NATURE AND CLIMATE NEXUS

Nature-Based Solutions for Urban and Rural Landscapes

Lecture Series + Project Design Clinic
17–19 September 2024 • ADB Multifunction Halls 2 and 3 • Hybrid

This training is organized by **the ADB Environment Group** together with the **Water and Urban Development Sector Group,** and the **Agriculture, Food, Nature, and Rural Development Sector Office.**

DAY 1

Nature-Based Solutions & Water Security: An Introduction

Speakers

Resilient watersheds/rural expert

Brooke Atwell

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The Nature Conservancy

Urban expert

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Urban Conservation
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OBJECTIVES

- Develop a shared understanding of Nature-based solutions and water security
- Understand how NBS can achieve multiple water security objectives
- Understand how to mitigate potential challenges to investing in NBS at scale and across a watershed, particularly in terms of funding and governance models

NATURE-BASED SOLUTIONS

DEFINITION AND OPPORTUNITIES FOR WATER SECURITY

Water Security

UN Water, 2013

The capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for:

- ✓ Sustaining livelihoods, human well-being, and socio-economic development
- ✓ Ensuring protection against water-borne pollution and water-related disasters, and
- ✓ Preserving ecosystems

…in a climate of peace and political stability

Water quality and quantity challenges, including drought and flooding, can be driven by any number of factors

Demography	Food Production	Energy Generation	Climate Change	Poor Water Management
• Population growth • Urbanization	• Food demand growth • Diet changes	• Energy demand growth • Biofuels • Storage	• Changes in precipitation (frequency, duration, intensity) • Glacial melt • Extreme weather events • Sea level rise	• Water contamination • Deficiencies in the legal framework • Institutional deficiencies • Poor governance • Lack of funding

Conventional modern approaches rely on technical fixes to improve water security

Water / Wastewater Treatment

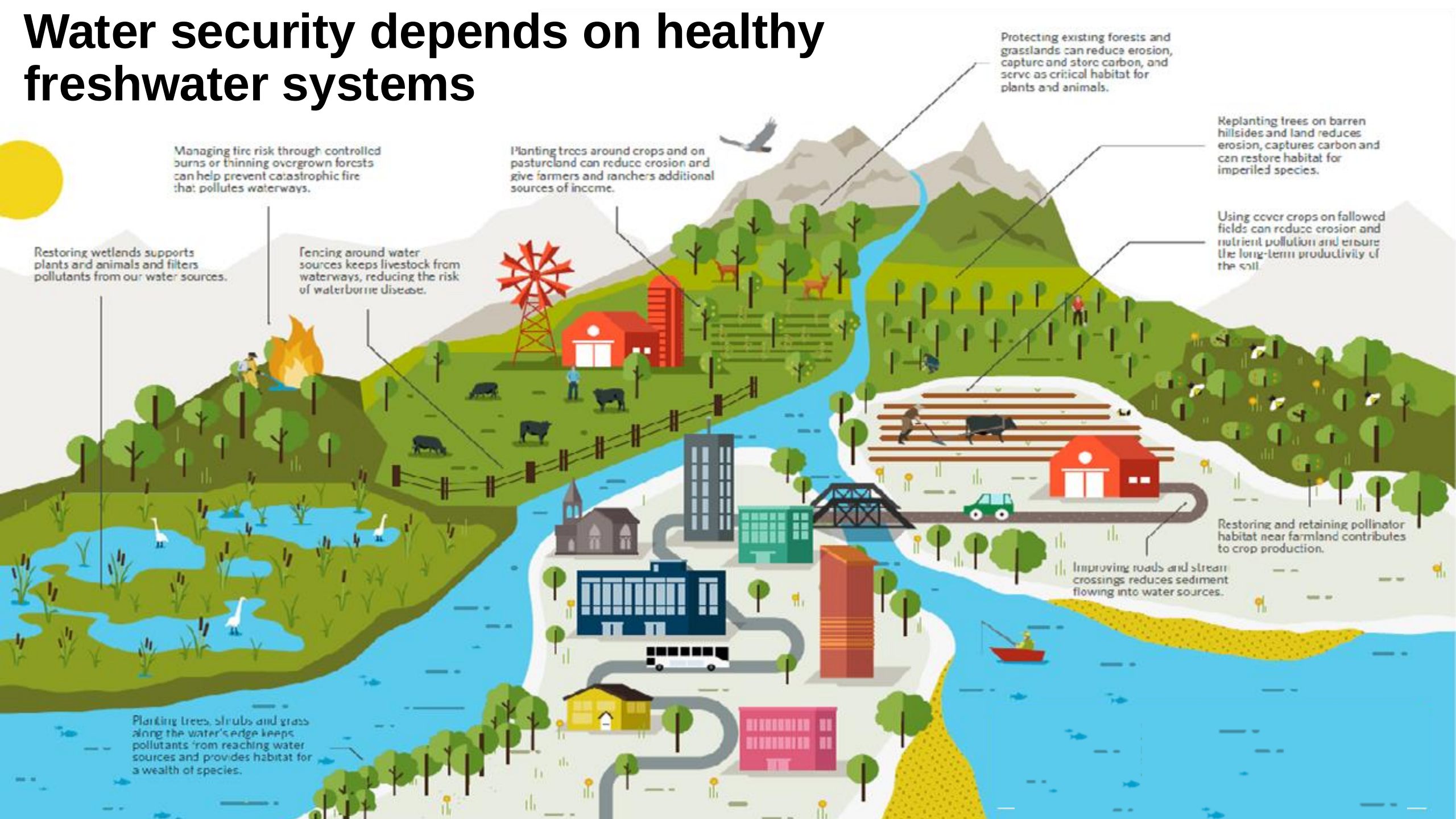
Built Reservoirs

Water Transport Infrastructu

Inter-basin Transfers

Desalinatio n Plants

Water security depends on healthy freshwater systems



Natural Infrastructure for Water Management

Investing in nature for multiple objectives

*Hybrid solutions that contain built elements that interact with natural features and seek to enhance their water related ecosystem services.

Nature-Based Solutions

IUCN, 2016

actions to protect, sustainably manage and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.

1 Protection

an intervention that prevents, or greatly limits, overexploitation of natural resources to achieve the long-term conservation of nature.

EXAMPLES
National park designation, fencing, support for park guards.

2 Restoration

an active or passive intervention that involves returning degraded, damaged or destroyed ecosystems to pre-disturbance state.

EXAMPLES
Reforestation, grassland revegetation, riparian restoration, wetlands restoration, floodplain restoration, invasive species removal, barrier removal

3 Management

all natural resource management interventions beyond protection and restoration.

EXAMPLES
Agricultural best management practices, ranching best management practices, forestry best management practices, fire management

4 Creation

the establishment, protection or management of artificial ecosystems.

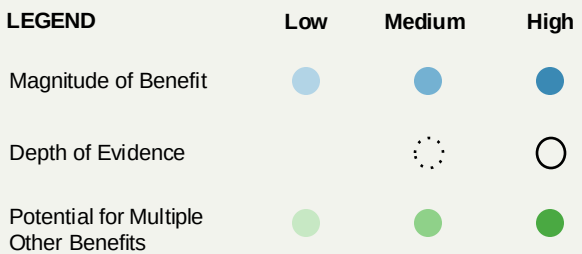
EXAMPLES
Artificial grasslands, created wetlands (not restored), urban green infrastructure (SUDS, bioswales, natural retention ponds)

Nature can help.

Nature-based solutions can improve water security and deliver multiple co-benefits. By investing in NBS at scale, we can improve water security, restore biodiversity, enhance communities' resilience to climate change and promote equitable, inclusive development

FIGURE 10: Summary table adapted from NBS Options Factsheets Deep Dive comparing typical water security benefits addressed and potential for co-benefits. TNC, 2022.

Water Security Challenge		Water Availability		Disaster Risk	Water Quality		Potential for other benefits
Ecosystem Benefit		Dry Season Flows	Groundwater Recharge	Flood Risk	Erosion & Sediment	Nutrients & Pollutants	
Protection							
1	Targeted Habitat Protection						
Restoration							
2	Revegetation						
3	Riparian Restoration						
4	Wetlands Restoration						
5	Floodplain Restoration						
Management							
6	Agricultural Best Management Practices (BMPs)						
7	Ranching BMPs						
8	Forestry BMPs						
9	Fire Management						
Created Habitats							
10	Artificial Wetlands						
11	Sustainable Urban Drainage Systems (SuDS)						



The Nature Conservancy

Ecosystem Services

Millenium Ecosystem Assessment

the benefits provided to people, both directly and indirectly, by ecosystems and biodiversity.

An ecosystem service must be linked to an identifiable set of human beneficiaries

Four Categories of Ecosystem Services

1 Provisioning

A **provisioning service** is any type of benefit to people that can be extracted from nature

EXAMPLES
Food, fiber, biomass fuel, freshwater, and natural medicines

2 Regulating

A **regulating service** is the benefit provided by ecosystem processes that moderate natural phenomena

EXAMPLES
air quality, climate, water runoff, erosion, natural hazards, pollination

3 Cultural

A **cultural service** is a non-material benefit that contributes to the development and cultural advancement of people

EXAMPLES
Ethical values, existence values, recreation, tourism

4 Supporting

Supporting services are those necessary for the production or the maintenance of all other ecosystem services

EXAMPLES
Nutrient cycling, water cycling, soil formation, photosynthesis

Ecosystem services provided by freshwater

examples not exhaustive

1 Provisioning

A **provisioning service** is any type of benefit to people that can be extracted from nature

- Water (quantity and quality) for consumptive use, e.g., drinking, domestic use, and agriculture and industrial use
- Water for nonconsumptive use, e.g., generating power and transport/navigation
- Aquatic organisms for food and medicines

2 Regulating

A **regulating service** is the benefit provided by ecosystem processes that moderate natural phenomena

- Maintenance of water quality (natural filtration and water treatment)
- Regulating flows, including flood control and subsurface flows
- Erosion control through water/land interactions

3 Cultural

A **cultural service** is a non-material benefit that contributes to the development and cultural advancement of people

- Recreation (river rafting, kayaking, hiking, and fishing as a sport)
- Tourism (touring freshwater ecosystems, wildlife watching)
- Connection with nature
- Sacred freshwater ecosystems

4 Supporting

Supporting services are those necessary for the production or the maintenance of all other ecosystem services

- Role in nutrient cycling (e.g., role in maintenance of floodplain & delta fertility), primary production
- Predator/prey relationships and ecosystem resilience

NBS can improve water security and generate multiple co-benefits

WATER SECURITY

1. **Maintain or improve water quality**
2. **Maintain or improve river flows and aquifer recharge**
3. **Reduce impact of flooding**

CLIMATE CHANGE ADAPTATION

1. Reduce soil erosion, and improve soil quality
2. Urban heat reduction
3. Reduce frequency and intensity of forest fires, floodings and droughts

BIODIVERSITY CONSERVATION

1. Landscape diversity
2. Protect and expand natural habitat
3. Limit expansion of invasive species

CLIMATE CHANGE MITIGATION

1. Reduce greenhouse gases emissions
2. Carbon sequestration

HUMAN HEALTH AND WELL-BEING

1. Improve food security
2. Reduce exposure to polluting substances
3. Amenity value and recreational benefits
4. Improved mental health

JOBS AND SOCIAL COHESION

1. Create jobs particularly in rural areas
2. Promote urban-rural solidarity

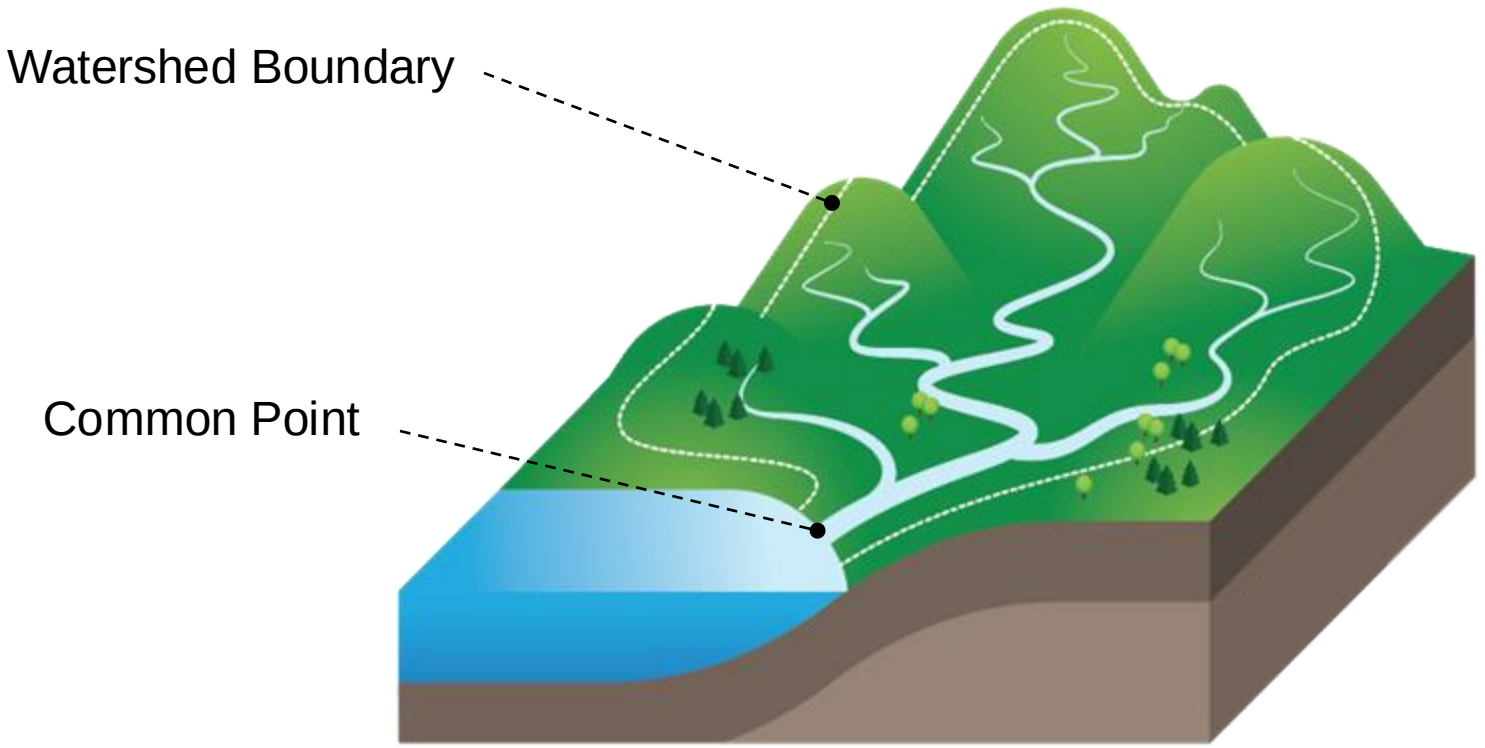
This NBS training focuses on the watershed scale

Watershed

Synonym: catchment, basin.

any surface area from which runoff resulting from rainfall is collected and drained through a common point.

It is the basic unit of analysis for surface water systems and provides the geographic framing for everything we are going to discuss in this training.

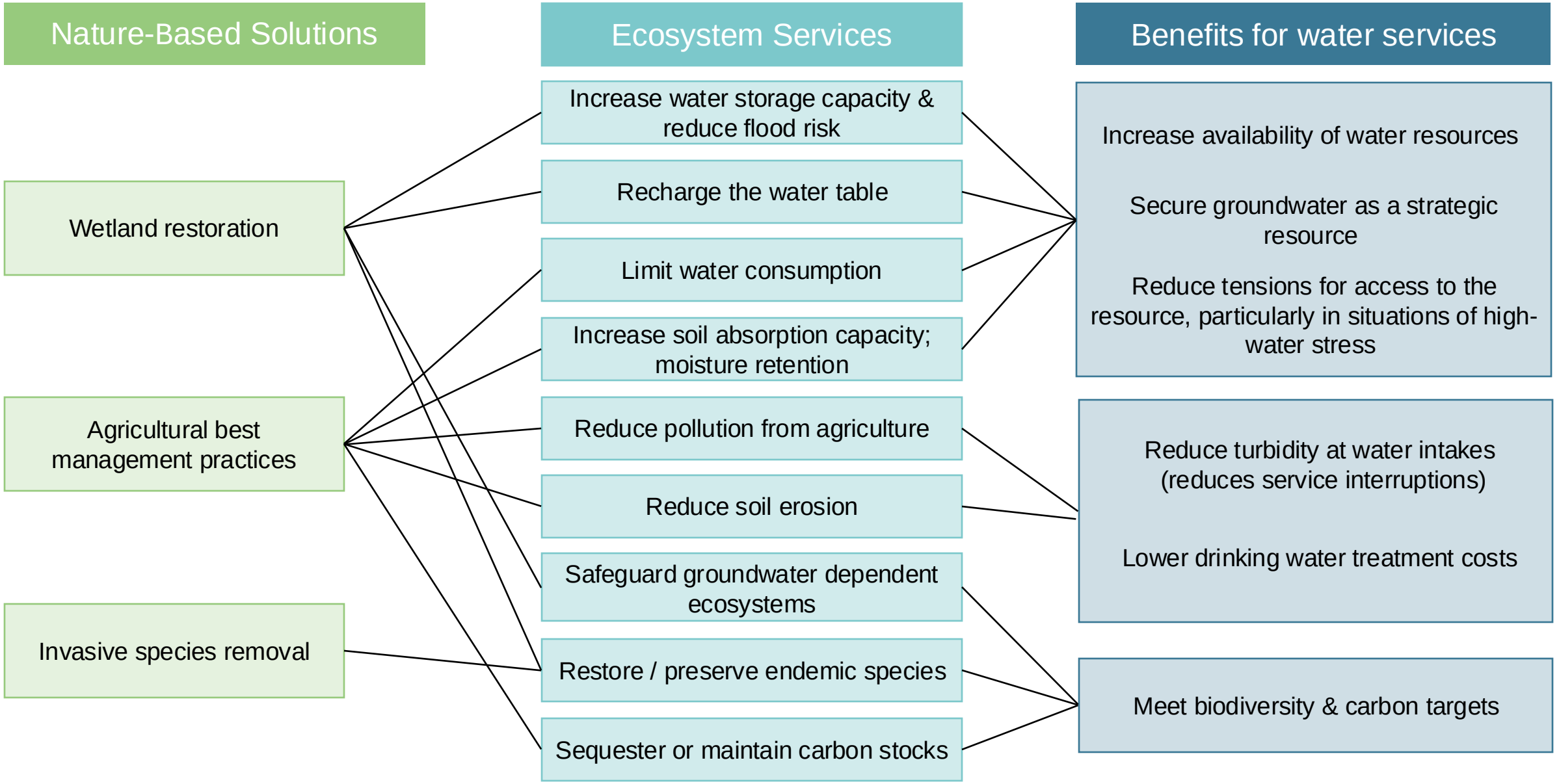


Watershed health can be severely impacted by human activity

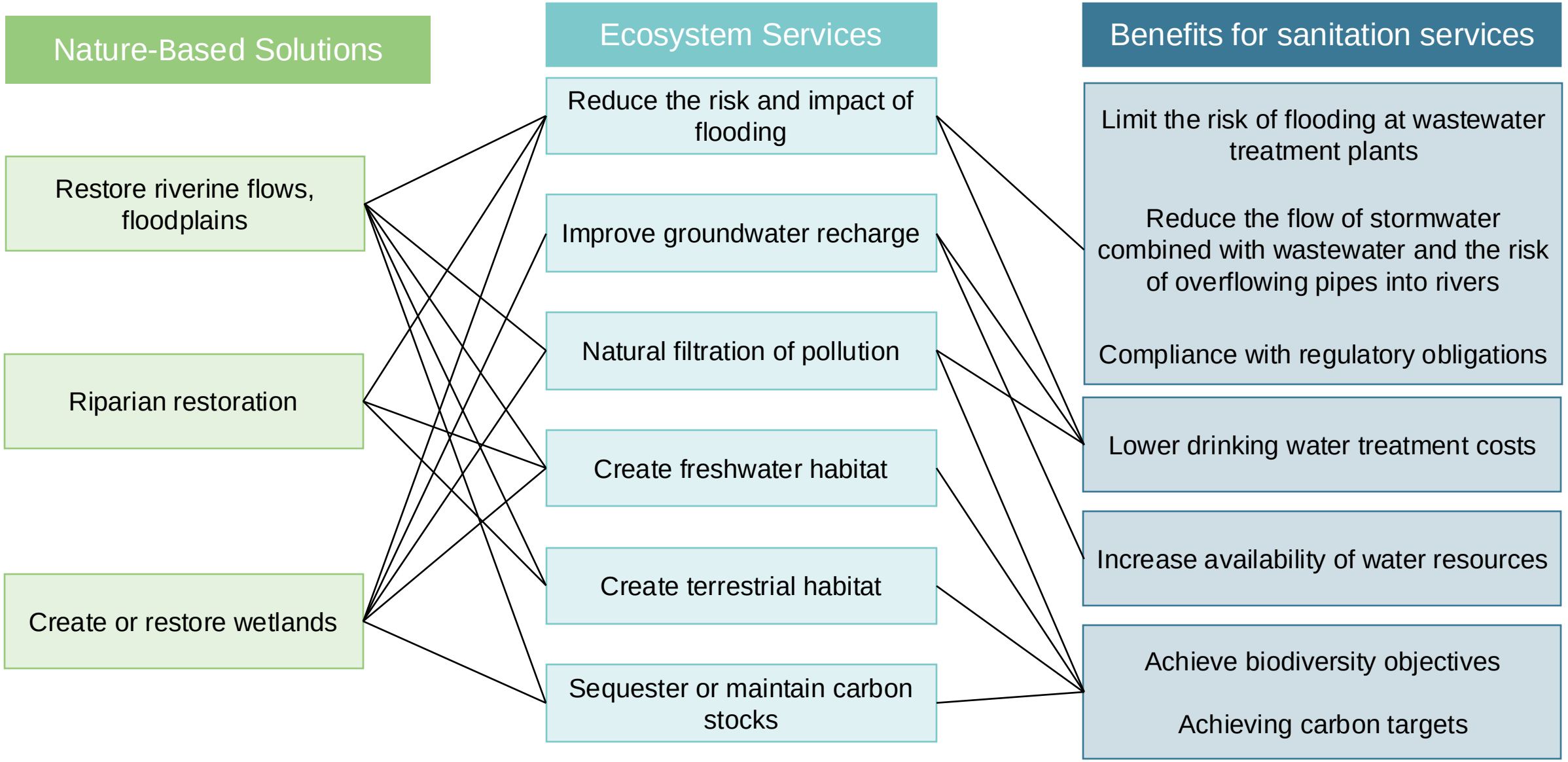
Human Activity (Direct Driver)	Impact on Ecosystems	Ecosystem Services at Risk
Dam construction	Alters timing and quantity of river flows. Water temperature, nutrient and sediment transport, delta replenishment, blocks fish migrations	Provision of habitat for native species, recreational and commercial fisheries, maintenance of deltas and their economies, productivity of estuarine fisheries
Dike and levee construction	Destroys hydrologic connection between river and floodplain habitat	Habitat, sport and commercial fisheries, natural floodplain fertility, natural flood control
Diversions	Depletes stream flow	Habitat, sport and commercial fisheries, recreation, pollution dilution, hydropower, transportation
Draining of wetlands	Eliminates key component of aquatic ecosystem	Natural flood control, habitat for fish and waterfowl, recreation, natural water purification
Deforestation / land use	Alters runoff patterns, inhibits natural recharge, fills water bodies with silt	Water supply quality and quantity, fish and wildlife habitat, transportation, flood control
Release of polluted water effluents	Diminishes water quality	Water supply, habitat, commercial fisheries, recreation
Overharvesting of freshwater biomass	Depletes species populations	Sport and commercial fisheries, waterfowl, other biotic populations
Introduction of exotic species	Eliminates native species, alters production and nutrient cycling	Sport and commercial fisheries, waterfowl, water quality, fish and wildlife habitat, transportation
Release of metals and acid forming pollutants into the atmosphere	Alters chemistry of rivers and lakes	Habitat, fisheries, recreation, water quality
Emission of climate altering air pollutants	Potential for changes in runoff patterns from increase in temperature and changes in rainfall	Water supply, hydropower, transportation, fish and wildlife habitat, pollution dilution, recreation, fisheries, flood control

Source: Postel and Richter, 2003

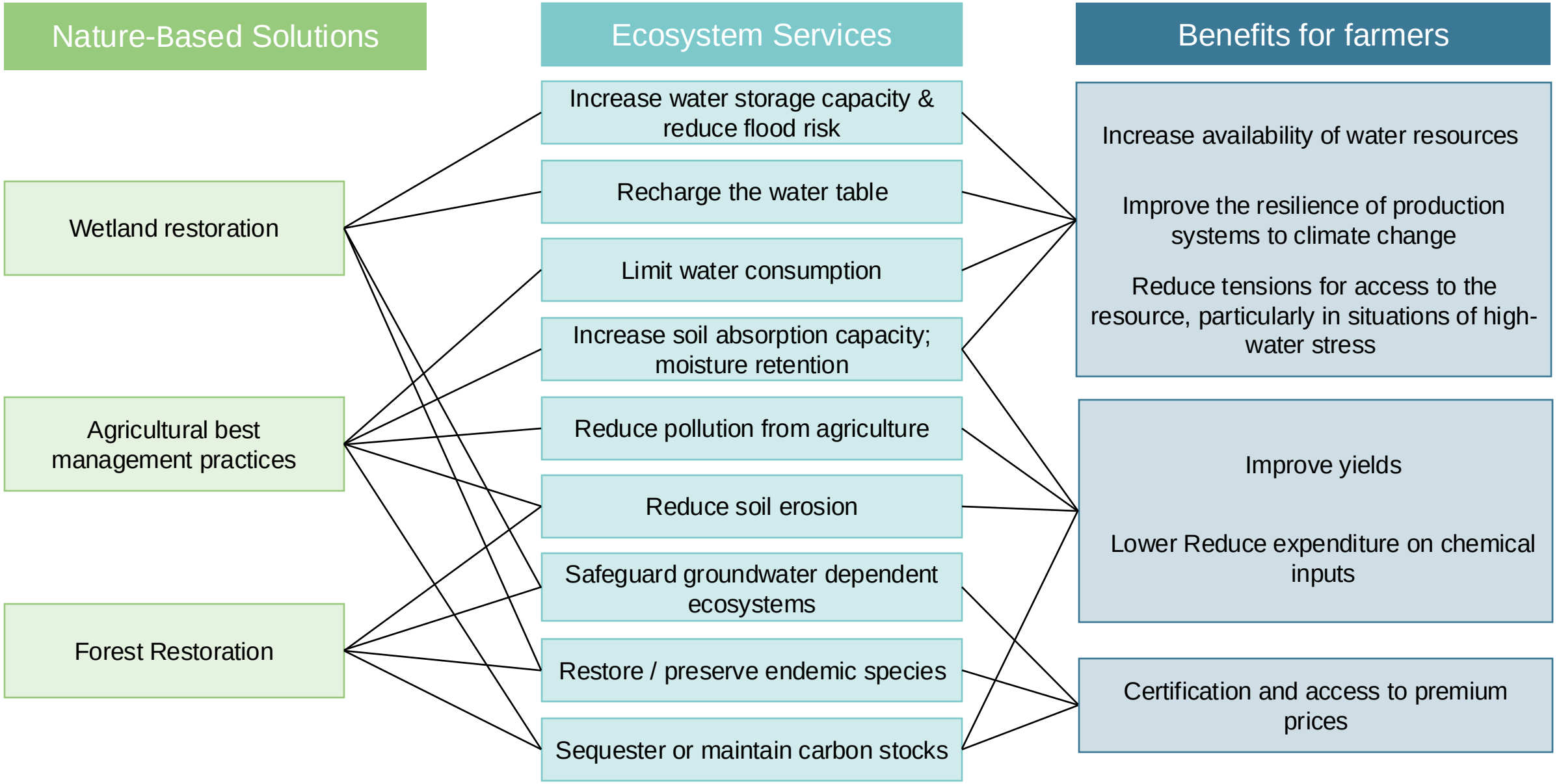
NBS: examples of benefits for water services



NBS: examples of benefits for sanitation services



NBS: examples of benefits for farmers



NBS are often combined with grey infrastructure to address water security challenges, and can be incorporated as an add-on to an existing asset or intentionally integrated into planning & design

1 **"Add-on" to an existing asset or system**

Complements an already finalized set of grey infrastructure to enhance benefits, improve inputs that enter into the water management system, polish output, improve flexibility of deployment (portfolio-based), etc. Can be iterative and help adapt to land use & climate change

Example: restoration to enhance water quality or artificial wetlands to polish outputs

2 **Intentional integrated planning for new or growing development**

Early co-development to maximize water security and other co-benefits. Implies analyzing design impacts of green on grey and overall watershed approach.

Example: combining grey irrigation infrastructure upgrades with agricultural BMPs to help improve crop production and reduce water use in an underperforming and/ or water stressed agricultural area

Only ecosystem — *Mixed human / natural systems* — **Human-engineered**

Green only
NBS as primary infrastructure investment

EXAMPLE
To reduce urban flooding, flood district removes levees and "re-wilds" the river to slow flows, laterally, before entering the city

Green-Grey hybrids
Enhance benefits & resilience

EXAMPLE
Water service provider builds a new water treatment plant that incorporates natural retention ponds and restored wetlands into asset design

Greener grey
Minimize risks or compensate impacts

EXAMPLE
Hydropower operator invests in upstream restoration to reduce sediments flowing into an existing asset

NBS for Improving Wastewater Quality

Tertiary Treatment « Add-on »

Vegetated Discharge Area

Thionville, France

- Urban area with 80,000 inhabitants in north-eastern France
- 1.9 ha vegetated discharge zone downstream from the WWTP managed by Veolia
- Primary focus: foster biodiversity and provide educational and touristic opportunities for local residents (schools) and visitors (bike path)
- Secondary: Wastewater polishing – although impacts are not currently tracked
- Very modest cost included in water tariff

Rehabilitation of Wetlands to Treat Industrial Wastewater

Beijing, China

- Sinopec Group is China's largest petrochemicals group
- Local population and authorities expressed concerns about the impact of the plant on the environment
- Veolia – through a contract with Sinopec – manages the reuse of industrial effluents to restore the ecosystem of a wetland while taking advantage of its natural properties for water purification.

Upstream Investments for Source Water Protection

Drinking Water Supply « Integrated Planning »

New York City
Production and distribution of drinking water to 8 million people

Objective: ensure New York City's compliance with the Safe Drinking Water Act's drinking water quality standards

Nature-based Solution Implemented :
Investment of $1.5 billion over 10 years to implement the New York City Watershed Agreement

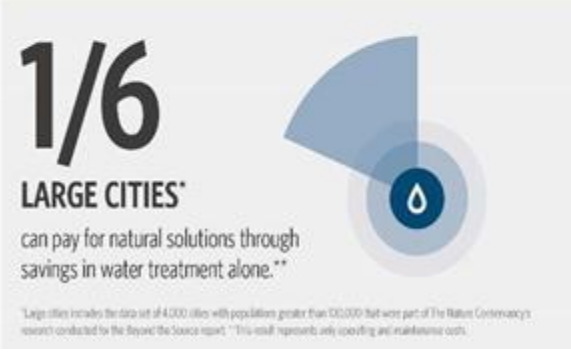
- **Improvement of agricultural practices** (nutrient control, manure management)
- **Ecosystems protection**, notably through the acquisition of land

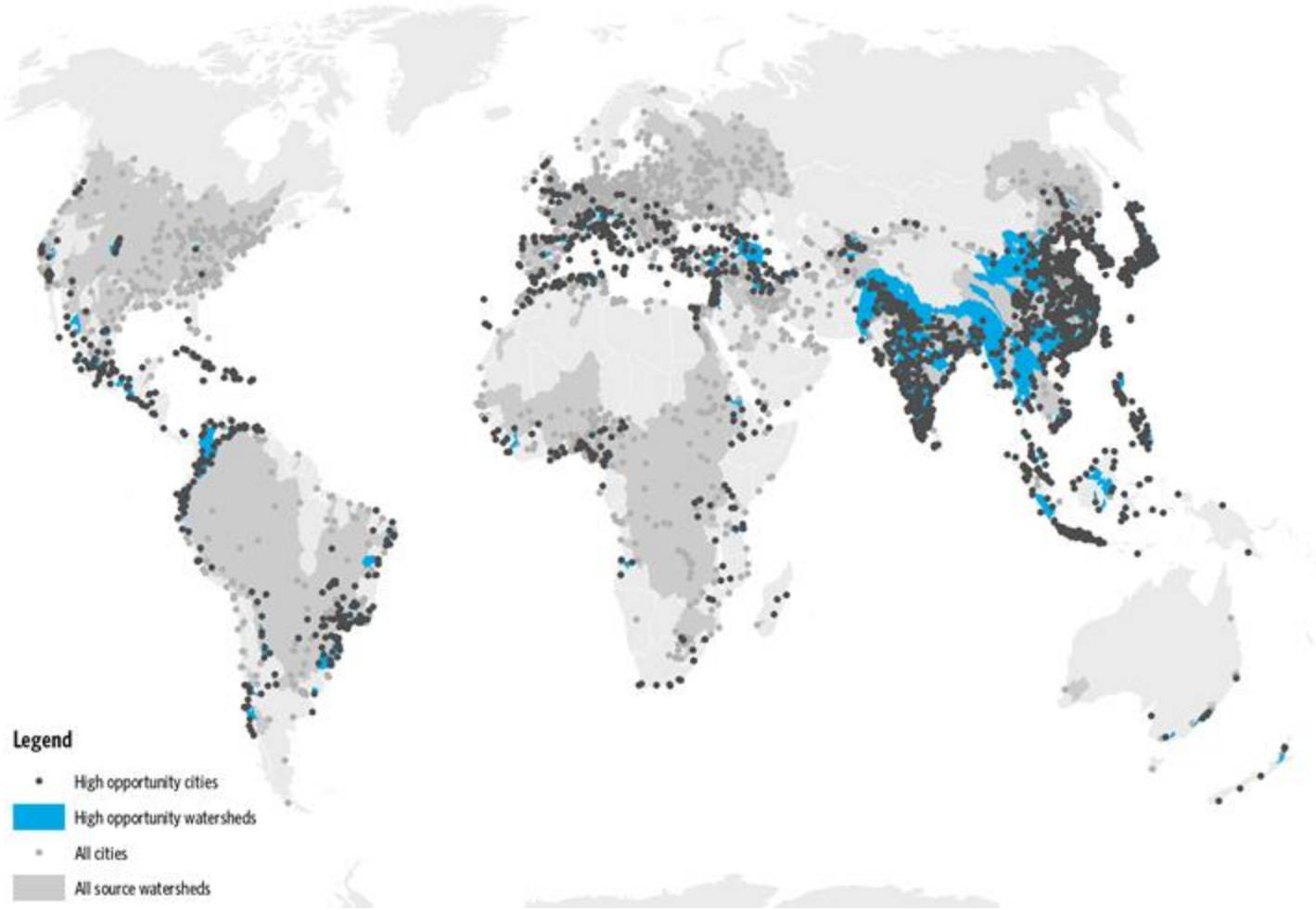
Results:
New York's drinking water quality is among the best in the world
⇨ 300M USD annual savings compared to the cost of a new treatment plant

Investing in NBS for nutrient and erosion control significantly reduces water treatment costs for more than 2000 cities, globally

2000 cities could generate a positive ROI if they invested at scale in NBS in their watersheds, potentially impacting **664 million people around the world.**

This would be possible for half of all cities for less than $2/person/year





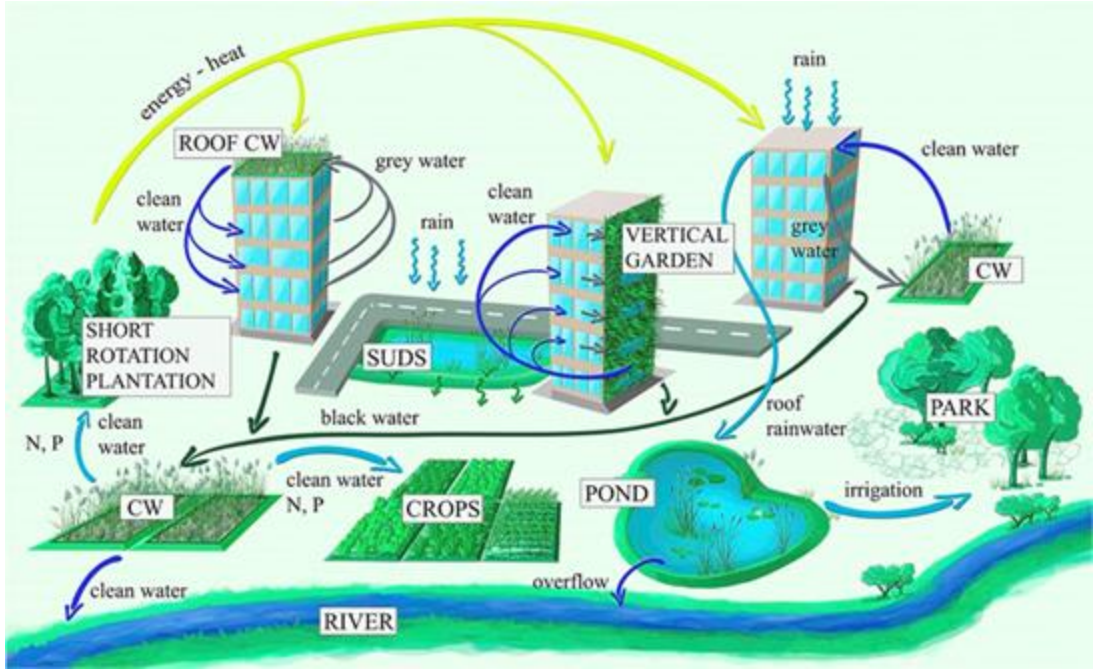
Source: TNC, Beyond the Source (2017)

Why hybrid urban NBS

'The battle for sustainable development will be won or lost in cities'

UN Deputy Secretary-General, Jan Eliasson, June 2015

- Three quarters of 2050's infrastructure doesn't yet exist.
- We have an opportunity to integrate nature into urban infrastructure investment to:
  - control surface run-off volumes and timing and hence reduce the risk of flooding during heavy rainfall events
  - reduce storm water volumes through interception, evaporation and infiltration
  - improve water quality as part of sustainable treatment systems
  - Provide fit for purpose water sources
  - achieve economic of scale ***and scope*** through unlocking a wide range of co benefits and potential revenue streams e.g. reducing urban heat island effect, increasing economic activity, enhancing health and wellbeing outcomes
- Flexibility and scalability of NBS means they can be cost effectively applied in an integrated way across:
  - high density cities and peri urban areas
  - formal and informal settlements
  - multifunctional corridors and destinations
  - public and private realms.



Masi et al. (2018) Journal of Environmental Management, Vol. 216, 275-284

Urban NBS for Climate Resilience

‘The battle for sustainable development will be won or lost in cities’

UN Deputy Secretary-General, Jan Eliasson, June 2015

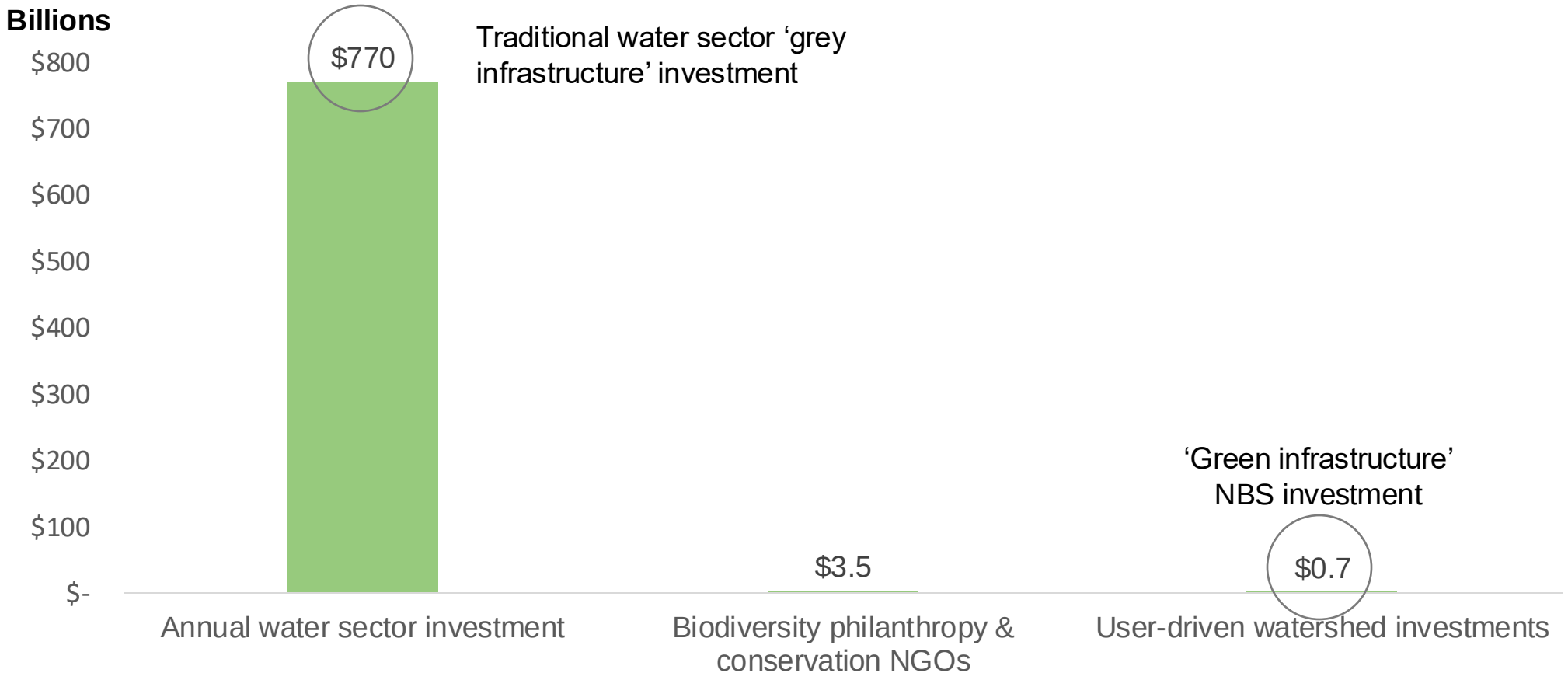
Nature based solutions can support more climate resilient communities and deliver a great range of values, as part of multifunctional infrastructure

INVESTING IN NATURE-BASED SOLUTIONS

A BRIEF INTRODUCTION TO GOVERNANCE AND FUNDING

Investments in NBS remain marginal when compared to broader water sector investments

Re-orienting just 1% of annual water sector investment toward nature-based solutions would eclipse all philanthropic spending on conservation combined.



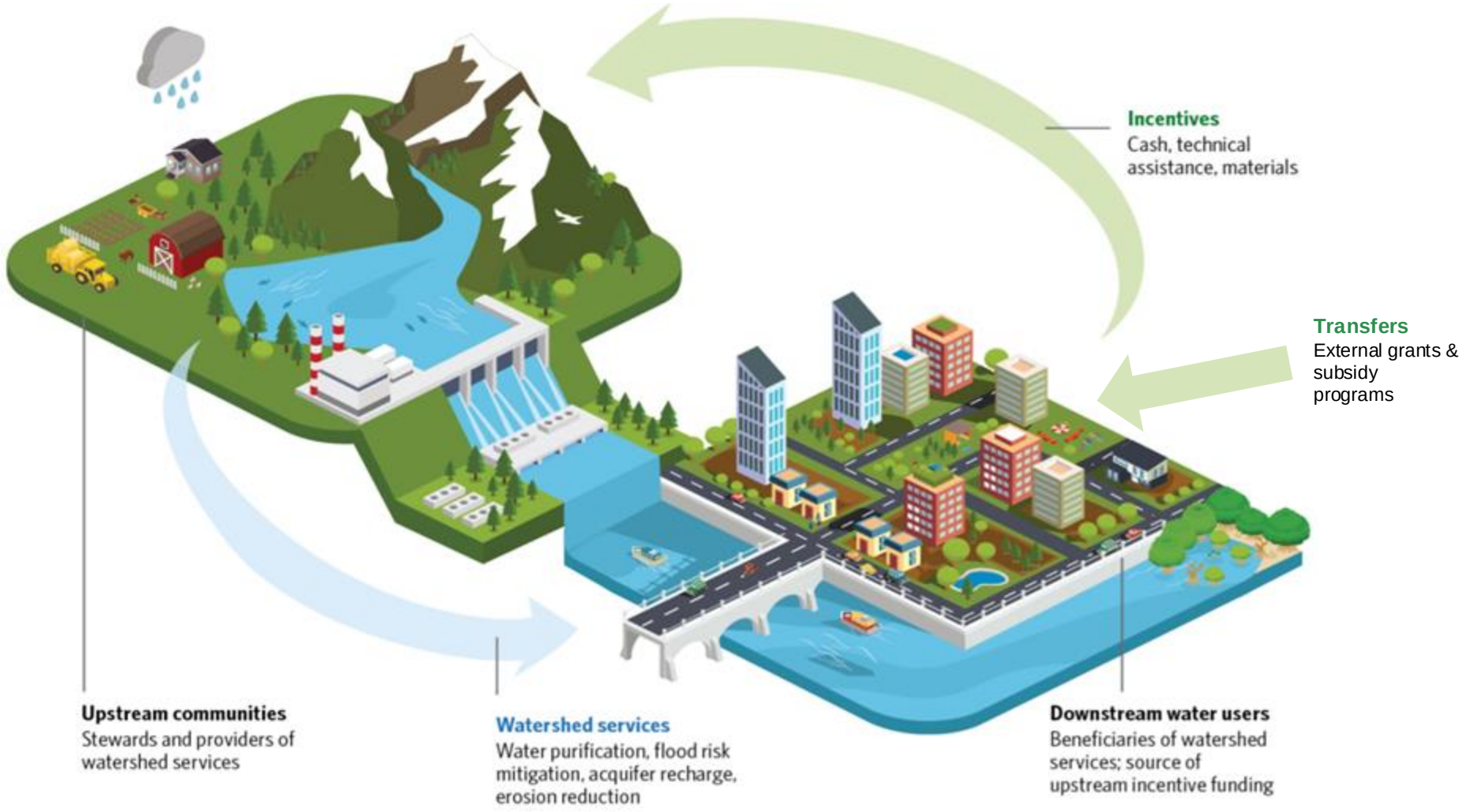
Sources. Annual water sector investment: GWI 2018; philanthropy & conservation NGO funding: Deutz (2020) Financing Nature: Closing the Global Biodiversity Financing Gap; Salzman (2018) Payments for Ecosystem Services: Past, Present & Future

By leveraging co-benefits, NBS can attract multiple potential revenue streams

Benefits	Beneficiaries	Potential Revenue Streams
• Better water quality • Provision of water quantity • Flood risk reduction • Improvement of air quality • Increased soil health • Carbon sequestration • Enhancement of biodiversity • Recreational value • Health and wellbeing • Resilient communities • Urban heat reduction • Job creation	• Water and sewerage utilities • Water-dependent corporates • Public authorities and state agencies • Insurance and reinsurance companies • Farmers and landowners • Local communities • General public	• Environmental tariffs • Payments for ecosystem services • Public subsidies • Commercial revenues • Operational / capital expenditure savings • Visitor fees and eco-tourism

Source: Nature contributing to water security: an Investor Guide, World Water Council (with Finance Earth and TNC)

Mobilising funding from downstream beneficiaries can be essential to support investment upstream in the watershed



Watershed Investment Programs, like Water Funds, leverage the power of nature-based solutions to improve water security and climate resilience

The Water Fund Mechanism

Water funds are **collective action governance platforms** that bring together different water users – usually utilities, businesses, agriculture and local government – **to invest in ecosystem protection and upstream communities** within the catchments they depend on.

Watershed Investment Programs design bespoke NBS programs that meet local stakeholder needs, bridge institutional gaps, and mobilize diverse sources of funding

	PROGRAM PREPARATION			PROGRAM IMPLEMENTATION
	 Pre-Feasibility	 Feasibility	 Design	 Execution
OBJECTIVE	Understand the water security challenges and explore the high-level potential for NbS to address them	Determine whether a specific viable path exists to deploy NbS and achieve impact	Marry interest and ambition into a cohesive actionable package	Operationalize proposed design and adaptively manage to ensure long-term objectives
KEY QUESTIONS	• What is the water security challenge? • Which NbS options are most relevant? • Which stakeholders care, and why? • Is there a favourable institutional and funding context? • Can collective action serve to enhance outcomes?	• What is the local absorption capacity, social acceptance, and costs and benefits profile for prioritized NbS options? • What is the target implementation scenario, and do funders believe it has an attractive benefit/cost profile? • Is additional fundamental work required (e.g., technical analysis, stakeholder engagement) to move to WIP design?	• What is the institutional vision and concrete technical objectives? • What is the governance, funding and operational arrangement to achieve those objectives?	• How to maximize operational efficiency and transparency? • How can field monitoring be used to validate results? • Do core program objectives (e.g., NbS options list) require revision?

Stakeholder Engagement. Engaging relevant and motivated stakeholders in your WIP's development to ensure program viability and social acceptance.

Science. Building the case for the WIP through scientific analysis and ensuring credibility through monitoring and evaluation of NbS investments.

Funding and Financing. Attracting the required resources is a fundamental enabling condition for program execution, and motivating WIP investors typically requires a blend of science-based evidence, program co-creation and political will.

Governance. Outlining the roles and responsibilities of different stakeholders when making decisions about the WIP's development and long-term execution.

Implementation. Understanding the implementation requirements and associated capacity-building needs to roll-out the WIP against the target execution timeframe.

TNC supports over 50 watershed investment programs operating on every continent

Outcomes include over **530,000 hectares of land under improved management** and an estimated **100,000 people with increased place-based economic opportunity**. We have received **300+** requests pending from corporations, governments, utilities.

Visit the Resilient Watersheds website (nature.org) for more information about our Flagship Programs.

Q&A

THANK YOU