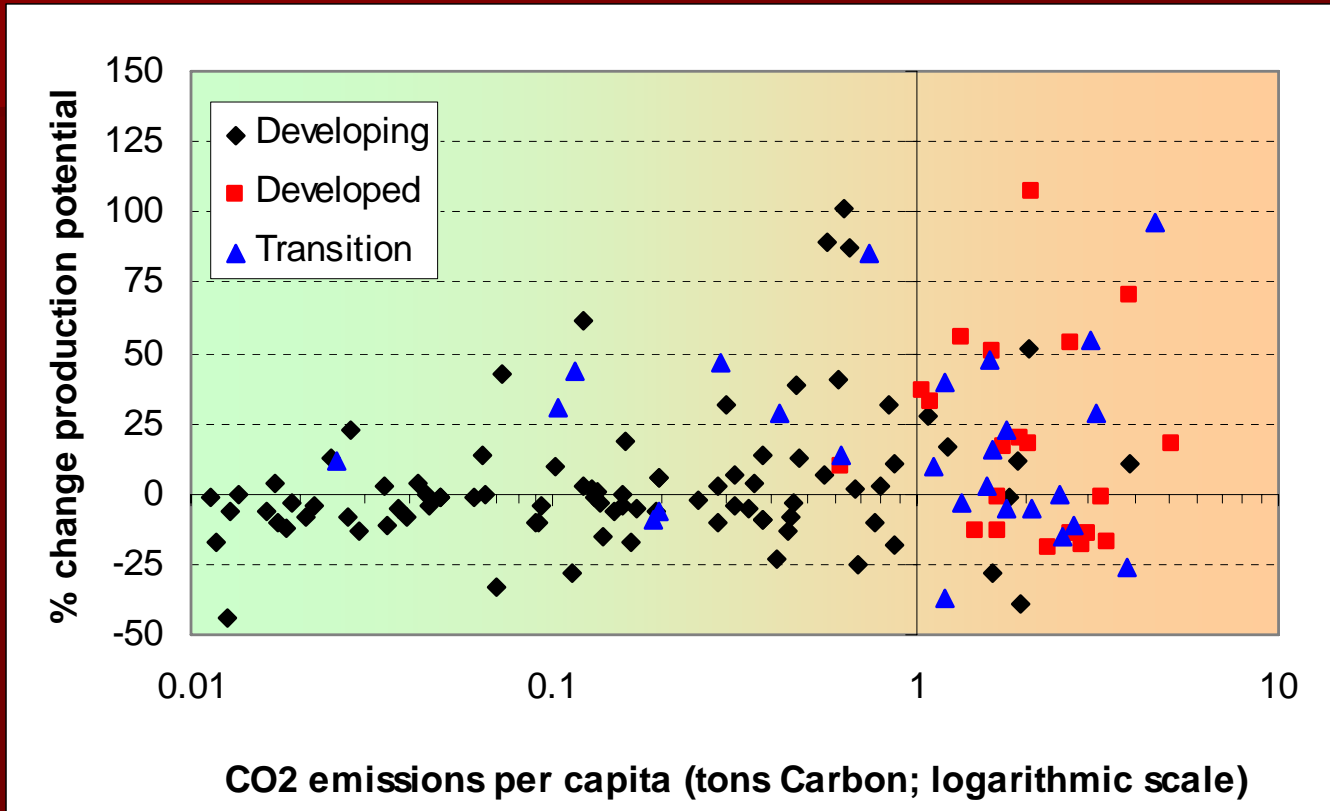
India: Climate Change Yield Impact - 2050

	Wheat	Rice	Maize	Pulses	Roots	Oil	Sugar
H3A1f	-22.8	2.8	-1.4	9.2	4.2	-2.5	-7.1
H3A2	-17.2	-2.1	-2.2	3.7	-10.7	-5.5	-6.9
H3B2	-15.9	-1.9	-2.3	5.0	-2.3	-4.0	-7.0
H3B1	-17.6	4.1	-0.6	6.8	8.1	0.8	-4.2
CSA1	-16.2	-0.4	-0.8	8.7	3.2	-2.0	-5.9
CSA2	-14.8	-2.2	-0.6	7.1	-0.6	-2.6	-6.9
CSB2	-15.1	-2.8	-0.8	6.6	3.2	-2.8	-7.0
CSB1	-16.0	-3.0	-2.0	4.1	-2.9	-4.2	-6.5
C2A2	-18.0	1.6	2.1	17.8	17.8	3.6	-8.0
C2B2	-17.5	3.5	1.5	17.6	18.4	3.7	-5.6
NCA2	-15.1	3.6	-0.1	12.7	21.4	1.2	-3.4
NCB2	-16.1	3.0	-0.9	10.7	20.1	-0.3	-3.2

Note: weighted yield impact for rain-fed and irrigated cultivation (% change).

Climate Change Impacts and Carbon Dioxide Emissions

ECHAM4, 2080s



(Fairness and Equity?)

Greenhouse gas emissions since 1950:

75% from developed countries, 25% from developing countries

Mozambique

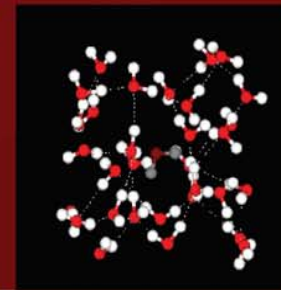
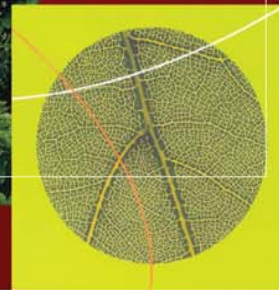
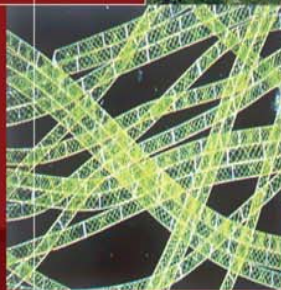
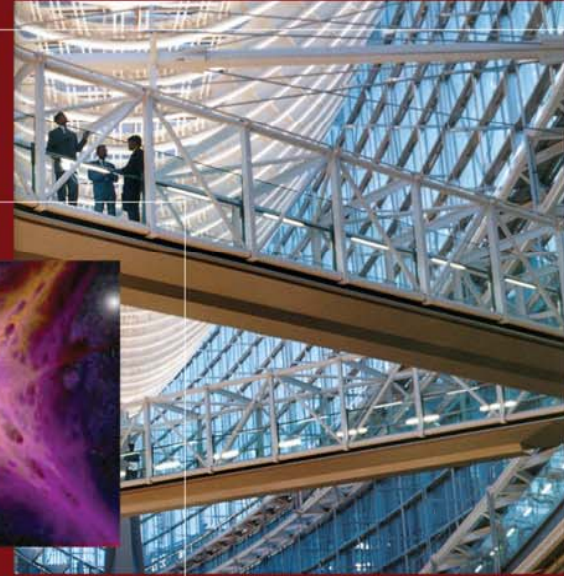
Population: 18 million (Year 2050: 28 million)
Undernourished: 14 million
Depth of Hunger: 420 calories per capita per day

GDP per capita: \$ 105
30% of GDP from Agriculture
75% of Population in Agriculture

1997 CO2 Emissions per capita
Mozambique 0.1 tons
Developing Countries 1.9 tons
OECD 11 tons

AEZ/Canadian Climate Change Results 2080
25% loss in cereal production

The web of life

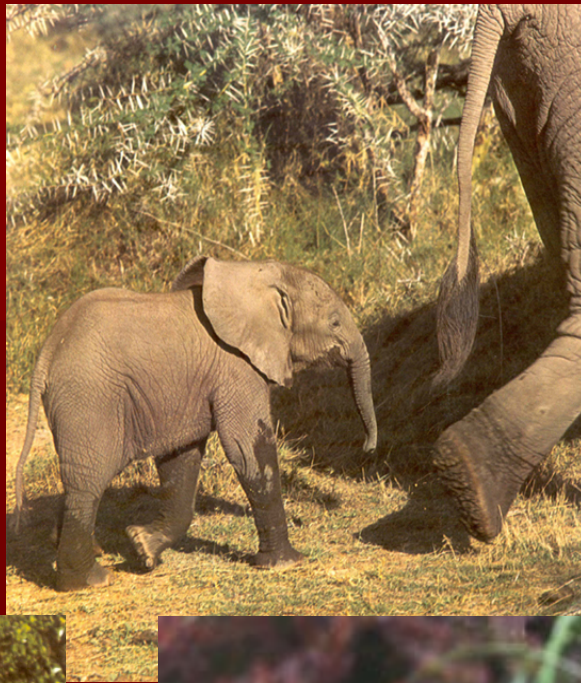


Human are but one species

In a world of millions and million of species

All inter-linked in the web of life on Earth

**Remembering and acting for those that have
no voice in their own survival
and in the future of our ONE Earth**



The Next Generation ?



**All life is precious
Healthy Eating for a world
Free from Hunger and Obesity**

**If the environment is destroyed
Human food will be threatened**

**And the first to perish
Will be our closest relative**