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# **Global Challenges of the XXI Century: Food Vulnerability, Climate Change and Sustainability**

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Science and Technology (RETAC)**

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2. Sustainable development
3. What is a widening, deepening and sectorialization of security?: some definitions
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6. Food production paradigms
7. How could climate change affect food security?
8. Public policy of mitigation and adaptation
9. Top-down and bottom-up strategies to food sovereignty and sustainable development

# Global Environmental Change (GEC)

## Ecosphere

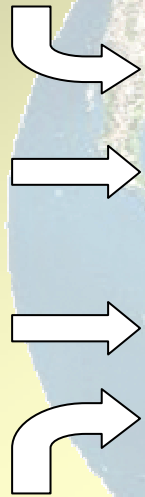
Atmosphere

**Climate  
Change**

Hydrosphere

Biosphere

Lithosphere  
Pedosphere



## Anthroposphere

Societal  
Organisation

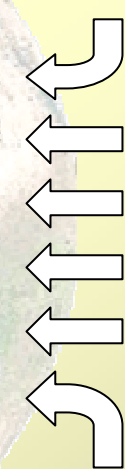
Economy

Transportation

**Population**

Science &  
Technology

Psychosocial  
Sphere

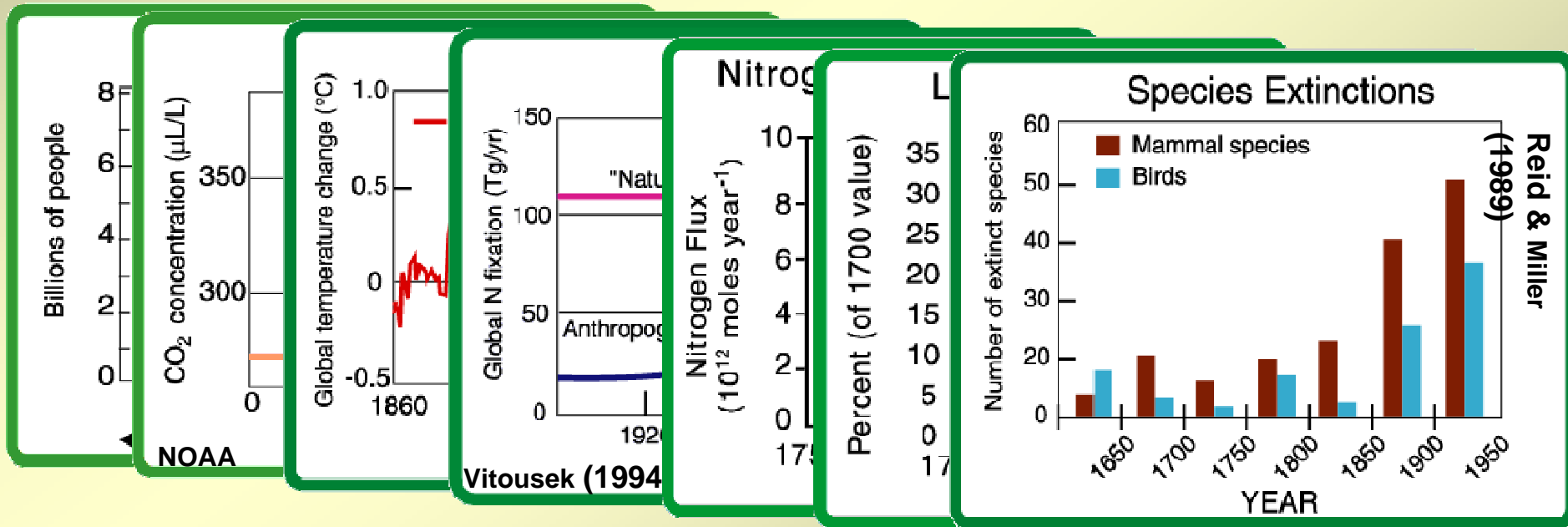


**Global  
Environmental  
Change**

**GEC poses threats, challenges, vulnerabilities and risks for international, national and human security and survival**

# What is Global Environmental Change:GEC

- GEC is more than climate change
- Includes the natural **plus** the human components
- Represents a constellation and interaction of multiple domains:



**UN Brundtland Commission:** “Development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs” (1987: 5).

**Outcome** 6 decades of development; 3 decades of sustainable development:

- 1 billion of the world’s population live in a consumer society
- 5.4 billions are poor
- 1 billion with hunger (100 million people more in 2009), illness and lack of school education and future
- 1 billion without safe water
- 1.5 million children die/year due to water-born illnesses
- 2.4 billion without improved sanitation
- present financial crisis raised unemployment by 250 million
- disasters increased & affected more developing countries

# 50 Indicators of Sustainability

Theme	Sub-theme	Indicator
Atmosphere (9)	Climate change	Emissions of greenhouse gases
	Ozone layer depletion	Consumption of ozone-depleting substances
	Air quality	Ambient concentration of air pollutants in urban areas
Land (10)	Agriculture (14)	Arable and permanent crop land area
		Use of fertilizers
		Use of agricultural pesticides
	Forests (11)	Forest area as a percent of land area
		Wood harvesting intensity
	Desertification (12)	Land affected by desertification
	Urbanization (7)	Area of urban formal and informal settlements
Oceans, seas and coasts (17)	Coastal zone	Algae concentration in coastal waters
		Percent of total population living in coastal areas
Fresh water (18)	Fisheries	Annual catch by major species
	Water quantity	Annual withdrawal of ground and surface water as a percent of total available water
		Water quality
Biodiversity (15)	Ecosystem	Area of selected key ecosystems
		Protected area as a % of total area
	Species	Abundance of selected key species

# Security an object of analysis

- **Security is an ambiguous and highly contested political and scientific concept.**
  - Security is a value, a goal and a legitimizer of policies
  - What are the reasons for the global reconceptualization?
- **Reconceptualization of security occurs due**
  - a) Peace and security: Charter of UNO after WW Two
  - b) End of Cold War: Change of international order
  - c) Globalization: Non-state actors & processes beyond sovereignty
- **Since 1994: major shift from state-centred inter(national) to human security** **Since 2000: Securitization of issues of global environmental change: environmental, climate, water, food, soil security**

# Defining security as: term, concept, value, goal and means?

## Scientific concept

- A term: **Security** (lat.: *securus* and *se cura*)
- Introduced: **Cicero & Lucretius** referring to a **philosophical & psychological state of mind**
- **Political concept: Pax Romana**
- ‘Security’ as a **political value** has no independent meaning; is related to **individual/societal value systems**
- **UN Charter (1945): 2 referents:**
  - Preamble: “we the peoples of UN”
  - Art. 1: purpose: “maintain international peace and security”.
  - Human vs. international security
- **Social science:** *security* is **ambiguous and elastic** in its meaning (Art 1993)
- Refers to frameworks, dimensions, issue areas, societal conventions, changing historical conditions and circumstances

## Political concept

- **Tool to legitimate** public funding for an accepted purpose: safety, protection (military and police)
- **Political acceptability** (support) **gaining and regaining power**



# What is security?

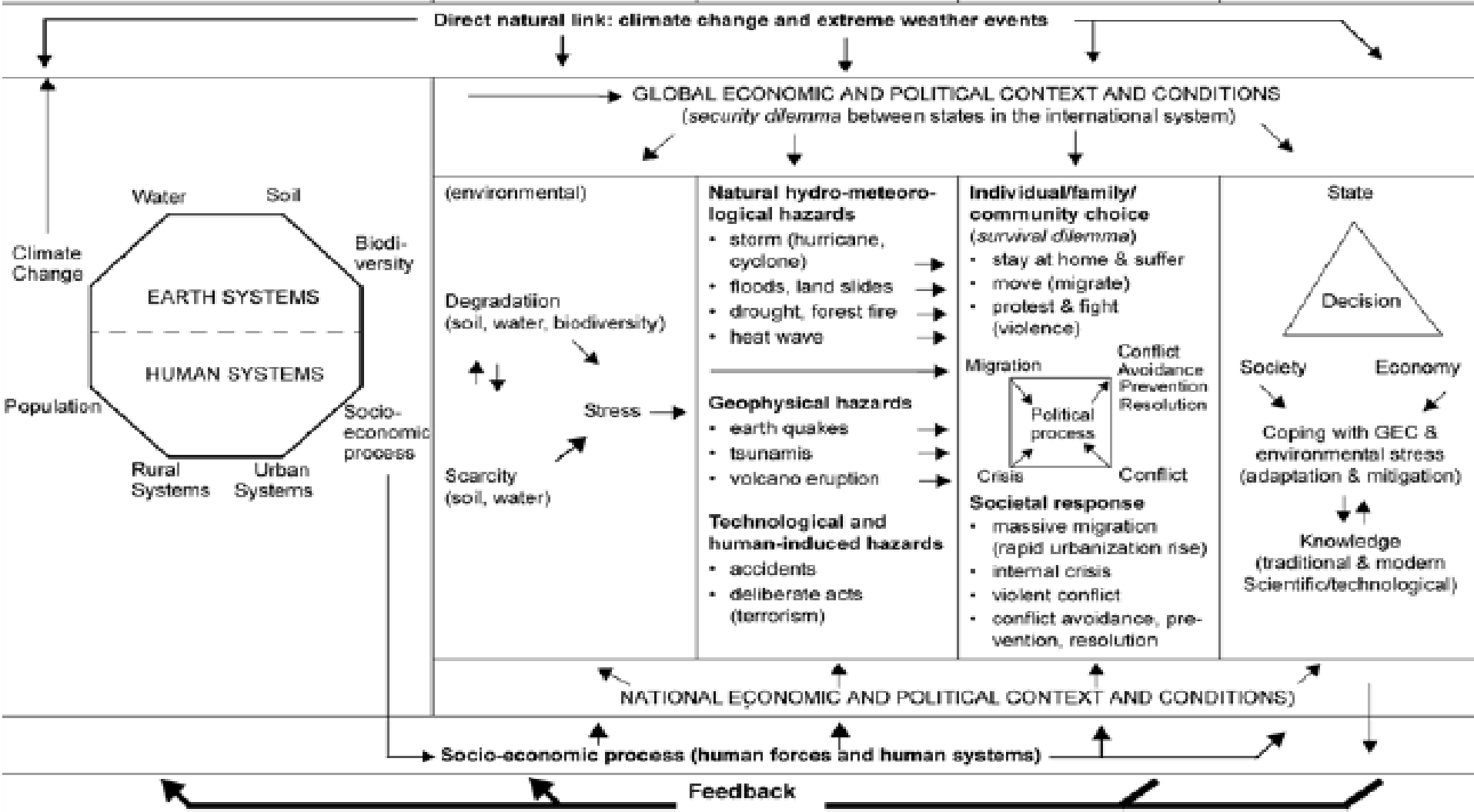
- Arnold Wolfers (1962), realist pointed to two sides of security concept: “Security, in an **objective sense**, measures the absence of **threats** to acquired values, in a **subjective sense**, the absence of **fear** that such values will be attacked”.
- Absence of “threats”: interest of policy-makers
- Absence of “fears”: interest of social scientists, especially of constructivists: “Reality is socially constructed” and is **intersubjective**.

# HUGE: Widening and deepening security concepts

<b>Determination</b> <b>Which security?</b>	<b>Reference object:</b> <b>Security of whom?</b>	<b>Value at risk:</b> <b>Security of what?</b>	<b>Source(s) of threat:</b> <b>Security from whom or what?</b>
<b>National security</b>	<b>The State</b>	<b>Territorial integrity</b>	<b>State, substate actors</b>
<b>Human security</b>	<b>Individual, humankind</b>	<b>Survival of humankind people</b>	<b>Nature, state, globalization</b>
<b>Environmental security</b>	<b>Ecosystems, rural and urban systems, water and food</b>	<b>Sustainability</b>	<b>Humankind, Nature</b>
<b>Gender security</b>	<b>Gender relations, indigenous people, minorities</b>	<b>Equity, identity, social relations, solidarity, tolerance</b>	<b>Patriarchy, totalitarian institutions (élites, governments, religious fundamentalism, dominant cultures), intolerance</b>

# Security Risks: PEISOR Model

Pressure	Effect	Impact	Societal Outcome	(Policy) Response
Causes of Global Environmental Change (GEC)	Socio-economic interaction Environmental scarcity, degradation and stress	Natural and human-induced hazards	Individual choice ( <i>survival dilemma</i> ) Societal response	National and international political process, state, societal and economic actors and knowledge



# Complex Human & Natural Interrelation

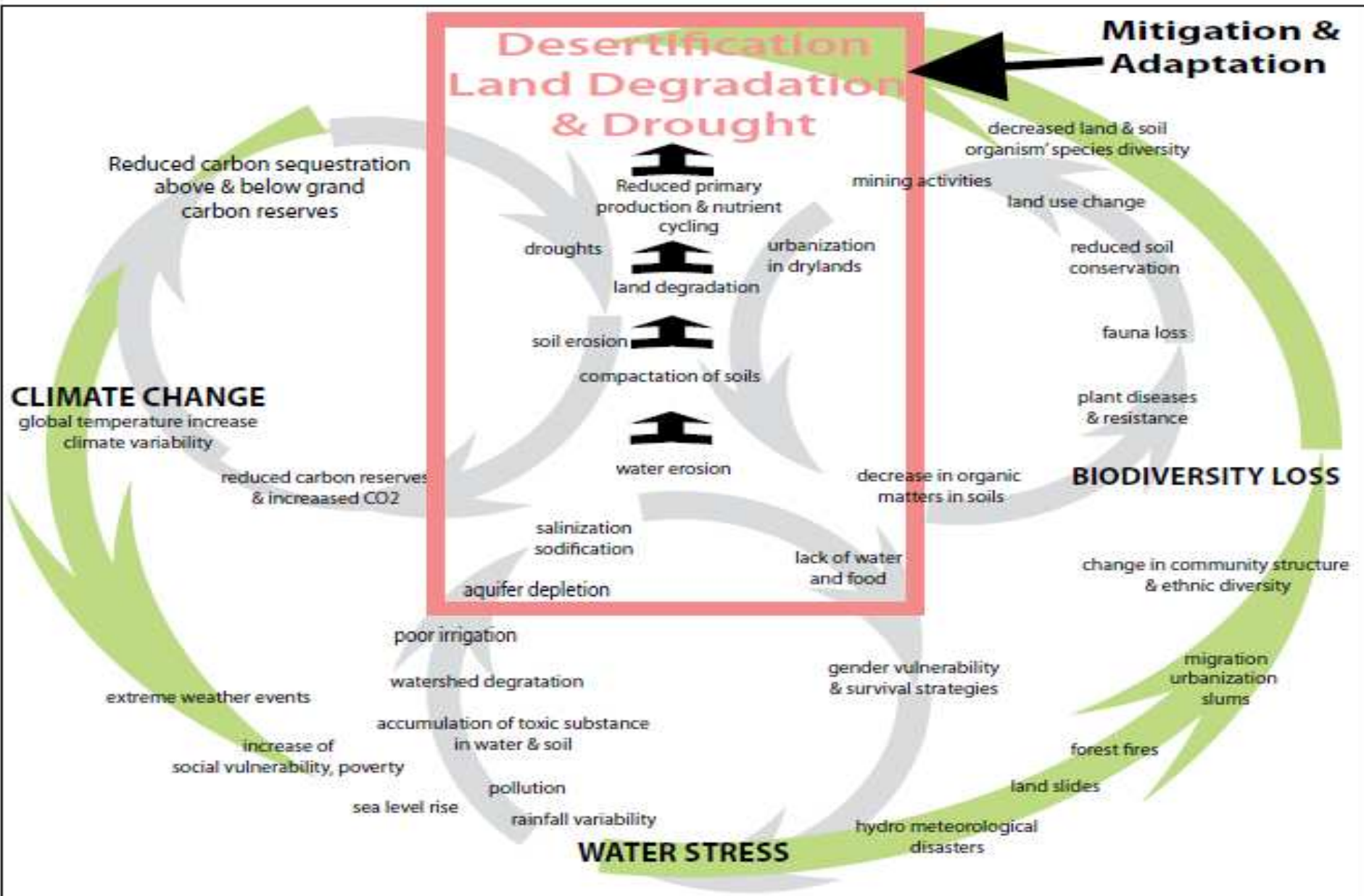
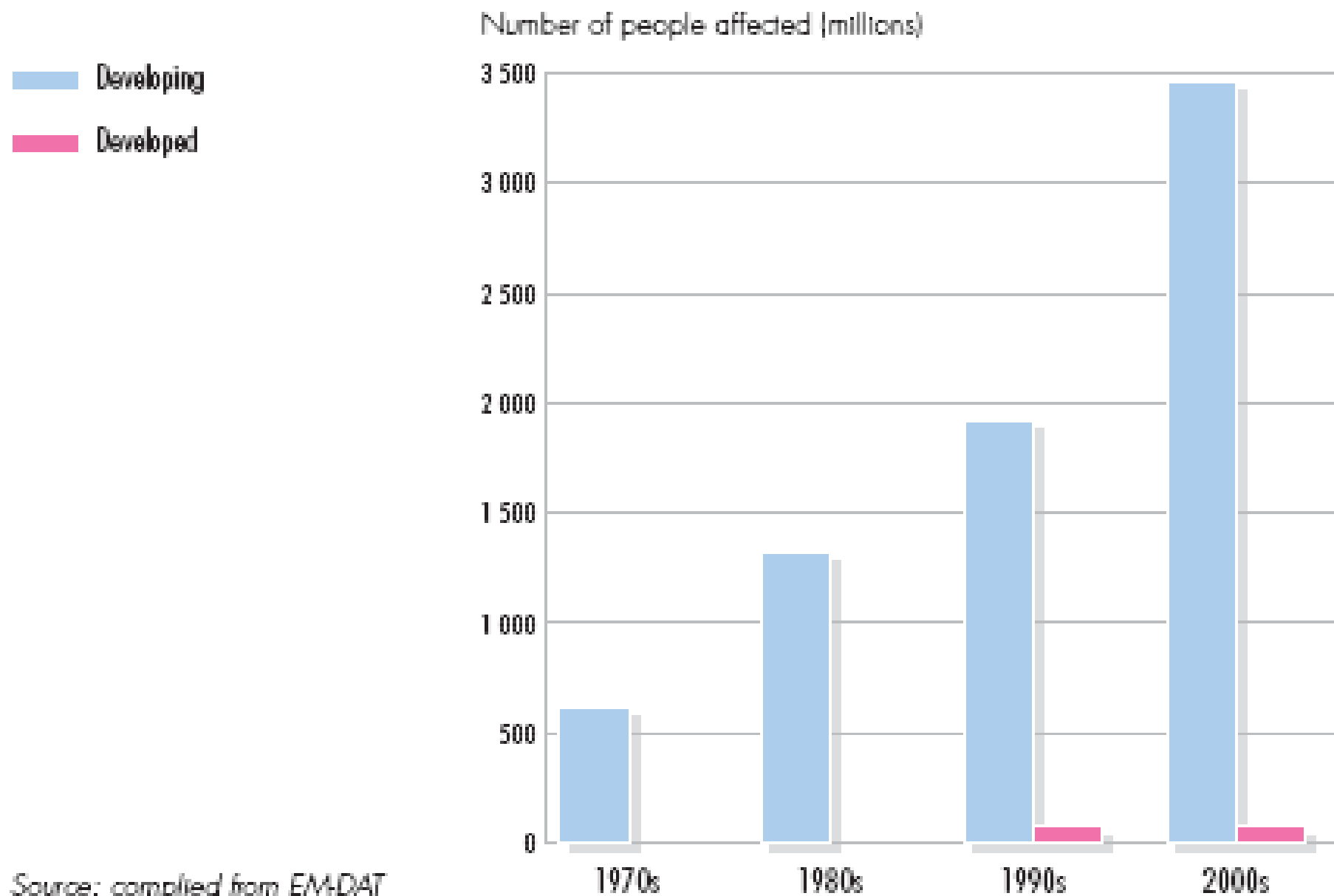


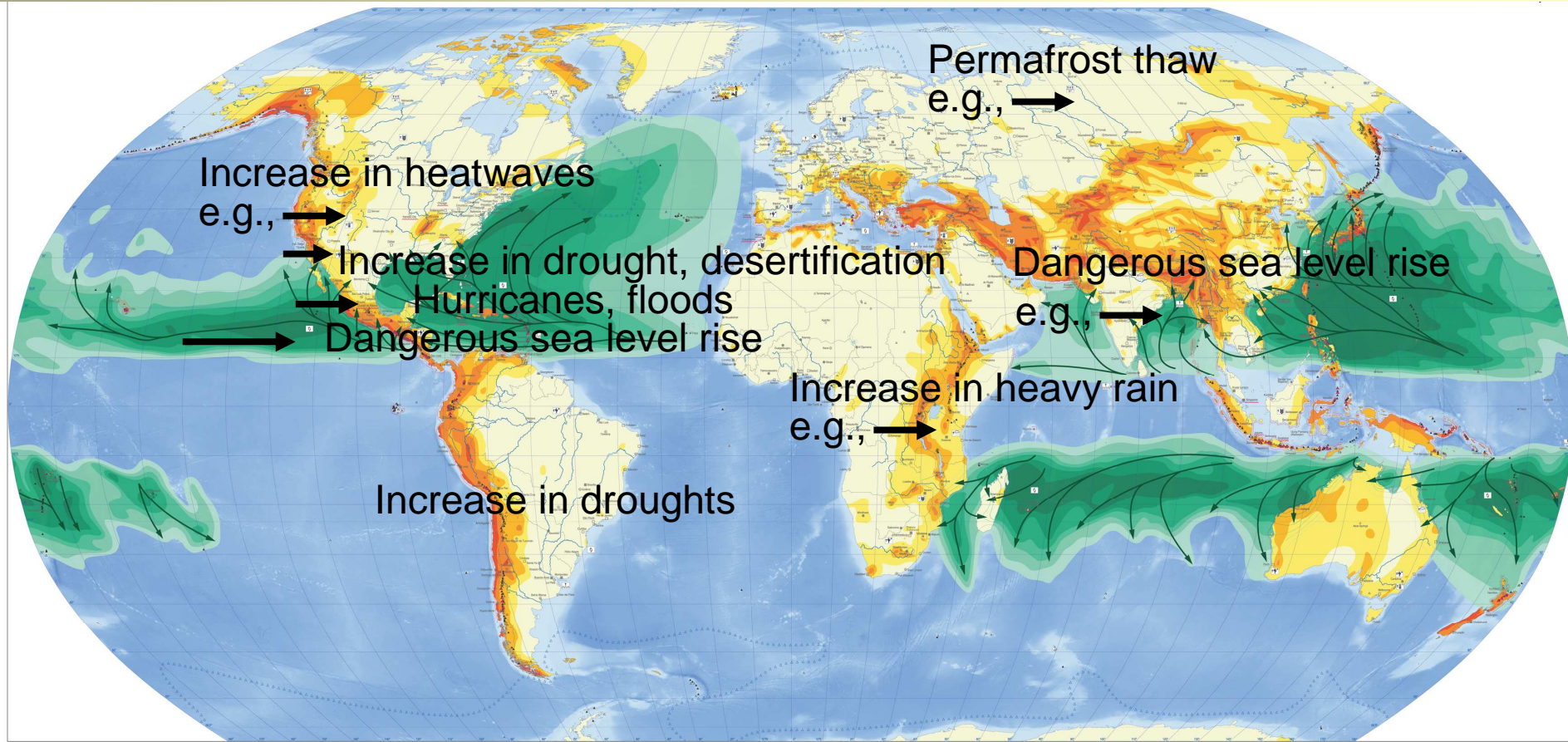
Figure 8.5 Number of people affected by climate-related disasters in developing and developed countries



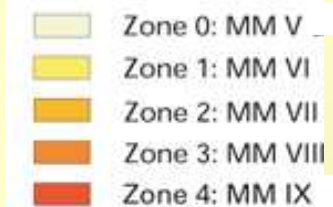
Source: compiled from EM-DAT



# Climate Threats, Disasters and Impacts

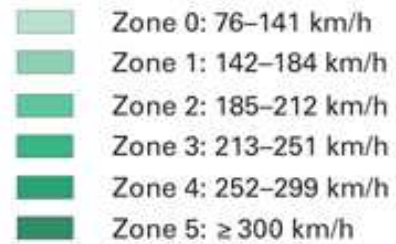


## Earthquakes



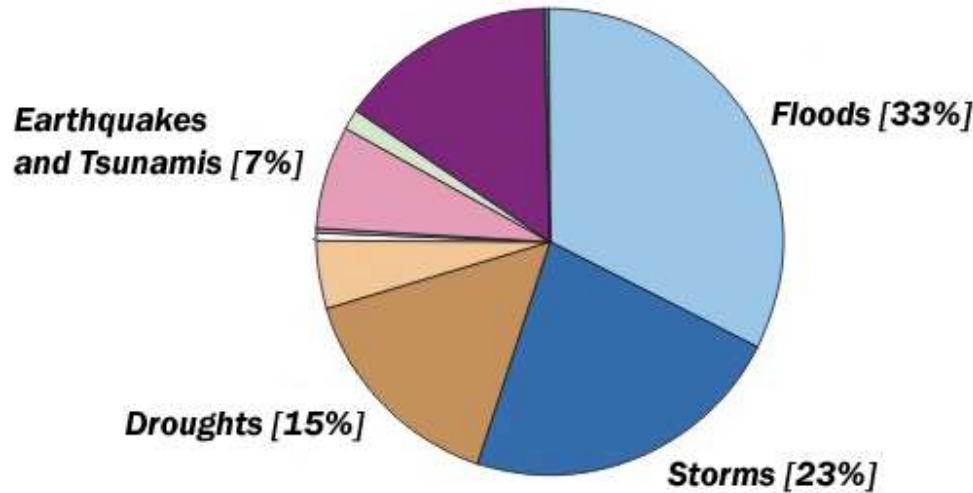
MM: modified Mercalli scale

## Tropical Hurricanes

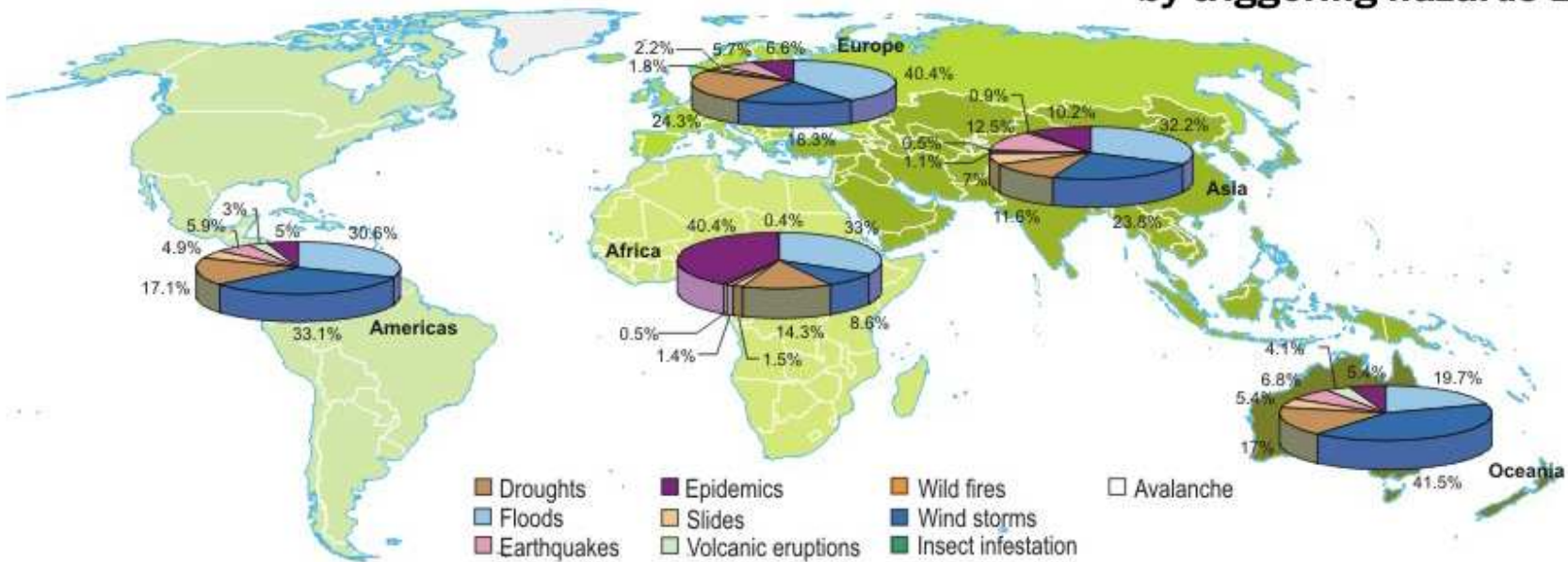


Münchener Rück  
Munich Re Group

# Distribution of disasters 1994-2003



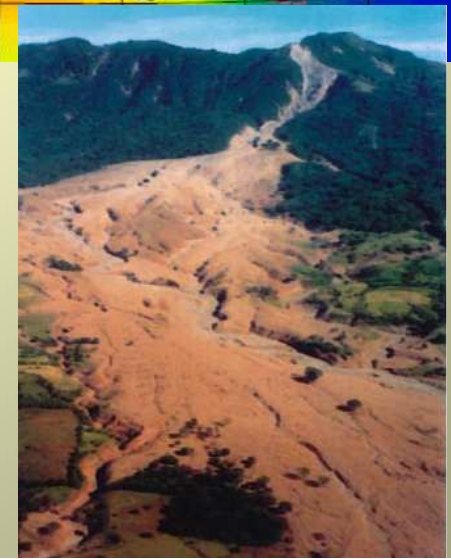
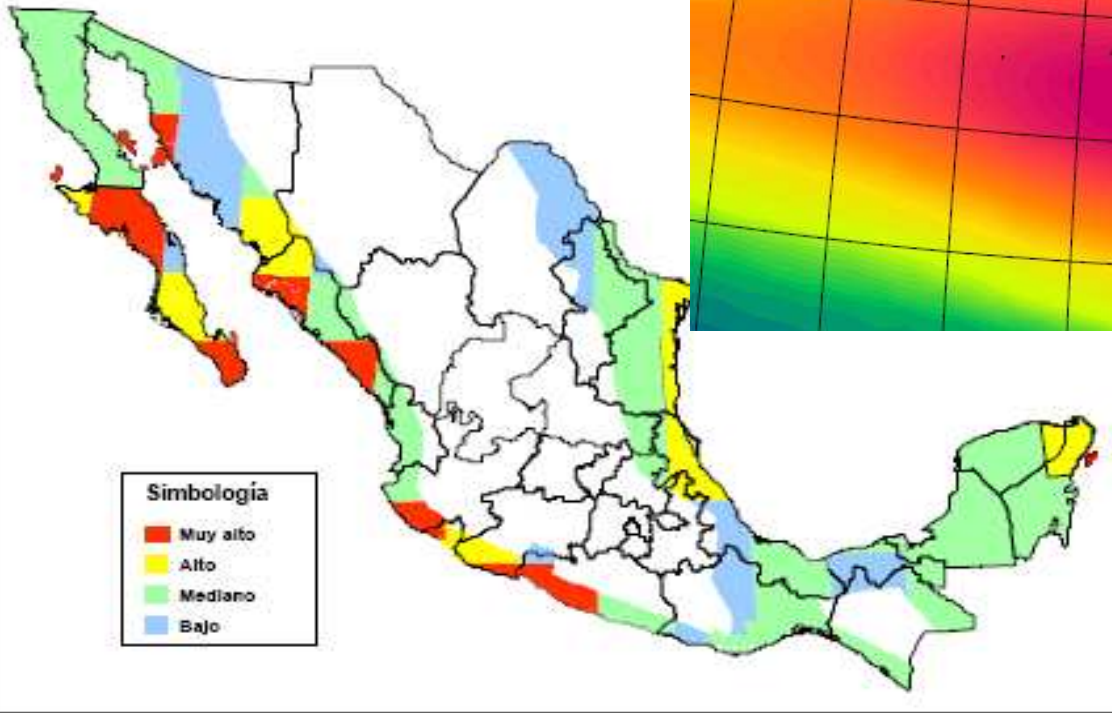
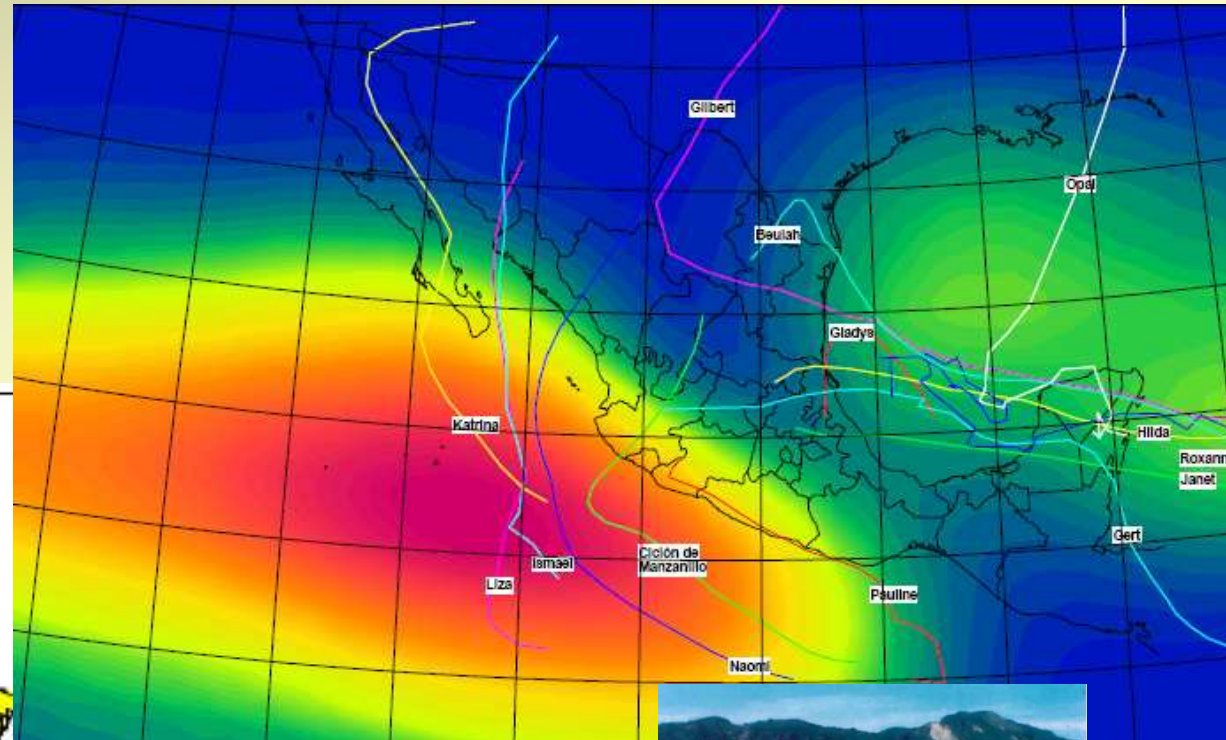
**Regional distribution of disasters: by triggering hazards 1994-2003**





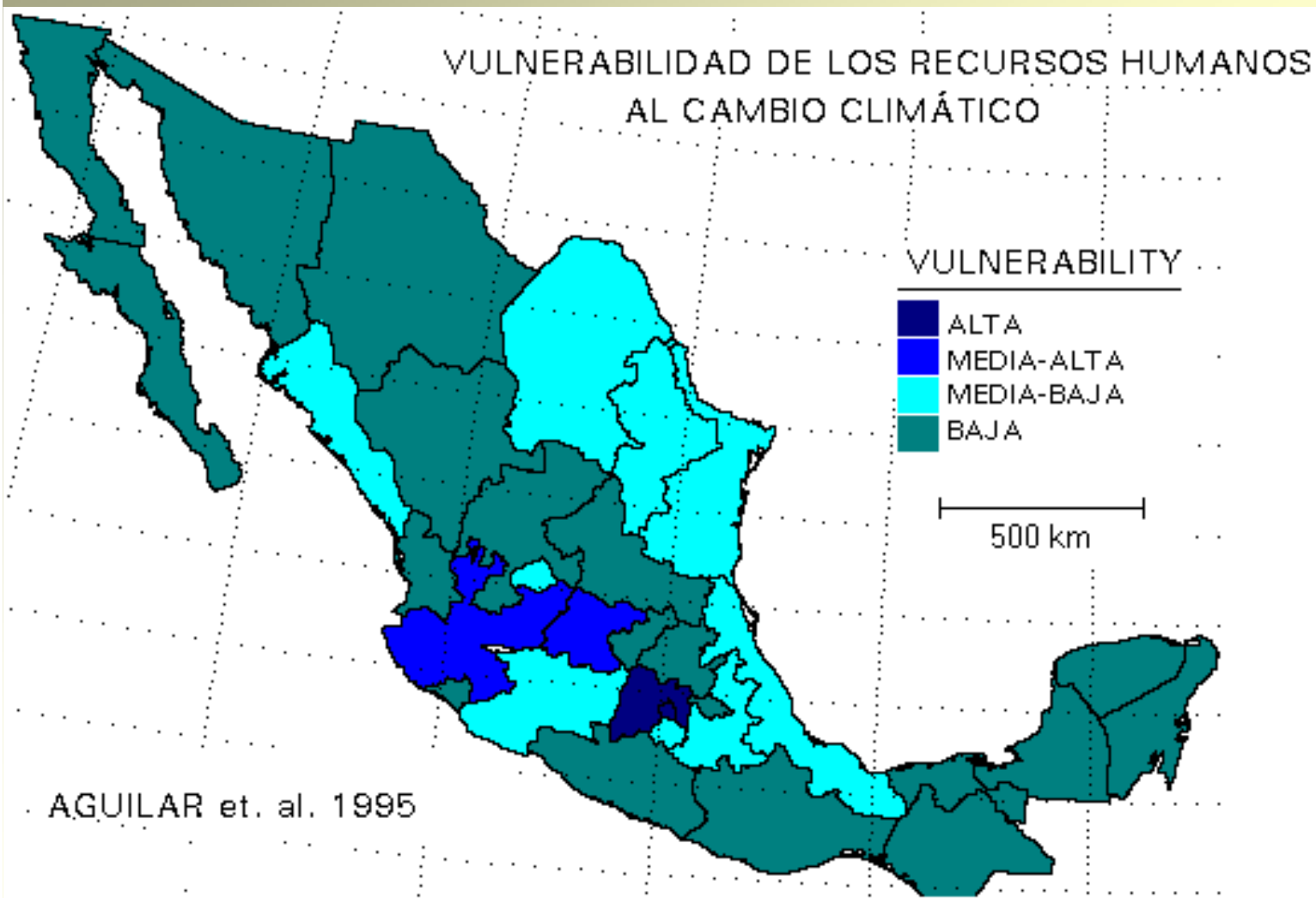
# Mexico highly vulnerable to CC

Source: CENAPRED, 2001





# Vulnerability of Human Settlement



**Vulnerability related to population density, growth, morbidity, water consumption/  
scarcity / pollution and the impact of CC**

# Erosion, desertification in Mexico

Figura 9  
Desertificación en la República Mexicana



Figura 10  
Salinización en México



Figura 11  
Erosión hídrica en México

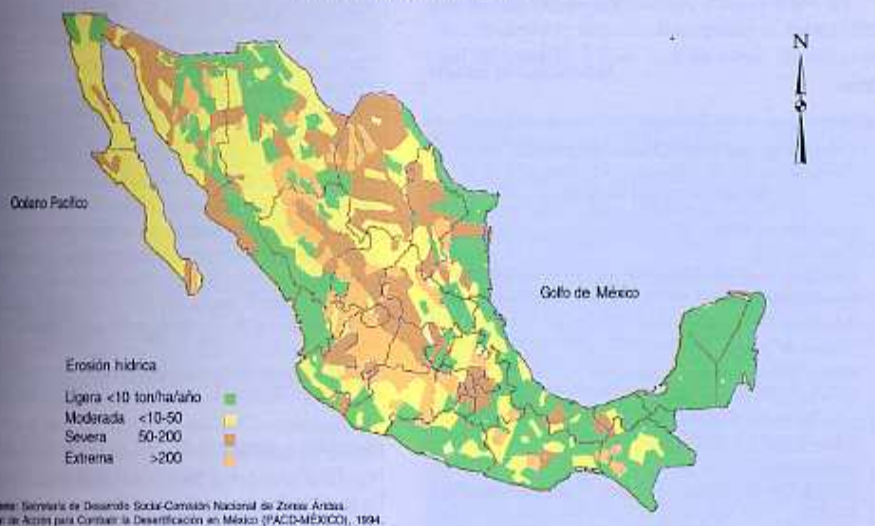
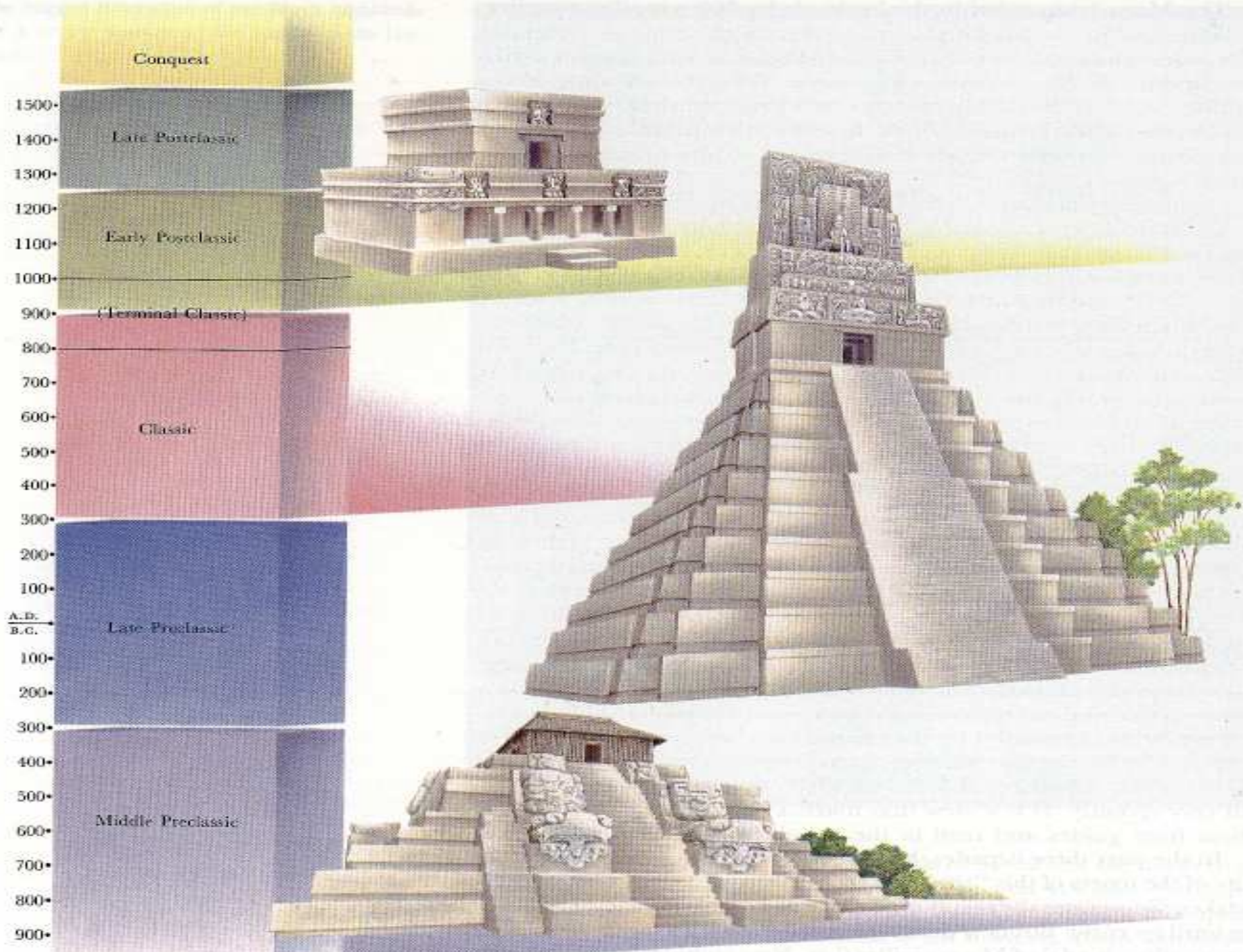


Figura 12  
Erosión eólica en México







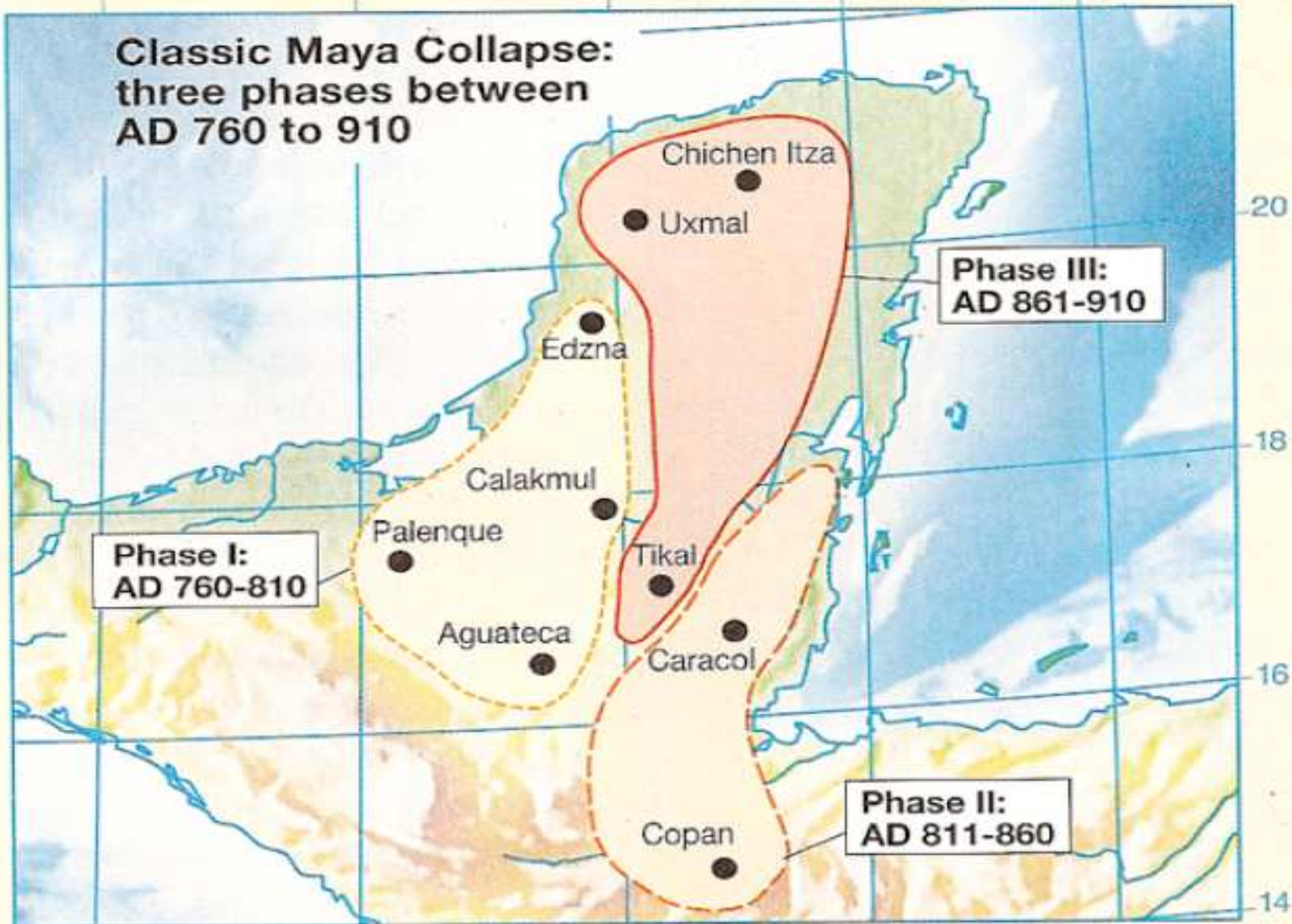


94

90

86

# Classic Maya Collapse: three phases between AD 760 to 910



20

18

16

14

**Phase III:  
AD 861-910**

**Phase I:  
AD 760-810**

**Phase II:  
AD 811-860**

Chichen Itza

Uxmal

Edzna

Calakmul

Palenque

Tikal

Aguateca

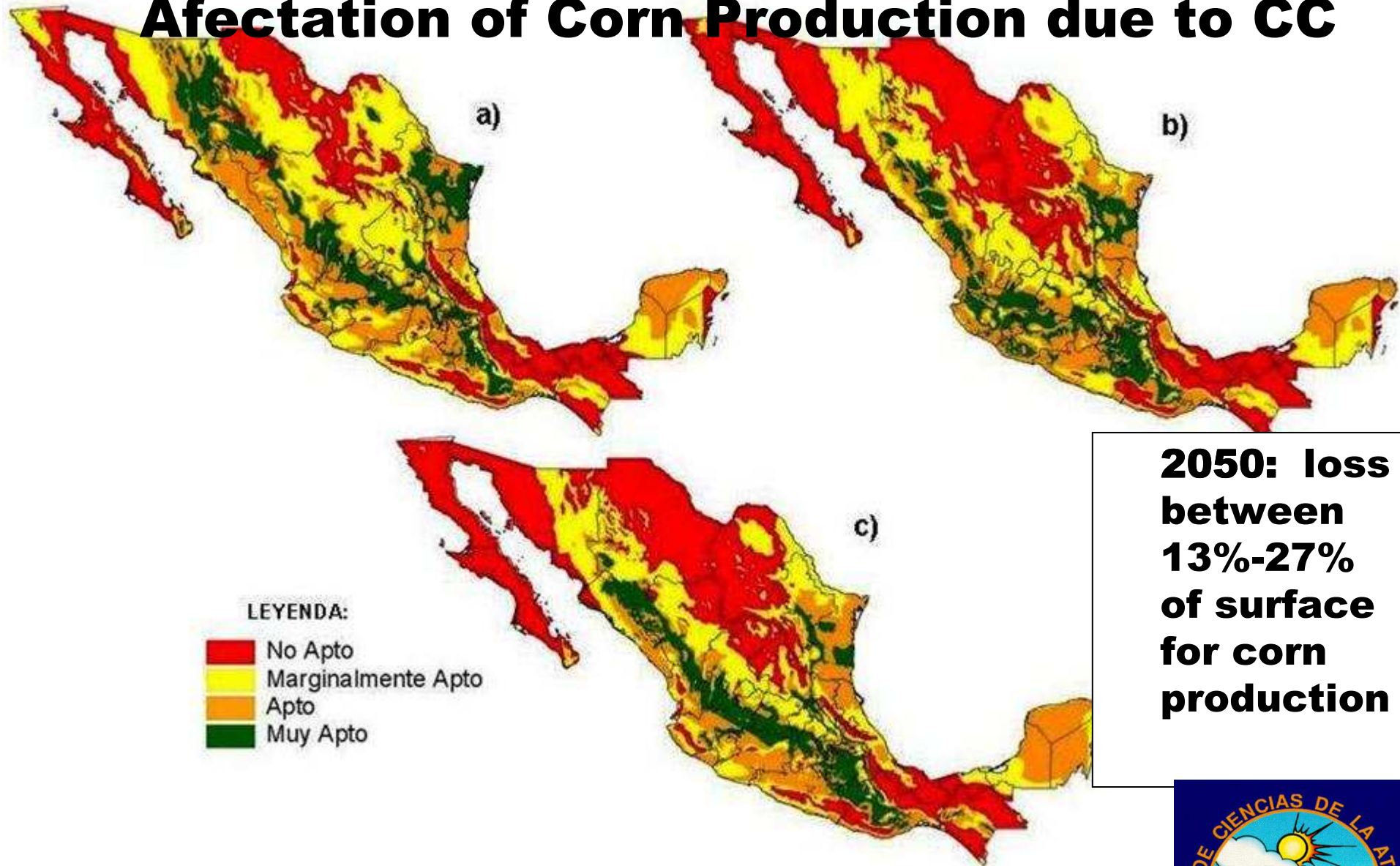
Caracol

Copan

# History of present droughts



# Afectation of Corn Production due to CC

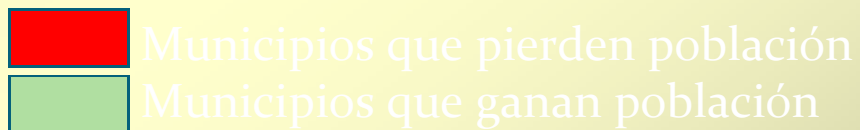
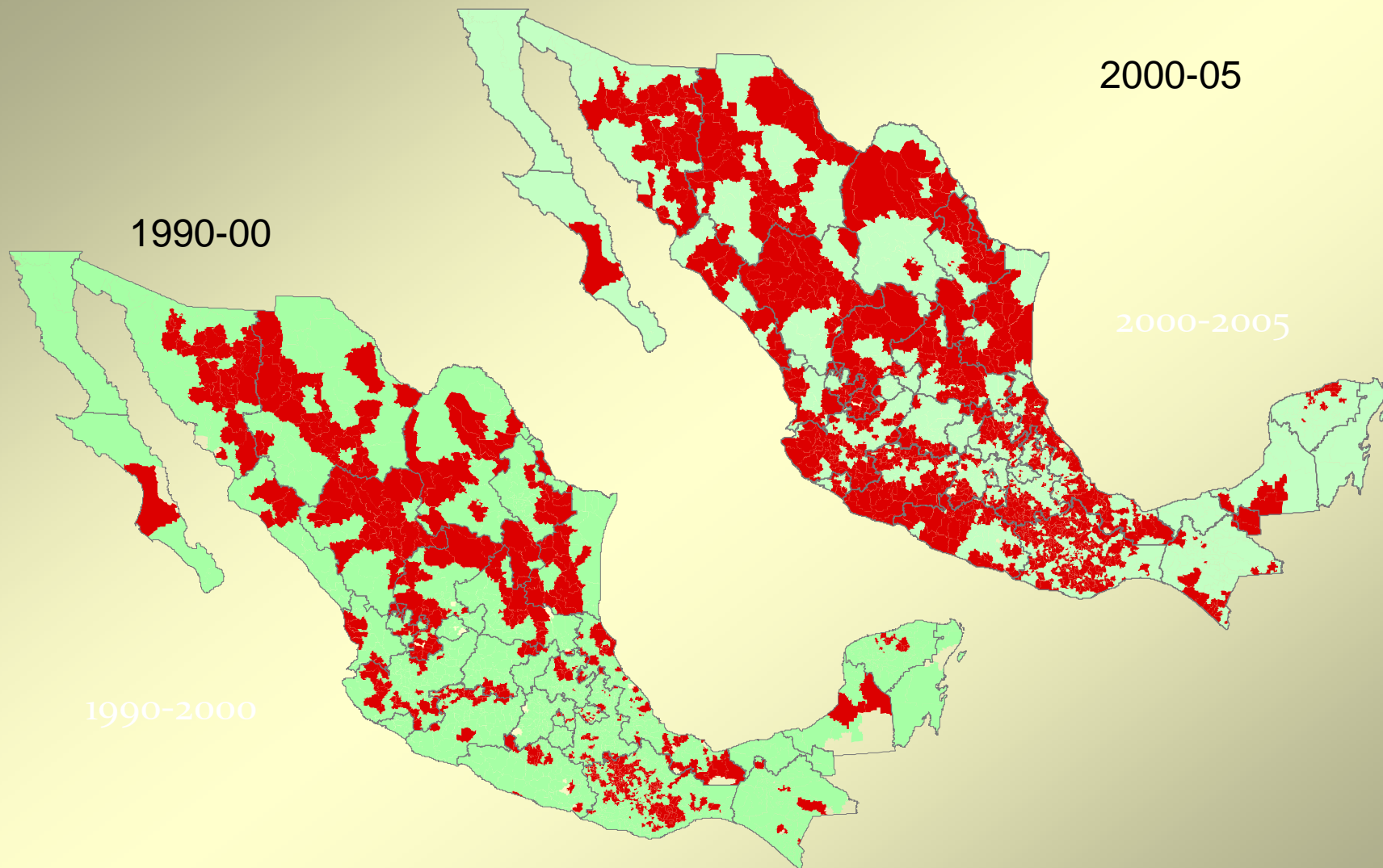


Monterroso, A. G, Rosales, 2006.





# Loss of Population in Mexico



FUENTE: Censos Generales de Población y Vivienda, 199 y 2000. INEGI  
II Censo General de Población y Vivienda, 2005. INEGI



**World food situation**



## **Some definitions on food security**

*Food security* exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life.

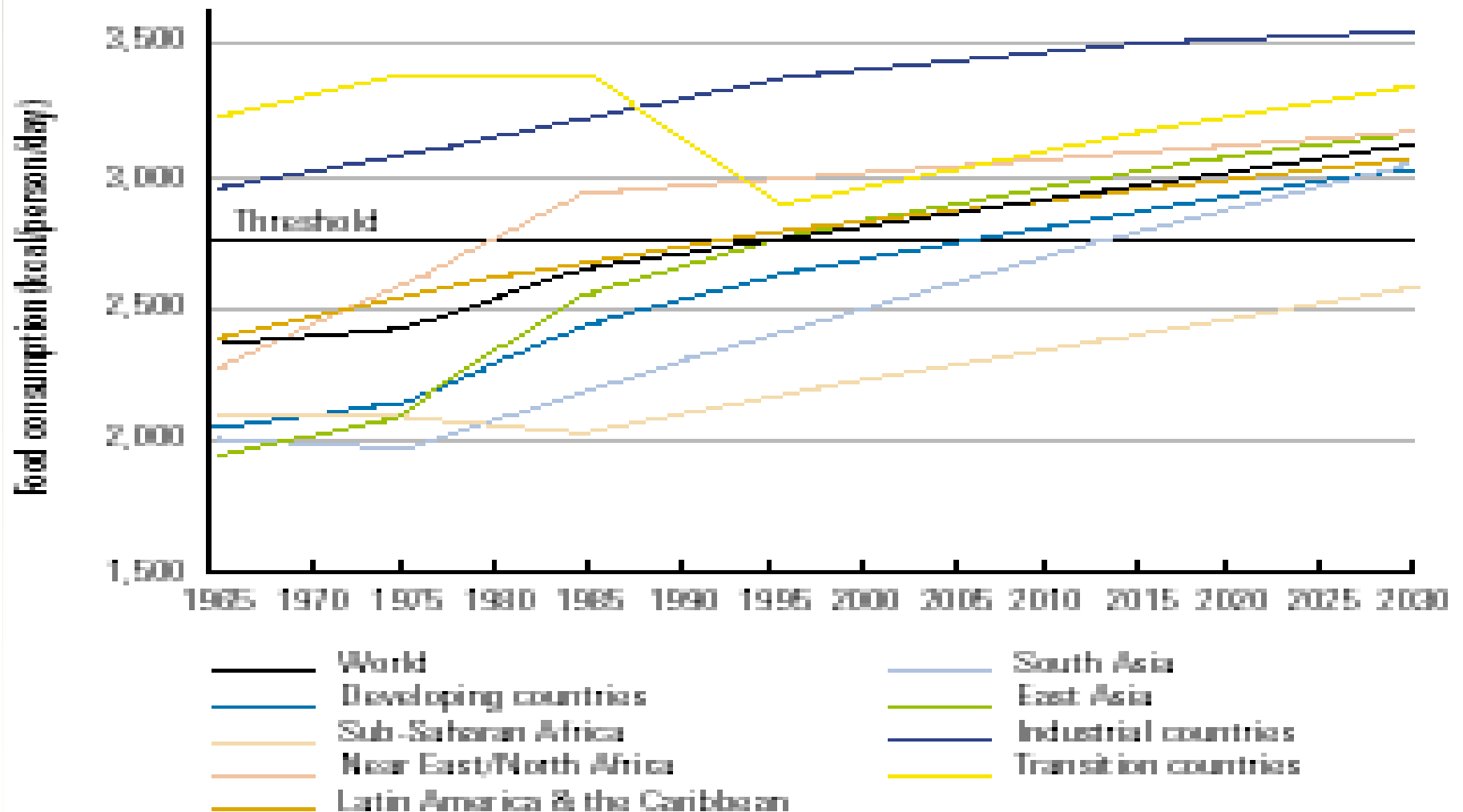
*Household food security* is the application of this concept to the family level, with individuals within households as the focus of concern.

Vulnerable people are greatly exposed to famine (FAO, 2003)

# ***Via Campesina's* food sovereignty**

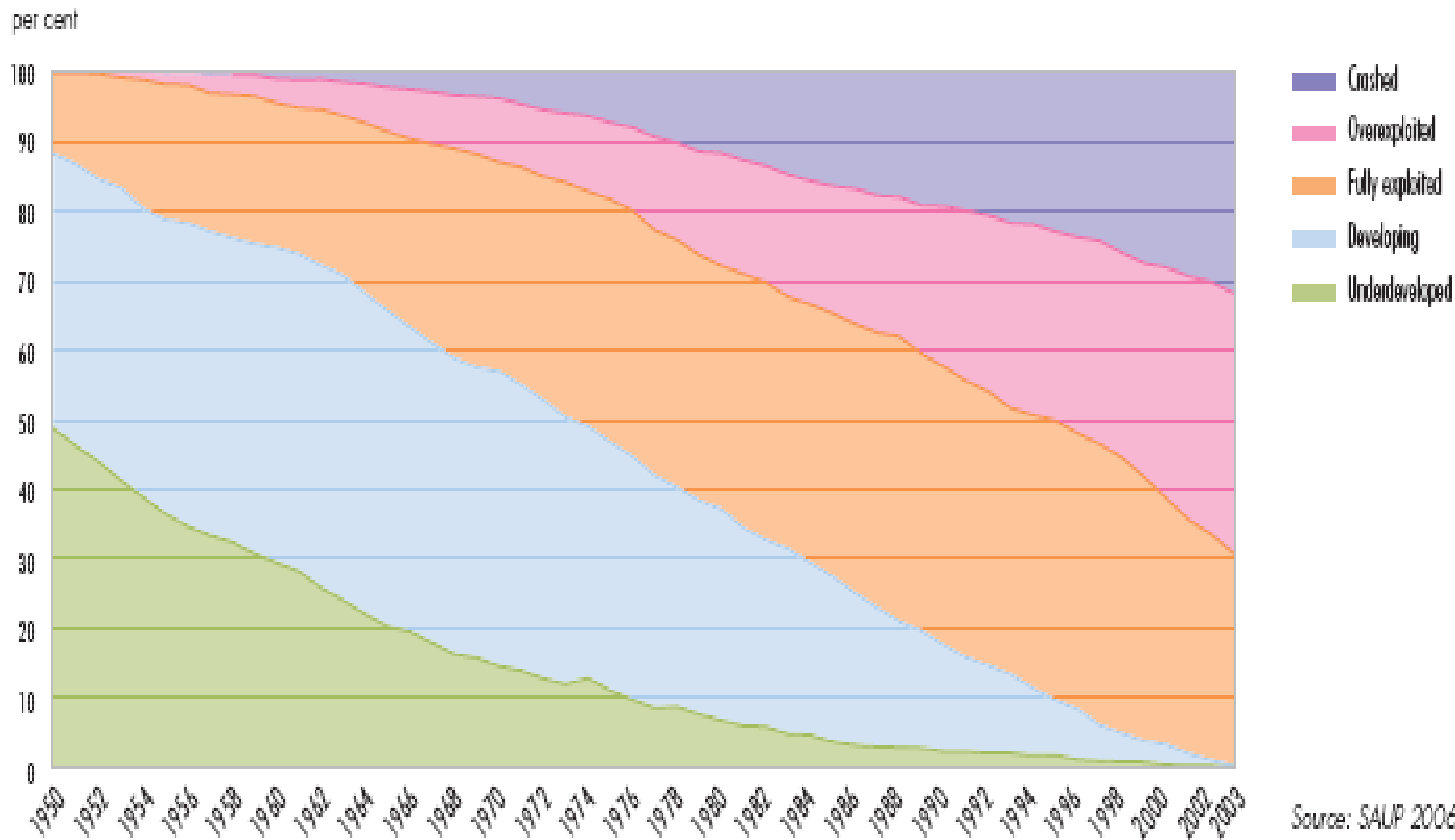
“Food sovereignty is the right of people, communities, and countries to define their own agricultural, pastoral, labour, fishing, food and land policies which are ecologically, socially, economically, and culturally appropriate to their unique circumstances. It includes the right to food and to produce food, which means that all people have the right to safe, nutritious and culturally appropriate food and to food-producing resources and the ability to sustain themselves and their societies” (2004).

# Evolution of food situation in the world

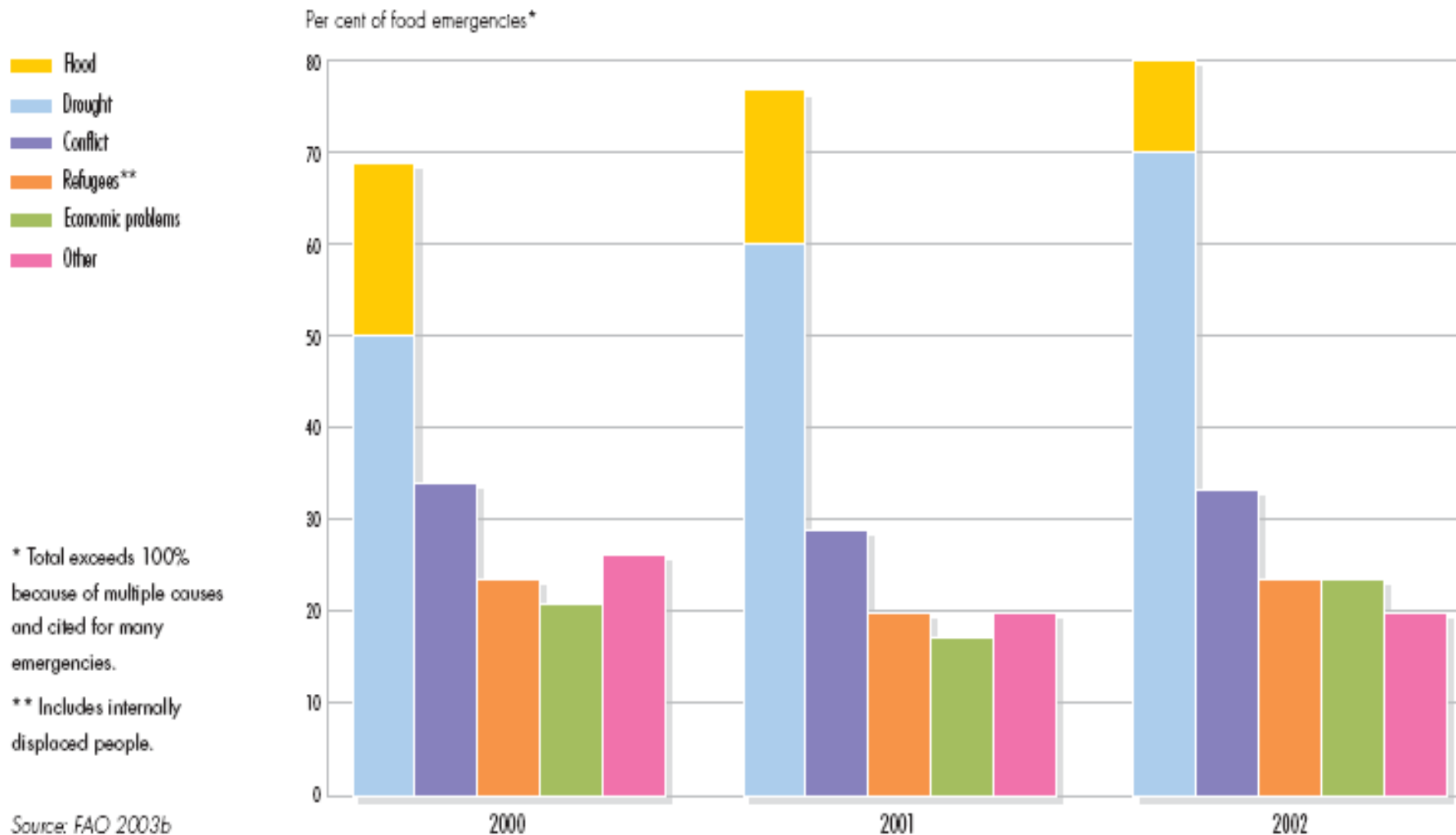


# Exploitation of marine fish stocks

Figure 4.13 Exploitation status of marine fish stocks



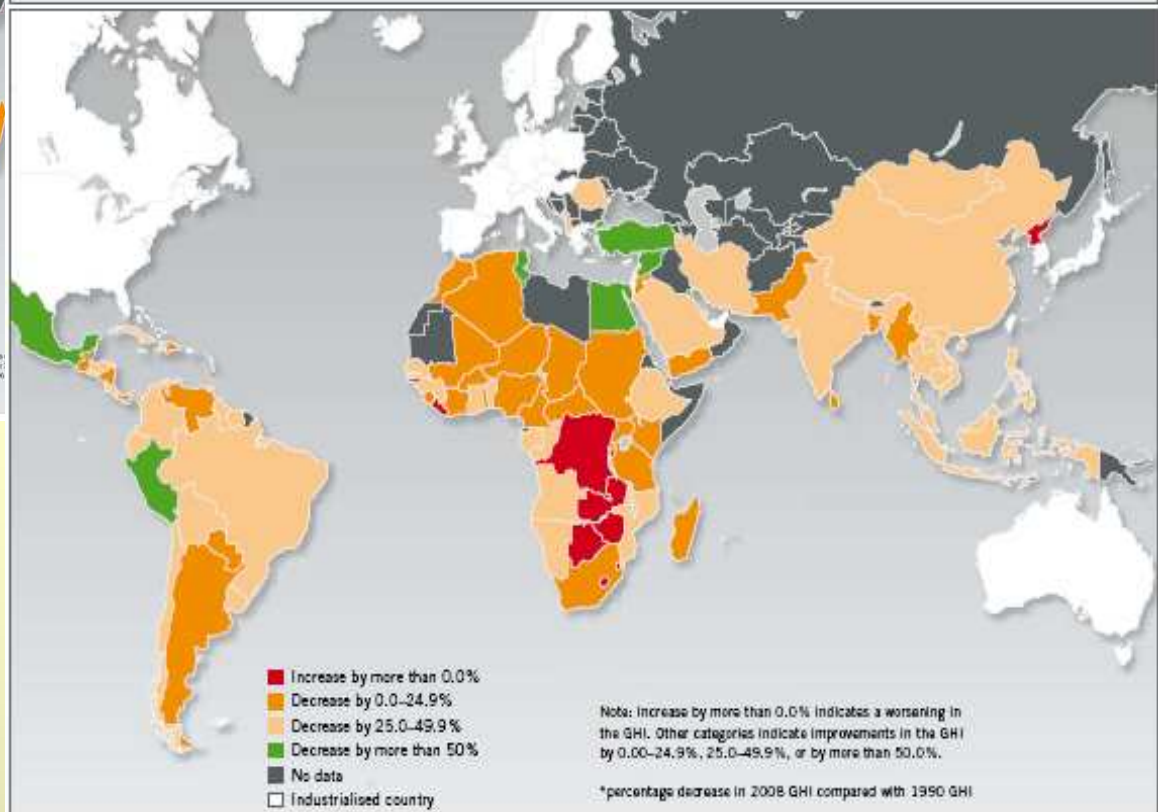
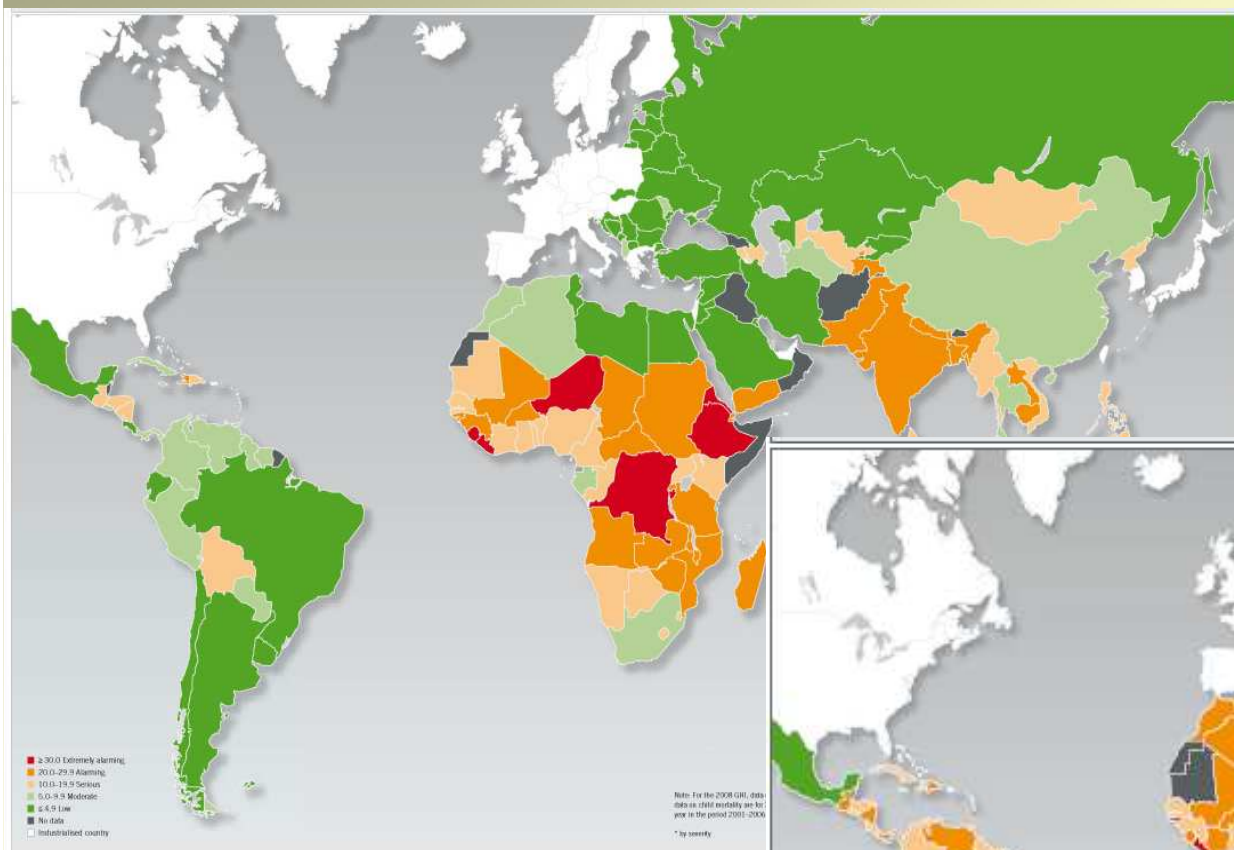
# Causes of food emergency



# Global Hunger Index 1990 & 2008

← 2008 Global Hunger Index.

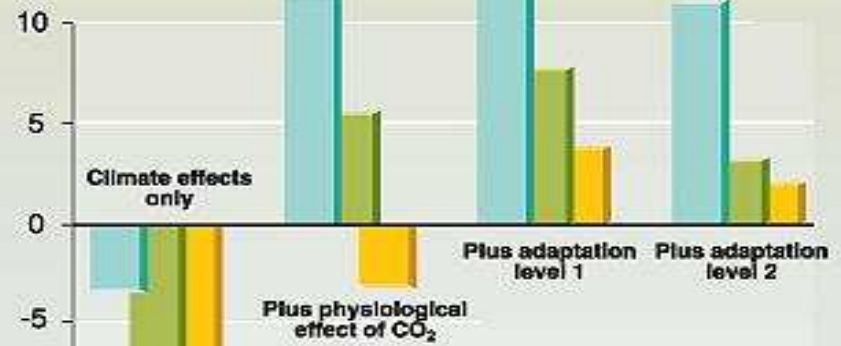
Country progress in reducing the Global Hunger Index between 1990 and 2008 ↓



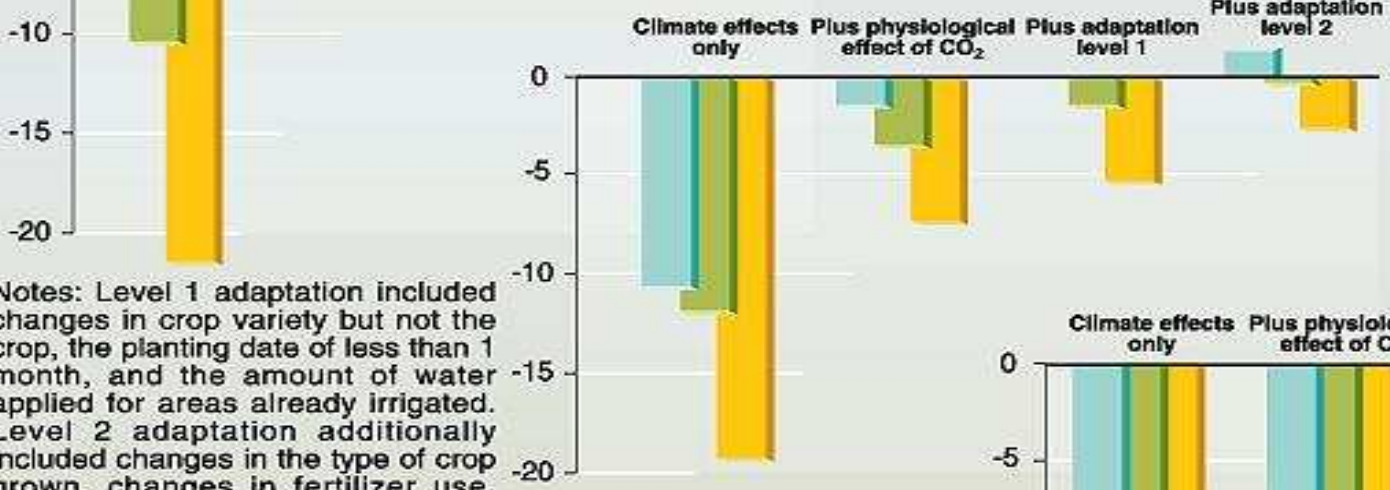
Source: IFPRI, 2008

# Change in cereal production under three different GCM equilibrium scenarios in percent from base estimated in 2060

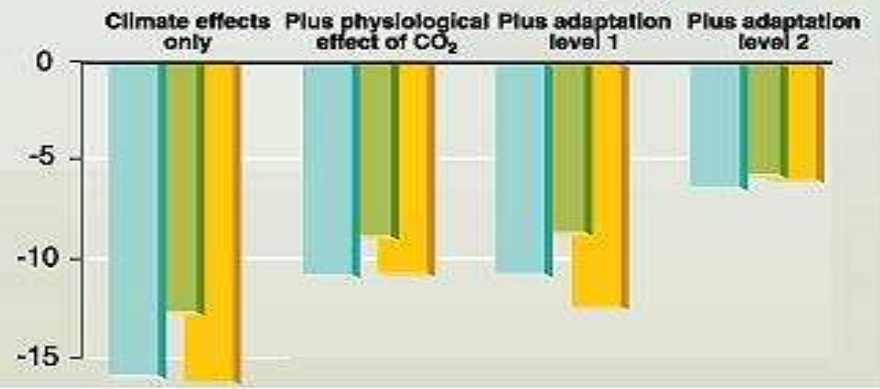
## Developed countries



## World total



## Developing countries



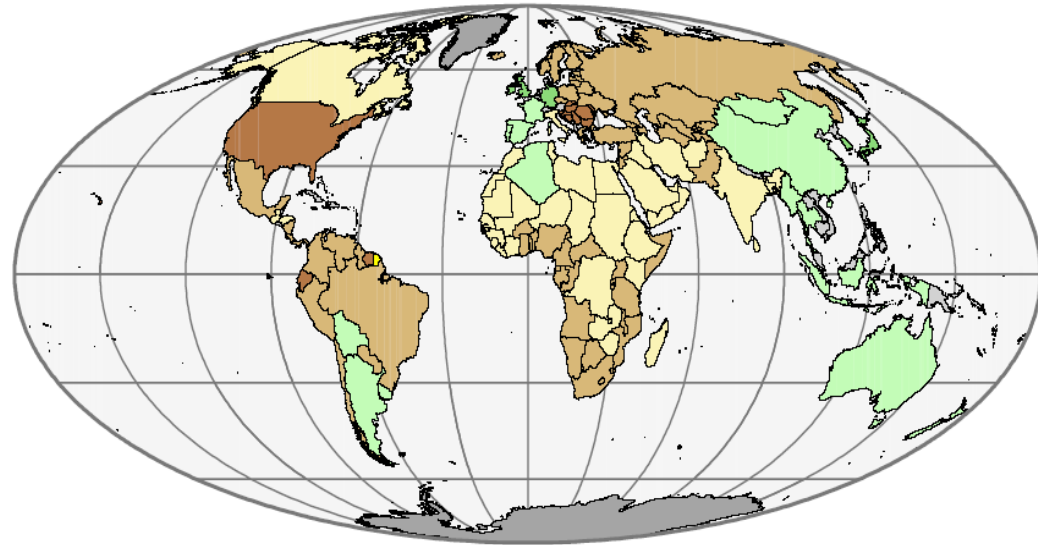
Notes: Level 1 adaptation included changes in crop variety but not the crop, the planting date of less than 1 month, and the amount of water applied for areas already irrigated. Level 2 adaptation additionally included changes in the type of crop grown, changes in fertilizer use, changes in the planting of more than 1 month, and extension of irrigation to previously unirrigated areas.



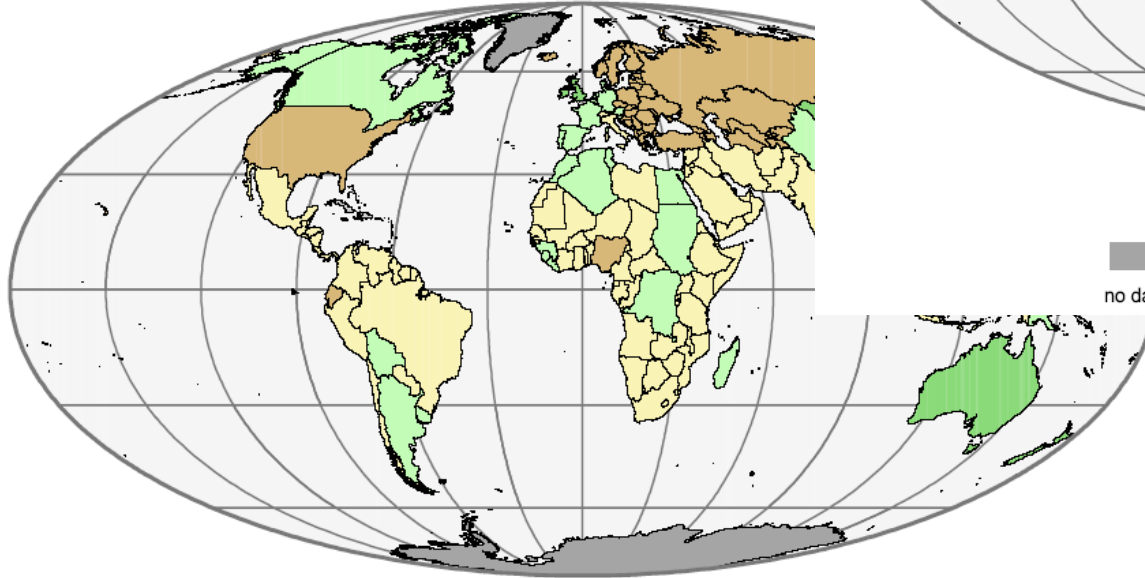
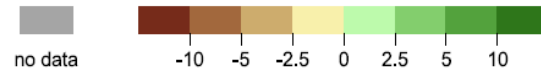


# Food Scenarios: 2020, 2040-2069

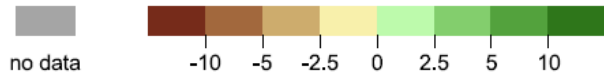
Food security 2040 - 2069 (HADCM3 GGA1)



potential yield change [%]



potential yield change [%]





# Complex interaction: soil, fertility and vegetation

+ Temperature of soil

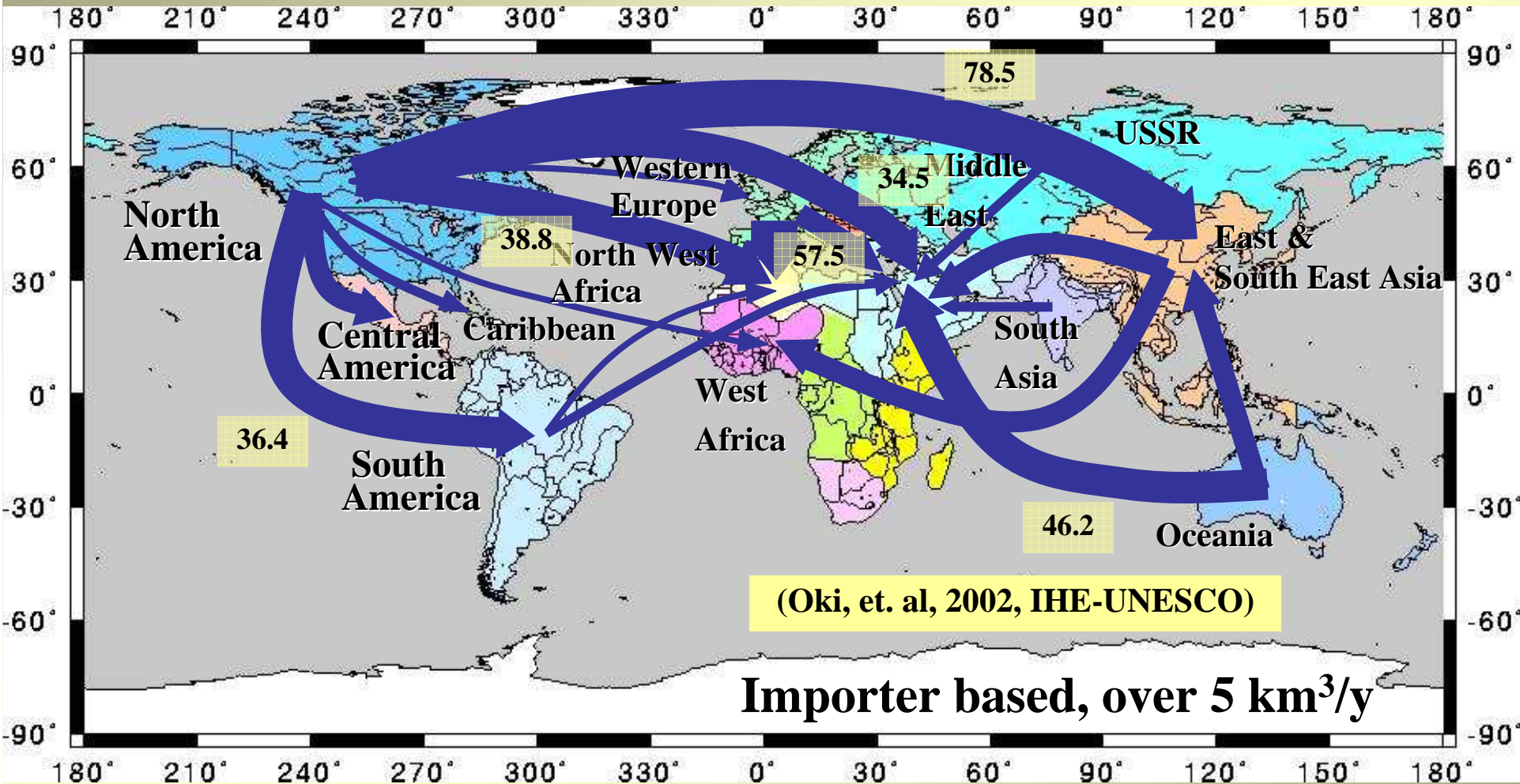
+ Descomposition of loss of OM  
+ CO<sub>2</sub> emissions

+ Loss of OM due to erosion



- Recarche of water
- Soil fertility
- Productivity

# Food and virtual water in 2000 (only grains)

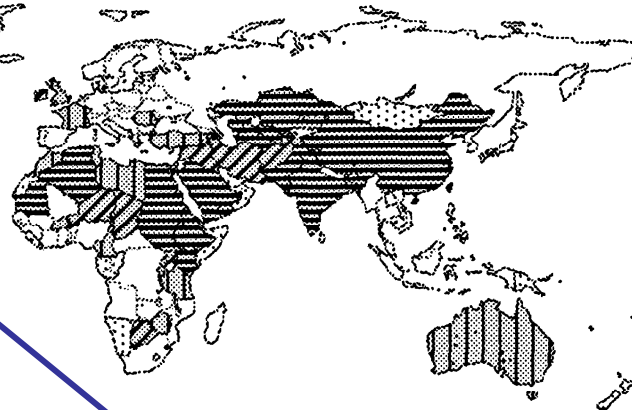
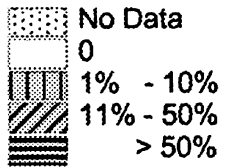


(Based on Statistics from FAO etc., for 2000)



# Food Insecurity Scenario

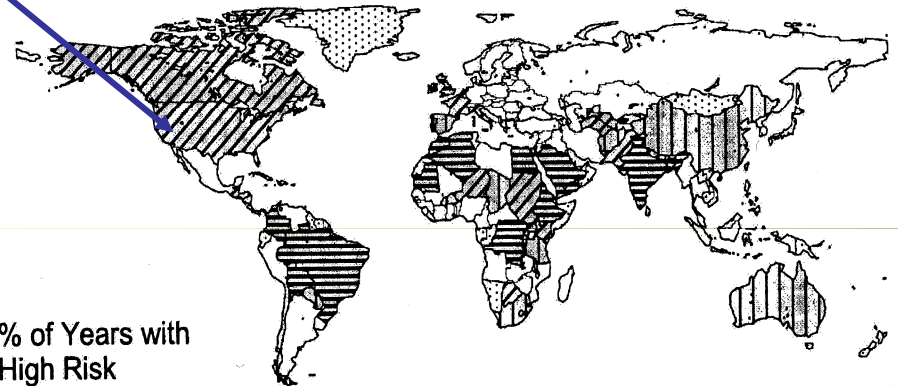
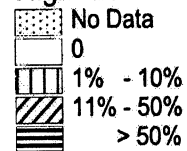
% of Years with High Risk



GLASS 0.5, Budapest Scenario:  
 a) GDP and climate 1984  
 b) GDP and climate 1901-1995  
 19.1.1999, me, Budapest.apr

Figure 4. High Potential for Food Crisis 1901-1995.

% of Years with High Risk



GLASS 0.5, Budapest Scenario: GDP; 2001-2050 and  
 a) historical climate (1901-1950)  
 b) baseline A climate with historical variability (1901-1950)  
 19.1.1999, me, Budapest.apr

Source: Alcamo, 2002

Figure 6. High Potential for Food Crisis 2001-2050  
 – with GDP Increase and Climate Change.

# **Social, human, gender and food insecurity: a problem of equity**

- Drought, Land Degradation and Desertification (DLDD) covers one third of the world land surface and affects around 485 million people; 46% in Africa with 43% of desert.
- In Africa the productivity loss/year is estimated in 0.5-1%
- DLDD poses multiple global, regional and national security issues: food, water, climate, livelihood, health, urban, rural and transportation security.
- DLDD induces large-scale forced migration movements, hunger riots and emerging conflicts on scarce resources.
- One billion of people suffer from hunger and food price rise provoked 65 million more hungry people. MDG can not be reached and affects above all rural and urban poor.

# Threats to food sovereignty: three models of food production

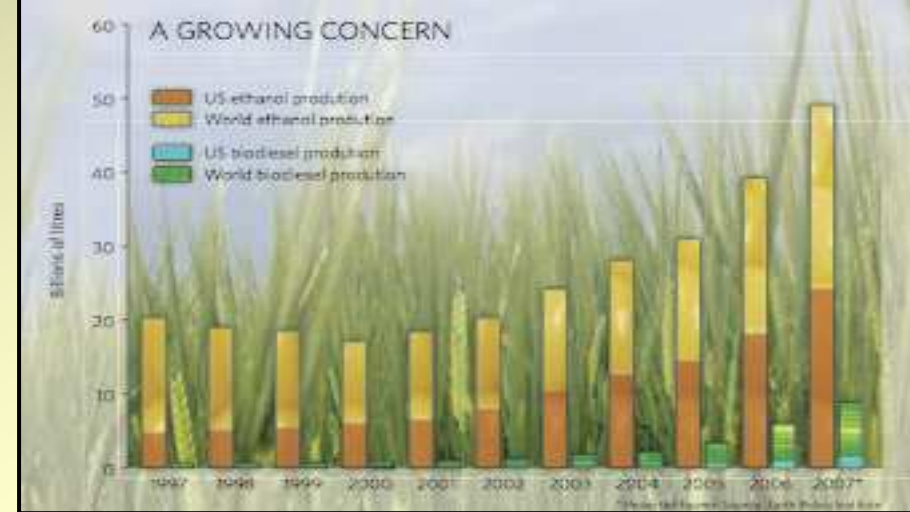


# **Productivity paradigm**

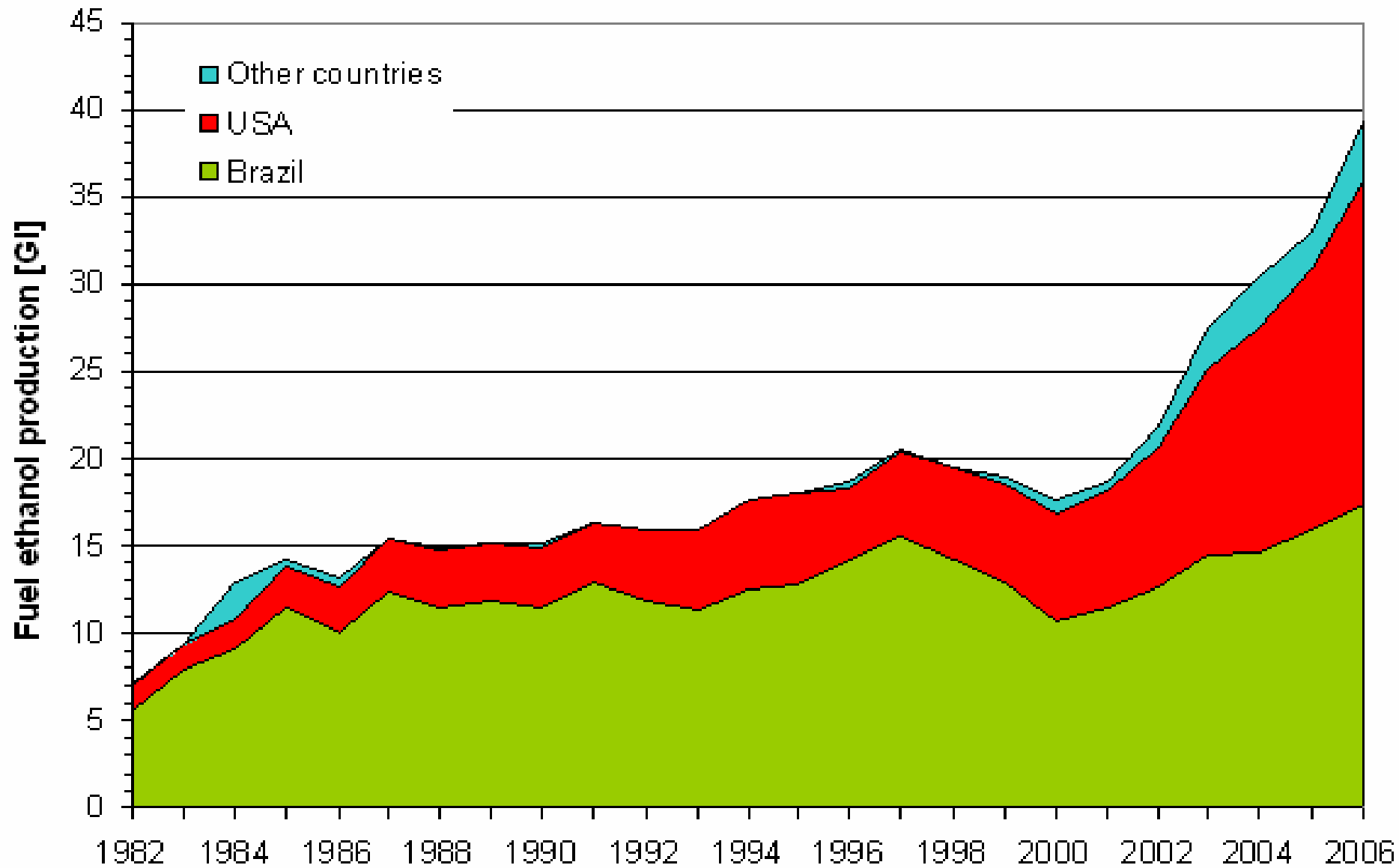
- **Green revolution with intensive use of chemicals, veterinarian drugs, improved seeds, machines, fossil energy, and irrigation systems;**
- **industrialization of agriculture.**
- **cheap and homogenous food for urban areas with government subsidies,**
- **Low food prices leaving poverty in the countryside.**
- **Production controlled by agronomists, veterinarians, and the chemical industry.**
- **Ministry of Agriculture managed natural resources: soils, water, forests, flora, fauna, and fish. Health and environment concerns were marginal.**
- **Limits of this model: negative effects on health, environment (scarcity in water and oil resources) and the destruction of rural livelihood.**

# Hunger and bioenergy

- Cultivation for bioenergy, electricity and heat
  - Crops (grains and agricultural waste)
  - Forest waste
  - Solid municipal waste
- Who produces? OCDE; Brazil
- Why?
  - Energy security
  - Climate change mitigation
  - Rural development
- Required characteristics
  - Native, perennial, rapid growth, resistance to illnesses, no competition to food, not invasive
  - Switchgrass (*Panicum virgatum*)
  - Alamo

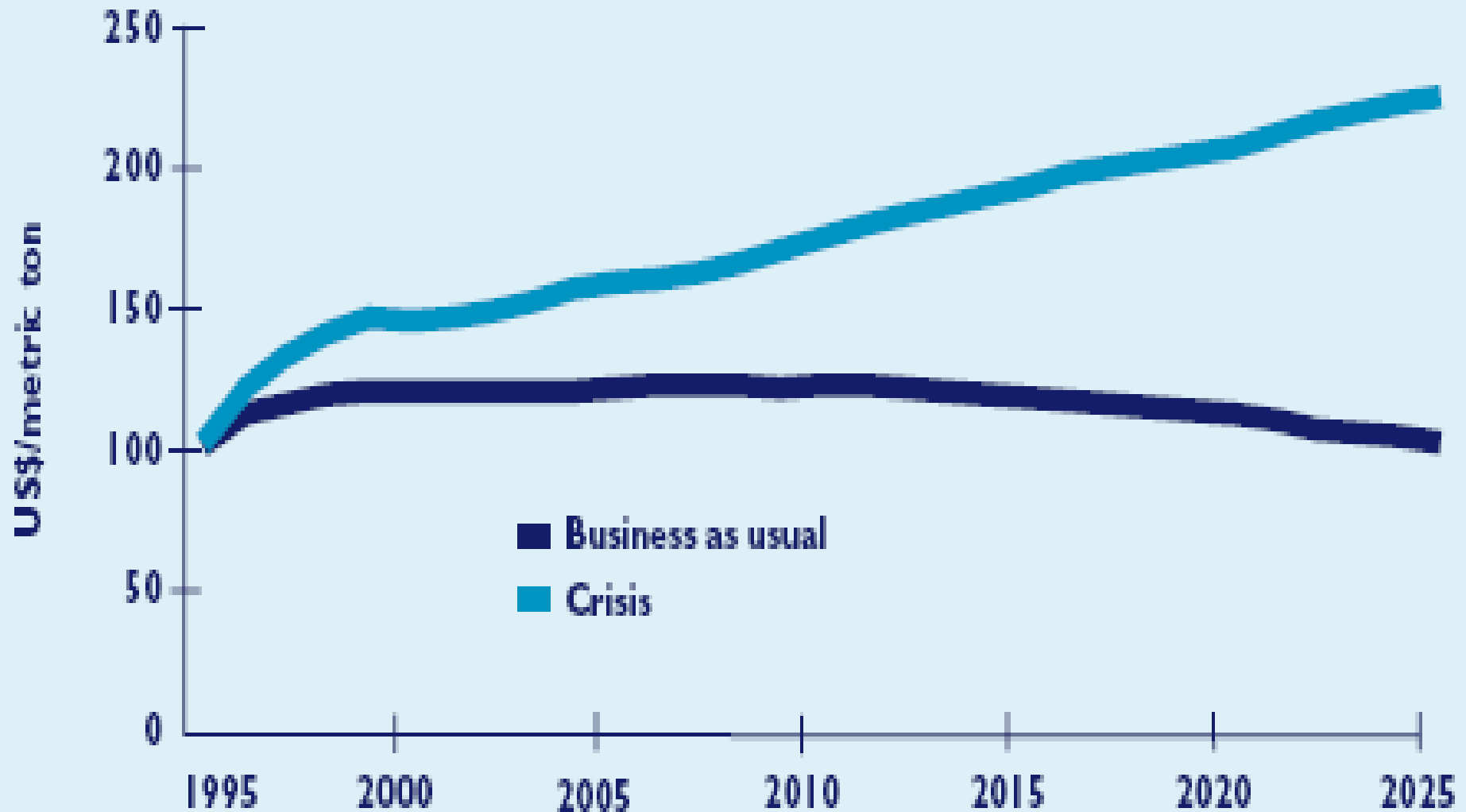


# Biofuels





# International corn prices



source: Rosegrant, Mark W.; Cal, Ximing; Cline, Sarah A., 2002: 20

# Food Price Speculation, November 2009

## FAO Food Price Index



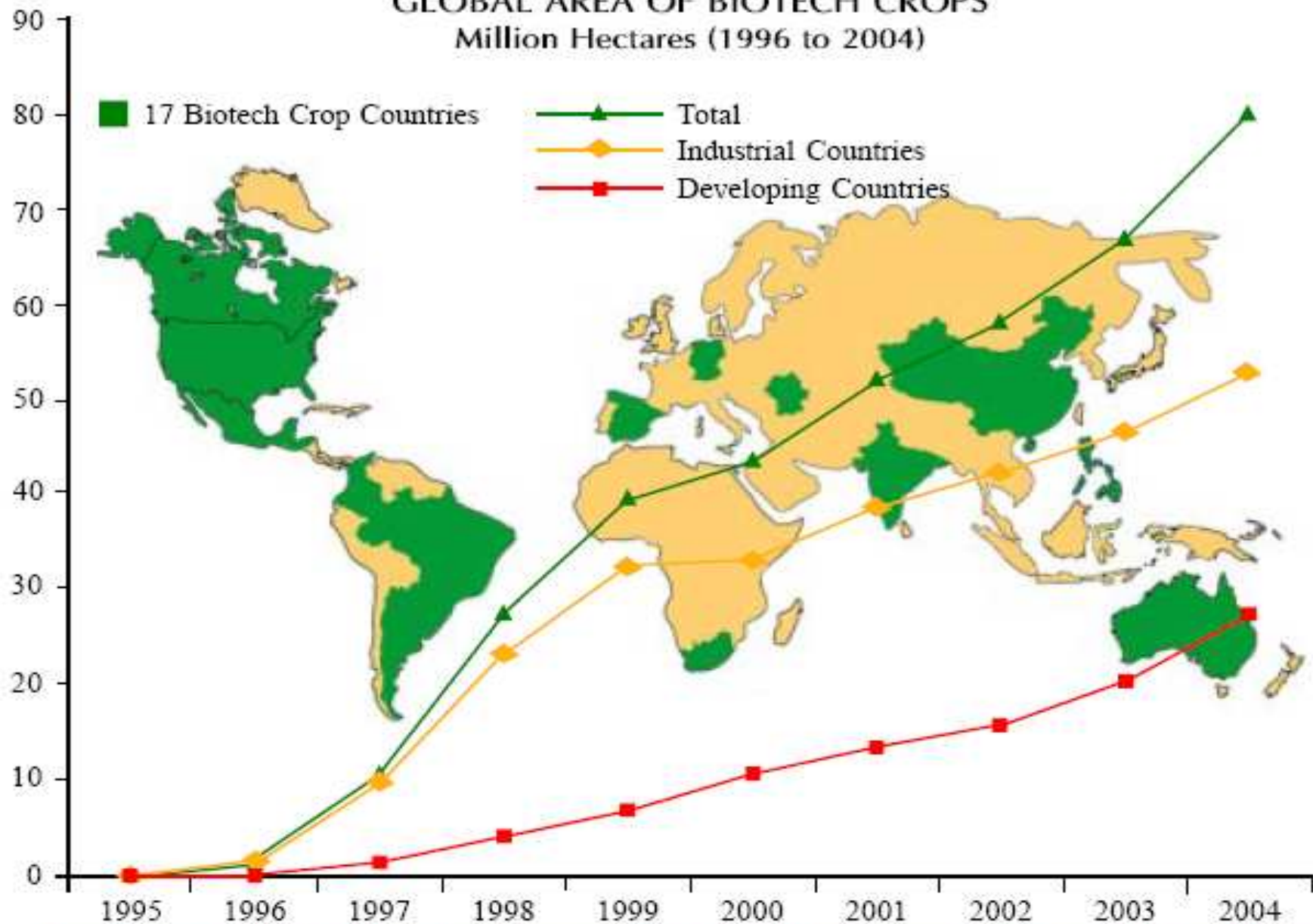
## Food Commodity Price Indices



# Life science paradigm

- *Life science model* integrates the food chain in form of clusters relating production, transformation & trade of food.
- Combines genetic research with field experiments, biotechnology, engineering, nutrition, pharmacology, health, and mobile field labs controlled by multinational food chains.
- Offers clean, safe, and homogenous products that can stay for weeks on the shelves of supermarkets, thanks to *genetically modified genes and organisms with some undesired social, health and environmental effects.*
- Cornucopian vision of life where MNE resolves environmental, social, and health problems through science and technology.
- Increases costs of production and food prices due to TRIPs, and created monopolies of agro-chemicals and food transformation.
- Food get transformed into medicine (Nestlé, 2002)

# GLOBAL AREA OF BIOTECH CROPS Million Hectares (1996 to 2004)



*Increase of 20%, 13.3 million hectares or 32.9 million acres between 2003 and 2004.*

Source: Clive James, 2004

# Green agriculture

- Green model generates symbiotic relations and mutual dependence between nature and food production, using soft methods of agriculture.
- Regionally diverse, utilizes polycultivation, association of crops, rotation, mixed agriculture, bio-fertilizers, fixation of nitrogen from air to soil, bio-pesticides, traditional methods of soil conservation and food, inte-gral management of water, plagues, and environmental services.
- Local agricultural production, transformation and trade, with access for peasants to water, seeds, credits
- Women as key producers for food issues, care about vulnerable and consolidate livelihood,
- When livelihood in villages and countries is guaranteed public resources for poverty and hunger alleviation can be reduced and reallocated for other development purposes, creating stable social relations synergies and cooperation.



# Alternative food integration with livelihood

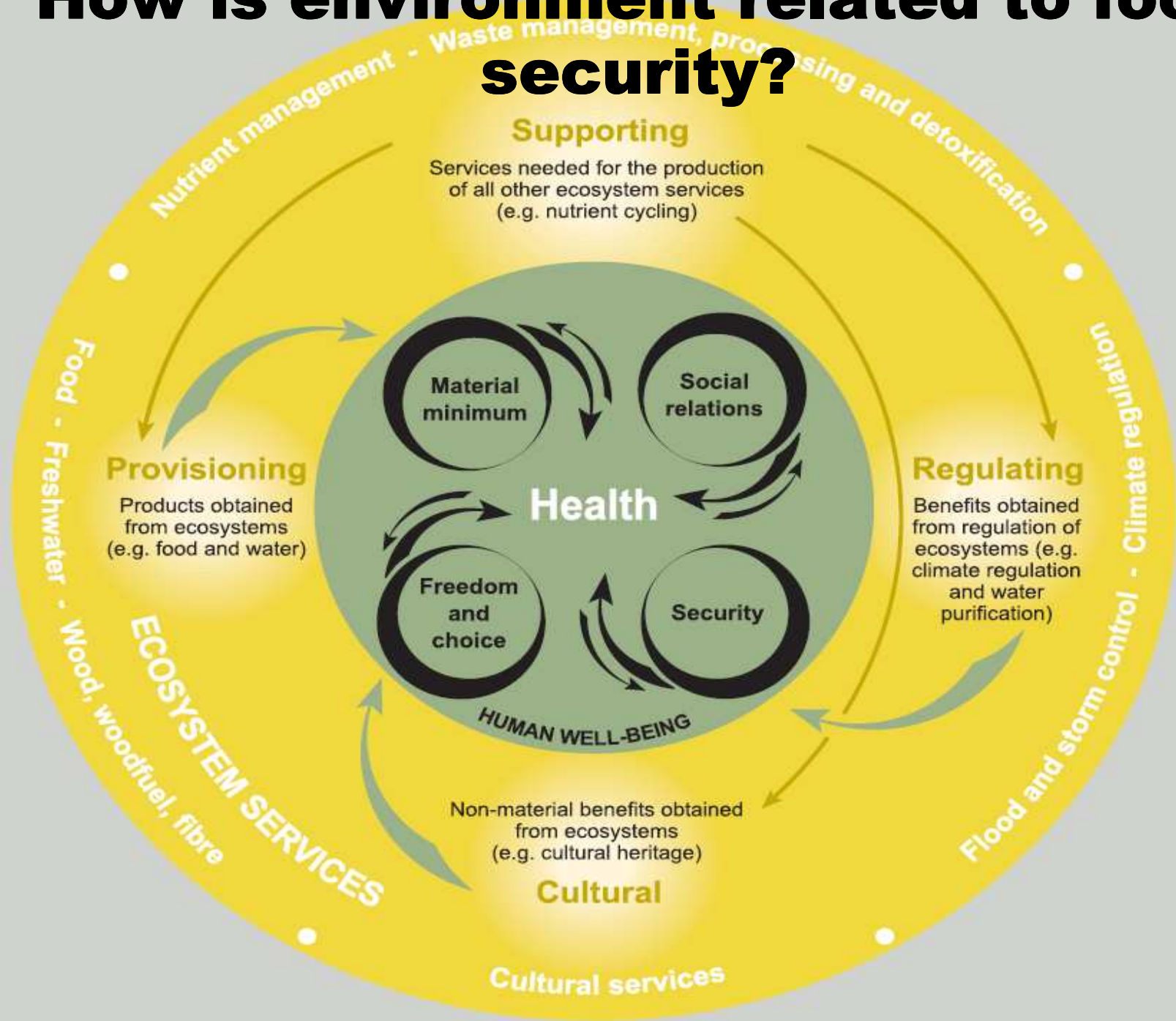


# Integral policy: poverty alleviation and environmental recovery





# How is environment related to food security?



# Women are key food producers

- Women are in all parts of the world responsible for food and food transformation
- In most countries of Sub-Saharan Africa women represent:
  - 33 % of the rural labour force;
  - 70 % of paid rural daily work;
  - 60-80 % of self-subsistence crops and local sale;
  - 100 % of food transformation;
  - 80% of harvest, transportation from the fields to the community and food storing;
  - 90% of weaving and hooking;
  - 60% of market activities (FAO, 2008)



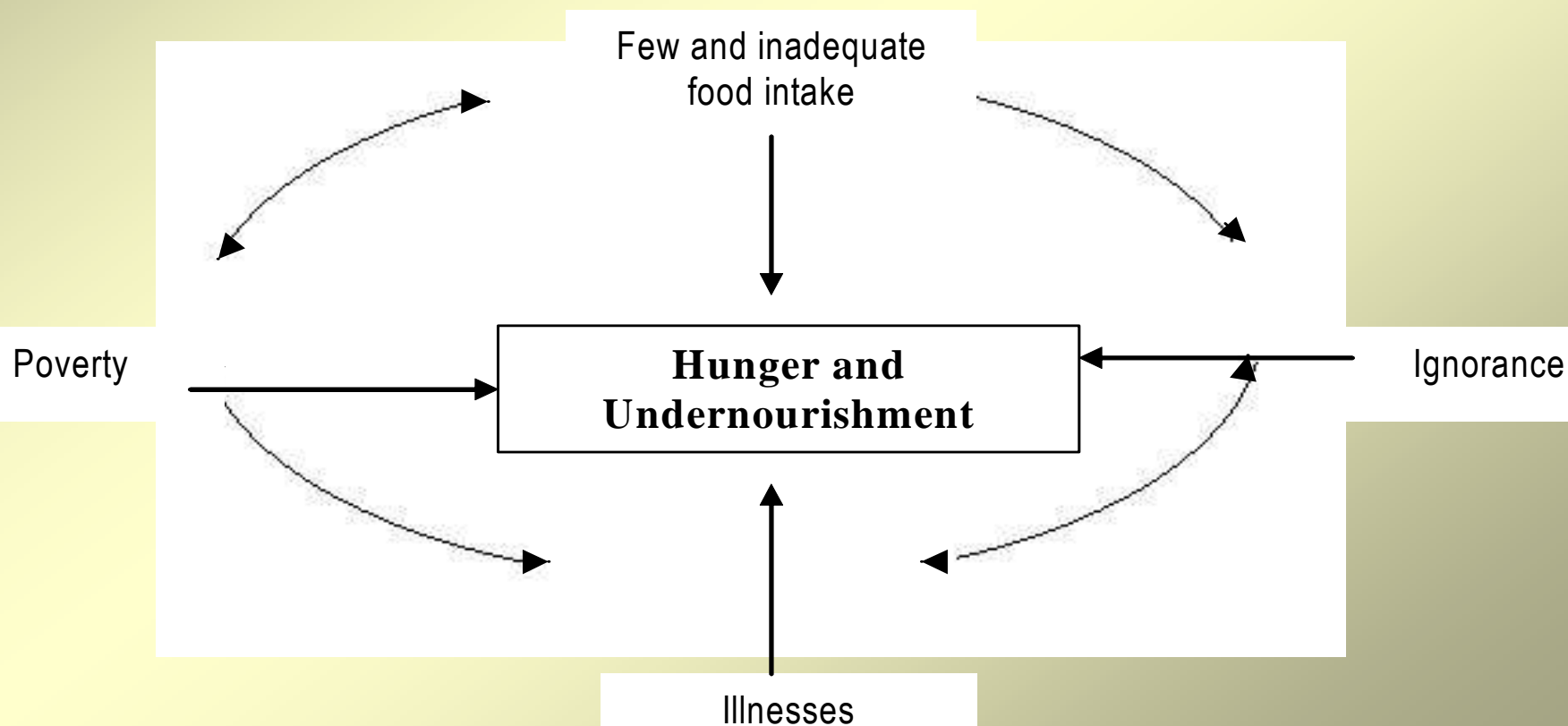
# Survival Strategies





# Survival strategies, micro business and local food sovereignty

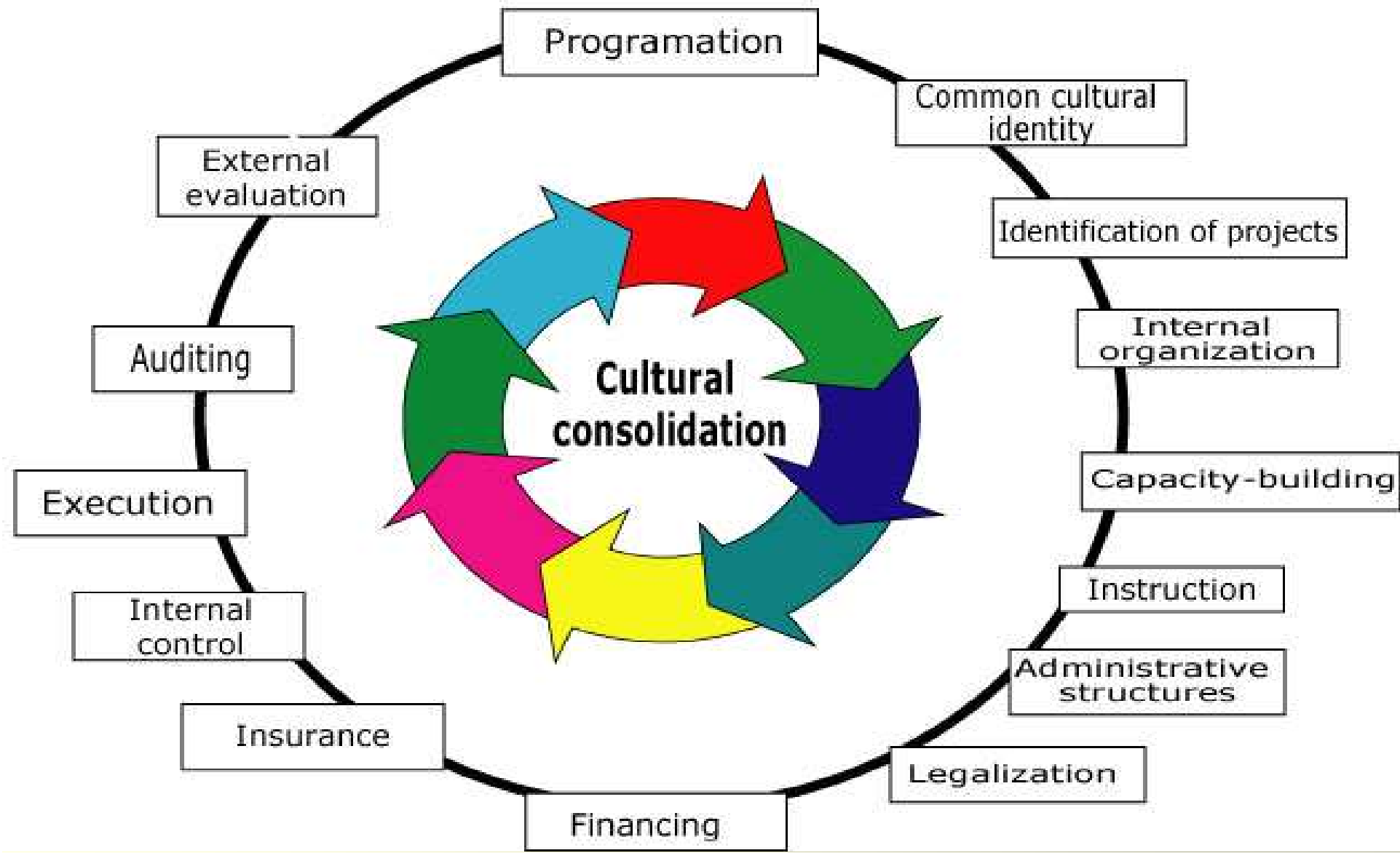
Vicious circle of hunger, undernourishment, poverty, and ignorance. Source: Chávez/Ávila/Shamah (2007: 208).



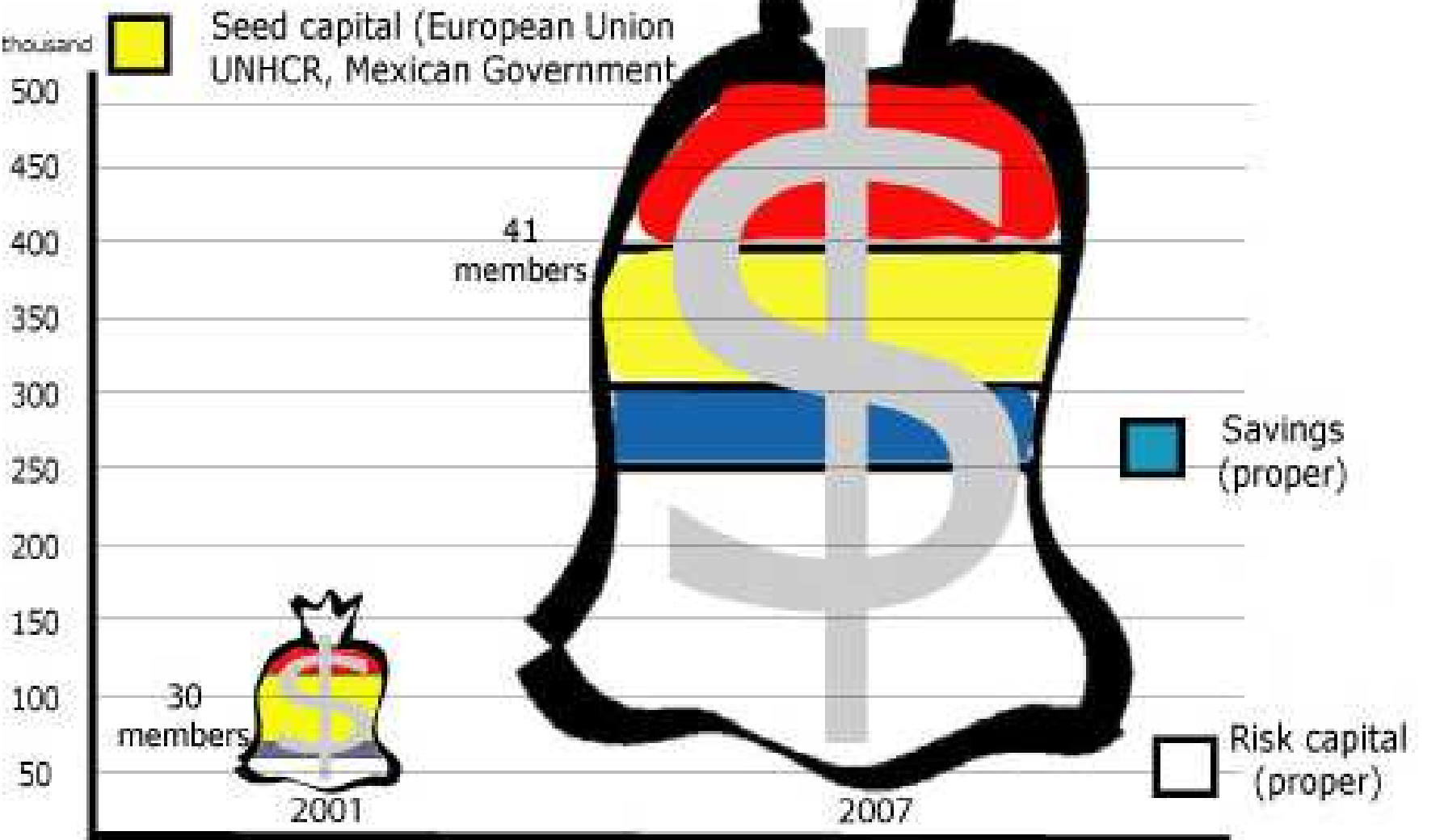
# **Survival Strategies** (Oswald, 1991, 2007)

1. Massive rural migration to urban slums
2. Illegal occupation of marginal and risky land
3. Construction of shelter with precarious materials (waste)
4. Chronic unemployment of men and lack of cash
5. Selling unnecessary goods
6. Credits from family members and neighbors
7. Economic crises increases and lack of food
8. Recollection of perished fruits and vegetables
9. Collective popular kitchen
10. Rotation of women in collective community work (kitchen, child rearing)
11. Common struggle for basic services (electricity, water, access, community center)
12. Communal organization for regularization of land and services
13. Struggle for public subsidies and poverty alleviation programs
14. Temporary paid work
15. Multiple activities: services, handicraft, food, washing, ironing, paid jobs
16. Social organization against organized crime and gangs
17. Empowerment and fight against intra-family violence
18. Social and economic consolidation of colony and families

# Fig 1. Model of self-reliant entrepreneurship



# Self-sufficient Micro-business in Campeche, Mex.

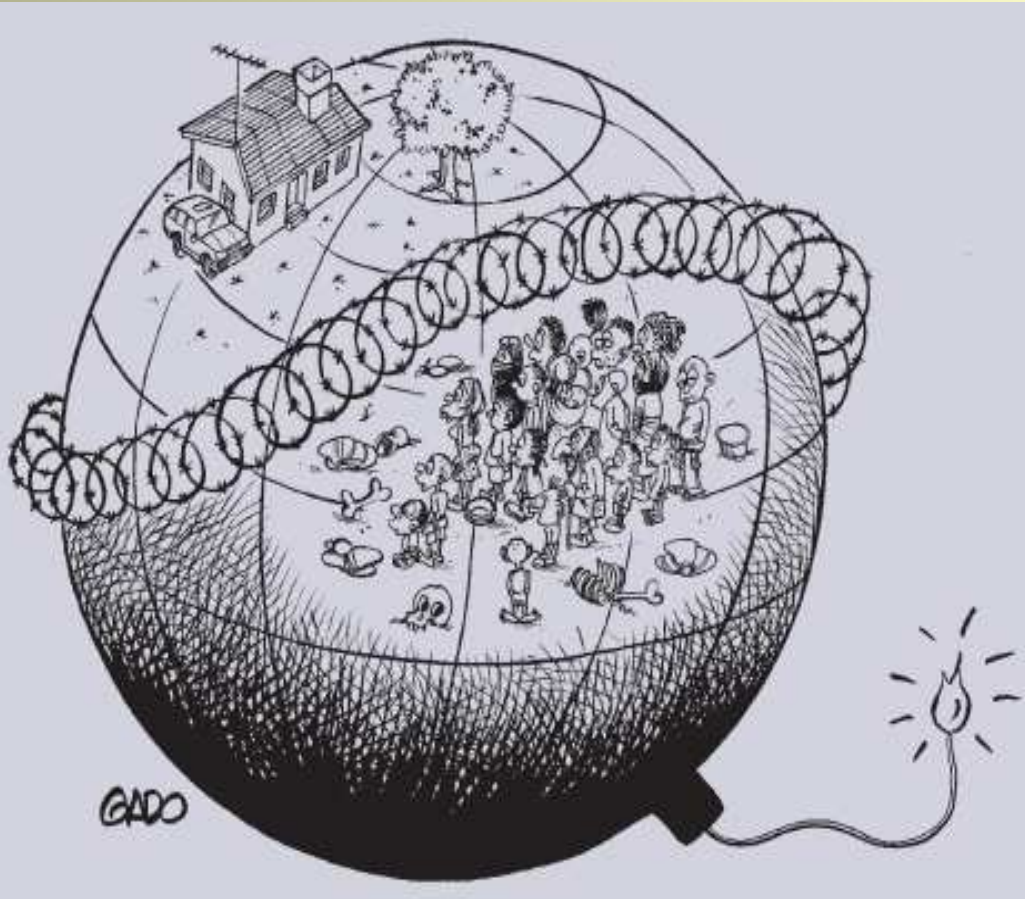


# **Transition to Alternative Livelihoods and Sustainable Economy**

- **Decentralized governance: traditional knowledge from women, peasants, *grassroots* movements against desertification**
- **Consolidation of leadership (local clergymen, spiritual leaders, doctors, lawyers, schools, teachers) and training (old/young people, migrants)**
- **Off-farm jobs create financial resources to recover degraded land and feed people**
- **Concrete Action Programmes to prevent migration, crises and conflicts.**

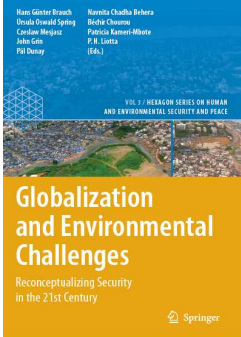


# Future of Humanity: Sustainable Peace with HUGE or business as usual?



1) **cooperation** with solidarity vs. isolationism and elite behaviour; 2) **cultural diversity** vs. economic monopoly; 3) **peace with ahimsa** vs. himsa; and violence; 4) **spirituality** vs. secularity.

# Conflictive Situation: Widening, Deepening & Sectorialization of Security Threats Vulnerabilities & Risks Challenges,



Security dimension ⇒ ↓	Military	Political	Economic	Environmental ↓	Societal
Level of interaction					
Human and social groups (women, children, elderly)	Drug war, human, arm, drug, organ trafficking	Failed state	Food and health security	<b>Cause &amp; victim</b>	Food, water and health security
Human security ⇒		Public insecurity	Employment, income security		Gender security
Societal, community security	Border control	Public (in)security	Water, Food & Health sec.	↑ ↓	↑ ↓
National security	War on terrorism since 2001		Energy security, maquila, cheap labour force	↑ ↓	Energy  Food, Water & Health security
International and Regional security	Merida agreement including Central America		Water & virtual water security	↑ ↓	Water & soil security
Global and planetary security ⇒	Terrorism	Intern. Migration, drug and human trafficking	Financial crisis, money laundering	CC; GEC; biodiversity loss, desertification	Health security

# Ecosystem Services and Well-being

## ECOSYSTEM SERVICES



## CONSTITUENTS OF WELL-BEING

### Security

- PERSONAL SAFETY
- SECURE RESOURCE ACCESS
- SECURITY FROM DISASTERS

### Basic material for good life

- ADEQUATE LIVELIHOODS
- SUFFICIENT NUTRITIOUS FOOD
- SHELTER
- ACCESS TO GOODS

### Health

- STRENGTH
- FEELING WELL
- ACCESS TO CLEAN AIR AND WATER

### Good social relations

- SOCIAL COHESION
- MUTUAL RESPECT
- ABILITY TO HELP OTHERS

### Freedom of choice and action

OPPORTUNITY TO BE ABLE TO ACHIEVE WHAT AN INDIVIDUAL VALUES DOING AND BEING



**ARROW'S COLOR**  
Potential for mediation by socioeconomic factors

- Low
- Medium
- High

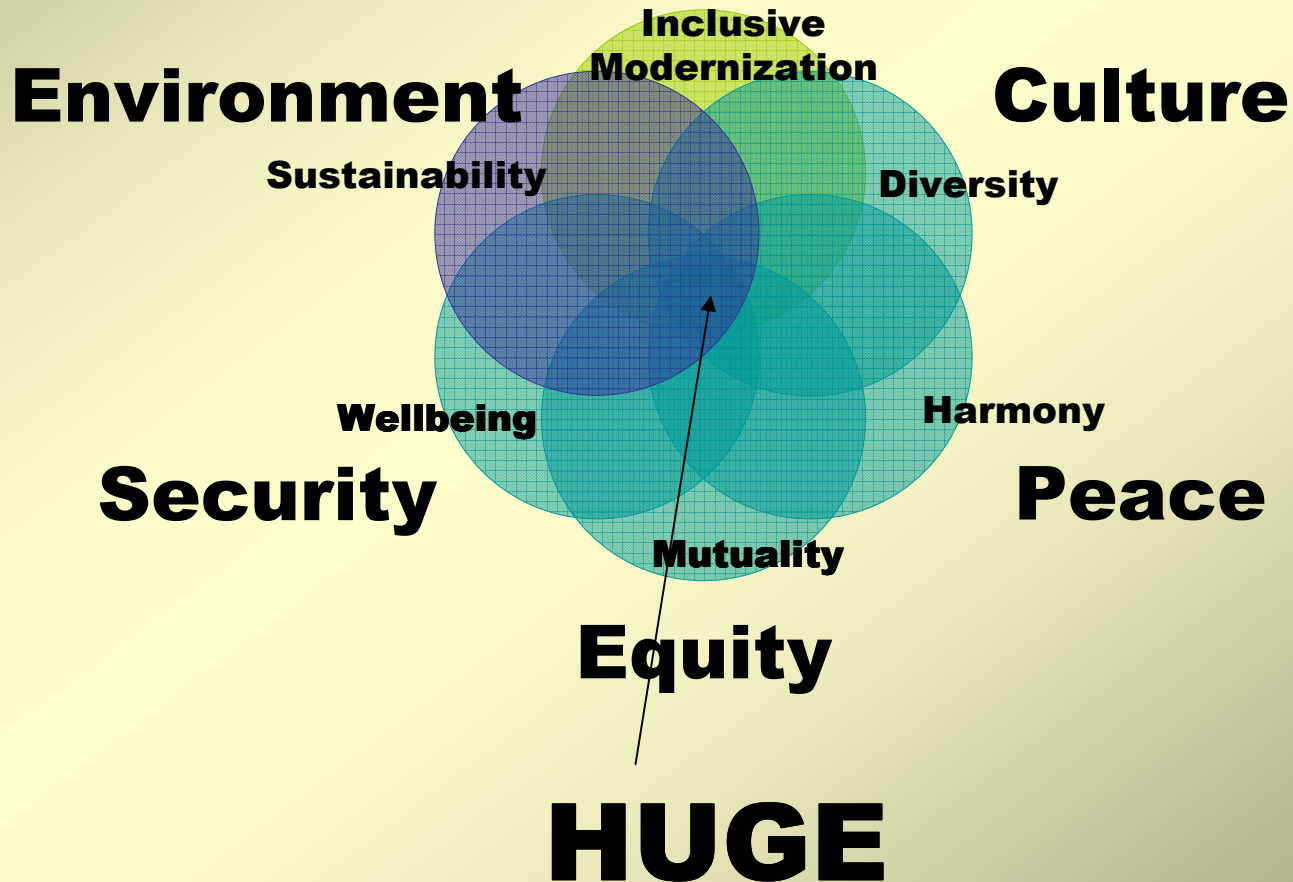
**ARROW'S WIDTH**  
Intensity of linkages between ecosystem services and human well-being

- Weak
- Medium
- Strong

Source: Millennium Ecosystem Assessment

# Sustainable Peace with a HUGE Sustainable Development

## Development





**Thank you for your attention**

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