Improved Environmental & Socio-Economic Baseline Information for Hydropower Planning

ISH11 Project - Overview

November 2015
Overview

- ISH11 Project Objective & Scope
- Information needs for Hydropower
- Examples of hydrologic, sediment & water quality data uses
- ISH11 Improvement Recommendations
- Available Documents
ISH11 Project Objective:
To support MRC Member Countries to gain a clear and scientifically-sound understanding of conditions, changes and trends in the LMB to inform hydropower planning and management.
4. Acquire essential knowledge to address uncertainty and minimise risk of the identified development opportunities

A range of studies will be conducted to address the uncertainties and risks of basin development opportunities.

The uncertainties and risks associated with basin development opportunities, including uncertainties of climate change, require early implementation of a range of studies of strategic importance to fill knowledge gaps and to develop risk mitigation measures, necessary for the opportunities to move to the next stage of study or transboundary appraisal, as required. The list of these studies is provided in Section 4.4 below. Immediate analysis will be undertaken of:

- Sediment and nutrient trapping and their consequent risks.
- Reduction of capture fisheries and social implications.
- Biodiversity changes.
- Social and livelihood impacts in the mainstream corridor, Tonle Sap, and 3S system.
ISH11 Project Objective

To support MRC Member Countries to gain a clear and scientifically-sound understanding of conditions, changes and trends in the LMB to inform hydropower planning and management.

The monitoring programme must:

- build on and complement *existing monitoring* undertaken by LMB member countries and the MRC;
- be fully *owned and supported* by the MRC’s member countries;
- provide information to allow evaluation of *transboundary* impacts associated with *hydropower* developments and changes; and
- be *practical* and able to be implemented in the *long-term* in line with the decentralisation strategy of the MRC.
Project Approach

1. Review and summarize international best practice.

2. Review existing monitoring activities of the MRC Programmes and Member Countries to see how well the information collected supports hydropower planning, decision-making and ongoing management needs.

3. Develop recommendations for improvement and an implementation plan to trial these recommendations.

4. Test the feasibility and practicability of the recommended monitoring programme improvements, and fill priority data gaps, during a 12-month period.

5. Based on this experience, develop recommendations for long-term basin-wide monitoring.
Thematic Scope

- **Economic**
  - Energy security & distribution
  - Income & revenue
  - Industries
  - Employment
  - Infrastructure
  - Transport
  - Markets
  - Costs

- **Social**
  - Populations & demographics
  - Livelihoods
  - Living standards
  - Health
  - Culture & religion

- **Environmental**
  - Fisheries
  - Aquatic ecology
  - Terrestrial ecology
  - Geomorphology
  - Sediments
  - Water quality
  - Hydrology
  - Meteorology

- **Technical**
  - Design features
  - Generation, operational rules
  - Assets
  - Standards
  - Safety

- **Governance**
  - Policies
  - Legislation
  - Institutions
  - Law and order
  - Compliance

All dimensions have implications for each other
### ISH11 Relationships to MRC Programmes

<table>
<thead>
<tr>
<th>ISH11 Discipline Specialists:</th>
<th>MRC Programmes:</th>
<th>MRC Monitoring Programmes:</th>
<th>Databases:</th>
<th>End Uses:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquatic ecology specialist</td>
<td></td>
<td></td>
<td>Aquatic ecology monitoring (EHM)</td>
<td>BDP Scenarios and analyses</td>
</tr>
<tr>
<td>Water quality, sediments &amp; hydrology specialist</td>
<td></td>
<td></td>
<td>Water quality monitoring (WQMN)</td>
<td>Ecological health report cards</td>
</tr>
<tr>
<td>Database specialist</td>
<td></td>
<td></td>
<td></td>
<td>Water quality report cards</td>
</tr>
<tr>
<td>Fisheries specialist</td>
<td>Information &amp; Knowledge Management Programme (IKMP)</td>
<td>Sediment monitoring (DSMP)</td>
<td>MRC Master Catalogue</td>
<td>MRC Data Portal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hydrology monitoring (HYCOS)</td>
<td></td>
<td>MRC Toolbox &amp; Decision-Support Framework</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fisheries monitoring</td>
<td>Fisheries database</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Various technical reports</td>
<td></td>
</tr>
</tbody>
</table>
Hydropower information needs – technical
Hydropower information needs – socio-economic & environmental
Hydropower information needs can vary over time

The Hydropower Project Life Cycle (~100 years)

- **Planning and pre-feasibility (~10 years)**
- **Design, feasibility, impact assessments (~3 years)**
- **Construction (~7 years)**
- **Operation (~80 years)**

Hydropower information needs can vary over time:

- **Water resource estimation**
- **Impact assessment and predictions**
- **Construction management**
- **Effectiveness of mitigation measures**
- **Need for operating rule changes**
- **Often major refurbishment after ~50 years**
- **Interpretation of changes in environmental condition**

- **Planning and pre-feasibility (~10 years)**
- **Design, feasibility, impact assessments (~3 years)**
- **Construction (~7 years)**
- **Operation (~80 years)**

Sometimes change of ownership, and/or relicensing, after some time period.
### Temporal Scales and Perspectives

#### YEARS
- Initial reservoir organic decay decreases, reservoir water quality settles
- Erosional processes initially significant, move towards new equilibria
- Changes to environmental and socio-economic conditions settle into new norms

#### MONTHS
- Reservoir and river water level fluctuations typically change seasonally
- Ecological changes will be strongly seasonally based
- New resource-based livelihoods will be re-oriented around any new seasonality

#### DAYS / HOURS
- If a peaking station, water level changes can occur on these time scales
- Environmental and social implications of peaking operations require a different level of scrutiny, relating to frequent channel dewatering, bank slumping, and public safety.

#### EVENT-BASED
- A number of changes will be linked to floods / dam spills and droughts / long-term maintenance shutdowns. Catastrophic events can include dambreak.

#### DECADES
- Construction and dam-filling can each be as long as a decade for some projects
- Dam life can be 50-100 years; major refurbishments/upgrades after decades
- Relicensing and/or end of concession may occur after some years or decades
- Changes in surrounding land-uses and community values over decades
- Decommissioning and rehabilitation at end of life
Information needs relating to hydropower planning & management in the LMB can vary by geographic scale:

**MEKONG BASIN LEVEL:** Water resource availability, regional energy demand/price, grid availability, regional agreements (water/energy/trade), basin wide resource pressures and status, transboundary cumulative impacts and effectiveness of mitigation, development status, equity in resource access, information

**NATIONAL LEVEL:** Water resource availability, national energy demand/price/security, grid access, carbon intensity, contribution to GDP growth, development status vs goals (industrial, human), cumulative impacts and effectiveness of mitigation, fit with policies, legislative frameworks and compliance, stakeholder support, information

**LOCAL LEVEL:** Water resource access, reliance on river, electricity access, good and services, transport, infrastructure, employment, health, education, living standards, community governance, culture, impacts and effectiveness of mitigation (predicted and actual), community safety, risk, stakeholder support, communication, information

**PROJECT LEVEL:** Water resource availability, siting and design, market, grid, costs, revenues, investors, demand, off-takers, good and services, transport, infrastructure, labour, contracts, impacts and effectiveness of mitigation (predicted and actual), compliance, safety, standards, risk, communication, information
Information needs relating to hydropower planning & management in the LMB can be similar at different geographic scales.

**MEKONG BASIN LEVEL:** Water resource availability, regional energy demand/price, grid availability, regional agreements (water/energy/trade), basin wide resource pressures and status, transboundary cumulative impacts and effectiveness of mitigation, development status, equity in resource access, information.

**NATIONAL LEVEL:** Water resource availability, national energy demand/price/security, grid access, carbon intensity, contribution to GDP growth, development status vs goals (industrial, human), cumulative impacts and effectiveness of mitigation, fit with policies, legislative frameworks and compliance, stakeholder support, information.

**LOCAL LEVEL:** Water resource access, reliance on river, electricity access, good and services, transport, infrastructure, employment, health, education, living standards, community governance, culture, impacts and effectiveness of mitigation (predicted and actual), community safety, risk, stakeholder support, communication, information.

**PROJECT LEVEL:** Water resource availability, siting and design, market, grid, costs, revenues, investors, demand, off-takers, good and services, transport, infrastructure, labour, contracts, impacts and effectiveness of mitigation (predicted and actual), compliance, safety, standards, risk, communication, information.
Have HPPs improved local health standards?
Number of cases of malaria over time in area of influence of HPPs
Number of algal blooms over time in area of influence of HPPs

Are HPPs causing algal blooms?

Data supports management questions

Management questions

Indicator

- Economic
  - Industries
    - Goods & Service Industries
      - No. new goods & service industries
        - HPP locations
    - HPP locations
  - No. malaria cases presenting

- Social
  - Health
    - Number of malaria cases
      - HPP locations
  - Disease

- Environmental
  - Water quality
    - Chlorophyll-a, nutrients, algae
      - HPP locations
  - Biological
    - HPP locations

Parameters / data

Dimension

Parameter group

Parameter type
A Management Systems Approach

- Management Actions
- Decision-Making
- Results Analysis, Data Sharing & Reporting
- Implementation

Objectives Establishment

- Ongoing review and modification as needed
- Ongoing QA/QC procedures & data mgmt
- Ongoing capacity building & successional planning

Monitoring Programme Design & Formal Agreement
1. **Locations:**
   
a) Cover all Mekong River hydro ecological zones  
b) Near proposed or operational hydropower project or group of projects  
c) Enable understanding of mainstream processes  
d) Facilitate understanding of changes occurring across national boundaries  

2. **Parameters:**
   
a) Provide input to indicators related to hydropower planning and management  
b) Able to be replicated across the basin  
c) Able to be measured and analysed at a low cost  
d) Able to help predict as well as explain cause and effect of changes  

3. **Timing:**
   
a) Length of record covers the cycles of natural variability (seasonal, annual, decadal)  
b) Frequency captures natural or operational system changes and migratory cycles  

4. **Information management:**
   
a) Systems allow information to be centrally archived and shared  
b) Quality management systems are in place to ensure consistency across countries  

5. **Information use:**
   
a) Information is readily available for users (e.g. Member Countries, developers, NMCs, Line Agencies)  
b) Links to tools are available for decision-support and analysis
Hydrologic data uses

- HP planning
- Lake level mgmt
- Flood forecasting
- Navigation
- Irrigation
- Water Supply

Spatial information

Short-term information
- 2011

Long-term trends
- 1960-2004
Suspended sediment data uses

- Patterns of sediment delivery into HP impoundments
  - Timing of sluicing
- Sediment rating curves
  - Planning of mitigation measures
- Sediment grain-size
  - Trapping efficiency
- Sediment load calculations
  - Volume loss in impoundments
- Regional context
Sediment & flow data uses

Long-term trends & variability

- Changes to sediment delivery necessitate changes to HP management
Seasonal sediment data uses – suspended sediment

- Seasonal patterns & spatial trends
  - Timing of sediment inputs to HPs
- Mekong is a flood pulse system
- Mekong is a sediment pulse system
- Seasonal patterns are changing
  - HP management & mitigation require flexibility
Bedload data uses

Patterns & volume of sediment delivery into HP impoundments
- Volume losses
- Timing of mitigation measures (mining / bypass)

Sediment rating curves
- Planning of mitigation measures

Changes to the downstream channel

Regional context
Seasonal sediment data uses – bed materials

- **Flood season**
  - Gravel >2mm
  - Coarse & VC Sand 0.5-2mm
  - Med Sand 0.25-0.5mm
  - Fine & VFSand 0.063-0.25mm
  - Silt 0.002-0.063

- **Dry season**
  - Sediment inputs vary by season
  - Affects nature & distribution of sediment within impoundment
  - Affects mitigation approaches

DSMP results
Water quality data uses

Integrate sediment & WQ information: Nutrient budgets
- Reflect land-use changes
- Within impoundment changes
- Understand regional patterns

Integrate flow & WQ information: Seasonal water cycles
- Inputs to HP impoundments

WQMNN results
D.O. Affected by Cascade Design & Inflows

Mid-depth intake – high inflows

High level intake – low inflow

High level intake – V low inflow

High level intake - high inflows
HP data needs - summary

- Monitoring to guide design, construction, operations, decommissioning
- Systematic, representative & accurate information
  - Systems approach
  - Data management over life of project
- Range of time-scales
  - Daily to decadal
- Range of geographic scales
  - Upstream
  - Within impoundment
  - Downstream
- Basin level info available from MRC
- Maximise information by linking HP project level info to regional understanding

Grain-Size Distribution 2012-13

Percent

<table>
<thead>
<tr>
<th></th>
<th>Clay</th>
<th>Silt</th>
<th>Fine Sand</th>
<th>Med Sand</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Socio-Economic Proposals

<table>
<thead>
<tr>
<th>Improvement Proposal</th>
<th>Proposal Details</th>
<th>MRC Programme</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SE1:</strong> Centralisation, harmonisation and accessibility of hydropower relevant socio-economics information</td>
<td>Ensure BDP Socio-Economics Database project includes priority social and economic parameters relevant to hydropower; these will need to be prioritised.</td>
<td>BDP</td>
</tr>
<tr>
<td><strong>SE2:</strong> SIMVA Improvements – adjustments to MRC approach for 2013 survey</td>
<td>Embed recommendations for improvement regarding hydropower-relevant information into the Nov-Dec 2013 SIMVA survey.</td>
<td>EP</td>
</tr>
<tr>
<td><strong>SE3:</strong> SIMVA enhancements for hydropower – trialling self-monitoring approaches</td>
<td>Self-monitoring approaches could be (a) at the district level through annual surveys; and (b) at the community level through resource assessments and RiverWatch approaches</td>
<td>EP</td>
</tr>
</tbody>
</table>
## Fisheries Proposals

<table>
<thead>
<tr>
<th>Improvement Proposal</th>
<th>Proposal Details</th>
<th>MRC Programme</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>F1: Historical fisheries data review</strong></td>
<td>Review existing monitoring data in detail to better ascertain present state of knowledge and identify potential cost-savings</td>
<td>FP</td>
</tr>
<tr>
<td><strong>F2: Habitat assessment standard method</strong></td>
<td>Method development and trialling, in consultation with ISH11 Aquatic Ecology and Sediments, Water Quality and Hydrology specialists</td>
<td>FP (also EP, IKMP)</td>
</tr>
<tr>
<td><strong>F3: Fish sampling standard method</strong></td>
<td>Method development and trialling</td>
<td>FP</td>
</tr>
<tr>
<td><strong>F4: Biological analysis standard method</strong></td>
<td>Method development and trialling</td>
<td>FP</td>
</tr>
</tbody>
</table>
# Aquatic Ecology Proposals

<table>
<thead>
<tr>
<th>Improvement Proposal</th>
<th>Proposal Details</th>
<th>MRC Programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>AE1: <em>Historical aquatic ecology data review</em></td>
<td>Review existing monitoring data in detail to better ascertain present state of knowledge and identify alternative data analysis approaches</td>
<td>EP</td>
</tr>
<tr>
<td>AE2: <em>Integration of bio-monitoring with hydropower relevant disciplines</em></td>
<td>Will be undertaken at locations meaningful to hydropower; will be used to determine new indicators and demonstrate how to link aquatic ecology data with other disciplines’ data sets</td>
<td>EP</td>
</tr>
<tr>
<td>AE3: <em>Phytoplankton monitoring</em></td>
<td>Trial addition of phytoplankton monitoring to existing Ecological Health Monitoring programme during March/April and September</td>
<td>EP</td>
</tr>
<tr>
<td>AE4: <em>Bio-monitoring database</em></td>
<td>Design for database improvements that would include upgrading of identification keys, provision of taxonomic identification training, better documentation, and upgrading of the database for better usability</td>
<td>EP</td>
</tr>
</tbody>
</table>
# Sediments, Water Quality and Hydrology Proposals

<table>
<thead>
<tr>
<th>Improvement Proposal</th>
<th>Proposal Details</th>
<th>MRC Programme</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SWH1: Historical sediments, water quality and hydrology data review</strong></td>
<td>Review existing monitoring data in detail to better ascertain present state of knowledge and identify alternative data analysis approaches.</td>
<td>IKMP, EP</td>
</tr>
<tr>
<td><strong>SWH2: Integrate water quality in with sediment and flow monitoring</strong></td>
<td>Water quality sample collection would be at same locations and timing as sediment and flow data collection; water quality would be collected via depth-integrated sampling and be analysed for total organic carbon and extractable nutrients.</td>
<td>IKMP, EP</td>
</tr>
<tr>
<td><strong>SWH3: Enhance existing sediment monitoring</strong></td>
<td>More comprehensive bedload sampling and grain-size analysis built into the regular sediment sampling programme.</td>
<td>IKMP</td>
</tr>
<tr>
<td><strong>SWH4: Improved geomorphic data for hydropower information</strong></td>
<td>Develop methods and trial geomorphic analysis activities that could be undertaken on a 5-yearly basis, including aerial photo analysis, bathymetric and longitudinal surveys, river cross-section analysis, and bed material surveys.</td>
<td>IKMP</td>
</tr>
</tbody>
</table>
# Information Use Proposals

<table>
<thead>
<tr>
<th>Improvement Proposal</th>
<th>Proposal Details</th>
<th>MRC Programme</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IU1: Improving End-Use of Hydropower Information</strong></td>
<td>Consider improvements to information uses building on the MRC Data Portal and TookKits, such as (a) extractable hydropower information datasets, and (b) web-based condition/knowledge presentation approaches</td>
<td>IKMP</td>
</tr>
<tr>
<td><strong>IU2: Indicators for Hydropower Information</strong></td>
<td>Consider improvements to information uses via indicators, specifically providing recommendations for (a) State of the Basin Report, and (b) Basin Development Planning scenarios</td>
<td>BDP</td>
</tr>
<tr>
<td><strong>IU3: Guidance for Member Countries Developers/Operators regarding Hydropower Information</strong></td>
<td>Consider guidance to (a) Member Countries and (b) Developers/Operators so that info collected at national and project scales could be consistent with the MRC Basin-wide Parameters and Methods</td>
<td>ISH</td>
</tr>
</tbody>
</table>
ISH11 – Available Reports

- ISH11 Phase 2 Report & Annexes
  - Summary of information needs, gap analysis & recommendations
  - Annexes for each discipline
    - Review of best practice
    - Summary of information availability in the LMB
    - Detailed gap analysis & recommendations

- Information Sources to Support LMB Hydropower Information Needs
  - Bain wide information sources
  - Hydropower information sources
  - Thematic information sources (hydrology, sediments & geomorphology, water quality, aquatic health, fisheries, social & economic)
  - Summary of HP relevant information being collected by monitoring location
Thank you