Climate Change in the MENA Region: Effects on Water and Agriculture

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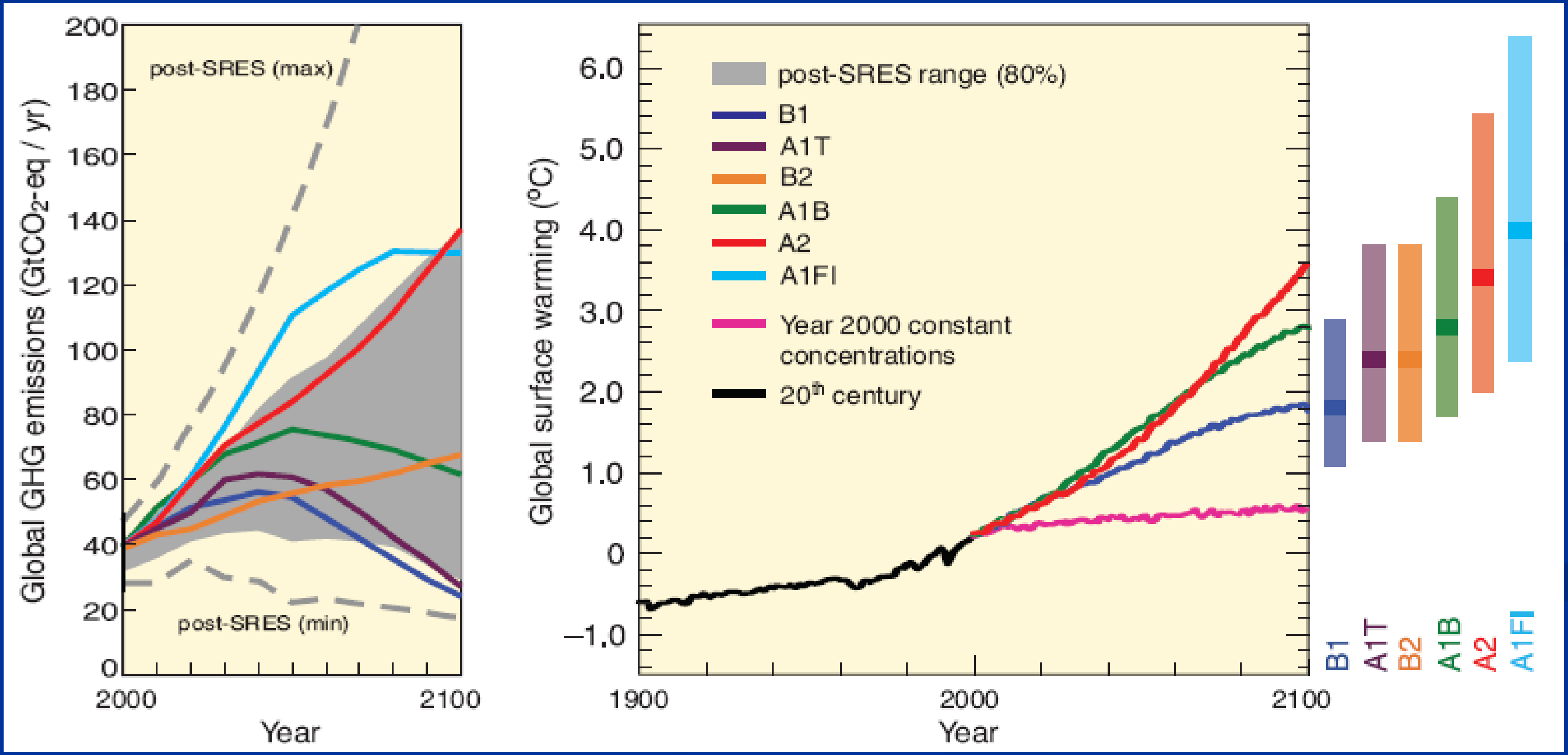
Contents

Climate Change

- Climate Change (CC) - any long-term significant change in the expected patterns of average weather over time
- CC results from many factors including:
  - ✓ dynamic processes of the earth itself
  - ✓ human activities
- Mechanisms attributed to the recent CC are:
  - ✓ increasing atmospheric concentrations of greenhouse gases (GHGs) such as carbon dioxide, methane and nitrous oxide
  - ✓ changes to land surface, such as deforestation
  - ✓ increasing atmospheric concentrations of aerosols
- GHGs emissions now stand at 385 ppm, shot past the safe level of 350 ppm

Climate Change Scenarios

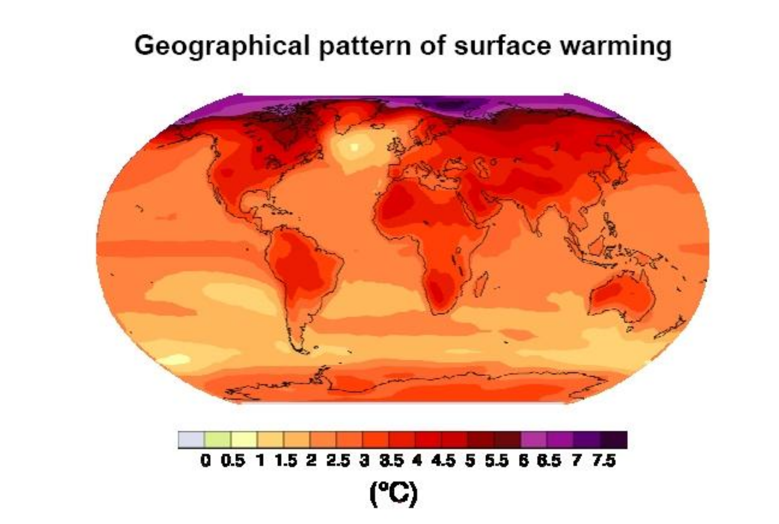
- Six scenarios with different assumptions were developed to simulate GHG projections and their effects on CC until 2100



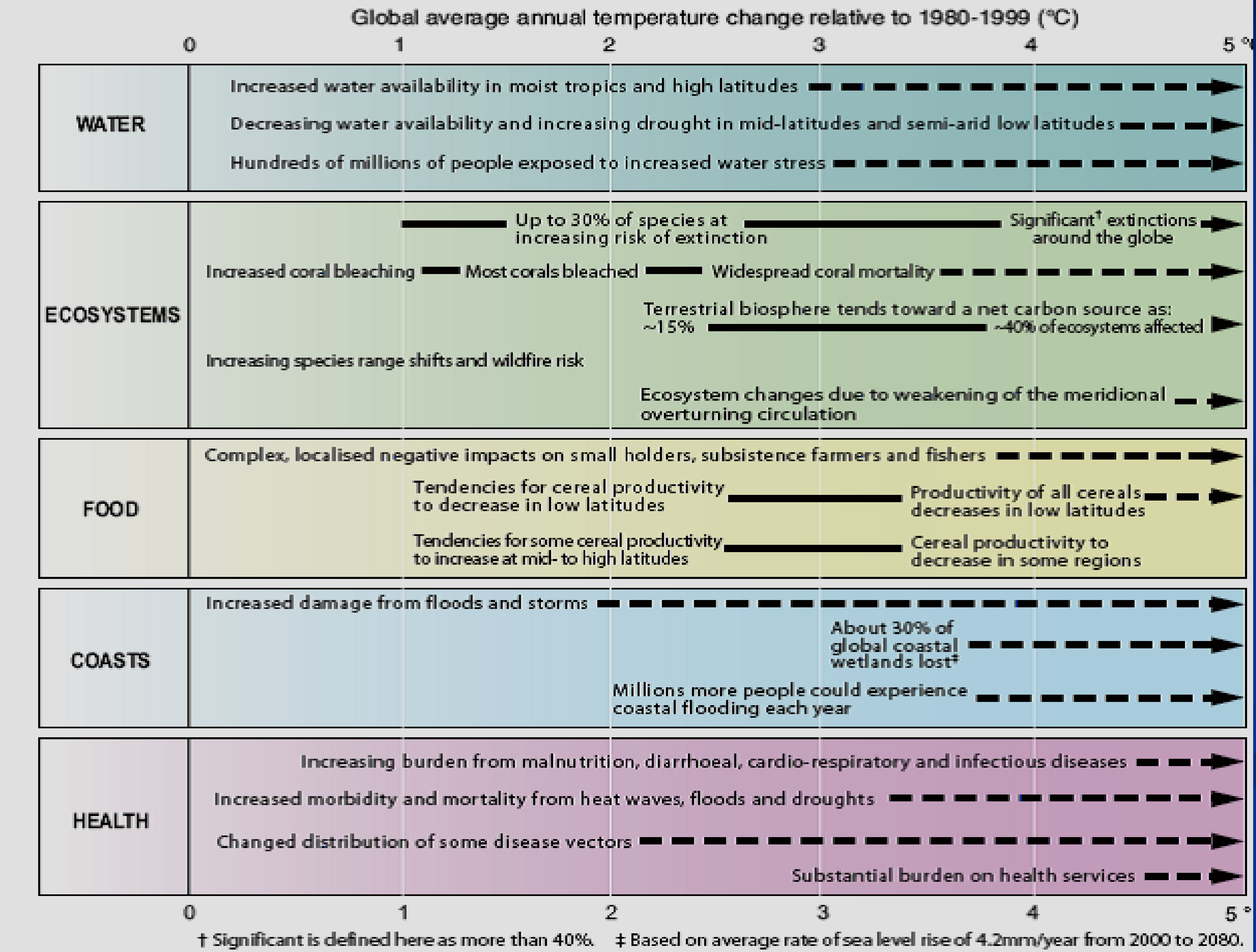
Source: IPCC , 2007

Climate change

- Average global surface temperature likely to rise between 0.6° to 4°C by 2100
- Increases in precipitation in the high-latitudes
- Decreases in precipitation in most subtropical and semi-arid regions by as much as about 20%
- Decreases in runoff
- Changes in frequency and intensity of droughts, flooding and storms
- Ice cap shrinking and rising sea levels by 0.18 to 0.59 m

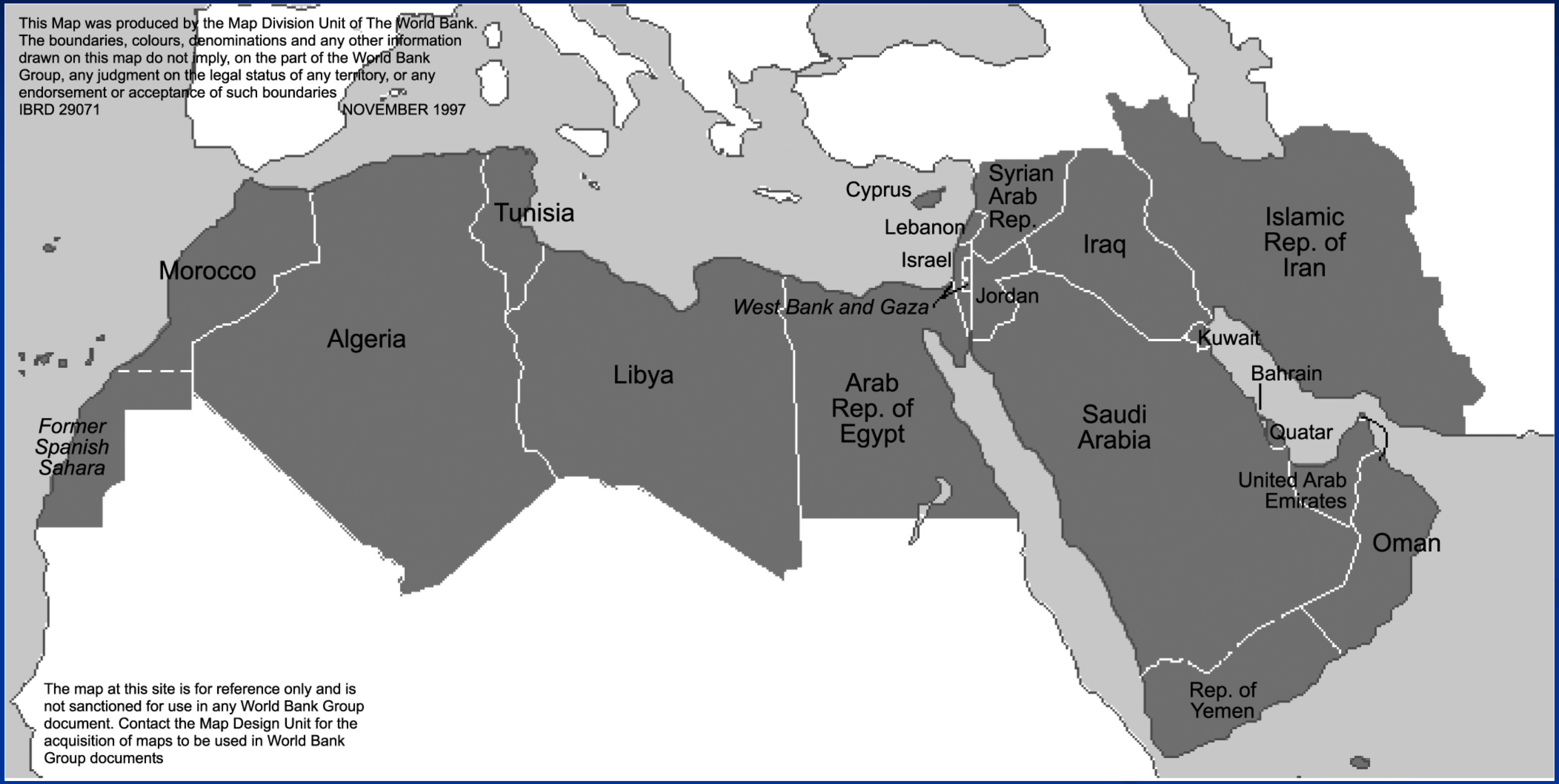


Climate change- How will it affect different sectors?



Source: IPCC , 2007

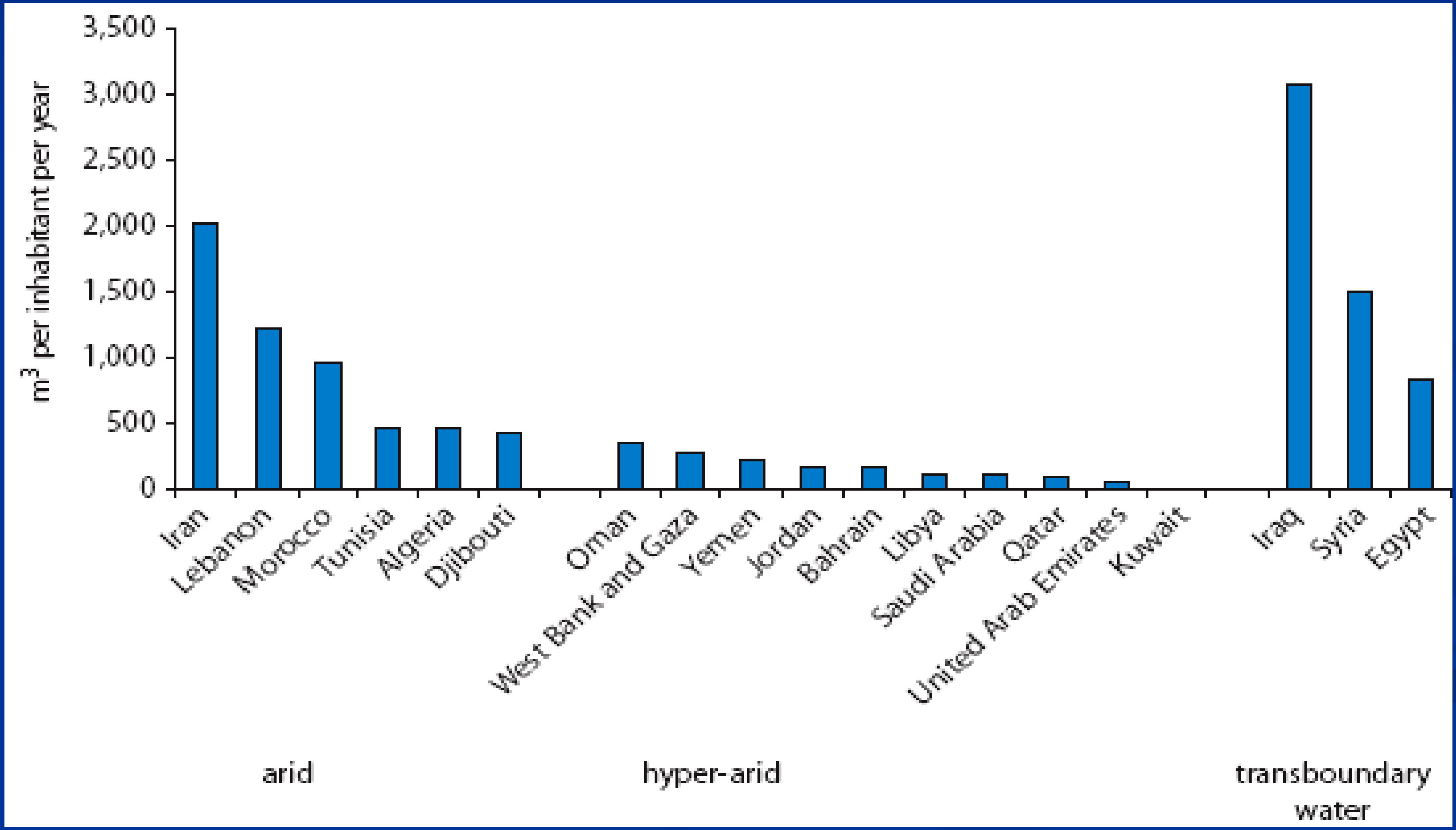
MENA Region



- 18 countries from Morocco in NW Africa to Iran in SW Asia
- The population is about 6% of the total world population
- Oil is the main natural resource of the region, with 70% of the world's reserves

MENA Water Sector

Most water stressed region in the world

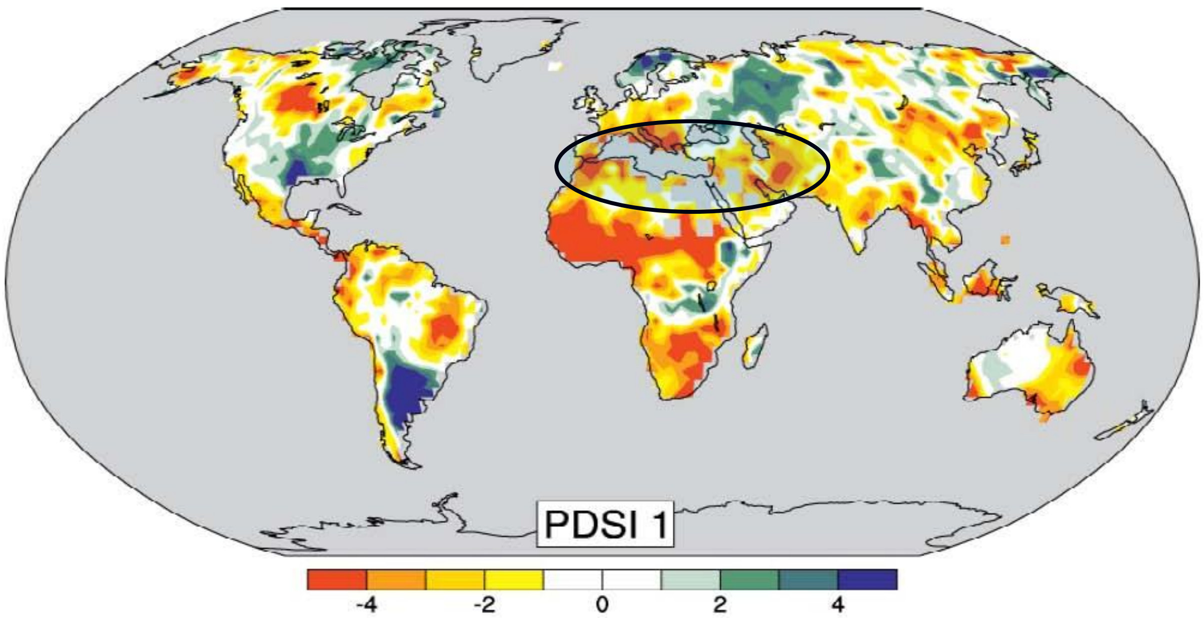


Source: FAO-AQUASTAT

MENA water status

- Renewable water resources (RW) declined to 1/3rd of its level in 1960
- Many countries (e.g., Yemen, Jordan, Libya, Algeria, Palestine) experiencing acute water shortage
- Drought frequency is increasing

Palmer Drought Severity Index (PDSI) for 1990 to 2002.

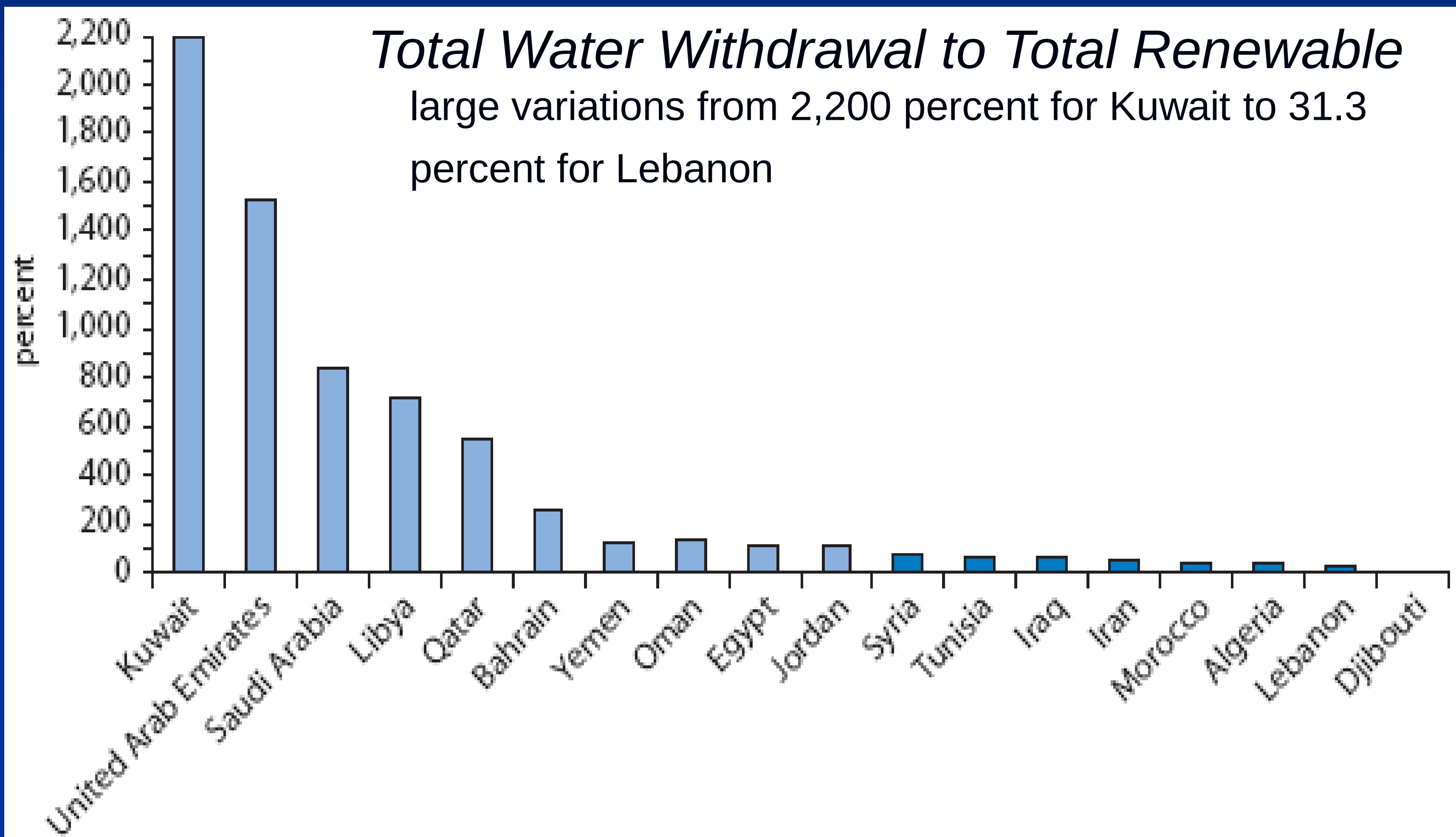


Source: IPCC Fourth Assessment Report, 2007

The Palmer Index measures drought as normalized departure of temperature and precipitation from long terms normals. In the Maghreb and parts of the Mashreq, there have been extreme droughts in 1990-2002 (Palmer index of -4)

MENA Water Sector

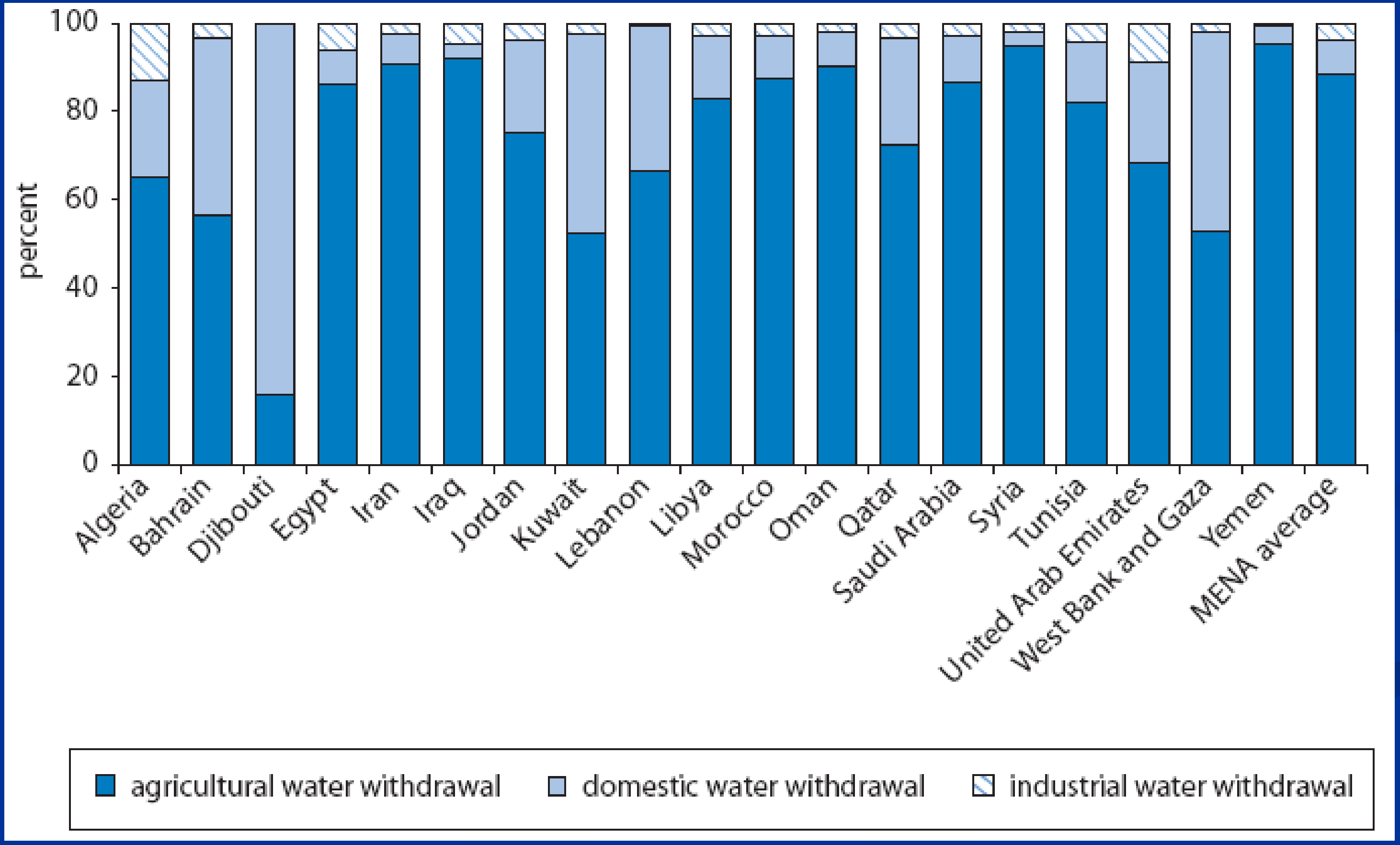
World's highest in renewable water resources withdrawn



Source: FAO-AQUASTAT

MENA Water Sector

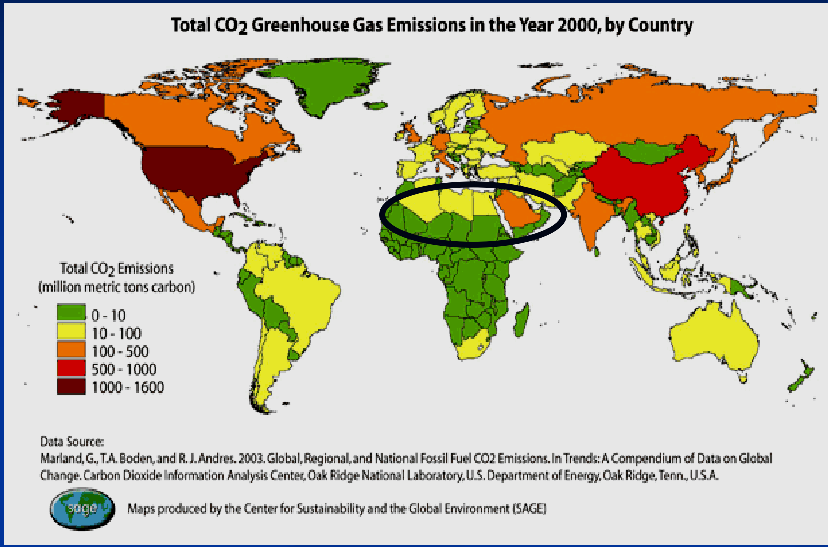
- Sector Water Use: Agriculture sector uses nearly 85 percent of total water resources, generates only 8 percent of the GDP on average (e.g., Oman 1.5%, Jordan 2.25%, Syria 21.3% in 2005)

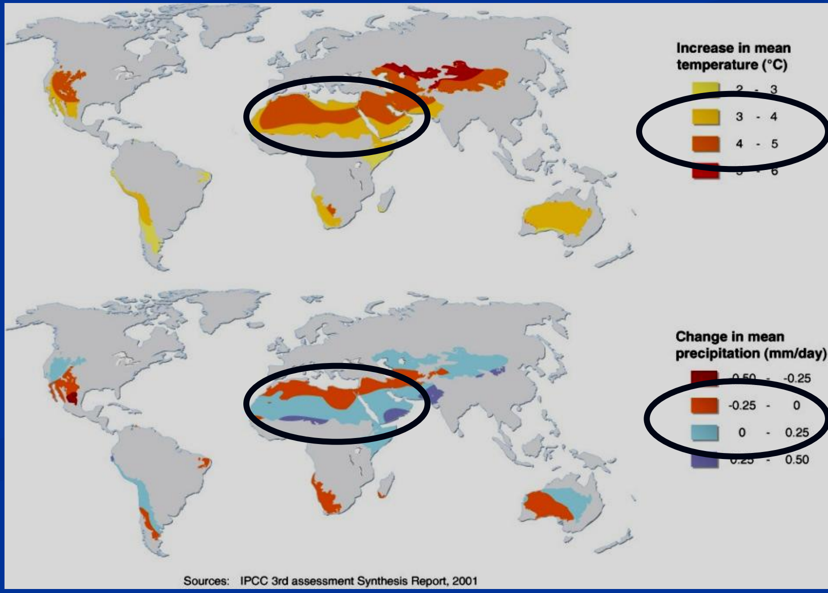


Source: FAO-AQUASTAT

Climate Change: Impact on MENA

- One of the most vulnerable regions, though least polluting in the world (GHG emissions 4.5%)
- Emissions growth (84% are oil generated) has outpaced all the other regions (1995-2004)
- Temperatures are expected to increase by 2-2.5°C by 2050
- General decrease in annual precipitation by 10.5%, but up to 30- 40 % in Morocco, Saudi Arabia, Yemen and UAE

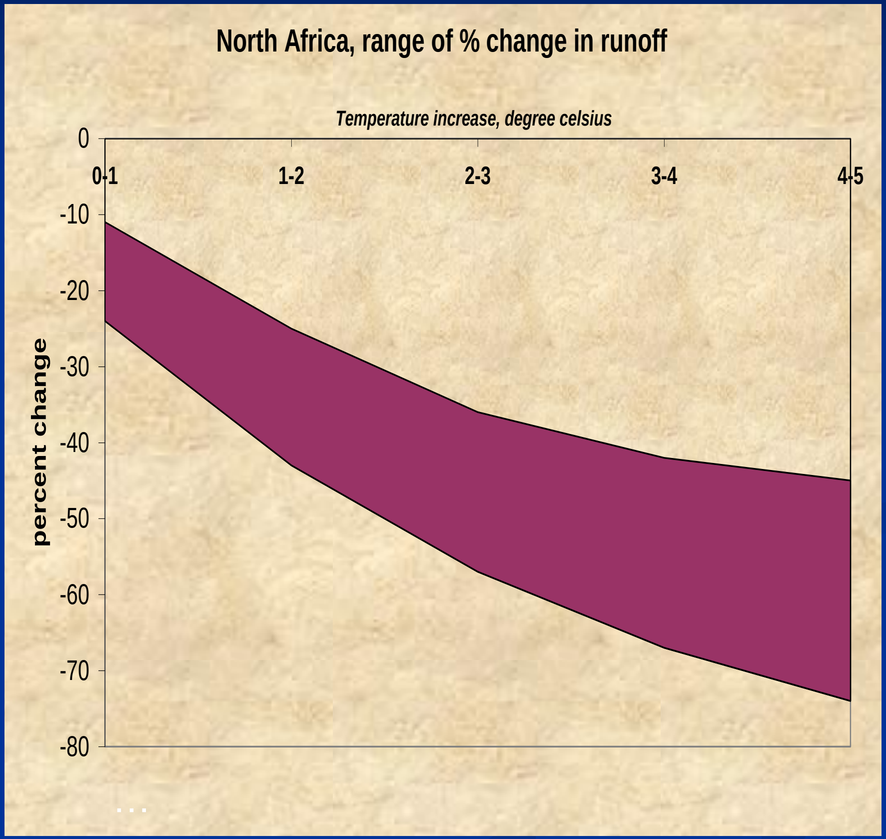




In 2071-2100, relative to 1961-1990

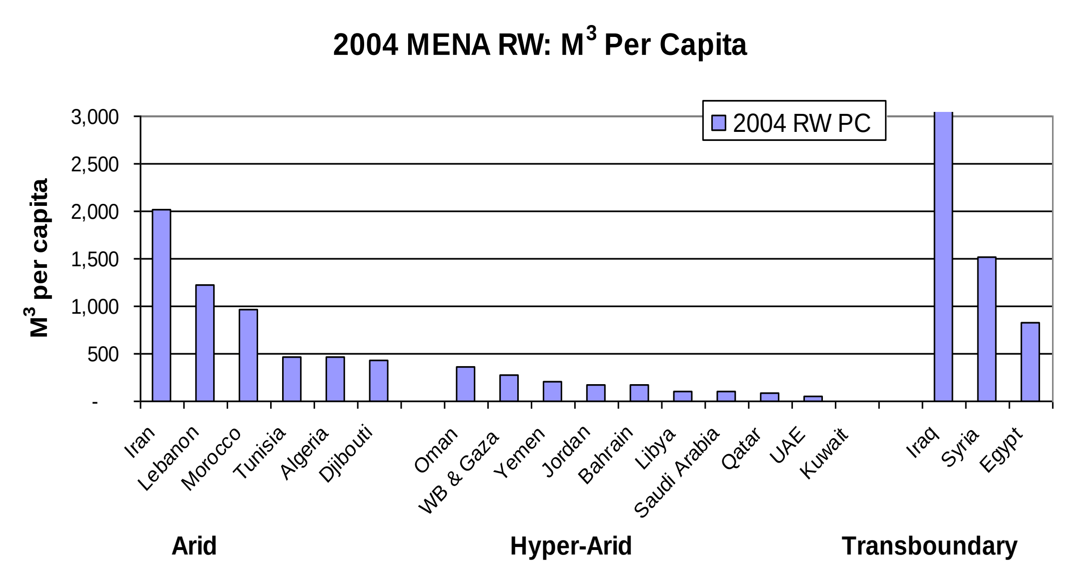
How Will CC Affect the MENA Water Status?

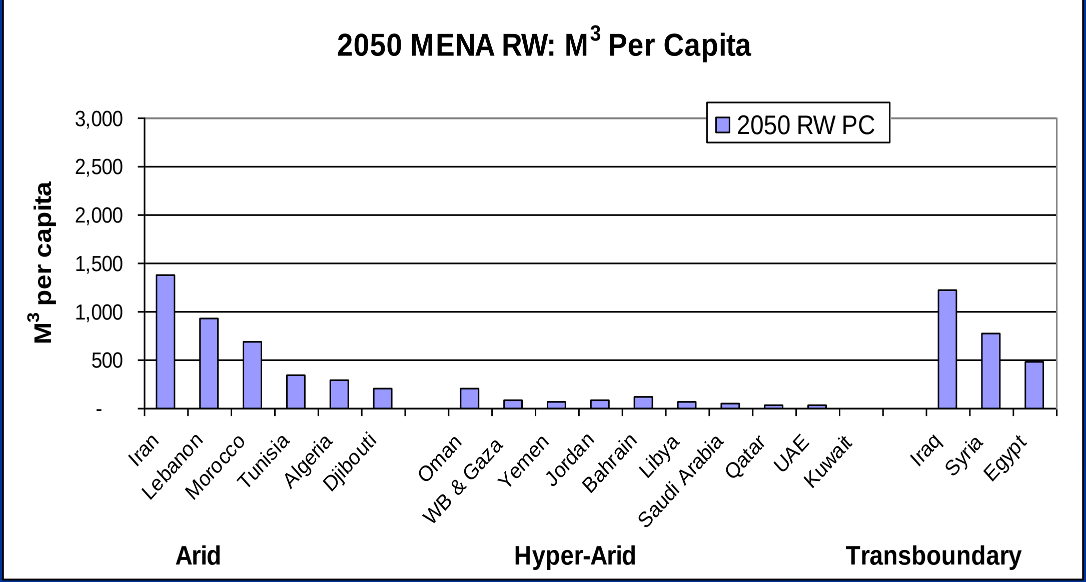
- Accelerating drought cycle and desertification projected – especially for N. Africa
- Runoffs to decrease by 20- 30%
- Reduced surface water infiltration will worsen unsustainable depletion of groundwater
- Increasing urban population (by 93% between 1995-2050) and demographic growth (>2%) will put more pressure on Renewable Water (RW) resources



Source: Worldbank

How Will CC Affect the MENA Water Status?



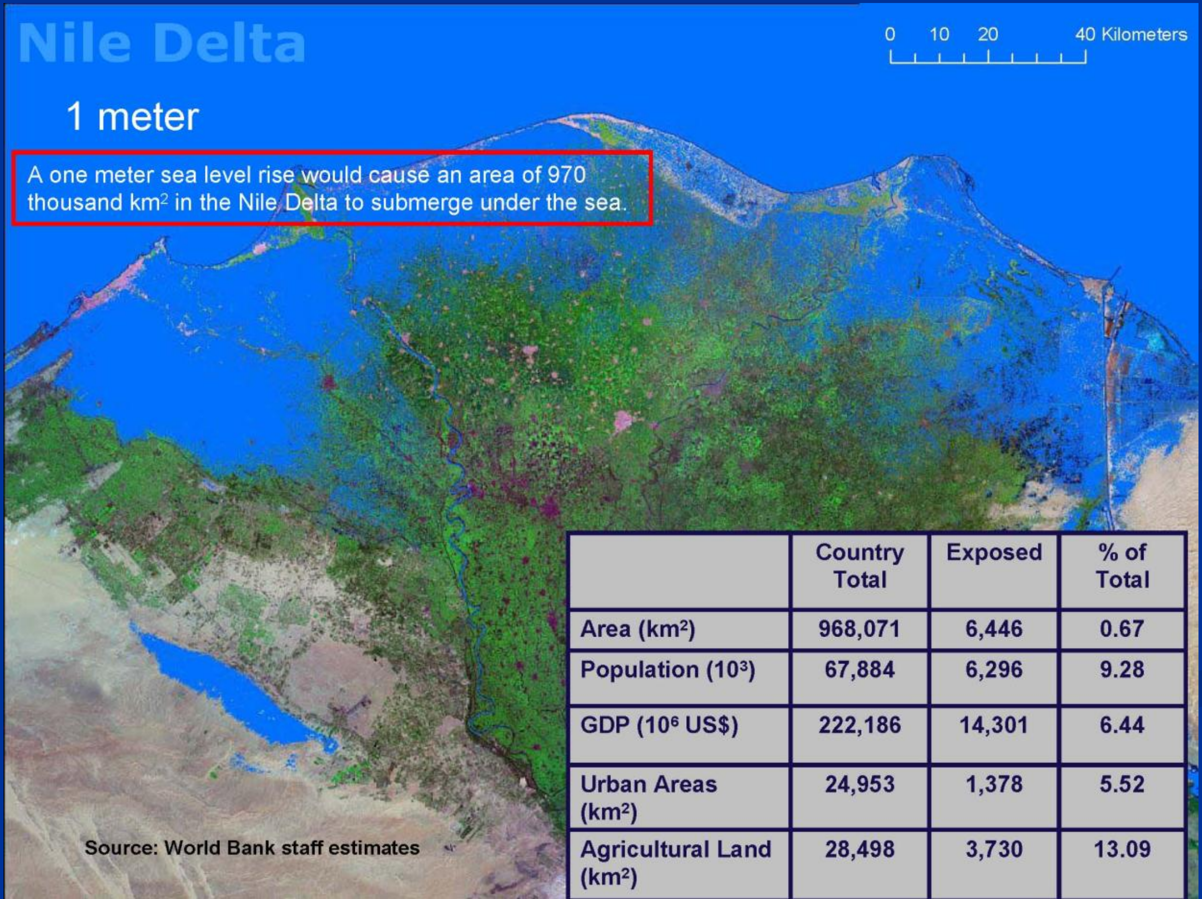


Source: FAO-AQUASTAT

- Water availability expected to decrease by 30-50% by 2050
- RW pc/pa to decrease to less than 550 m3 putting the region in ‘absolute scarcity’ state
- Water Services governance, access, efficiency and water-related disease indicators also to deteriorate

How will CC affect the MENA water status?

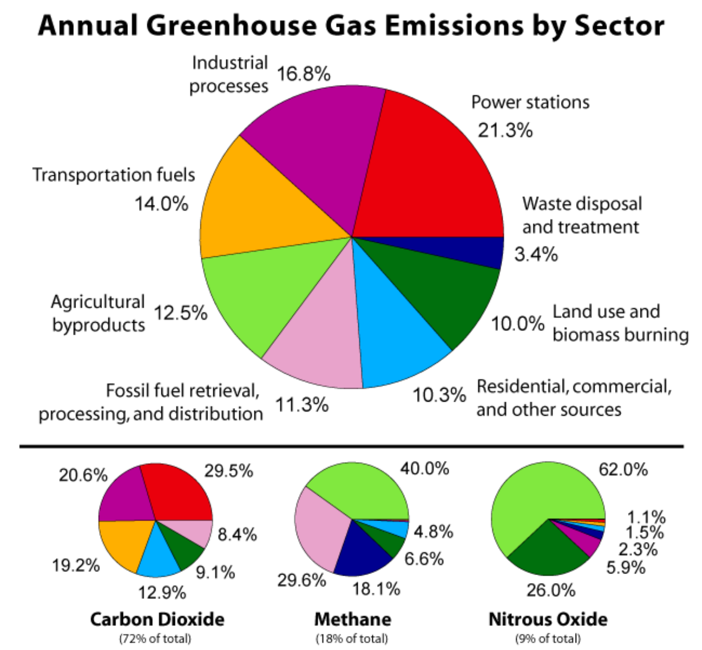
- Rising of sea level – Effects are expected to be higher compared to rest of the world
- Low-lying areas in Tunisia, Qatar, Libya, UAE, Kuwait and particularly Egypt are at risk



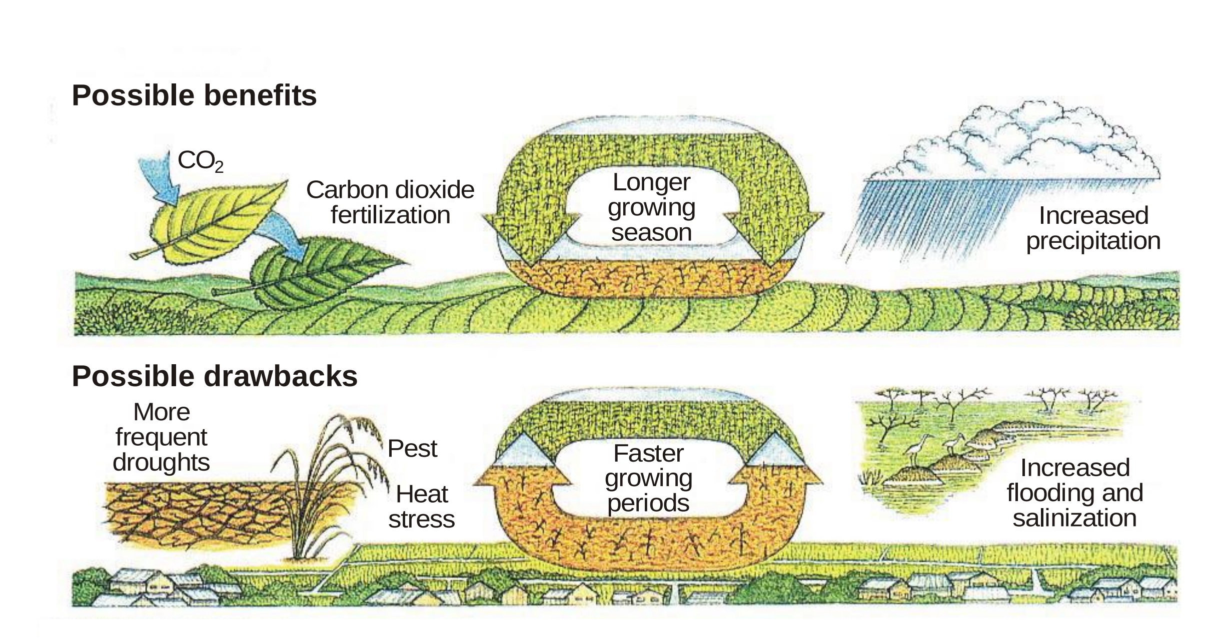
	Country Total	Exposed	% of Total
Area (km²)	968,071	6,446	0.67
Population (10^3)	67,884	6,296	9.28
GDP (10^6 US$)	222,186	14,301	6.44
Urban Areas (km²)	24,953	1,378	5.52
Agricultural Land (km²)	28,498	3,730	13.09

Climate Change and Agriculture

- One of the sectors most sensitive to CC
- Agriculture itself contributes to 12.5% of global GHG emissions
- CC presents agriculture with both benefits and drawbacks



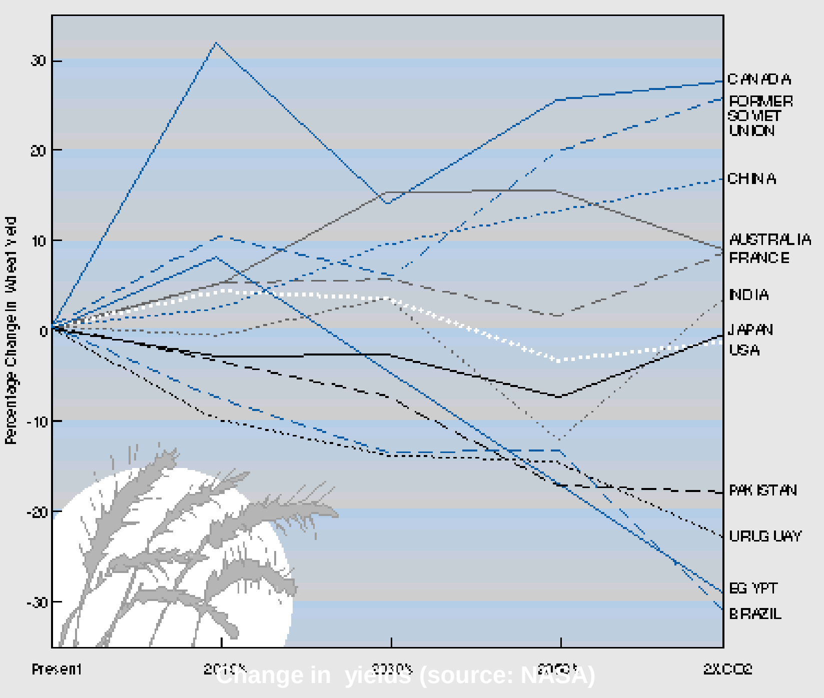
Source: Global Warming Art



Source: *Scientific American*, March, 1994

Climate Change and Agriculture…

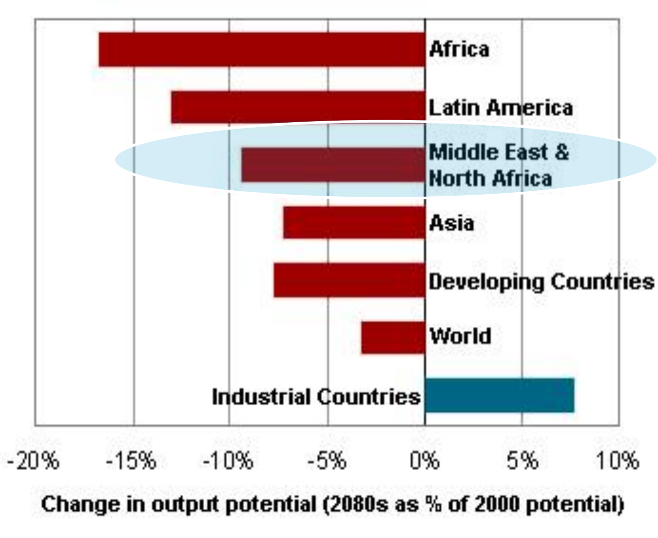
- Under business as usual scenario, global agricultural productivity could decline between 10-25% by 2080
- Decline in yield in rain-fed agriculture can be as much as 50% for some countries
- Among crops, biggest losers are cold-weather crops such as strawberry (-32% in area of cultivation), wheat (-18%), rye (-16%) and oats (-12%)
- Among the winners are pearl millet (+31%), sunflower (+18%), chickpea (+15%) and soybean (+14%)



Change in yields (source: NASA)

Climate Change – Impact on MENA Agriculture

- MENA has High dependency on climate-sensitive agriculture
- Crops and livestock will face increased heat stress – yield reduction by up to 10%
- Increase in crop water demand by 5-8% by 2070 with fall in productivity of water
- Intensified evaporation to increase the salt accumulation in soils
- Increase in pest infestations in warmer climates - leads to greater use of chemical pesticides
- Rise of seas level poses threat to agriculture in low-lying coastal areas – particularly Egypt
- Natural ecosystems such as rangelands and forests are less resilient and more vulnerable



How climate change will affect smallholder farmers?

- **Rural households engaged in subsistence agriculture and smallholder farmers are most vulnerable**
- **Increased likelihood of crop failure**
- **Increase in disease and mortality of livestock, forced sale of at disadvantageous prices**
- **Increased livelihood insecurity results in assets sale, indebtedness and dependency on food aid**
- **Downward spiral of human development indicators, such as health and education**
- **Rural-to-Urban migration likely to increase as many rural livelihoods become less viable**

Dealing with climate change - At large

'The ability of any country to take advantage of the opportunities and to avoid the drawbacks depend on the availability of adequate resources and quality research base' (Rosenberg and Hillel, 1995)

Options/Strategies include both mitigation and adaption

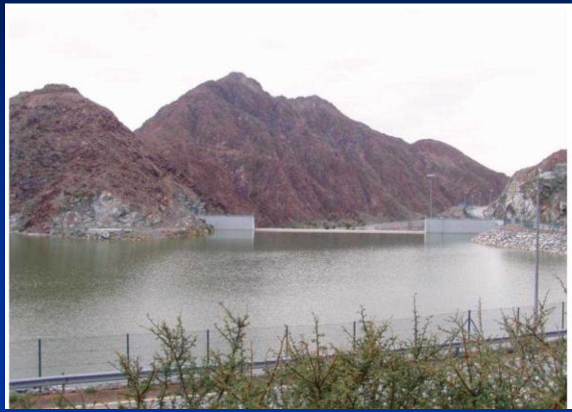
Mitigation

- **Reducing demand for emissions-intensive goods and services**
- **Enhancing removal of CO_2 through carbon recovery and storage (e.g. afforestation)**
- **Development of low-carbon energy technologies**
- **Reducing non-fossil fuel emissions by switching to renewable energies**
- **Wastewater treatment and recycling**

Dealing with climate change - At large

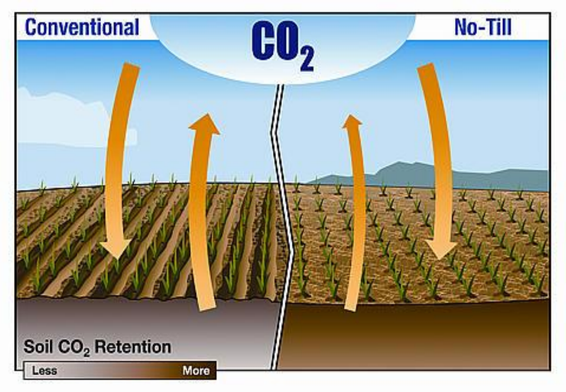
Adaptation

- Expanded rainwater harvesting
- Water storage, conservation and reuse
- Desalination
- Sector-wide water reforms to balance water demand and supply
    - ✓ Reducing loss in quantity and quality of water
    - ✓ Reducing quality and quantity of water required for a specific task
    - ✓ Adjusting the nature of task to accomplish with less water
    - ✓ Ensuring equity in cost associated with and benefits resulting from Water Demand Management (WDM) adoption
- Restoration of degraded lands



Dealing with climate change - At farm level

- Introducing crop varieties and/or species with increased resistance to heat shock, salinity and drought
- Improving irrigation efficiency - Altering amounts and timing
- Conserving soil moisture through appropriate tillage methods (e.g. crop residue retention, zero tillage)
- Land use changes to take advantage of modified agroclimatic conditions
- Diversifying income though livestock raising, forestry and fisheries
- Creating awareness and Integrating smallholder farmers to emerging structure and mechanisms to deal with climate change



ICBA's R&D in Adaptation to Climate Change

ICBA's Mandate

"To help Water-scarce countries improve productivity, social equity and environmental sustainability through an integrated water resource systems approach, with special emphasis on saline and marginal quality water."

Strategies

- **Identify new and improved salt-tolerant germplasm (conventional crops and halophytes) to sustain ecosystem productivity in changed climates**
- **Develop alternative production systems and technologies to improve productivity in marginalized environments**

International Center for Biosaline Agriculture, Dubai, UAE

- **Develop low-cost technologies for low-quality water-use by small scale farmers**
- **Promote policies, legal and institutional framework for sustainable resource management and reduction of impact on climate change**
- **Establish stronger partnerships with NARS to test and adopt new technologies for ecosystem resilience**

ICBA's R&D …

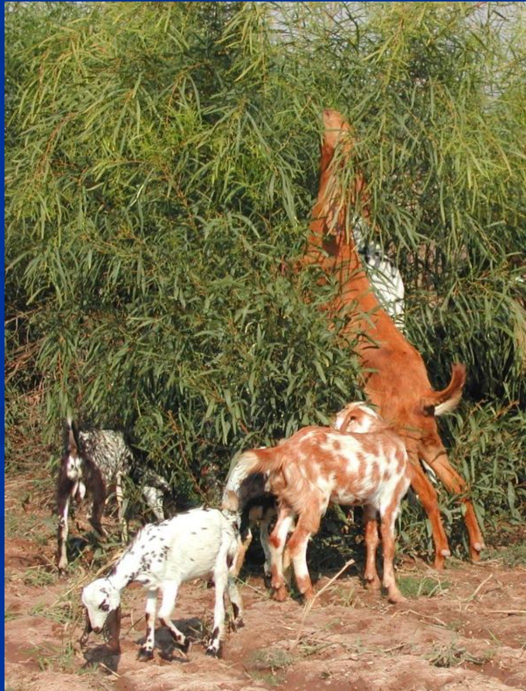
Project Name	Participating Countries	Adaptation/Resilience Strategy
Forage project for the WANA Region	Jordan, Oman, Pakistan, Palestine, Syria, Tunisia, UAE	New germplasm, Production systems development, Promote policies and institutional framework, Partnerships to test/adopt new technologies
Sorghum and pearl millet for enhanced crop-livestock productivity	Egypt, Iran, Oman, Tunis, Yemen	New germplasm, Production systems development, Partnerships to test/adopt new technologies
Biosaline Forestry (BIOSAFOR) - Biomass for Bioenergy	Bangladesh, India, Pakistan, Netherlands, Spain, Germany, UAE	New germplasm, Production systems development, Promote policies and institutional framework, Partnerships to test/adopt new technologies
Bright Spots in the Aral Sea	Uzbekistan, Kazakhstan Turkmenistan	Production systems development, Partnerships to test/adopt new technologies
Harnessing productivity in salt-affected of Indo-Gangetic, Mekong and Nile river basins	Iran, Egypt, Philippines	Production systems development, Promote policies and institutional framework, Partnerships to test/adopt new technologies
Biosaline agriculture at NPC, KSA	Kingdom of Saudi Arabia	Technologies for low-quality water use
Salt tolerant forage production systems in the Sinai Peninsula	Egypt	Production systems development, Partnerships to test/adopt new technologies

ICBA's R&D …

Project Name	Participating Countries	Adaptation/Resilience Strategy
Identifying new sources of income for poor farmers in Bangladesh	Bangladesh	Production systems development, Technologies for low-quality water use, Partnerships to test/adopt new technologies
Brine disposal from RO units	United Arab Emirates	Production systems development, Technologies for low-quality water use
Irrigation Planning & Management	United Arab Emirates	Production systems development, Technologies for low-quality water use, Partnerships to test/adopt new technologies
Reclaiming salt affected farms in Tajikistan	Tajikistan	New germplasm, Production systems development, Partnerships to test/adopt new technologies
Protecting water resources and combating salinity in Oman	Sultanate of Oman	Production systems development, Promote policies and institutional framework, Partnerships to test/adopt new technologies

ICBA's R&D…

Saving fresh water resources with salt-tolerant forage production in marginal areas



- Changes in climatic pattern negatively impacted agro-ecosystems in WANA and MENA regions
- Increase in salinity from unsustainable irrigation practices - loss of production and dislocation of poor farmers in many places
- Alternative production and management systems appropriate to the socioeconomic and environmental conditions to sustain livelihoods needed

Outcome

- Development of integrated forage-livestock feeding systems based on salt-tolerant forages and marginal quality water
- Amelioration of feed scarcity in small-scale farms
- Improved livelihoods of small-scale farmers in eight countries

ICBA's R&D…

Combating resource degradation in Central Asia and Caucasus

- Improper drainage systems severely affected agricultural production in Uzbekistan, Kazakhstan and Turkmenistan and Tajikistan
  - ✓ Very dry or water logged conditions
  - ✓ Salt accumulation on soil surface - Irrigated fields, once productive turned into degraded lands

Outcome

- Sorghum, pearl millet, fodder beet and alfalfa germplasm performing better than the locally grown materials identified
- *Acacia ampliceps, Atriplex nummularia, A. undulata* and *A. amnicola* with high potential for reclamation of salt affected marginal lands introduced

ICBA's R&D…

Agroforestry on saline wastelands

- Salt-tolerant grasses (*Sporobolus arabicus*, *Paspalum vaginatum)* and trees (*Acacia ampliceps*) tested at ICBA
- All species showed good potential for forage and nutrient management.

Balancing water demand and supply - Irrigation planning and management for sustainable agriculture development in the UAE

- Assessing irrigation water supply (both conventional and non-conventional resources) and demand trends to suggest necessary adjustments
- Evaluating water use efficiency of selected food and forage crops




ICBA's R&D…

Desalination - Sustainable use of Reverse Osmosis (RO) in agriculture

- Economic analysis of RO units for irrigation using saline groundwater
- Evaluating brine disposal practices to formulate guidelines to avoid groundwater contamination and environmental hazards
- Evaluating the brine induced salt movement through soil profile

Conservation of plant genetic resources adapted to marginal environments

- ICBA's genebank – a unique repository of germplasm of salt-tolerant species
- Over 9400 accessions of 220 species from 130 countries conserved
- Economically useful native plants with adaptation to the extremely hot and dry desert conditions being collected for conservation, research and future use

Thank you