

High-Quality Development of River Basins and Adaptation to Climate Change: Managing River Basins as a System

流域高质量发展与气候适应——流域系统管理

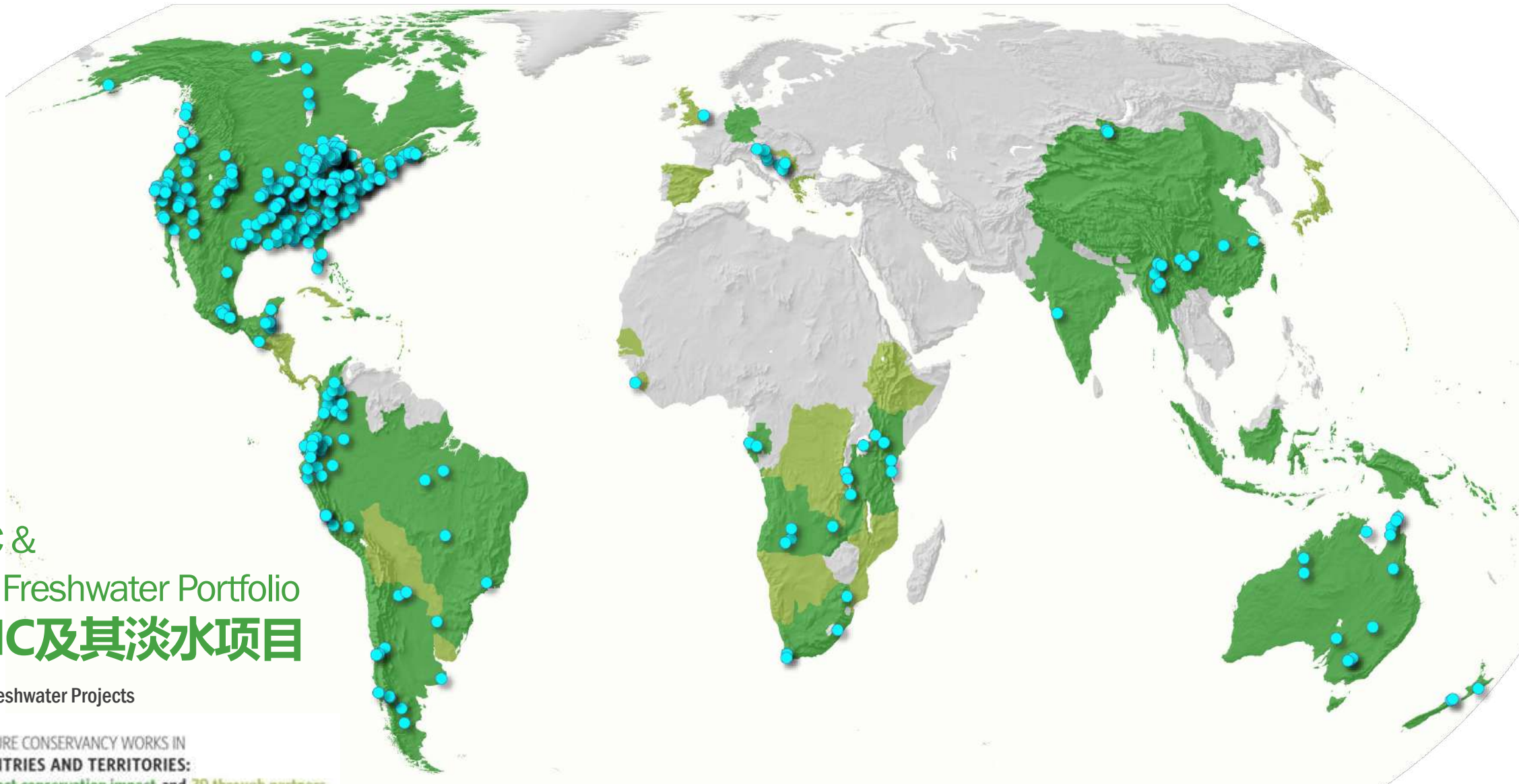
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TNC & Our Freshwater Portfolio TNC及其淡水项目

● Freshwater Projects

THE NATURE CONSERVANCY WORKS IN
76 COUNTRIES AND TERRITORIES:
37 by direct conservation impact and 39 through partners.





中国环境与发展国际合作委员会
China Council for International Cooperation
on Environment and Development



- 2020-2021

Scoping Study: Managing River Basin in Times of Climate Change
前期研究：气候变化背景下的流域管理

- 2021-2022

Special Policy Study: Low-carbon and Resilient Urban Development and Adaptation to Climate Change
专题政策研究：低碳韧性城市发展与适应气候变化

- 2022-2023

Special Policy Study: High-Quality Development of River Basins and Adaptation to Climate Change
专题政策研究：流域高质量发展与气候适应



Research Goals and 5 key principles

研究目标和关键原则

- Identify the universal **risks, challenges** and **specific manifestations** faced by major river basins.

确定流域面临的**普遍风险、挑战**和**具体表现**

- Summarize the **development trends** and **successful experiences** of several of the **world's major river basins**

总结部分**世界主要流域的发展趋势和成功经验**

- Targeted **recommendations** for high-quality development and climate adaptation in **China's and global river basins**.

面向**中国乃至全球的流域**高质量发展和气候适应的针对性**建议**

主要原则 Key Principle	可能的研究重点 Possible Research Focus
从源头到沿海履行责任 Fulfilling responsibilities from the source to the coast	区域合作机制 Regional Collaborative Governance Mechanism
根据百年愿景规划步骤 Planning steps according to the centennial vision	积极主动适应气候变化并提高韧性 Proactive in adapting to climate change and building resilience
人人参与，形成共同愿景 Everyone participating to form a common vision	基于多学科利益的协作组织 Collaborative organization based on multidisciplinary interests
在流域管理各方面考虑气候变化和其他主要压力源 Considering climate change and other major stressors in all aspects of river basin management	应对气候变化、其他压力源和灾害的不确定性 Addressing the uncertainty of climate change, other stressors and disasters
持续加强和创新 Continuous enhancement and innovation	管理方法、知识计划、政策工具和前瞻性融资机制等；国际交流 Management methods, knowledge programs, policy tools and forward-looking financing mechanisms, etc.; International exchange

Consider river basins as an important, perpetual, complex and uncertain system.

流域是重要、永续、复杂和充满不确定的生态系统

Pressures on functions and values of river areas

The river

- DAMS AND RESERVOIRS**
- Disturbed water flow
 - Sediment trapping
 - Methane emissions
 - Ecosystem interaction between river and lake
 - Ecosystem fragmentation, loss of wetlands, and blocking fish migration

- CANALISATION, SLUICES AND SHIPPING**
- Pollution
 - Disturbed water flow
 - Disturbed sediment flow
 - Ecosystem fragmentation, loss of wetlands, and fish migration obstacles

- FISHERIES, AQUACULTURE, SEDIMENT MINING AND WATER ABSTRACTION**
- Overfishing
 - Water pollution
 - River bed erosion
 - Water flow reduction
 - Reduced ecosystem quality

The catchment area

- AGRICULTURE, (DE)FORESTATION AND MINING**
- Mining
 - Fracking
 - Soil erosion
 - Nutrient emissions
 - Chemical pollution
 - Pesticide emissions
 - Groundwater abstraction
 - Change in forest water retention

- URBANISATION AND INDUSTRIALISATION**
- Plastics
 - Heavy metals
 - Legacy pollutants
 - Land subsidence
 - Sediment mining
 - Pathogen pollutants
 - Groundwater abstraction
 - Loss of floodplains and wetlands
 - Pharmaceuticals and (other) toxic substances
 - Soil sealing: Flash floods and urban flooding
 - Nutrient emissions, organic pollution and oxygen depletion

- PORT AND INDUSTRIAL DEVELOPMENT**
- Pollution
 - Water abstraction
 - Land subsidence
 - Loss of wetlands and mangroves
 - Disturbed water and sediment flow
 - Soil sealing: Flash floods and urban flooding

Interactions with the outside world

- WATER DIVERSIONS / TRANSFERS / RIVER INTERLINKING**
- Reduced water flow
 - Disturbed ecology (non-native species)

CLIMATE CHANGE AND AIR QUALITY

- Temperature rise
- Change rainfall patterns
- Intensified tropical storms
- Change in water temperature
- Change river discharge regime
- Change risk of floods and droughts
- More frequent/intense weather extremes
- Dry deposition pollutants and polluted rainfall

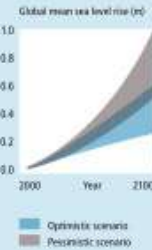
SOCIO-ECONOMIC

- Population growth
- Political (policy) shocks
- Economic development

VIRTUAL WATERFLOWS

SEA-LEVEL RISE

- Change inundation and food risk
- Change in salt intrusion
- Erosion



OUTFLOW INTO THE OCEAN

- Pharmaceuticals (and other) toxic substances
- Chemical pollution
- Nutrients and organic substances
- Fresh water
- Sediment
- Plastics

COASTAL ZONE & OCEAN

- (Toxic) algal blooms
- Oxygen depletion
- Wood growth
- Impacts on fisheries & aquaculture

River (including its estuary and delta) 河流 (包括河口和三角洲)

Dams; Canalization, sluices, river training and shipping; Fisheries and aquaculture; Sediment mining; Loss of floodplains, wetlands and water retention; pressures upon rivers in times of climate change

The Catchment Area 集水区

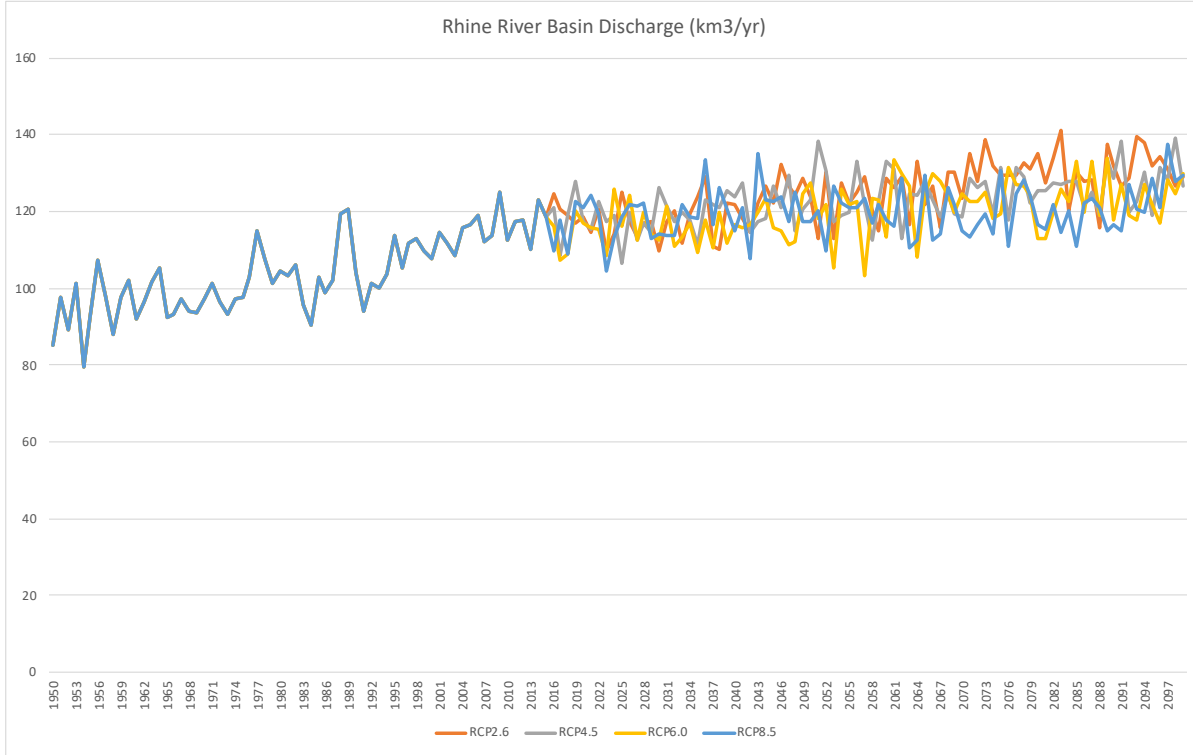
Pollution; Land Subsidence in Deltas; Change in Forest Water Supply Regulation Capacity; Soil Sealing; Groundwater Extraction; Soil Erosion; Deltas in Transition; Pressure in Catchment Areas in Times of Climate

Interactions with the outside world 与外界的交互

Climate Change Impacts; Sea-level Rise; Water Diversion, Transfers and River Interlinking; Non-native Species; Economic, Societal and Political Shocks; Air Pollution Into the Catchment; Pollution From The River Catchment to the Ocean; Pressures Linked to Transboundary Rivers

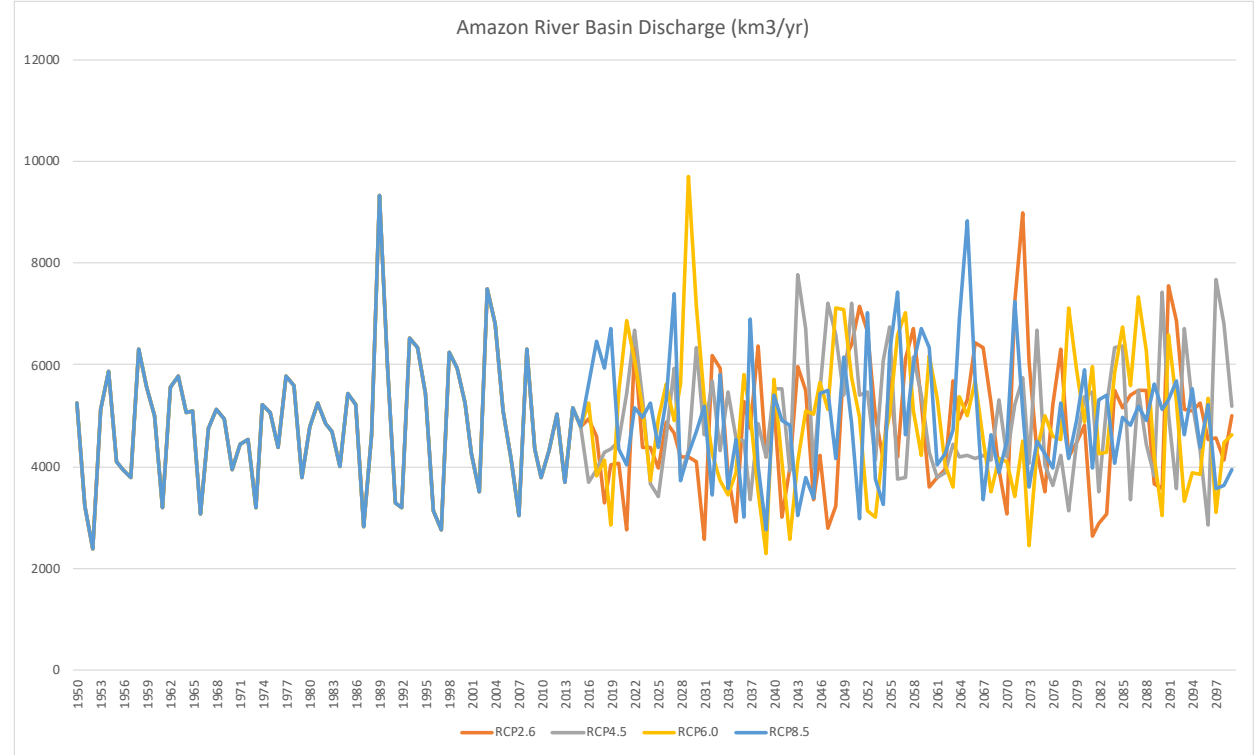
Climate Change and its Implication for hydrological patterns

气候变化对水文特征的影响



Rhine river basin: factor of 1.2 in max/min amplitude

莱茵河流域波动幅度为1.2倍



Amazon river basin: factor of 5 in max/min amplitude

亚马逊河流域波动幅度为5倍

A new balance between economic, social and ecological development and qualities 经济、社会和生态之间的新平衡

Climate change is structurally changing the **hydrological patterns**, increasing the frequency and intensity of weather extremes and creating more uncertainty.

气候变化正在结构性地影响**水文特征**，增加极端天气的频率和强度，并带来更多不确定性。

Existing pressures and related risks on river basins will be exacerbated by Climate change.

气候变化将加剧流域的**现有压力与风险**。

The socio-political environment is changing, striving for a transformation towards **ecological civilization/sustainable development**.

社会政治环境正在发生变化，向**生态文明/可持续发展转型**。

Shift from **function steers water** to **water steers function** 从**资源匹配功能**到**资源决定功能**

The functioning and qualities of river basins will set conditions and boundaries for human use and functions
河流的功能和质量将决定人类的使用和功能设计

Learn from history – Rhine and Mississippi

从历史中获益 – 莱茵及密西西比

Event	Response
North Sea Flood (1953) 1953年北海沿岸洪水	Delta Works (dams, storm surge barriers) guided by a special Delta Commission 三角洲特别委员会指导三角洲工程（水坝、风暴潮屏障）
Sandoz chemical leak disaster (1986) 1986年 Sandoz 化学品事故导致大量鱼类死亡	Rhine Action Programme (1987) countering aquatic pollution directed by ICPR (International Commission for the Protection of the Rhine) 莱茵河行动计划（1987年），由 ICPR（保护莱茵河国际委员会）指导打击水污染
Flood disasters (1993, 1995) 1993/1995 洪水灾害	Launched the "Room for the River" project 启动“还河流以空间”项目
EU Water Framework Directive (2000) and the Floods Directive (2007) 《水框架指令》（2000年）和欧洲洪水指令（2007年）	Growing awareness that improving quality and flood protection calls for basin-wide approach 通过全流域统筹方法提高治理水平和防洪能力的意识得到加强

Rhine river basin 莱茵河流域

- **Systematic transition**
系统性转变
- **New governance structures**
新治理结构
- **Natural disasters**
自然灾害

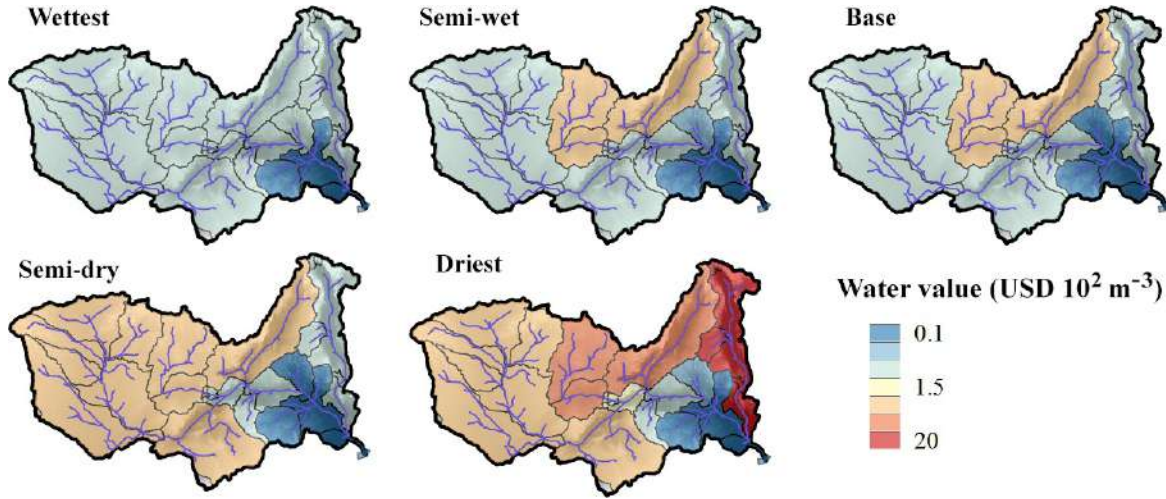
Mississippi River Basin 密西西比河流域

- **Federal and state governments**
联邦政府和州政府
- **Upstream and downstream**
上下游
- **Internal cooperation**
内部协作

Hydro-economic - Zambezi River Basin

水利经济学—赞比亚河

Average water value under climate change scenarios
不同气候变化情景下的平均水价值



Impact of climate change on the water-energy-food system
气候变化对水-能源-食物系统的影响

Key indicators	Driest	Semi-dry	Semi-wet	Wettest
Available runoff (10 ⁶ m ³ yr ⁻¹)	-62 195	-29 838	-892	40 156
Agriculture sector benefits (USD million per year)	-1644 (-15 %)	-176 (-2 %)	-206 (-2 %)	218 (+2 %)
Crop price index	+33 %	+7 %	+4 %	-4 %
Energy sector benefits (USD million per year)	-714	-365	-24	187
Hydropower production (GWh yr ⁻¹)	-15 668	-8801	-518	4981
CO ₂ emissions (Mt yr ⁻¹)	10	5	0	-2

- 1.6M km²
160万平方公里
- 8 countries
8个国家
- Population 47M
约4700万人口
- Rainfed agriculture and extractive industries
以农业、采矿业为主

• Zambezi River basin strategic(2018) - Zambezi River Commission
赞比亚河委员会于2018年制定了该流域的战略规划

A future preferred development pathway basic on ensuring the maintenance of moderate environmental flows and provision of flood protection.
确保维持适度的生态流量和提供防洪保护的前提下，规划未来发展路径。

Policy Recommendations

政策建议

- Form a **strategic and comprehensive solution** that covers the entire river basin, multiple sectors and objectives
形成贯通全流域、多部门、多目标的“**战略性综合解决方案**”。
- Establish a **comprehensive assessment mechanism for river basin** to comprehensively assess the impact of various policies, measures and construction practices on river basin governance
建立**流域综合评估机制**，综合评估各类政策、措施和建设行为对流域保护治理的影响。
- Strengthen **regional coordination** to create synergy across **time, space and sectors**
加强**区域协调**，形成**跨时间、跨空间、跨领域**合力
 - **Space**: based on spatial units of sub-basins and sub-regions, **preventing the transfer of problems to elsewhere.**
空间协同，基于次级流域、次区域的空间单元，**避免将问题转移到其他地区。**
 - **Sectors**: agriculture, industry, nature, urban, energy, transport, and other sectors commit to a fundamental development strategy to maximize cross-sectoral benefits, **preventing no negative impacts are transferred to other sectors.**
部门协作，农业、工业、生态、城市、能源等相关部门共同参与流域发展战略的制定，提高跨部门效益，**避免将负面影响转移到其他部门。**
 - **Time**: based on a review of history and a vision of the future, both in terms of learning from history and looking ahead to possible future impacts of basin activities as well as climate change, which should span at least 100 years, **preventing the transfer of problems to the future.**
时间视野，向历史学习，也对未来区域发展和气候变化的可能影响进行展望。展望时间跨度至少为100年，**避免将问题转移到未来。**
- Specify **specific management requirements** in different regions and time phases to ensure the measures are locally **acceptable, implementable and assessable.**
在相关法律框架下，在区域和时间尺度上明确**具体管理要求**，确保相关措施在执行层面**可接受、可实施、可考核。**

Good Practices and Promising Approaches: Hydropower by design – US Penobscot River

有益实践和方法：水电工程系统性规划——美国佩诺布斯科特河

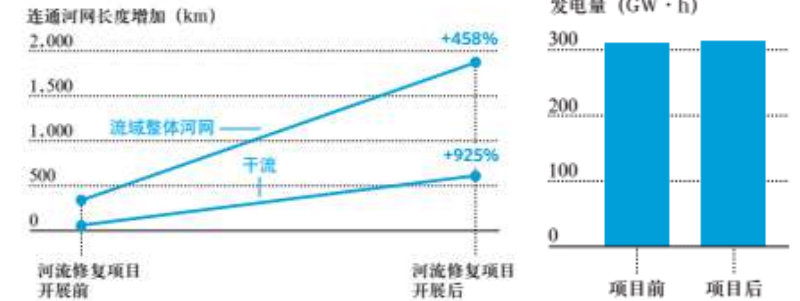
大坝拆除前的连通河网



大坝拆除后的连通河网



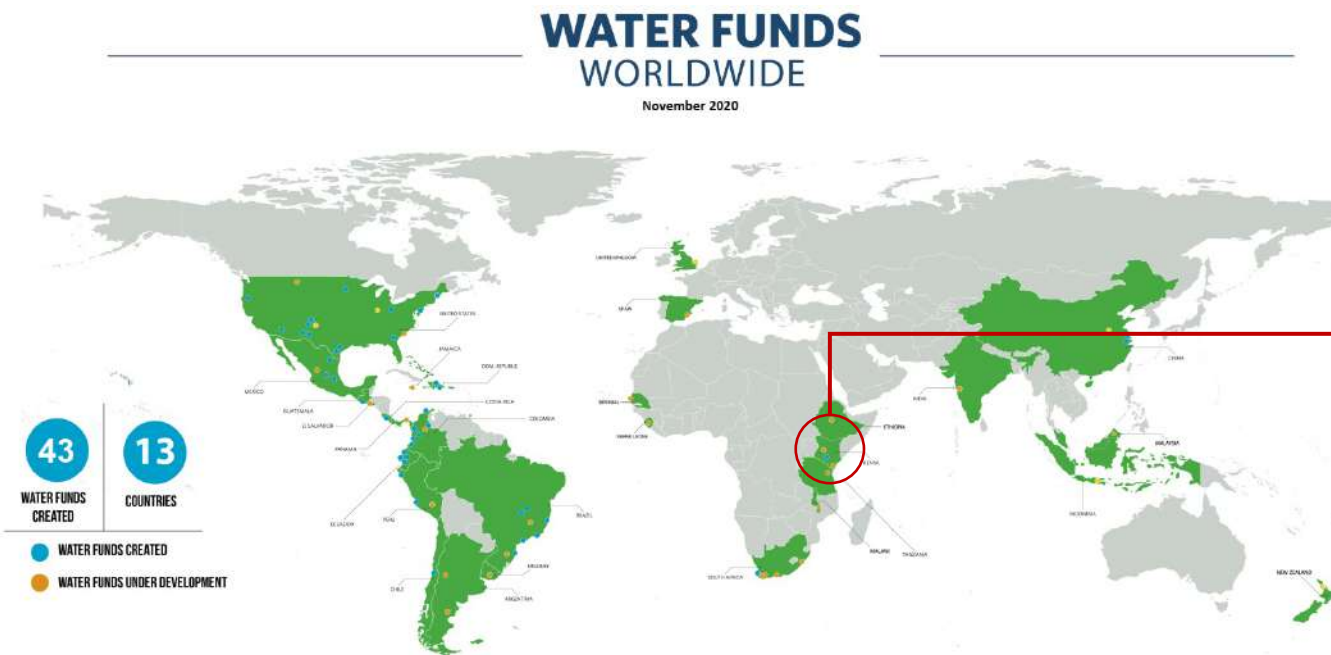
● 干流上的大坝 — 溯游鱼类可达河网 — 干流 — 流域整体河网



- Project Goal: To restore fish populations and meet hydroelectricity requirements (Water, Environment, Energy and Finance)
项目目标：恢复鱼类种群，并且满足水力发电量要求（水资源、环境、能源、财务）
- Multi-scenario assessment, systematic planning; implementation of the best option that minimizes environmental impacts without affecting hydroelectric capacity; monitoring and research
多情景评估，系统性规划；执行“不影响水力发电量情况下，对环境的影响最小”最佳方案；持续监测研究
- Multi-participant: hydroelectric companies, local communities, NGOs and government agencies
多方参与：水电公司、本地社区、非盈利保护组织、以及政府相关部门

Good Practices and Promising Approaches: Water fund – Upper Tana-Nairobi

有益实践和方法：水基金——上塔纳河-内罗毕水基金



The first water fund in Africa in 2015 成立于2015年，非洲第一个水基金

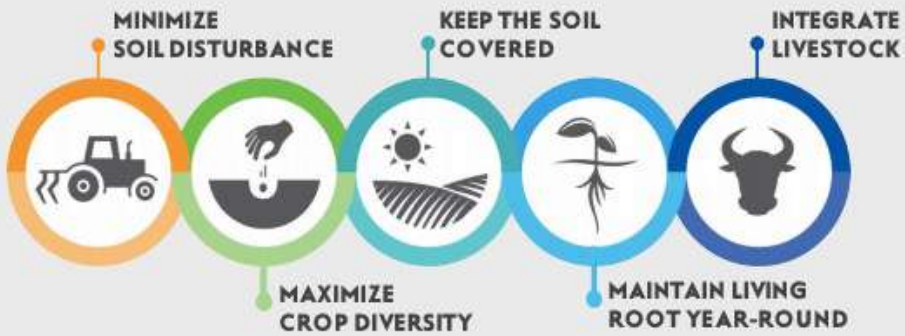
- Link the donors and major water consumers downstream with the farmers upstream, through the water fund committee
连接下游用水者和上游生产者，通过水基金管理委员会
- Erosion, non-point pollution
水土流失，农业面源污染

- ✓ Ensure clean water flows to **9 million people**
确保**900 万人**的清洁用水
- ✓ **73,000 hectares** of land in the watershed improved
流域**73,000公顷**土地管理得到改善
- ✓ **8,500 farms** certified by the Rainforest Alliance, **\$3 million USD** per year in increased agricultural yields for smallholders and agricultural producers
8,500 个农场获得雨林联盟认证，小农户和农业生产者每年合计**增收300 万美元**

Good Practices and Promising Approaches: Regenerative Agriculture

有益实践和方法：再生农业

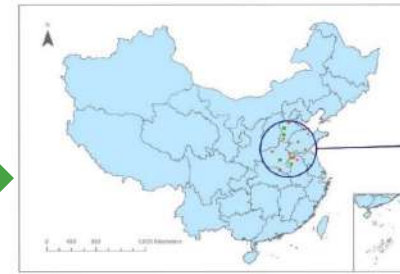
5 Core Principles of Regenerative Agriculture



3 Key Outcomes

- Improve soil health
- Foster biodiversity
- Promote economic resilience in farming communities

- 农机总站
- 鑫乐推荐
- TNC走访
- MAP试验点



Center of Agricultural Mechanization
Ministry of Ag and Rural Affairs
农业农村部农业机械化总站



中國農業大學
China Agricultural University

先正达集团中国
Syngenta Group China



The Nature Conservancy
大自然保护协会

North China Plain Pilot 黄淮海试点

Soil Health:

- 70% reduced machinery operation 减少70%农机作业
- 50-100% coverage of soil surface 50-100%土壤覆盖
- 100% straw to feed the soil 100%秸秆原地循环

Yield: No significant difference 没有产量差异

Farm Income: \$400-\$460/ha more profit 节省成本每亩 ¥ 150元

Resilience: 5-10% more water holding at drought seasons 在干旱期增加5-10%土壤持水能力



Good Practices and Promising Approaches: Yellow River Wetland Conservation Network

有益实践和方法：黄河流域湿地保护网络



- Founded in **2014**
成立于**2014年**
- Up to **100 members**
成员近**100家**
- Wetland management agencies, reserves, parks, research institutions, NGOs, etc.
成员类型：湿地管理机构、湿地保护区、湿地公园、湿地研究单位、社会团体等
- Qinghai, Sichuan, Gansu, Ningxia, Inner Mongolia, Shanxi, Shaanxi, Henan, Shandong
覆盖省区：青海、四川、甘肃、宁夏、内蒙古、山西、陕西、河南、山东

The Challenges 面临挑战



What We Strive For 奋斗目标



THANK YOU

谢谢

The Nature
Conservancy 

大自然保护协会