Global Change Grand Challenge Science Plan
Chapter 1: introduction

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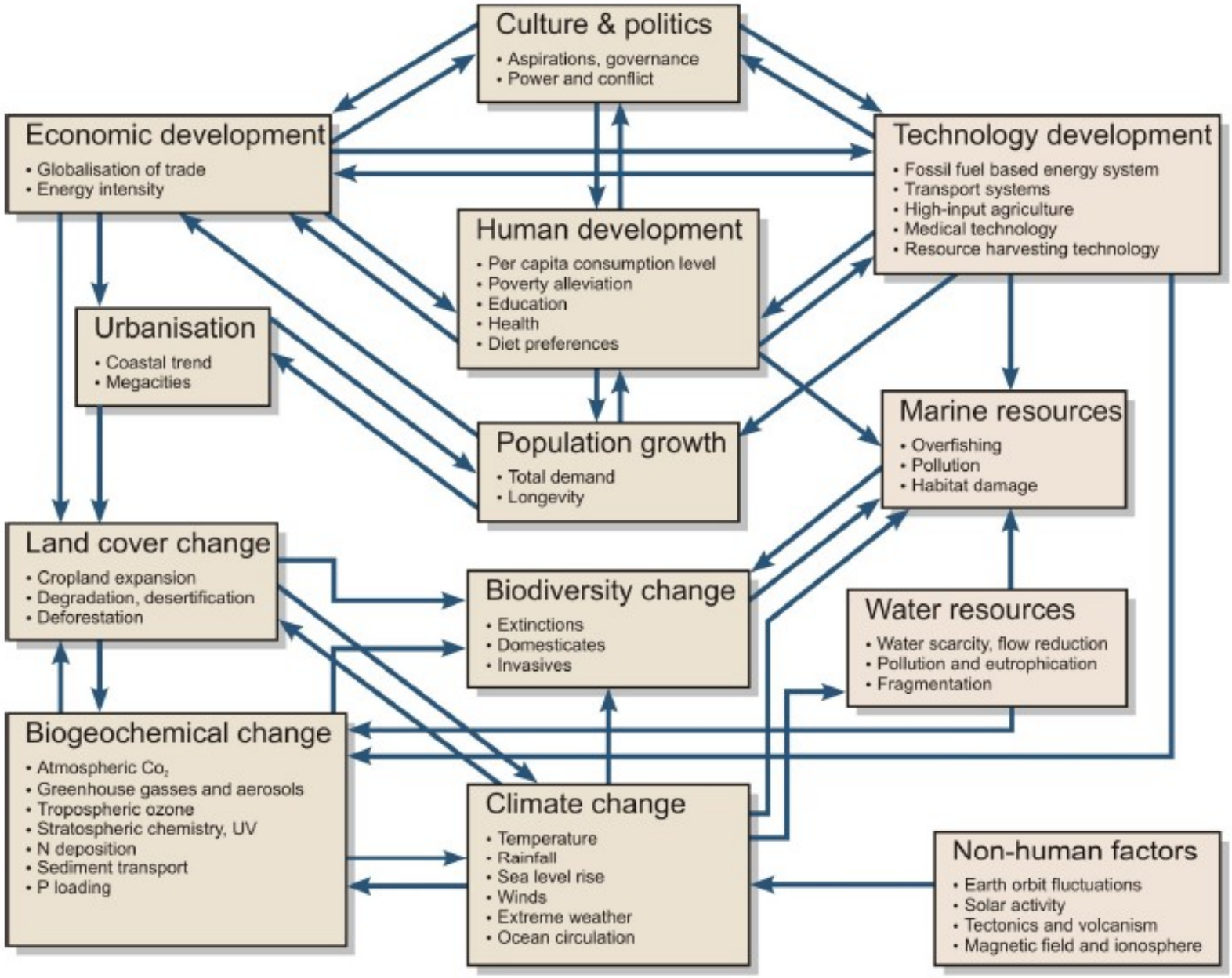
Objectives of the chapter

1. Define the scope of ‘Global Change’
2. Create a sense of urgency and importance
3. Establish criteria for the prioritisation of the research effort
4. Sketch the layout of the plan as a whole

What is in and what is out?

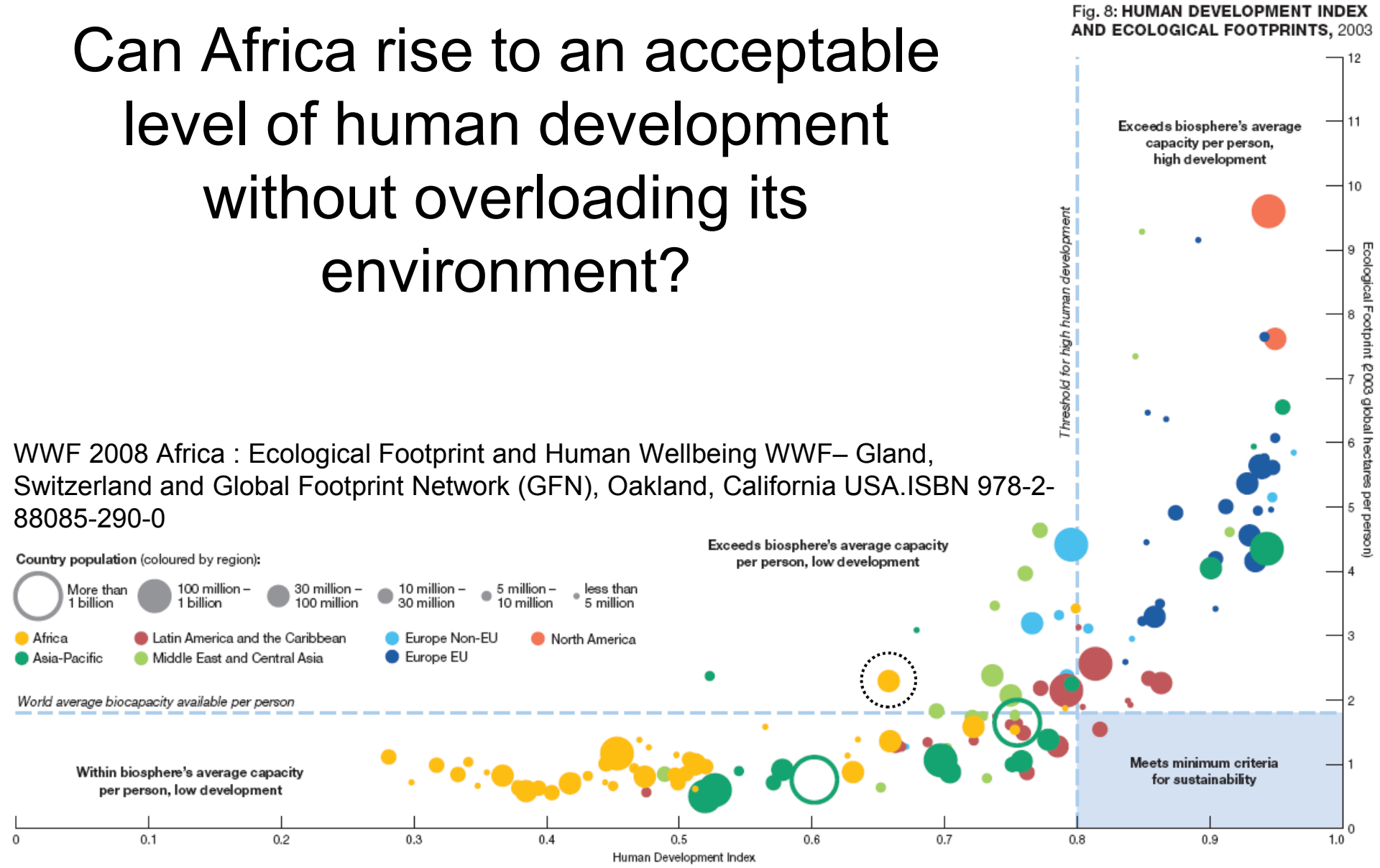
- This is ***Global Change***, not ***Climate Change***
  - Economic change, political change, land use change, atmospheric composition change and biodiversity loss are all ***in***
- Focus is contemporary change (ie past century to next century)
  - Palaeo-analysis is ***in*** as far as it illuminates contemporary issues
  - Deep time change (eg tectonics) is ***out***
- The unit of study is the *coupled human-ecological* system
  - Human sciences and humanities are ***in*** where relevant
  - Bear in mind that there is a Grand Challenge relating to human and social dynamics
- Energy system issues (ie most of mitigation) are ***out*** because they have their own Grand Challenge


Culture & politics
• Aspirations, governance
• Power and conflict
Economic development
• Globalisation of trade
• Energy intensity
Technology development
• Fossil fuel based energy system
• Transport systems
• High-input agriculture
• Medical technology
• Resource harvesting technology
Human development
• Per capita consumption level
• Poverty alleviation
• Education
• Health
• Diet preferences
Urbanisation
• Coastal trend
• Megacities
Marine resources
• Overfishing
• Pollution
• Habitat damage
Population growth
• Total demand
• Longevity
Land cover change
• Cropland expansion
• Degradation, desertification
• Deforestation
Biodiversity change
• Extinctions
• Domesticates
• Invasives
Water resources
• Water scarcity, flow reduction
• Pollution and eutrophication
• Fragmentation
Biogeochemical change
• Atmospheric Co_2
• Greenhouse gasses and aerosols
• Tropospheric ozone
• Stratospheric chemistry, UV
• N deposition
• Sediment transport
• P loading
Climate change
• Temperature
• Rainfall
• Sea level rise
• Winds
• Extreme weather
• Ocean circulation
Non-human factors
• Earth orbit fluctuations
• Solar activity
• Tectonics and volcanism
• Magnetic field and ionosphere

Urgency and Importance

- The world has changed more in the past 50 years than at any time in human experience
- The next 50 years are critical for the survival of modern civilisation
  - The capacity of the planet to absorb the byproducts of human activities
    - Greenhouse gases (leading to climate change)
    - Excess nutrients (leading to eutrophication of waters)
    - Toxins of many sorts in land, air and water
  - Resource limits
    - Peak oil
    - Land, water and genetic material to feed 9 Bn people by 2050
    - Freshwater for agriculture, industry and domestic use while keeping aquatic ecosystems functional
    - Wild-harvested resources such as fisheries, forests and rangelands

Can Africa rise to an acceptable level of human development without overloading its environment?



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Setting priorities

- National needs
  - What must we do because our wellbeing depends on it and nobody else is likely to do it?
    - Megacities, SA agriculture and forestry, fisheries, water
- National comparative advantage
  - What should we do because we do it best?
  - Geographical/locational
    - Southern oceans, upwellings, fynbos, succulent karoo
  - Disciplinary/historical
    - Dryland ecology, biodiversity
  - Geopolitical
    - Top-end developing country, emerging from a troubled past, participatory democracy, innovative laws.