Basin Planning and Environmental Flows in China

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Overview

1. Intro to water resources issues in China
2. Master basin planning
3. E-flows case study: Yellow River
4. E-flows case Study: Yangtze River

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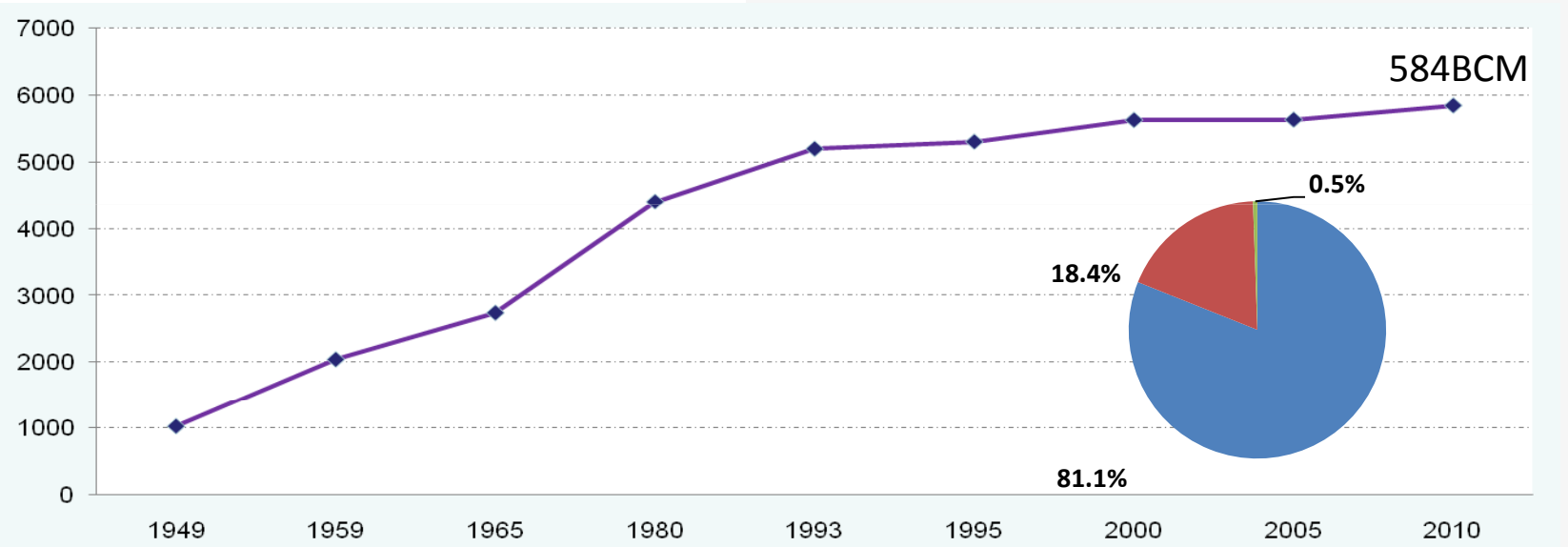
The context

- Annual water resources – 2.8 trillion m^3
- Rainfall – from 150mm to 2,000mm /yr
- 1,500 basins of >1,000 km^2
- Uneven distribution of water resources
- Per capita water resources 28% of world average
- Total water with drawls of 585 billion m^3 (20% of total renewable resource)



Water management in China

- Central, hierarchical system
- Central government sets national water policy
- 7 basin authorities, responsible for planning and oversight
- Provincial, prefecture and county governments with various responsibilities
- 2002 Water Law – provides planning and licensing system

Challenges

- Water shortages
- Pollution and water quality
- Flooding

Key responses

- No. 1 Policy document - “The Decision on Accelerating the Reform and Development of Water Conservancy” – and US$600 billion investment
- Master basin plans approved by State Council March 2013 for seven major river basins
  - Flood and drought prevention – includes objectives around both reducing flood risk and protecting ecosystems
  - Reasonable water allocation and efficient use
  - Water conservation and river health security
  - Institutional arrangements for water science
- Plans to be developed for 232 mid-sized basins
- Adoption of ‘Three Red Lines’ – limits on abstraction and pollution loads, and minimum efficiency standards

Recognition of environmental flows

- 2002 Water Law
  - Acknowledgement of requirement for water for the “ecological environment”
- 11th 5-year plan
  - “Building a Resource-Conserving and Environment-Friendly Society”
- Revision of Master Basin Plans
  - Recognition of environmental flows in plans for first time
- “Red-line” for water consumption

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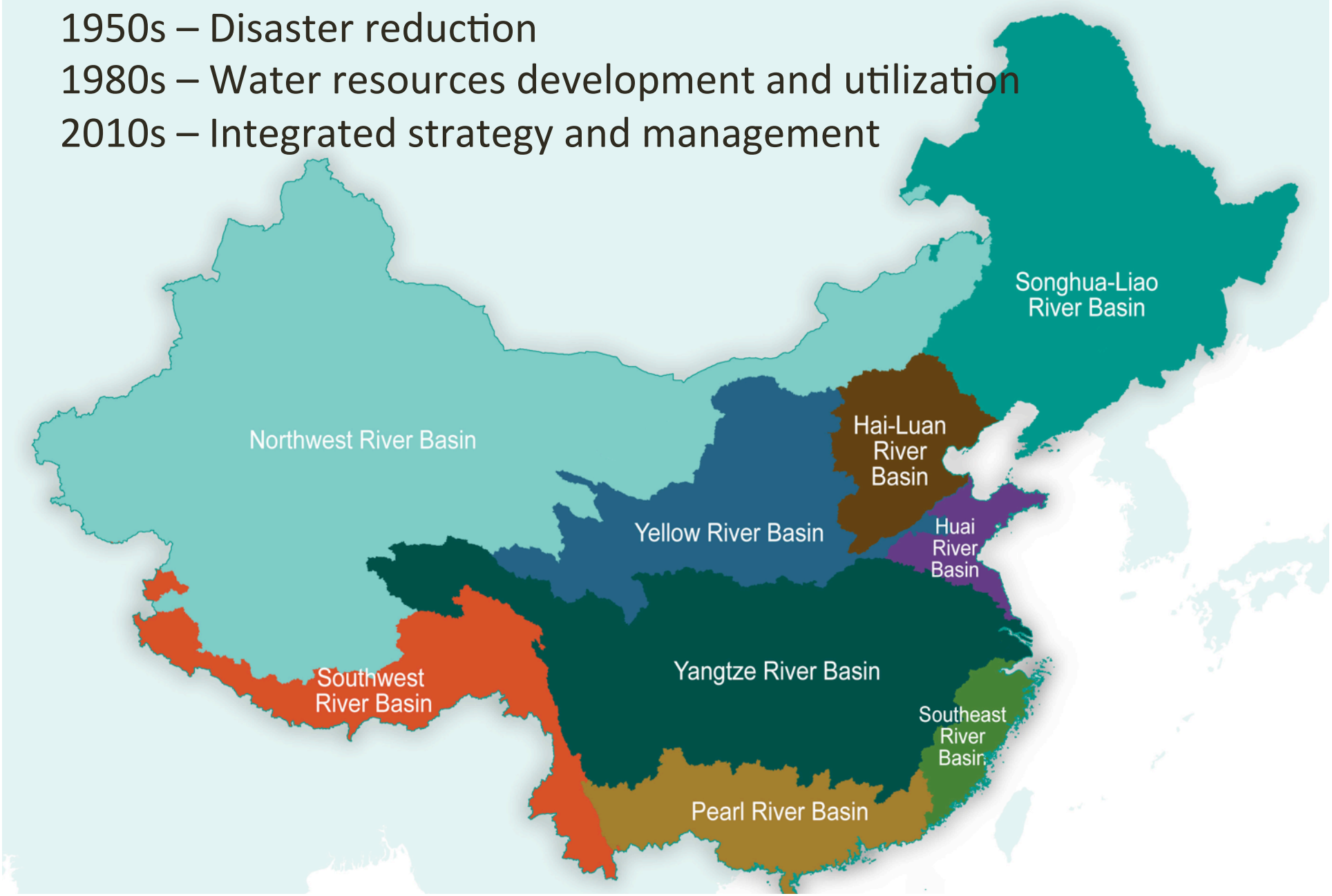
Three phases of Basin Master Plans

1950s – Disaster reduction
1980s – Water resources development and utilization
2010s – Integrated strategy and management



Drivers

- Extent of regulation of river systems
- Change in economic and social situation
- Change in physical condition of the basin
- Changes in objectives for the basin and management arrangements

A new approach

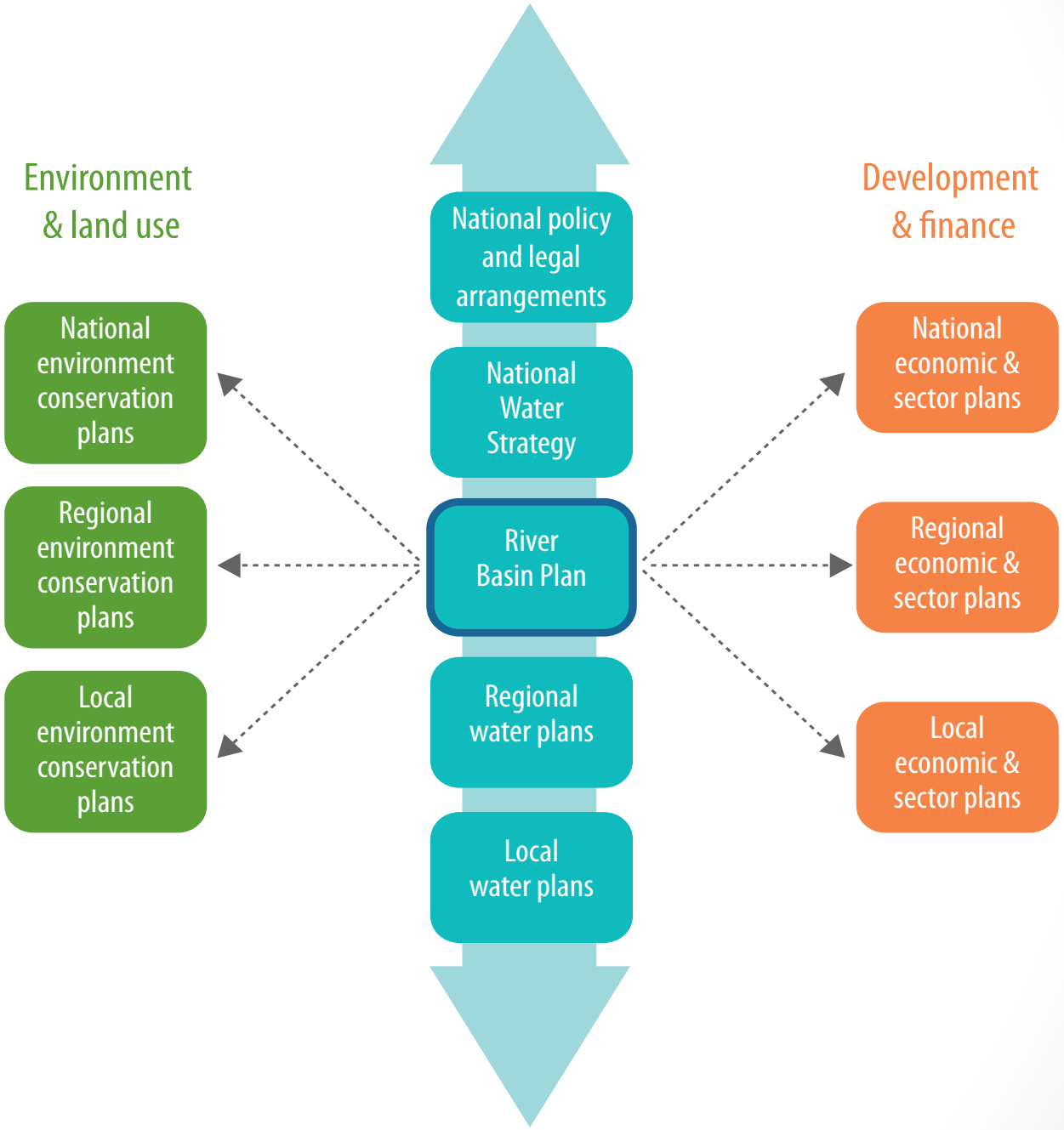
- Water planning vs. socio-economic and environmental planning
- Engineering vs. resource management
- Water resources development vs. water resources protection
- Spatial and segmented vs. strategic and integrated

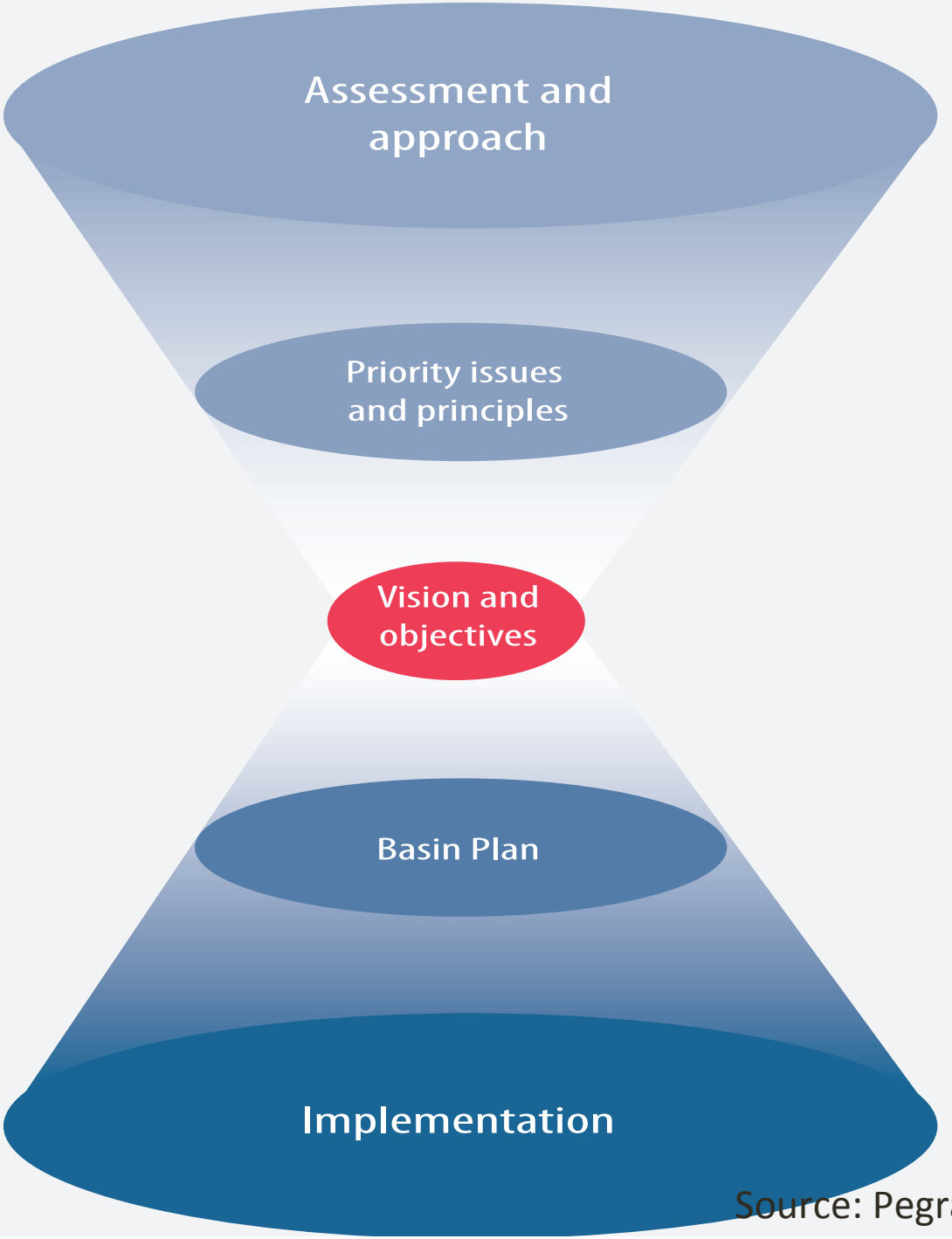
Manage trade-offs between:

- Human and nature
- Development and protection
- Regions and the river basin
- Engineering and management

	Technical water resources planning	Strategic basin planning
Extent of basin development	Basins with 'spare' water available for development and not facing significant environmental pressures	Complex or water-stressed basins requiring difficult tradeoffs between economic, social and ecological objectives
Issues of concern	Responding to identified water resources pressures	Responding to broader basin stress and socio-economic pressures
Purpose of basin planning	Reconciliation of water availability or quality with existing development goals: "water for the economy"	Water planning as an integral part of development planning: "water in the economy"
Objective	Development	Protection and management
Focus of attention	Water focused: water resources infrastructure systems	Society focused: economic, social and environmental systems supported by the river
Environmental requirements	Threshold levels, in particular water quality	Maintenance of ecosystem goods and services
Key skills in the planning process	Water planner led, with a focus on engineering skills	Co-operation between development, water and environment planners
Analysis techniques	"Technical optimisation" • WR infrastructure systems analysis • Economic cost-benefit analysis • Water quality assessment • Future water use projections	"Economic and environmental scenarios" • Integrated WR systems analysis • Social / economic analysis of water • Strategic environmental assessment • Scenario planning

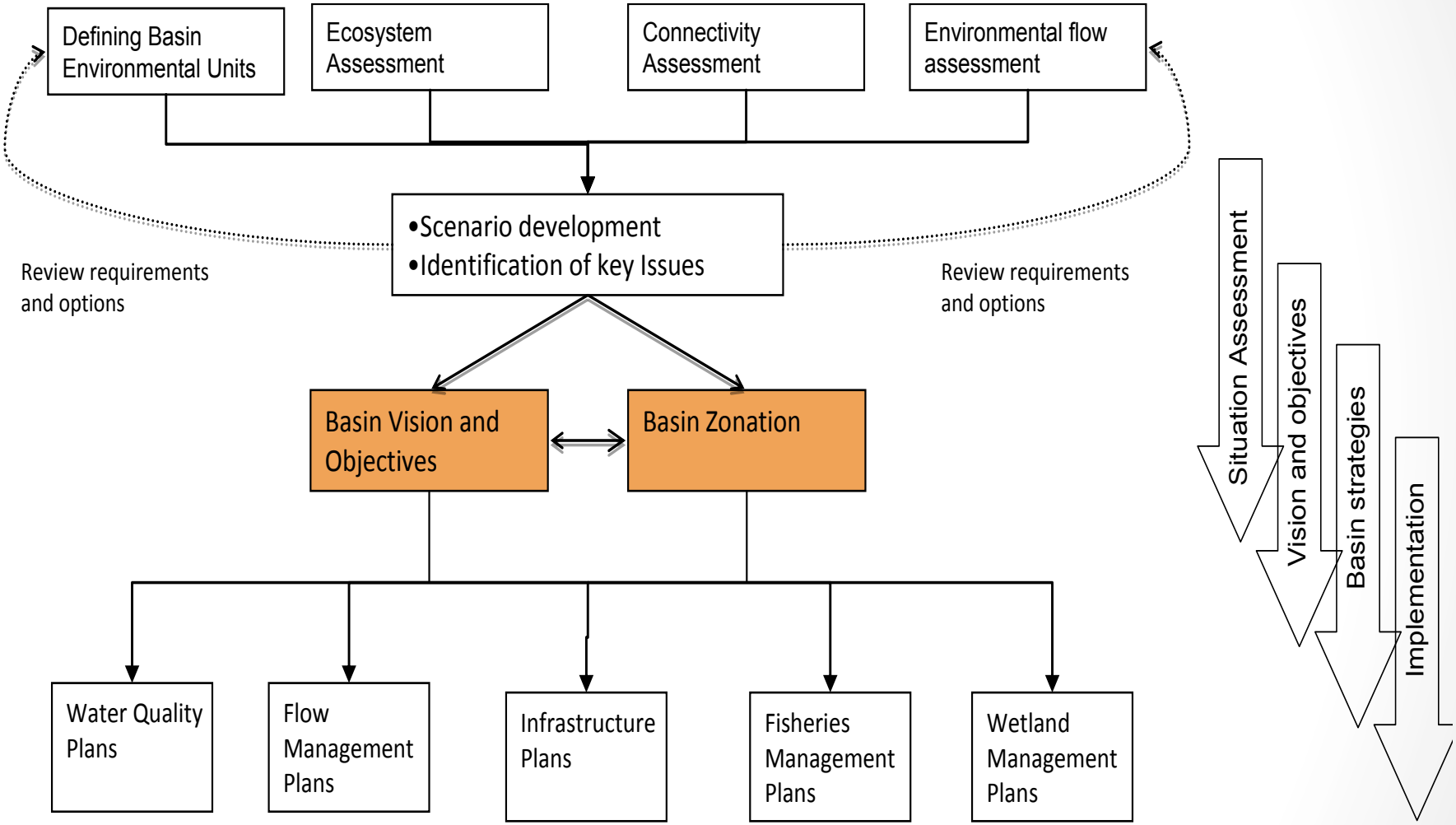
Alignment of water plans with other sectoral plans





Source: Pegram et al. 2013

Strategic environmental (basin) planning



River Basin Plan
Goals / Vision
Protection
Development
Disaster Risk
Institutional
Strategic objective and action
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Thematic plans
Financial mechanisms
Stakeholder engagement
Institutional coordination
Monitoring and information
Disaster/drought response
Waterlogging control
Flood risk management
Navigation
Hydropower
Water supply and irrigation
Water use efficiency
Water allocation
Water quality management
Groundwater protection
River and estuary protection
Wetland and lake ecology
Riparian and coastline
Implementation/Detailed Planning

Basin planning: lessons from China

- The importance of strategic basin planning as the issues in a basin become more complex
- Criticality of understanding of the role of water in the economy
- Recognition of linkage between basin function/condition and ecosystem services
- Understand the trade-offs

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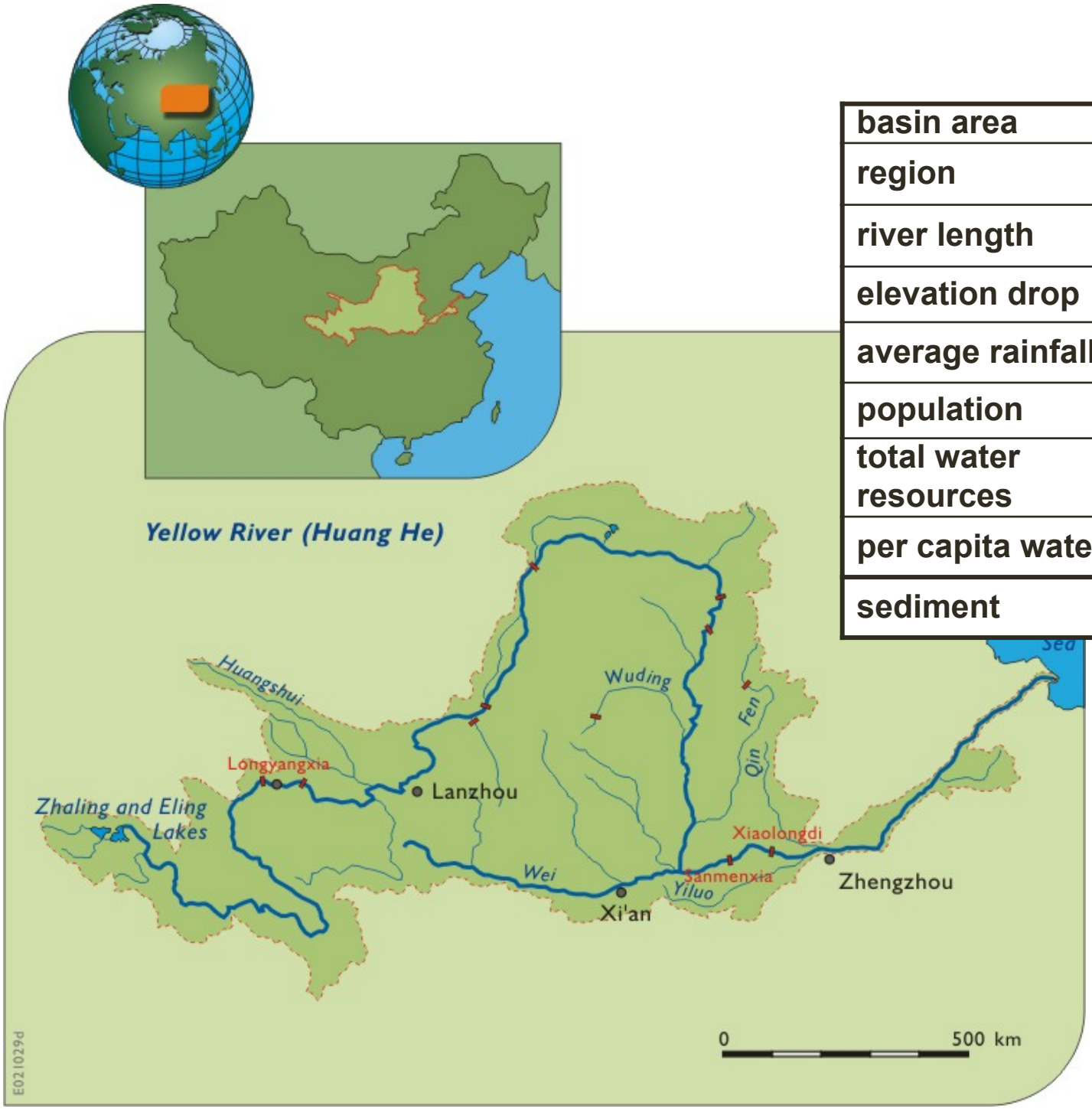
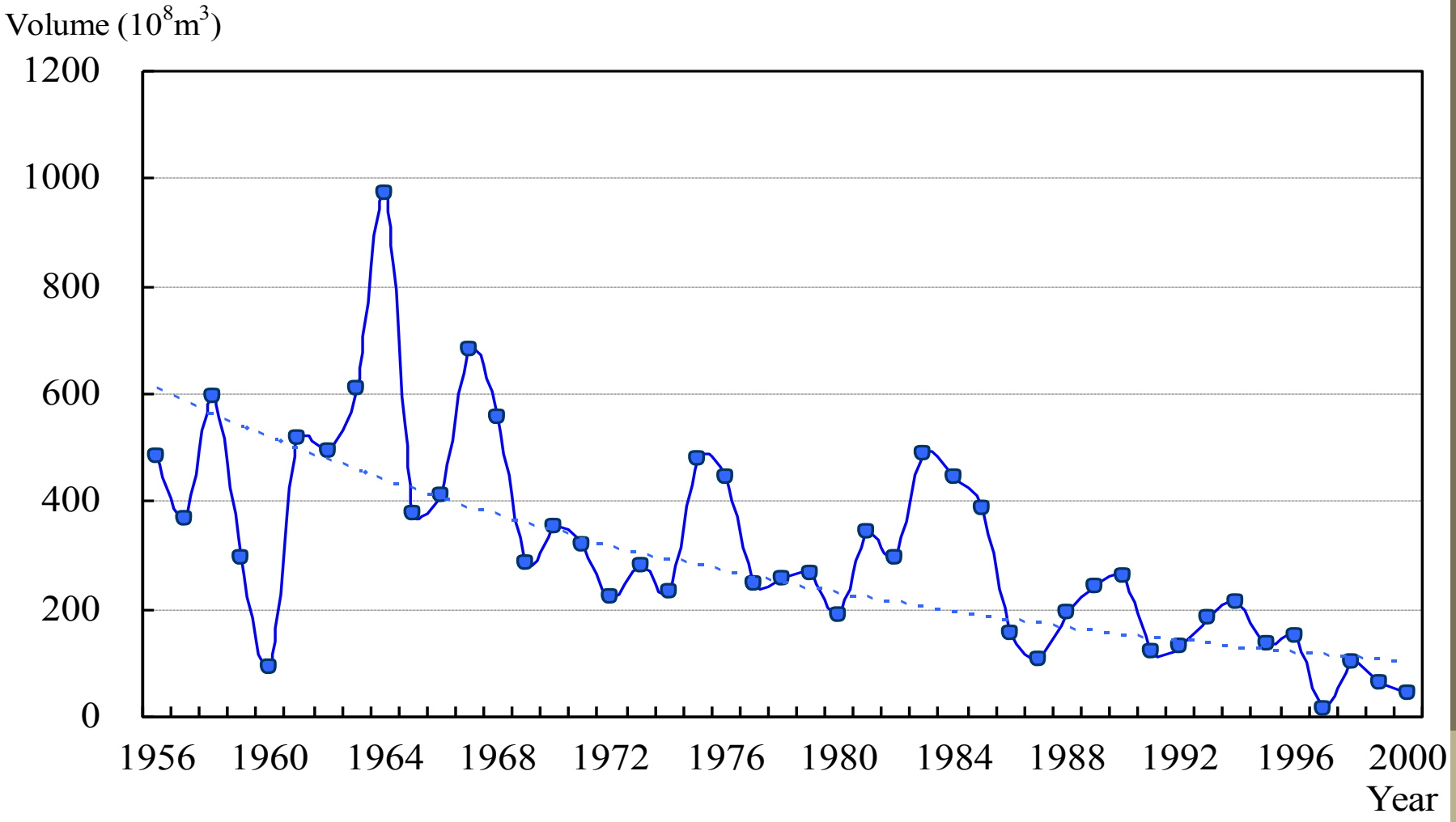
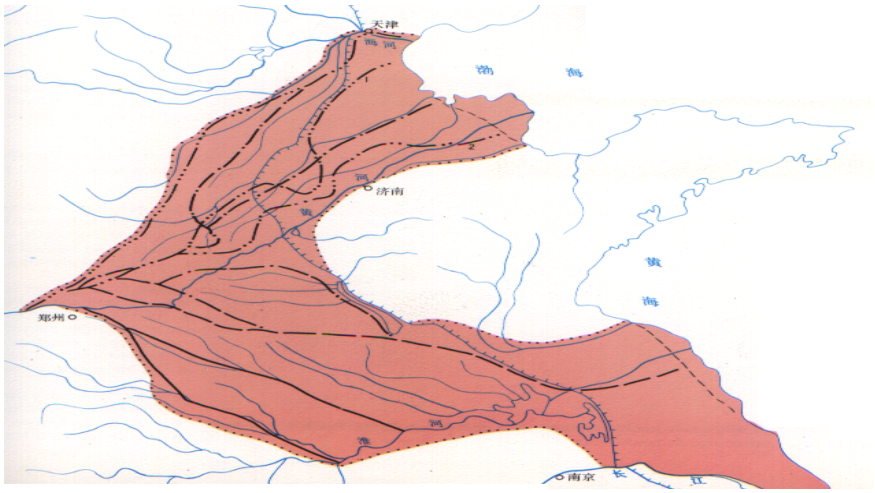


basin area	790,000 km^2
region	9 provinces
river length	5,464 km
elevation drop	4,480 m
average rainfall	450 mm
population	115 million
total water resources	58 billion m^3
per capita water	550 m^3
sediment	35kg/m^3

Yellow River flows 1956-2000

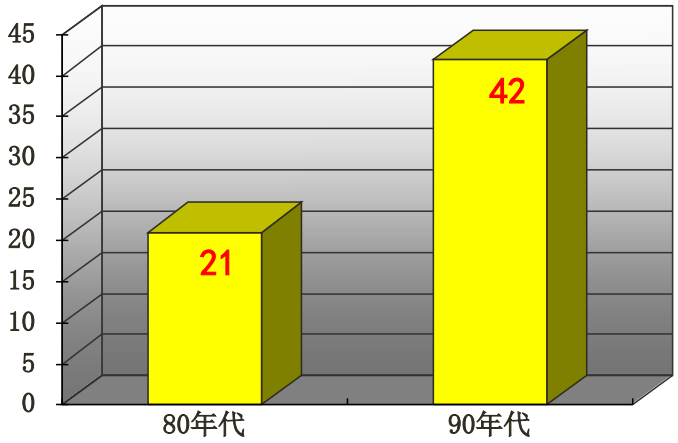


Management challenges in the Yellow River Basin



Floods

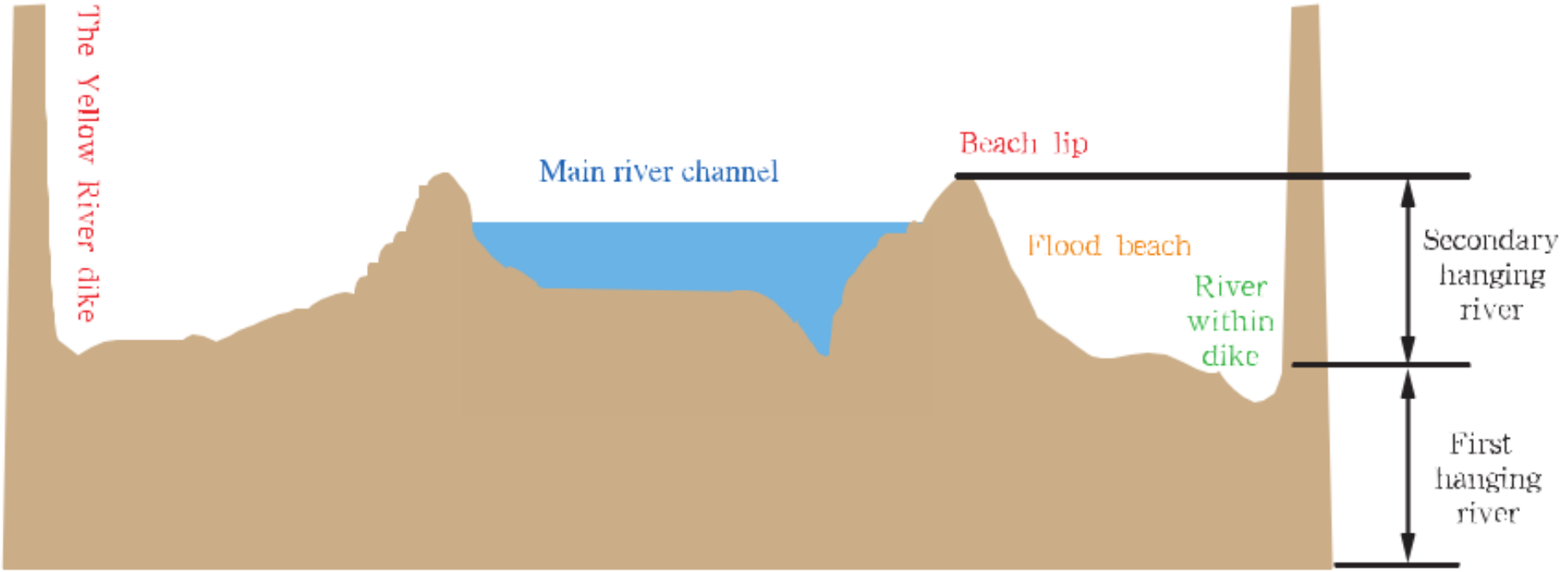
Water Scarcity



Water pollution

Soil Erosion/Sediment

Increased flood risk



Sediment deposition = raised river bed = high flood risk

Determining e-flow requirements

- Focus on sediment transport
- Identified needs to deal with 1 billion tons/yr
  - 400 million to be captured
  - 100 million to deposit in lower reach
  - 500 million to be flushed
- Flushing requirement of 21 billion m^3
- Includes a continuous minimum flow of 5 billion m^3 near the mouth during the non-flood period

1987 Water Allocation Scheme for the Yellow River

Province/ region	Water for agriculture (million m^3)	Water for other purposes (million m^3)	Total (million m^3)
Qinghai	1,161	249	1,410
Sichuan	40	0	40
Gansu	2,580	460	3,040
Ningxia	3,888	112	4,000
Inner Mongolia	5,251	609	5,860
Shaanxi	3,317	483	3,800
Shanxi	2,911	1,399	4,310
Henan	4,669	871	5,540
Shandong	5,324	1,676	7,000
Tianjin	0	2,000	2,000
Reserved for sediment flushing		21,000	21,000
Total	**29,141**	**28,859**	**58,000**

Annual regulation plan

- Regulates period November to June (non-flood period)
- Prepared annually in consultation with provincial departments
- Includes:
  - Maximum monthly abstraction and consumption for each province/region
  - Reservoir releases
  - Required flows at provincial boundaries
- During peak periods, refined every 10 days

E-Flows in Yellow River
Steps to implementation

1. Recognise the problem
2. Identify a clear objective
3. Where possible, provide a scientific basis to support decision-making
4. Incorporate the flow requirements within the allocation and management system
5. Allow flexibility for water dependent industries within the confines of a capped system
6. Continue to improve the system as information becomes available

Lessons from the Yellow River

- Natural capital plays a critical role in supporting water security
- E-flows assessments and objectives need to be customised to meet the local situation

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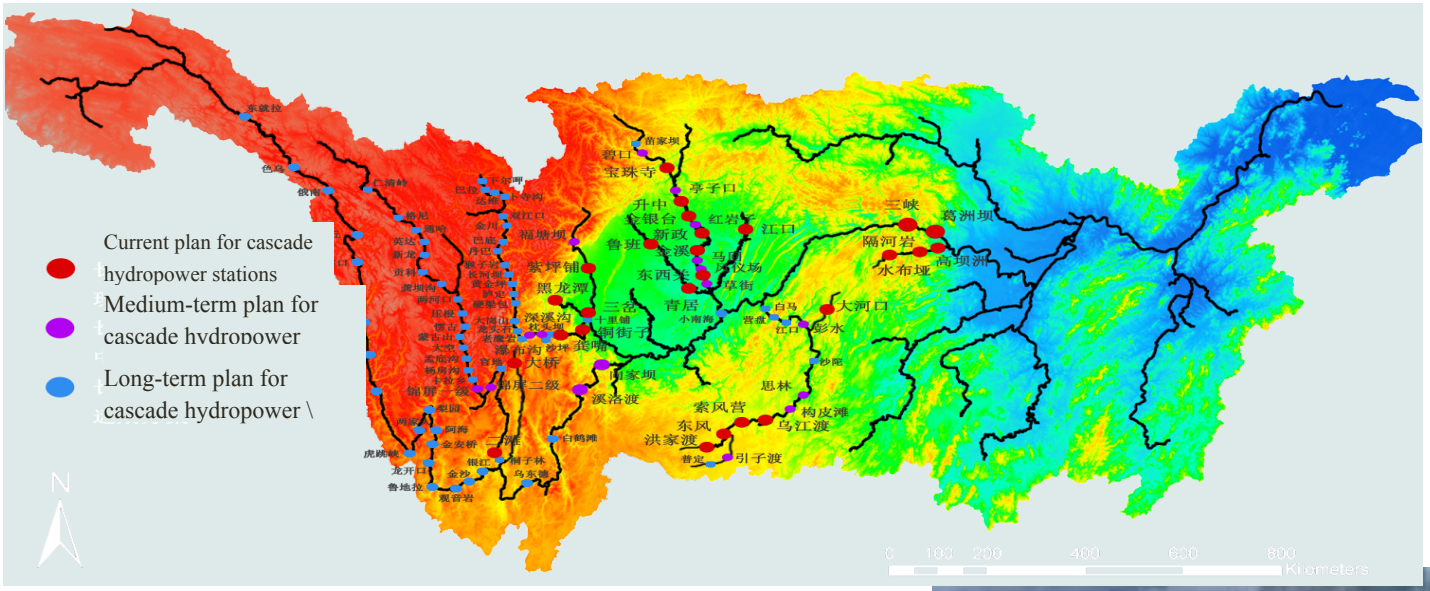
Development of the Yangtze Basin



- Storage capacity of 360 billion m^3, or 36.7% of annual average surface water resources
- 72 large hydropower station
- Total installed capacity of 1.2 trillion KW.

Impacts of changes to the flow regime

- Reduced sediment movement and consequences for connected lakes
- Collapse of fish fry for four major species of carp (95% reduction)
- Water quality issues and algal blooms on Tai Lake
- Saltwater intrusion in Yangtze estuary

Monitoring and adaption

- Recognition of:
  - High cost of changes to flow regime due to development
  - High cost of provision of eflows
- Implementation of extensive monitoring program to assess:
  - Impact of eflow trials
  - Impacts on Poyang and Dongting Lakes
  - Related ecosystem restoration works

Lessons from Yangtze

- Wide range of adverse impacts that can result from water resources development
- Importance of information to support rational decision-making and trade-offs

Final thoughts:

- While science and economics can inform planning and allocation decisions, these are ultimately socio-political decisions
- Such decisions should be made in a deliberate, transparent way, based on the best available science, and understanding the consequences