

Environment in the Koshi River Basin: Research status and future prospects

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- Context
- Findings from baseline assessment
- Planned future activities

Context

Freshwater ecosystems and their services are a key thematic area in the Koshi Basin Programme (KBP), reflected in:

- KBP's overall objective: to contribute to inclusive poverty reduction and enhanced resilience to climate change by securing and **sustaining freshwater ecosystem services through evidence based decision-making and transboundary cooperation.**
- KBP's three main objectives:
 - (1) develop new **policy relevant knowledge on how climatic and socio-economic drivers impact on ecosystem services and livelihoods of dependent populations,**
 - (2) develop and test actionable **adaptation pilots and livelihood strategies** considering their efficacy and acceptability by various socio-cultural and gender groups to **address increasing impacts on ecosystem services** and socio-economic situation at local, national and regional scales, and
 - (3) contribute to developing an **enabling environment for policy and decision makers to create integrated, innovative, equitable, inclusive and effective responses to protect and manage river basin ecosystems** and to reduce poverty in the frame of integrated natural resources management and improved basin-wide cooperation.

Findings from baseline assessment

Tibetan Plateau

High Himal

High Mountains

Middle Mountains

Siwalik

Plains

Indo Gangetic Plain



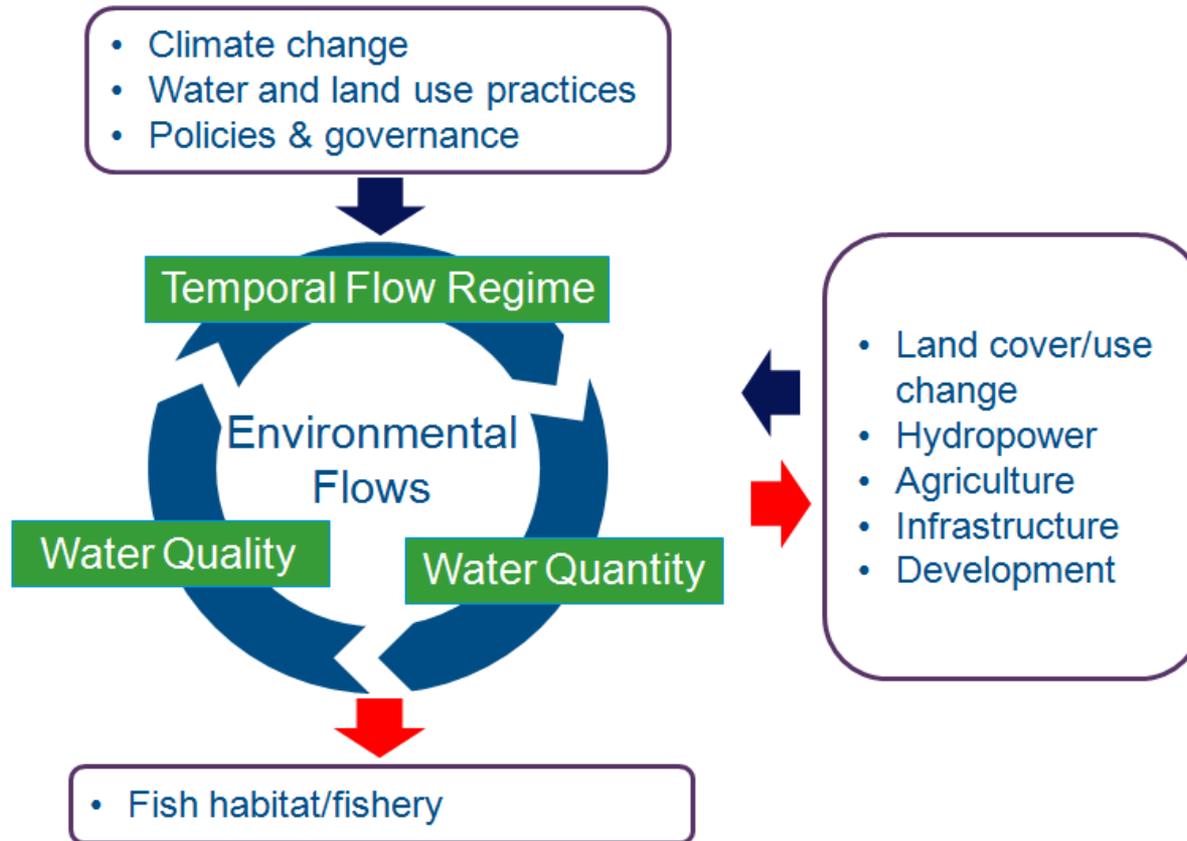
- Diverse physiography in the basin -> high diversity in ecosystems and habitat
- Main land cover:
 - 36% agricultural land (excl. orchards and plantations) mainly in the plain areas and mid hills
 - 33% grass- and shrubland with largest part in the Tibetan Plateau in China
 - 20% forest including needle- and broadleaved and mostly in Nepal
 - Around 6% covered by glaciers with largest portion in Arun sub-basin.

- **Major land cover/use changes between 1990 and 2010:** ↑ agricultural area by 238,453 ha, ↓ forest cover by 13,000 ha, ↑ built-up area.
- **Community forestry in Nepal** part has been a key instrument to sustain and increase forest cover and secure livelihoods. Still, deforestation and forest degradation is ongoing mainly caused by overgrazing, overharvesting, increasing pressure from growing populations, and lack of policy implementation and governance.
- **Provisioning** freshwater ecosystem services (e.g. water supply) are generally valued more than other services such as regulating (e.g. water purification or flood/drought regulation).
- **Water quality** is degrading mainly in southern downstream areas, due to pollution from agriculture and livestock but also waste, siltation from deforestation and conversion of forest into agricultural land, and soil erosion.
- **Climate change** (increasing temperature and more extreme events) is expected to impact on hydrological cycle, streamflow, ecosystem services, livelihoods and human well-being.
- Populations in the middle mountains and Terai already experience **climate related stress** now: erratic monsoon rainfall, floods and drought periods.
- Many **different studies undertaken in different places**, however, there is lack of a coherent overview and good understanding of the environmental situation across entire basin.

The importance of Freshwater Ecosystems

- **Freshwater ecosystems:** lakes, ponds, rivers, streams, springs, wetlands.
- Freshwater ecosystems provide **multiple benefits** to both the natural environment as well as to humans and livelihoods.
- Freshwater ecosystem **services:** freshwater supply, water purification, food/fish production, timber, fuelwood, water flow regulation, erosion control, carbon sequestration, climate regulation, flood regulation, biological diversity, etc.
- **Development** in the basin (agriculture, hydropower, etc.) largely depends on sustained quantity of water provided by the Koshi and its tributaries (provisioning services).
- **Water quality degradation** reduces water available for multiple uses e.g. fish production, drinking water, irrigation.
- **Environmental flows** e.g. fish habitat and production depend on adequate water quantity and quality.

Environmental Flows in the Koshi Basin



Environmental Flows can be used as parameter for the sustainability in water resources development, and as such could be integrated in local policy and governance frameworks.

Example: Monitoring of biological indicators that are sensitive to flow changes e.g. Ganges river dolphin or fish species.

Key wetlands in Koshi basin

- In Nepal part of basin, several key wetlands and important biodiversity are situated in protected areas.
- Protected areas are of high economic value due to tourism but are threatened by invasion of alien species, forest encroachment, excessive timber and fuelwood extraction, and land degradation.
- Wetlands provide many different services e.g. water storage, flood control, sediment trapping, water purification, food, fuelwood, cultural and spiritual values, habitat for species, etc.

Langtang National Park (1710 km²)

Gosaikunda, Bhairabkunda, Saraswatikunda, Nakund lakes, Panchpokhari lakes, Trisuli, Sunkoshi, Langtang Khola, 149 glacial lakes

Qomolangma National Park (33,800 km²)

Sagarmatha National Park (1148 km²)

Dudh Koshi, Bhote Koshi, Imja Khola, 343 glacial lakes

Makalu Barun National Park (1500 km²)

Arun River, 121 glacial lakes

Kanchenjunga Conservation Area (2035 km²)

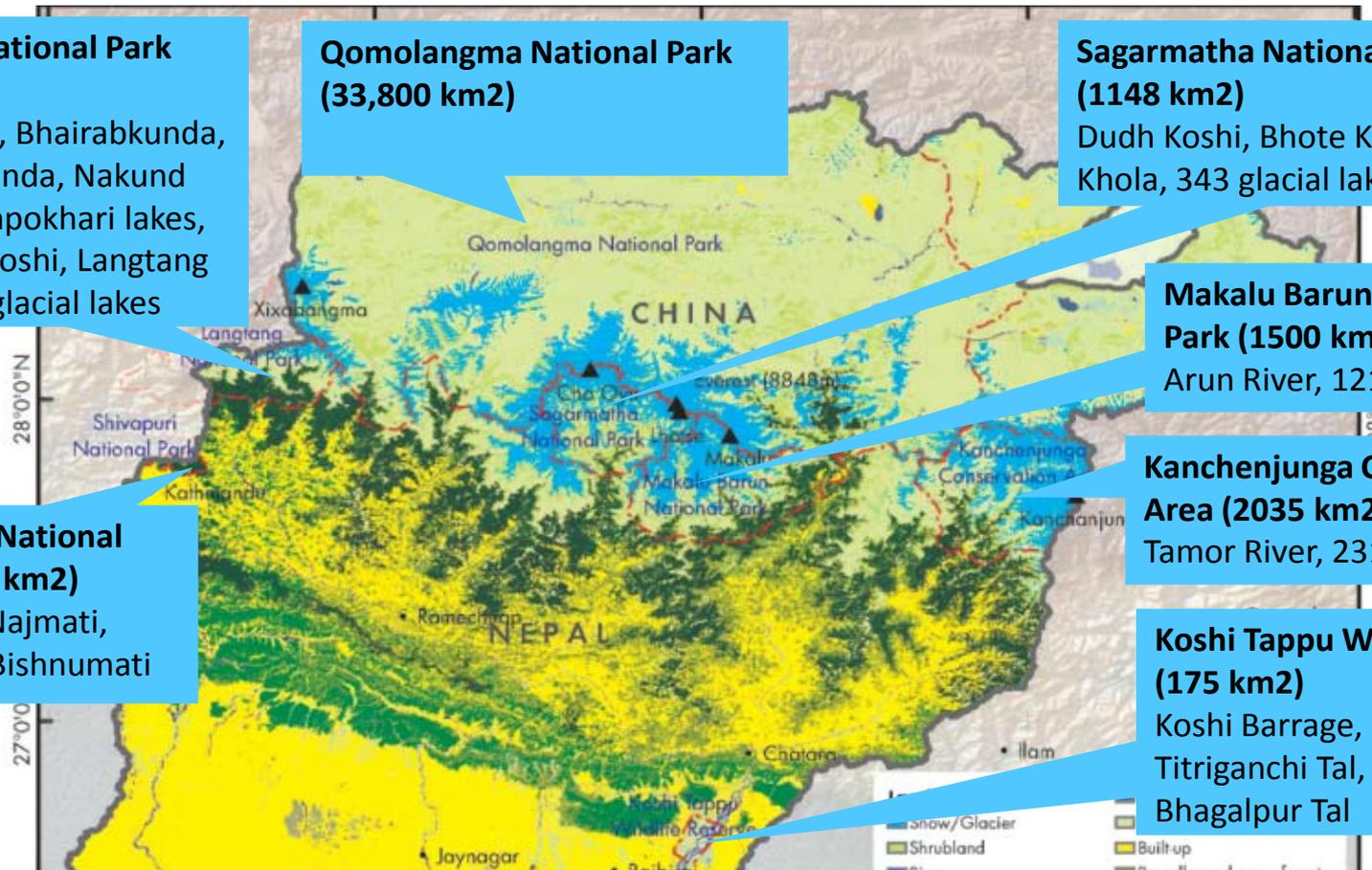
Tamor River, 231 glacial lakes

Shivapuri National Park (144 km²)

Bagmati, Najmati, Syalmati, Bishnumati

Koshi Tappu Wildlife Reserve (175 km²)

Koshi Barrage, Koshi River, Titriganchi Tal, Kamalpur Tal, Bhagalpur Tal



Freshwater Ecosystem Services

Freshwater Ecosystem Services		Koshi Tappu Wildlife Reserve, Nepal	
		Main ecosystem services as perceived by local stakeholders (Birdlife 2011)	% of total economic value of ecosystem services i.e. 16 million USD p/y (Sharma 2012)
Provisioning Services	Water quantity and quality for consumptive use (for drinking, domestic use, agriculture, industrial use)	<ul style="list-style-type: none"> • Wild and cultivated foods, livestock, fish • Groundwater recharge • Plant fibre, fuelwood 	85.3% (livestock fodder, floodplain agriculture, fish, energy, domestic water supply, other)
	Water for non-consumptive use for power generation and transport/navigation		
	Aquatic organisms for food and medicines		
Regulating Services	Maintenance of water quality (natural filtration and water treatment)	<ul style="list-style-type: none"> • Climate regulation (drought control), reducing impacts from weather events, air quality regulation • Water purification • Carbon storage • Biological control • Flood regulation (prevention) • Soil fertility • Soil erosion regulation • Pollination 	7.2% (flood control/prevention, carbon sequestration)
	Buffering flood flows, erosion control through water/land interactions and flood control infrastructure		
Cultural Services	Recreation (river rafting, kayaking, hiking, and fishing as a sport)	<ul style="list-style-type: none"> • Spiritual/religious value to communities • Aesthetic benefits/inspiration • Knowledge (studies support local people) • Health • Tourism 	7.5% (only for tourism)
	Tourism (river viewing)		
	Existence values (personal satisfaction from freeflowing rivers)		
Supporting Services	Role in nutrient cycling (role in maintaining floodplain fertility), primary production	<ul style="list-style-type: none"> • Species habitat/genetic diversity 	N/A
	Predator/prey relationships and ecosystem resilience		

- Total wetland value is 16 Mio USD p/y, but full values and associated tradeoffs of freshwater ecosystem services still not well understood.
- Integrating economic valuation into policy and decision-making processes will help to improve understanding.

- Despite various studies, there is lack of environmental data and monitoring for the entire basin and hence coherent overview of the natural environment across the basin.
- Climate change impacts.
- How to balance too much and too little water e.g. plains vs. high altitude areas.
- How to fulfill increasing needs and competing demands for water e.g. irrigation/food security.
- Water quality degradation and its impacts on fish habitat/fisheries and water for domestic use.
- Hydropower and infrastructure development.
- Policies vs. implementation.

- To ensure sustainability of freshwater ecosystems that are a critical basis for human well-being, livelihoods and development, it will be important:
 - to get a good overview of status and trends of freshwater ecosystems/services, through assessing broad spectrum of services provided by freshwater ecosystems across entire basin.
 - to improve understanding of critical freshwater ecosystem services.
 - to inform decision-making on how freshwater ecosystems can be sustained and managed for their multiple use and benefits.

Rapid freshwater
ecosystem assessment in
the Koshi basin
(planned 2013/2014)

Rapid freshwater ecosystem assessment in the Koshi basin

Objective

- Assess status and trends of freshwater ecosystems and their critical services in the Koshi River Basin, related to **economic development** and **water-food-energy nexus**
To **inform basin stakeholders and decision-makers** at different levels
To identify **research priorities** for assessment and monitoring, **economic valuation**, and **benefit-sharing** mechanisms

Main outcomes

- Knowledge product on status and trends of the freshwater ecosystems in the Koshi River Basin with recommendations on the sustainable management of these ecosystems.
- Workable basis for further ecosystem-related work i.e. on-the-ground assessments in hotspot areas, freshwater ecosystem monitoring, economic valuation of critical freshwater ecosystem services, and investigating viable benefit-sharing mechanisms for freshwater ecosystem services.

- Research framework for rapid freshwater ecosystem assessment.
- Current status and trends of freshwater ecosystems and their critical services in the basin.
- Identification and mapping of key freshwater ecosystem services and freshwater ecosystem hotspot areas.
- Future scenarios and implications for human well-being and economic development, looking at interlinkages among freshwater ecosystems/services within the water-food-energy nexus.
- Inventory of key freshwater ecosystem services and relevant parameters incl. relevance/benefit for humans and natural environment, quantification (as far as possible), variables and indicators, sources of data/information, etc. to be used as reference system in monitoring and management.
- Baseline data and research priorities in the areas of environmental monitoring, economic valuation, and benefit-sharing mechanisms.

- Basin-wide assessment building on proven approaches and frameworks e.g. DPSIR (Drivers-Pressures-States-Impacts-Responses), Millennium Ecosystem Assessment (MA, 2005).
- Mainly based on secondary data.
- Supported by selected field assessments and remote sensing data.
- Process in close consultation with stakeholders.
- Results validated by stakeholders.
- Makes use of synergies with other related activities under KBP as well as similar work undertaken by ICIMOD and partners.

- **Implementing partner** – undertakes rapid assessment in Koshi basin.
- **Knowledge partner** – provides technical inputs, and shares data and information.
- **Stakeholder partner** – provides local and site-specific insights to assessment also in terms of needs and requirements, and contributes to validation of results.

Thank you

ICIMOD



Sagarmatha National Park



Koshi Tappu Wildlife Reserve



Hydropower dam on Sun Koshi River



Dapcha watershed area, Khabre district, Nepal



Arun valley