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The Next Generation: Global Dams Data, Spatial Analytical Tools, and Transboundary Dam Safety

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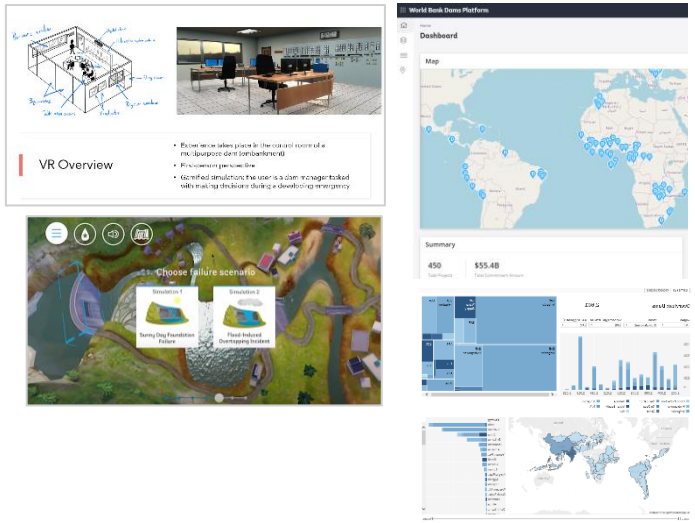
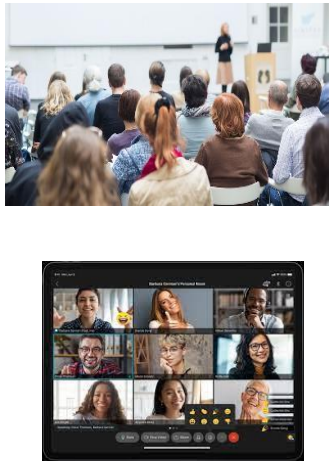
Global Program for Enhancing Resilience & Safety of Dams and Downstream Communities

Analytics and Technical Guidance

Digital Innovation and Databases



Trainings



Partnerships

CIGB ICOLD

ICH harmonisation for better health

iha international hydropower association

GWSP GLOBAL WATER SECURITY & SANITATION PARTNERSHIP

GFDRR Global Facility for Disaster Reduction and Recovery

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- Technical Guidance Note: Economics of Dam Safety
- Technical Guidance Note: Transboundary Dam Safety
- Global Database & Protocols for the World's Dams
- Spatial Analytics: Sedimentation Risk Assessment Tool

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SAFETY OF DAMS AND DOWNSTREAM COMMUNITIES

Technical Guidance Note: Dam Upgrading for Green Growth

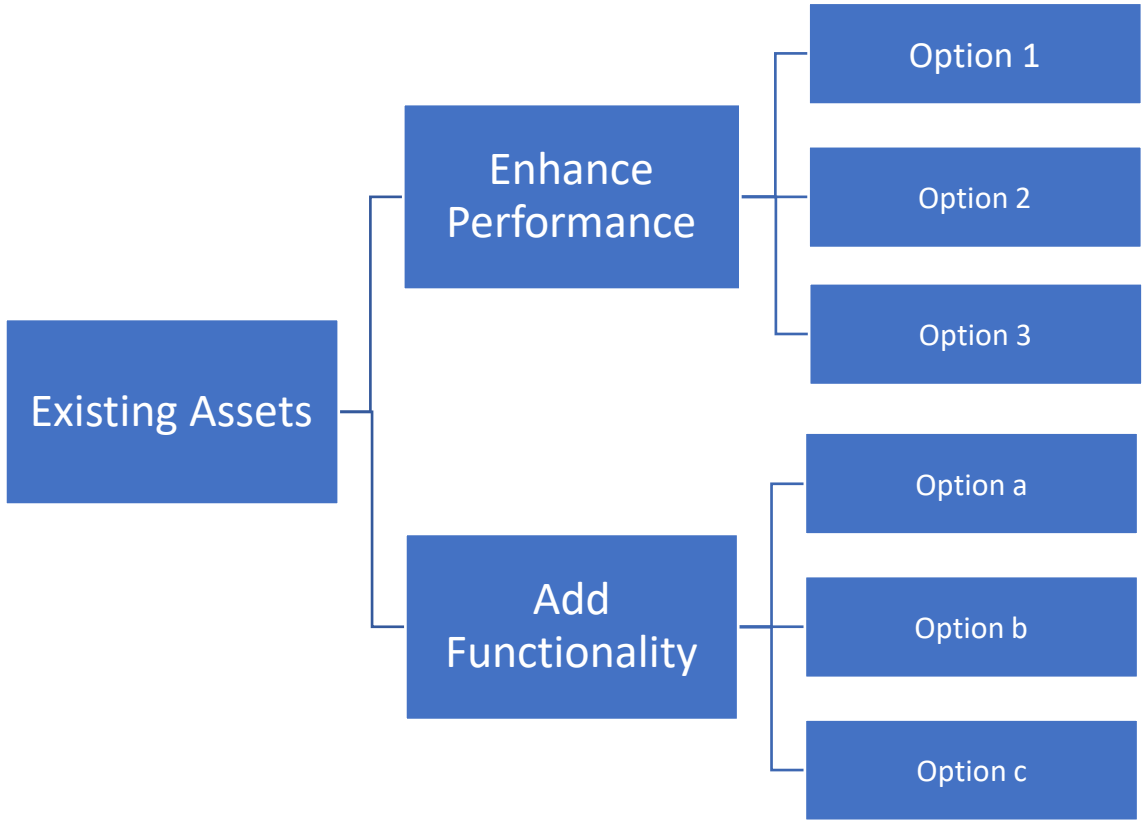
SAFETY OF DAMS AND DOWNSTREAM COMMUNITIES

Technical Guidance Note: Economics of Dam Safety

SAFETY OF DAMS AND DOWNSTREAM COMMUNITIES

Technical Guidance Note: Transboundary Dam Safety

Technical Guidance Note: Contributing to Green Growth



- A typology of different options for retrofitting and upgrading existing dams to increase the contributions to green growth
- A framework on how to scope different options and compare them from technical and institutional aspects
- Cost comparisons and development of marginal cost curves
- Case studies to illustrate good international industry practices

Technical Guidance Note: Economics of Dam Safety

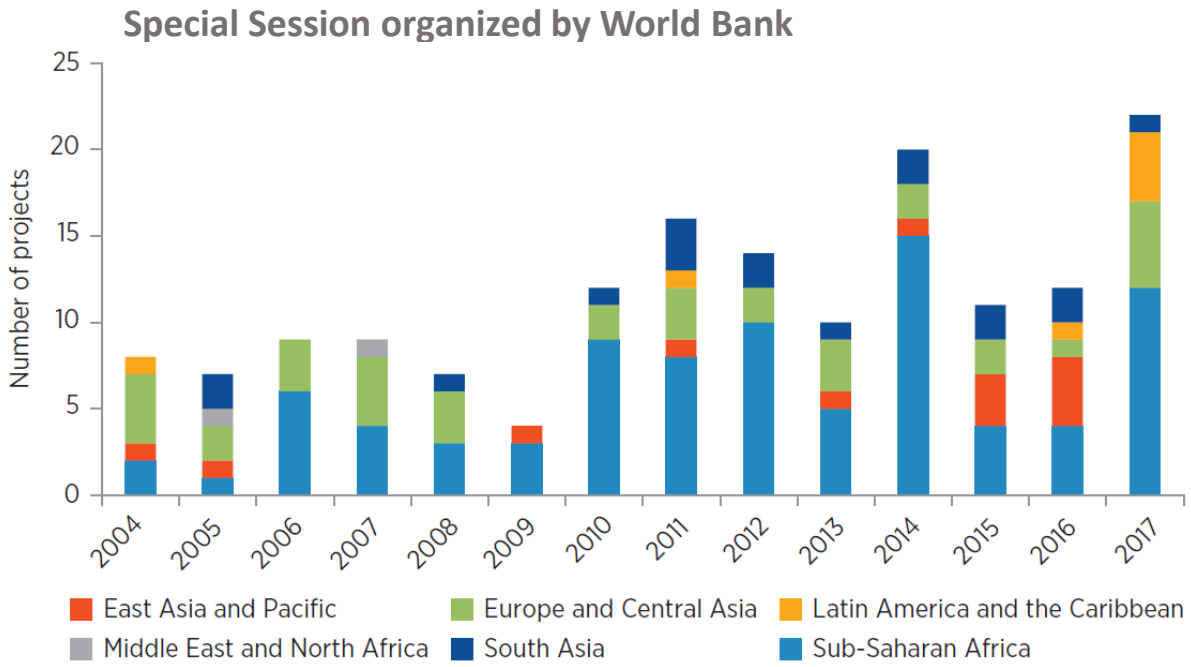
- Economics relating to the safety of dams and downstream communities to inform good international industry practice and, additional research requirements
- Advise on the various pathways and economic linkages which can affect development and productivity for different types of dam related projects (new dam development, individual rehabilitation projects, portfolio rehabilitation programs).
- Focusing on how the risk of dam failure is incorporated into ex-ante benefit-cost analyses based on new dam development projects, individual rehabilitation projects, and portfolio rehabilitation programs, as well as the implications of no project options, and how future uncertainty related to climate change can be incorporated.
- Application of systems approaches to evaluation of individual investment projects that can potentially maximize net economic benefits (and minimize net costs), including considerations of cooperative and non-cooperative behaviours among jurisdictions within a transboundary context.
- Recommendations on how to improve decision making, such as addressing issues of inter-generational equity, uncertainty, declining discount rates, multipliers, and minimum benchmarks for determining good international industry practice.

Technical Guidance Note: Transboundary Dam Safety

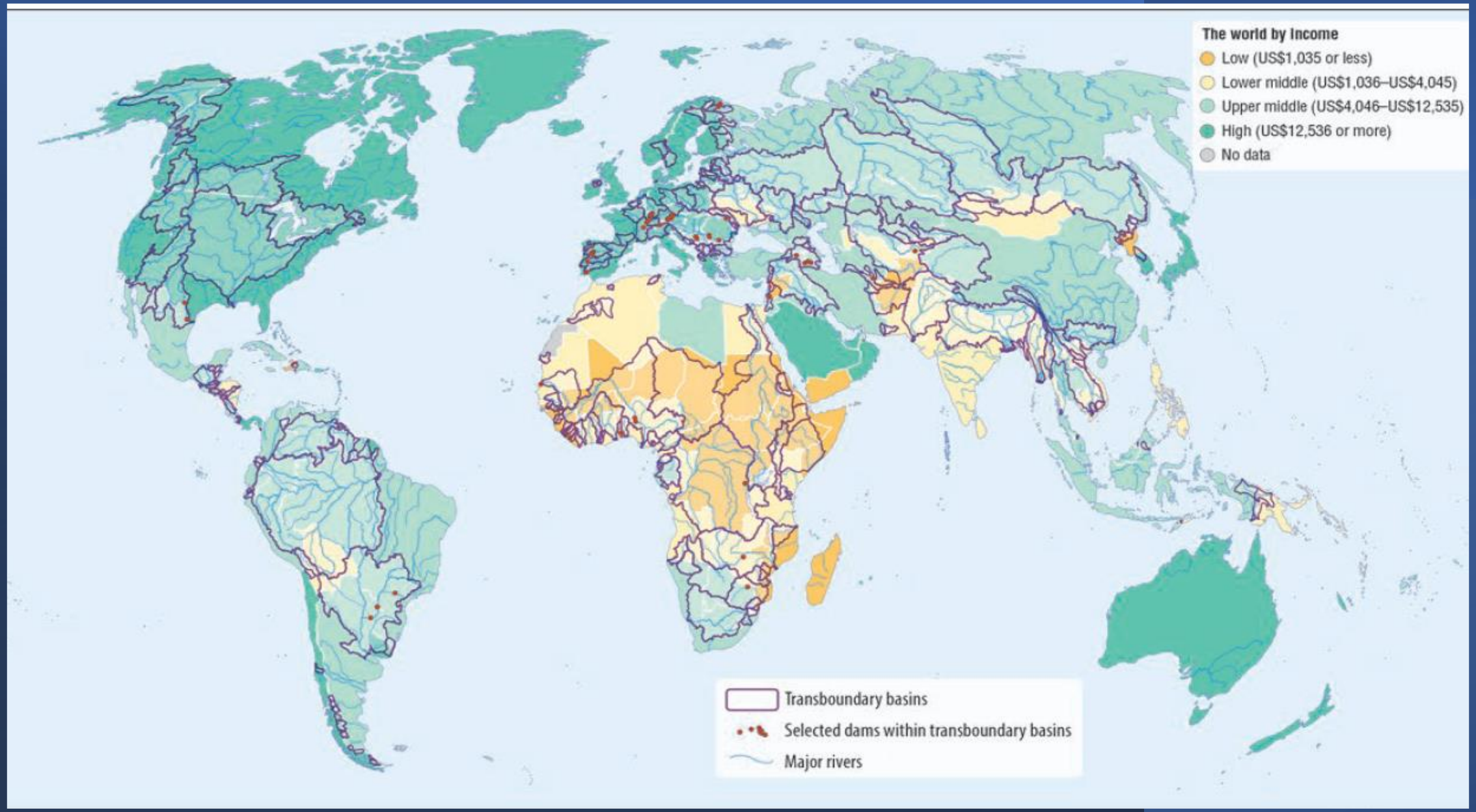
- Differences in dam classification, hazard definitions, and dam design and review standards
- The coexistence of different standards of care requirements and definitions, and whether they are defined by a statute or through case law
- Transboundary dam safety–related risks that are not captured by the regulatory regime
- The question of whether and how a dam owner can be held liable in tort (for example, due to negligence or strict liability) for damage caused across an administrative border

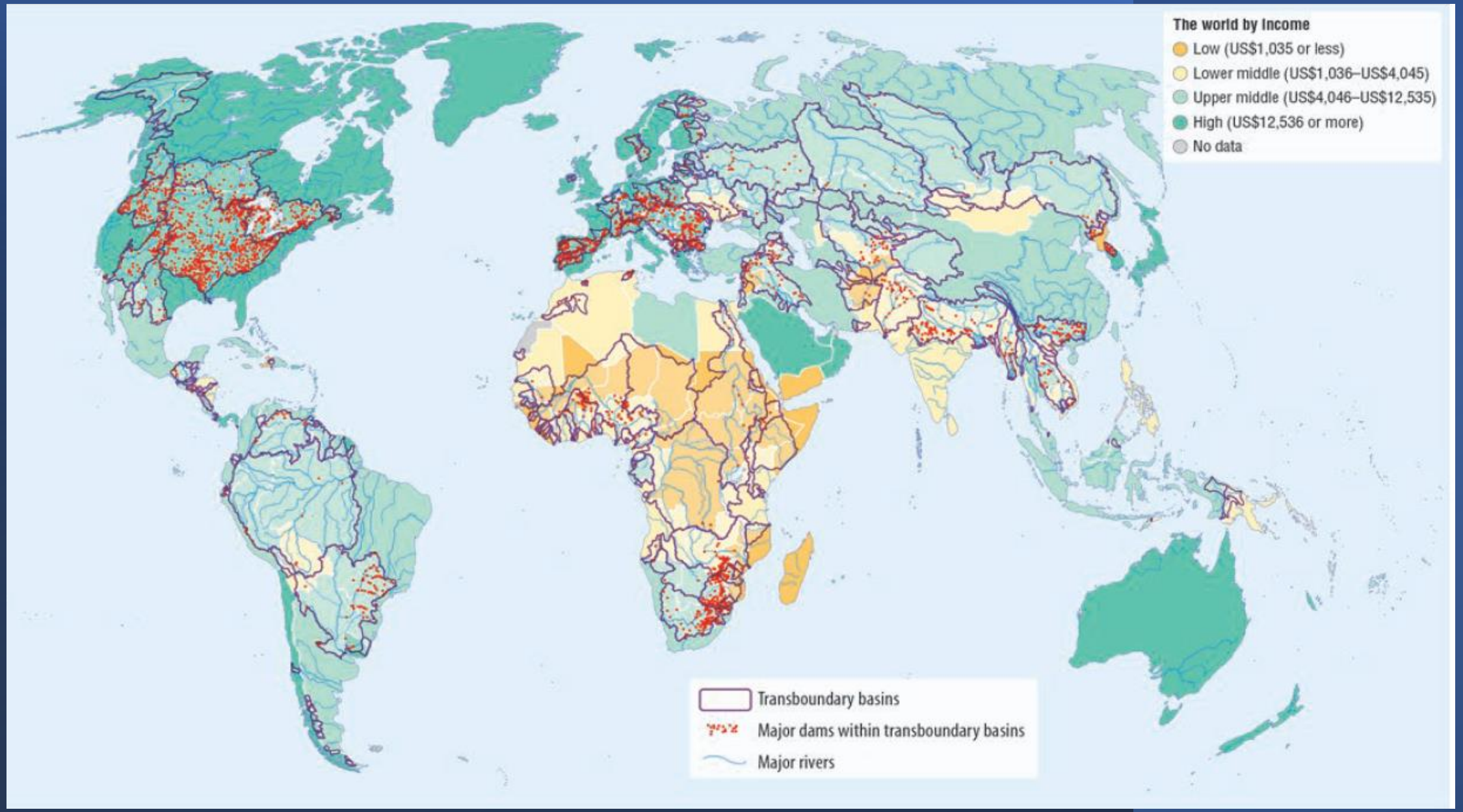
- **Definitions**
- **Legal and Institutional Arrangements**
- **Regulatory Regime for Transboundary Dam Safety**
  - **Capture of Regulated Dams**
  - **Classification of Dams for Proportioning Regulatory Mandates**
  - **Dam Classification and Design Standards**
  - **Requirements for Surveillance, Inspection, and Review**
  - **Requirements for Operation and Maintenance**
  - **Record Keeping and Data Sharing Agreements**
  - **Education and Training**
  - **Enforcement and Dispute-Resolution Mechanisms**
- **Emergency Preparedness and Public Safety**
- **Financing Mechanisms for Transboundary Dam Safety**

World Bank financed transboundary projects related to dam safety (FY04-FY17) by region



Region	Total number of dams	Transboundary dams	Dams located in transboundary basins
East Asia and Pacific	29,588	2	127
Europe and Central Asia	7,113	42	772
Latin America and the Caribbean	2,633	4	151
Middle East and North Africa	1,507	1	59
North America	10,435	2	1,212
South Asia	5,381	0	120
Sub-Saharan Africa	1,861	8	483
Total	**58,518**	**59**	**2,924**


The world by income
Low (US$1,035 or less)
Lower middle (US$1,036–US$4,045)
Upper middle (US$4,046–US$12,535)
High (US$12,536 or more)
No data
Transboundary basins
Selected dams within transboundary basins
Major rivers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Transboundary basins
Major dams within transboundary basins
Major rivers

Benefits of Transboundary Dam Safety Considerations

- Improved management and coordinated operation of water infrastructure to accommodate multipurpose water use
- The possibility of jointly facing common external threats, such as floods, droughts, and other climate risks
- Optimized location of infrastructure to increase benefits and reduce costs
- More effective emergency preparedness
- Enhanced resilience and environmental sustainability
- Increased financial and economic returns
- Increased economies of scale
- Improved political stability and peace dividends
- Accelerated economic development

Protocol for Development of Global Dam Databases

- Proliferation of databases based on advances in remote sensing and machine learning tools to identify waterbodies and barriers
- Range of attributes contained in each of the datasets varies considerably: from only point coordinates to offering up to 70 individual dam or reservoir characteristics
- The information for the target attributes is often inconsistent between individual dams (i.e., datasets with a large amount of attribute fields may still be highly incomplete if most fields are void of information)
- Difficult to conclude on the actual level of completeness in terms of dam and reservoir information
- Undermines global analytics leading to misleading understanding of dams and their contribution to development, as well as proper planning, mitigation and management.

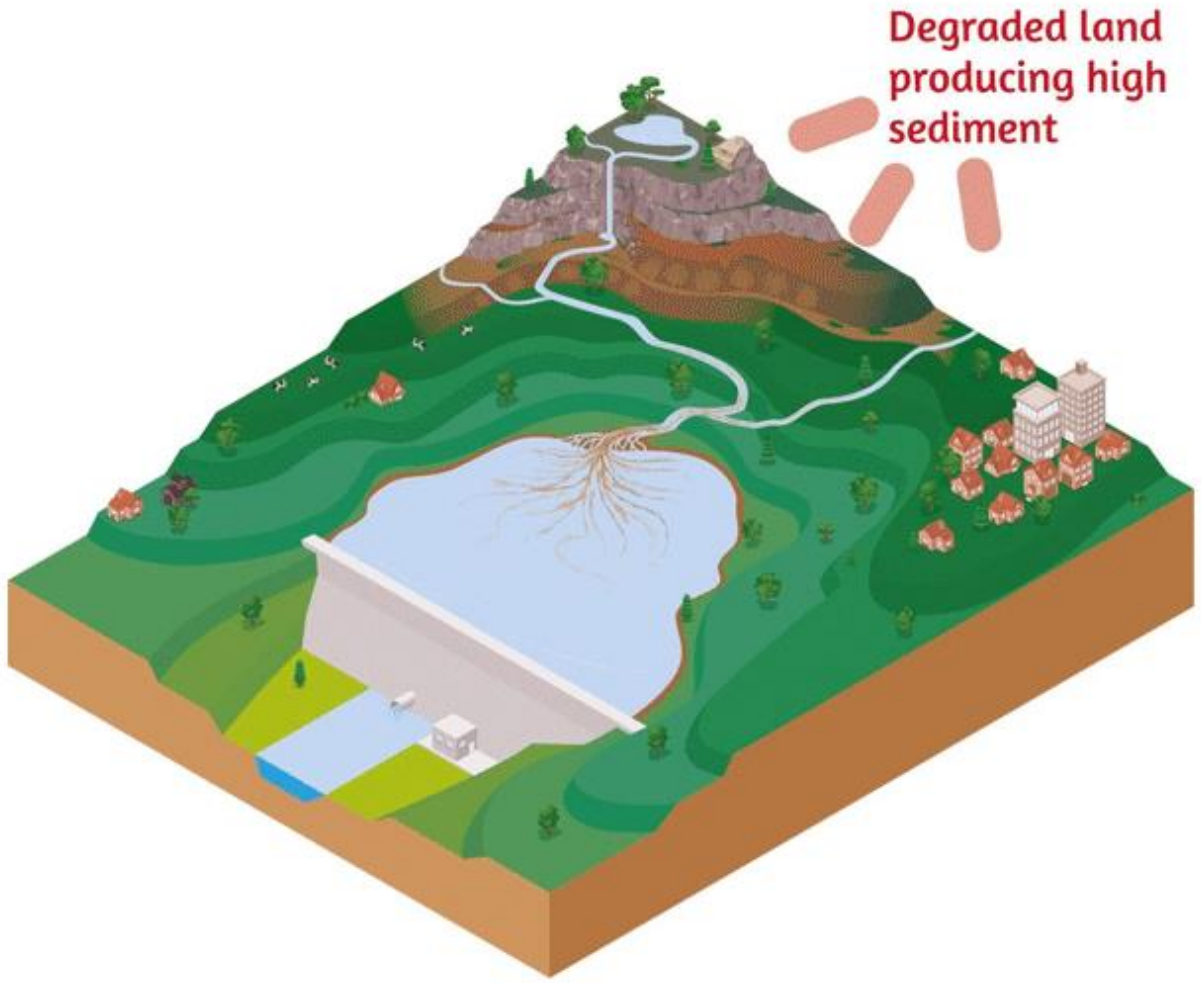
Dataset	Year published	# Records	Attributes	Georeferenced	Aligned to HydroSHEDS	Including polygons	Update status	License
Deltares Reservoirs	n.a.	>70,000	Unknown	Yes	No	Yes	Unknown	Free
ICOLD World Register of Dams (WRD)	1958, 2022	>59,000	41, incl. height, purpose, year, reservoir volume	Partial	No	No	Annually	Individual license with subscription fee (€ 230)
Open Street Map (OSM)	2022	>50,000	Multiple, inconsistent	Yes	No	Some	Regular	Free (ODbL 1.0)
GlObal geOreferenced Database of Dams (GOODD)	2020	>38,000	Coordinates only	Yes	Yes	No	Irregular	Unrestricted
Global River Obstruction Database (GROD)	2022	>30,000	Coordinates and obstruction type	Yes	No	No	Unknown	Free (CC-BY 4.0)
Georeferenced global dams and reservoirs dataset (GeoDAR)	2022	>24,000	ID number from ICOLD-WRD, and copied GranD attributes	Yes	No	Yes	Unknown	Free (CC-BY 4.0)
FAO AQUASTAT Georeferenced Database on Dams	2014	>14,000	27, incl. height, purpose, year, reservoir volume	Partial	No	No	Irregular (last update 2014)	AQUASTAT license (free for educational and non-commercial purposes)
Hydrology of Lakes and Reservoirs (HYDROLARE)	2022	<1,000	Multiple, inconsistent	Yes	No	Yes	Unknown	Free and unrestricted upon request from authors
World Resources Institute Global Forest Watch Major Dams	2014	~5,000	Multiple, inconsistent, incl. reservoir volume	Yes	No	No	Last update 2019	Free (CC-BY 4.0)
JRC Global Surface Water Explorer Reservoirs	n.a.	?	Unknown	Yes	No	Yes	Regular	Free (CC-BY 4.0)
Global Reservoir and Dam database (GRanD)	2011, 2019	7,320	57, incl. height, purpose, year built or removed, reservoir volume	Yes	Yes	Yes	Current version 1.3	Free for non-commercial use
World Bank's Global Dams Database	2020	6,155	Multiple, incl. name, reservoir volume; inconsistent completeness	Yes	No	No	Regular, last update 2020	Free (CC-BY 4.0)
Future Hydropower Reservoirs and Dams Database (FHReD)	2015	3,700	Coordinates, planning or construction stage, hydropower capacity	Yes	No	No	Irregular	Upon request from authors
Global Reservoir and Lakes Database (GREALD)	2022	3,278	Multiple, incl. name, type, and satellite overpass information	Yes	No	Yes	Irregular	Upon request from authors
Global Lakes and Wetlands Database (GLWD)	2004	654	Multiple, incl. name, reservoir volume	Yes	No	Yes	Now obsolete (succeeded by GranD)	Free for non-commercial use

Comprehensive consolidated database should include at a minimum the following :

- Dam point coordinates and/or reservoir polygon (ideally co-registered to a river network)
- Name of dam/reservoir
- Name of impounded river/basin
- Name of administrative unit and country
- Year of construction (and completion, or refurbishment)
- Height of dam
- Length of dam
- Surface area of reservoir (ideally with minimum, maximum, and average extent)
- Storage capacity of reservoir (ideally with dead, maximum, and active storage amounts)
- Year of removal (if applicable)
- Amount of inflowing (and outflowing) river discharge of the reservoir (ideally per month)
- Area of upstream catchment draining into the reservoir
- Main purpose of reservoir (ideally secondary also)
- Information on whether a lake existed before
- Number of people resettled due to reservoir construction
- Information on the economic parameters of the dam/reservoir
- Extent of irrigated area supported by the reservoir
- Amount of installed hydropower capacity (in MW)
- Information on ecological transparency (e.g., are fish ladders present, is it a run-of-river dam)
- Quality index regarding the reliability of the listed information

STRENGTHENING SPATIAL ANALYTICS - A GEOSPATIAL SEDIMENTATION RISK EVALUATION TOOL

FOR THE SAFETY OF DAMS AND DOWNSTREAM COMMUNITIES



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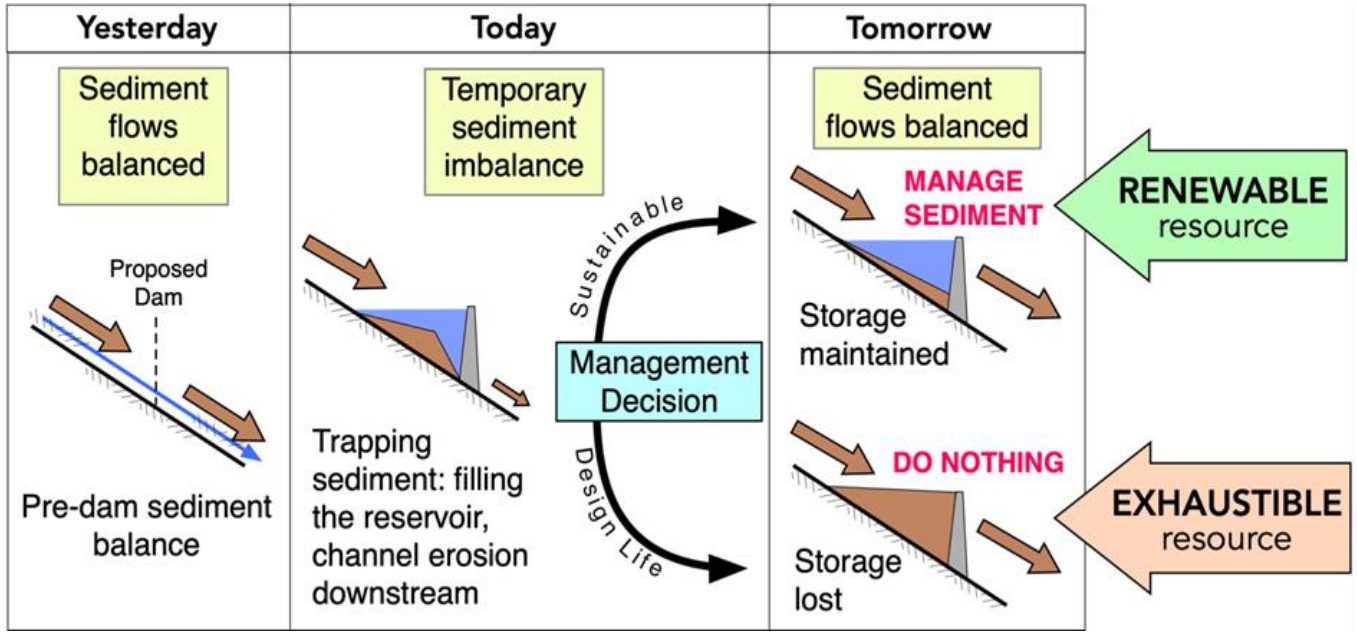
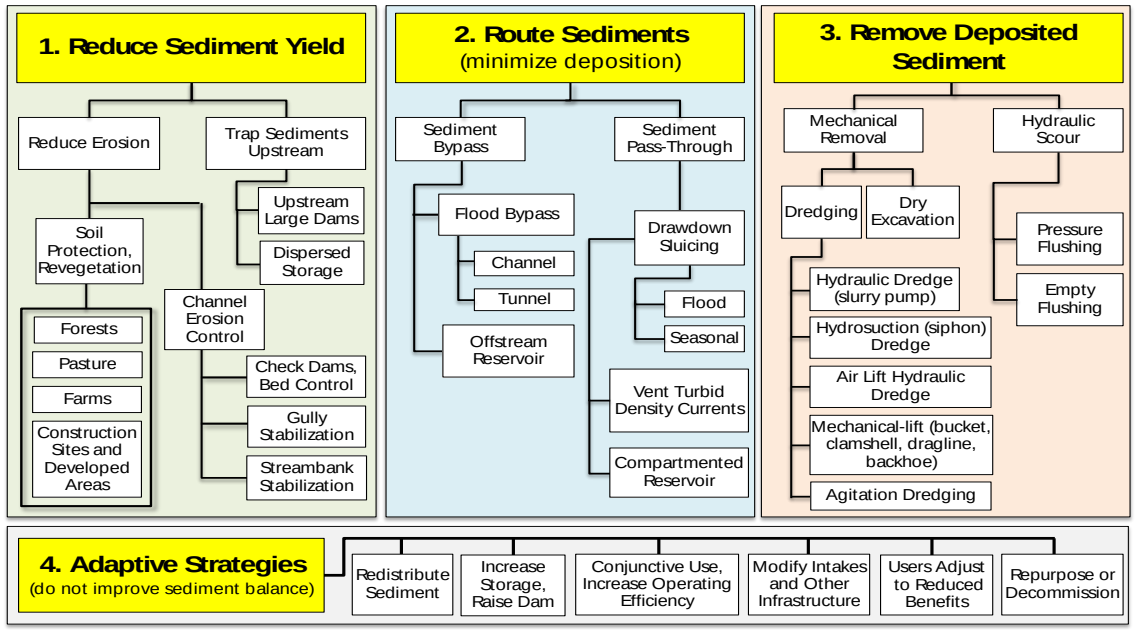
Objective ->

1. To develop a first order screening tool for identifying storage related projects vulnerable to sedimentation and inform development of appropriate sediment management strategies.
2. This will be based on estimates of erosion potential, quantification of sediment transport, and characteristics of reservoirs and dams.





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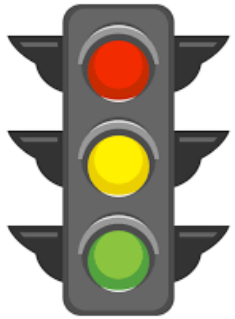
Sedimentation Risk Evaluation Tool

Erosion modelling

Sediment transport modelling

Satellite data

Reservoir characteristics



Dams in cascade?

Climate change impact?

Environmental and Social aspects?

The Next Generation: Opportunities for Further Collaboration and Cooperation between ICOLD and the World Bank

1. Review and input into the Technical Guidance Notes
2. Identifying good industry practice and case studies for the Technical Guidance Notes
3. Contributing to development a standard protocol for dam databases
4. Contributing to development of a comprehensive, global dams database
5. Who should we be reaching out to / working with / service providers & external consultants

Thank you!

Contact: mwishart@worldbank.org