



Red Temática del Agua Conacyt

Hexagon Series on Human and Environmental
Security and Peace VOL 7



Úrsula Oswald Spring
Editor



Water Resources in Mexico

Scarcity, Degradation, Stress, Conflicts,
Management, and Policy

 Springer

Global Environmental Change and Integral Water Resource Management: Lessons Learnt form a Mexican Perspective

Úrsula Oswald Spring
CRIM-UNAM

**National Coordinator of
the Water Research
Network (RETAC)**

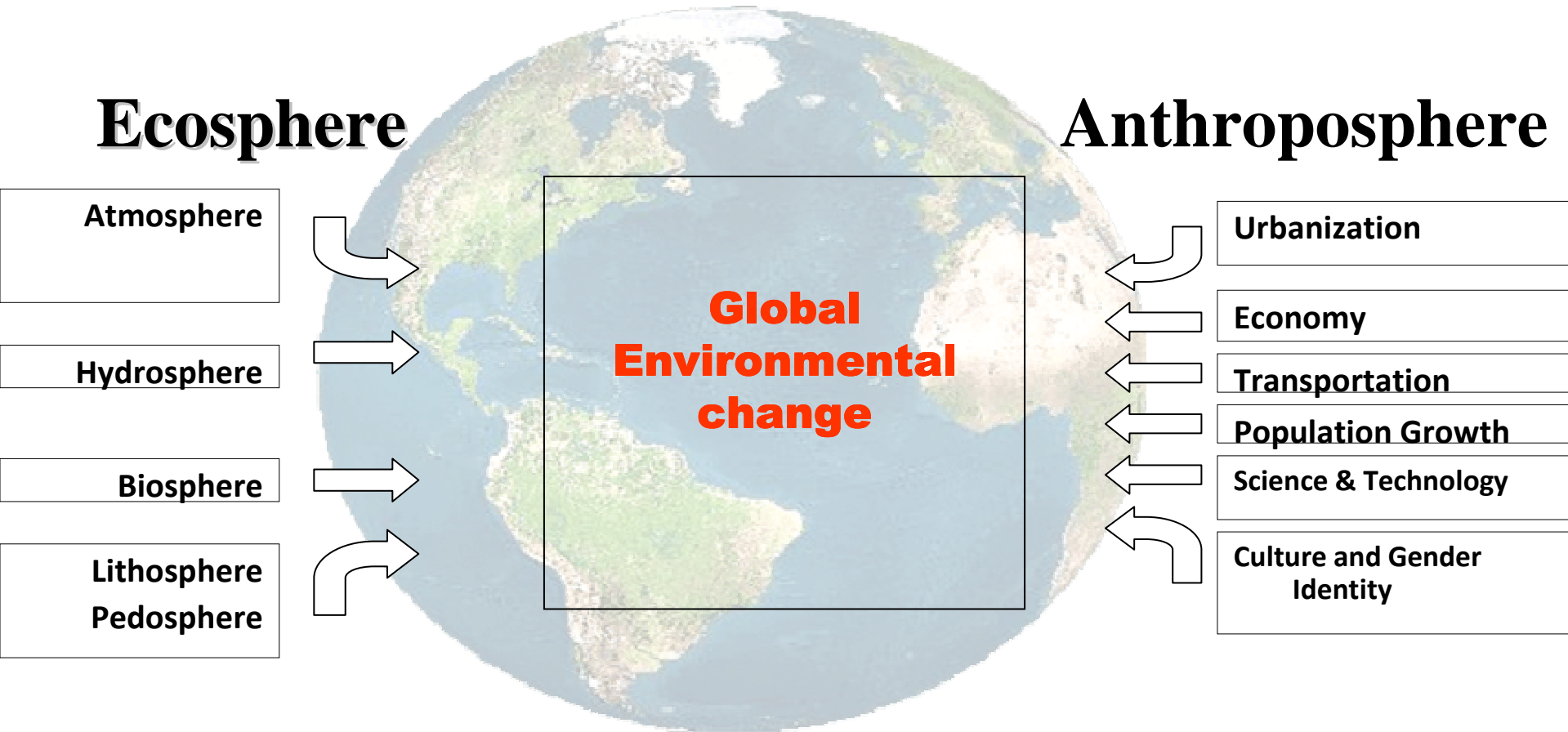
Desden, 11-13 of October, 2011

Content

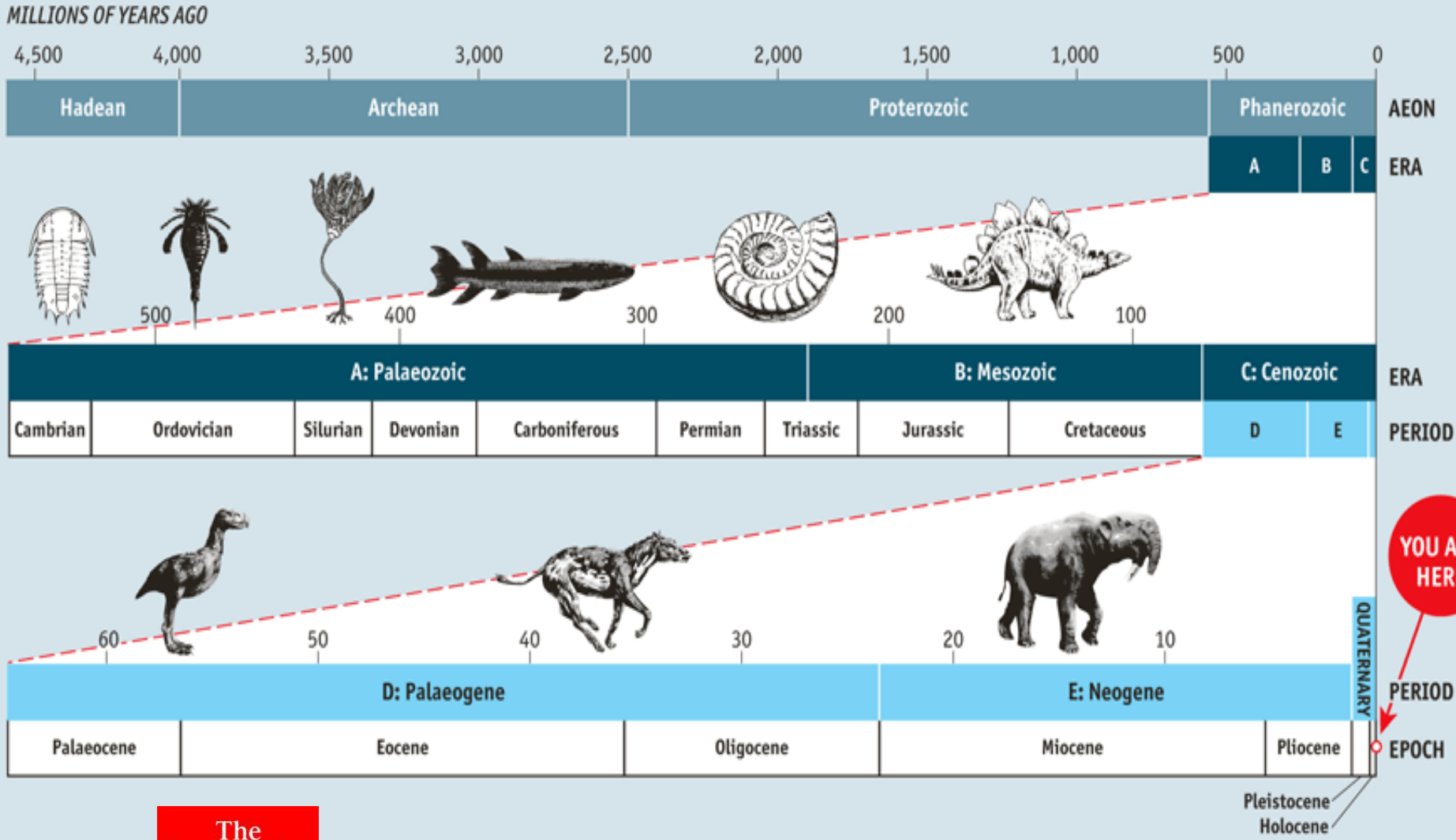


- 1. Global environmental change (GEC) in the Anthropocene**
- 2. Effects of GEC on nature and humans**
- 3. GEC paradox and implications on integrated water resource management**
- 4. Complex interrelations between water and other natural resources**
- 5. Integrated water resource management**
- 6. State of art in water research in Mexico**
- 7. Threats and challenges**
- 8. Lessons learnt**

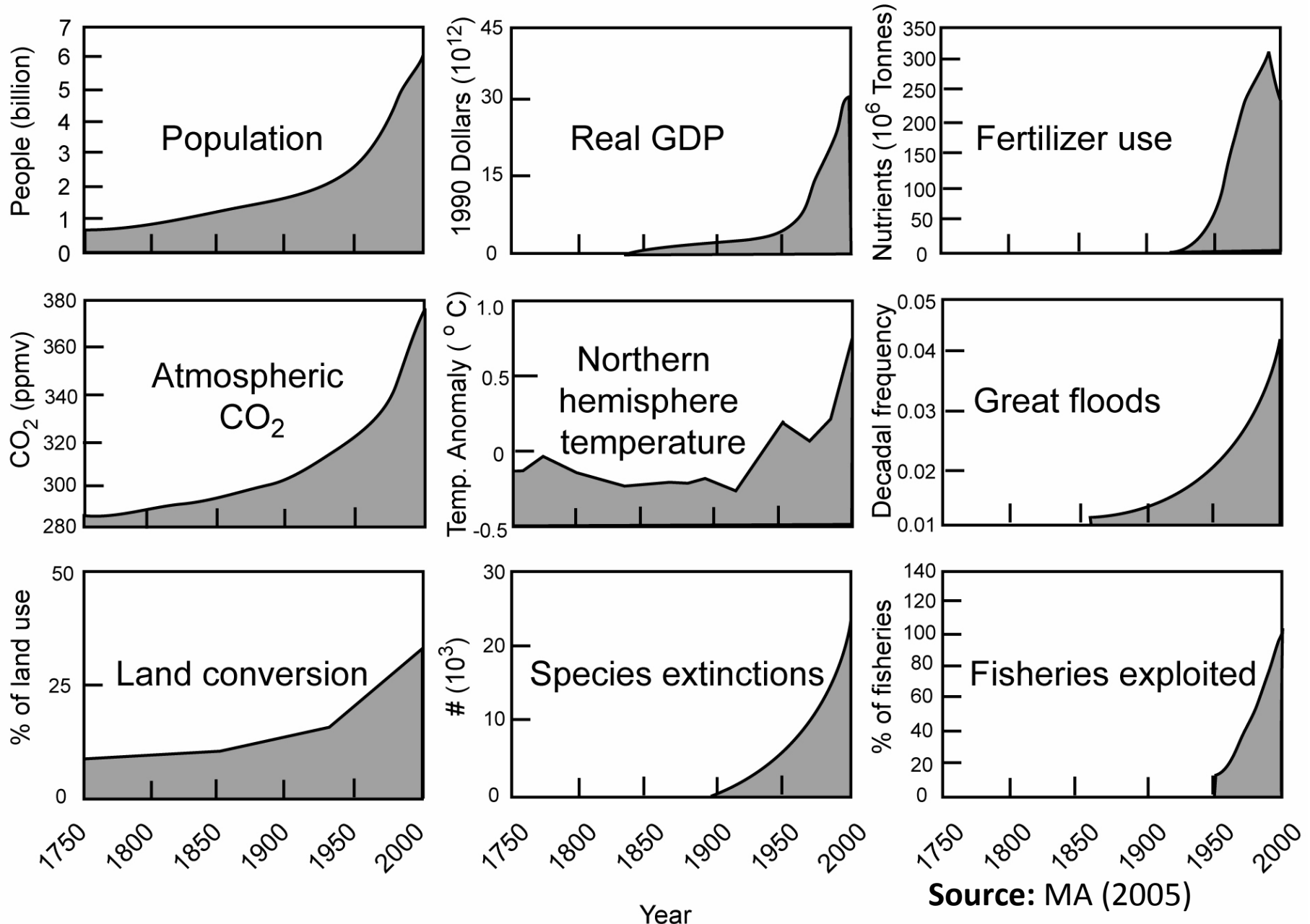
Global Environmental Change (GEC)



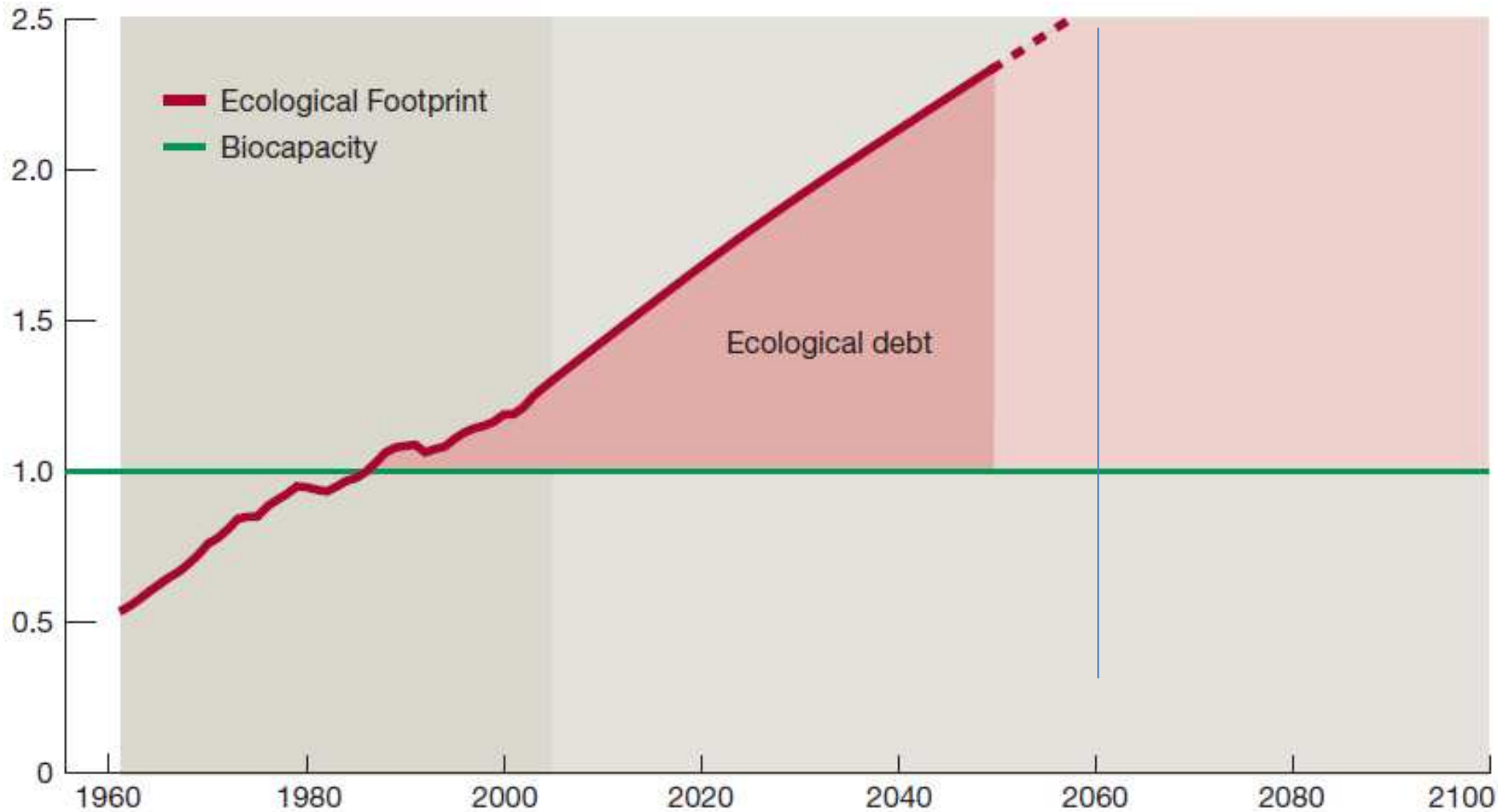
Earth history: Humans came late



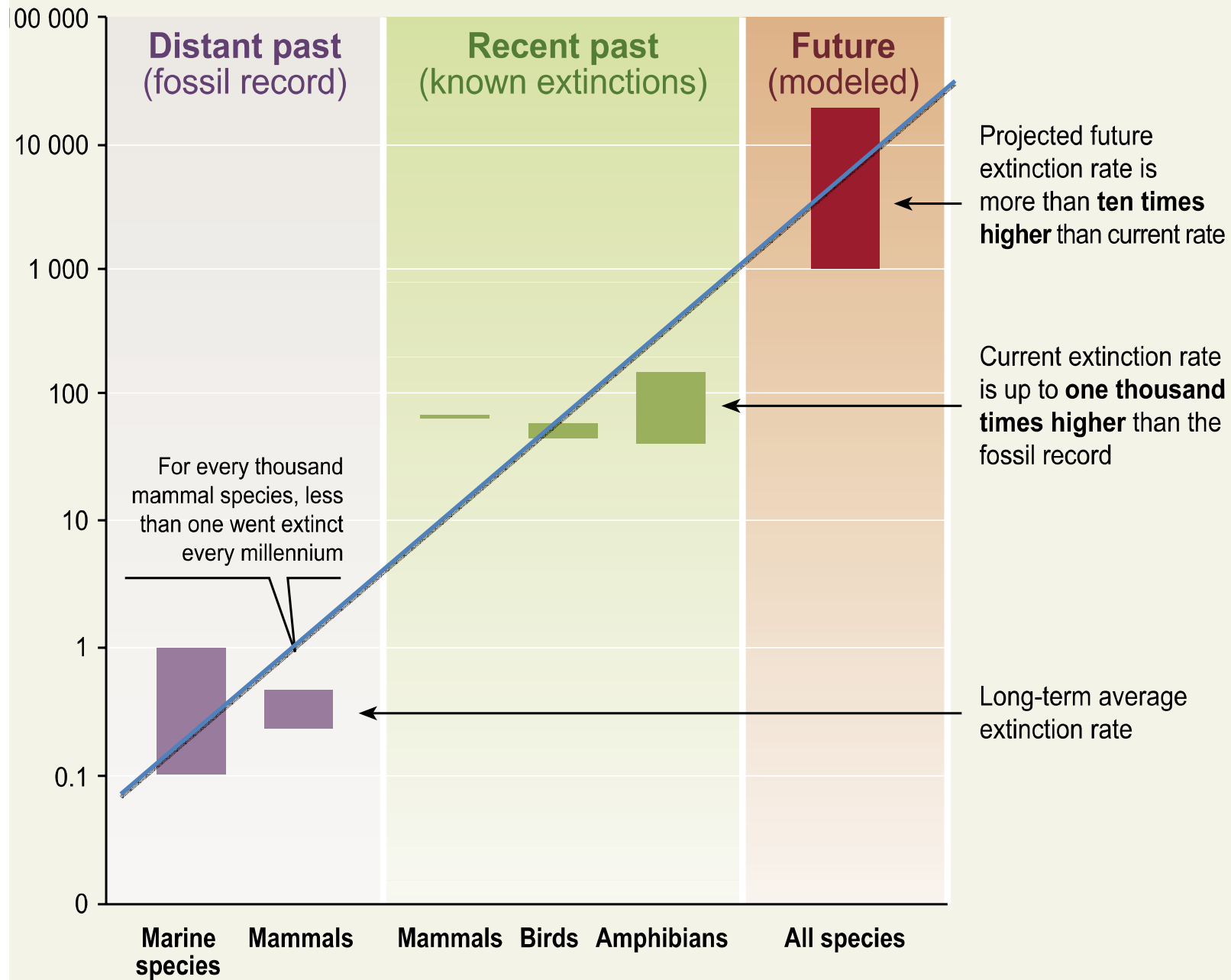
2. Effects of GEC on nature and humans



5. Ecological Footprint: with present consumerism in 2060 we require 2.5 planets



Extinctions per thousand species per millennium

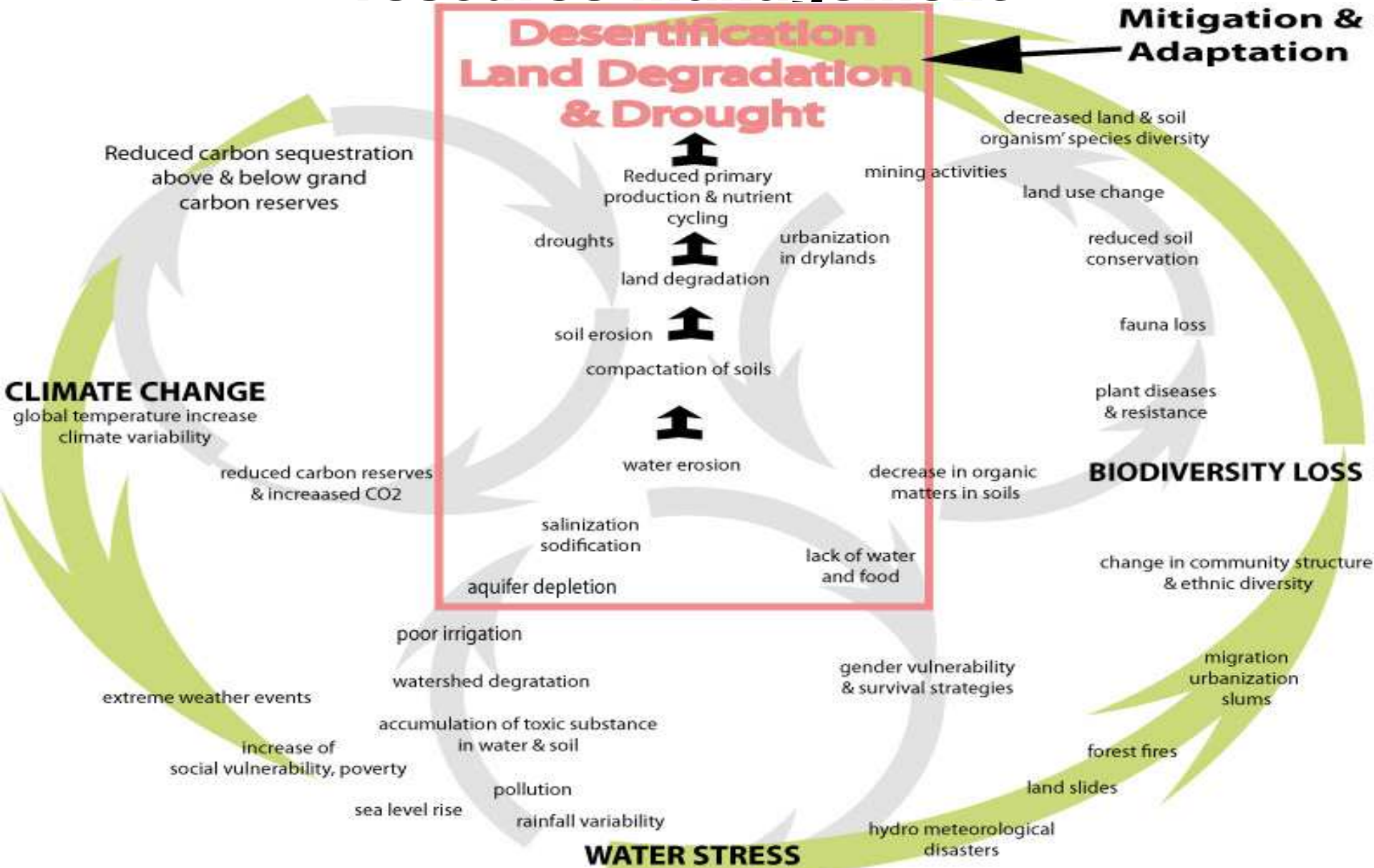


Source: Millennium Ecosystem Assessment

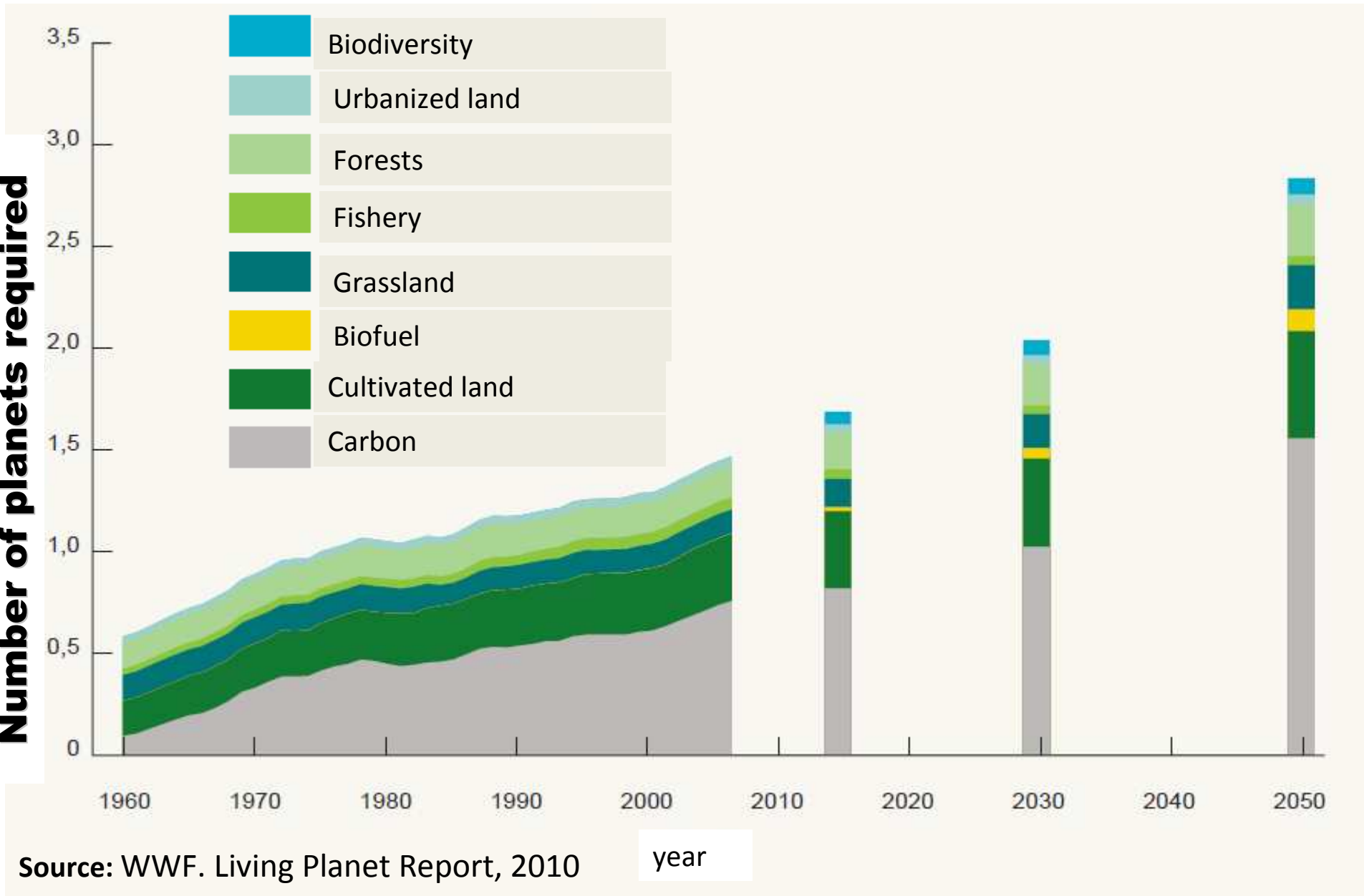
3. GEC paradox & implications on IWRM

1. Global environmental change and climate change are increasing biodiversity loss, risks and hazards, creating dangerous feedbacks and potential tipping points.
2. Hydrometeorological extreme events are getting stronger, affecting humans, infrastructure and ecosystems, and in some regions more frequent.
3. On the one hand we have declaratory goals by the G-8 to reduce the impacts of GEC, especially greenhouse gases by 50% to 80% by 2050; on the other hand real emissions are rising at the highest level of established scenarios by IPCC and the implementation of the commitments of UNFCCC (1992) and the Kyoto protocol (1997) are uncertain.
4. Recent financial and economic crises are delaying further a legally binding regime and the dominant business-as-usual approach will not re-establish the equilibrium between nature and human beings.

4. Complex interactions: integrated water resource management



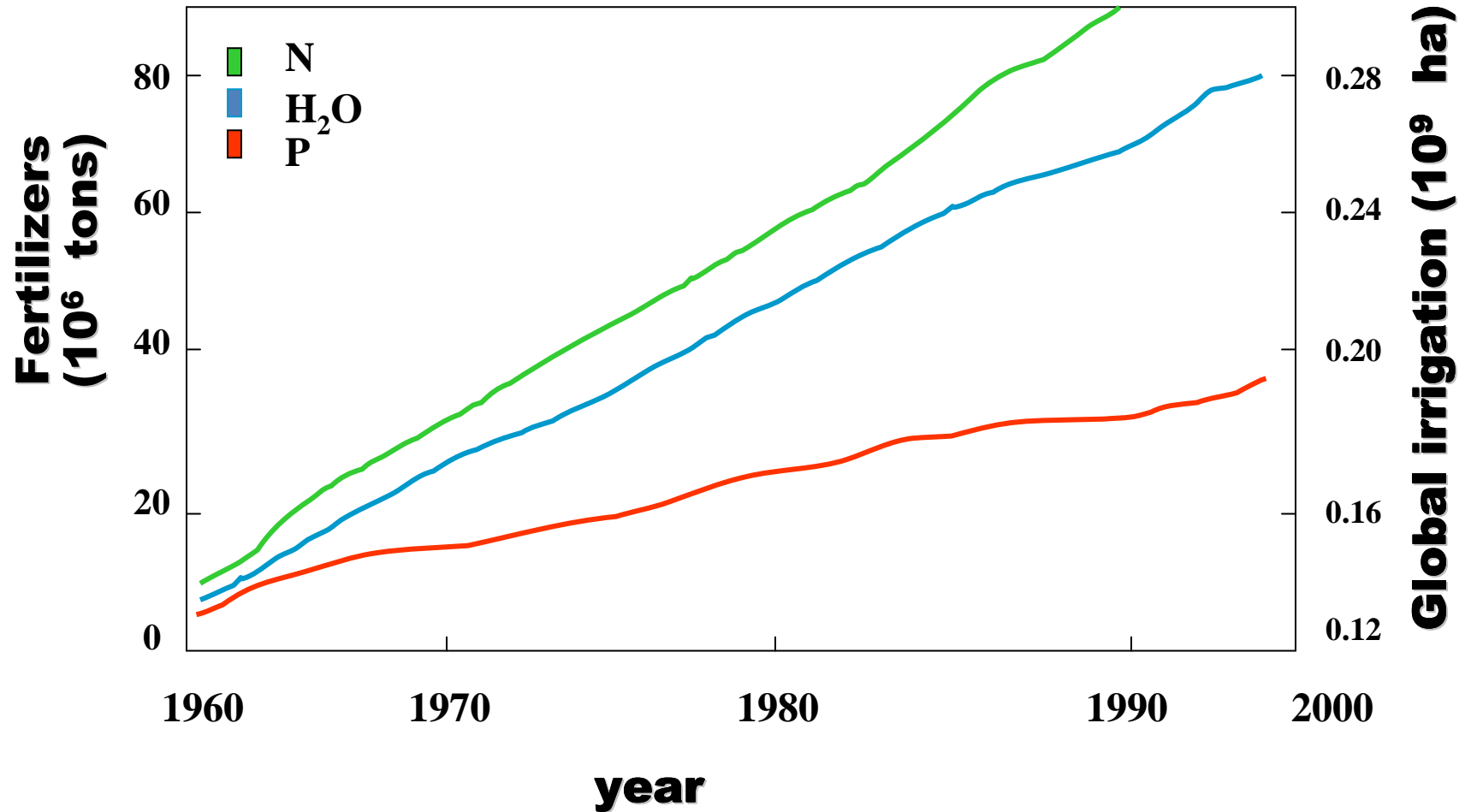
Projections of anthropogenic impacts on the planet



Source: WWF. Living Planet Report, 2010

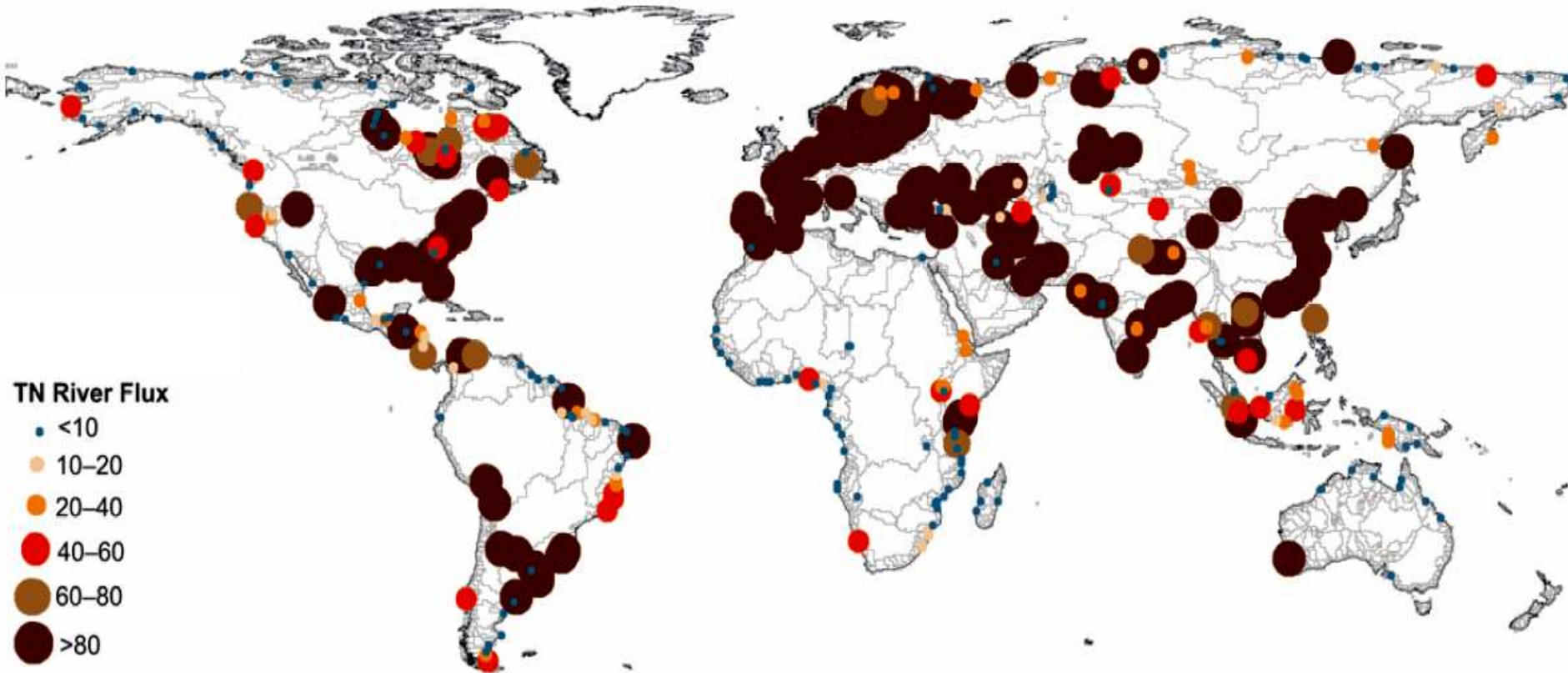
year

Global Use of Water and Fertilizers (H₂O, N, P)



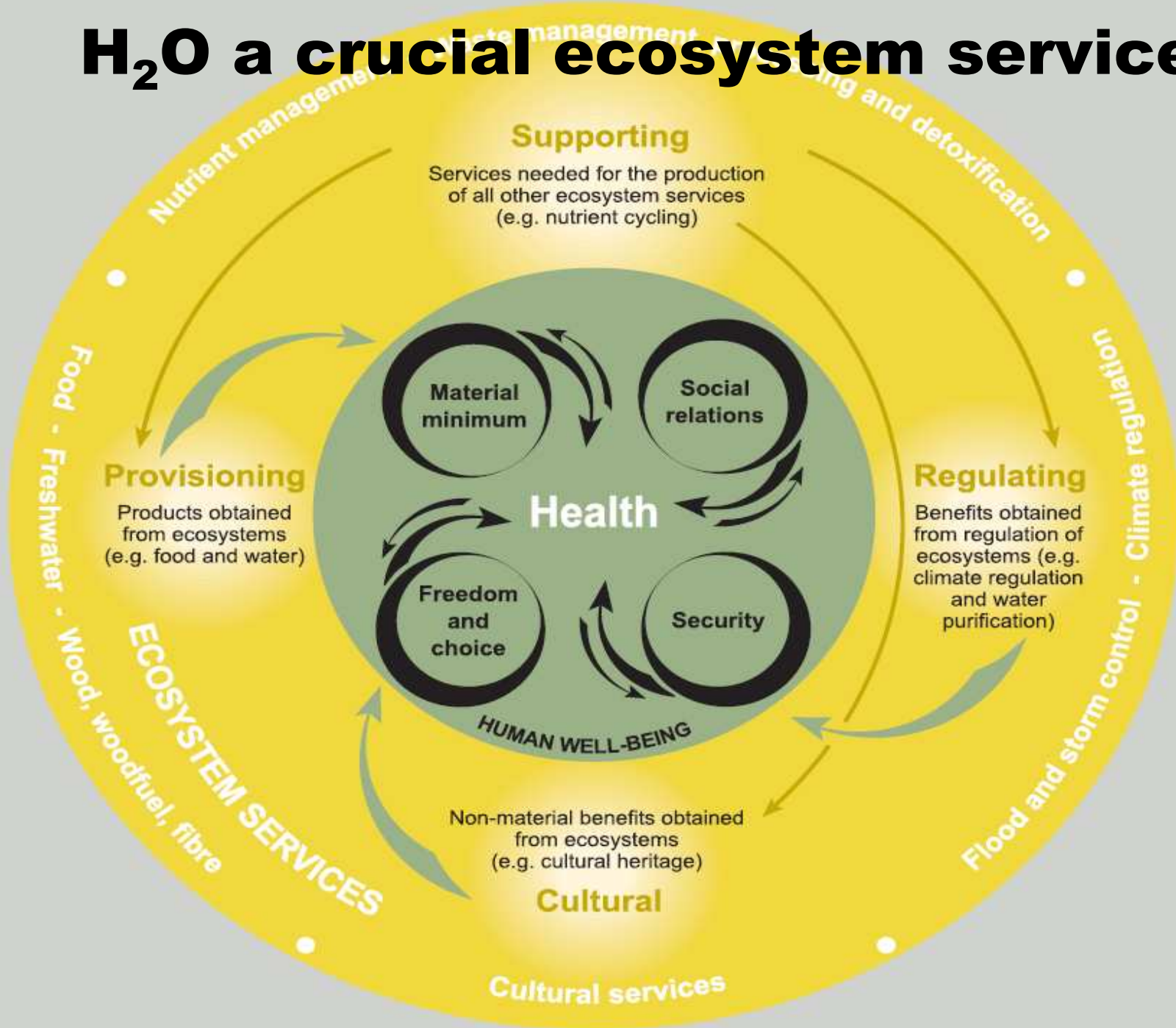
Eutrophication—percent increase in nitrogen flows in rivers since mid 1990's

Dead zones



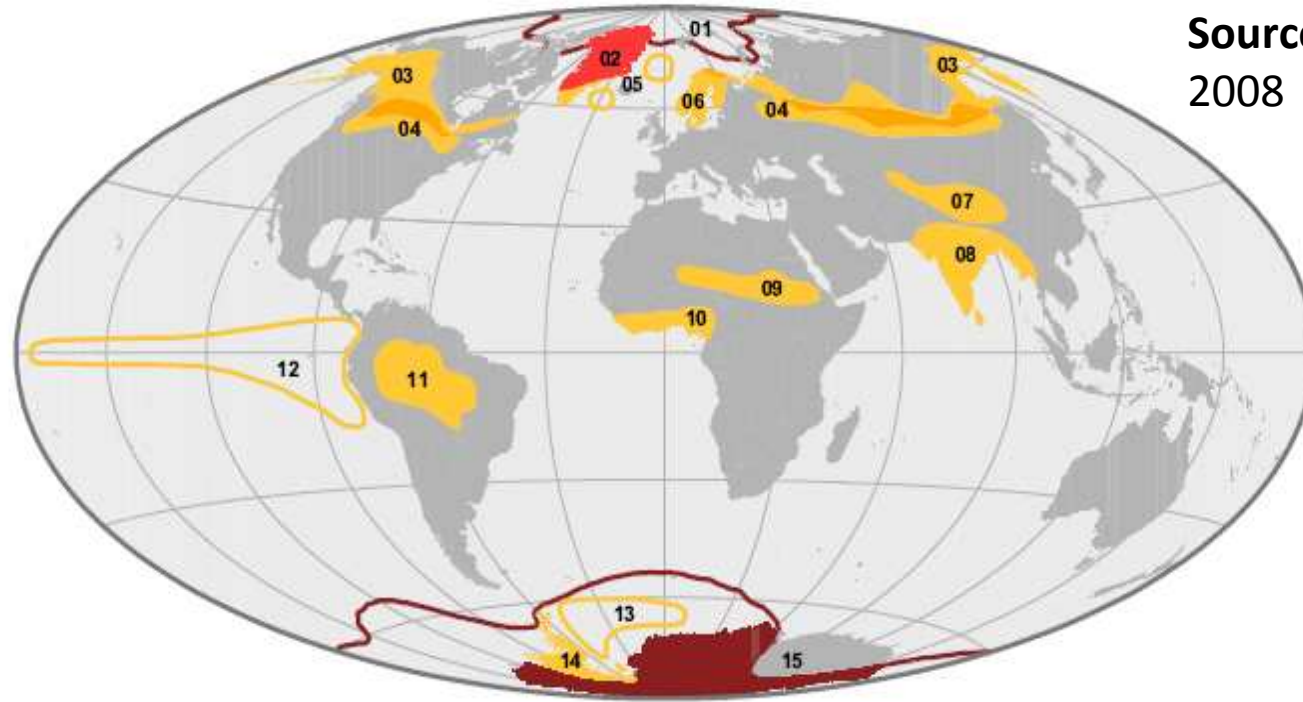
Source: Millennium Ecosystem Assessment, 2005

H₂O a crucial ecosystem service



(Potential) anthropogenic tipping points in climate system

Source: Schellnhuber, 2008



 tipped already  in limbo  still stable

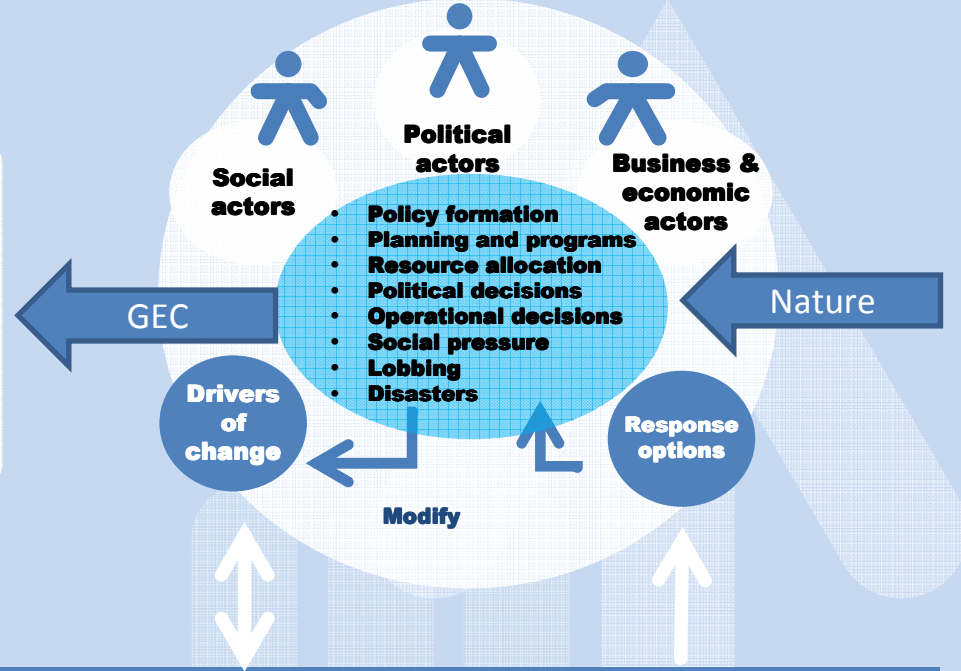
01 Arctic Sea Ice Loss
02 Greenland Ice Sheet
03 Thawing Permafrost /
Methan Escape
04 Boreal Forest Dieback
05 Suppression of Atlantic
Deep Water Formation

06 Climatic Change-Induced
Ozone Hole over Northern Europe
07 Albedo Tibetan Plateau
08 Indian Monsoon
09 Re-Greening Sahara /
Sealing of Dust Sources
10 West African Monsoon

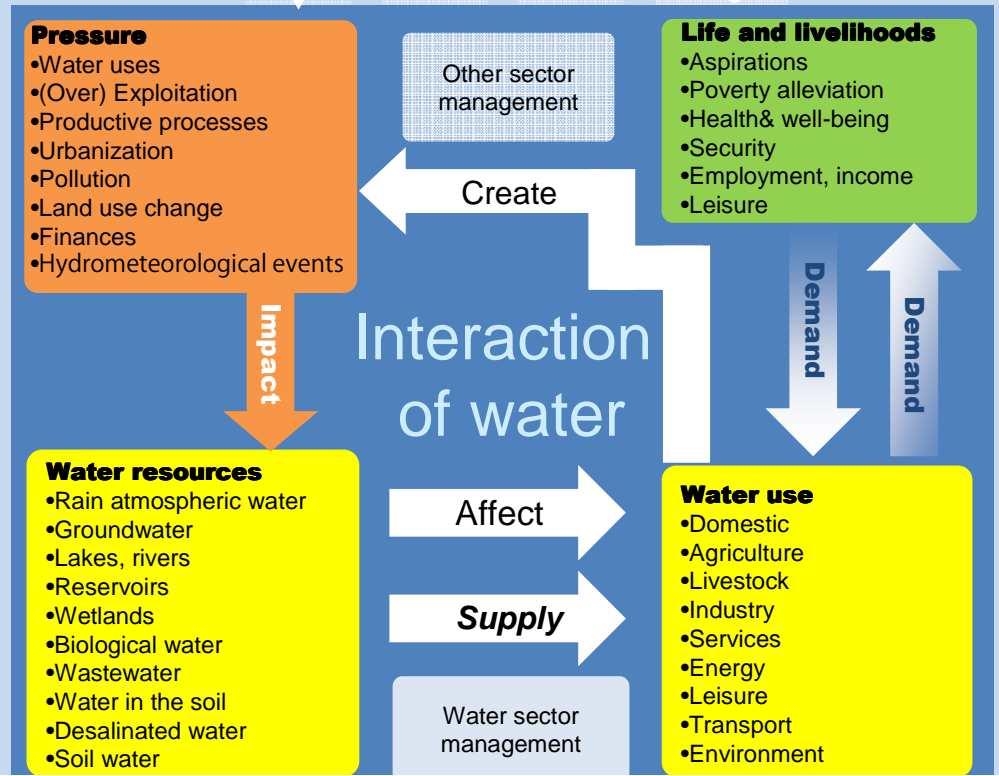
11 Dieback of Amazon Rainforest
12 Southern Pacific Climate Oscillation
13 Antarctic Deep Water Formation /
Nutrients Upwelling
14 Westantarctic Ice Sheet
15 Antarctic Ozone Hole

CEG: Global Environmental Change:

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



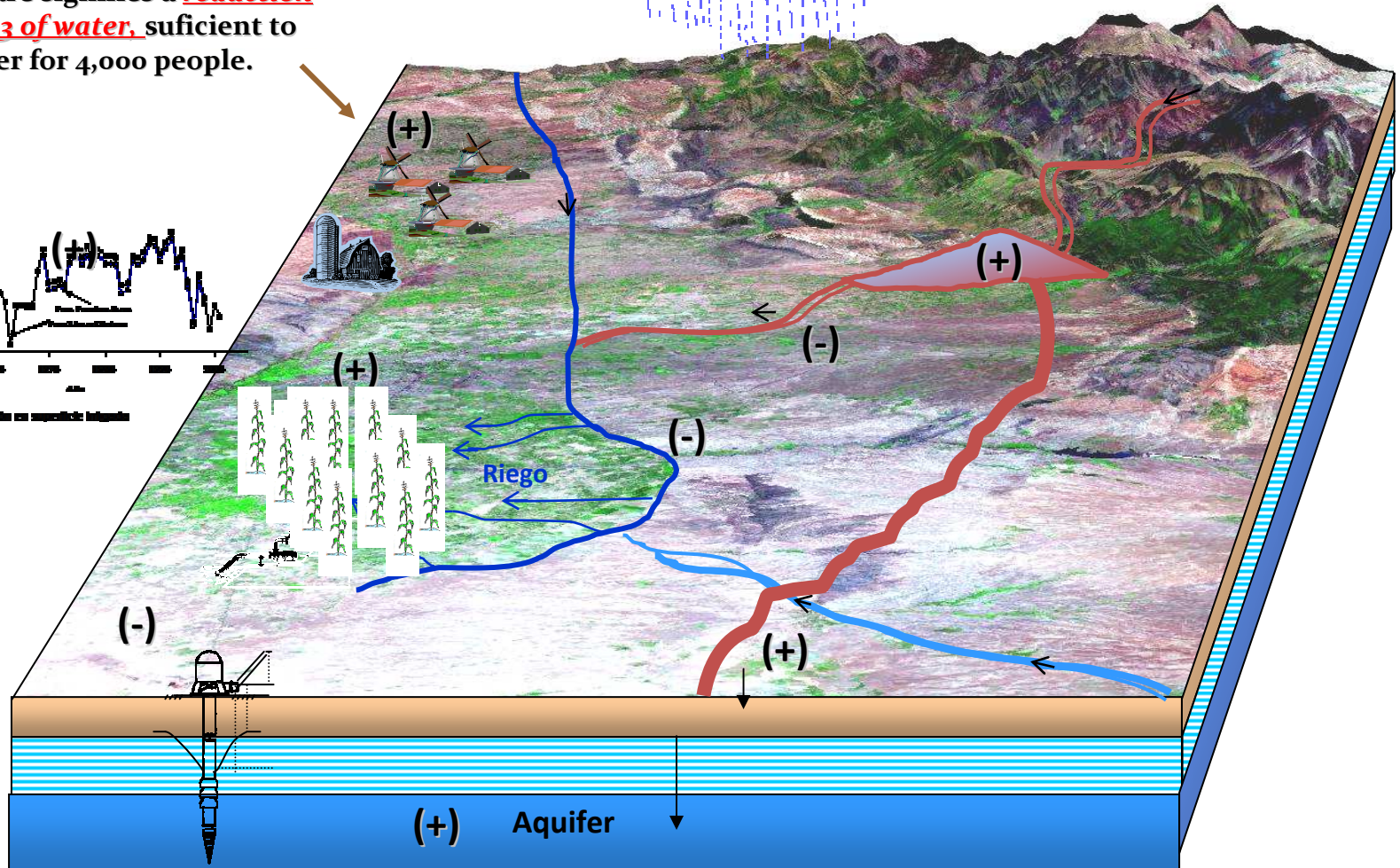
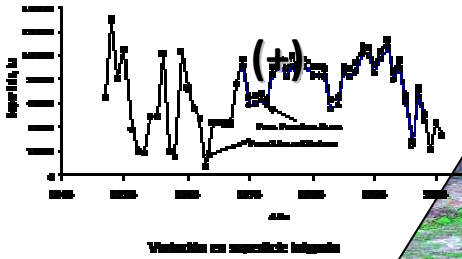
5. Integrated water management



Source: based on Global Water News, #9, p. 4

Cascading Impact: Crops resistant to drought

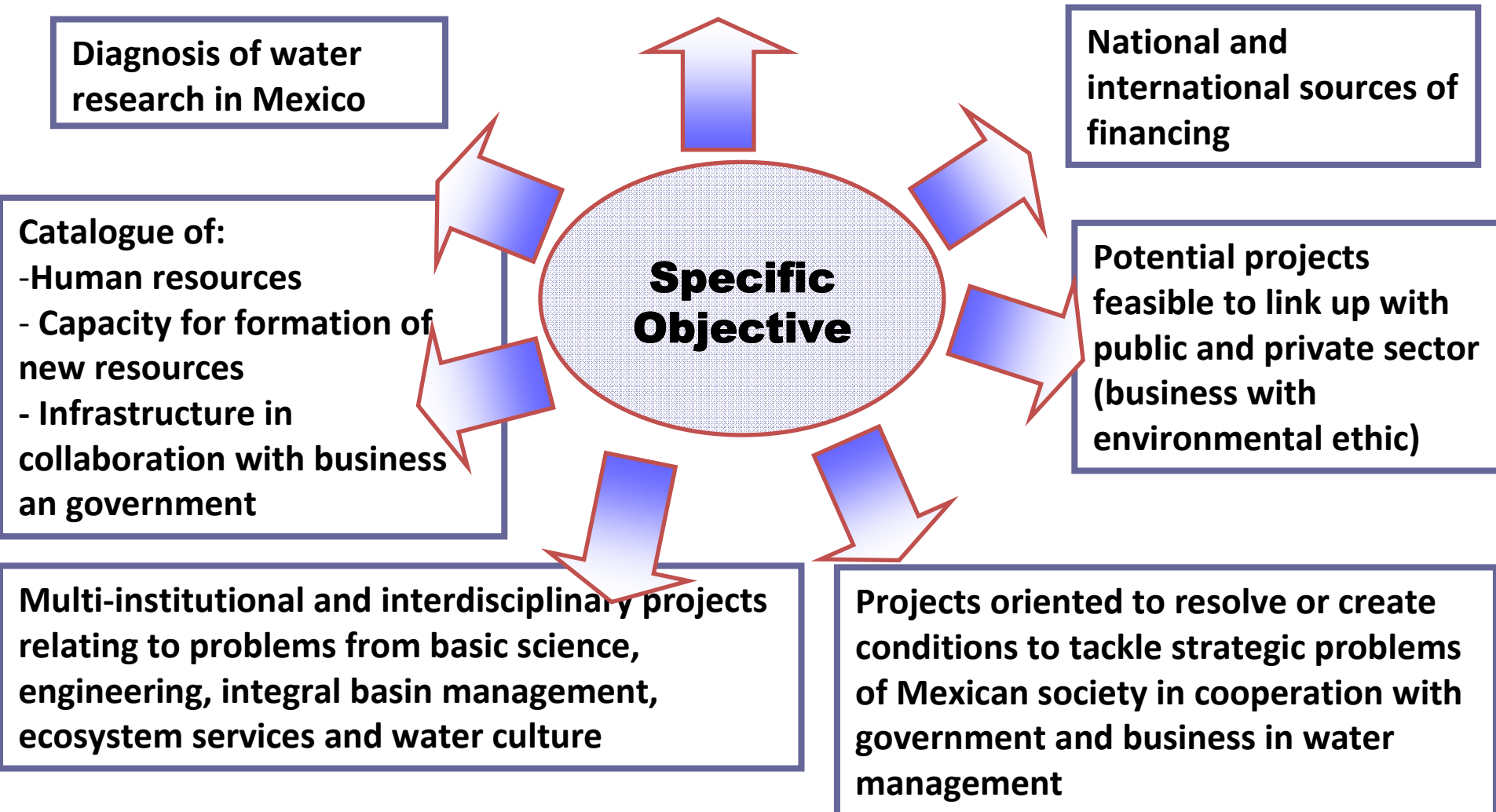
10cm of less water for irrigation in one hectare signifies a **reduction of 1000 m³ of water**, sufficient to offer water for 4,000 people.



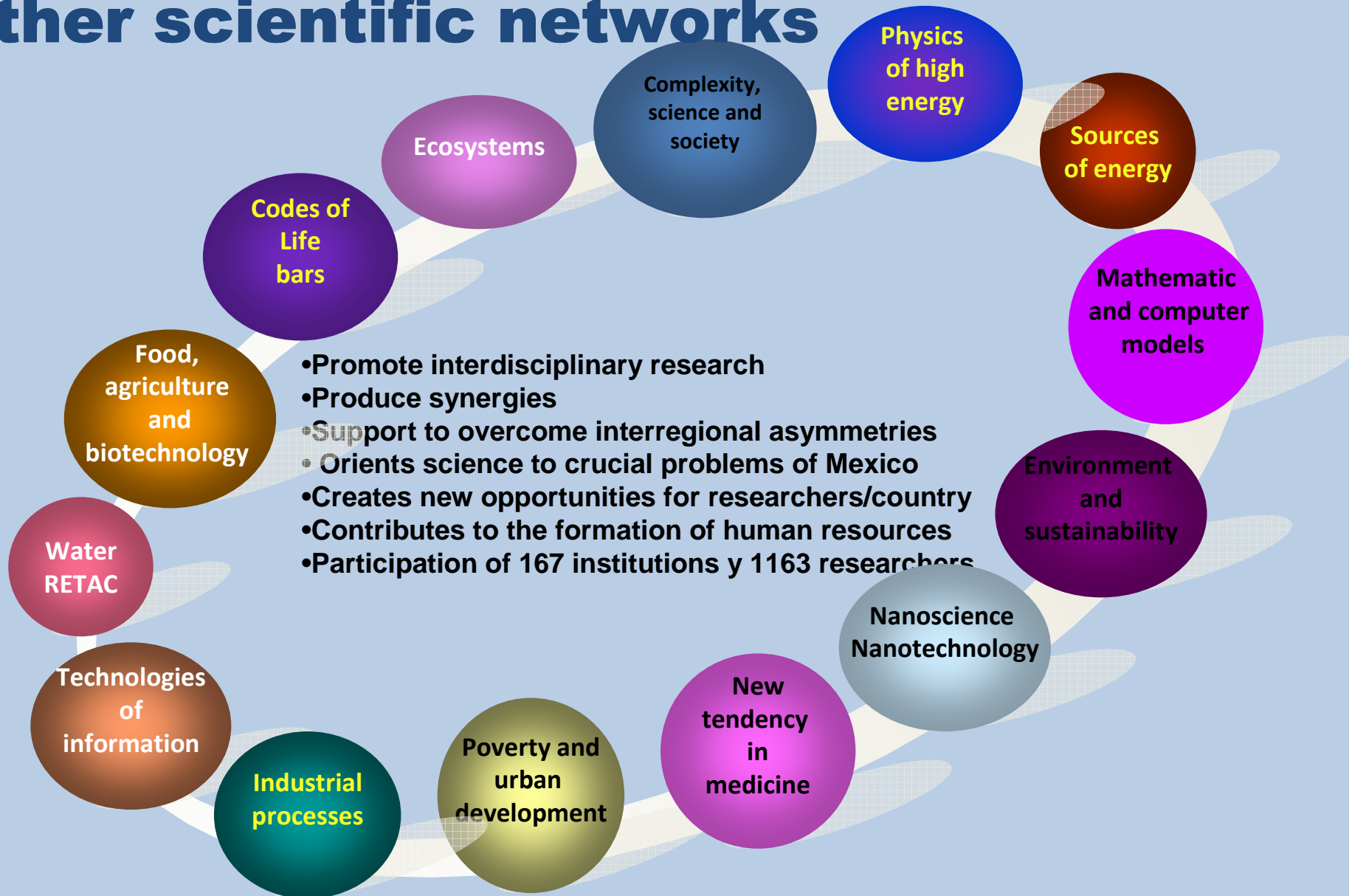
Relation: biotechnology, genetic, hydrology, agriculture sociology, economy, health, livelihood, poverty alleviation, etc.

6. State of art in water research in Mexico

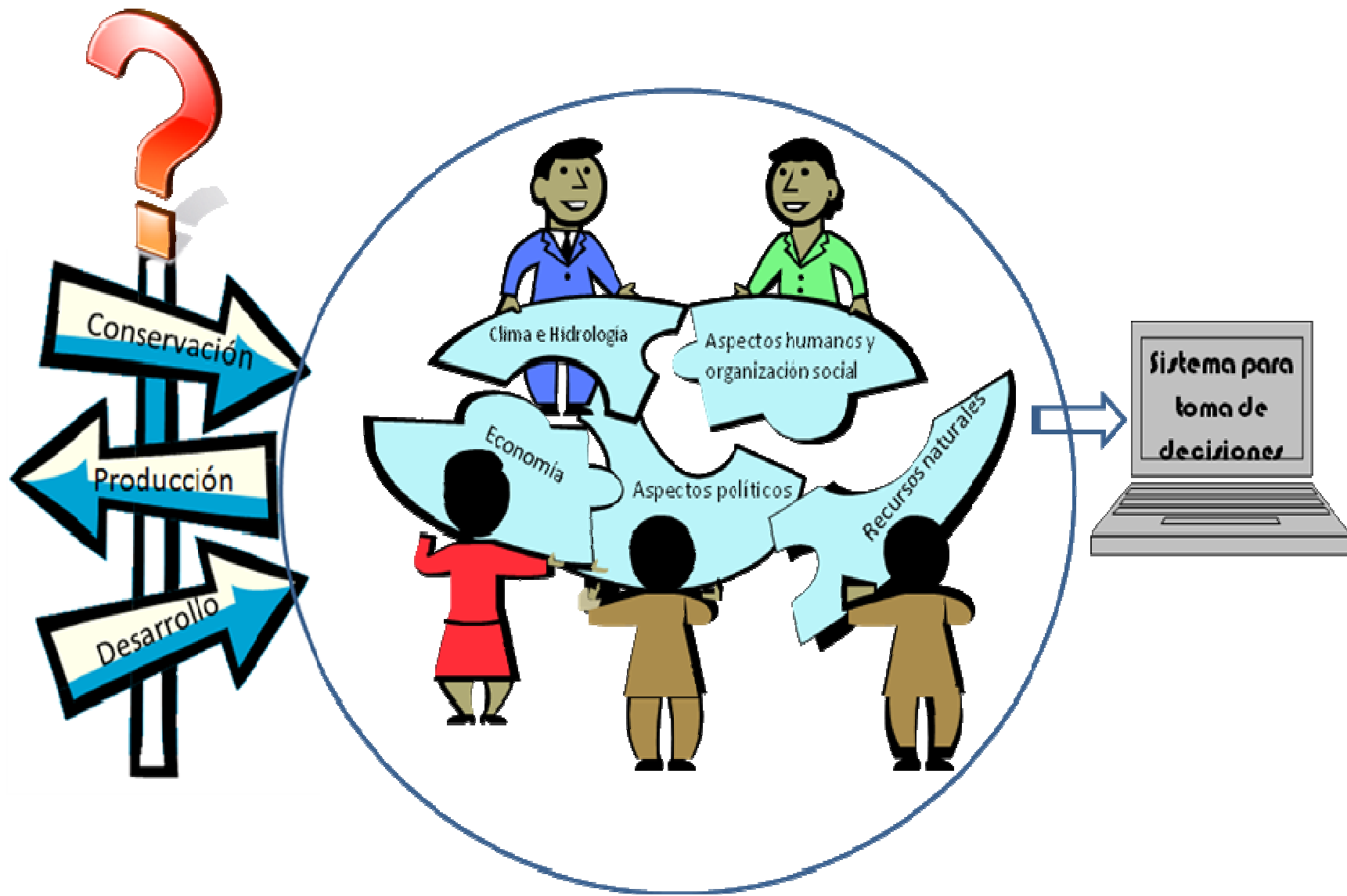
Elaboration of a national policy of scientific and technological research of water with institution-building, business involvement and models for resolutions of urgent problems



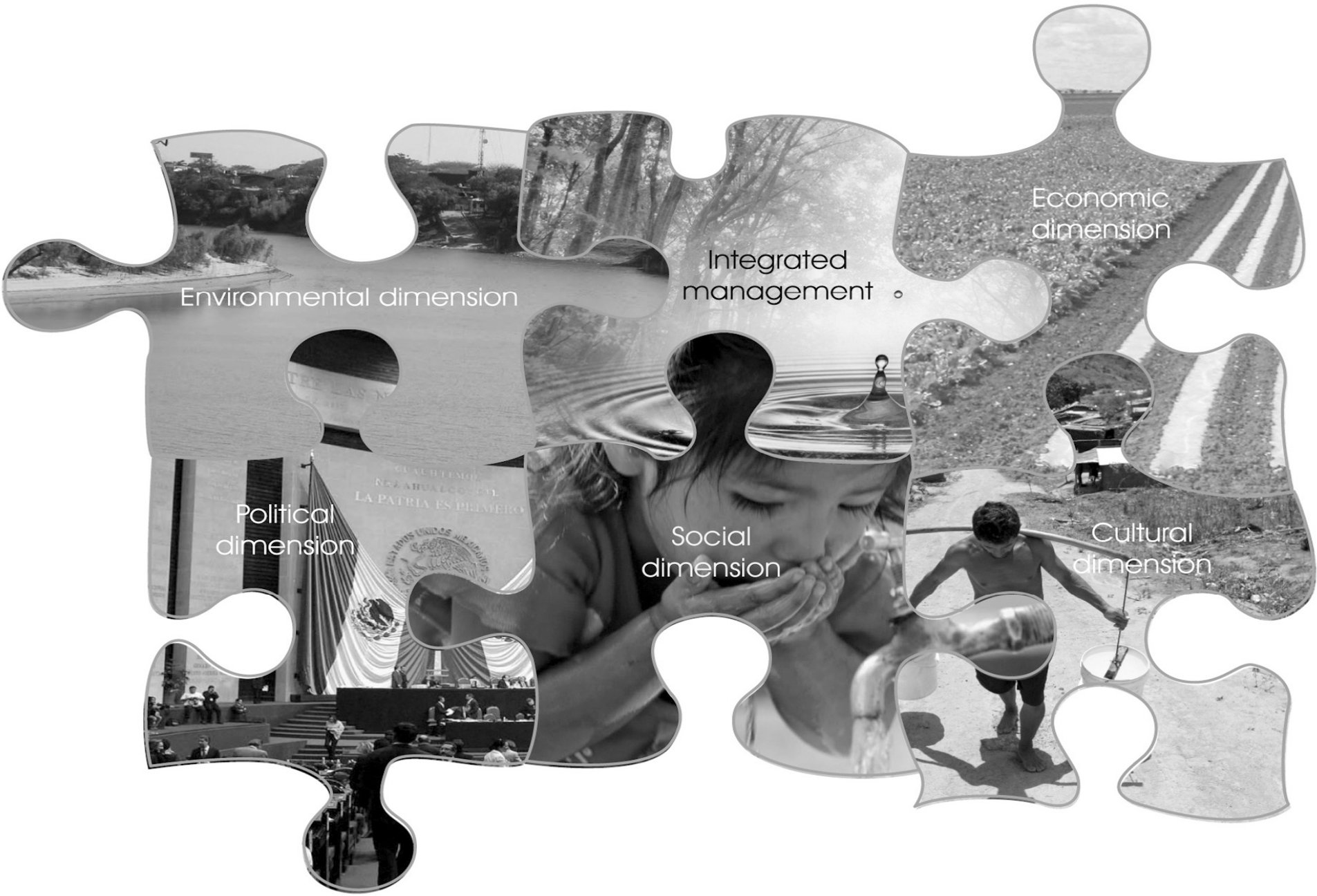
Transversal interrelation of RETAC with other scientific networks



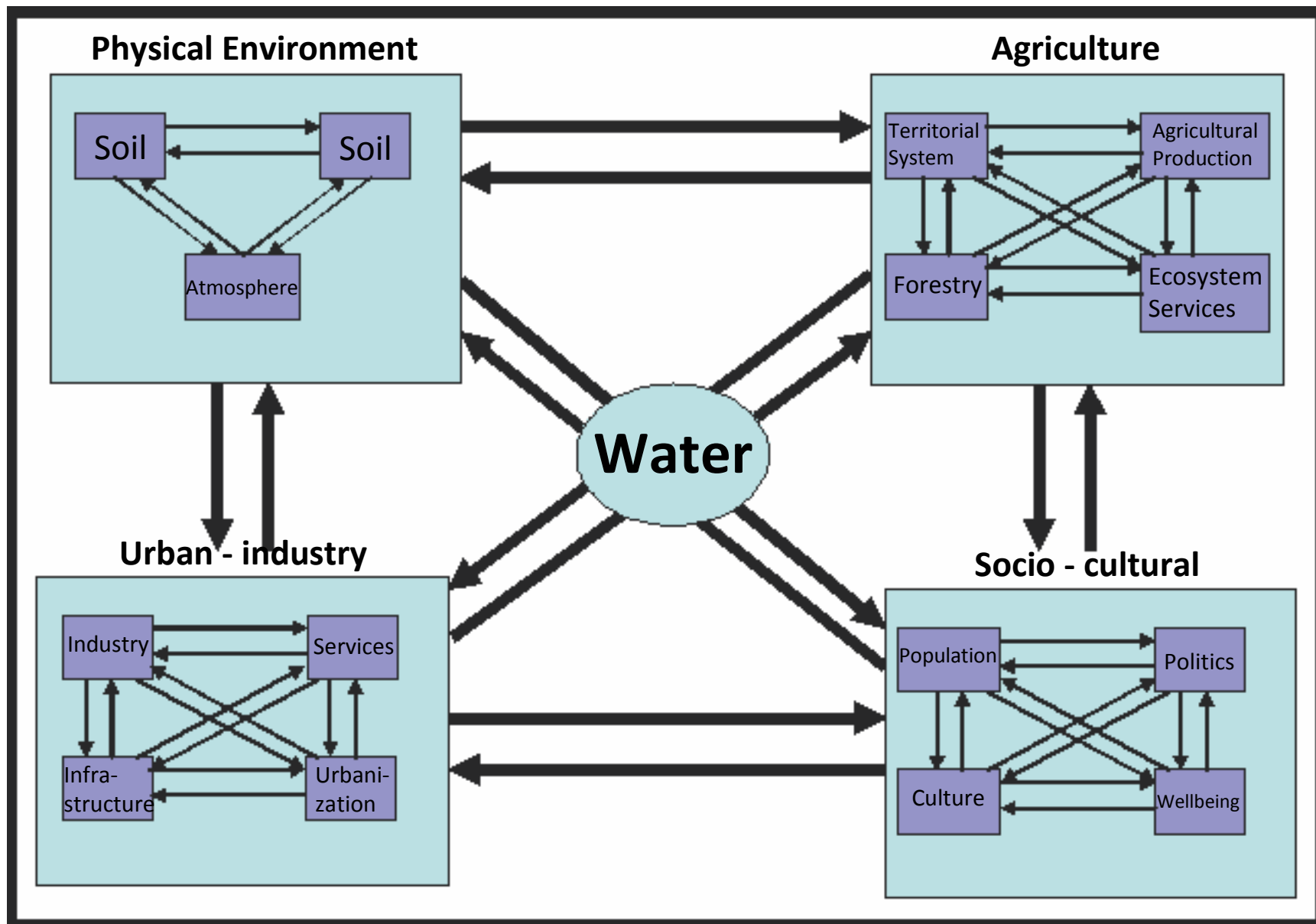
Multidisciplinary, multi-sectorial and multi-institutional research



Integrated water resource management

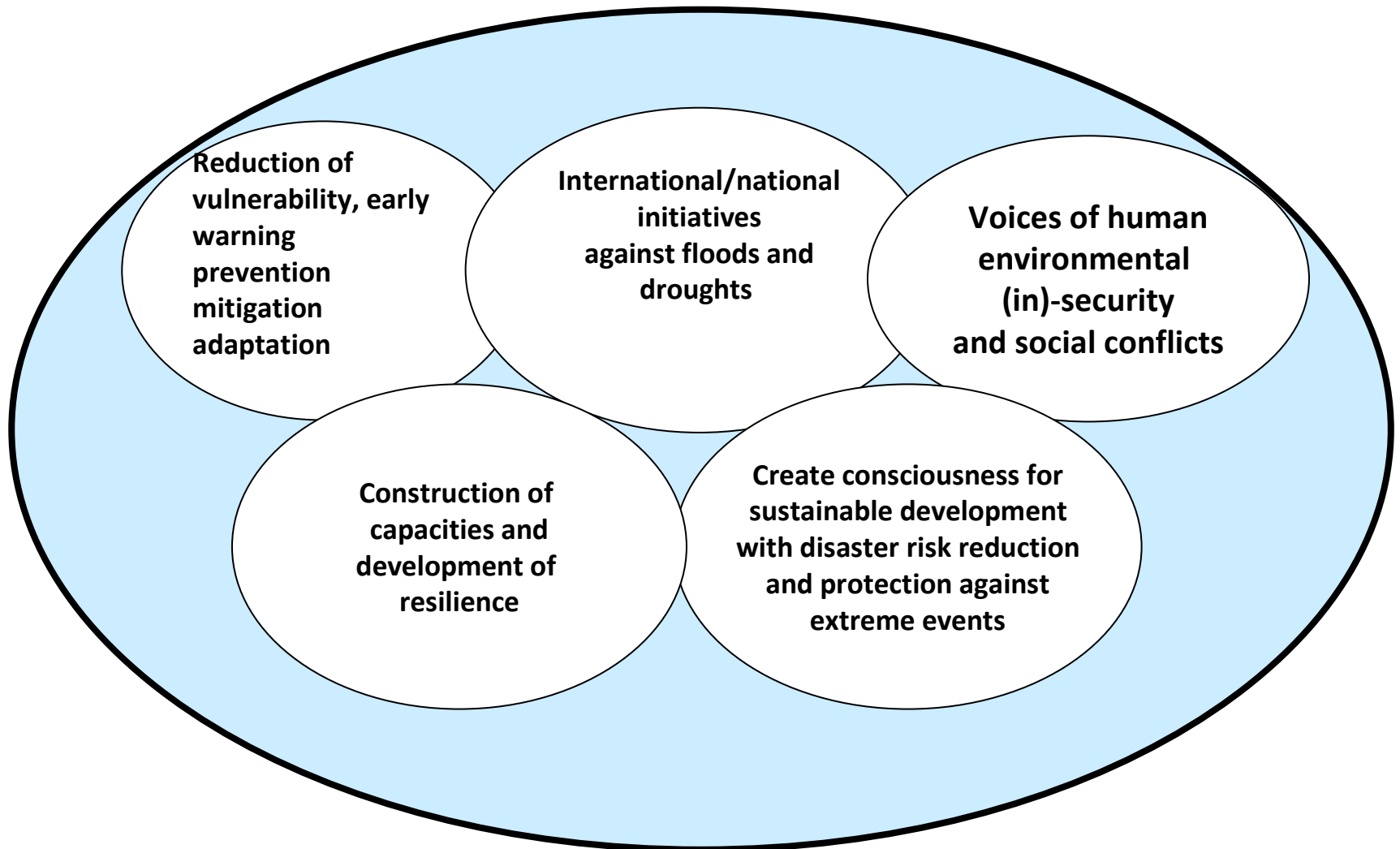


System approach of an integral water management and sustainable development (Oswald, 2005)

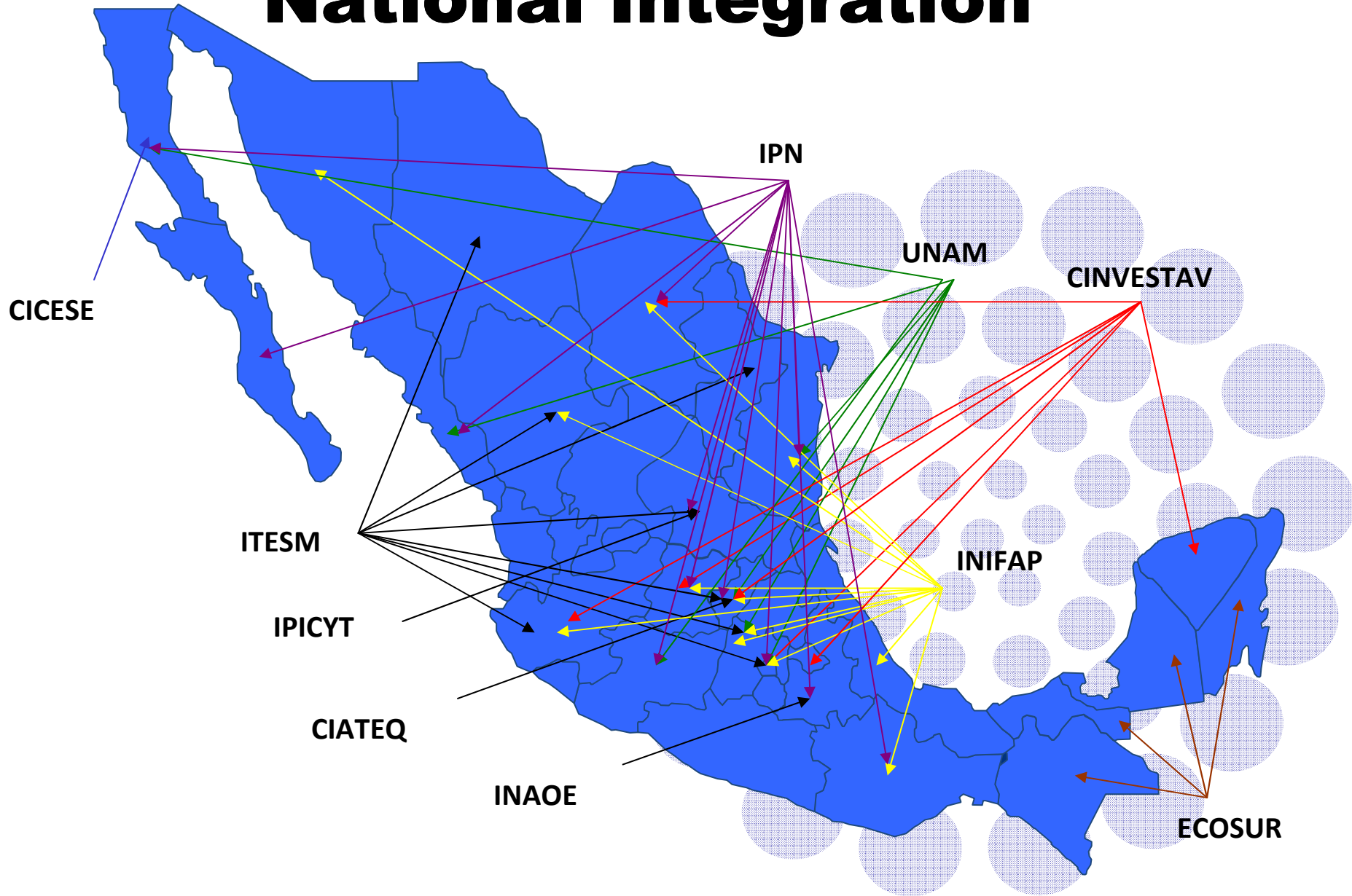


Central objectives of the research of RETAC in Mexico

The basin as a hydrological unit for planning and development of multi-sectorial, multi-institutional and multidisciplinary research and actions

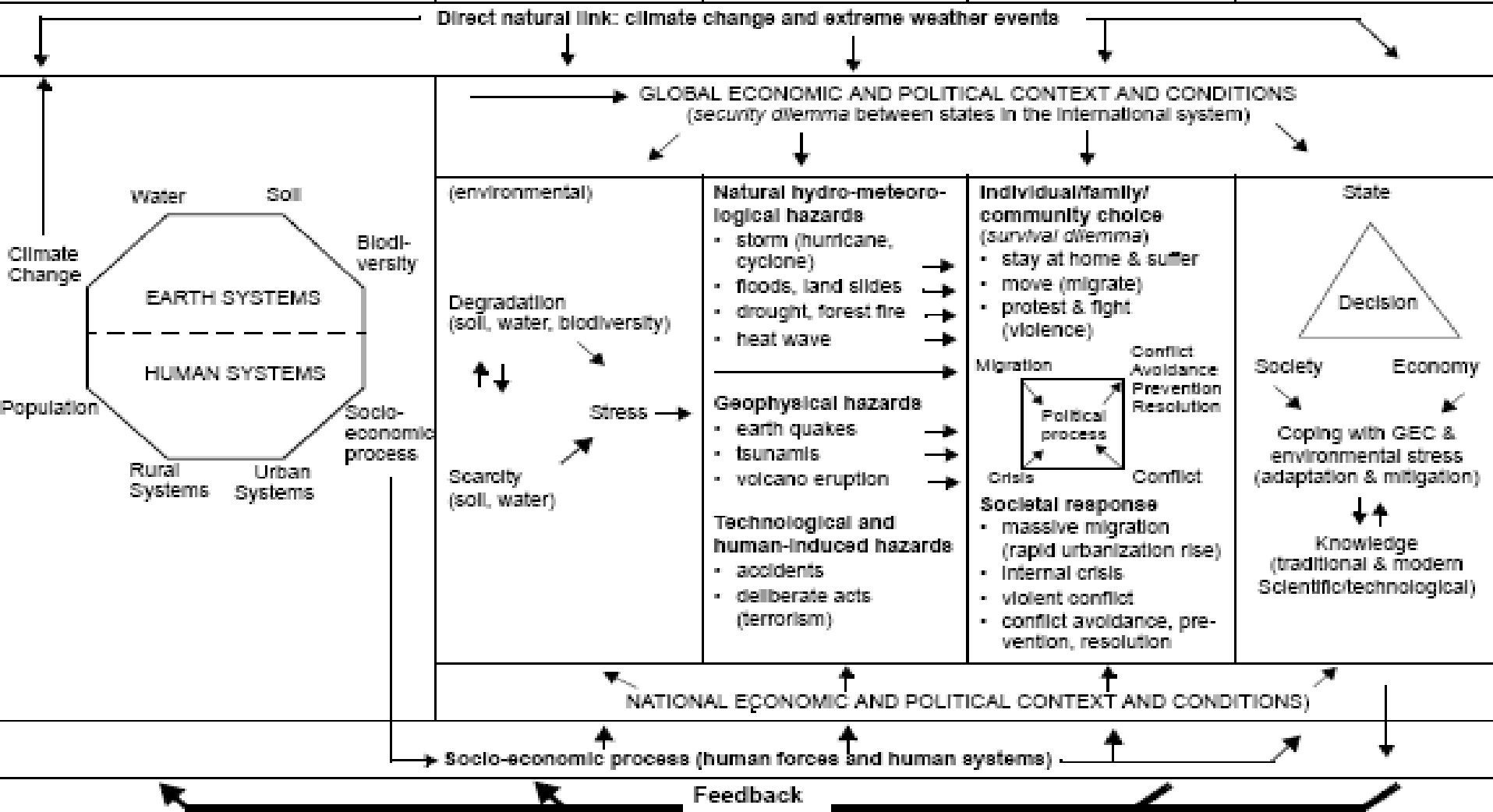


National Integration

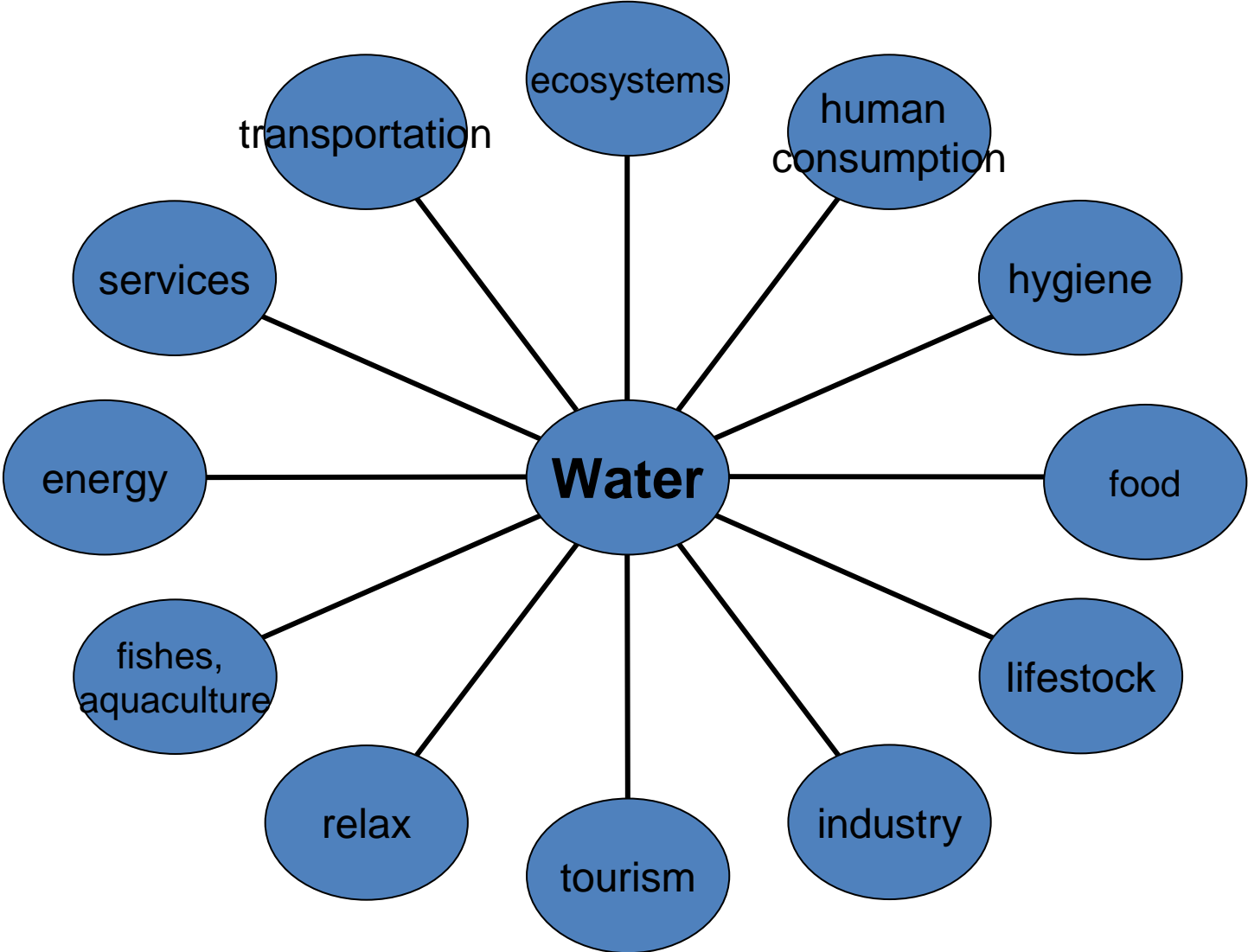


The PEISOR Model

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 (survival dilemma) Societal response	National and international political process, state, societal and economic actors and knowledge

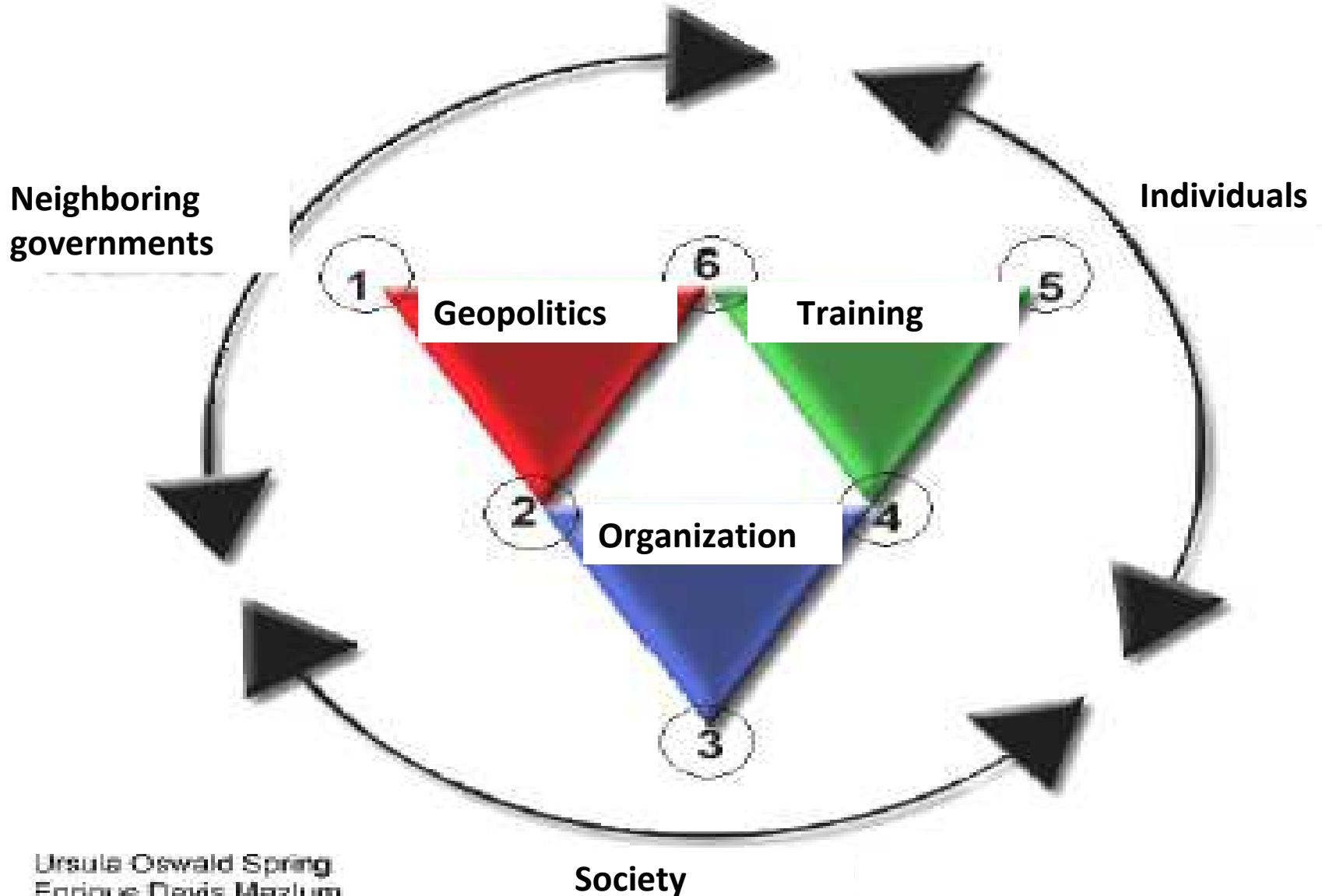


Integrated Water Resource Management



Source: Oswald 2007

Hydrodiplomacy



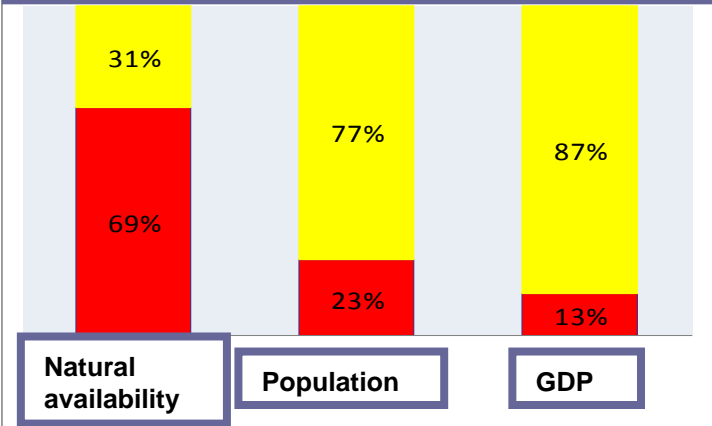
Reality of water in Mexico



Precipitation, population and use of water

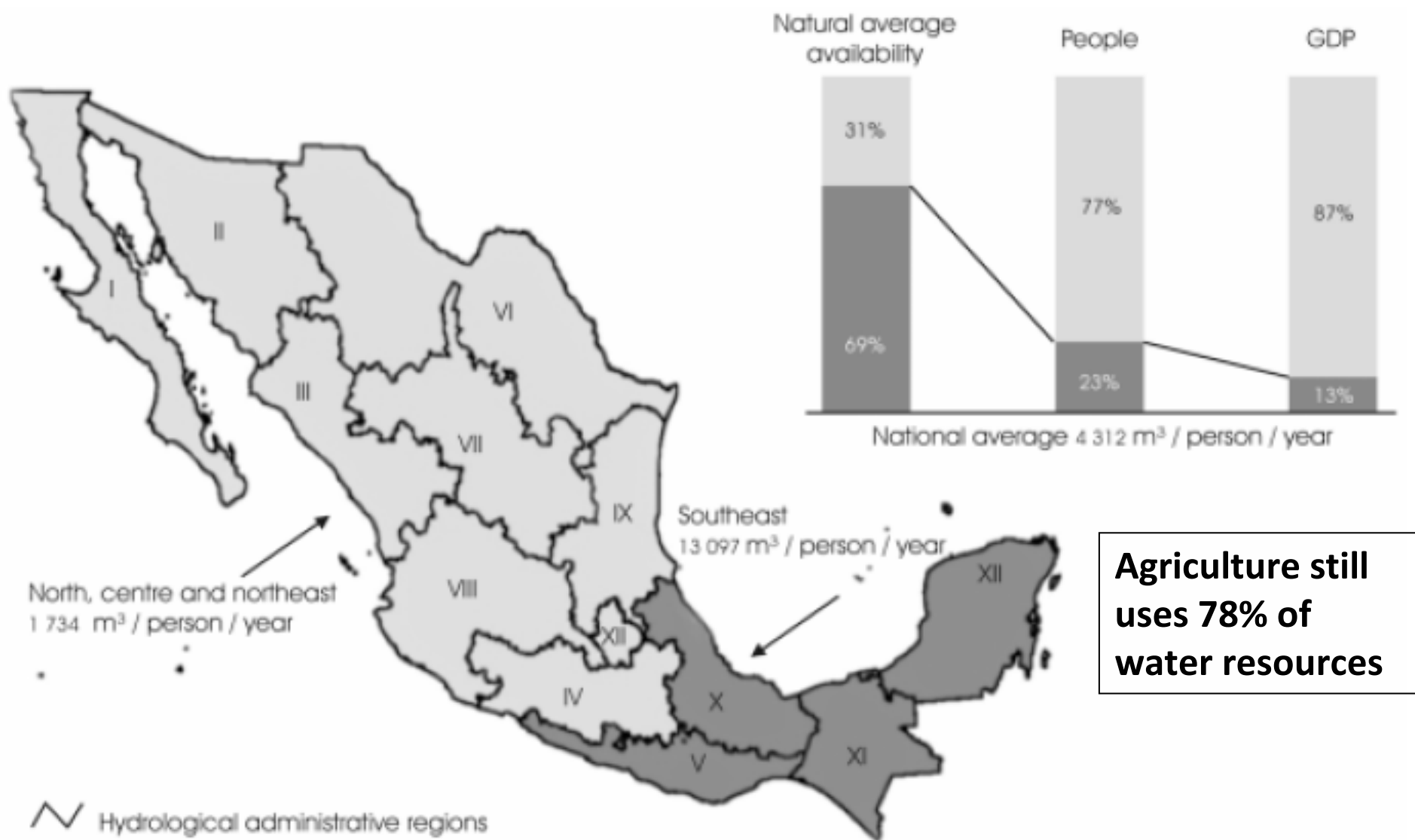


National average: 4,212 m³/hab./year

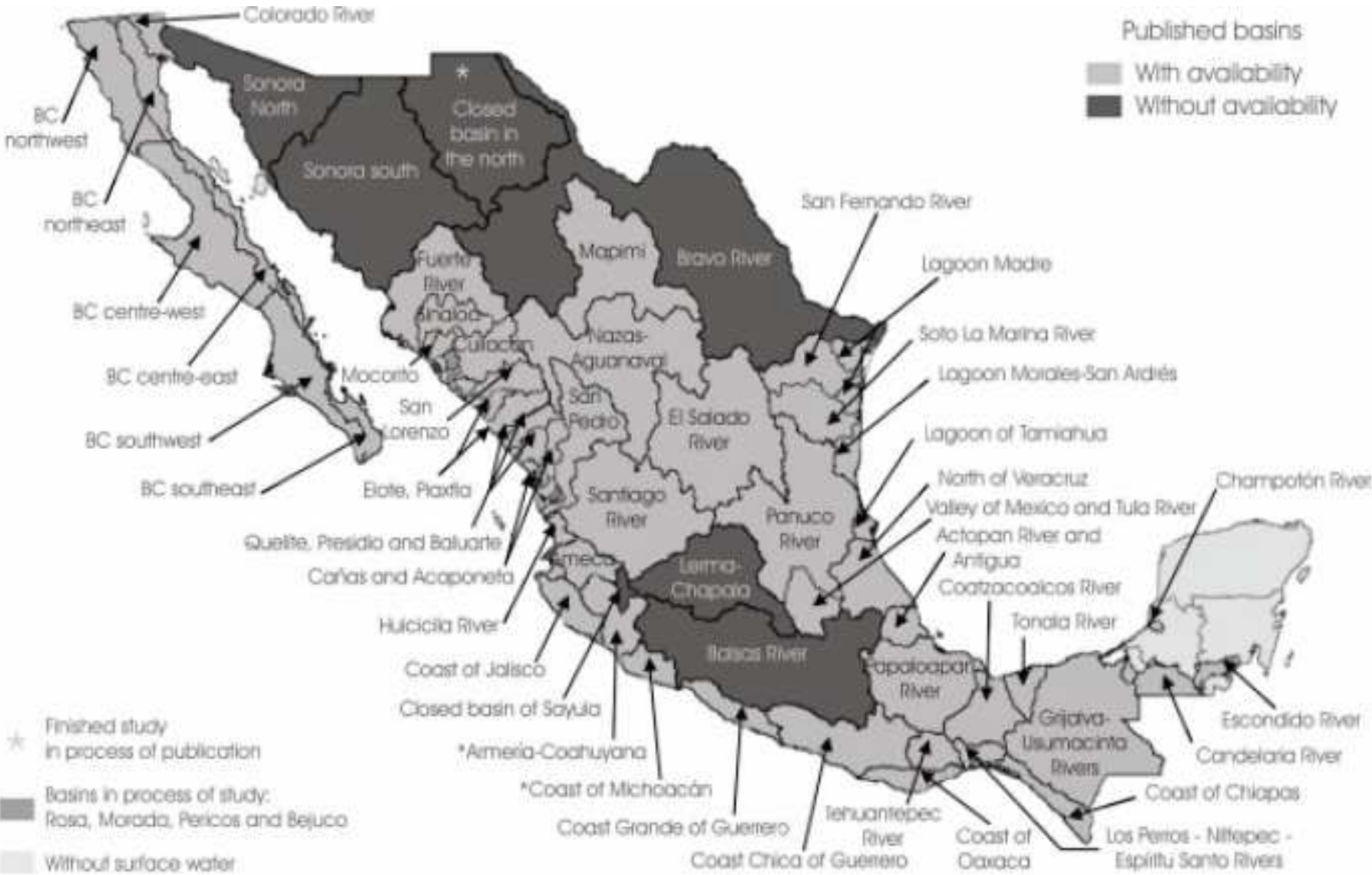


- Precipitation average per year in Mexico: 1,522 km³ equivalent to a swimming pool of 1 km depth & the extension of Mexico City.
- 72% (1,084 km³) of this water evaporates
- Average precipit.: 711 mm/year
- North: only 25% of precipitation
- 27.5% get to south and south-east; 49.6% in the poor states of Chiapas, Oaxaca, Campeche, Quintana Roo, Yucatán, Veracruz and Tabasco
- 67% of rain during June to September

Imbalances of water, population and GDP

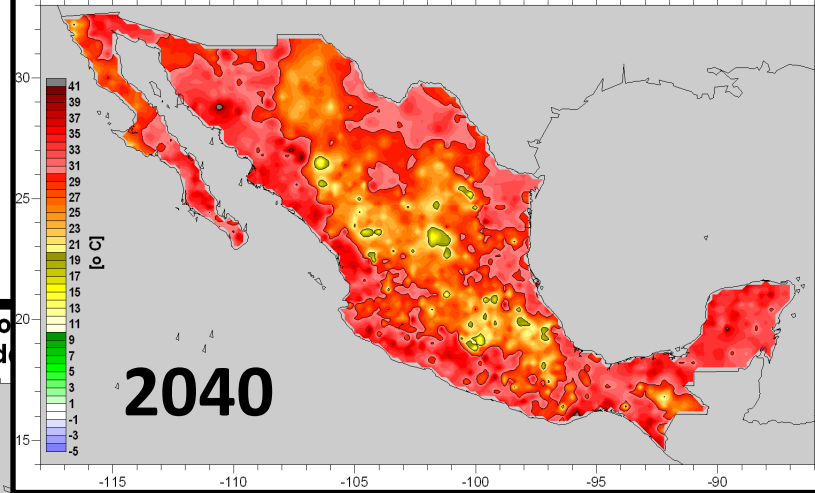


Water basin in Mexico

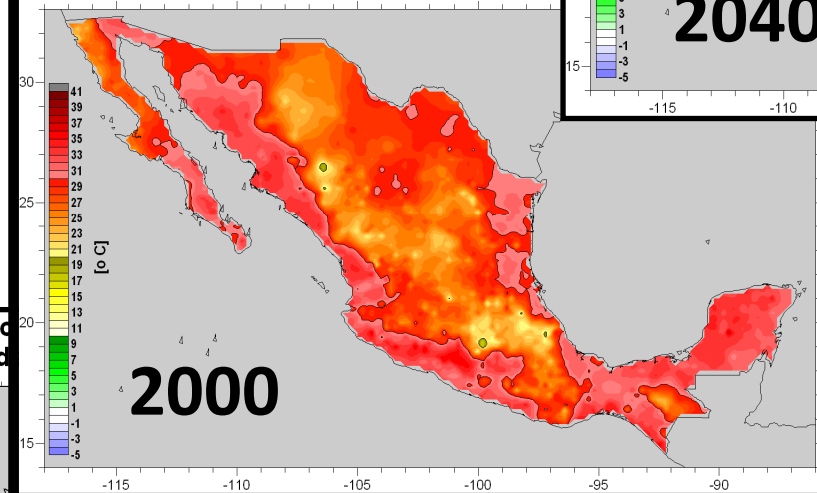


Climate change and higher temperatures

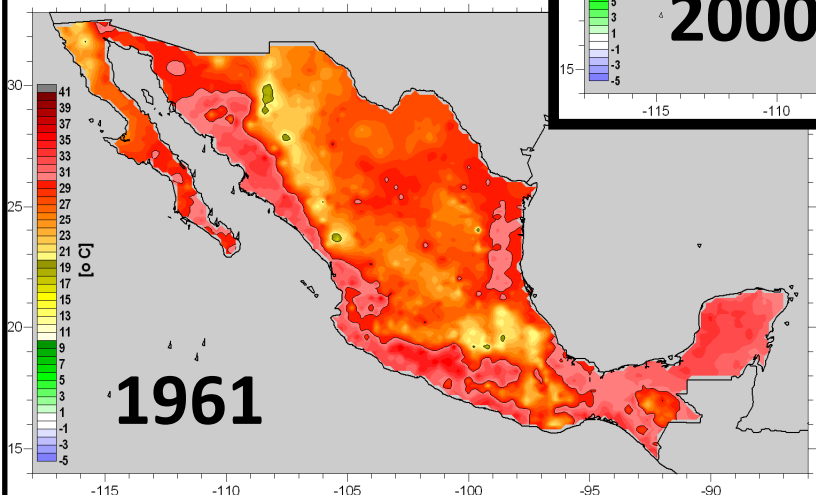
Temperatura máxima (promedio 365d) extrapolada al 2040
(no datos directos, sino rectas de tendencia ajustadas)



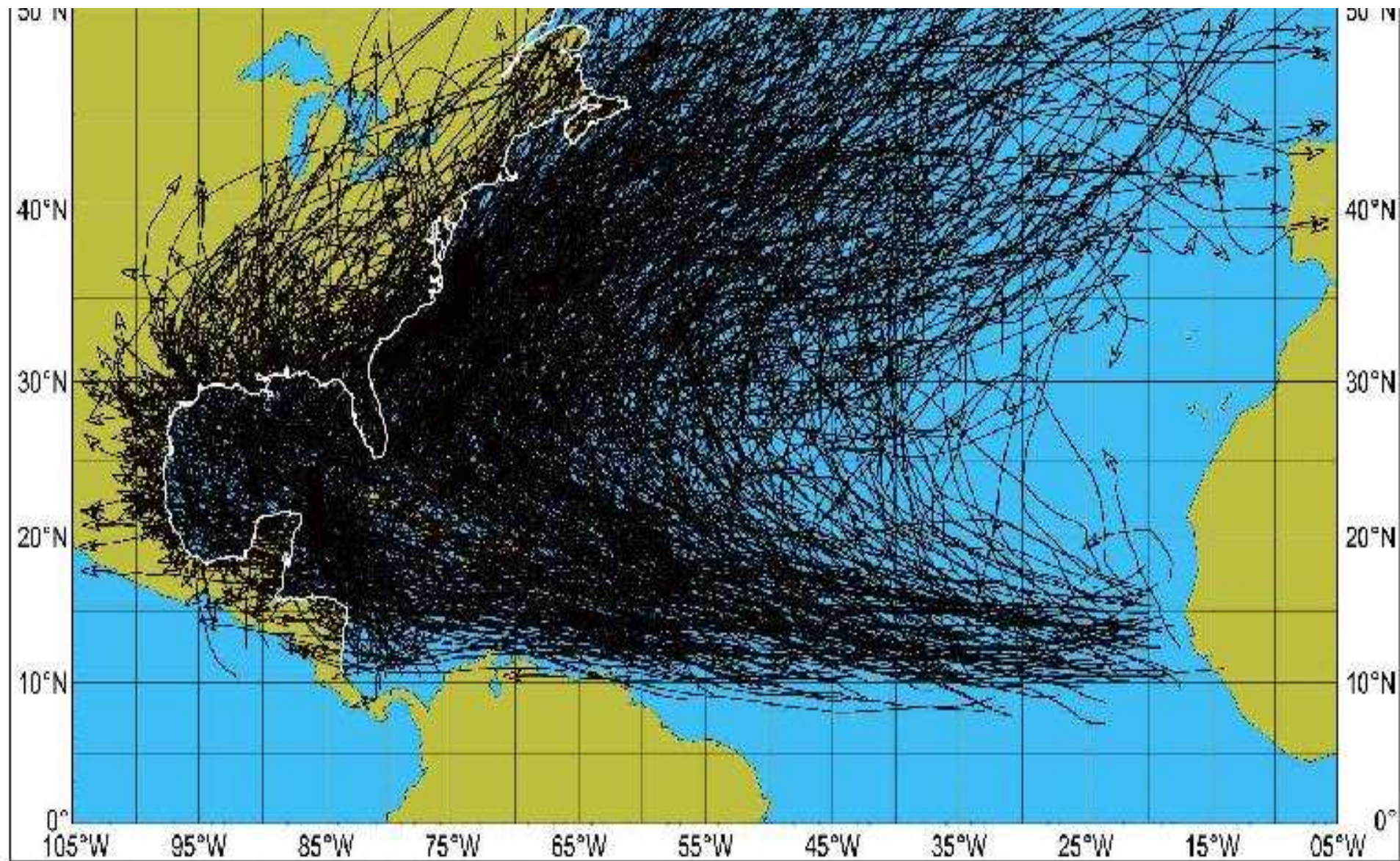
Situación de temperatura máxima (promedio 365d)
(no datos directos, sino rectas de tendencia ajustadas)



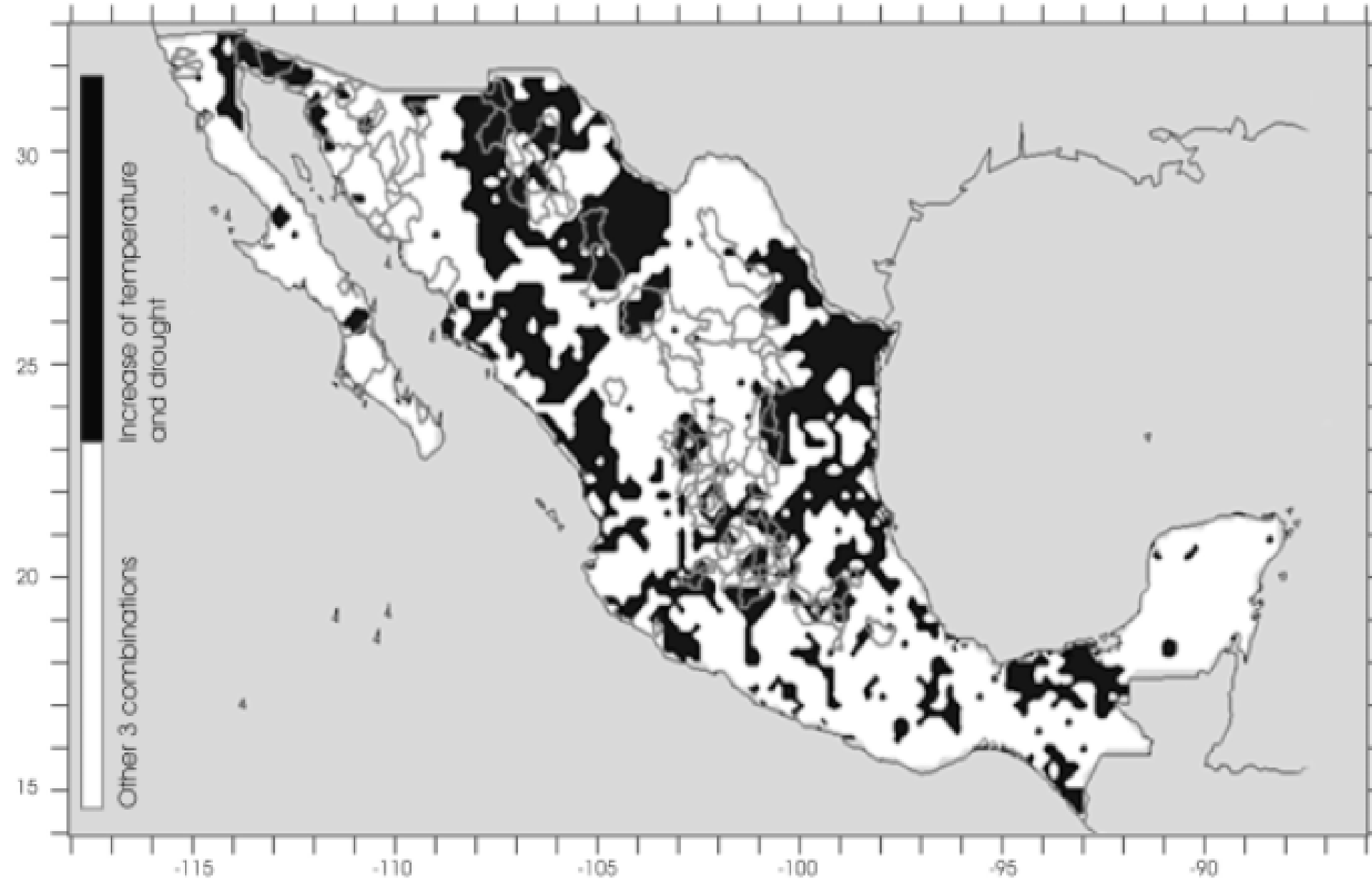
Situación de temperatura máxima (promedio 365d)
(no datos directos, sino rectas de tendencia ajustadas)



Paths of hurricanes during the 21st century



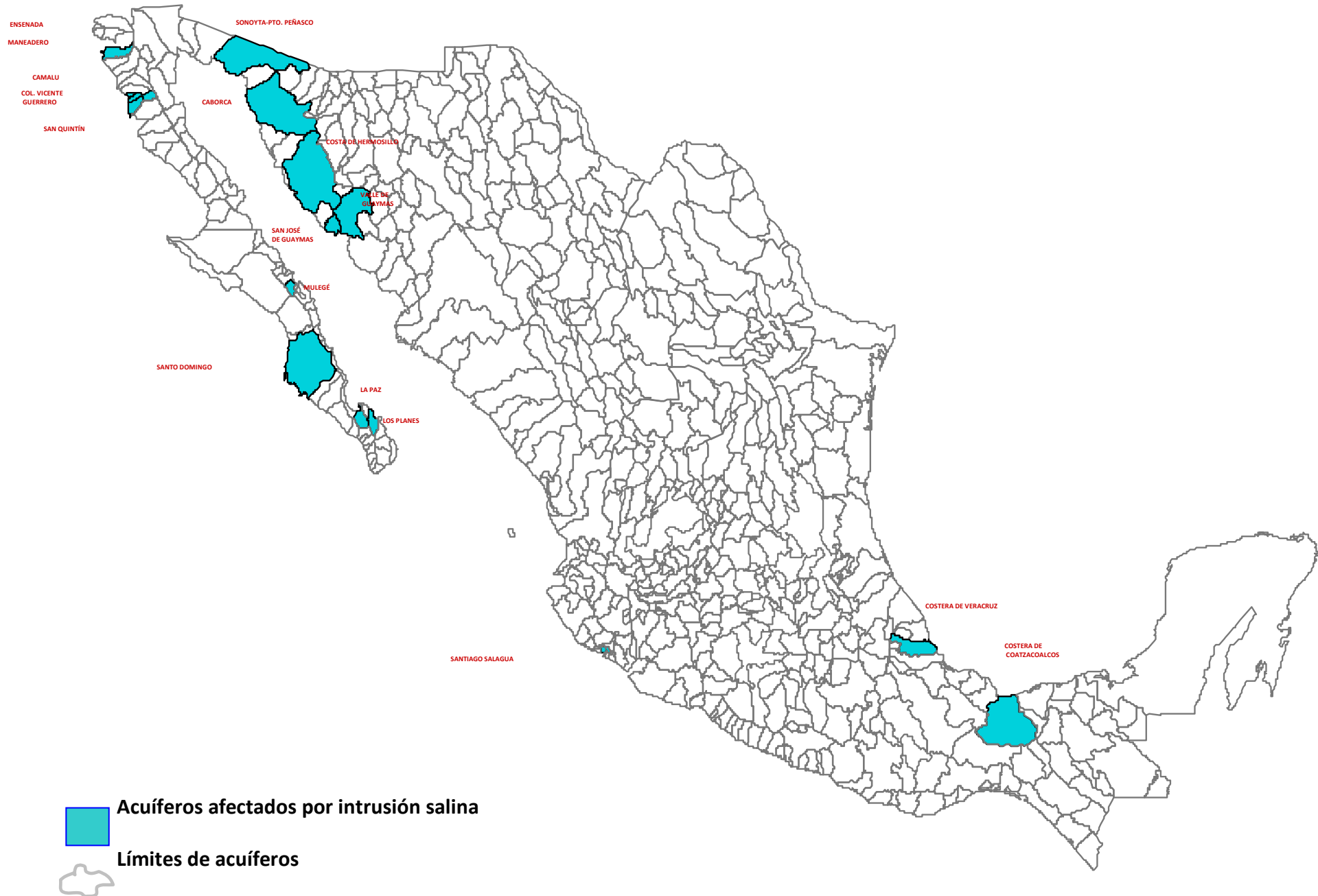
Overexploited aquifers



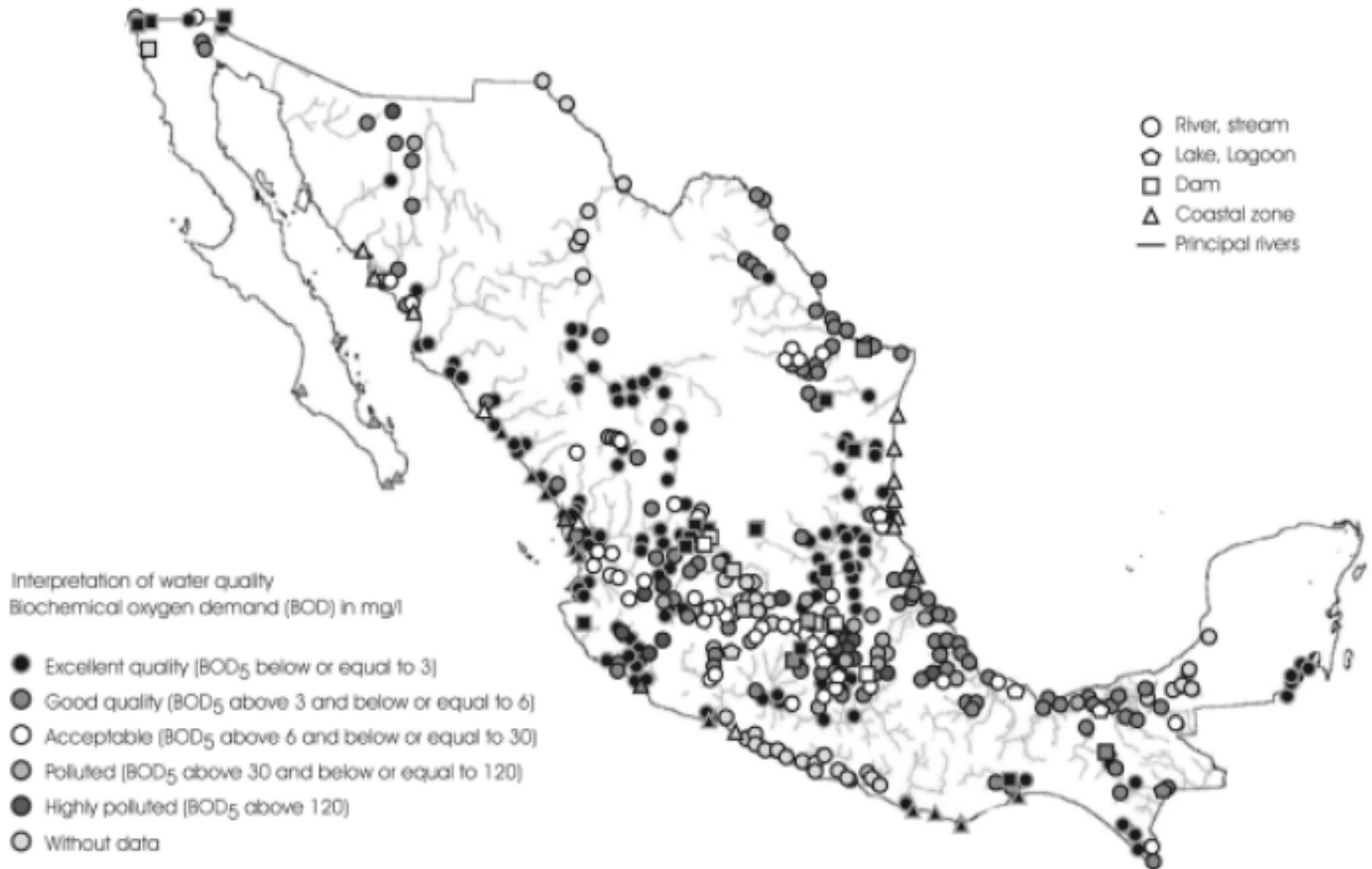
7. Threats and challenges



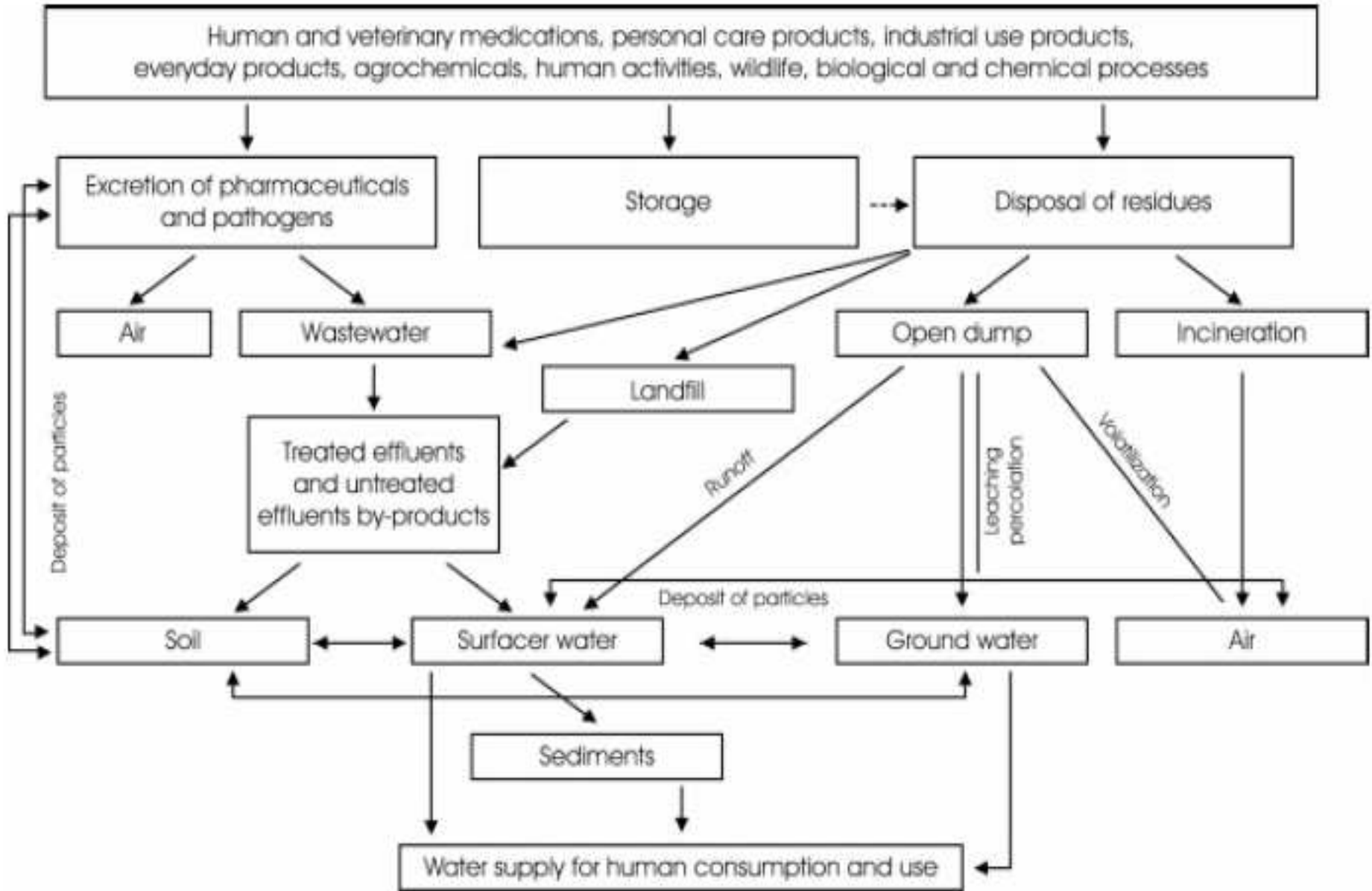
Intrusion of sea water into aquifers



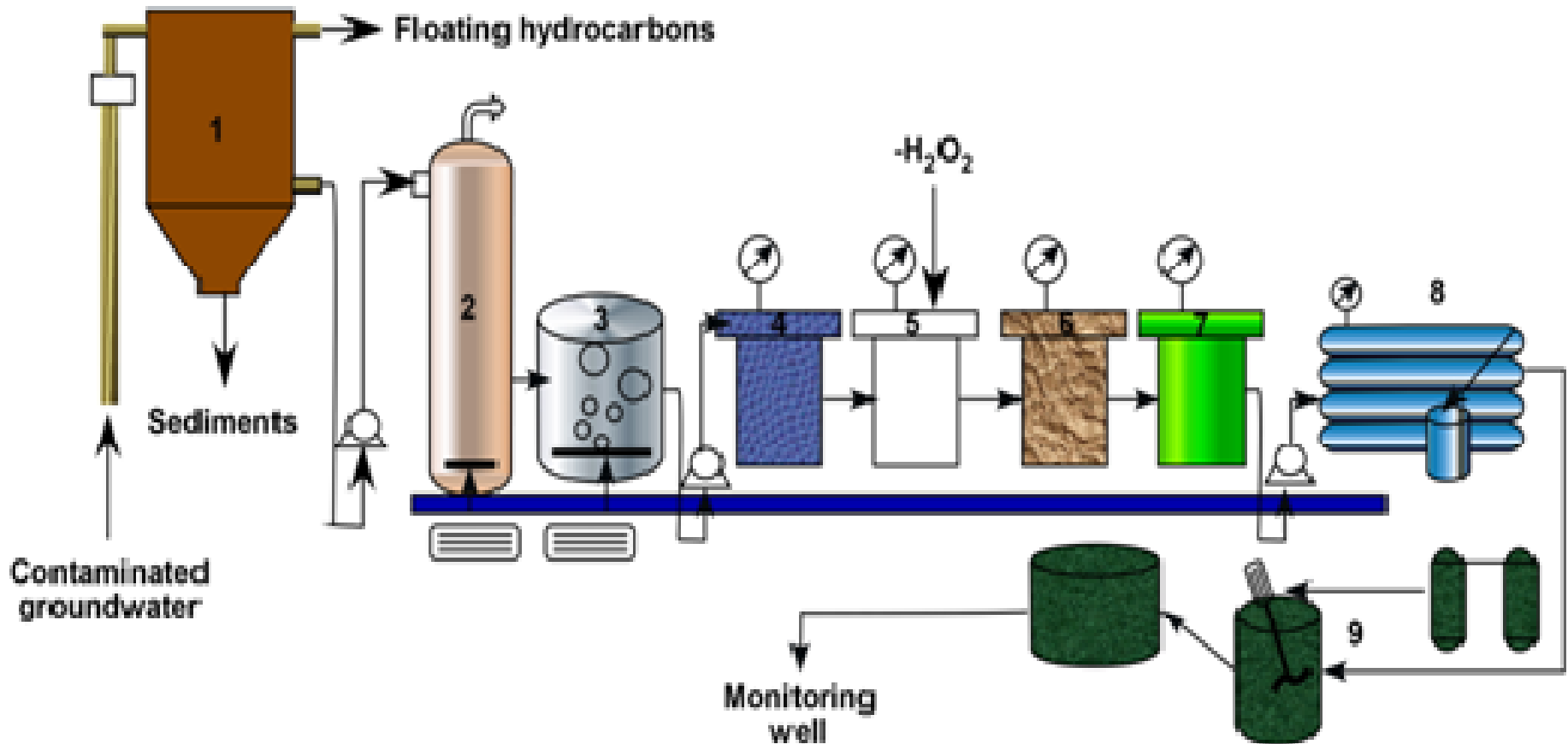
Biochemical Demand of Oxygen












Processes of emergent pollutants



Hydrocarbon remediation



- | | | | | | |
|---|--------------------|---|-----------------------------|---|----------------------|
|  | 1 Feed tank |  | 4 Sand-Anthracite filter |  | 7 Water softener |
|  | 2 Desorption tower |  | 5 Chemical reactor |  | 8 Reverse osmosis |
|  | 3 Bi-oxidation |  | 6 Activated charcoal filter |  | 9 Reinjection system |



8. Lessons learnt

Dissemination of information on water security issues based on the scientization of water research, through cooperation with leading universities and research institutes globally.

Policy Advocacy

Epistemic community to foster cooperation & bring together science and policy making on issues of water basins (FAO, WHO, WMO, UNDP, UNEP, UNESCO), and international workshops for systematic interchange of practical experiences for territorial governance with social cohesiveness. Pro-active strategies for adjustment and mitigation to water threats.

Capacity Building

- **Strengthening traditional and innovative knowledge for embedding the assessment of basin management into the environmental impact and risks assessment, land use planning and environmental auditing.**
- **Training on best practices for conflict settlement mechanisms at the sub-regional and national levels.**

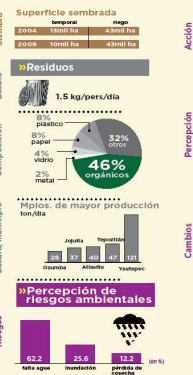
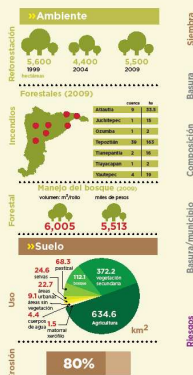
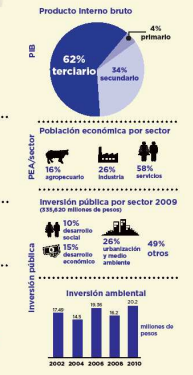
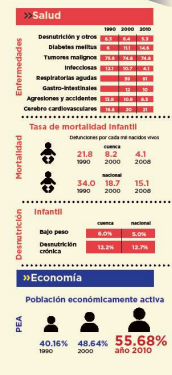
Financing: Channelling Resources

International, climate related financial institutions (IFAD, GEF), local micro-credit, insurance, land use conservation, micro-investments for local development programmes and, regional organizations and national donors (ministries of development cooperation and environment) to improve policies for water security.

Mi Río Yautepec

Niños, niñas y adultos de 13 municipios de los estados de Morelos y México construimos el futuro de nuestro río para hacer de este pequeño territorio un lugar seguro de trabajo, educación, agua limpia, bosques y selvas.

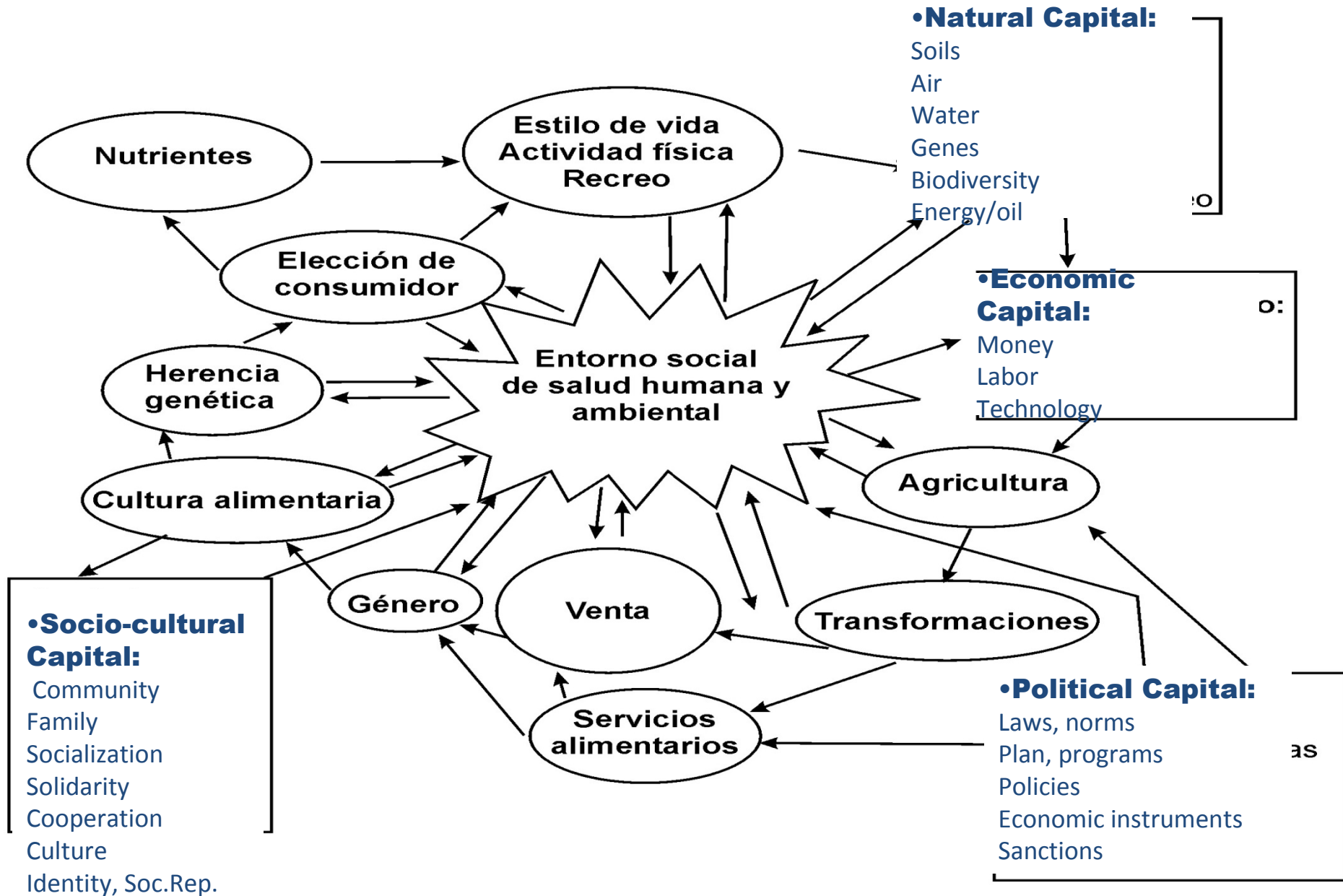
2 Pueblos Mágicos



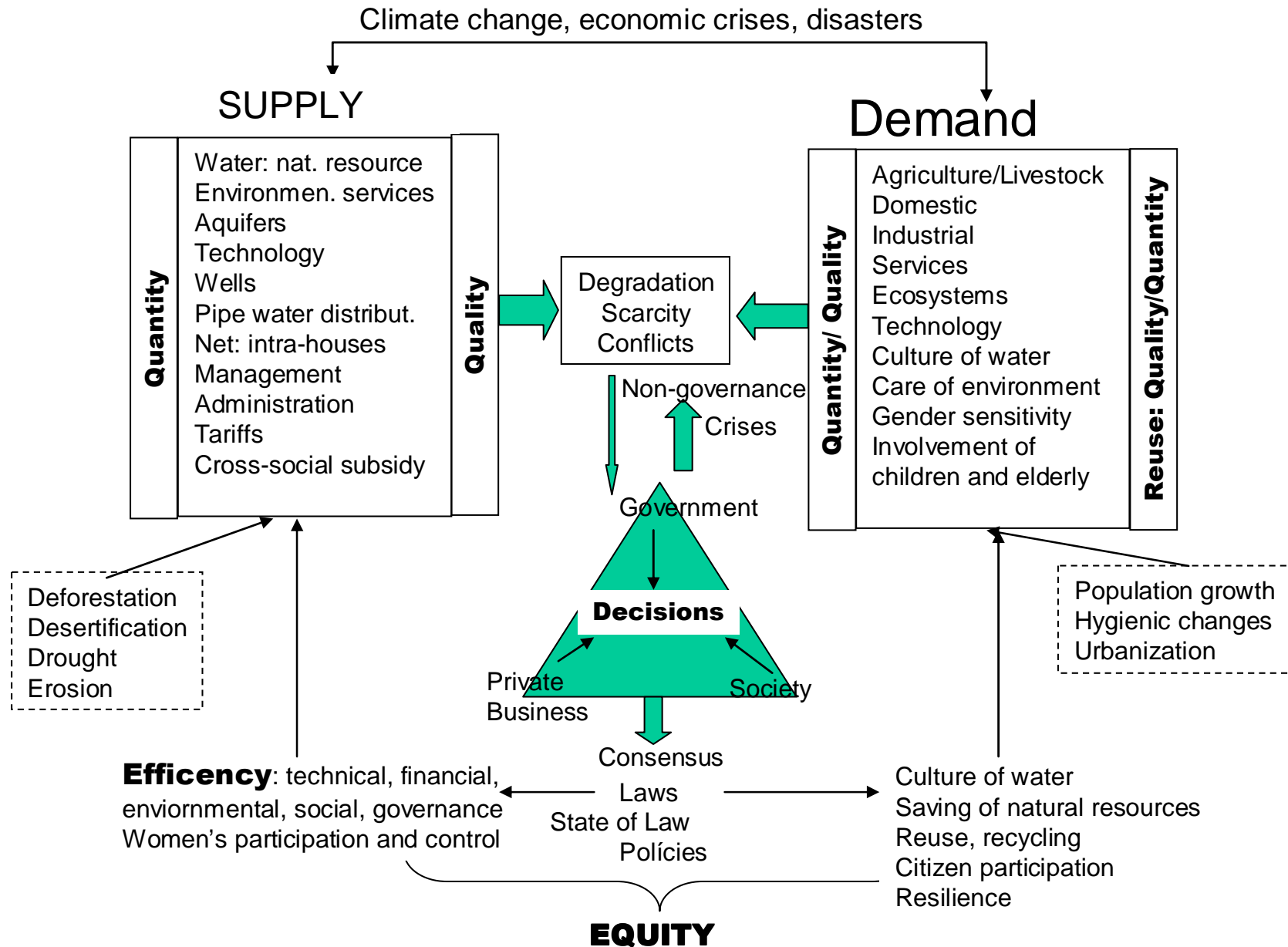
Gestión ambiental (al final del primer año): inversión \$ 350 millones	Gestión ambiental mediano plazo (4 años): inversión \$ 950 millones
<ul style="list-style-type: none"> 3 presas rompedoras y derivadoras 15 actualizaciones de planes de ordenamiento urbano y ambiental 1 modelo matemático de riesgo hídrico 1 PTA Yautepec rehabilitada Reubicación y ampliación de colectores 1 Asociación de Usuarios del Río Yautepec 2 viveros y un centro de germoplasma 15 millones de árboles reforestados 3 centros de acopio de residuos sólidos 3 mercados con separación de desechos 3 compostas de residuos orgánicos 3 juegos recuperados 10 hectáreas de producción rural sustentable Manejo integral del manantial Michiate y resolución del conflicto comunitario 	<ul style="list-style-type: none"> 1 presa Morelos 1 1 cauce de alivio en barranca La Noplera 2 viveros con 15 millones de plantas nativas 60 millones de árboles reforestados 4 bioparques y 5 manantiales recuperados 3 programas de desarrollo ecoturístico Construcción de colectores 13 planes de ordenamiento urbano y ambiental 15 centros de acopio 13 compostas de residuos orgánicos comerciales 1 relleno intermunicipal 5 mil ha de producción rural sustentable 15 escuelas con cultura ambiental Inventario de flora y fauna nativa 2 mil micro empresas Programa de ecoturismo
Planeación ambiental (10 años)	
Social Educación socioambiental Abatimiento de polvaredas Integración de ONG's Vínculo entre y con Ayudantías Consejo comunitario desarrollo rural sustentable Capacitación nutricional Combate a diabetes Prevención de embarazos en adolescentes Medicina y curaciones tradicionales	Económico 10 mil empleos 10 mil ha de agricultura orgánica Mercado justo Pago por servicios ambientales 1 centro de encadenamiento productivo 5 mil microempresas 5 mil huertos domésticos 5 mil manejo forestales Ecoturismo cultural
Ambiental 7 presas contra inundaciones 150 millones de árboles reforestados 20 mil ha de suelos recuperados 1 centro de cultura ambiental 3 rellenos sanitarios intermunicipales 1 ordenamiento integral de la cuenca 5 mil ha de riesgo eficiente 500 ha de árboles frutales	Político Justicia ambiental Legislación ambiental Vigilancia ciudadana Tribunal ambiental ciudadano Seguridad humana y ambiental Equidad de género Derecho de niños Contraloría ciudadana

Multi-stakeholder, multidisciplinary and integrated management of the Yautepec river with involvement of the four levels of government, social community, trade social movements, NGO, schools and affected people

Integrated basin water resource management

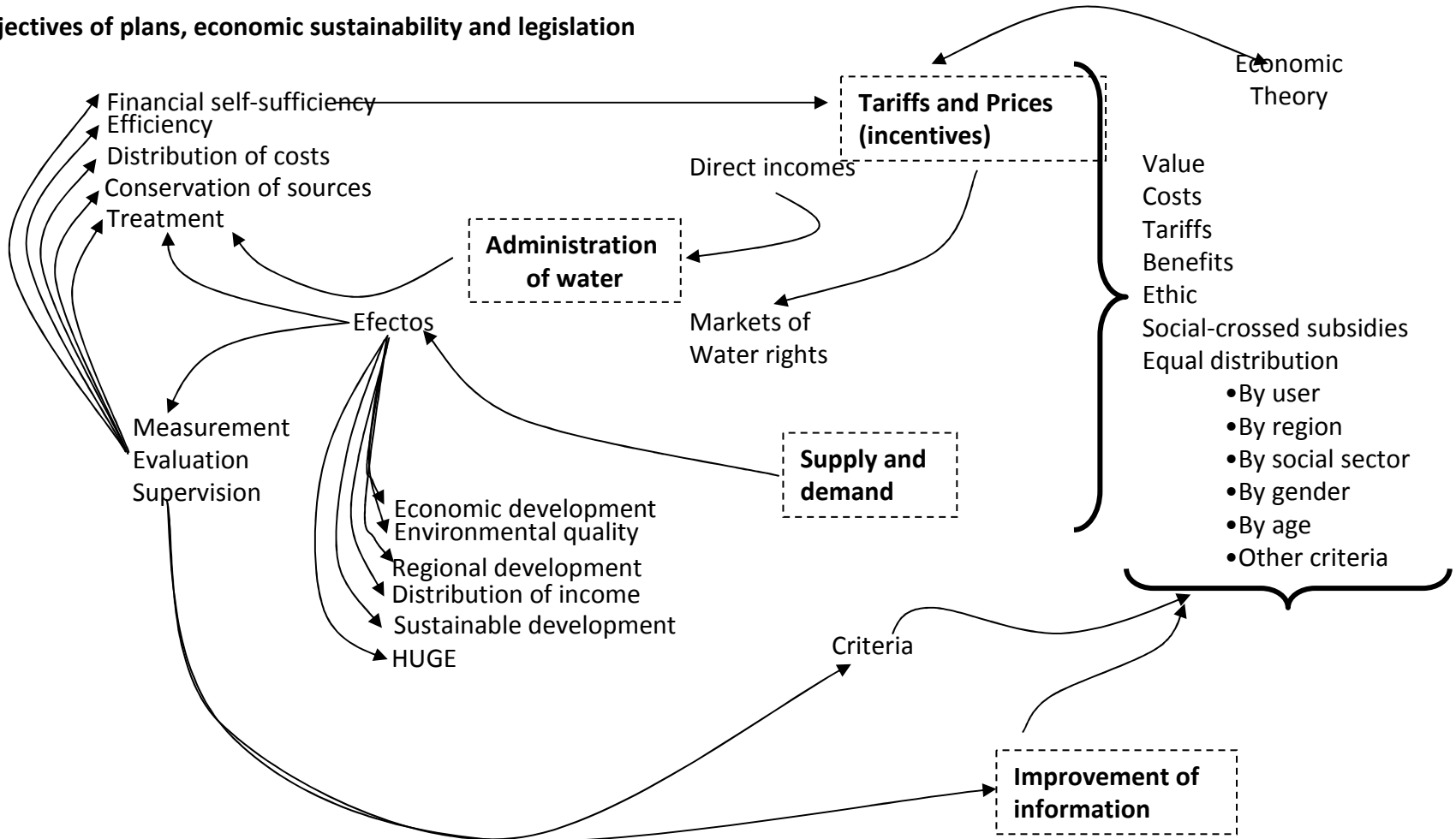


Efficiency and Equity with Natural Resources



Economy of Water

Objectives of plans, economic sustainability and legislation





Úrsula Oswald Spring
Editor



Water Resources in Mexico

Scarcity, Degradation, Stress, Conflicts,
Management, and Policy

Springer

Los retos de la investigación
del agua en México

ÚRSULA OSWALD SPRING
Coordinadora

Colaboración de
IGNACIO SÁNCHEZ CONTRERAS
RISAH MENÉNDEZ
RODOLFO RIVERA ESPINO
ALEXANDRA MARTÍN DOMÍNGUEZ
JOSÉ GABRIELA PÉREZ
CHRISTOPHER WITTENBERG



Summary

Water resources in Mexico are threatened by **scarcity, pollution, and climate change**. In **two decades** water consumption has **doubled**, producing water stress in dry seasons and **semi-arid and arid** regions. Water stress is rising due to physical and economic stress. In seven parts a multidisciplinary team analyzes hydrological processes in basins and their interaction with climate, soil, and biota. **Competing water use** in agriculture, industry, and domestic needs requires **savings, decontamination processes, and desalination** to satisfy the growing demand. Water **quality affects health and ecosystems**. This creates **conflicts and cooperation** that may be enhanced by **public policy, institution building, and social organization**.

Index of the Book

- **Preface**
- **Acknowledgement**
- **Introduction**
- **Part 1: Hydrological processes and management of basins**
- **Part 2: Water use, availability and alternative sources**
- **Part 3: Water quality, pollution and health**
- **Part 4: Social effects, conflicts and hydrodiplomacy**
- **Part 5: Public policy, institutions, legal aspects and economy of water**
- **Concluding remarks**
- **Abbreviations**
- **Biographies of Authors**
- **Analytical Index**
- **List of Tables, Maps, and Graphs**



Thank you for your attention

uoswald@gmail.com

**[http://www.afes-press.de/html/
download_oswald.html](http://www.afes-press.de/html/download_oswald.html)**