System of clean water and monitoring of water quality

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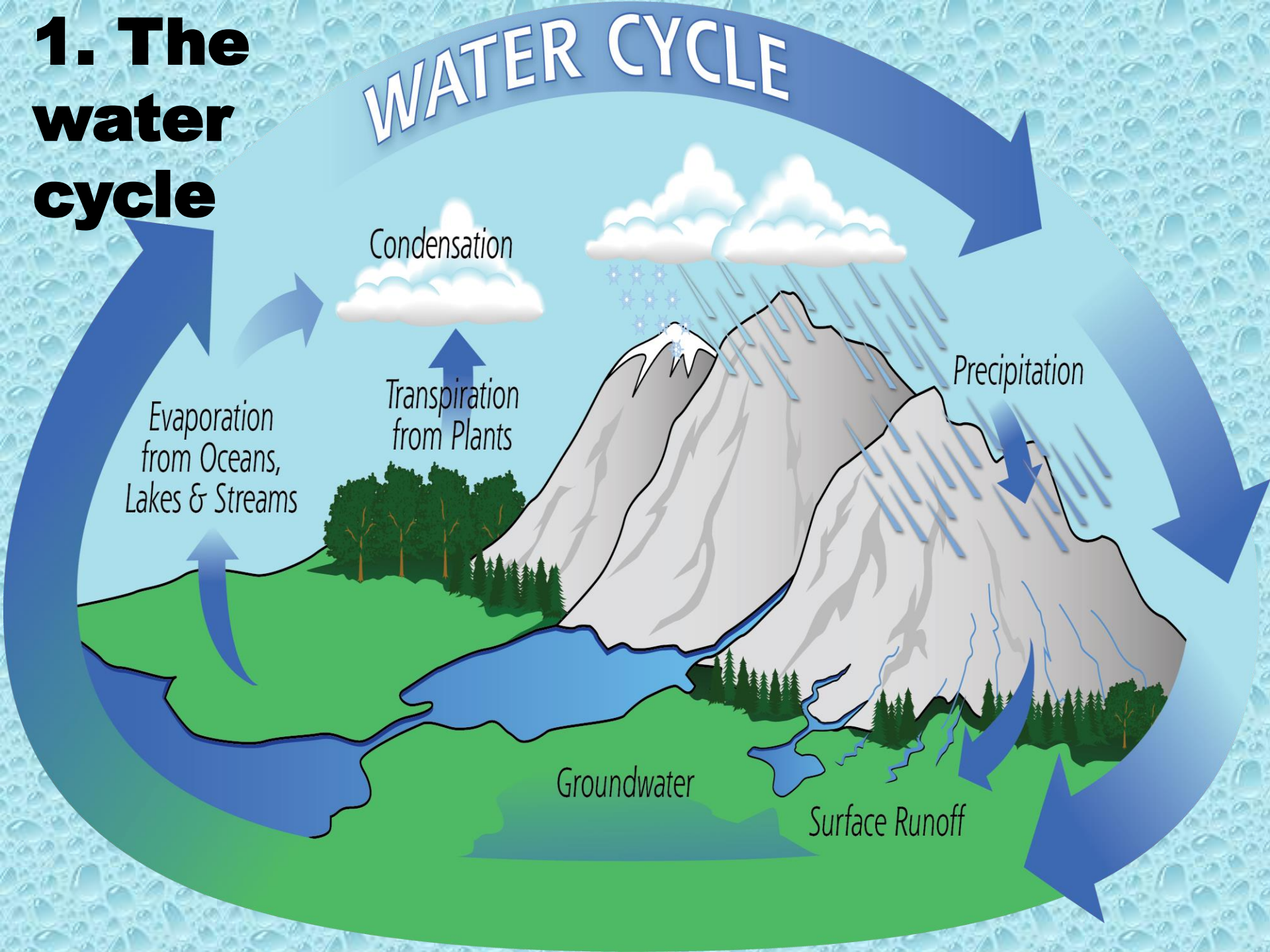
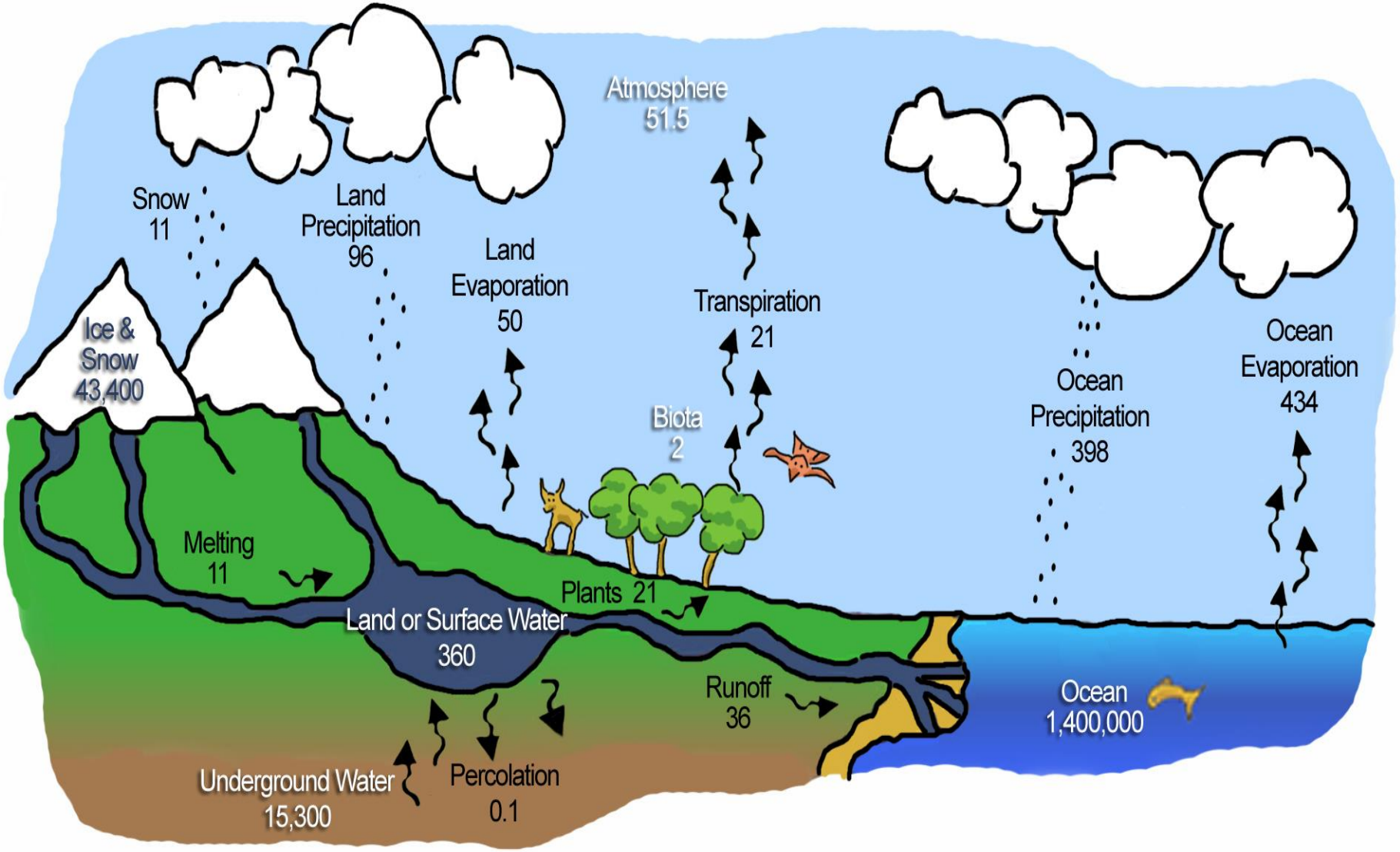
CRIM-UNAM
Mexico City, 15th of June 2017

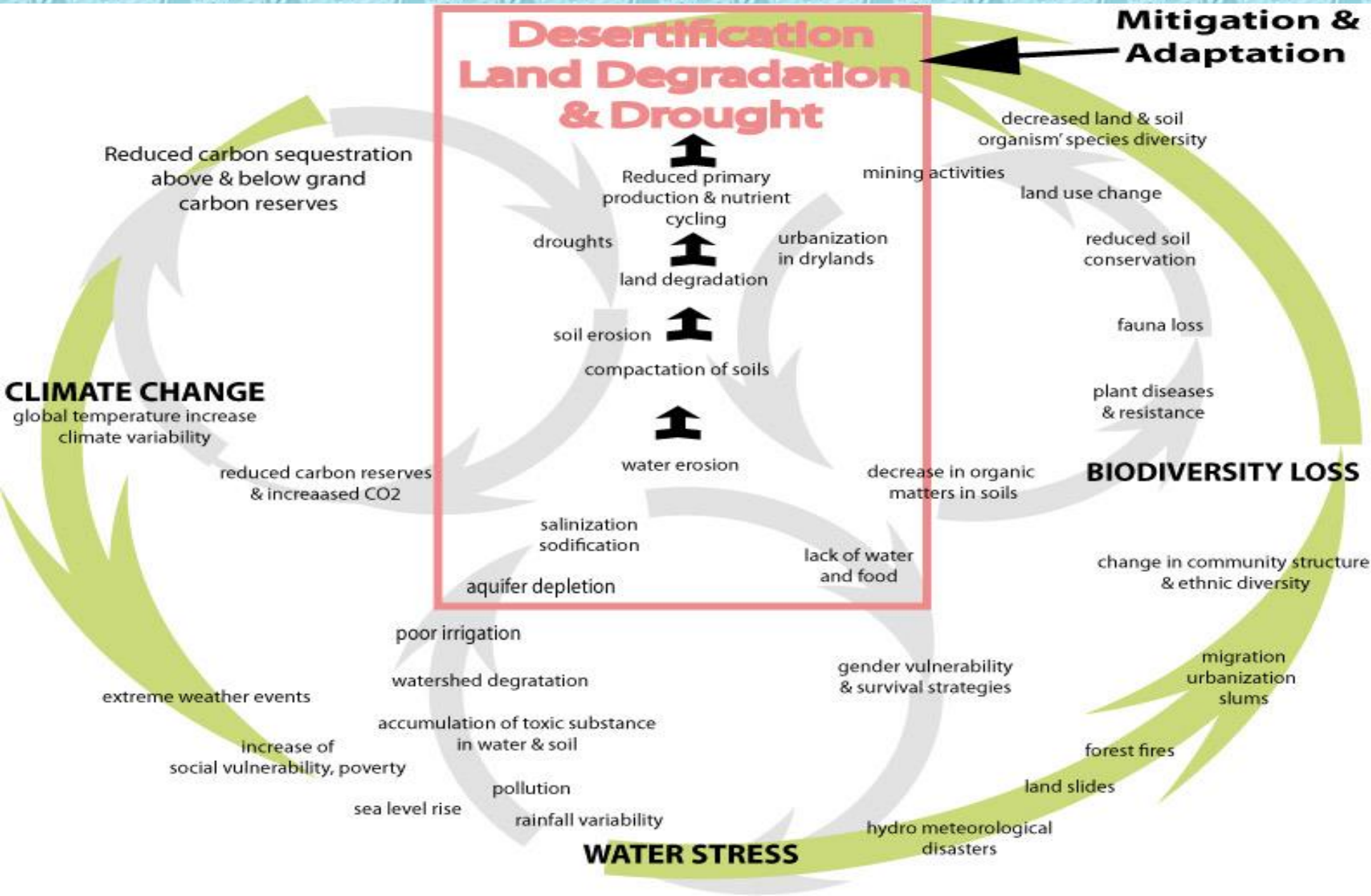
Content

1. The water cycle

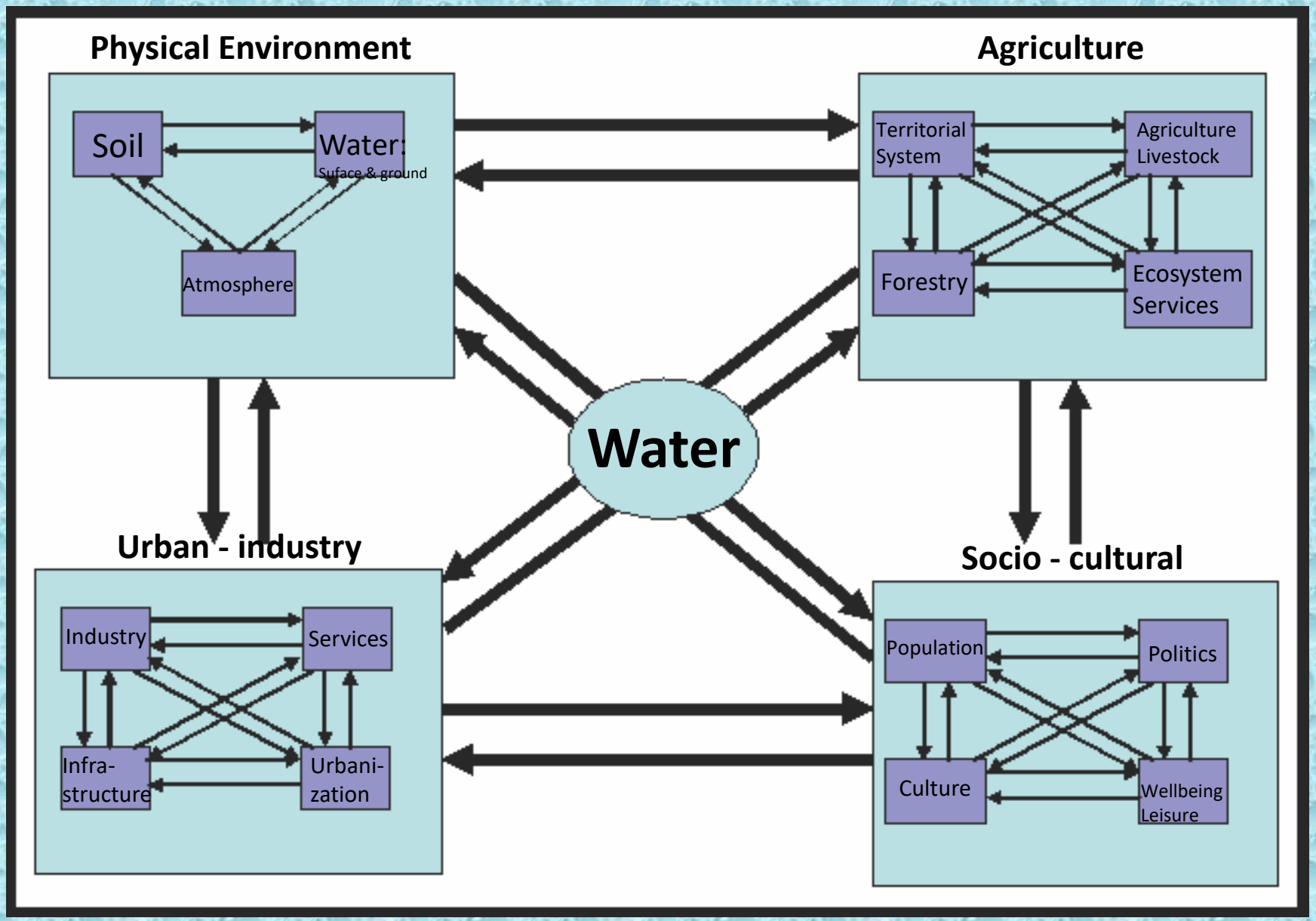



Atmosphere
51.5
Snow
11
Land
Precipitation
96
Land
Evaporation
50
Transpiration
21
Ice &
Snow
43,400
Biota
2
Ocean
Precipitation
398
Ocean
Evaporation
434
Melting
11
Plants 21
Land or Surface Water
360
Runoff
36
Ocean
1,400,000
Underground Water
15,300
Percolation
0.1

Interactions of water, climate, biodiversity and soils

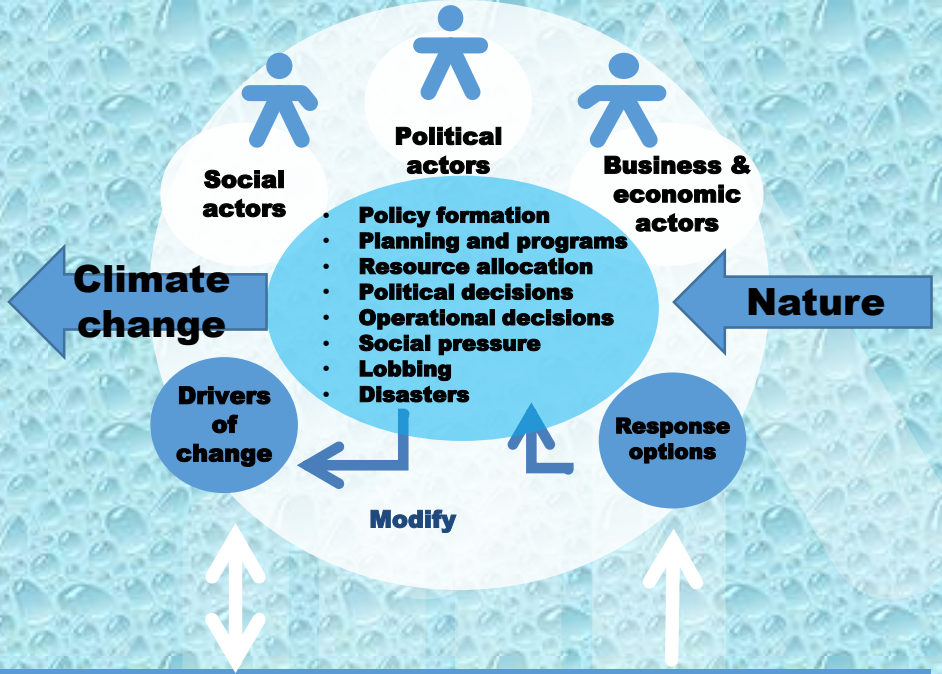


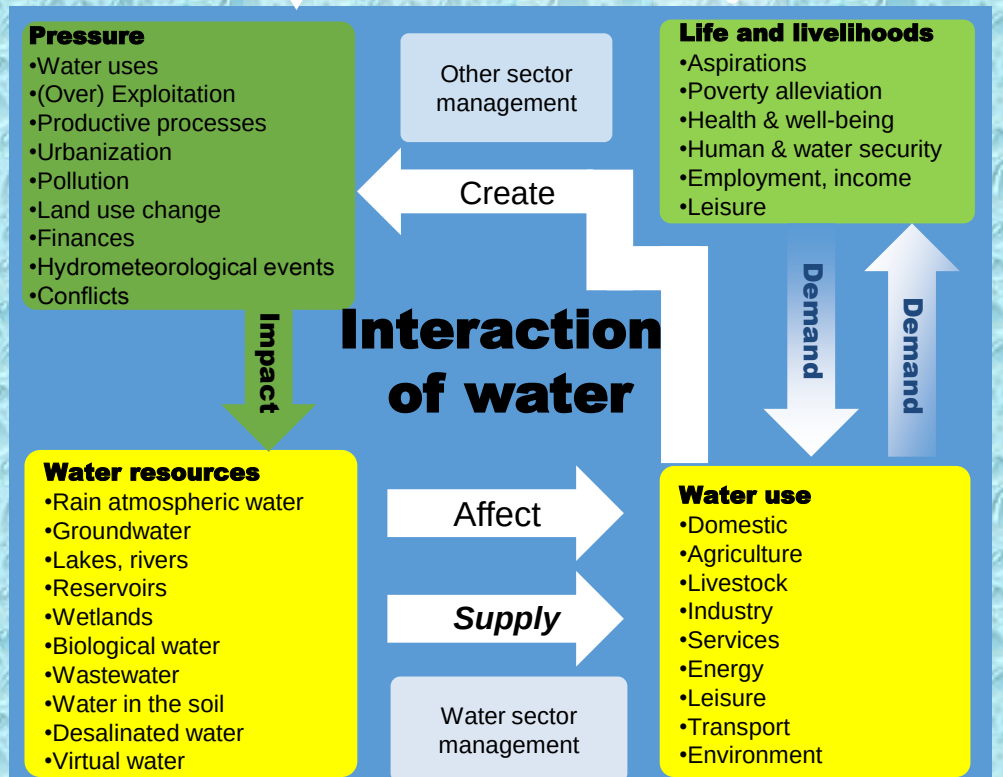
Open dissipative and self-regulating system approach of water management



CEG: Global Environmental Change:

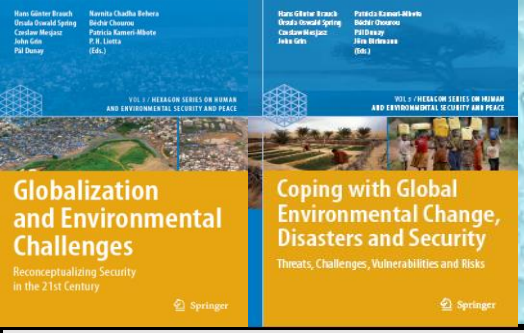
- Demographic
- Urbanization
- Food
- Social organization
- Economy and finance
- Policy & law
- Technology
- Environment
- Hydrometeorological events
- Culture



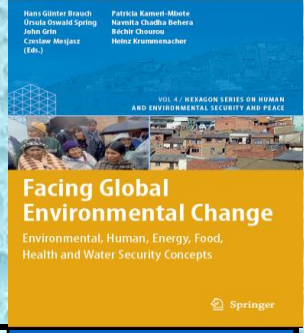


Dissipative self-organizing system of water management

Source: Oswald, transformed from Global Water News, #9, 2010, p. 4



Widening, Deepening and Sectorialization of Security Threats and Risks



Security dimension⇒ ⇓ Level of interaction	Mili-tary	Politi-cal	Economic	Environ-mental ⇓	Societal
Human and gender **Human, gender security ⇒**	Land mines	Failed state	Food & health security	**Cause & victims**	Food & health security
Community security	Border control	Public security	Water, food & health sec.	Ecosystem services	⇓⇑
National security	During Cold War shrinking (in USA since 2001 ⇑ & since 2009 ⇓)		**Energy security**	⇓⇑ CC, biofuels, water	**Water, energy food, & health security**
International and Regional security			Water security	⇓⇑ Water, CC	Water security
Global and planetary security ⇒	Terro-rism	Intern. migration	Financial crisis	CC; GEC; biodiversi-ty loss	Health security

What is water security?

- **One common goal:** *to provide water security in the 21st Century to everybody on the planet:*
  - ensuring that **freshwater**, coastal and related ecosystems are protected and improved;
  - every person has access to enough **safe water** at an affordable cost to lead a healthy and productive life
  - sustainable development and **political stability** are promoted;
  - the vulnerable are protected from the risk of water-related **hazard**
- Water resources are under **threat** from pollution, overexploitation, land-use changes, unsustainable use, climate change and other anthropogenic forces.
- Links between threats and poverty: the **poor** are hit first and hardest (slum dwellers without basic services).
- One simple conclusion: **business as usual is not an option.**

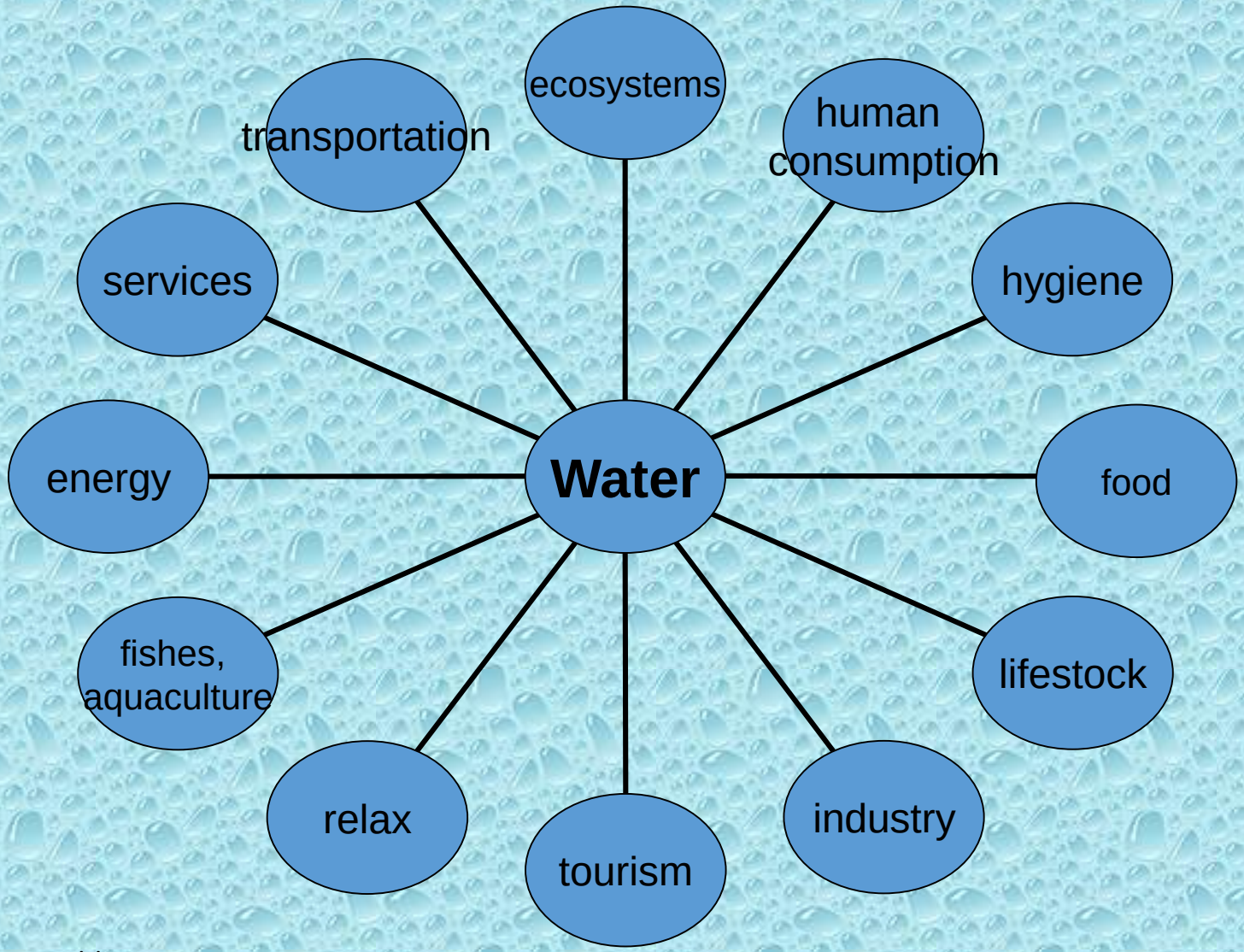
Water security

- **In many regions, changing precipitation or melting snow and ice are altering hydrological systems, affecting water resources in terms of quantity and quality.**
- **Many terrestrial, freshwater, and marine species have shifted their geographic ranges, seasonal activities, migration patterns, abundances, and species interactions in response to ongoing climate change.**
- **At present the worldwide burden of human ill-health from climate change is relatively small compared with effects of other stressors and is not well quantified.** However, there has been increased heat-related mortality and decreased cold-related mortality in some regions as a result of warming. Local changes in temperature and rainfall have altered the distribution of some waterborne illnesses and disease vectors.

Water security: a new concept

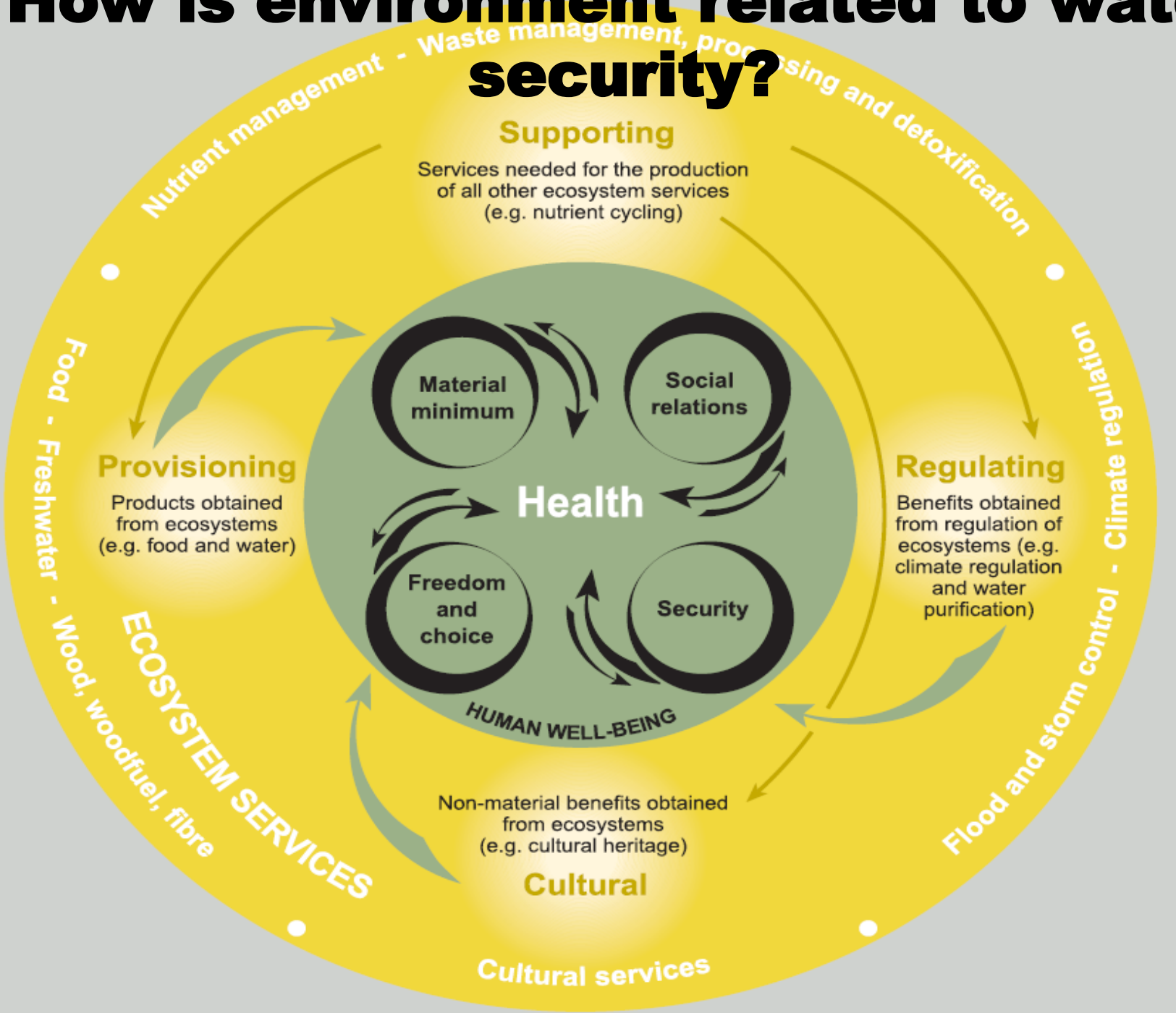
- Water is a major object of analysis in **environmental** security to maintain ecosystem services, and to protect the biological and hydrological cycles, the ecosphere.
- Water is a key element of **societal** security affecting wellbeing, recreation, and joy of life. It requires policy initiatives to avoid hydrological disasters and illnesses through protective and preventive, **resilience-building**, early warning, and evacuation to safe places in case of extreme weather events.
- Water is an issue of **economic** security that creates development opportunities.
- Water is a precondition for **food** security offering permanent, sufficient, accessible, safe, and nutritional food that is culturally accepted.
- Water is essential for **health** and **livelihood** security to protect people from thirst, waterborne illnesses, vector diseases, but also from floods, drought, and plagues.

Complexity of WaterSecurity



Source: Oswald 2007

How is environment related to water security?

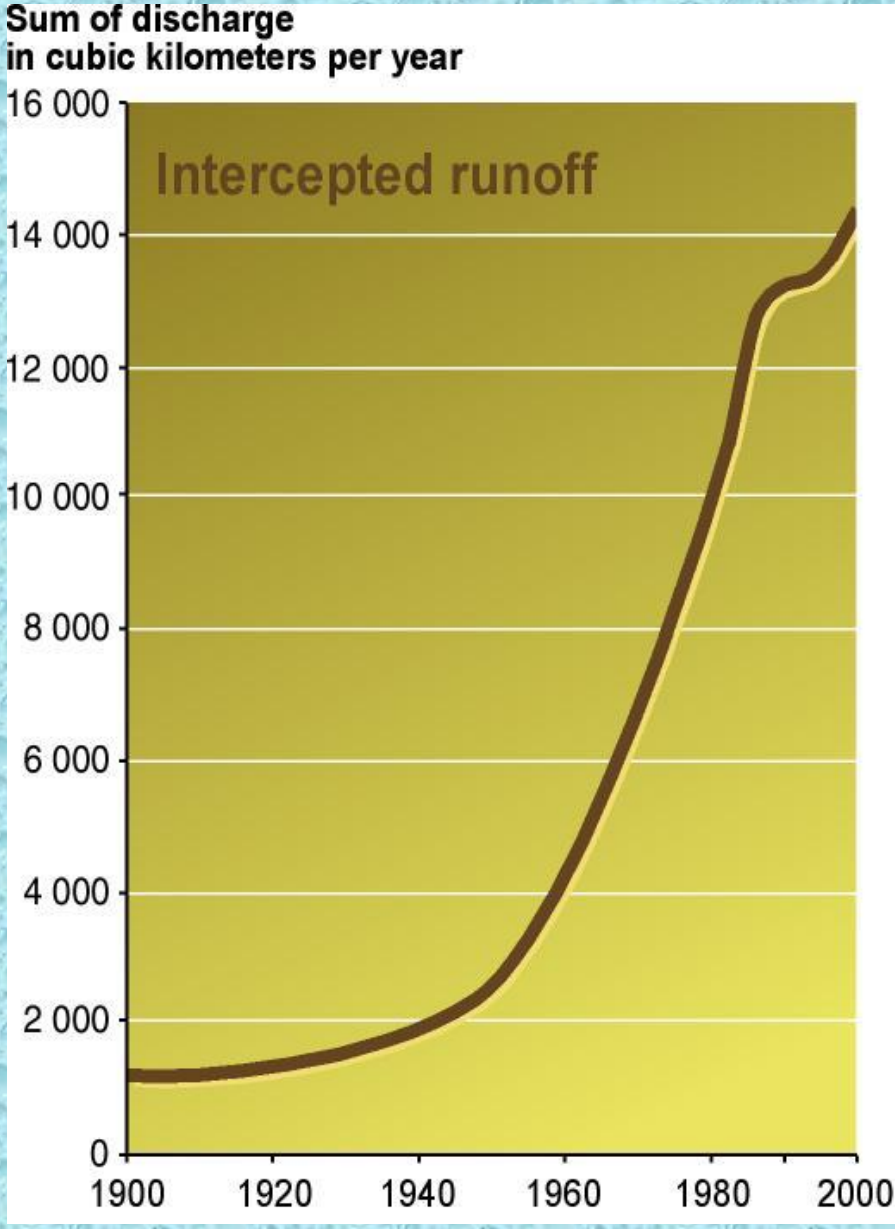


Water abuse and unexpected changes in ecosystems

- 20% of coral reefs are lost and 20% are degraded during the last 50 years
- 35% of mangroves have been lost in 50 years
- Dams have multiplied by 4 since 1960
- The diversion of rivers and lake has doubled since 1960; the majority of water (70% in the world, 78% in Mexico) is used for agriculture.

There are 3-6 times more water in dams tan in natural rivers

Fuente: MA (2005)



- Water is vital for **life and health** of people and ecosystems
- **15 out of 24 ecosystem services** are degraded or used unsustainably
- **Soil nutrient** depletion, erosion, desertification
- Depletion of **freshwater reserves** and pollution of groundwater
- **Overfishing** is pressuring fragile soils
- **Loss of tropical forest** and of biodiversity reduces water and food availability
- **Urbanization** is diminishing the availability of land for water capture and food production.


Water as a human right
Water is life
Civil society participation
Political willness with clear policies & programs
Safe water & improved sanitation
Environmental restoration ecosystem services care
Urban & rural planning
Peaceful conflicto resolution hydrodiplomacy
Gender perspective
Transparency in government & enterprises
Norms reinforced
Laws with citizen control
Protection of vulnerable
Finances S&T

Limits to Water Security

- Hydrological environment: physical stress related to supply of water, inter and intra-annual variations, spatial distribution, social differences in access, physical vulnerability and biological and physical-chemical quality of water
- Socioeconomic surrounding: economic stress due to socioeconomic structures, stakeholder behaviors (people, farmers, businessmen), values of water, costs of piping and cleaning water, social vulnerability
- Climate change impacts: socio-physical threats are reduced by mitigation and adaptation capacities, governmental response, early warning, evacuation, participative governance, resilience-building
- Conflicts: socio-political risks are prevented by water cooperation, treaties, and integrated water resource management (IWRM)

Uses and volumes of fresh water in MExico

- Agriculture & livestock: **76-77%;**

  6.3 millions of hectares are of irrigation
- Domestic & municipal consumption: **13%**
- Industries: **10%**

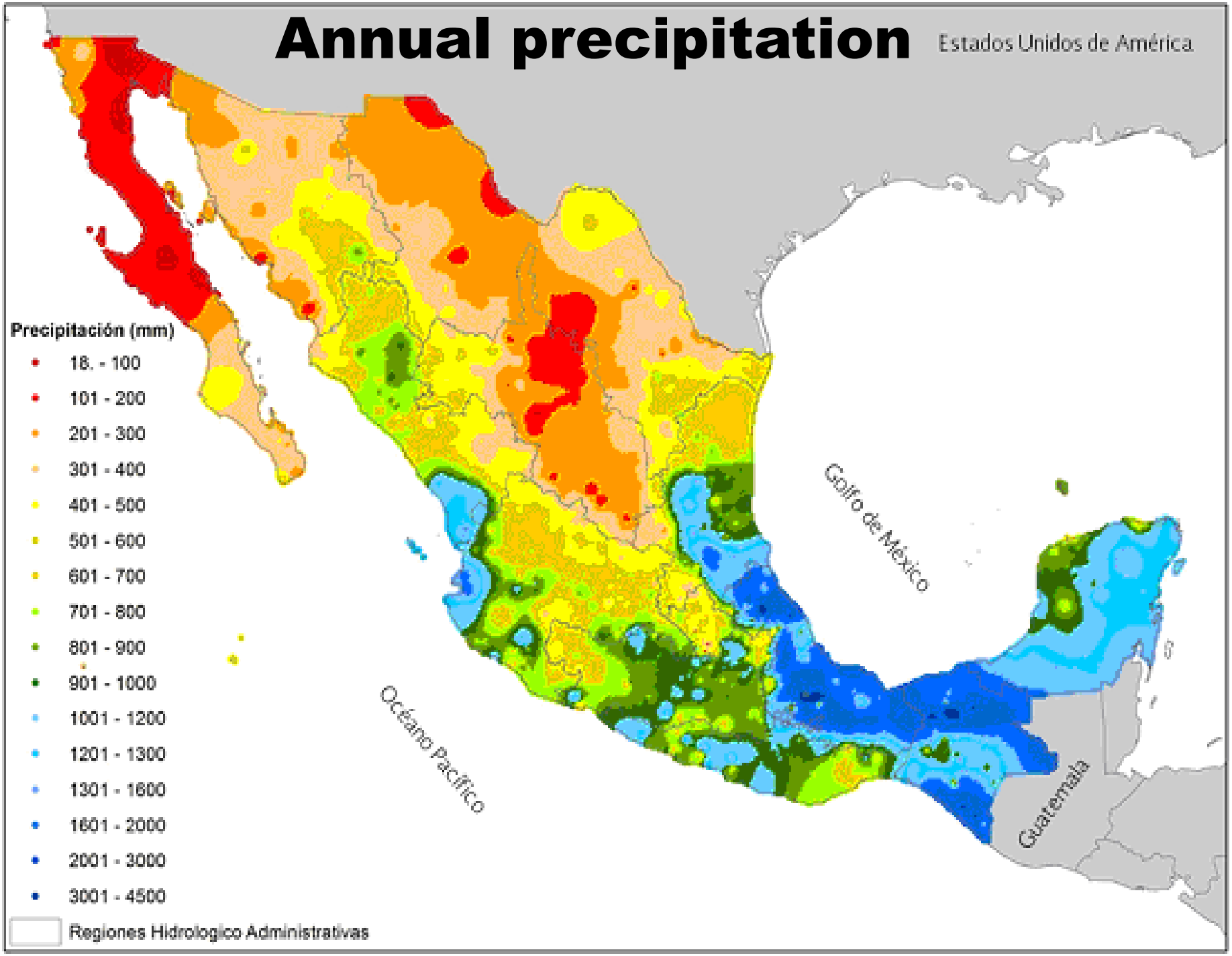
Volume of water (millions of m3):

Precipitation	1 522 000
Rivers	412 000
Dams	180 000
Lakes & lagoons	14 000

Mexican surface water constrains: temporary, regional, sectorial, social & population growth

- 67% de the Mexican rain occur from **June to September**
- In Baja California it rains only **199 mm/year**; in Tabasco **2588 mm**. The average is about 770mm/year
- **Agriculture** use about 76% of the water and produce 4-5% of GDP.
- **Chiapas, Oaxaca & Guerrero** are the three states with the highest **lack of basic safe water** and drainage services.
- **Per capita availability** got reduced from 18,035 m3 in 1950 to 3,982 m3 in 2015, due to population growth, aggravated by **urbanization** and higher demand of water.
- From 1994 on the **precipitation got reduced**, but there were **flash floods** (Conagua 2015) with landslides. Mexico lacks the infrastructure to avoid disaster from flash floods, especially in the **drylands**.

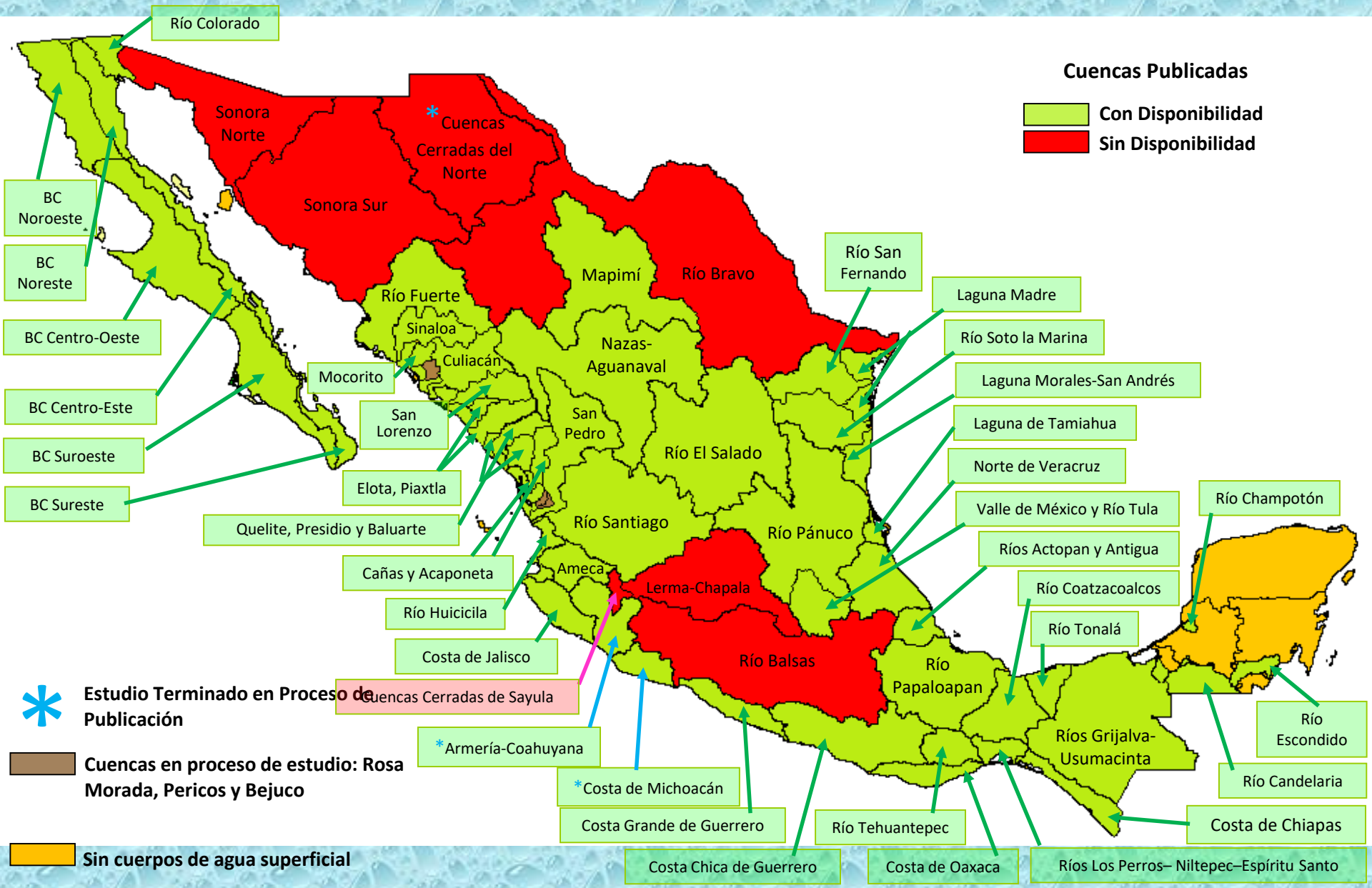
Annual precipitation



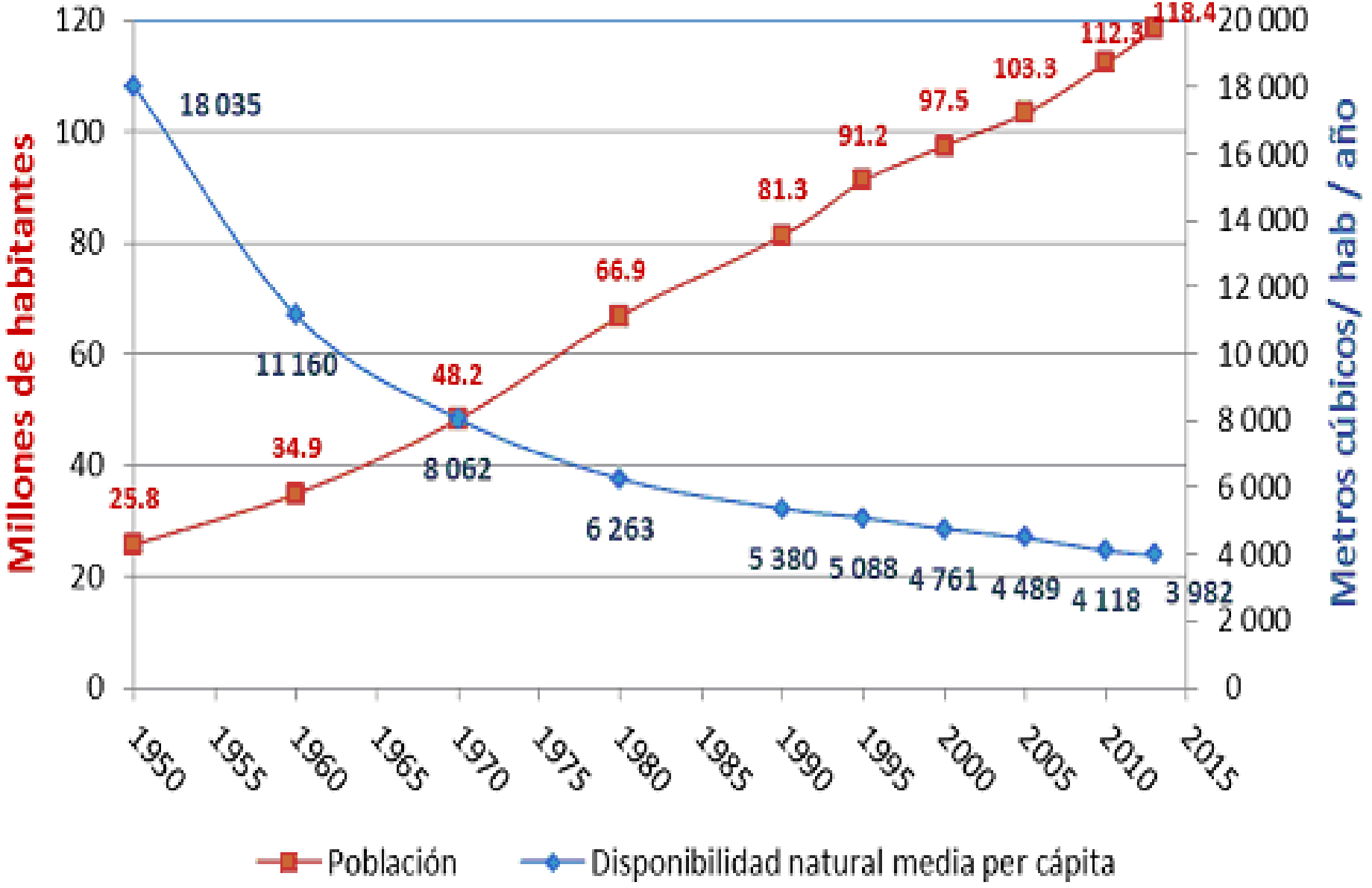
Basins or watersheds

- Mexico has **837 watersheds** of different characteristics and sizes, **42 main rivers** that run on the Pacific, the Atlantic and the interior, whose rivers flow into lagoons or inland dams.
- The uses and uses of surface and groundwater are divided into **13 Hydrological and Administrative Regions**
- 653 aquifers; **140 are overexploited** and represent almost 90% of the domestic water supply
- **Groundwater is strategic** for the country because of its greater potential and its quality compared to the superficial

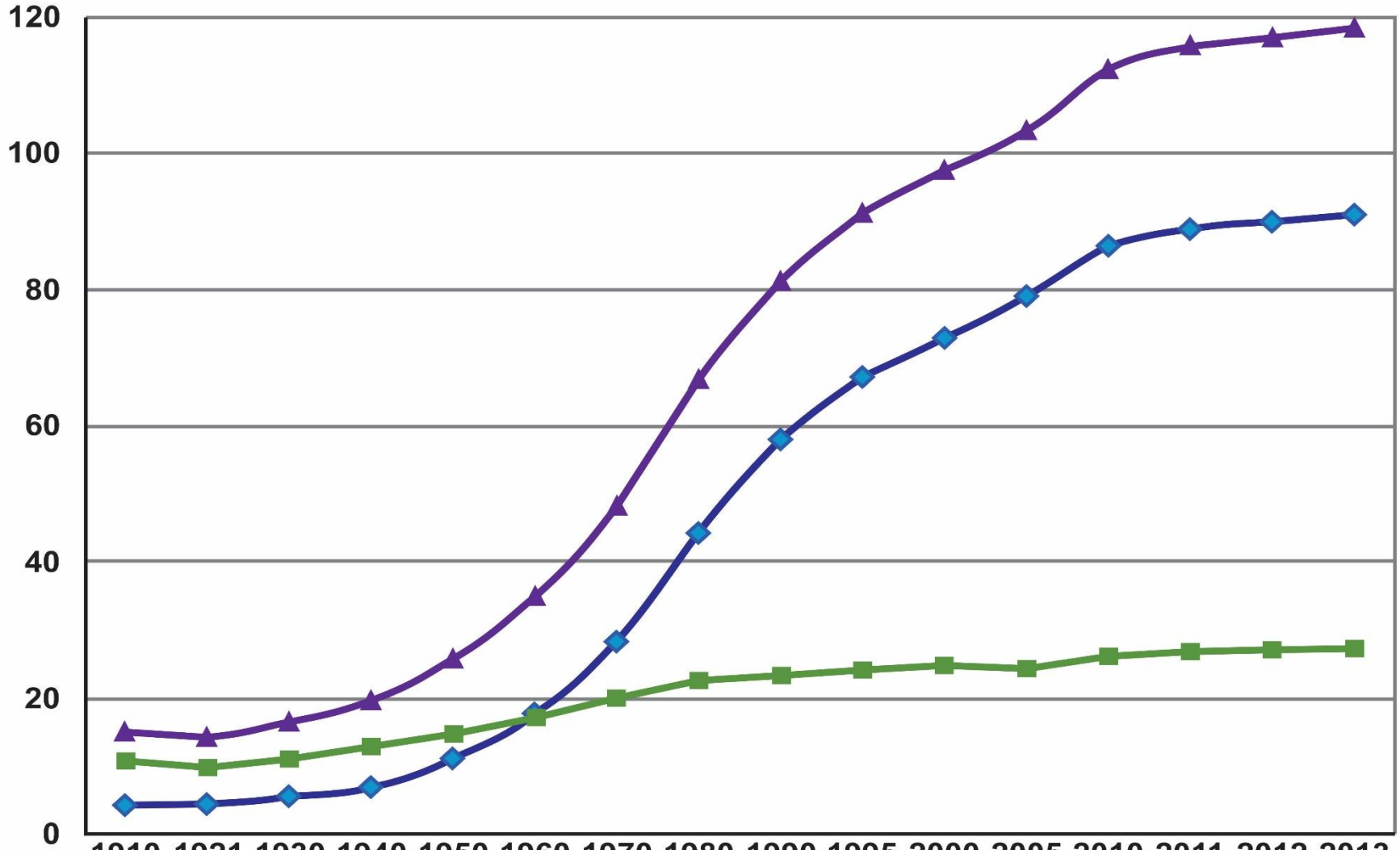
Administrative regions of water management



Natural availability of water /cap

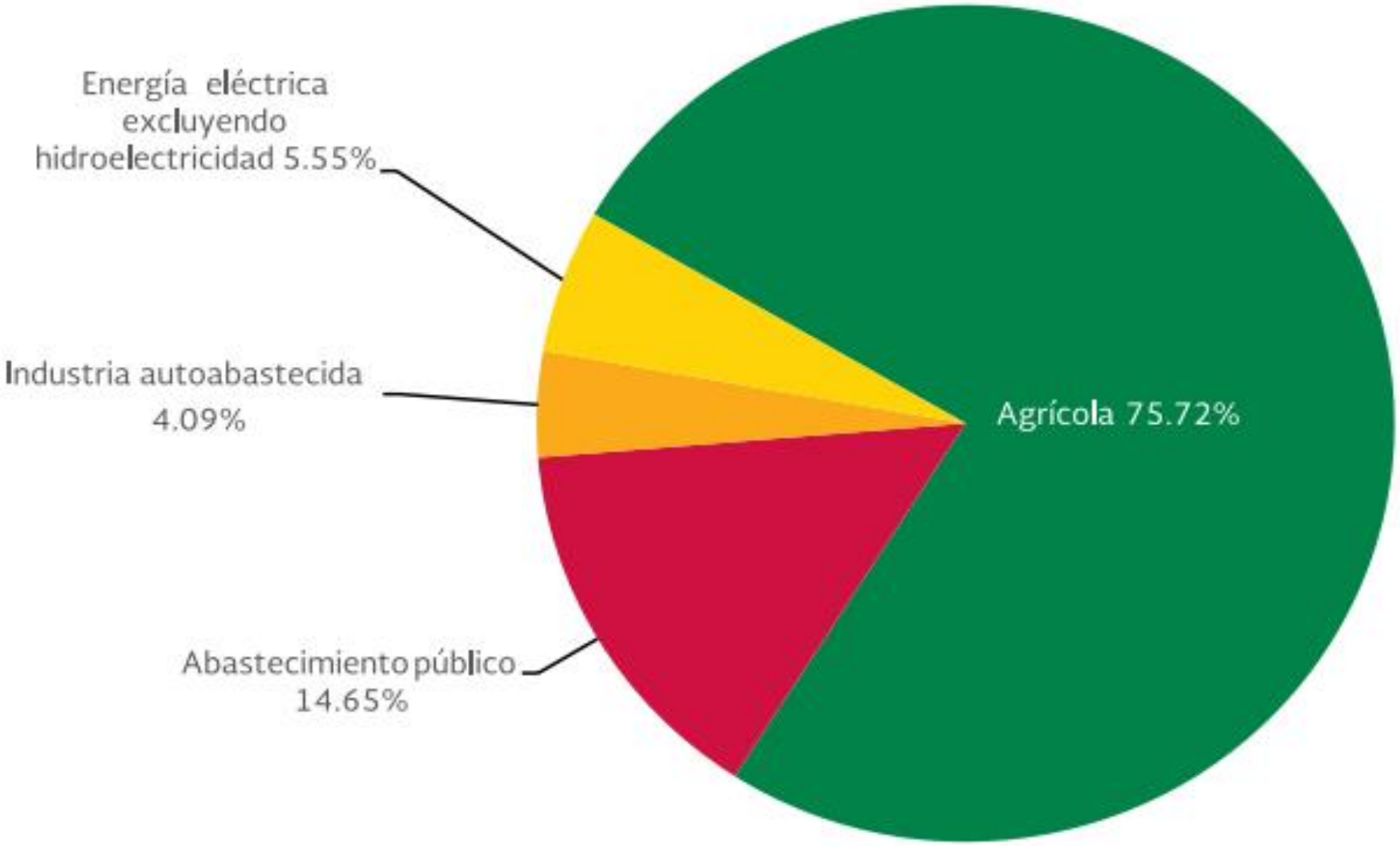


Evolution of rural and urban population

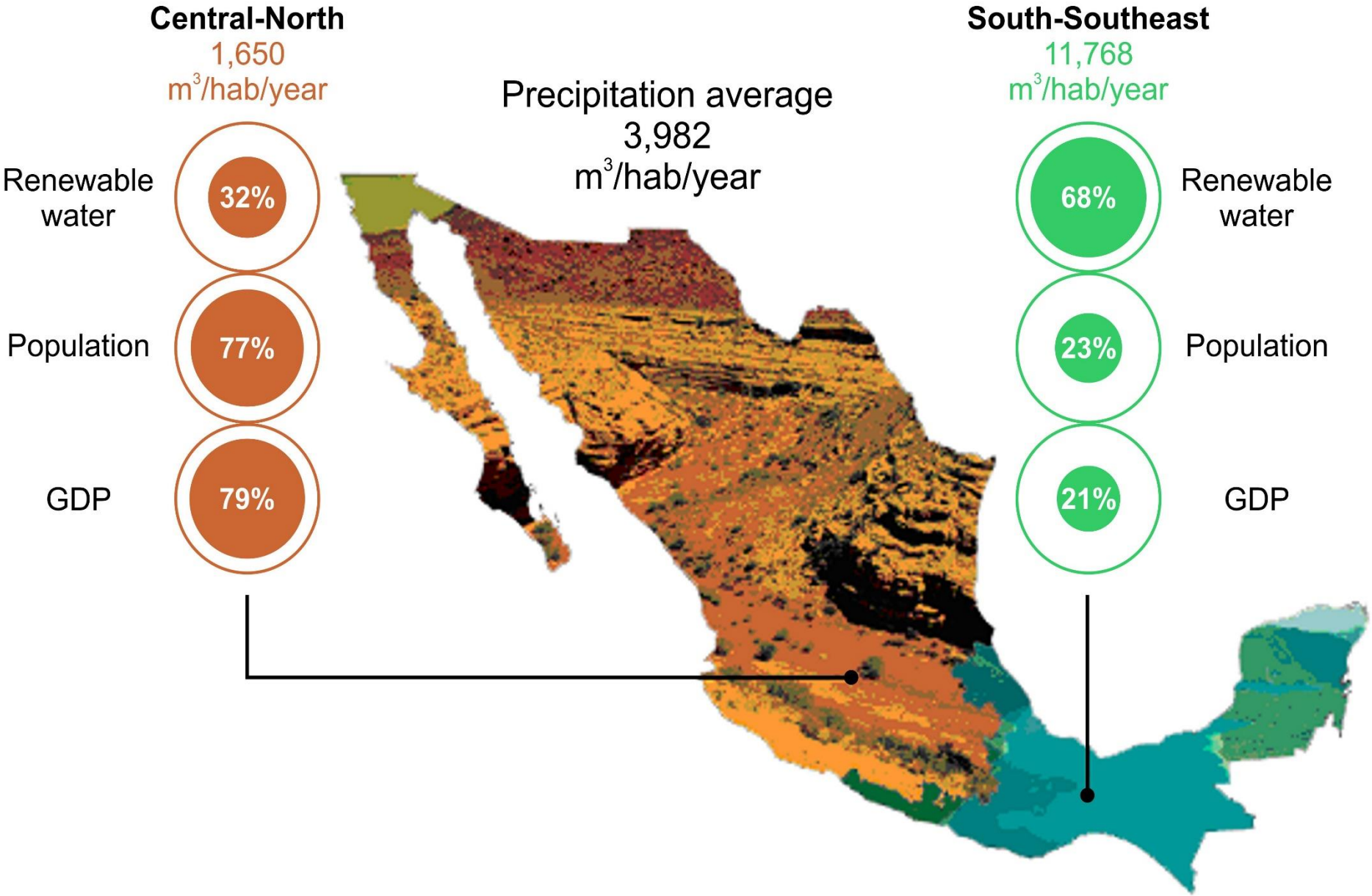


	1910	1921	1930	1940	1950	1960	1970	1980	1990	1995	2000	2005	2010	2011	2012	2013
Total	15.2	14.3	16.6	19.7	25.8	34.9	48.2	66.8	81.2	91.2	97.5	103.3	112.3	115.7	117.1	118.4
Urban	4.3	4.5	5.5	6.9	11.0	17.7	28.3	44.3	58.0	67.0	72.8	79.0	86.3	88.9	90.0	91.1
Rural	10.8	9.9	11.0	12.8	14.8	17.2	19.9	22.5	23.3	24.2	24.7	24.3	26.0	26.8	27.0	27.3

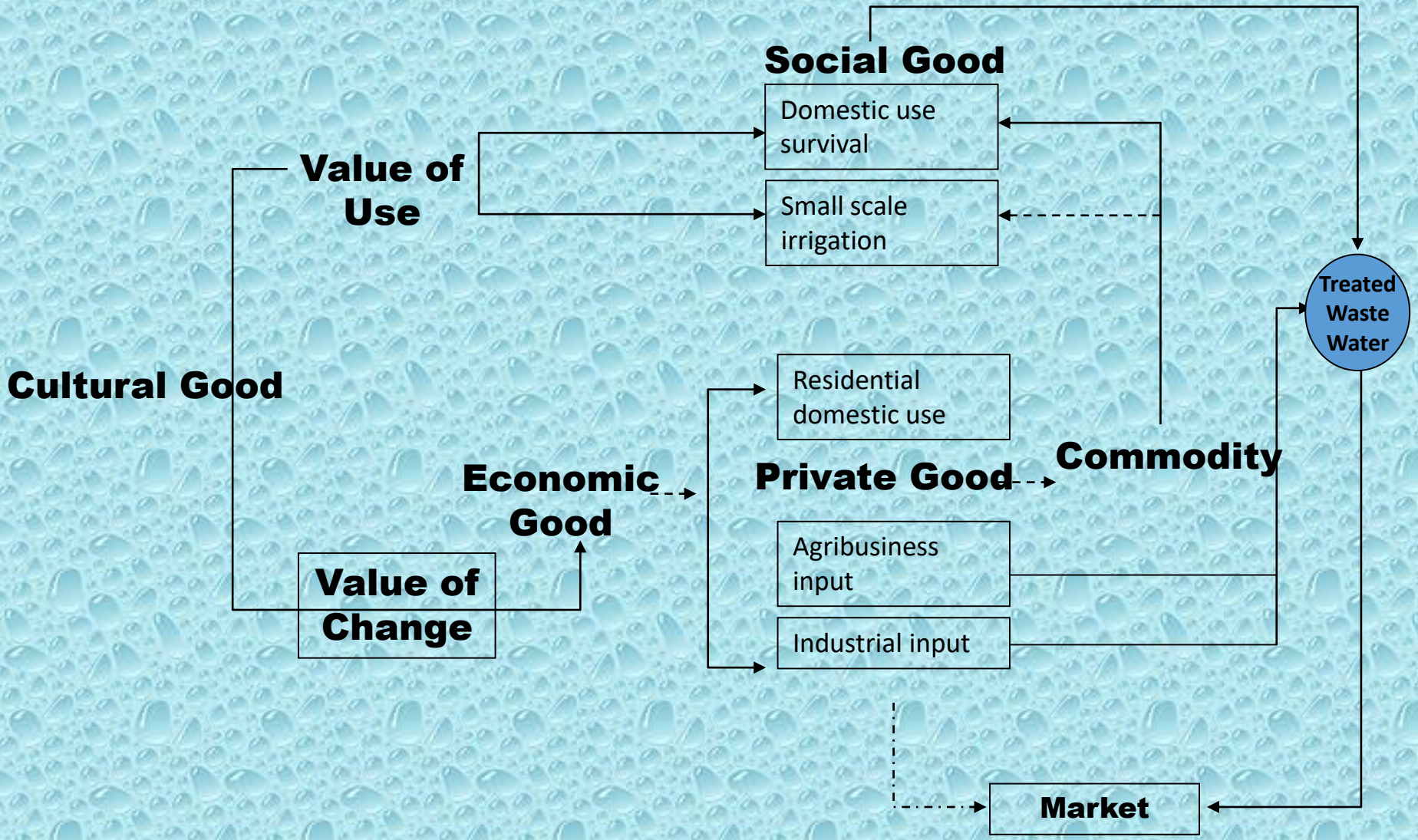
Use of water


Energía eléctrica excluyendo hidroelectricidad 5.55%
Industria autoabastecida 4.09%
Abastecimiento público 14.65%
Agrícola 75.72%

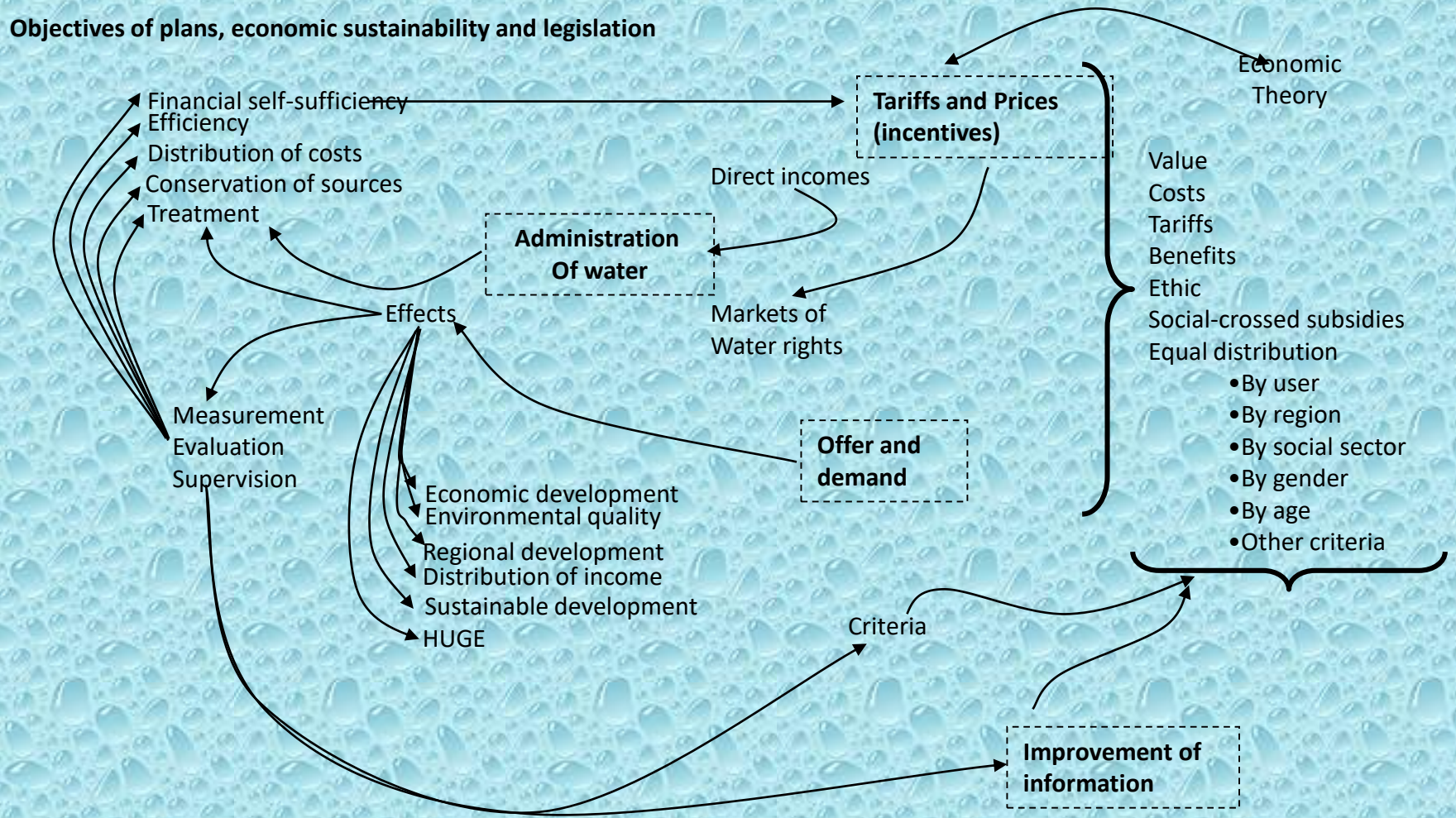
Water, GDP and people



Economy of water in Mexico



Administration of water



2. What is clean water?

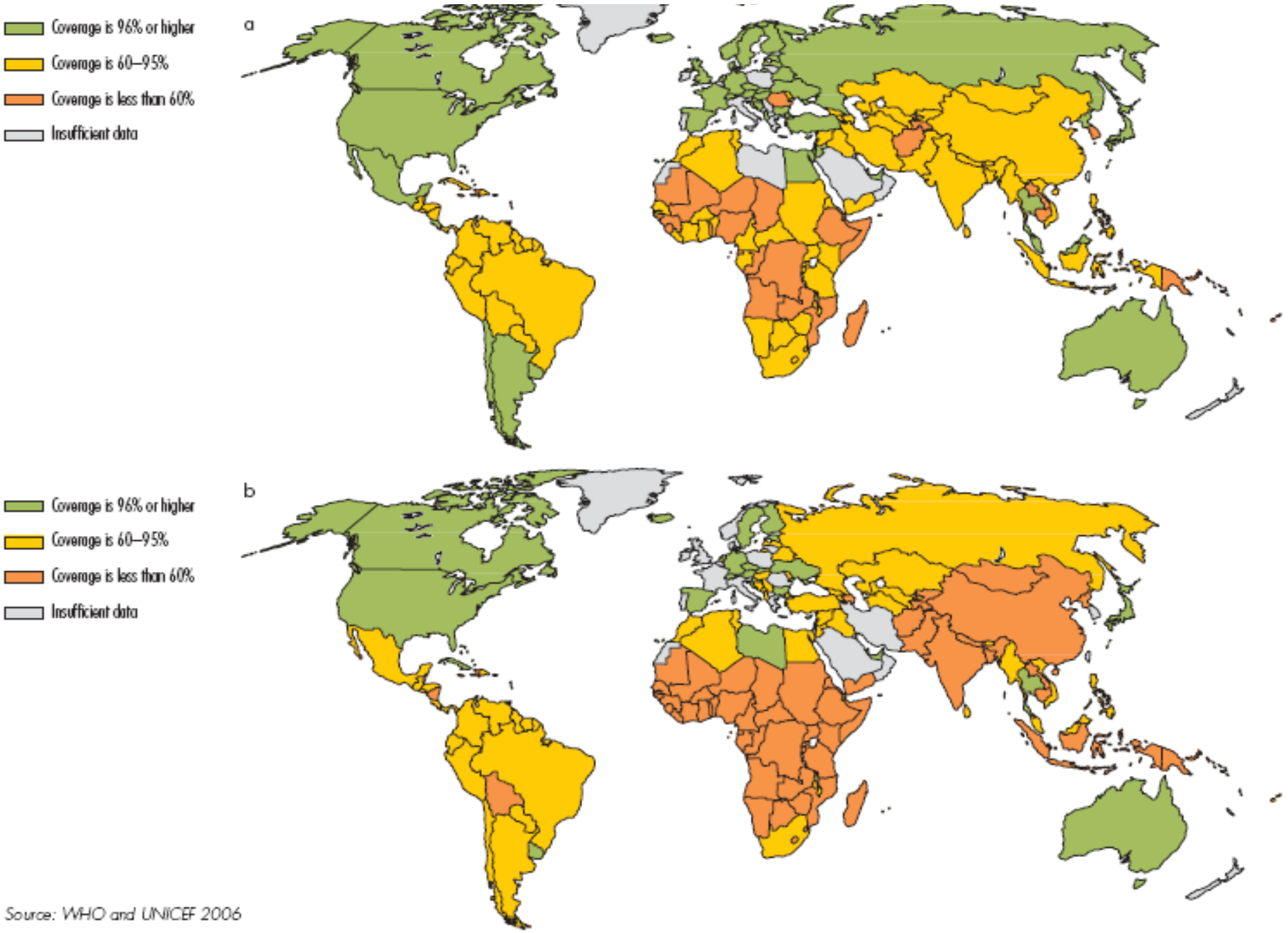
- Free of organisms
  - bacterias
  - virus
  - protozoarios
- Free from toxic substances
  - inorganic
  - organic
- Aestetically acceptable
  - flavor
  - odor
  - colour

- Approximately 3.5 million people die each year due to inadequate water supply, sanitation and hygiene.
- The biodiversity of freshwater ecosystems has been degraded more than any other ecosystem, especially the coastal systems.

Pollution of water worldwide

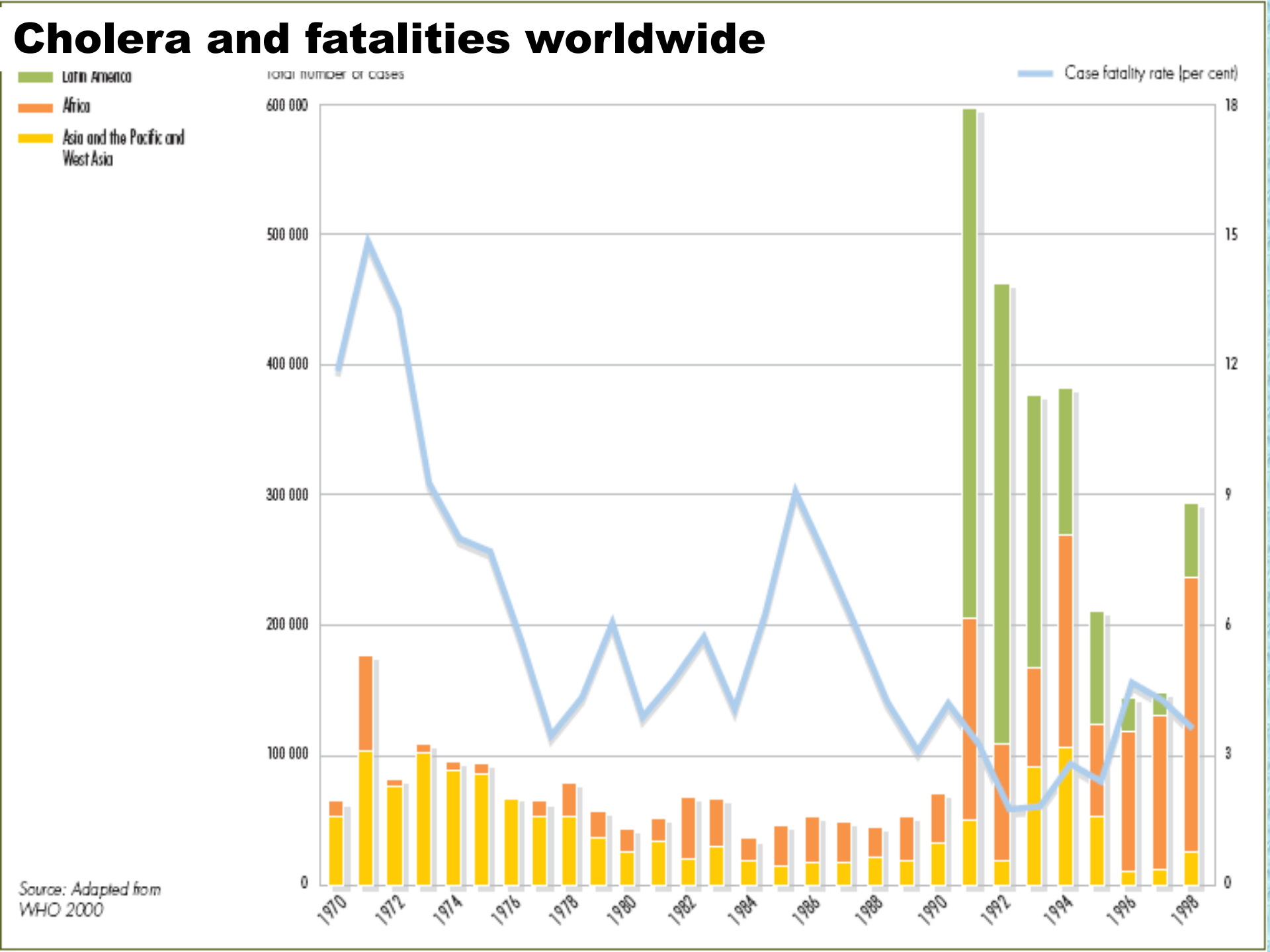
- In developing countries 2.2 million people die each year due to diseases related to lack or polluted water, inadequate sanitation and lack of hygiene.
- Over 2.5 billion people still lack access to improved sanitation. Meeting the MDG on water supply and sanitation would reduce the annual global disease burden by an estimated 10%, with an annual benefit cost ratio of approximately 7:1.
- The social and environmental costs to ignore the necessity for improved sanitation (including hygiene, recollection and treatment of sewage water) is higher than including this costs into the programs of safe water.

Drinking water and sanitation coverage worldwide



Source: WHO and UNICEF 2006

Cholera and fatalities worldwide



Source: Adapted from WHO 2000

4. Monitoring water in Mexico: importance of safe water and its purification

- **80% of diseases are** related to polluted water in Mexico
- **50% of infant mortality** is related to polluted water
- Mortality due to diarrhea in children less tan 5 years old is in average **20.65/100,000**. However, in **Puebla, Oaxaca y Chiapas** the values are 41.59, 44.67 y 49.82/100,000 (INEGI-Conagua, 2015).

How to avoid diseases? Preventive microbiological indicators to avoid epidemics

1. **Aerobic mesophilic bacteria**: Not more than **1 mg/kg**
2. **Total coliforms**: **small amount:** 308 +- 1L (35°C +- 1°C) in lactose cultivation during 24 hours: potential diseases: Enterobacteriaceae such as Escherichia, Klebsiella, Enterobacter, Serratia, Citrobacter, Salmonella, etc.
3. **Fecal coliforms**: **0 are allowed** (produce all types of intestinal diseases such as Escherichia, Klebsiella, Enterobacter, etc.)

Multiplication of bacteria

Hospital Infantil de México Federico Gómez

MULTIPLICACION DE LAS BACTERIAS EN CONDICIONES FAVORABLES:

Agua, nutrientes, temperatura, pH

0	1
20	2
40	4
60	8
80	16
100	32
120	64
140	128
160	256
180	512
200	1,024
220	2,048
240	4,096
260	8,192
280	16,384
300	32,768

R. De la Cruz G.

Physical-chemical evaluation of quality of water

- **Monitoring of water in Mexico**
- The Biochemical Oxygen Demand (BOD5),
- The Chemical Oxygen Demand (COD)
- The Total Suspended Solids (TSS).

- **Biochemical oxygen demand or BOD** is a chemical procedure for determining the amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic material present in a given water sample at certain temperature over a specific time period.
- **Chemical Oxygen Demand** (COD) is a measurement of the oxygen required to oxidize soluble and particulate organic matter in water.
- The term "**total suspended solids**" refers to matter **suspended** or **dissolved** in water or wastewater, and is related to both specific **conductance and turbidity**. TSS include all particles suspended within the water column that will not pass through a filter.

T2.15 Distribución porcentual de sitios de monitoreo en cuerpos de agua superficiales por RHA, de acuerdo al indicador DBO_5, 2013

BOD5

Clave	RHA	Excelente	Buena calidad	Aceptable	Contaminada	Fuertemente contaminada
I	Península de Baja California	1.2	23.8	34.5	38.1	2.4
II	Noroeste	11.8	53.9	31.6	1.3	1.4
III	Pacífico Norte	12.5	60.5	26.5	0.5	0.0
IV	Balsas	17.9	17.3	43.9	17.0	3.9
V	Pacífico Sur	26.2	39.3	29.5	5.0	0.0
VI	Río Bravo	46.9	20.3	31.1	1.7	0.0
VII	Cuencas Centrales del Norte	8.7	65.2	26.1	0.0	0.0
VIII	Lerma-Santiago-Pacífico	7.5	26.4	53.4	10.0	2.7
IX	Golfo Norte	64.9	20.2	11.6	2.5	0.8
X	Golfo Centro	25.7	36.9	32.5	4.4	0.5
XI	Frontera Sur	51.1	34.8	12.5	1.6	0.0
XII	Península de Yucatán	54.7	35.8	9.5	0.0	0.0
XIII	Aguas del Valle de México	1.5	7.5	55.2	23.9	11.9
	Total	26.2	30.4	34.3	7.5	1.6

Fuente: CONAGUA (2014l).

T2.16 Distribución porcentual de sitios de monitoreo en cuerpos de agua superficiales por RHA, de acuerdo al indicador DQO, 2013 **COD**

Clave	RHA	Excelente	Buena calidad	Aceptable	Contaminada	Fuertemente contaminada
I	Península de Baja California	0.0	7.1	25.0	54.8	13.1
II	Noroeste	0.0	7.9	47.4	42.1	2.6
III	Pacífico Norte	0.0	2.3	59.1	36.7	1.9
IV	Balsas	1.2	10.3	34.6	40.4	13.5
V	Pacífico Sur	0.8	17.2	31.1	41.8	9.1
VI	Río Bravo	32.1	13.6	37.6	15.7	1.0
VII	Cuencas Centrales del Norte	0.0	0.0	54.3	43.5	2.2
VIII	Lerma-Santiago-Pacífico	0.3	3.1	25.3	63.5	7.8
IX	Golfo Norte	49.4	8.2	18.9	21.0	2.5
X	Golfo Centro	13.7	6.8	49.4	27.7	2.4
XI	Frontera Sur	37.5	21.1	25.4	14.8	1.2
XII	Península de Yucatán	28.3	26.4	18.9	26.4	0.0
XIII	Aguas del Valle de México	2.9	3.0	17.9	46.3	29.9
	Total	13.8	8.9	33.2	38.1	6.0

Fuente: CONAGUA (2014l).

T2.17 Distribución porcentual de sitios de monitoreo en cuerpos de agua superficiales por RHA, de acuerdo al indicador SST, 2013 **TSS**

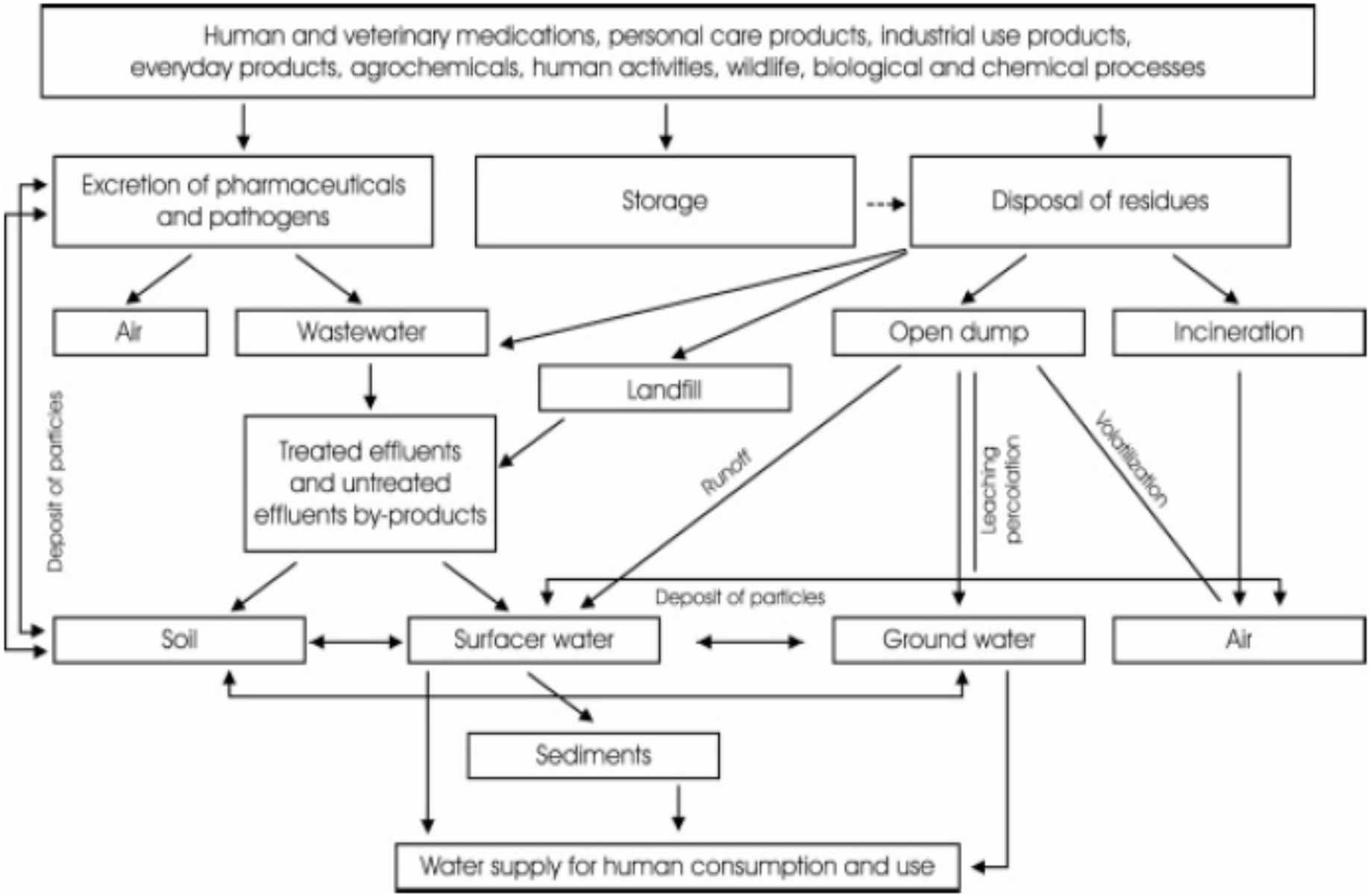
Clave	RHA	Excelente	Buena calidad	Aceptable	Contaminada	Fuertemente contaminada
I	Península de Baja California	69.5	21.4	5.7	2.4	1.0
II	Noroeste	42.2	36.7	10.2	7.0	3.9
III	Pacífico Norte	34.3	39.9	14.9	8.6	2.3
IV	Balsas	34.8	32.0	9.5	16.3	7.4
V	Pacífico Sur	32.1	15.5	17.7	24.1	10.6
VI	Río Bravo	45.4	32.8	12.3	9.2	0.3
VII	Cuencas Centrales del Norte	37.0	34.8	15.2	4.3	8.7
VIII	Lerma-Santiago-Pacífico	34.5	28.4	20.9	12.7	3.5
IX	Golfo Norte	40.8	34.9	16.4	7.2	0.7
X	Golfo Centro	60.1	29.4	5.9	4.2	0.4
XI	Frontera Sur	44.2	28.0	11.6	11.0	5.2
XII	Península de Yucatán	76.4	19.6	2.5	1.5	0.0
XIII	Aguas del Valle de México	26.9	43.3	17.9	11.9	0.0
	Total	43.3	29.1	13.4	10.7	3.5

Fuente: CONAGUA (2014l).

Basins with high pollution

M2.13 Cuencas con sitios de monitoreo fuertemente contaminados para DBO_5, DQO y/o SST, 2013

Processes of emergent pollution



Costs due to polluted water

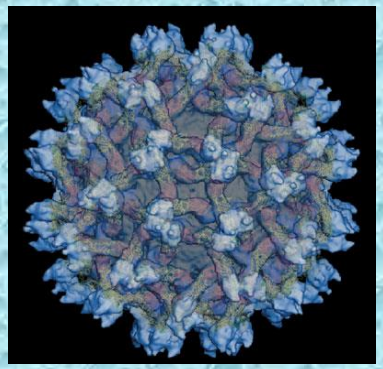
Although water cleaning is expensive, not doing is is even more expensive, due to:

- **Risks to human health by contamination and vectors**
- **Deterioration and destruction of rivers and banks as recreational and flood mitigation zones**
- **Reduction of water available for human and productive uses**
- **Pollution and destruction of marine and aquatic life**
- **Destruction of industrial fisheries**
- **Conflicts among users about the quality and quantity of water, drought for crops, thirst for people**


Water-borne and vector diseases

Dengue, chikungunya, zika: vectors

Increase of population exposed to dengue: **35% - 60%** and estimations in 2085 ~ **6 billion people at risk**



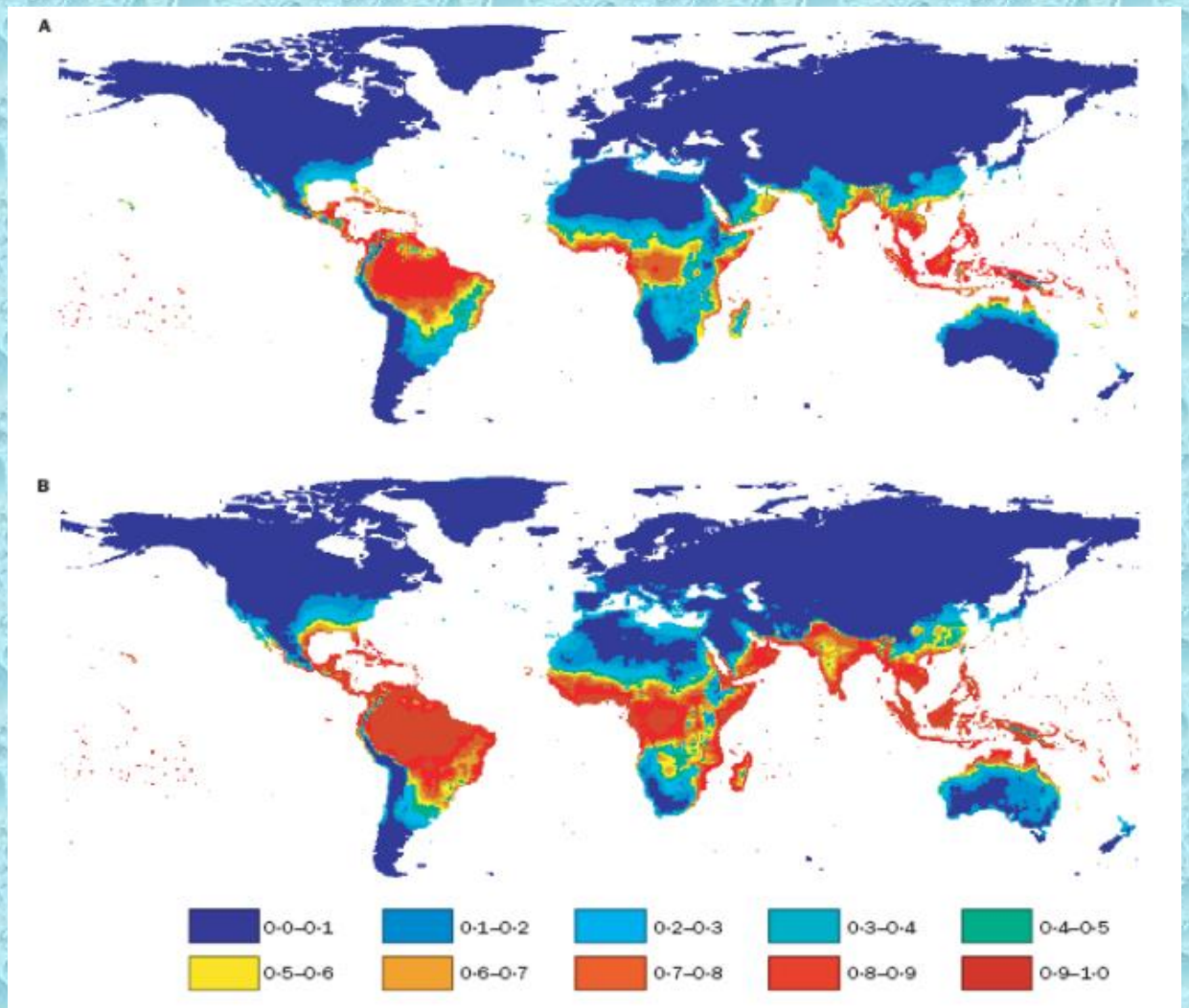
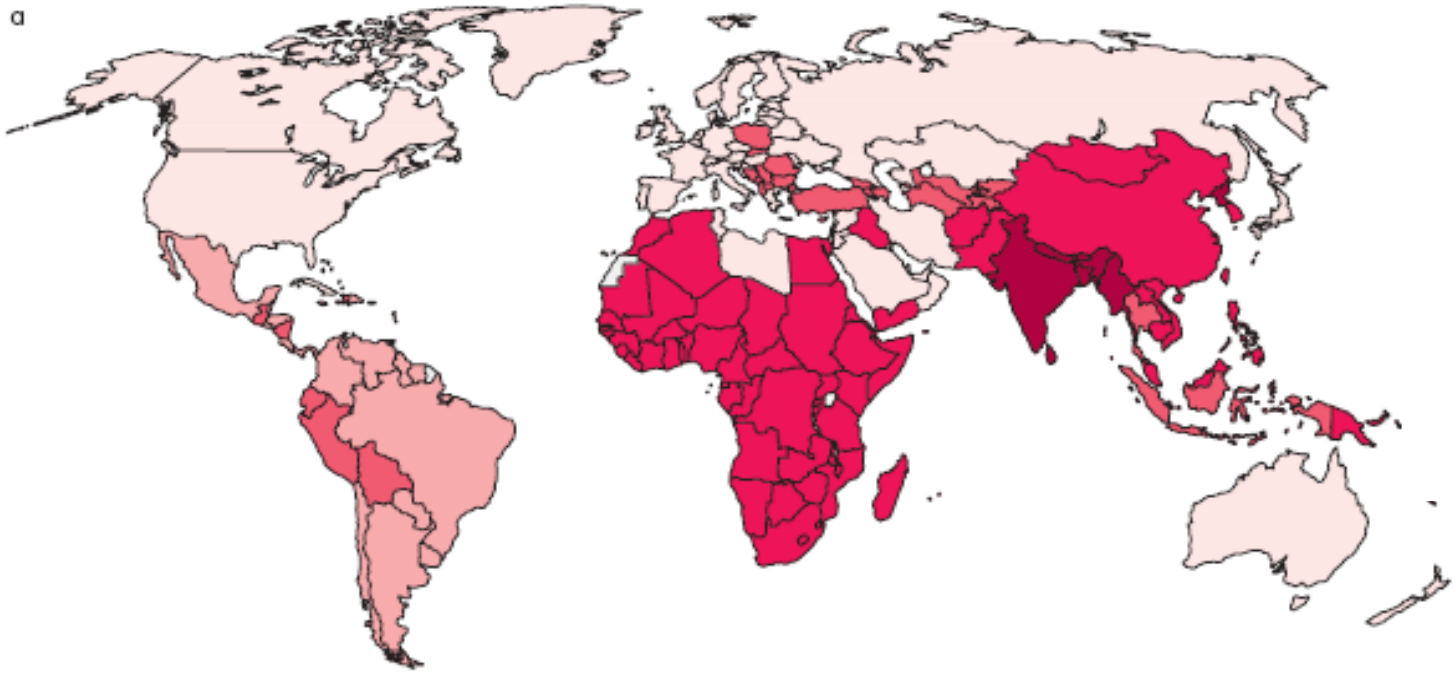


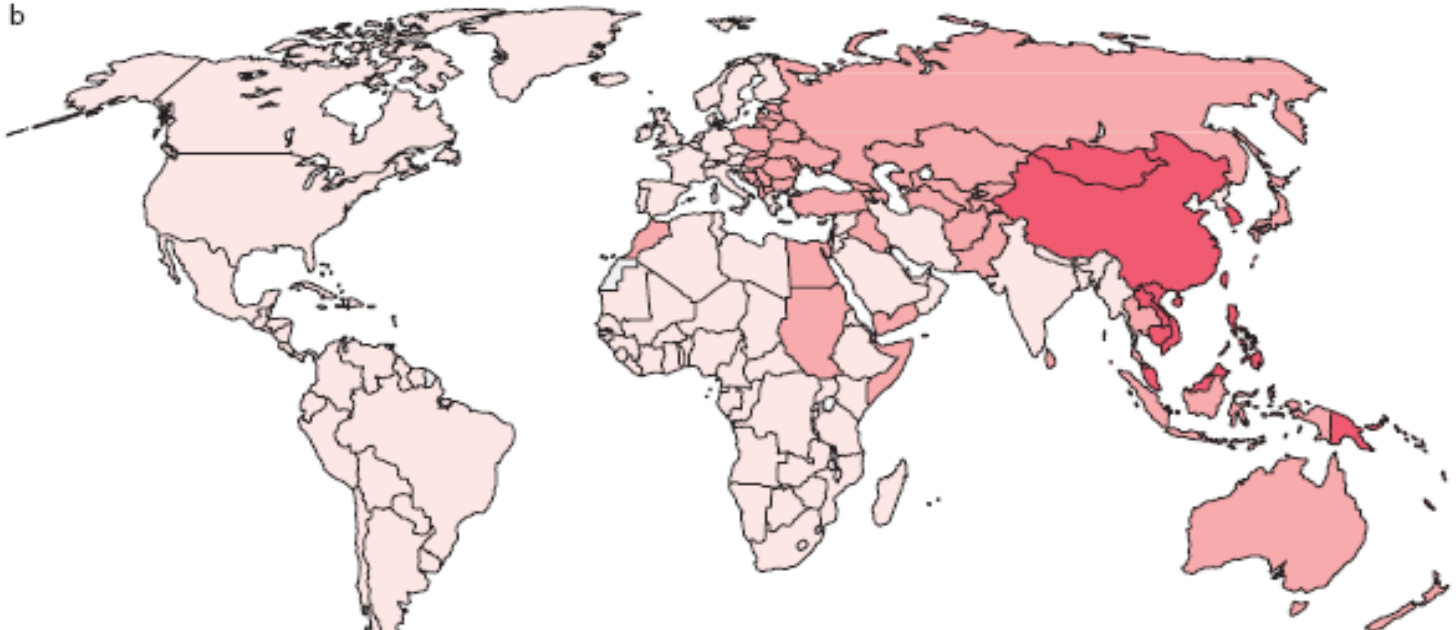
Figure 2: **Estimated baseline population at risk in 1990 (A) and estimated population at risk in 2085 (B)**

Hales et al., 2002

Global desease attributed to indoor and urban PM10 pollution



Source: GEO4: 55



Notes: DALYs – Disability Adjusted Life Years. One DALY is equivalent to the loss of one year of healthy life. This is the only quantitative indicator of burden of disease that reflects the total amount of healthy life lost to all causes, whether from premature mortality or from some degree of disability.

Water-borne illnesses in Mexico

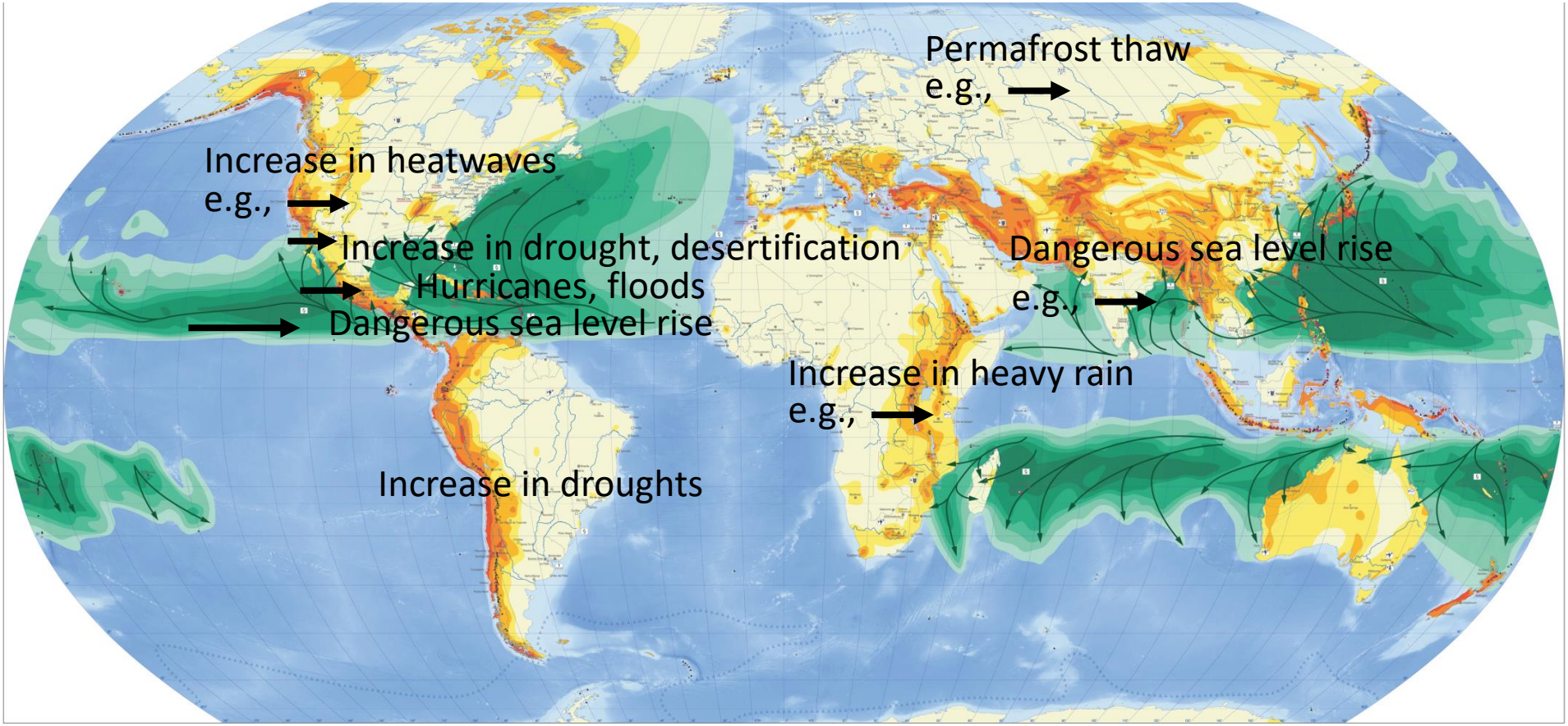
1. **Arsenic** pollution affects 400,000 people in Mexico (Source: Millennium Environmental Assessment, 2005)
2. **Diarrhea:** dead: 1984: 212.3; 1993: 60.4/100,000 mostly children less than 5 years old
3. **Malaria:** 2.77 to 7.27 cases by 100 000 people/year between 2000 a 2005; estimation: 30% of people are at risk.
4. **Dengue:** 2004 to 2008: increase in Mexico: 800%: 80% in South-Southeast: 6 months 2007: 5,520 cases: 4,359 classic type; 1,161 hemorrhagic type (Source: General Direction of Epidemiology 1984-2008)
5. **Chikungunya & Zika:** increase from 2015 on in central and southern Mexico

Water is in Mexico a basic human right

Article 4th of the Constitution:

Everyone has the right to adequate, safe, acceptable and affordable access, disposal and sanitation of water for personal and domestic consumption. The State will guarantee this right and the law will define the bases, supports and modalities for the access and equitable and sustainable use of the water resources, establishing the participation of the federation, the federative entities and the municipalities, as well as the participation of the citizenship for the attainment of these ends.

5. Challenges of safe water in Mexico & climate change (CC)



Earthquakes

- Zone 0: MM V
- Zone 1: MM VI
- Zone 2: MM VII
- Zone 3: MM VIII
- Zone 4: MM IX

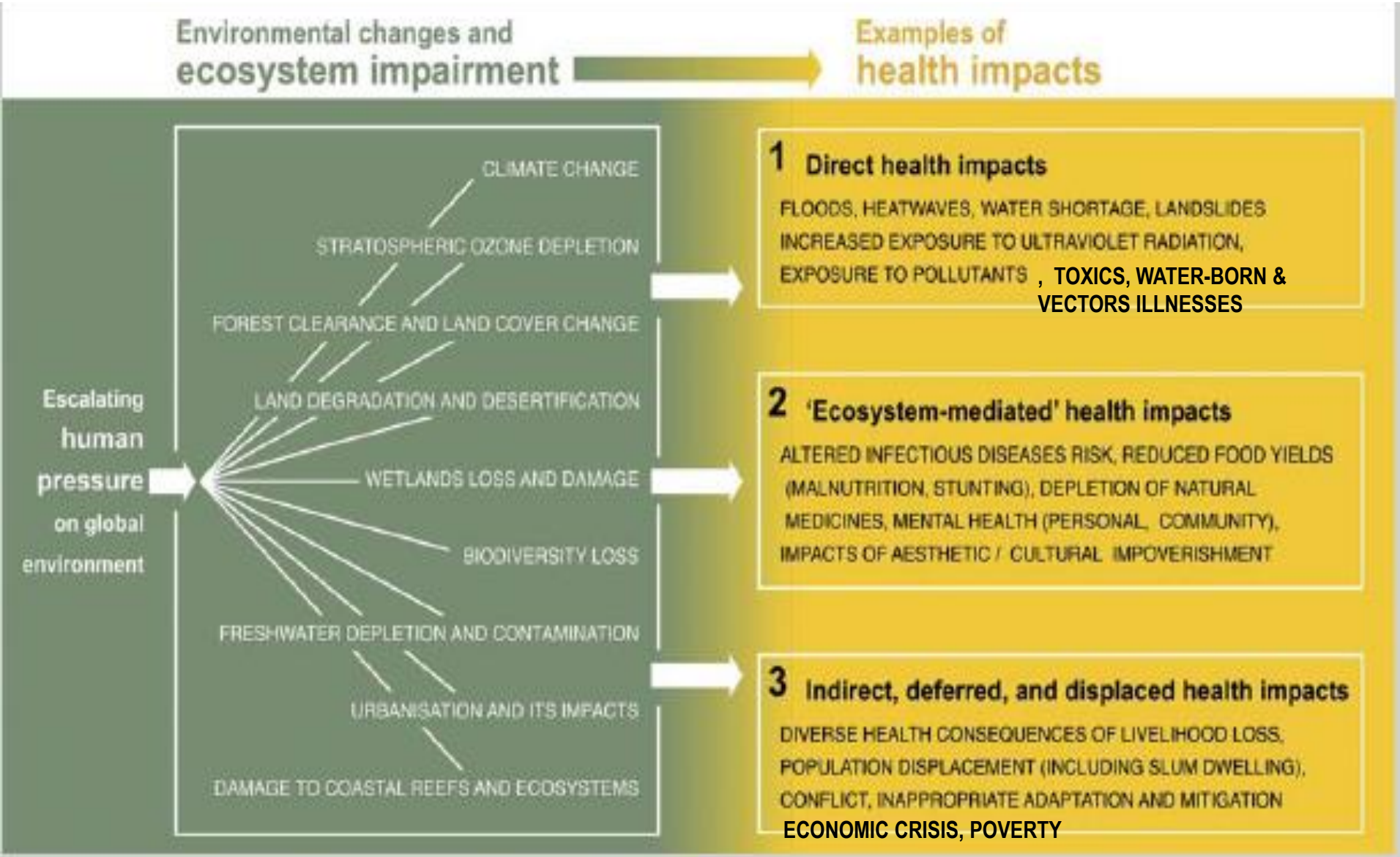
MM: modified Mercalli scale

Tropical Hurricanes

- Zone 0: 76–141 km/h
- Zone 1: 142–184 km/h
- Zone 2: 185–212 km/h
- Zone 3: 213–251 km/h
- Zone 4: 252–299 km/h
- Zone 5: ≥ 300 km/h

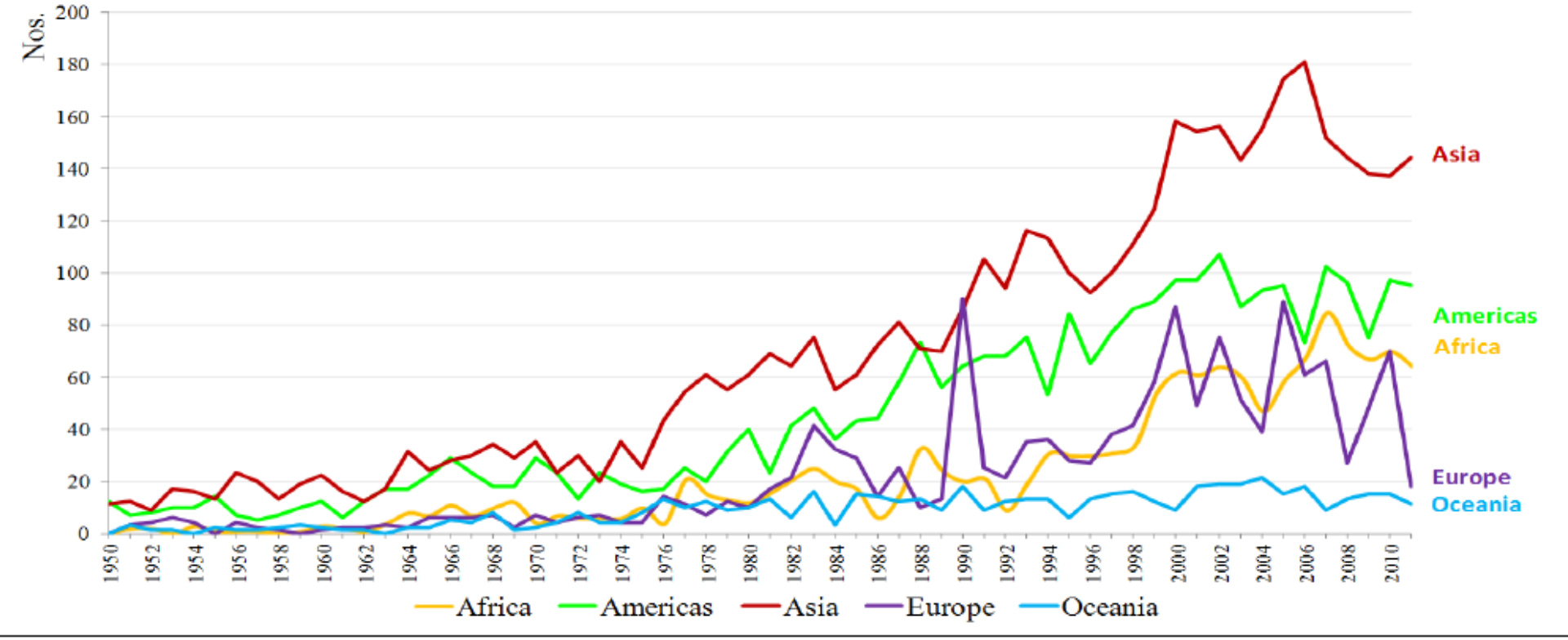
Münchener Rück
Munich Re Group

Threats to water security in Mexico

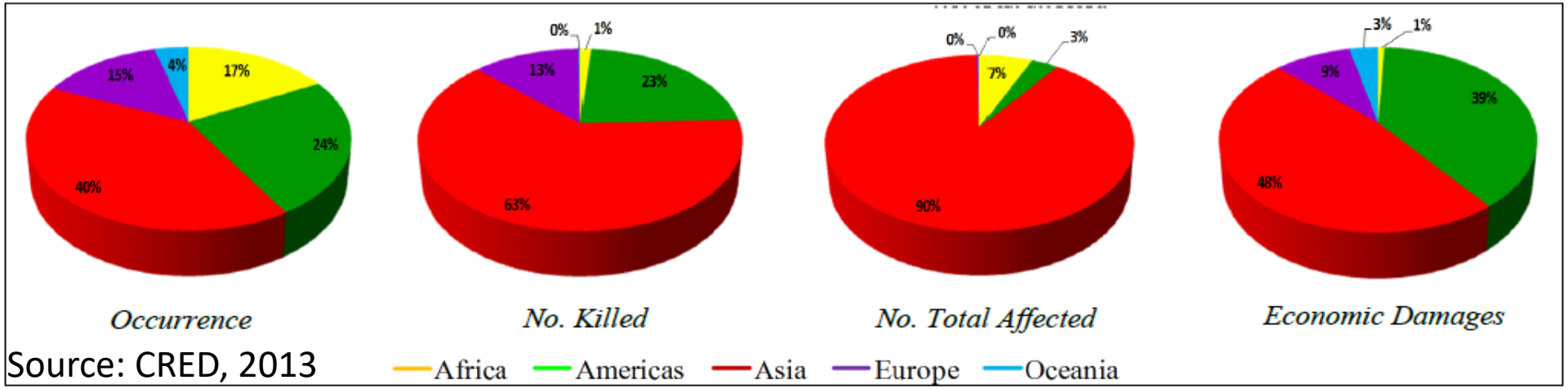


This figure describes the causal pathway from escalating human pressures on the environment through to ecosystem changes resulting in diverse health consequences. Not all ecosystem changes are included. Some changes can have positive effects (e.g. food production).

60 Years of Disasters worldwide: 1950-2011



Asia's share: 2002-2011



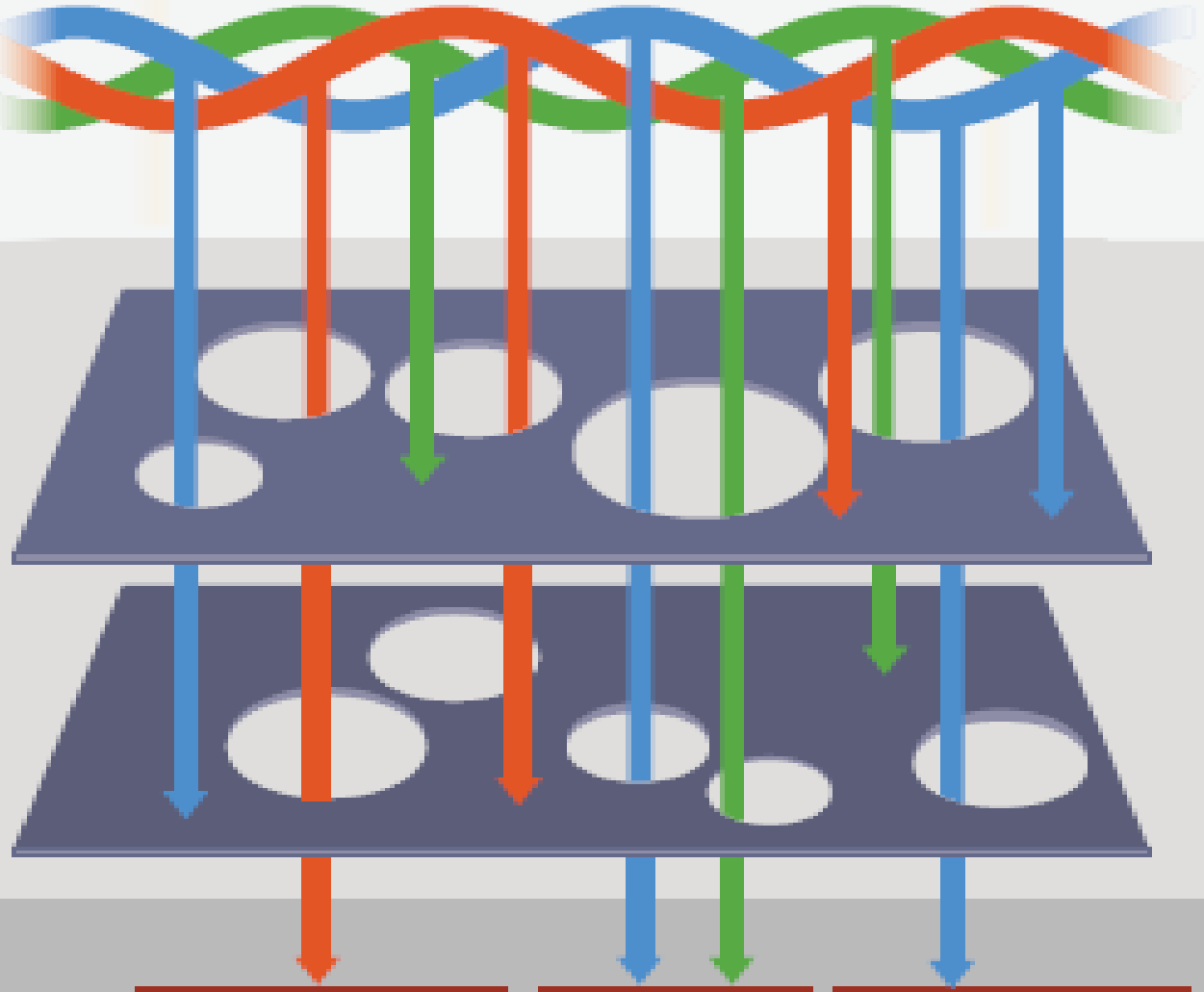
Source: CRED, 2013

Multiple stressors

Climate change

Globalizations

Technological change



Institutions such as:

- Social protection
- Relief organizations
- Disaster prevention

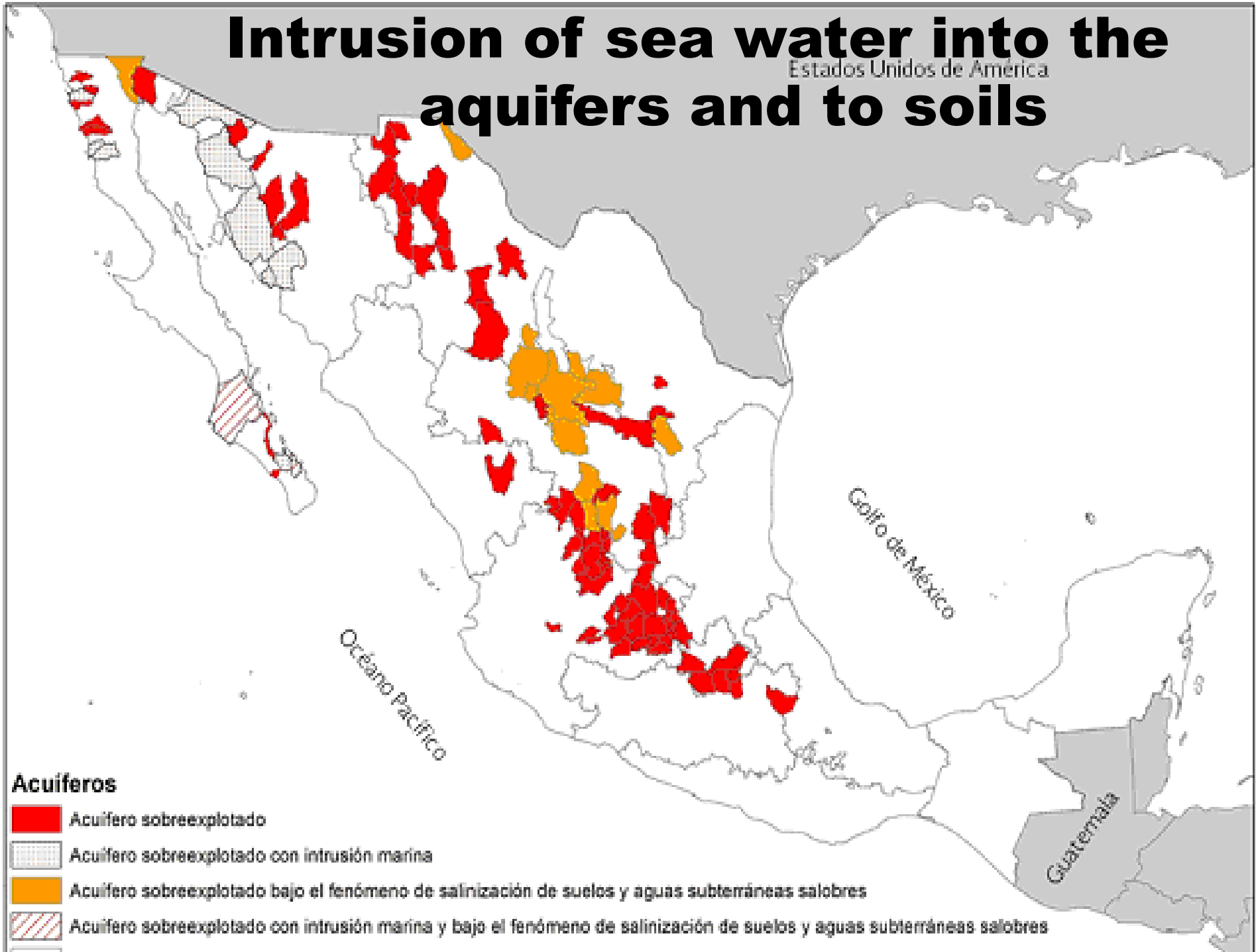
Livelihoods

Displacement

Food crisis

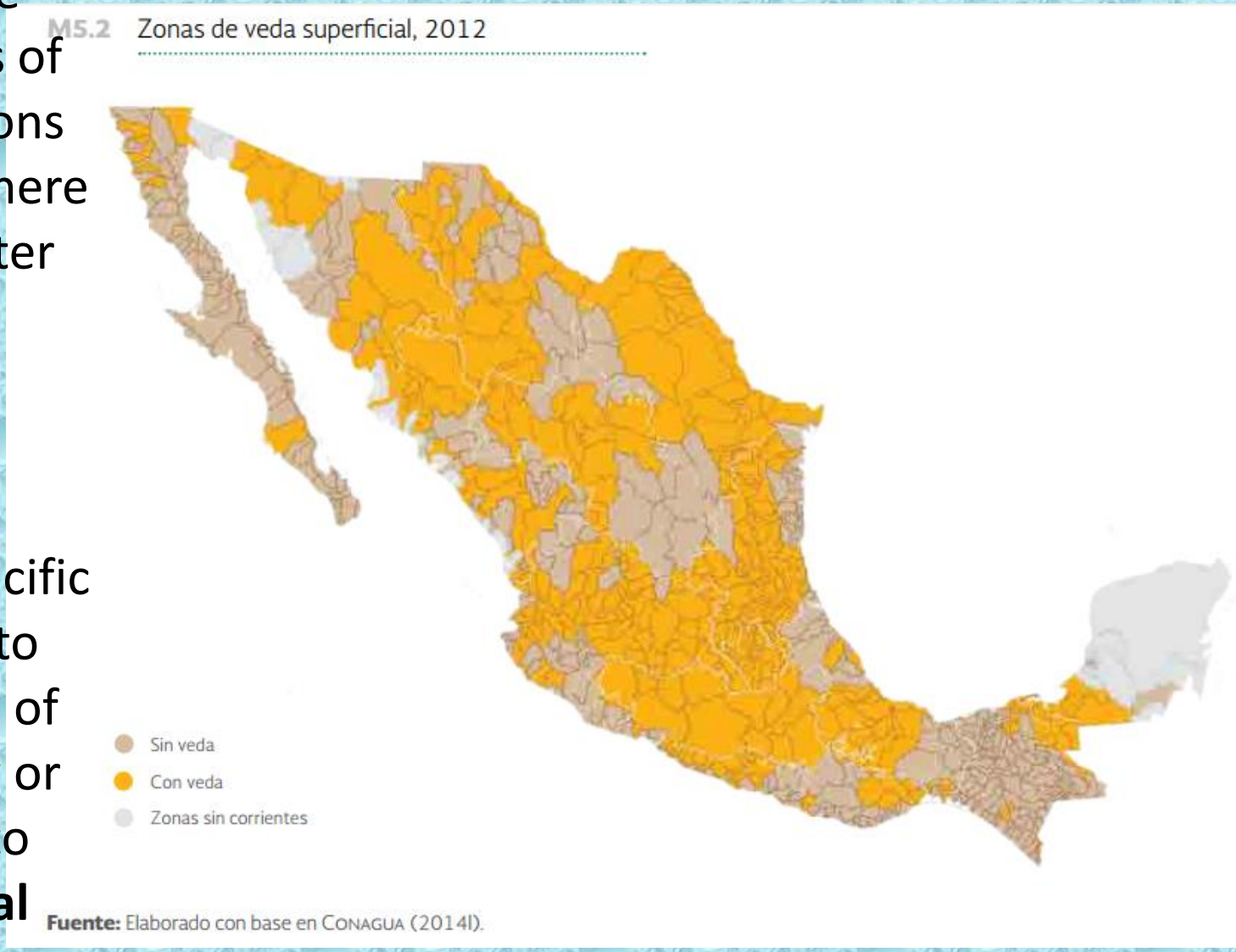
Destroyed homes

Intrusion of sea water into the aquifers and to soils

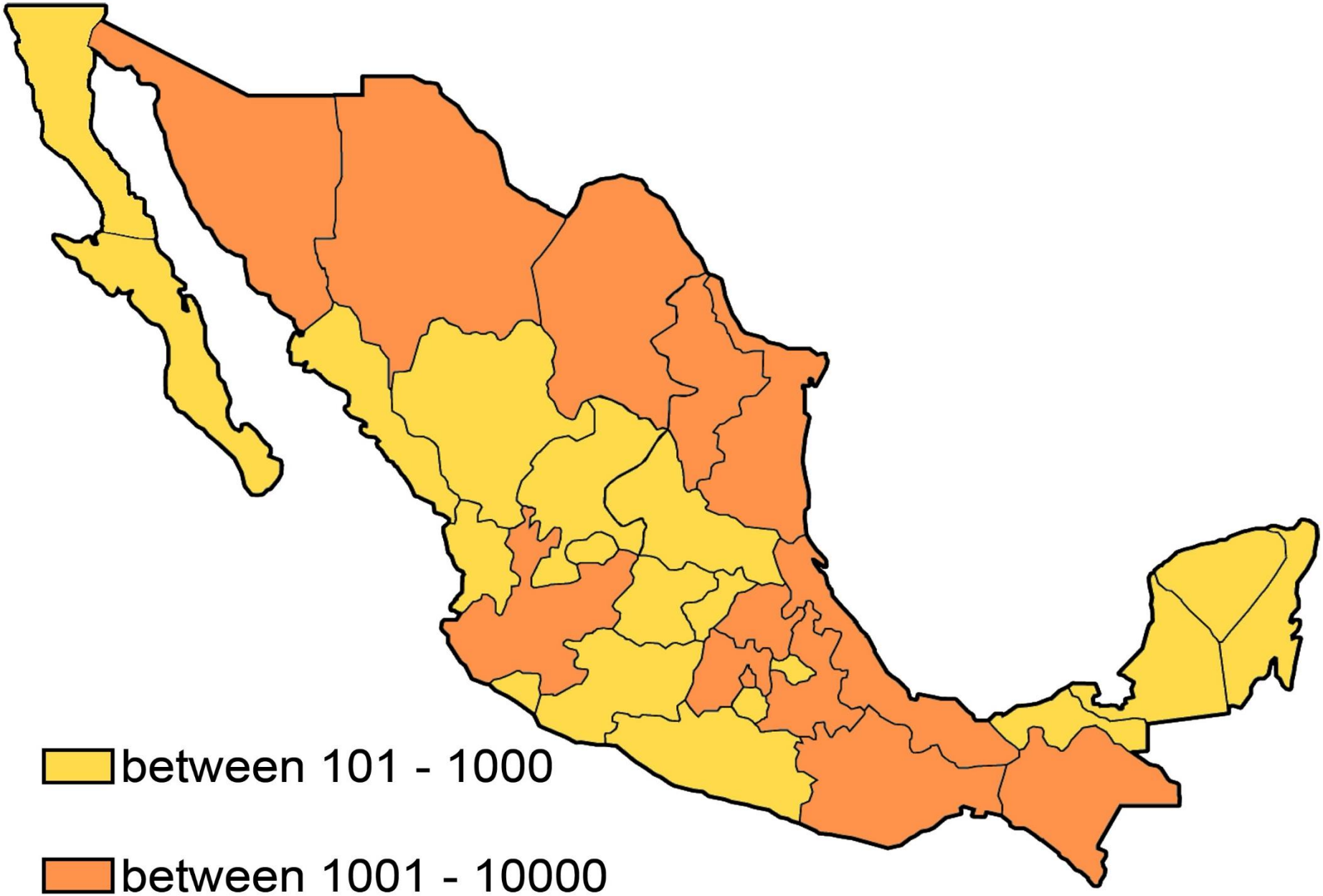


Overexploitation of groundwater: 146 decrees of prohibition; 4 aquifer regulations; 3 decrees of regulated areas; 3 declarations of reserve areas for public urban use, covering approximately 55% of the national territory

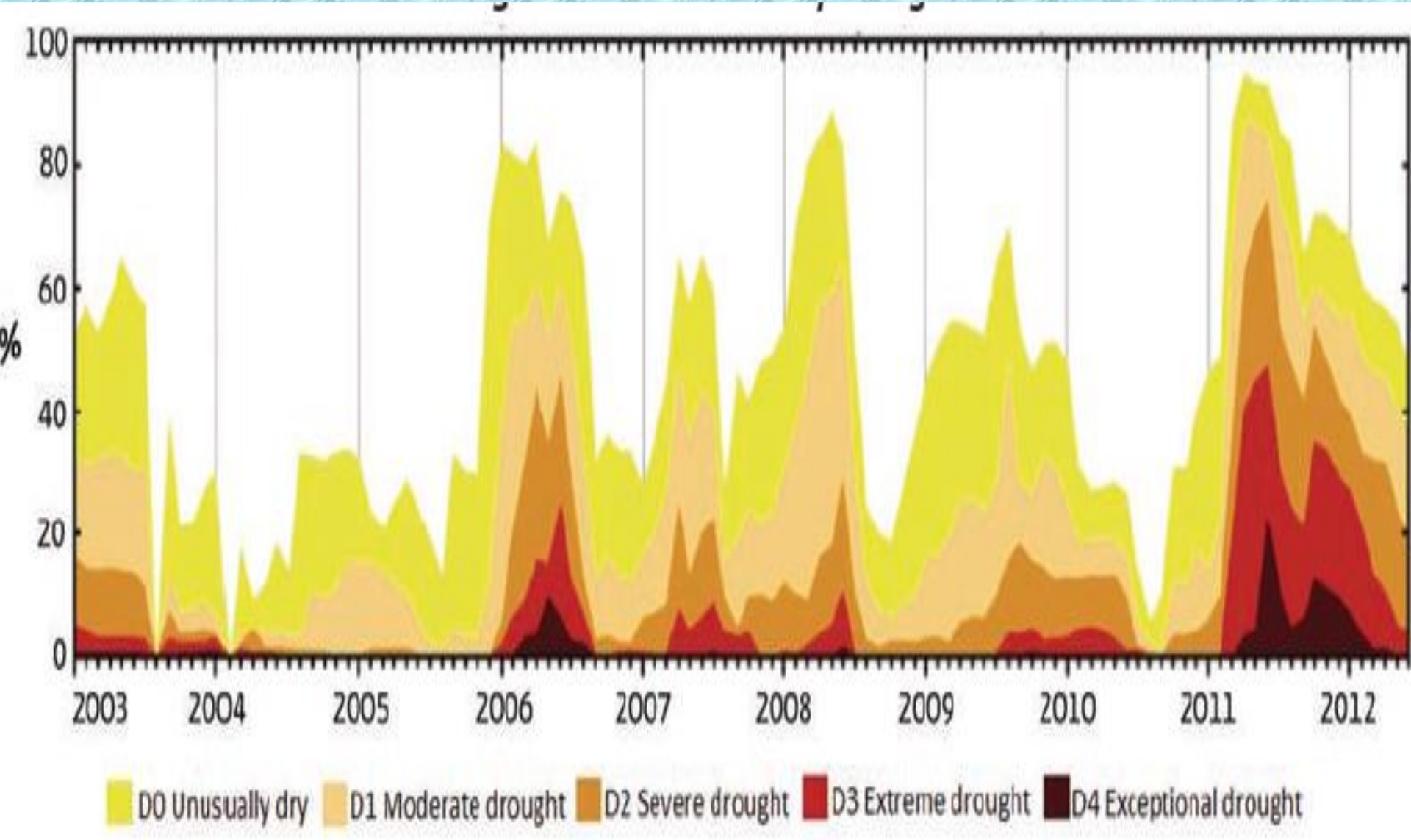
Areas of **surface closure** (veda) are the specific areas of hydrological regions or watersheds where no additional water use is authorized than the legally established and these areas are controlled by specific regulations, due to the deterioration of water in quantity or quality, in order to **grant hydrological sustainability**



Poverty and disasters in Mexico

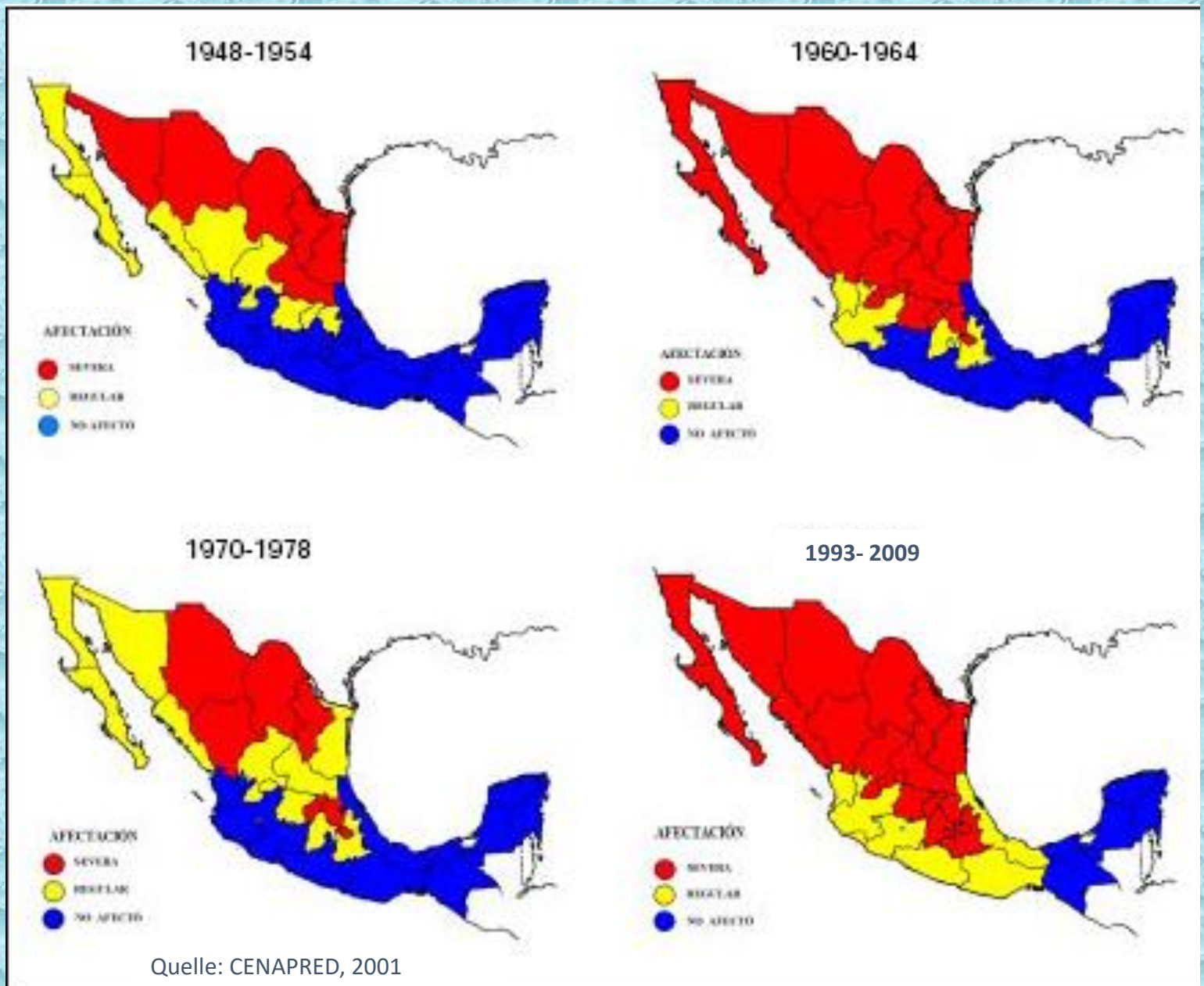


Recent droughts in Mexico



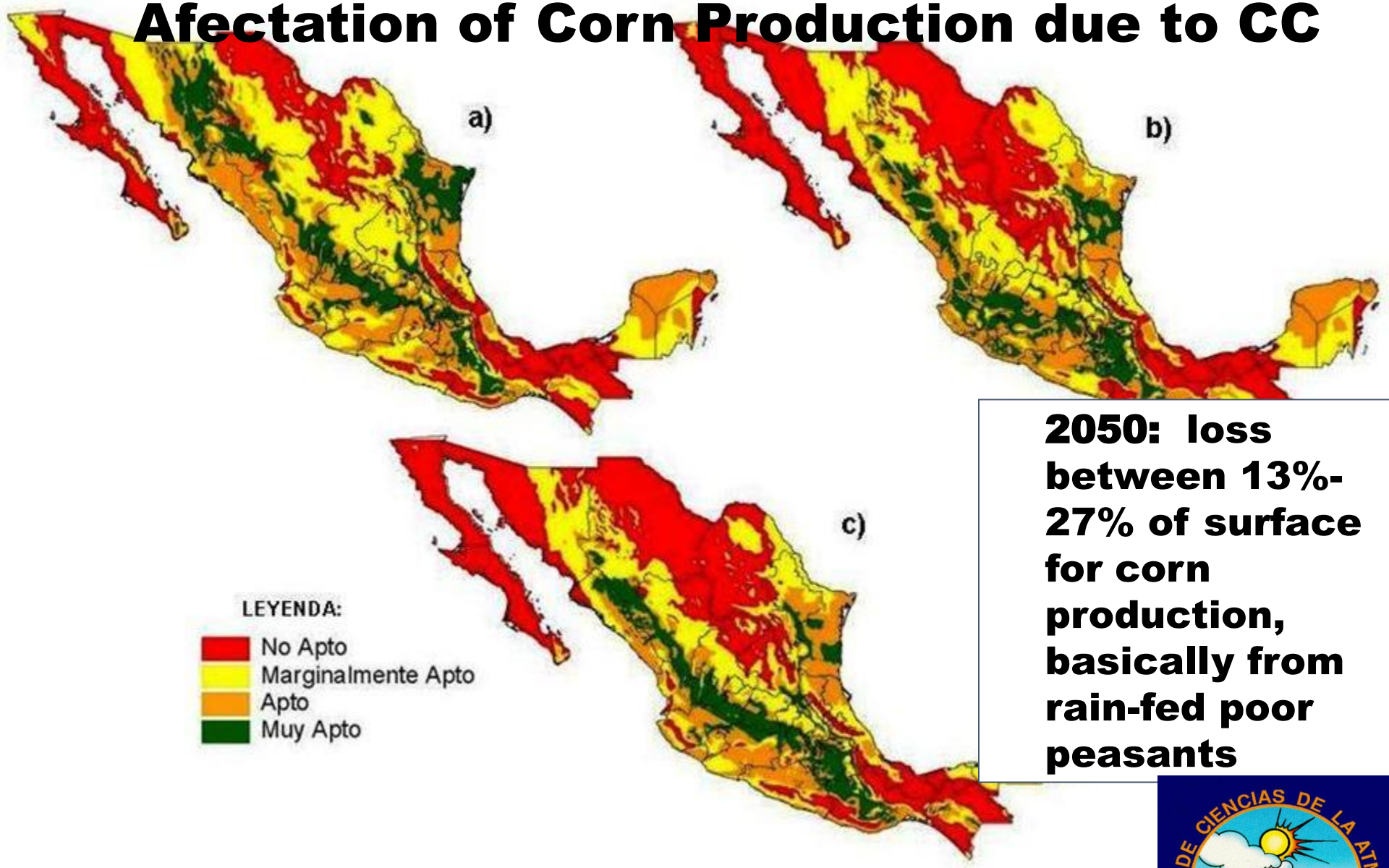
Affected surface (%) in Mexico due to the drought from 2003 to 2012

History of droughts



Quelle: CENAPRED, 2001

Afectation of Corn Production due to CC

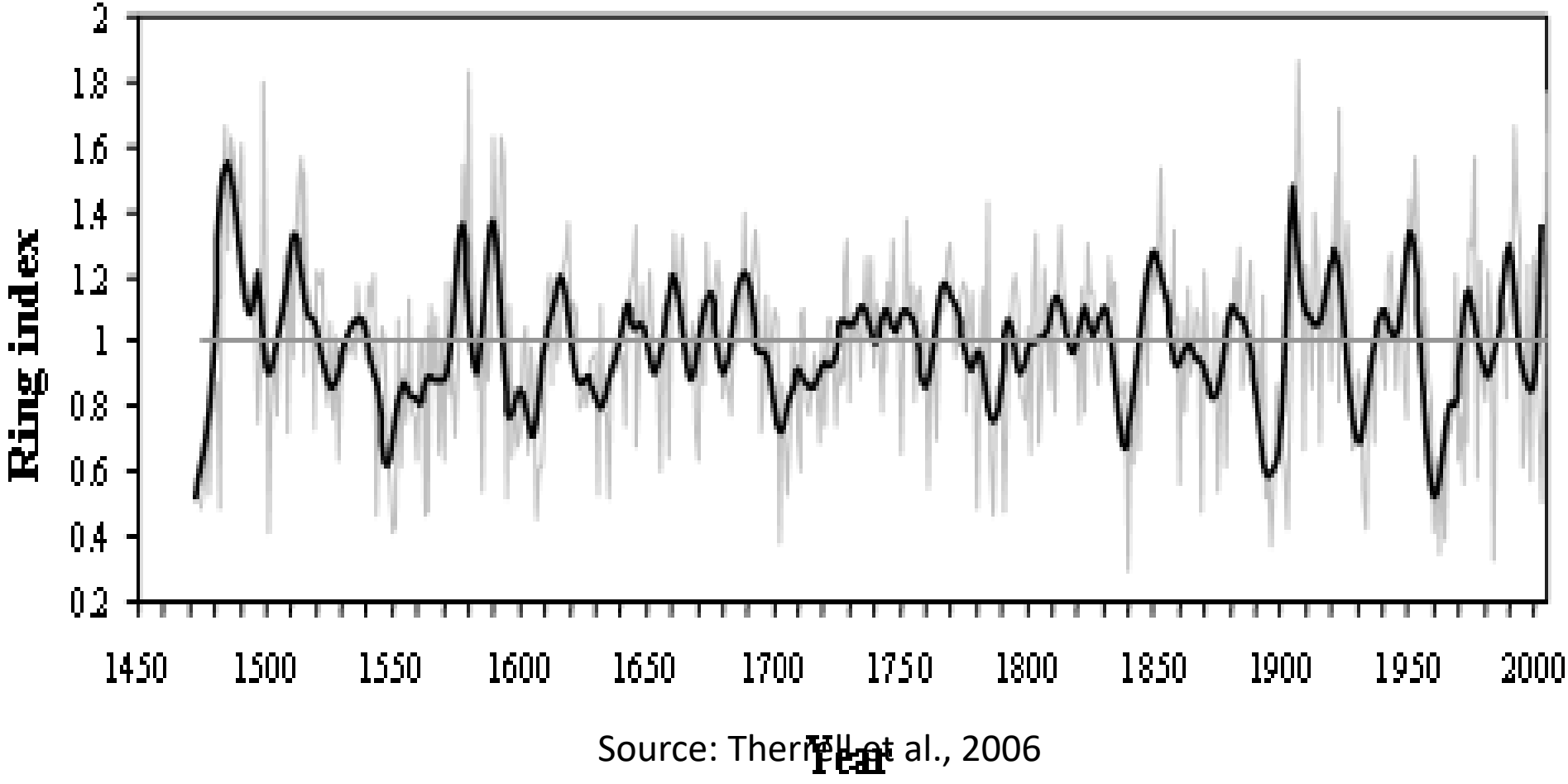


2050: loss between 13%-27% of surface for corn production, basically from rain-fed poor peasants

Monterroso, A. G, Rosales, 2006.

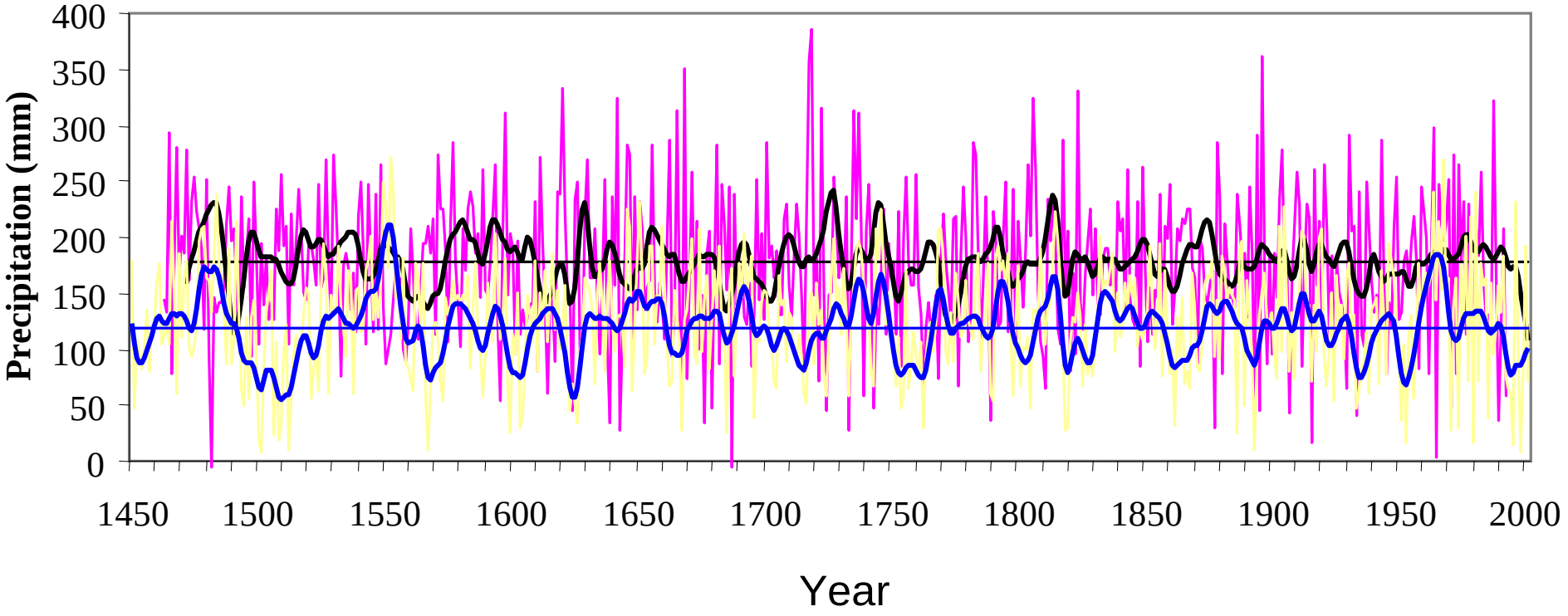
CENTRO DE CIENCIAS DE LA ATMOSFERA
UNAM

Historical droughts: Tree rings

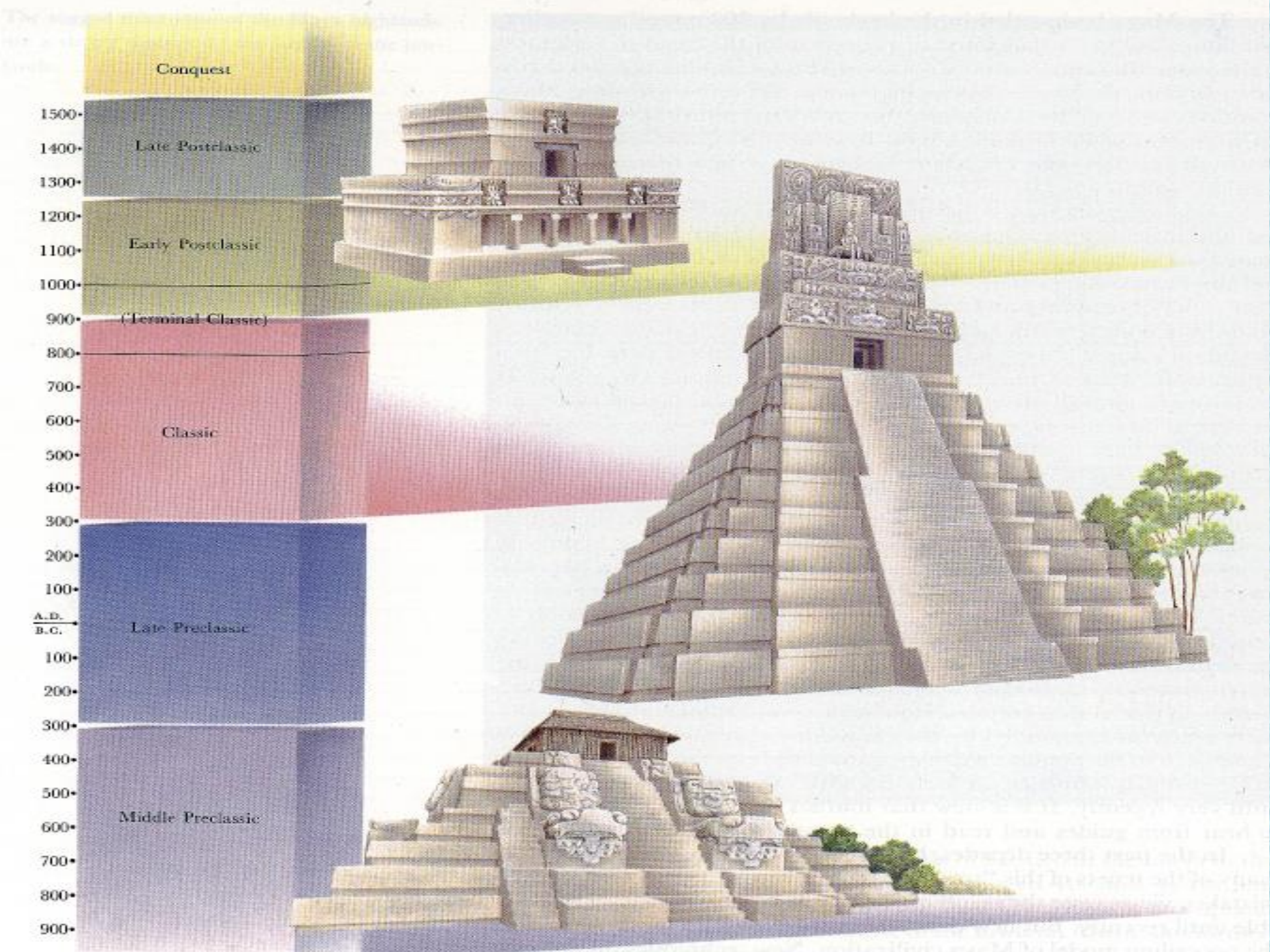


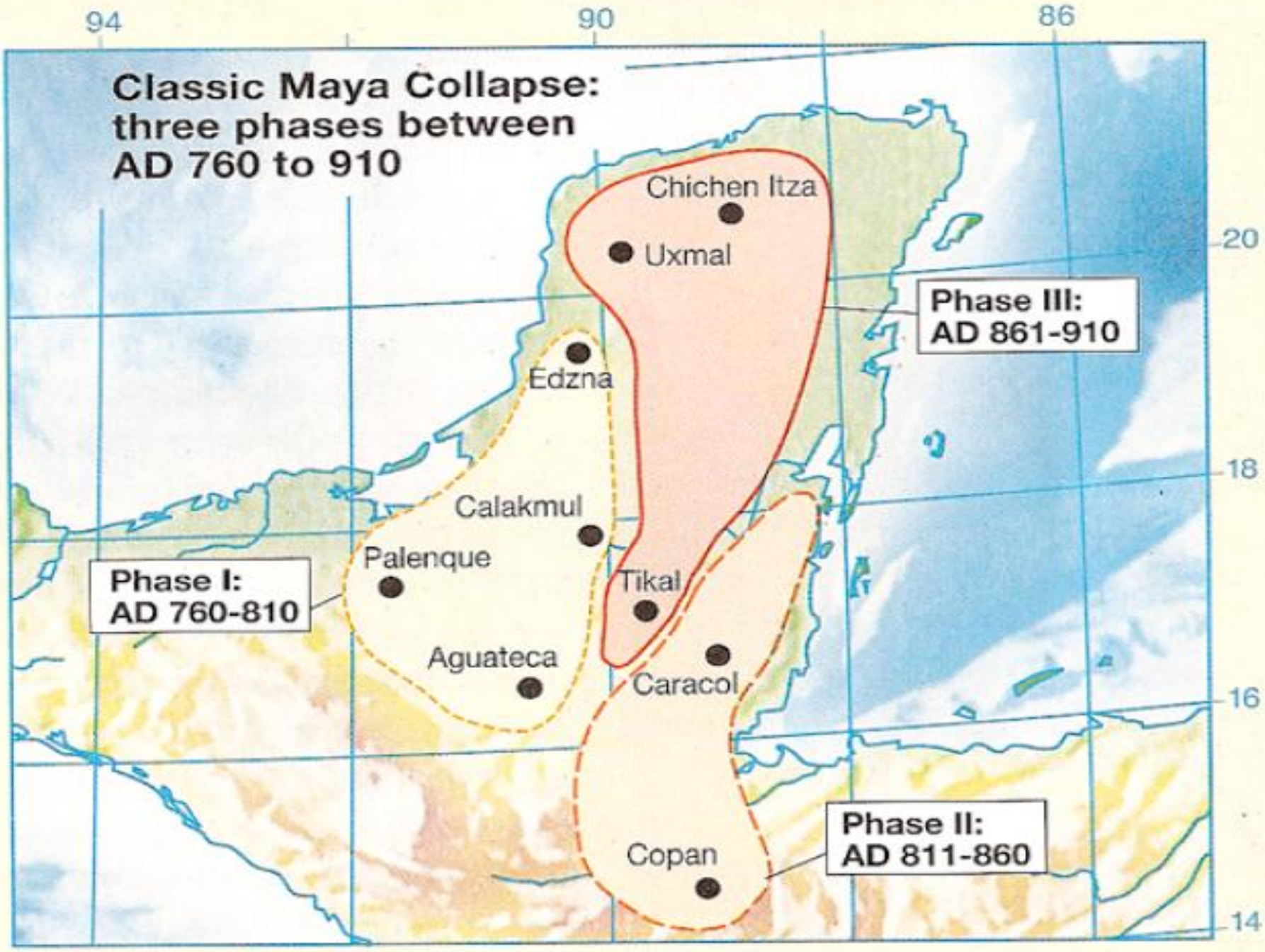
Source: Therrell et al., 2006

Historical rainfall reconstruction



Magenta and yellow lines indicate annual rainfall variability for the northern state of **Chihuahua** and **Sonora** and Northern state of **Durango** and **Sinaloa** respectively. Black and blue lines are 10 years moving average of precipitation; horizontal lines shows mean annual rainfall. Data above the average are wet years and below are dry years (Villanueva et al., 2008).


Conquest
1500
1400
Late Postclassic
1300
1200
1100
Early Postclassic
1000
900
(Terminal Classic)
800
700
600
Classic
500
400
300
200
100
A.D.
B.C.
Late Preclassic
100
200
300
400
500
600
Middle Preclassic
700
800
900


Classic Maya Collapse:
three phases between
AD 760 to 910
94
90
86
20
18
16
14
Chichen Itza
Uxmal
Edzna
Calakmul
Palenque
Tikal
Aguateca
Caracol
Copan
Phase I:
AD 760-810
Phase II:
AD 811-860
Phase III:
AD 861-910

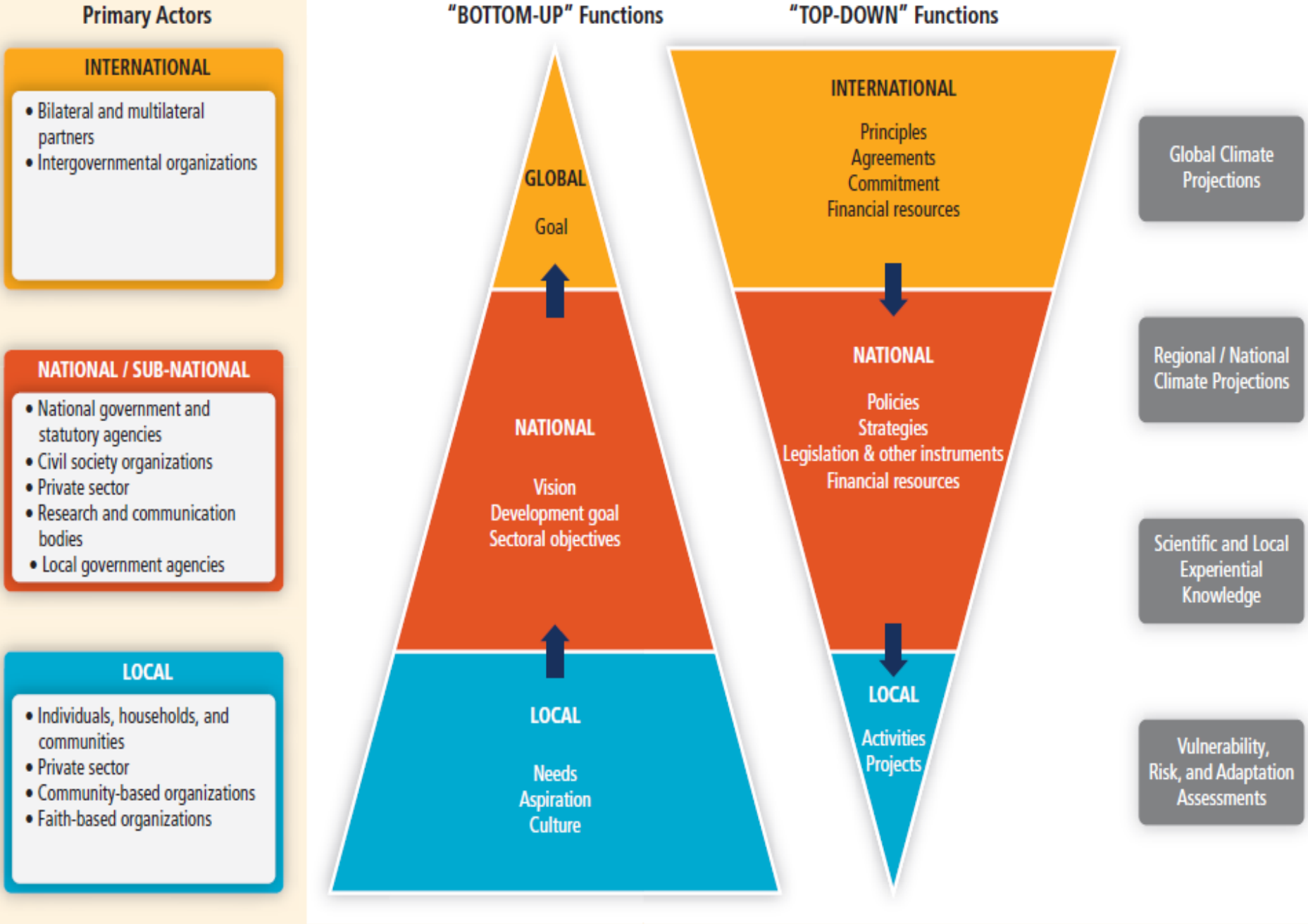
Obstacles to a dignified livelihood with safe water

- Policy
- Planes & projects
- Transparency
- Citizen participation
- Resolution of conflicts
- Negotiated model of country

- Financing, credits
- Investments
- Research
- Technological development
- Applications (renewables)

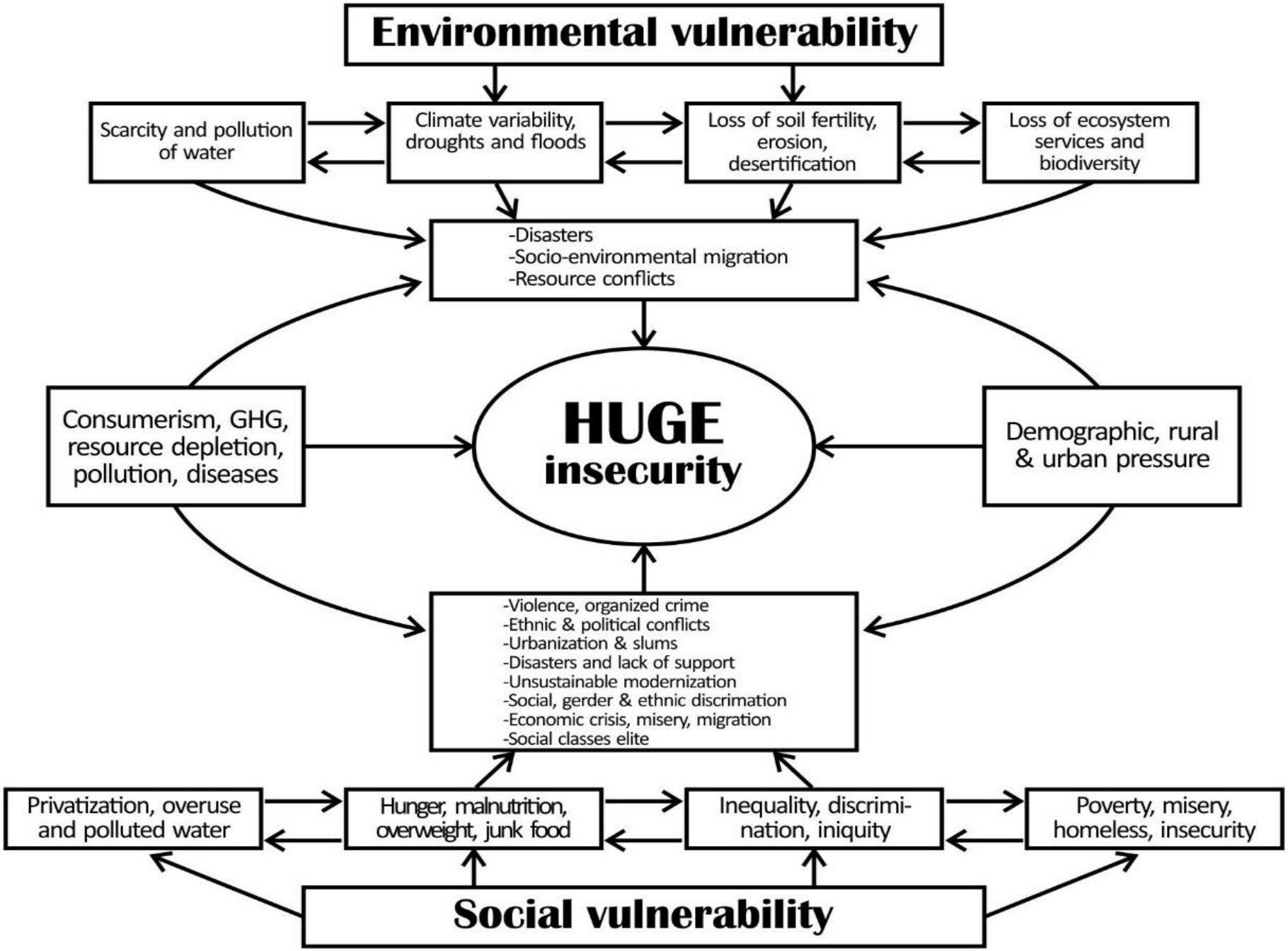
- DRR, DRM
- Training
- Development projects
- Early warning
- Environmental recovery
- Culture

Glocal

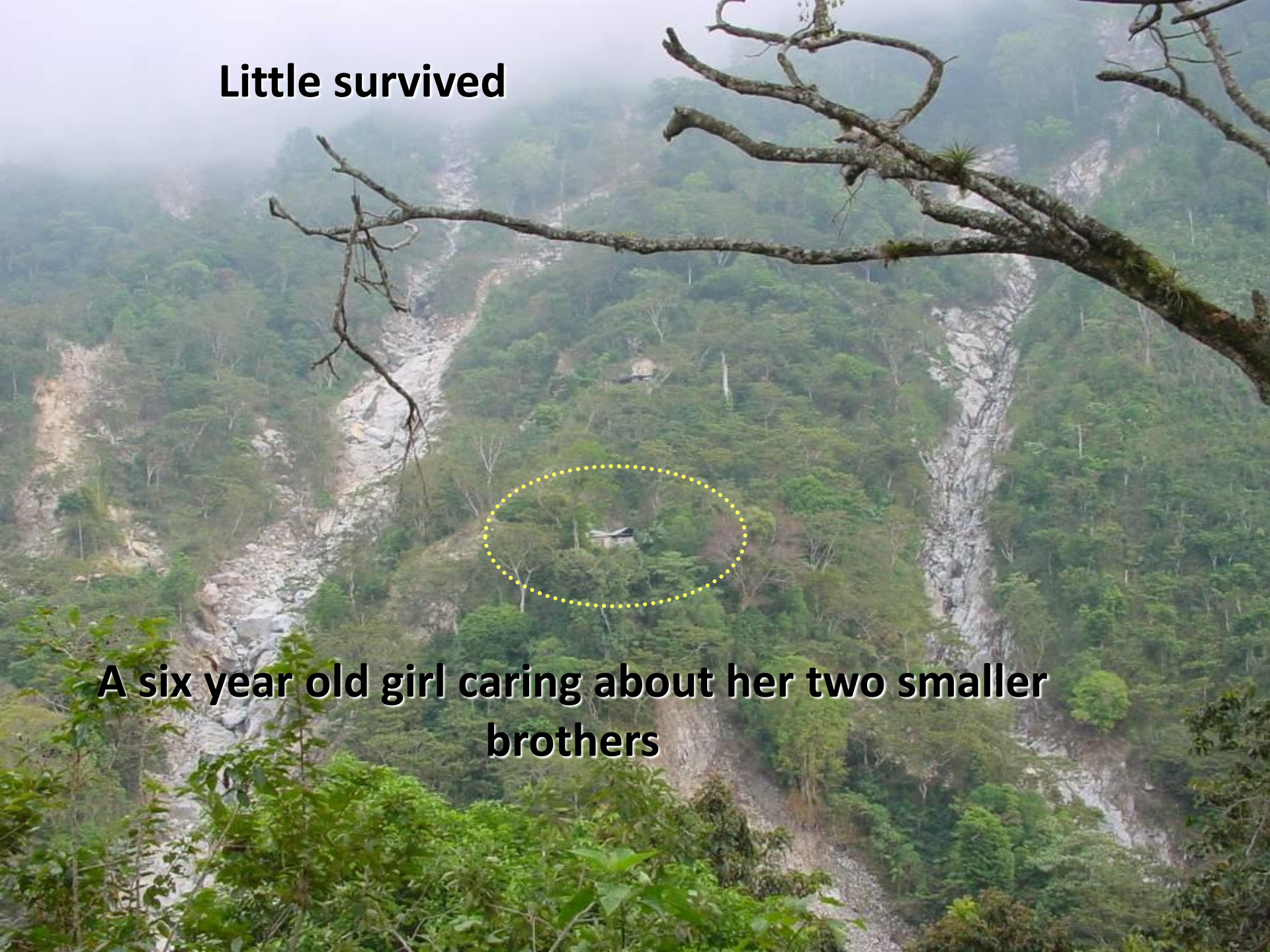

Primary Actors
"BOTTOM-UP" Functions
"TOP-DOWN" Functions
INTERNATIONAL
• Bilateral and multilateral partners
• Intergovernmental organizations
NATIONAL / SUB-NATIONAL
• National government and statutory agencies
• Civil society organizations
• Private sector
• Research and communication bodies
• Local government agencies
LOCAL
• Individuals, households, and communities
• Private sector
• Community-based organizations
• Faith-based organizations
GLOBAL
Goal
NATIONAL
Vision
Development goal
Sectoral objectives
LOCAL
Needs
Aspiration
Culture
INTERNATIONAL
Principles
Agreements
Commitment
Financial resources
NATIONAL
Policies
Strategies
Legislation & other instruments
Financial resources
LOCAL
Activities
Projects
Global Climate Projections
Regional / National Climate Projections
Scientific and Local Experiential Knowledge
Vulnerability, Risk, and Adaptation Assessments


Adaptation and preventive behavior
Galan

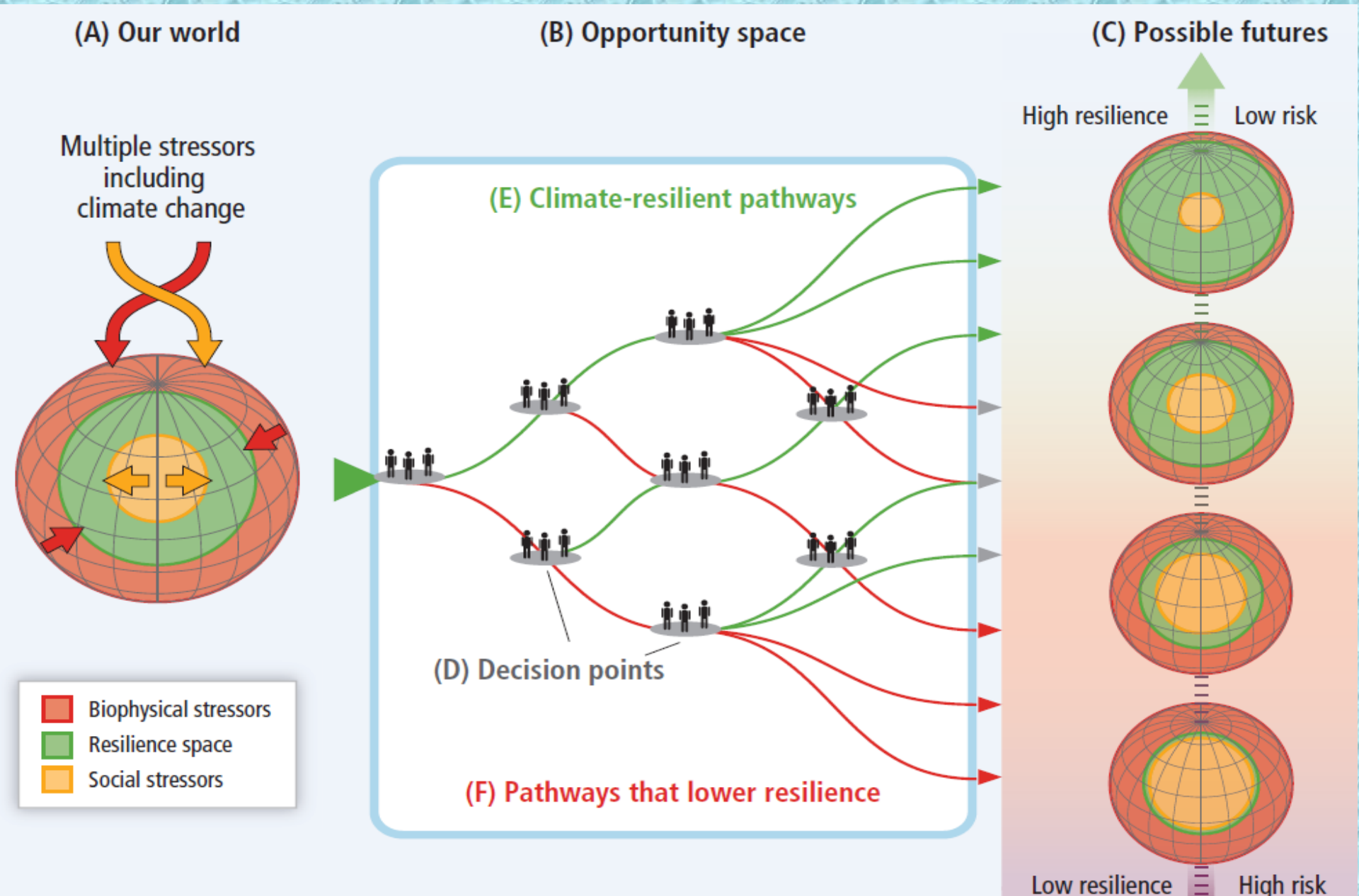

Dual vulnerability


Environmental vulnerability
Scarcity and pollution of water
Climate variability, droughts and floods
Loss of soil fertility, erosion, desertification
Loss of ecosystem services and biodiversity
-Disasters
-Socio-environmental migration
-Resource conflicts
Consumerism, GHG, resource depletion, pollution, diseases
HUGE insecurity
Demographic, rural & urban pressure
-Violence, organized crime
-Ethnic & political conflicts
-Urbanization & slums
-Disasters and lack of support
-Unsustainable modernization
-Social, gerder & ethnic discrimation
-Economic crisis, misery, migration
-Social classes elite
Privatization, overuse and polluted water
Hunger, malnutrition, overweight, junk food
Inequality, discrimi-nation, iniquity
Poverty, misery, homeless, insecurity
Social vulnerability

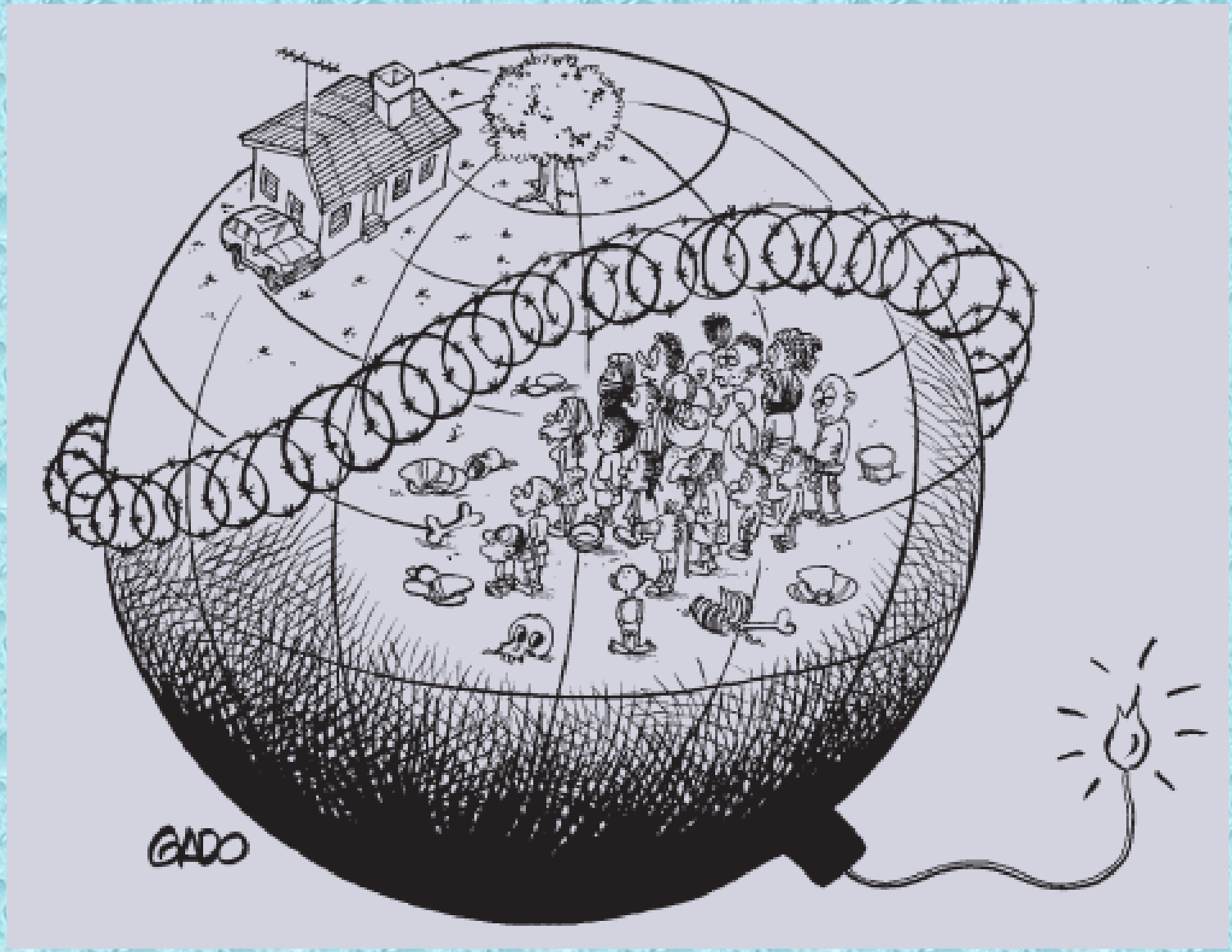

40% of soil and forest was destroyed


Little survived
A six year old girl caring about her two smaller brothers

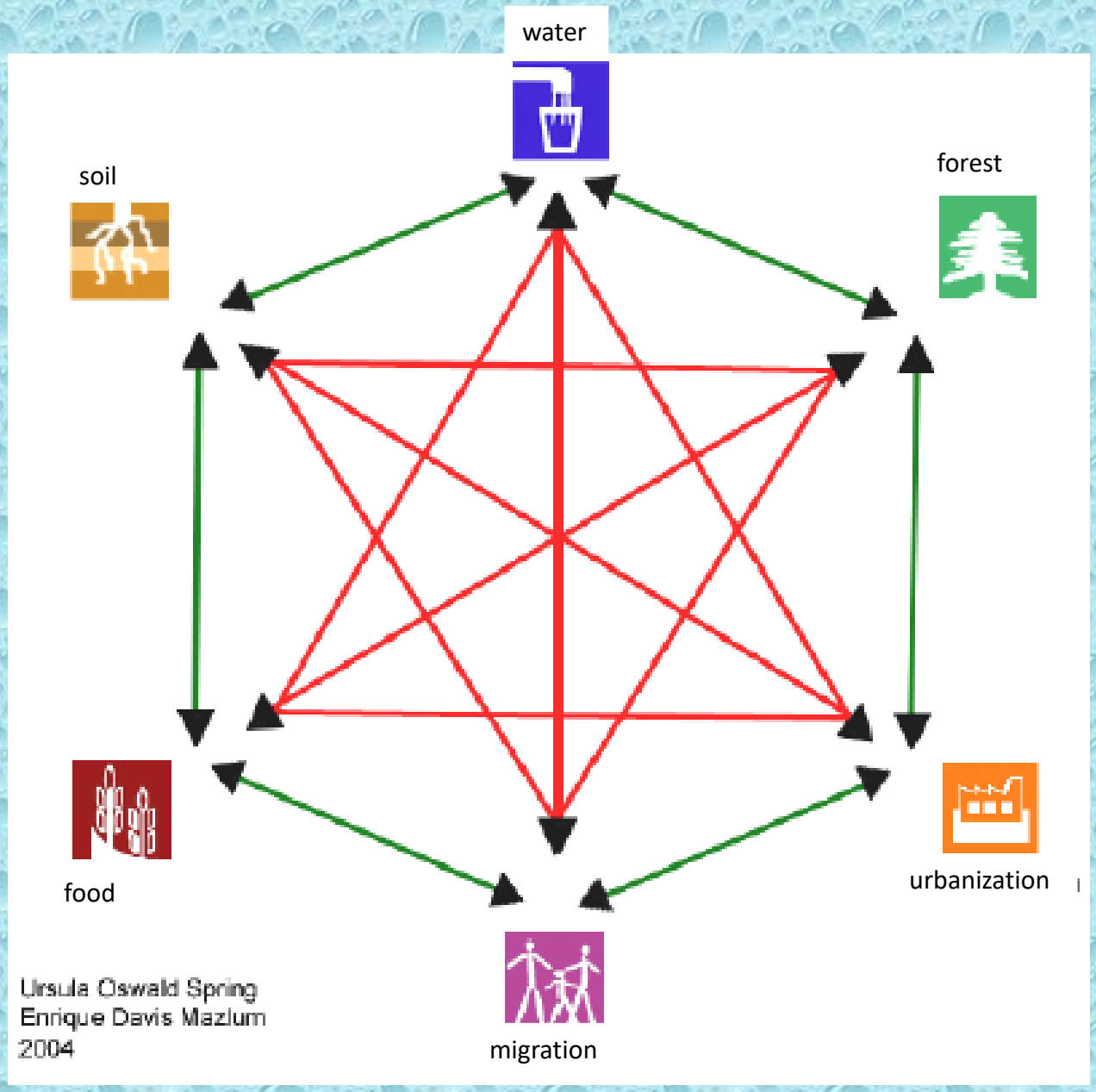
Multiple stressors



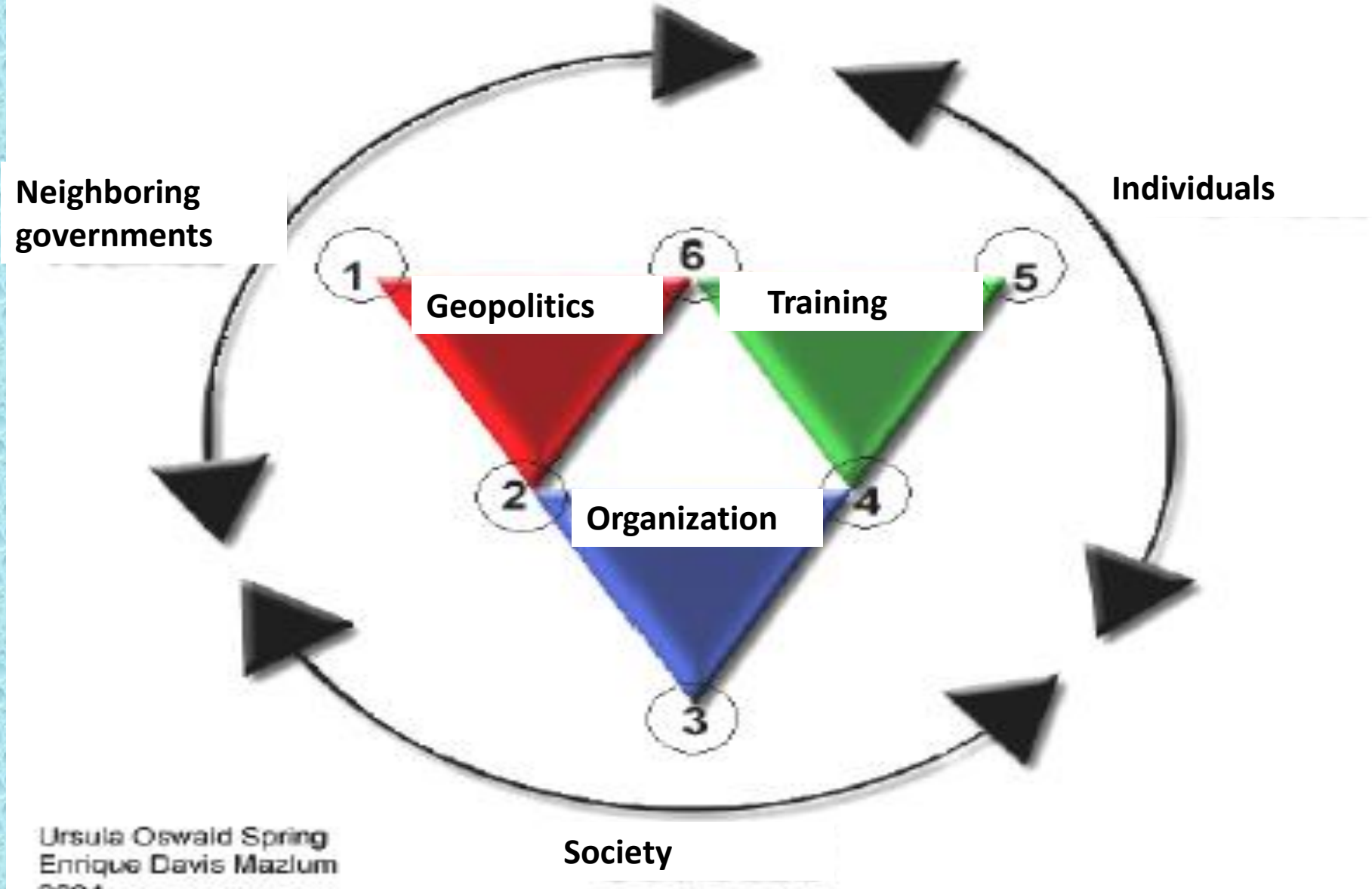
What kind of future do we want?



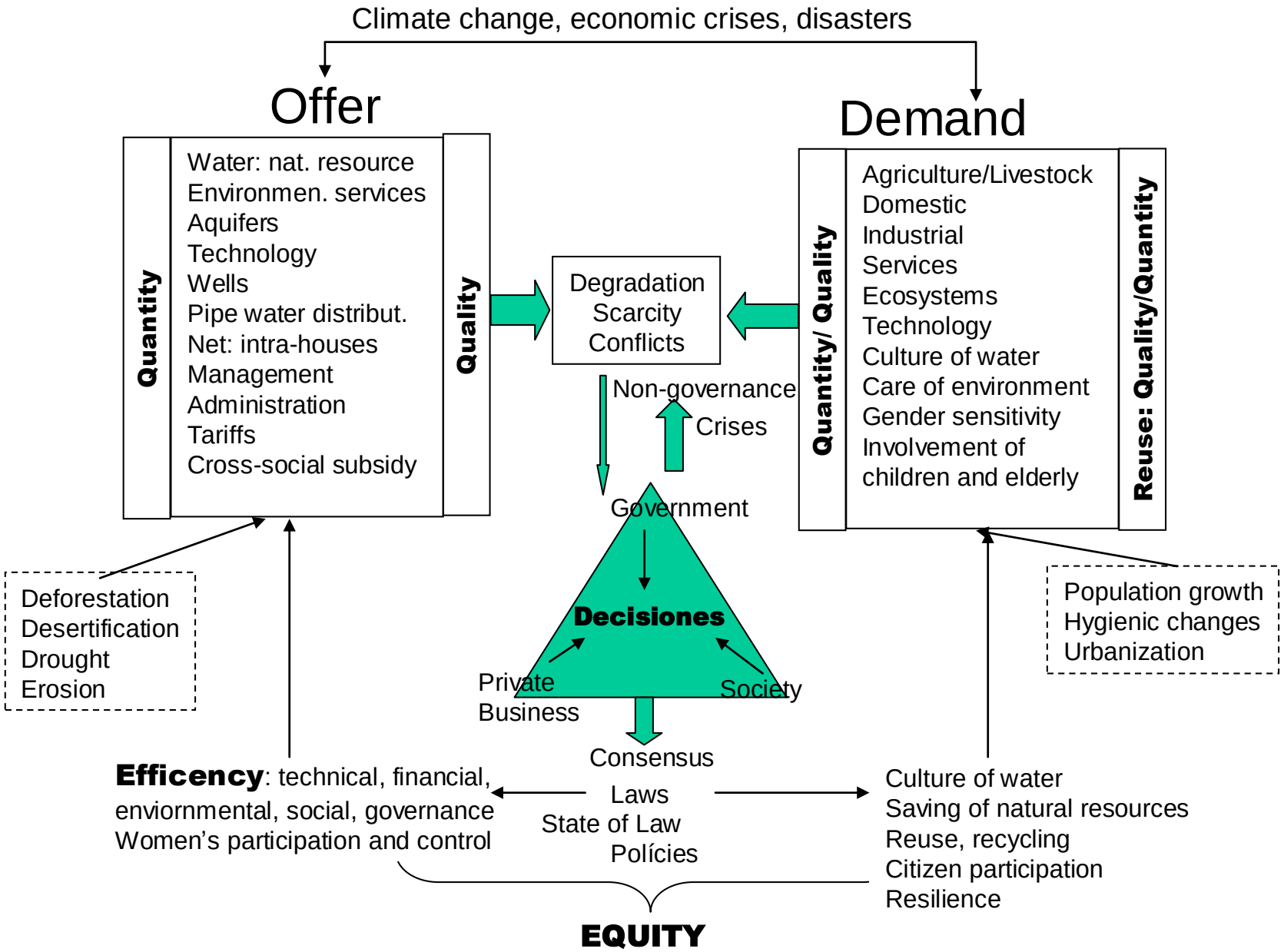
Conflicts related to water



Hydrodiplomacy



Efficiency and Equity with Natural Resources



Fuente: Oswald y Sandoval, 2006

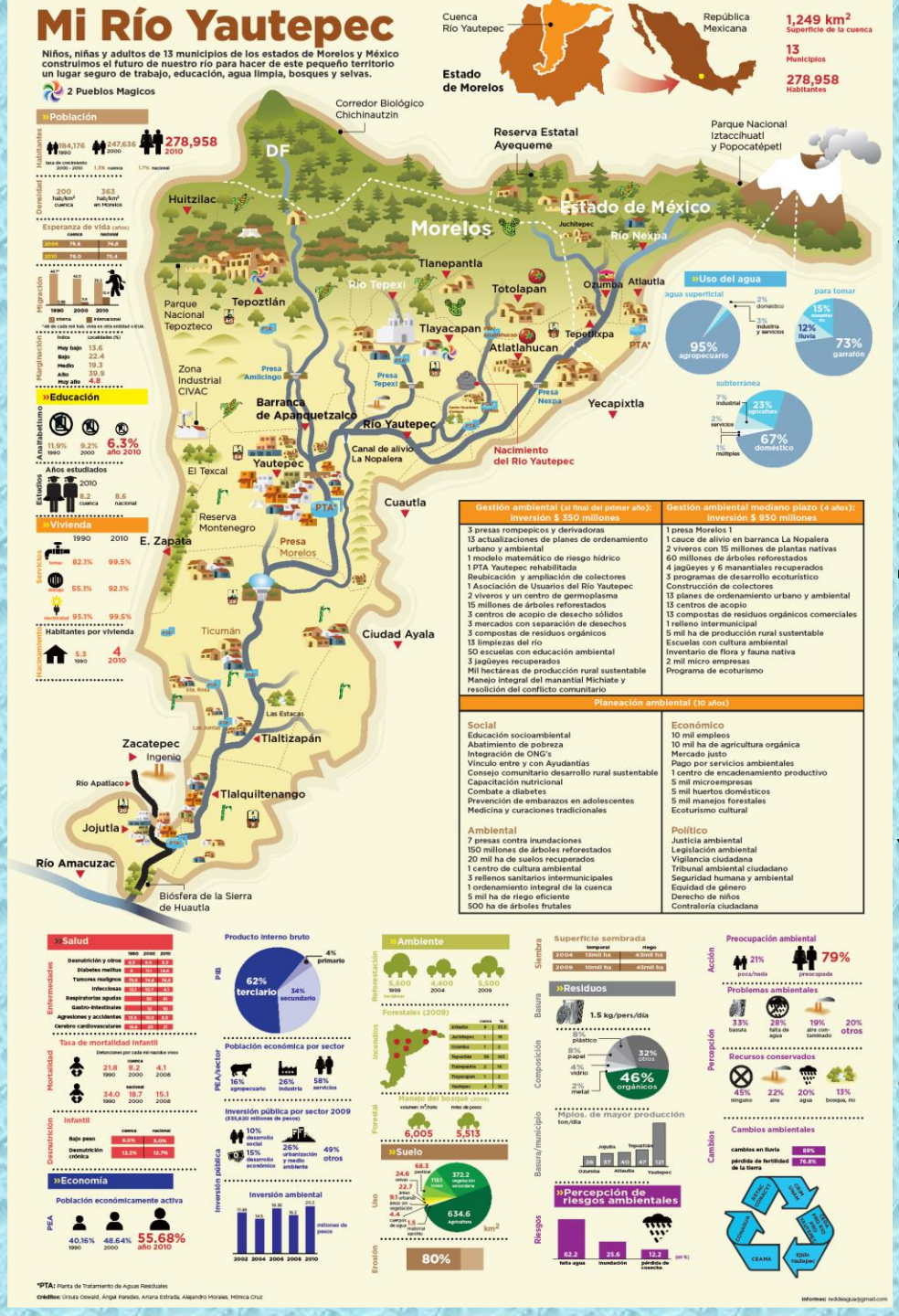
Case study: River Yautepec basin

Floods: 1986; 1998; 2010; 2011; 2012
Droughts: every year
Cholera epidemics: 1992
Dengue fever: from 2005 on
increase of 600%
Chikungunya: from 2012 on
Zika: from 2015 on

Threats

1. High altitude from Popocatepetl to Yautepec: 5400m down to 1200m
2. High speed of water with rocks and trees
3. Complex hydrology: with a lot of small rivers, often dried out and eroded
4. Deforestation, also in national parks
5. Soil erosion (80%)
6. High sedimentation in river bed
7. Extreme rainfalls
8. Large drought periods
9. Invasion of the river basin
10. Lack of infrastructure
11. Waste in the river
12. Lack of municipal planning
13. Initial cooperation among the three levels of government
14. Few participation of citizens


Integrated river basin management
with disaster risk reduction



Peasants, traders, micro-entrepreneurs, social movements, NGO's, citizens, scientists, people affected by disasters, women, children, teachers and the three levels of government developed an integrated basin management of the River Yautepec for reducing risks increased by climate change and are promoting a transition to sustainability from local niches.

6. Capacity Building and Financing

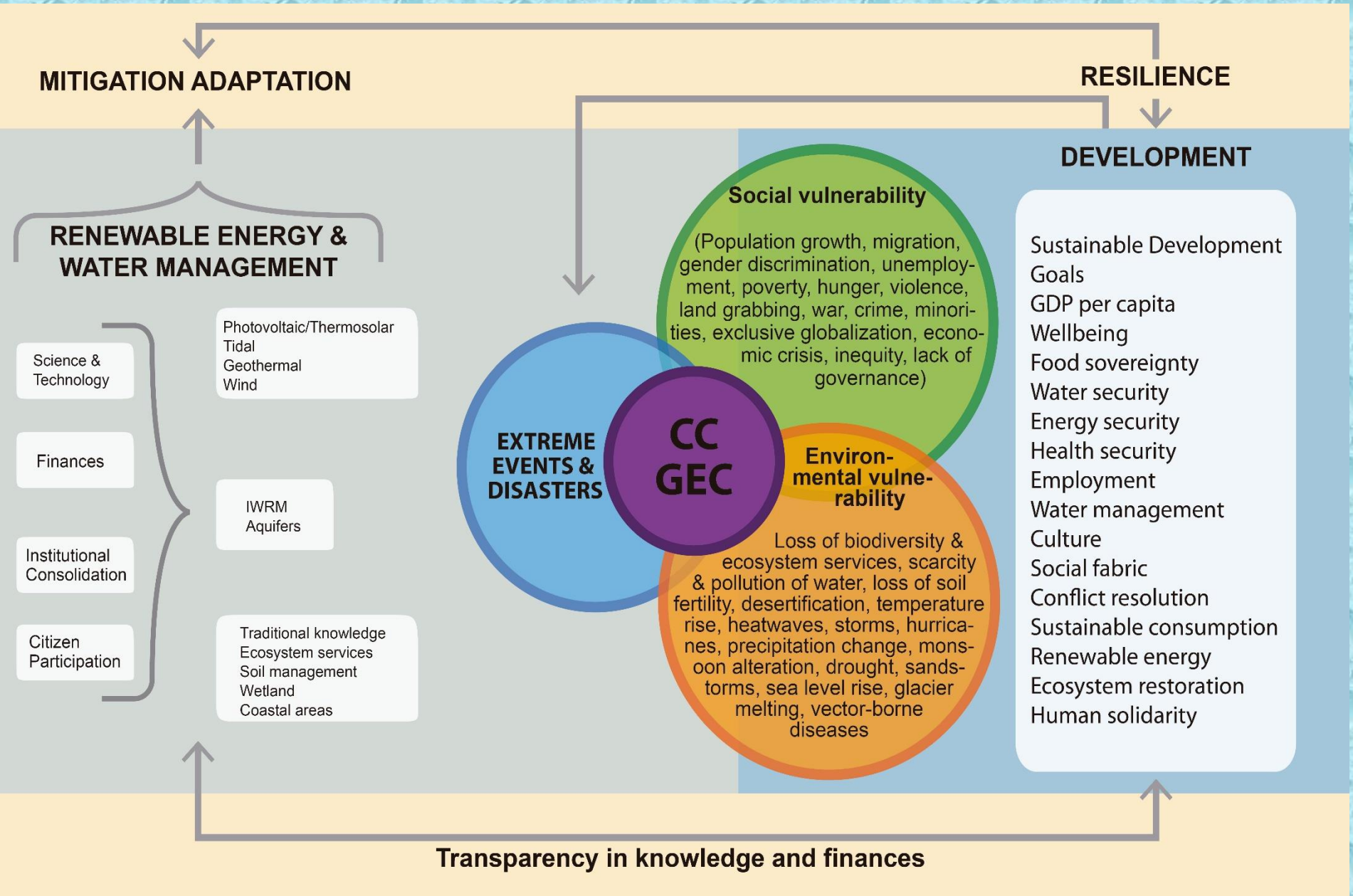
- Epistemic communities fostering cooperation & bringing together science and policy for improving WS
- Strengthening traditional and innovative knowledge for embedding the assessment of levels of WS into the environmental impact and risks assessment, land use planning and environmental auditing.
- Training on best practices for conflict settlement mechanisms at the local and national levels.
- Pro-active strategies for adjustment and mitigation to water threats and preventive social learning
- Financing: Channelling Resources: International, climate related financial institutions (IFAD, GEF), local micro-credit, micro-insurance, land use conservation, micro-investments for local development programmes, reforestation, regional organizations and national donors (ministries of development cooperation and environment) to improve policies for water security.

Water security vision in 2025

- **Empowering** women, men, and communities to decide on levels of access to safe water and hygienic living conditions, and on the **types of water used** in economic activities, and to organize to obtain them.
- **Producing more food** and creating more sustainable livelihoods per **unit of water applied** and ensuring access for all to the food required for healthy and productive lives.
- **Managing water** use to conserve the quantity and quality of freshwater and terrestrial ecosystems that provide services to humans and all living things.
- A **sustainability revolution** with deep changes in worldview, mindset, policy, governance and culture: a **new cosmovision to live with Earth in peace**.

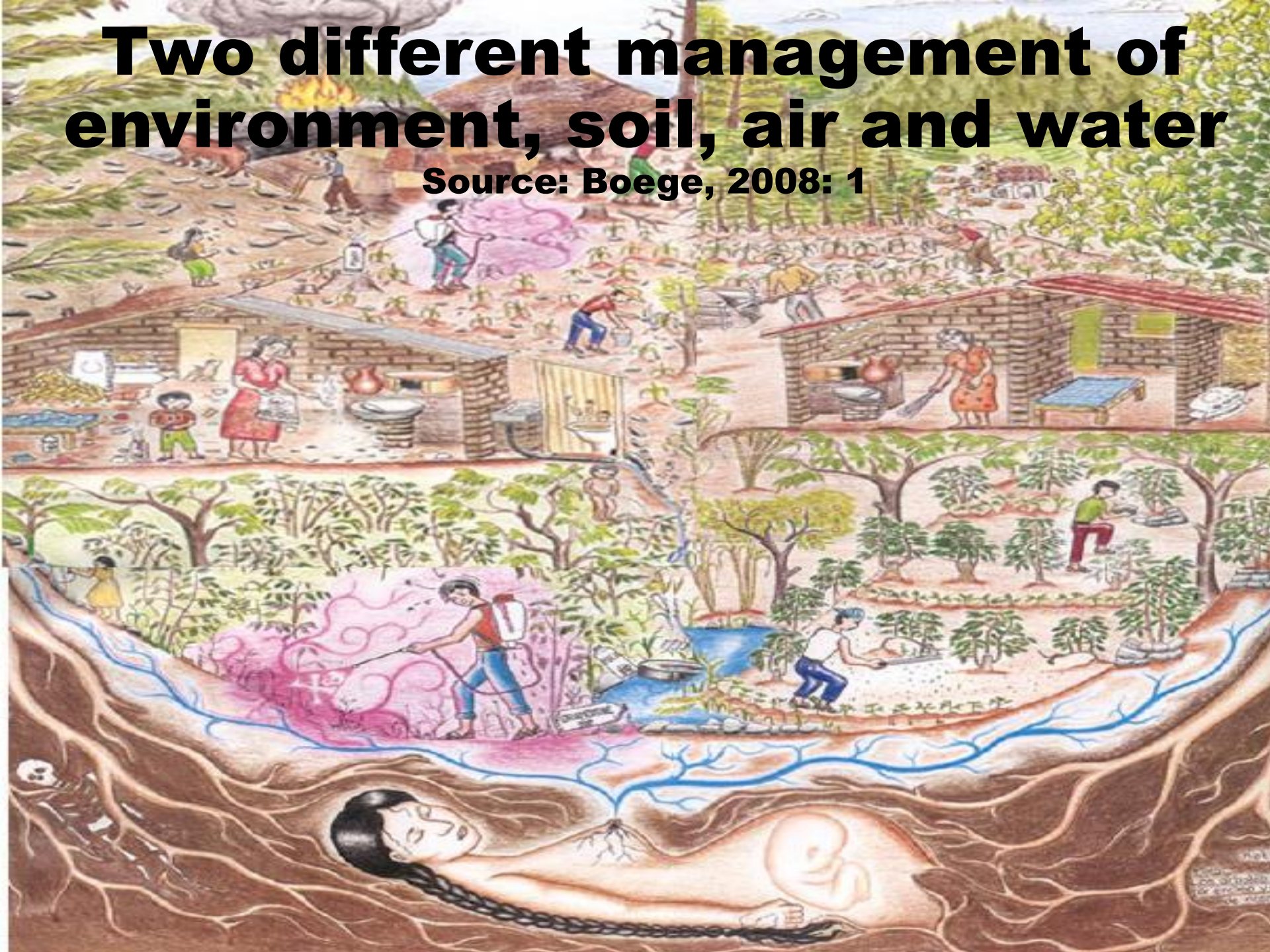

Conclusions. A human, gender and
environmental: a HUGE security

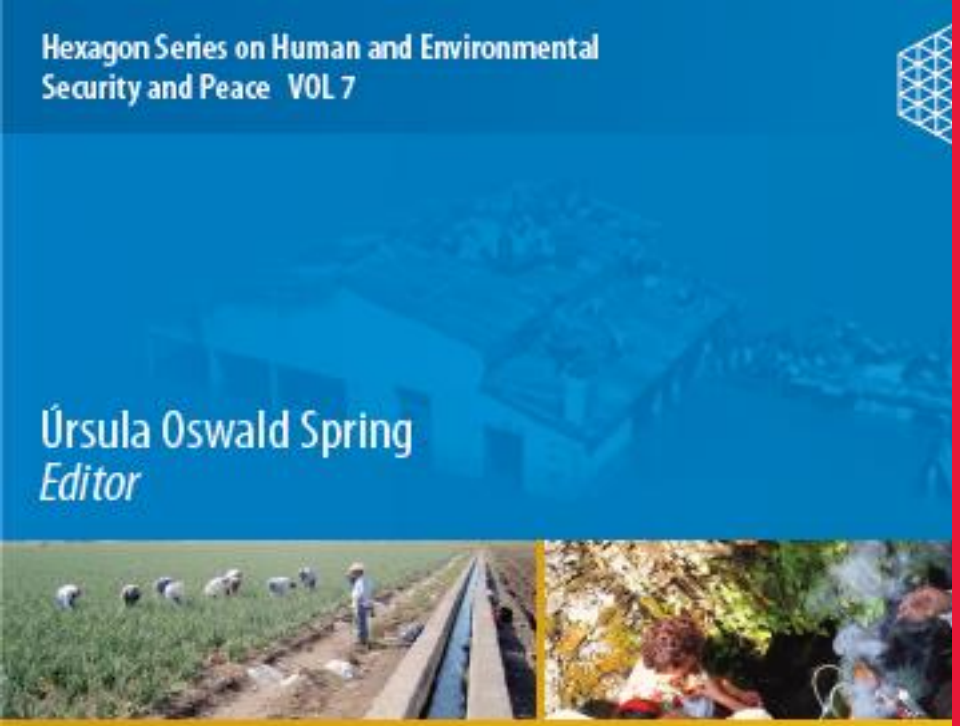
Transition to sustainablity



Two different management of environment, soil, air and water

Source: Boege, 2008: 1





Many thanks for your attention