Humanities Global Experiment with the Environment

Policy Questions and Research Needs

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Environmental Degradation

- Human activities are degrading the environment at the local, regional and global scales, undermining poverty alleviation, sustainable economic growth, and food, water and energy security. The key issues include:
  - Climate change
  - Loss of biodiversity and ecosystem services
  - Local and regional air pollution
  - Land degradation
  - Water degradation
  - Stratospheric ozone depletion

Some Key Policy Questions

- How do we alleviate poverty and ensure food, water and energy security in an environmentally and socially sustainable manner
- What constitutes dangerous anthropogenic perturbation to the climate and biological systems
- Is the concept of tipping points useful or a distraction
- How can we limit human-induced climate change and ecosystem degradation in a cost-effective and equitable manner
- How are environmental issues inter-linked and what are the synergies and trade-offs among the policy options that can be used to address them individually
- How do we value and create markets that capture the value of ecosystem services , e.g., carbon, pollination and water purification
- What are the costs on action versus the costs of inaction and what are the distributional effects
- How can individual and public and private sector behavior be influenced

Climate Change, Ecosystem Degradation and Air Pollution

- Climate change, ecosystem degradation (loss of biodiversity, land degradation and water pollution) and air pollution are development and security issues, i.e., they undermine:
  - poverty alleviation and the livelihoods of the poor
  - human health
  - personal, national and regional security

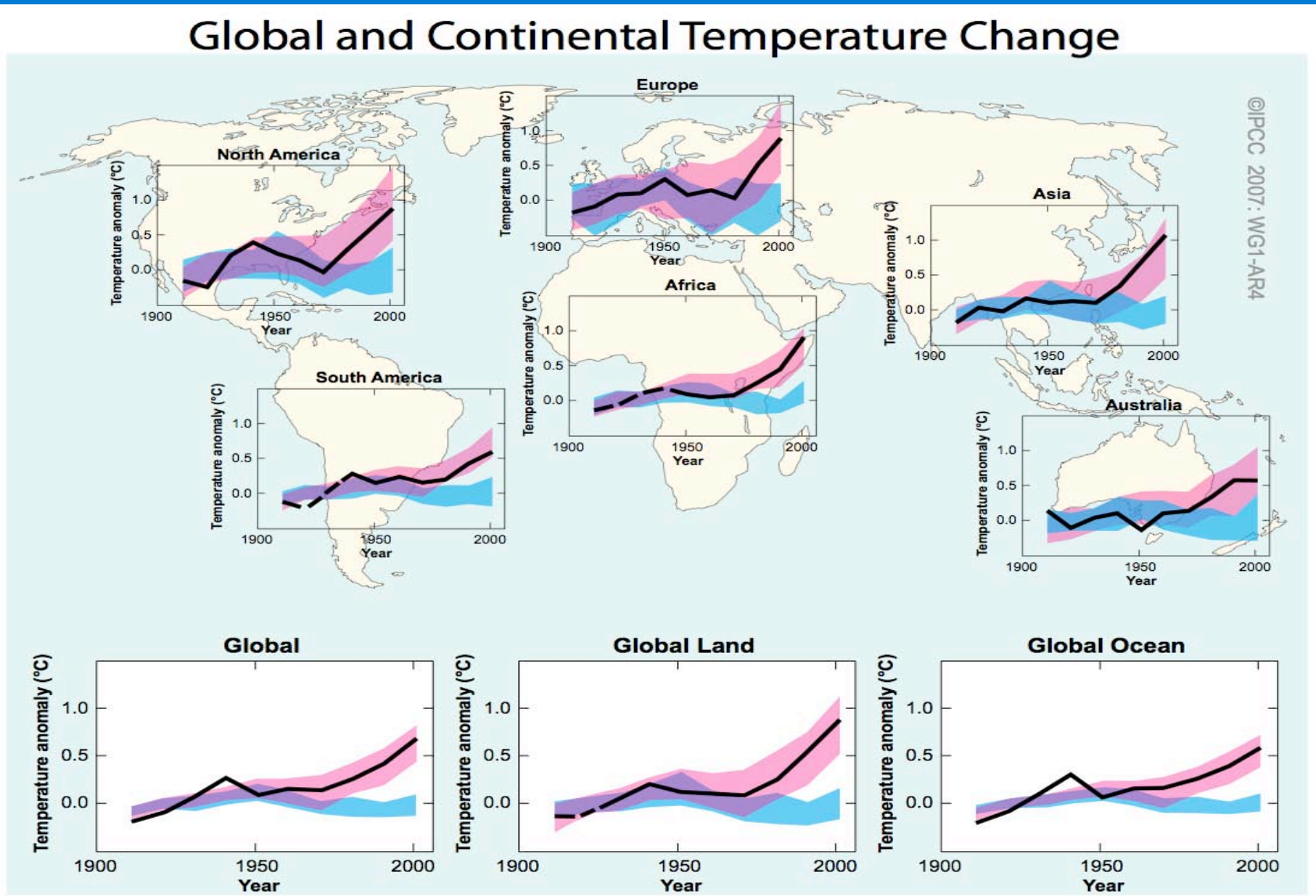
- Climate change and ecosystem degradation are inter- and intra-generational equity issues:
  - developing countries and poor people in developing countries are the most vulnerable
  - the actions of today will affect future generations

Climate Change

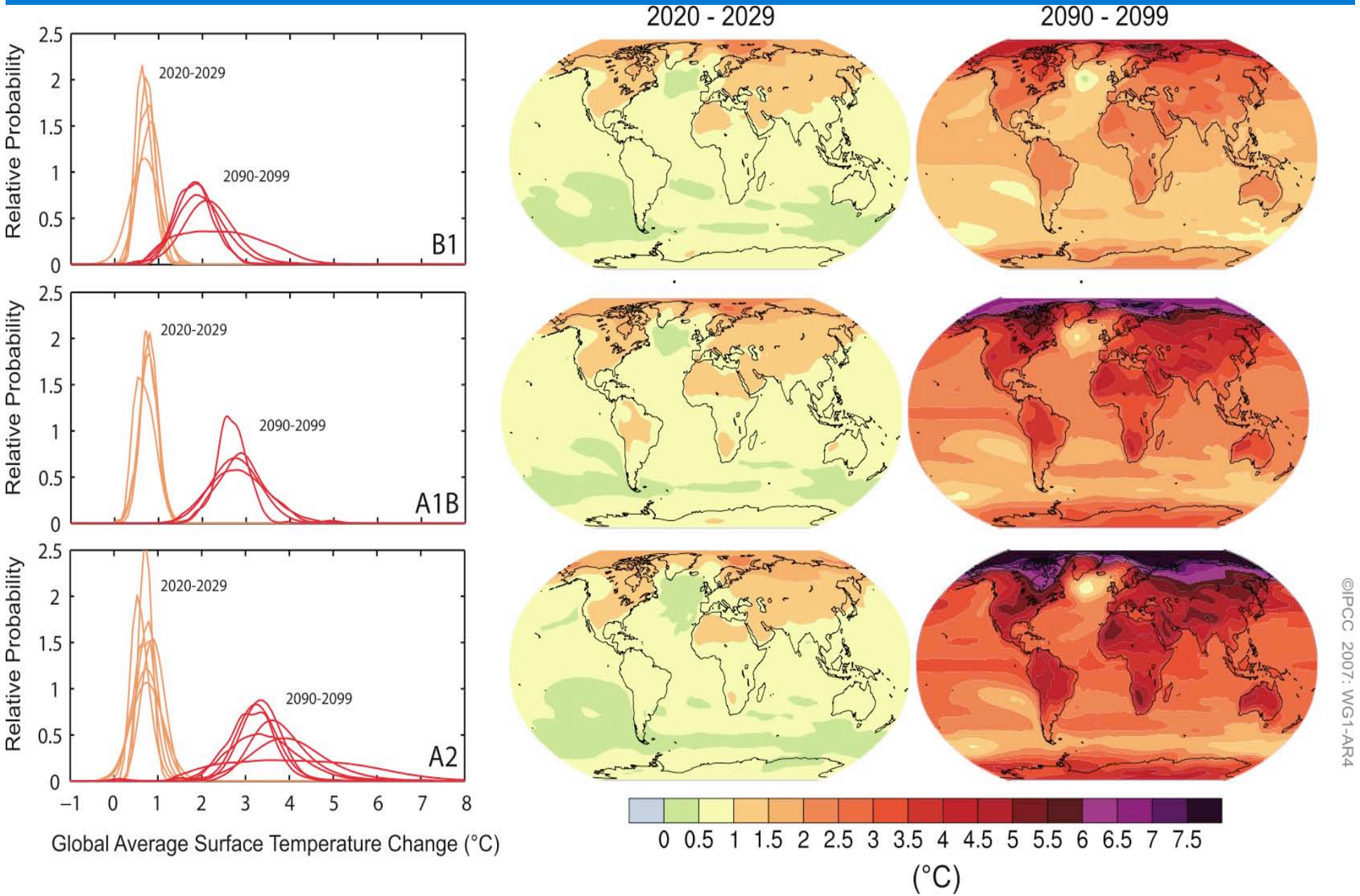
Climate Change

- The composition of the atmosphere, and the Earth's climate has changed, mostly due to human activities (highly certain), and is projected to continue to change, globally and regionally:
  - Increased greenhouse gases and aerosols
  - Warmer temperatures
  - Changing precipitation patterns – spatially and temporally
  - Higher sea levels – higher storm surges
  - Retreating mountain glaciers
  - Melting of the Greenland ice cap
  - Reduced arctic sea ice
  - More frequent extreme weather events
    - heat waves, floods and droughts
  - More intense cyclonic events, e,g., hurricanes in the Atlantic

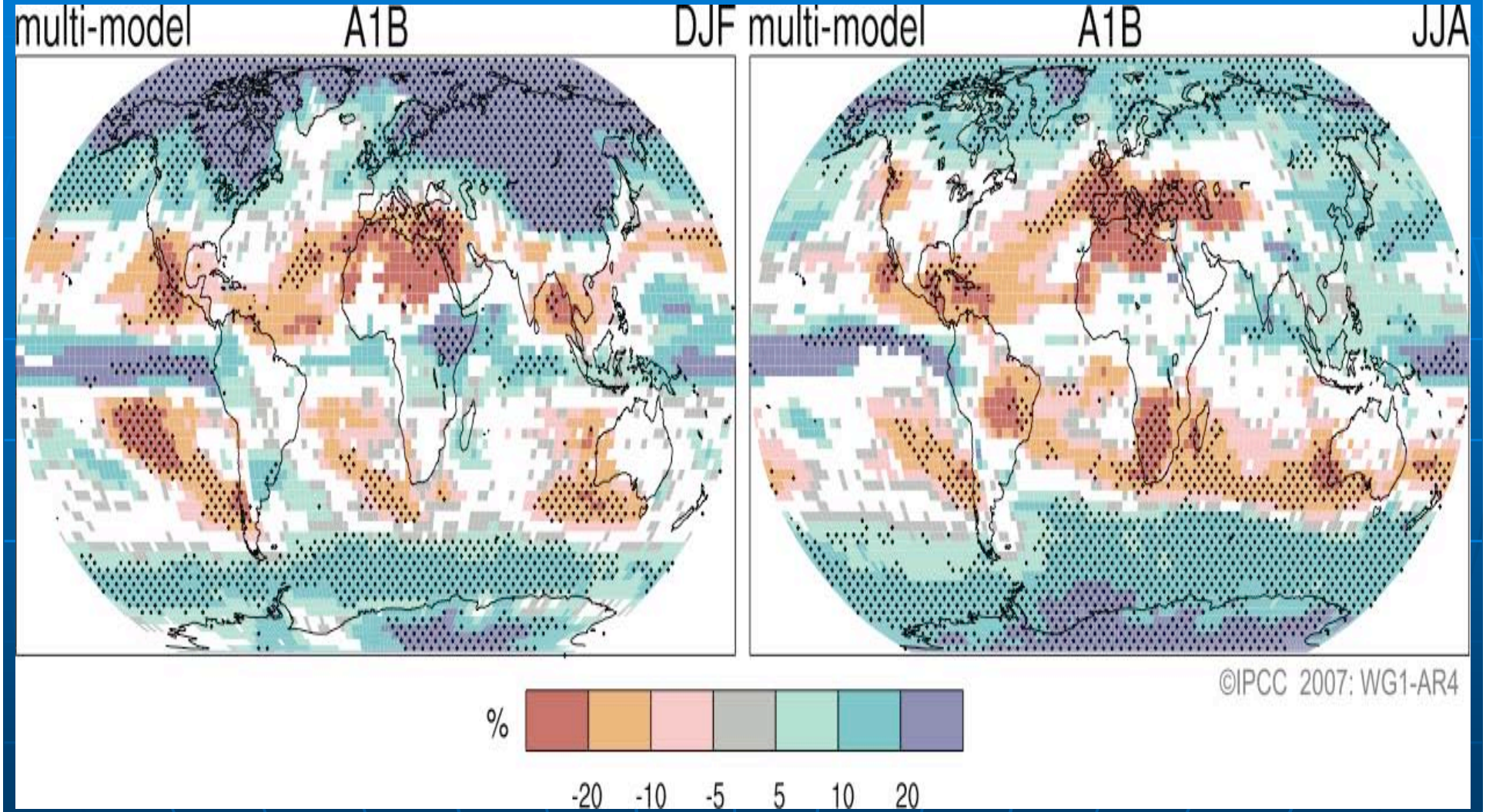
Attributing Observed Changes in Temperature



Surface Temperature



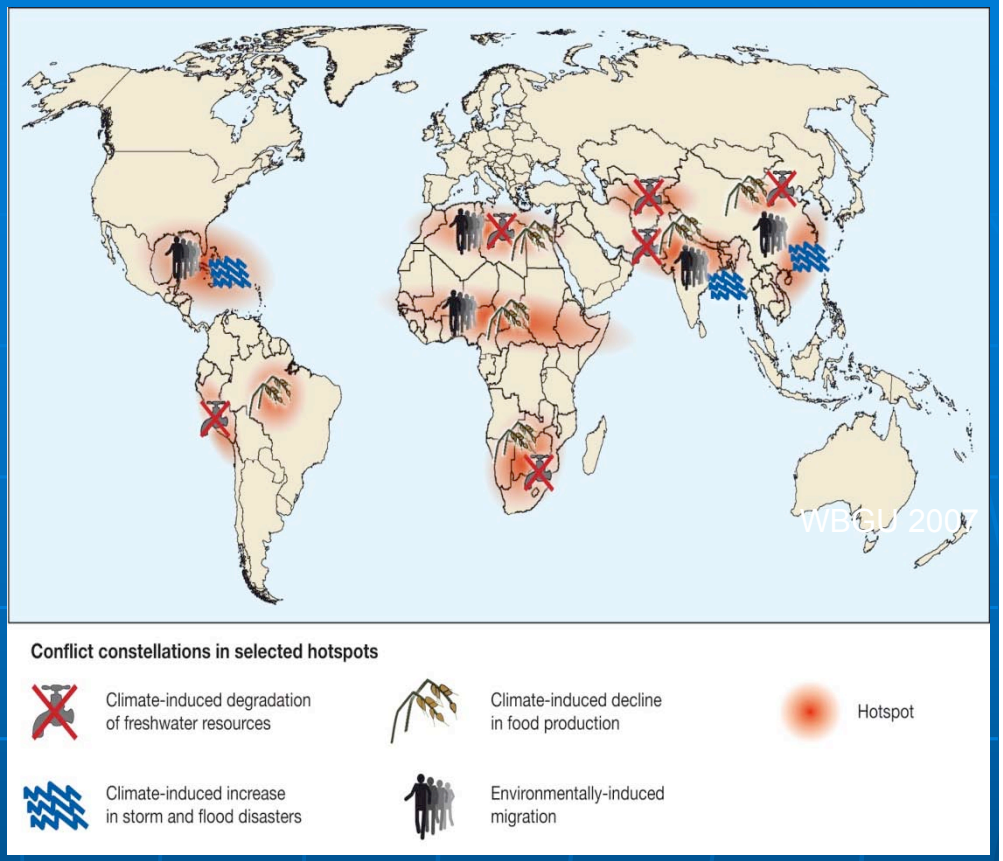
Precipitation



Projected Impacts of Human-induced Climate Change

- Decrease water availability and water quality in many arid- and semi-arid regions – increased risk of floods and droughts in many regions
- Decrease agricultural productivity for almost any warming in the tropics and sub-tropics and adverse impacts on fisheries
- Increase the incidence of vector- (e.g., malaria and dengue) and water-borne (e.g., cholera) diseases, heat stress mortality, threats nutrition in developing countries, increase in extreme weather event deaths
- Adversely effect ecological systems, especially coral reefs, and exacerbate the loss of biodiversity

Climate Change and Conflict



- Tens of millions of people displaced
  - Low lying deltaic areas
  - Small Island States
- Food shortages where with hunger and famine today
- Water shortages in areas already with water shortages
- Natural resources depleted with loss of ecological goods and services
- Increased incidence of disease
- Increased incidence of severe weather events

Climate Change, coupled with other stresses, can lead to local and regional conflict and migration depending on the social, economic and political circumstances

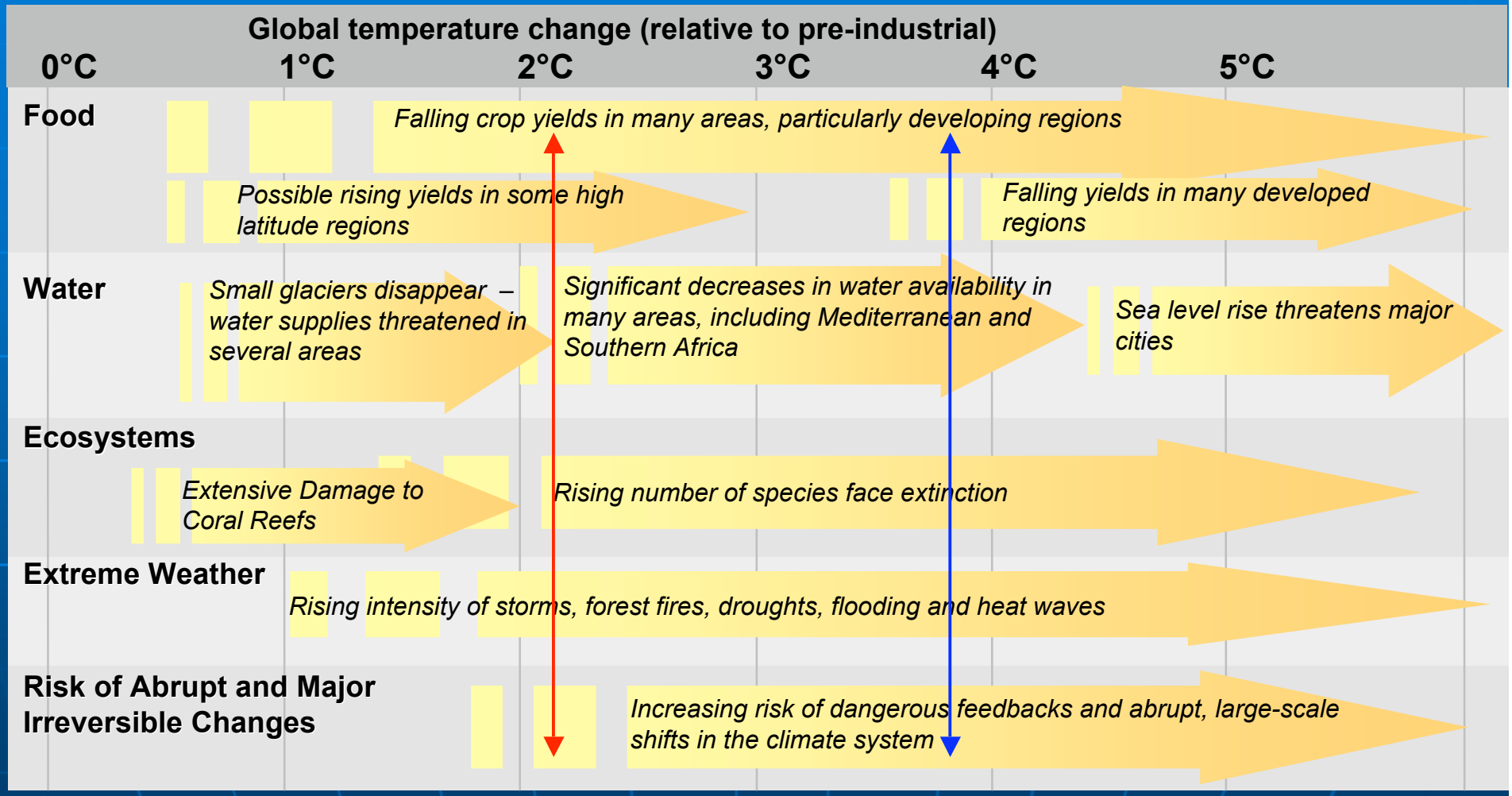
Climate Change Resilient Development

Requires cost-effective and equitable mitigation and adaptation and the recognition that the cost of inaction exceeds the cost of action

- **Mitigation:** While minimizing the emissions of greenhouse gases and transitioning to a low-carbon economy, access to affordable energy in developing countries is a pre-requisite for poverty alleviation and sustainable economic growth

- **Adaptation:** Requires integrating current climate variability and projected changes in climate in sector and national economic planning while recognizing the aspirations of local communities

Climate change impacts are now inevitable: the less mitigation, the more adaptation is required

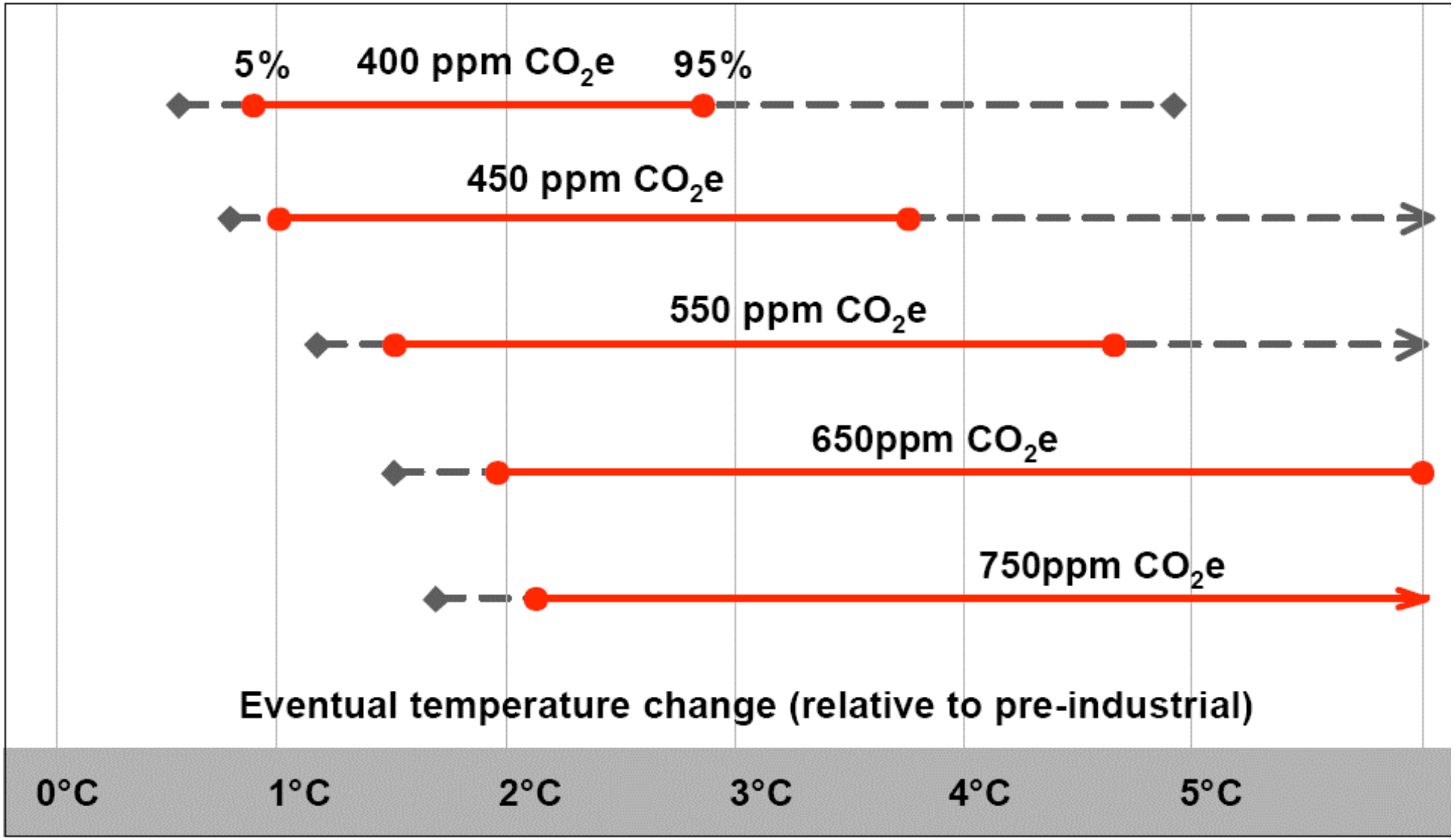


The risk of serious irreversible impacts increases strongly as temperatures increase

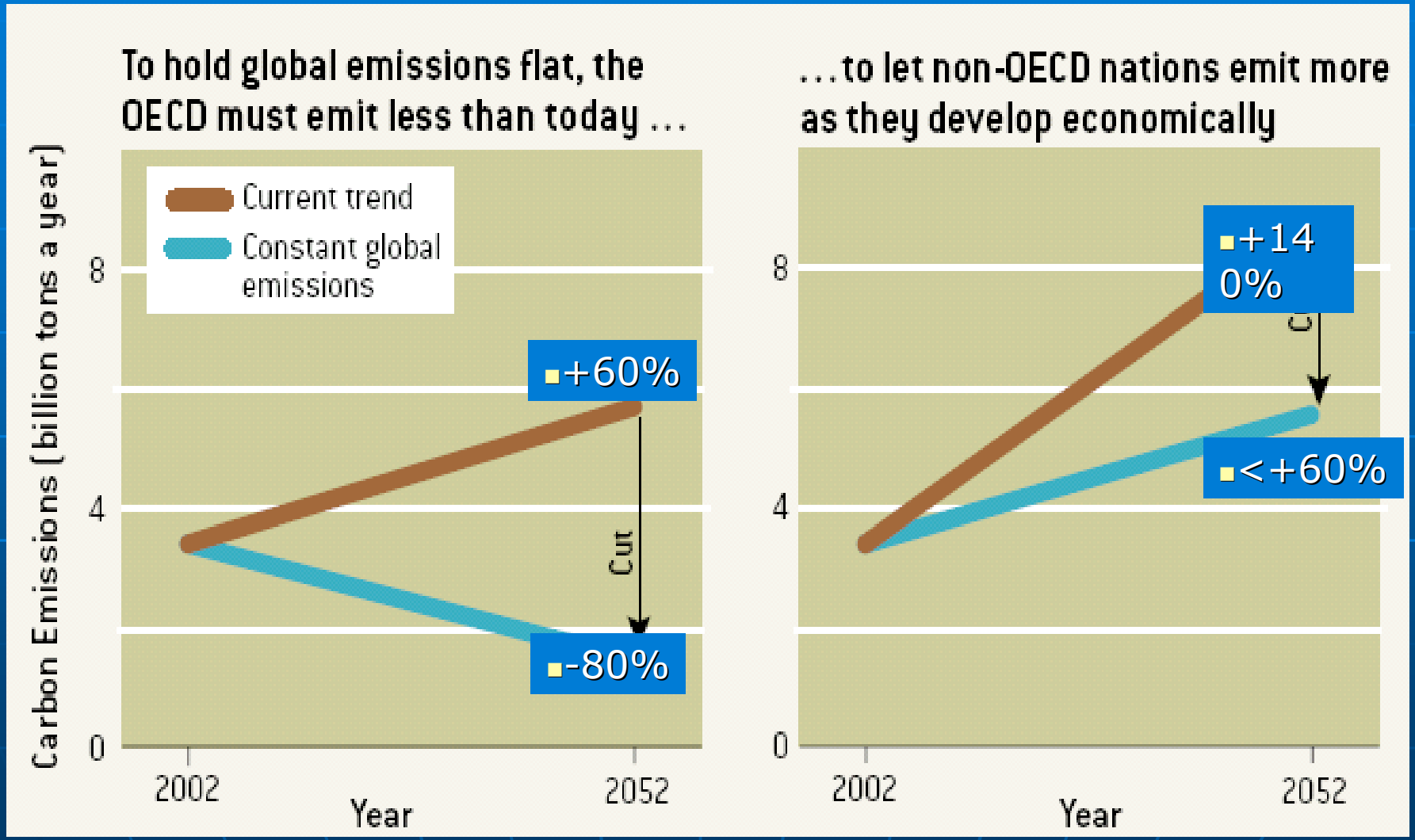
Aim to mitigate to 2ºC but prepare to adapt to 4oC

Emissions and Vulnerability to Climate Change

Emissions Paths to Stabilization



OECD and non-OECD shares - 50-year view



Mitigation Strategy

- Technology transformation
  - Carbon capture and storage
  - Future generation biofuels
- Mobilising behaviour change
  - Citizens
  - Private sector
  - Public sector
- Putting a price on carbon through
  - emissions trading
  - taxation
  - regulation - national, regional and global

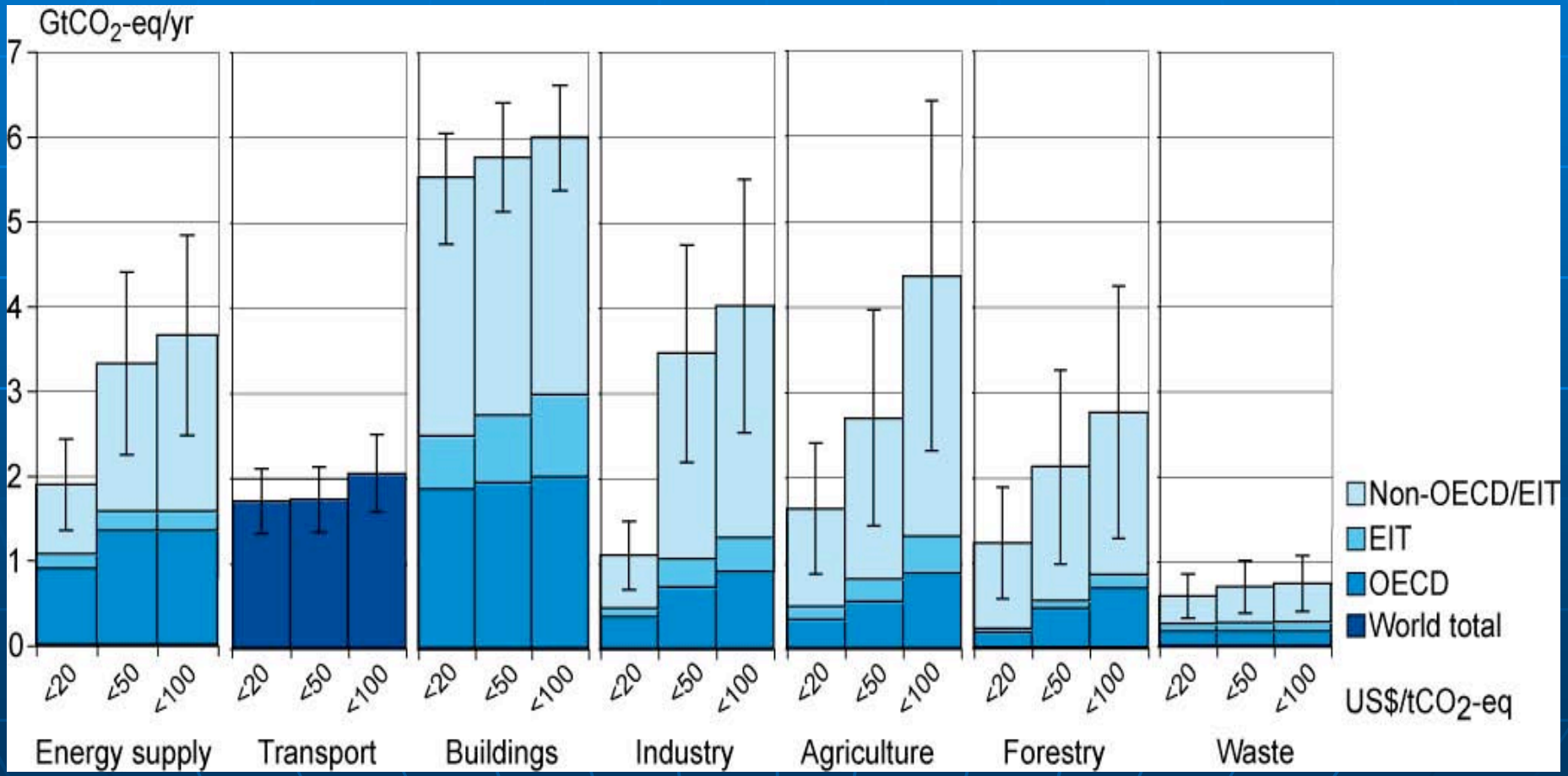
A major challenge is to maximize the market potential for low carbon technologies by minimizing the gap between their technical, economic and market potential

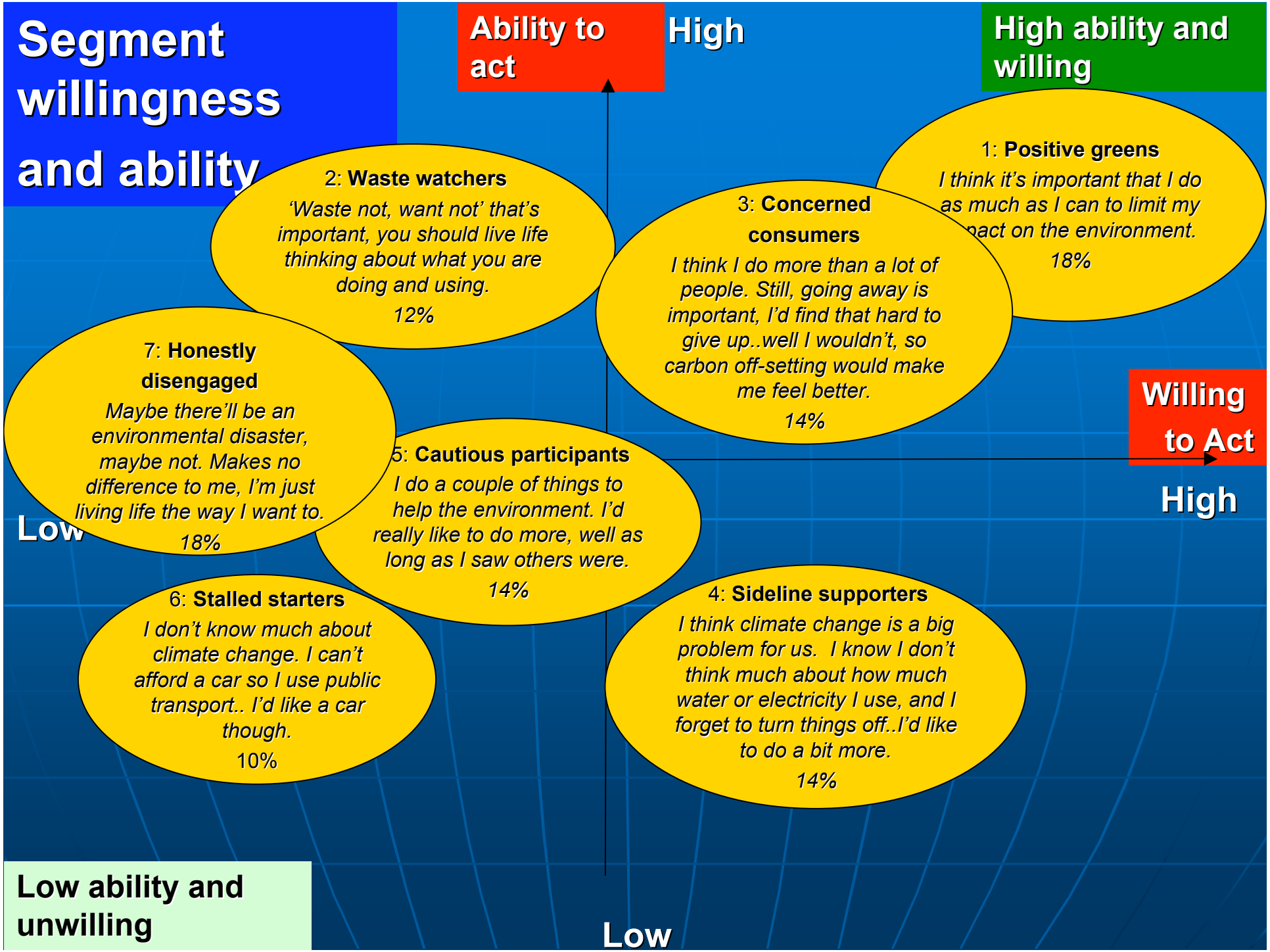
Potential technological options

- **Efficient production and use of energy:** coal plants (e.g., re-powering old inefficient plants and developing IGCC); vehicles (e.g., fuel cell cars) and reduced use of vehicles (e.g., mass transit and urban planning), buildings, and industries
- **Fuel shift: coal to gas**
- **Renewable Energy and Fuels:** Wind power; solar PV and solar thermal; small and large-scale hydropower; geothermal; bio-energy; wave and tidal power
- **CO_2 Capture and Storage:** Capture CO_2 in the production of electricity followed by geological storage (e.g., IGCC – CCS)
- **Nuclear fission:** Nuclear power
- **Forests and Agricultural Soils:** Reduced deforestation; reforestation; afforestation; and conservation tillage

Mitigation Potential Exists For All Sectors & Regions

- *At least* a 50% reduction global greenhouse gas emissions by 2050 is needed for a chance of meeting the EU 2°C target




Segment willingness and ability
Ability to act
High
High ability and willing
1: Positive greens
I think it's important that I do as much as I can to limit my impact on the environment.
18%
2: Waste watchers
'Waste not, want not' that's important, you should live life thinking about what you are doing and using.
12%
3: Concerned consumers
I think I do more than a lot of people. Still, going away is important, I'd find that hard to give up..well I wouldn't, so carbon off-setting would make me feel better.
14%
Willing to Act
High
7: Honestly disengaged
Maybe there'll be an environmental disaster, maybe not. Makes no difference to me, I'm just living life the way I want to.
18%
Low
5: Cautious participants
I do a couple of things to help the environment. I'd really like to do more, well as long as I saw others were.
14%
6: Stalled starters
I don't know much about climate change. I can't afford a car so I use public transport.. I'd like a car though.
10%
4: Sideline supporters
I think climate change is a big problem for us. I know I don't think much about how much water or electricity I use, and I forget to turn things off..I'd like to do a bit more.
14%
Low ability and unwilling
Low

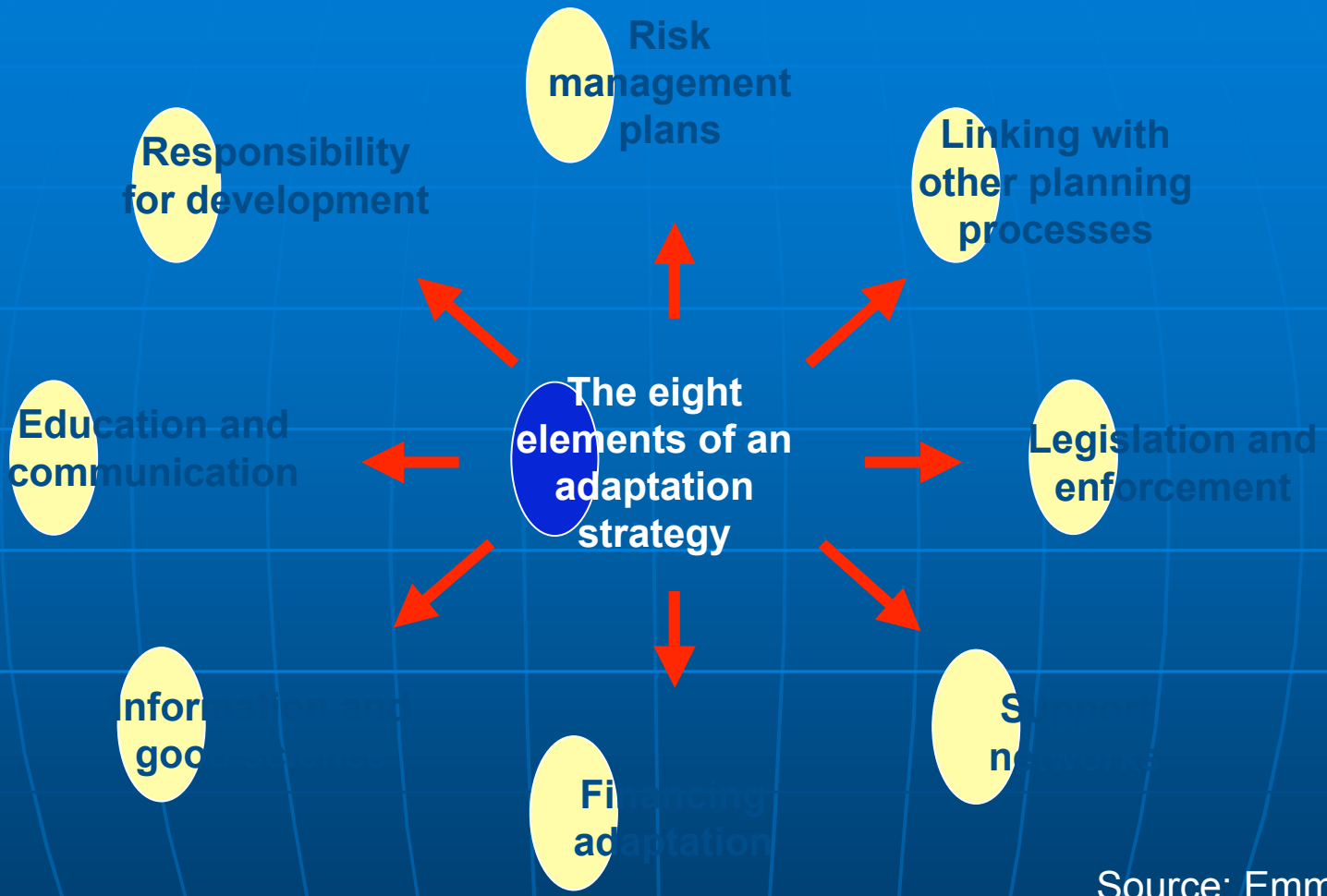
Policy Instruments

- Policies, which may need regional or international agreement, include:
  - Energy pricing strategies and taxes
  - Removing subsidies that increase GHG emissions
  - Internalizing the social costs of environmental degradation
  - Tradable emissions permits--domestic and global
  - Voluntary programs
  - Regulatory programs including energy-efficiency standards
  - Incentives for use of new technologies during market build-up
  - Education and training such as product advisories and labels
- Accelerated development of technologies requires intensified R&D by governments and the private sector

Major Mitigation Policy Challenges

- International policy
  - A long-term (2030 – 2050) global regulatory framework, involving all major emitters, with an equitable allocation of responsibilities – with intermediate targets
  - Kyoto plus 5 years will not provide the right signals to the private sector or national governments
  - Expand range of eligible CDM activities, including avoided deforestation, green investment schemes, energy efficiency standards, and exploring sectoral and programmatic approach
  - Key challenges include engaging USA, China and India

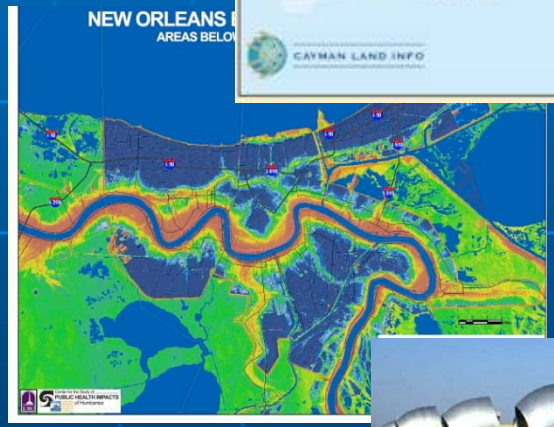
Elements of an adaptation strategy



Source: Emma Tompkins

- Delivery of adaptive responses depends on **governance** mechanisms
- Adaptive capacity and society's self-organisation is determined by **governance**
- Distribution of costs and benefits in society is determined by **governance**

Are there limits to how much we can adapt? ...physical, behavioural and technological limits



- **Physical limits:** there are physical limits to potential adaptation on small low lying islands e.g. Cayman Islands

- **Behavioural limits:** there are behavioural constraints that influence where we live and why, e.g. New Orleans

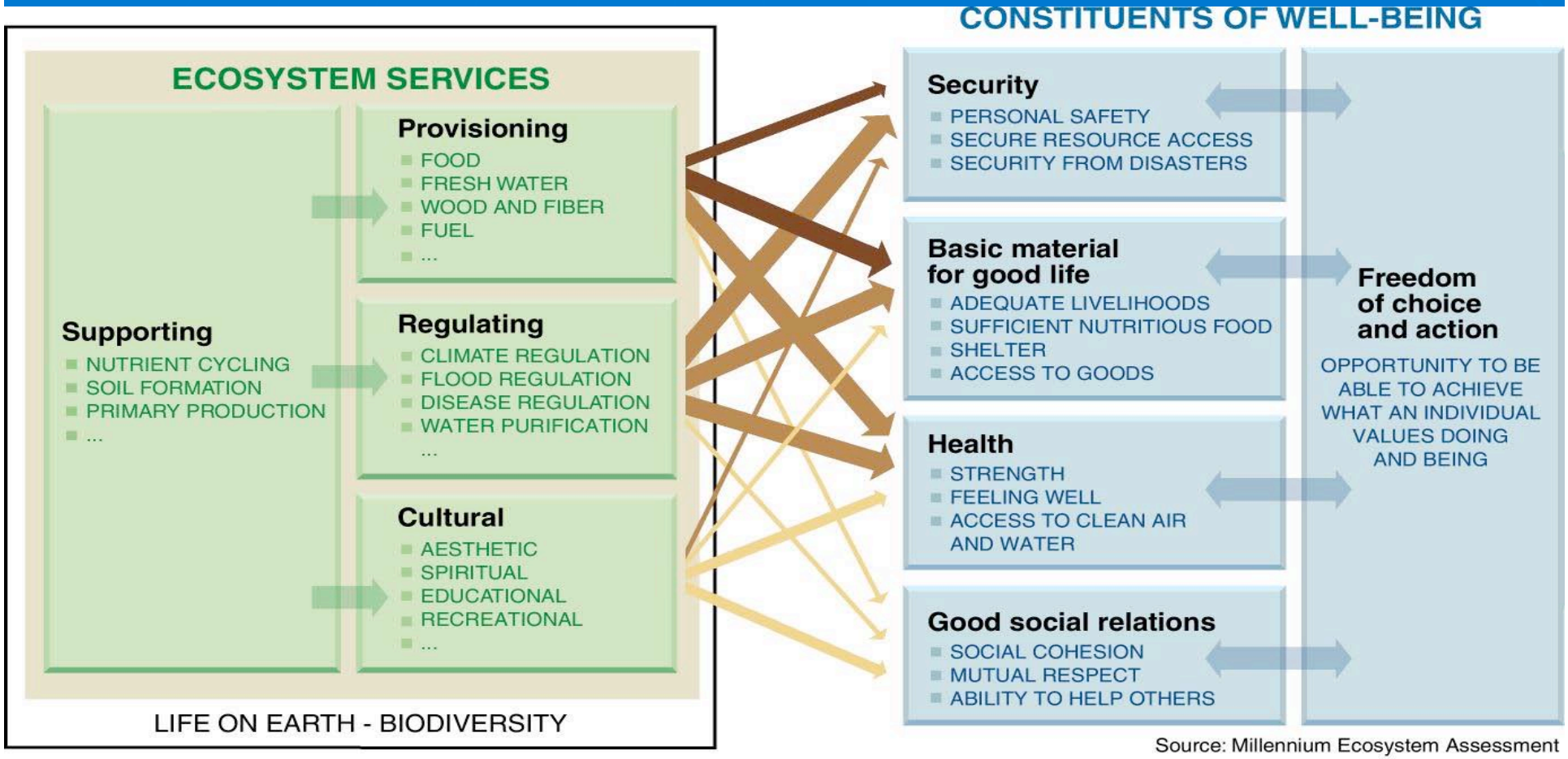
- **Technological limits:** there are technological limits to the flood defences that can be constructed, e.g. Thames Barrier, London

Elements of a Post-2012 framework

1. Long-term goal	(2C) 50% cut by 2050 on 1990 level
2. Developed country targets	30% cut by 2020 and 60-80 by 2050 for developed countries
3. Developing countries	Graduated approach to commitments
4. Carbon market	Broader, deeper, longer carbon market
5. Technology	Technology Protocols, IFI financing, R&D, energy fficiency
6. Adaptation	Adaptation integrated into development and finance strategies
7. LULUCF inc Deforestation	LULUCF integrated in post-2012 framework. Incentives to tackle deforestation
8. Aviation & maritime	Global sectoral approach

Ecosystem Services:
Biodiversity, Food Security and Water

Consequences of Ecosystem Change for Human Well-being



Source: Millennium Ecosystem Assessment

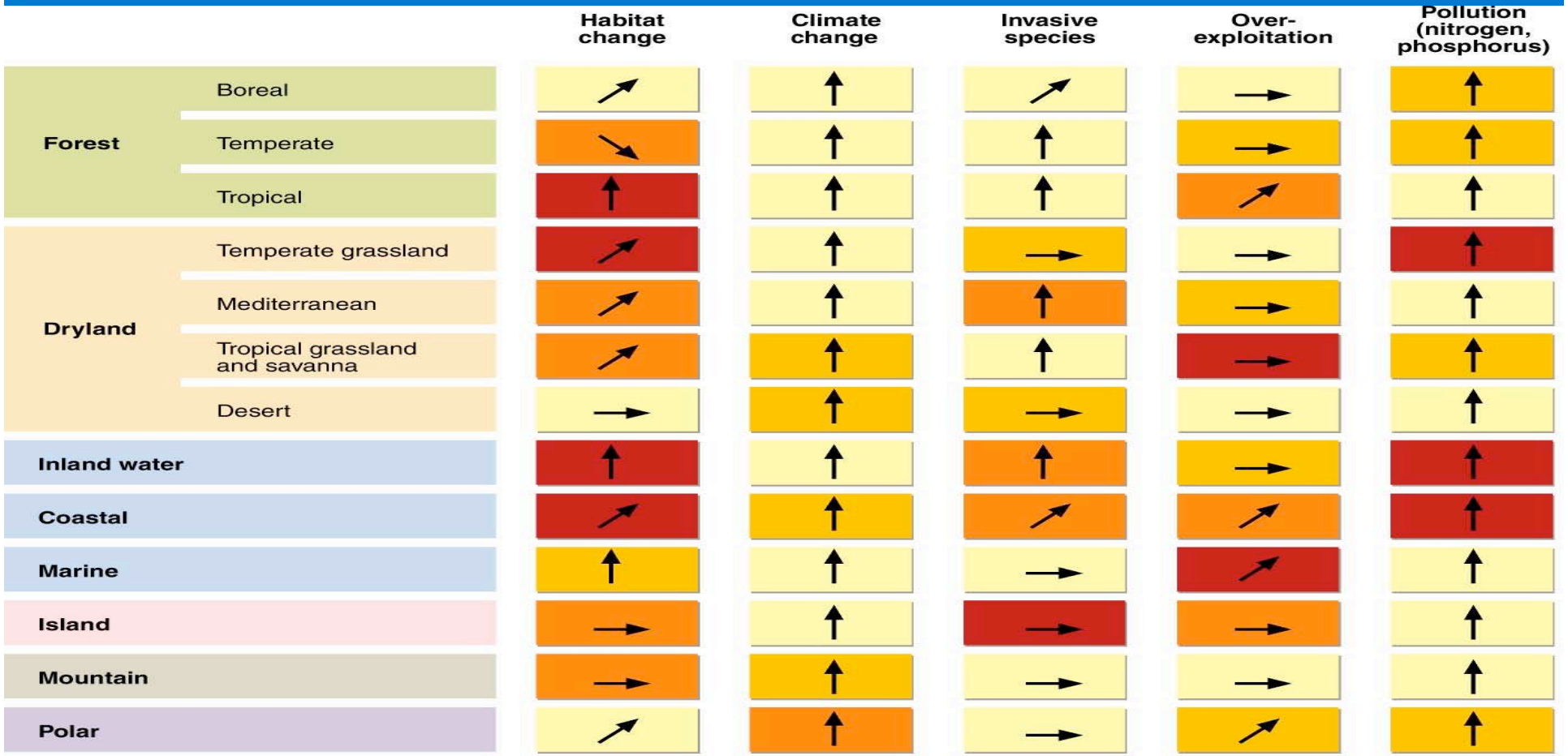
ARROW'S COLOR
Potential for mediation by socioeconomic factors

- Low
- Medium
- High

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

- Weak
- Medium
- Strong

Drivers of biodiversity loss growing



Source: Millennium Ecosystem Assessment

Options for Action: Sustainable use ecosystems (1)

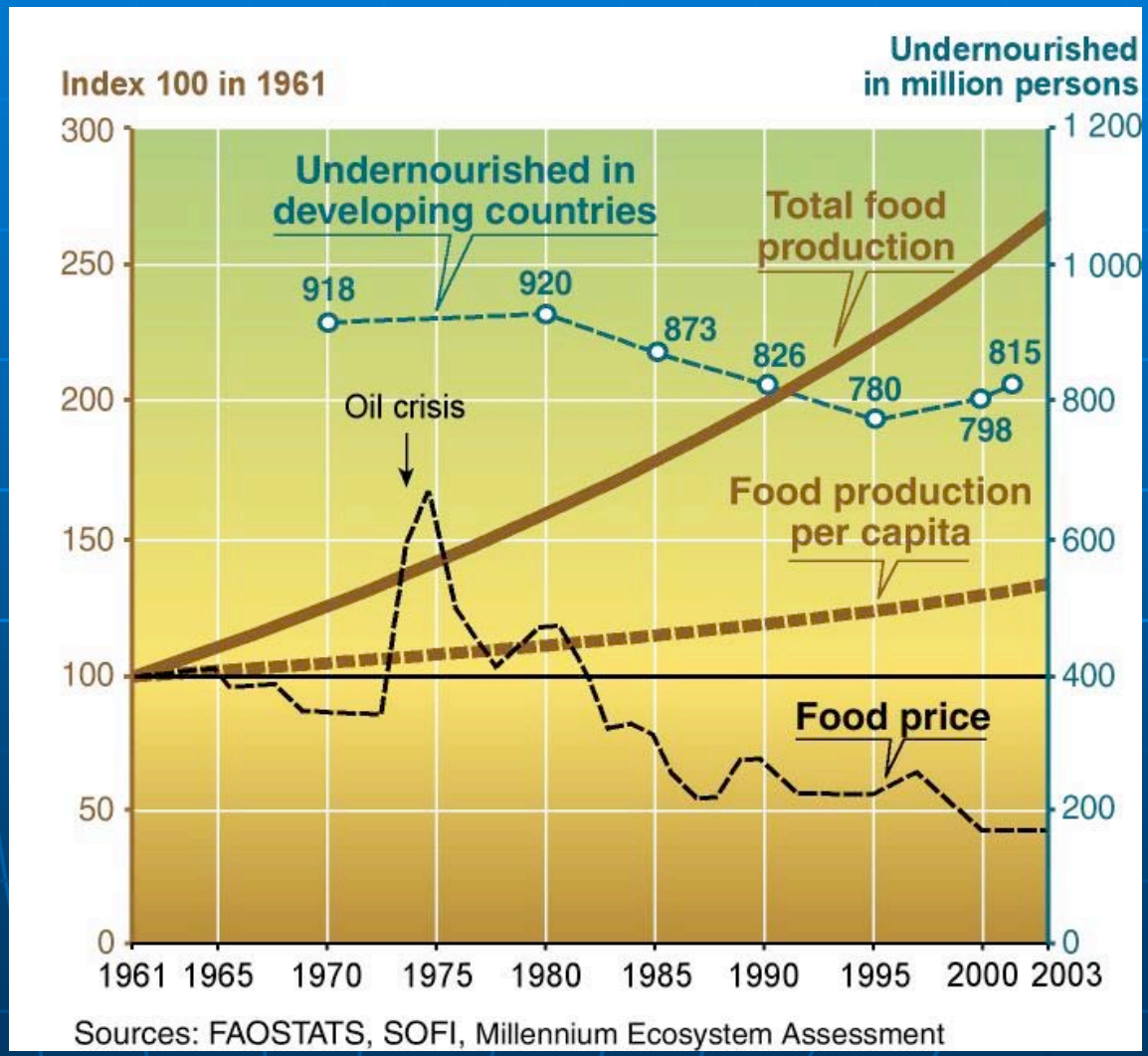
- Change the economic background to decision-making
  - Make sure the value of all ecosystem services, not just those bought and sold in the market, are taken into account when making decisions
  - Remove subsidies to agriculture, fisheries, and energy that cause harm to people and the environment
  - Introduce payments to landowners in return for managing their lands in ways that protect ecosystem services, such as water quality and carbon storage, that are of value to society
  - Establish market mechanisms to reduce nutrient releases and carbon emissions in the most cost-effective way

Options for Action: Sustainable use ecosystems (2)

- Improve policy, planning, and management
  - Integrate decision-making between different departments and sectors, as well as international institutions
  - Include sound management of ecosystem services in all planning decisions
- Develop and use environment-friendly technology
  - Invest in agricultural science and technology aimed at increasing food production with minimal harmful trade-offs
- Influence individual behavior

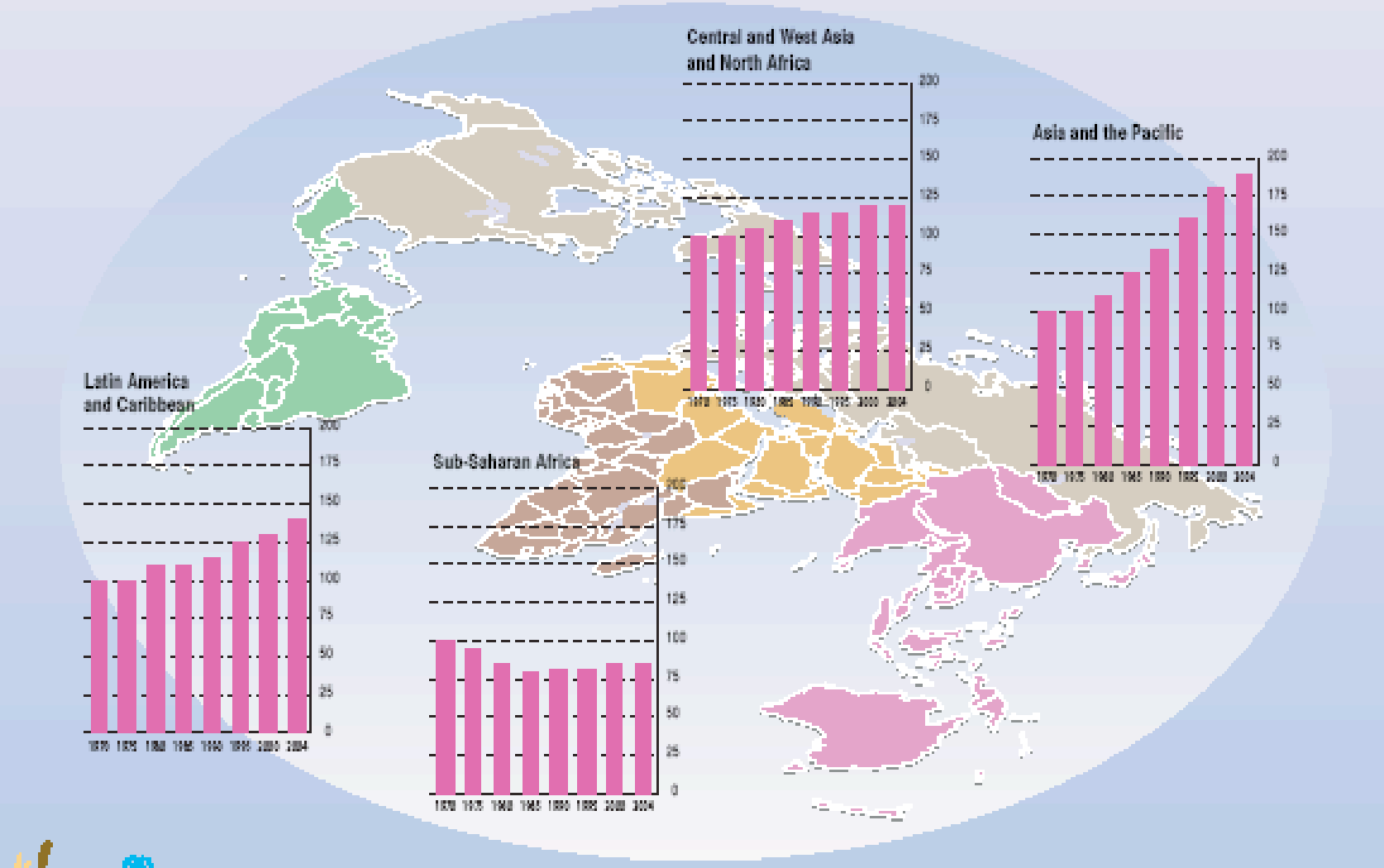
Changes to ecosystems have provided substantial benefits

- Food production has more than doubled since 1960
- Food production per capita has grown
- Food price has fallen



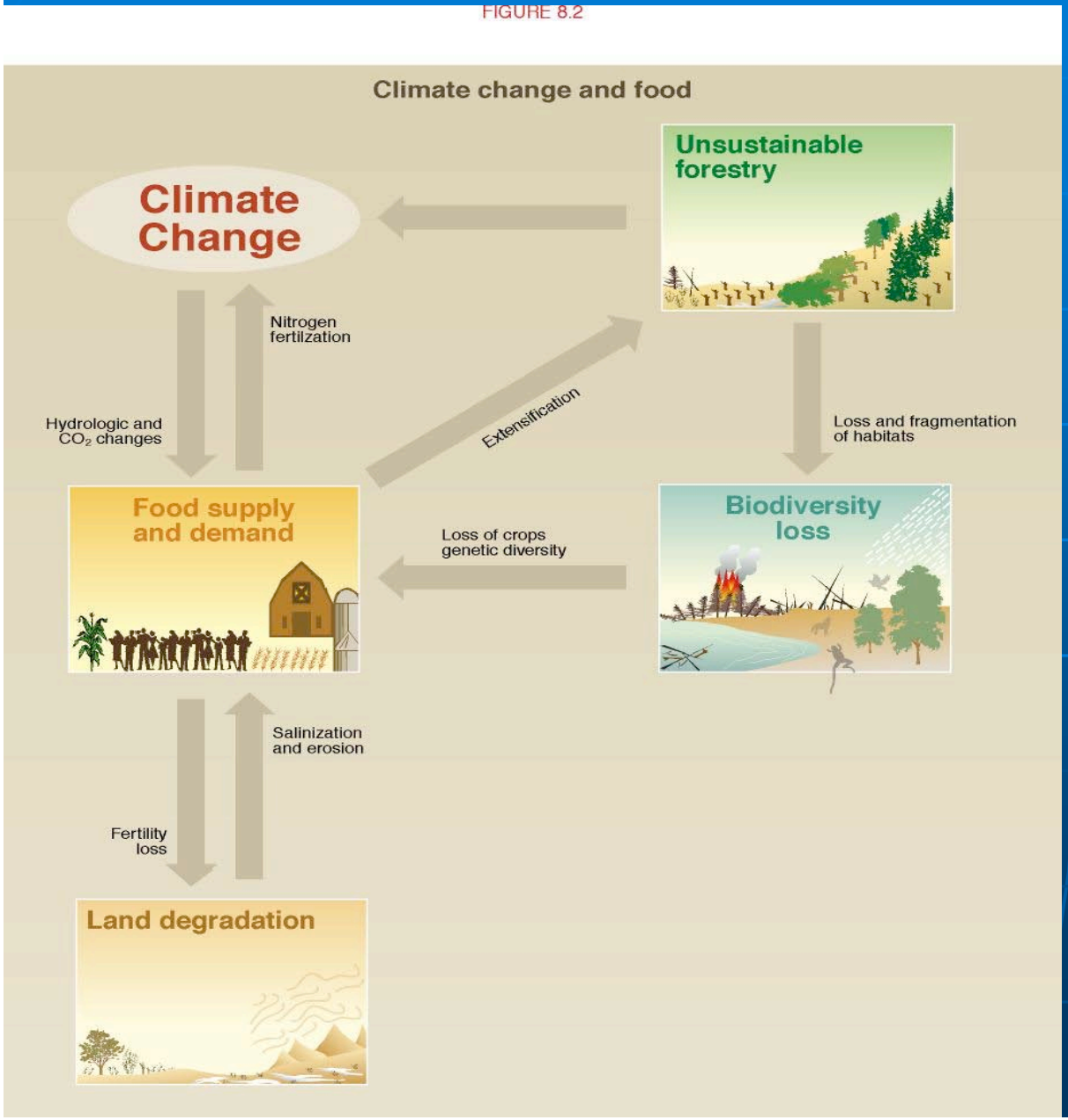
Total agricultural output 1970–2004

1970 = 100



SOURCE: The State of Food and Agriculture 2005, FAO Conference, 33rd session, 19–26 Nov. 2005 FAO, Rome, Italy

Agriculture and Environmental Degradation



- Can crop, animal and fish traits be improved to address the projected changes in climate – what are the roles of traditional breeding and modern forms of biotechnology?
- How will the loss of genetic diversity affect future agriculture?
- Can soil degradation be reversed and productivity enhanced?

Food Security

Drivers of the recent increase in food prices

- Poor harvests due to variable weather - possibly related to human-induced climate change
- Increased use of biofuels
- Increased demand
- High energy prices
- Speculation on the commodity markets
- Export bans from some large exporting countries

The future Challenge

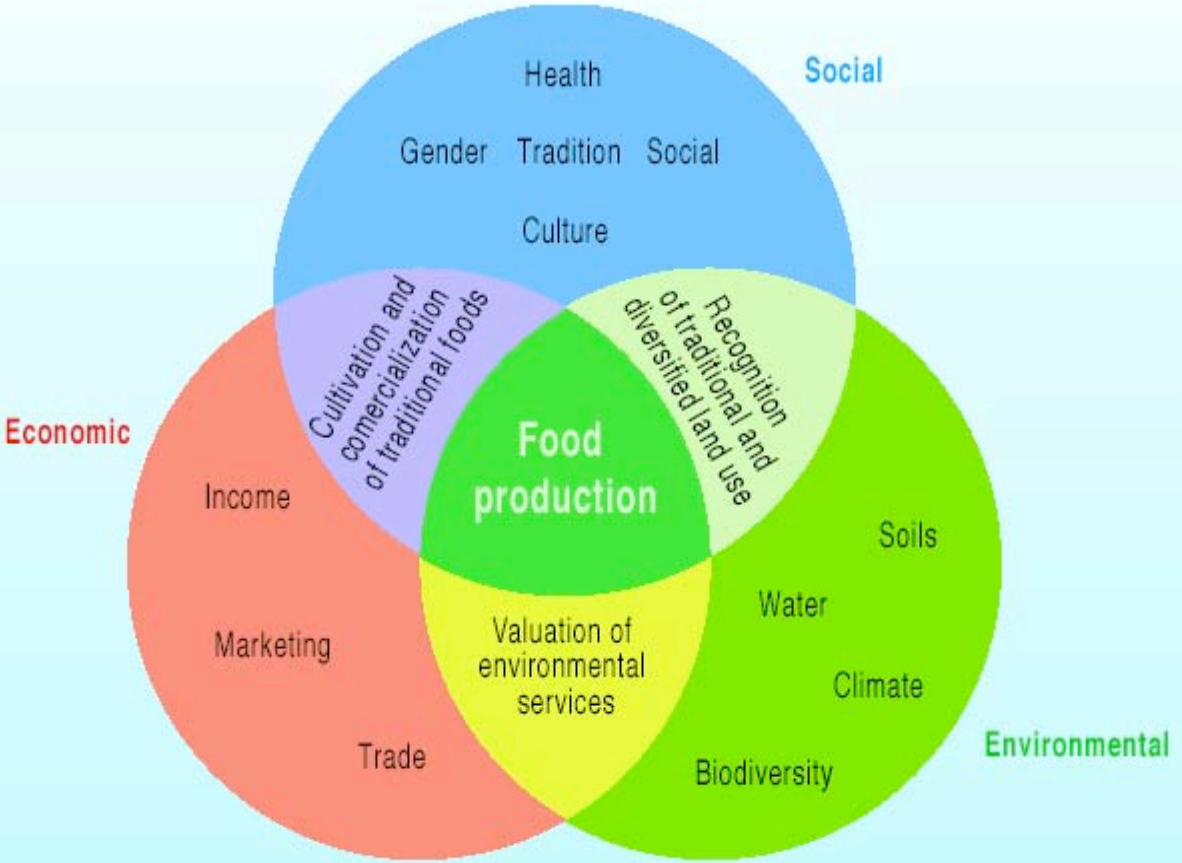
- The demand for food will double within the next 25-50 years, primarily in developing countries, **and** the type and nutritional quality of food demanded will change
- We need sustained growth in the agricultural sector to feed the world, enhance rural livelihoods and stimulate economic growth, while meeting food safety standards

Global Context for Food Security

- Less labor – disease, rural to urban migration
- Less water – competition from other sectors
- Less arable land – competition from energy crops
- High energy prices
- Distorted trade policies – OECD subsidies
- Land policy conflicts
- Loss of biodiversity: genetic, species and ecosystem
- Increasing levels of air and water pollution
- A changing climate

The Multifunctionality of Agriculture

The inescapable interconnectedness of agriculture's different roles and functions



Food Security: Options for Action

- Most of today's hunger problems can be addressed with appropriate use of current technologies, emphasizing agro-ecological practices (e.g., no/low till, IPM and INRM), coupled with decreased post-harvest losses

- Advanced biotechnologies may be needed to address future demands for increased productivity and emerging issues such as climate change and new plant and animal pests – but the risks and benefits must be fully understood

- Place the farmer in the middle – understand their needs and integrate as appropriate their local and traditional knowledge with formal AKSTD – innovation involving all relevant stakeholders along the complete food chain

Food Security: Options for Action

- Recognize the critical role of women and empower them (e.g., education, property rights, access to financing)
- Reform international trade, e.g., eliminate OECD production subsidies, eliminate tariff escalation on processed products, recognize the special needs of the least developed countries through non-reciprocal market access
- Provide payments to the farmer for maintaining and enhancing ecosystem services
- Increase public and private sector investment in research and development, extension services, and weather and market information

We can feed the world with affordable food, while providing a viable income for the farmer, but business-as-usual will not work

The Global Water Crisis

- Water scarcity is growing - by 2025 more than half of the world's population is projected to live under conditions of severe water stress
- Water quality is declining in many parts of the world
- 70% of all freshwater is used for irrigation - 15-35% of all irrigation systems are currently unsustainable with demand exceeding supply
- Water has the lowest rate of cost recovery among all infrastructure sectors (about 20%)
- Human-induced climate change is projected to decrease water quality and availability in many arid- and semi-arid regions

Options for Action

- **Implementation of the Dublin Principles**
  - **Ecological Principle:** River basin management (often transnational); multi-sectoral management, (agriculture, industry, households); land and water must be managed together
  - **Institutional Principle:** All stakeholders, state, private sector and civil society, especially women, must be involved in the management – principle of subsidiarity – action at the lowest level
  - **Instrument Principle:** Incentives and economic principles to improve allocation and enhance quality - pricing policies

Research Needs

- **Climate Change**
  - **Improved climate model projections at the spatial scale needed for impact and adaptation analyses;**
  - **Improved understanding of the impact of climate change, in the context of other stressors (e.g., conflict, perverse policies, inappropriate use of technologies), and the limits to adaptation, with emphasis on land-water interactions (food and water security), flooding and coastal erosion, migration,**
  - **Improved understanding of behaviour – individual, private and public sector**
  - **Development of pre-commercial energy production and consumption technologies, including IGCC, carbon capture and storage (pre- and post-combustion), future generation biofuels; fuel-cell and electric cars)**

Interdisciplinary Research

Research Needs

- **Biodiversity and Ecosystem Services**
  - **Improved understanding of how biodiversity at the genetic and species level influence ecosystem services**
  - **Improved understanding of how multiple stresses impact on ecosystem services**
  - **Improved understanding of how changes in ecosystem services affect human-well being**
  - **Improved valuation of ecosystem services (market and non-market)**

Interdisciplinary Research

In Conclusion

- There is no dichotomy between environmental protection and economic growth
- Get the economics right – eliminate perverse subsidies – value ecosystem services – internalize externalities – recognize the wealth of a nation is dependent on built, human, natural and social capital
- There are cost-effective and equitable solutions to address issues such as climate change and biodiversity loss, but political will and moral leadership is needed, and the changes in policies, practices and technologies required are substantial and not currently underway
- Public and private sector decision-makers need to take a longer-term perspective
- Advances in science and technology are required – investments are needed now to address these issues cost-effectively