Small Hydropower Resource Mapping Experience & Perspectives

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March 21, 2019
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Outline

- Hydropower mapping: various needs and contexts
- Our approach
- Conclusions and Perspectives
Various needs and contexts

SHER has successfully mapped the hydropower potential of Rwanda, Burundi, Tanzania, Madagascar and Vanuatu

<table>
<thead>
<tr>
<th>Country</th>
<th>Area [km²]</th>
<th>Pop. [million]</th>
<th>Pop. density [hab. / km²]</th>
<th>Approx. installed capacity (share of hydropower)</th>
<th>Period of the Study</th>
<th>Beneficiary (source of funding)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rwanda</td>
<td>26 338</td>
<td>12.0</td>
<td>456</td>
<td>156 MW (~50%)</td>
<td>2006-2007</td>
<td>Ministry of Energy (CTB-BTC)</td>
</tr>
<tr>
<td>Burundi</td>
<td>27 834</td>
<td>9.8</td>
<td>354</td>
<td>57 MW (~89%)</td>
<td>2011</td>
<td>Ministry of Energy (CTB-BTC)</td>
</tr>
<tr>
<td>Tanzania</td>
<td>945 087</td>
<td>49.2</td>
<td>52</td>
<td>1583 MW (~34%)</td>
<td>2013-2017</td>
<td>REA (World Bank – ESMAP)</td>
</tr>
<tr>
<td>Vanuatu</td>
<td>12 200</td>
<td>0.27</td>
<td>23</td>
<td></td>
<td>2016-2017</td>
<td>Dept. of Energy (World Bank)</td>
</tr>
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Also site identification / mapping at the region and/or catchment scale in DR Congo, Angola, ...
A few case studies in hydropower mapping

Different contexts and scales to handle

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<td>12 200 (80 islands)</td>
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Rwanda Hydropower Atlas

Key outcomes

- Based on an inventory of potential sites
- 360 Potential sites
- Extensive field work (100 site visits)
- Access database (with data from visited sites)
- 80% of the potential sites < 500 kW
Small Hydro Resource Mapping: Our approach

Stage 1: Data collection and Screening phase

- Data collection and Literature review
- Calculation of the hydropower potential along the river network

Stage 1 output: set of river stretches that are likely suitable for hydropower development

- High slope gradient
- Favorable hydrological conditions
- Impacted by the quality of the input data
- Feeds Stage 2
Small Hydro Resource Mapping: Our approach

Stage 2: Desk-based analysis of stage 1 outputs

- Analysis of river stretches by Hydropower Experts (stage 1 results)
  - Preliminary hydrological analysis
  - Satellite imagery
  - Topographic maps
  - Geological maps

- Stage 2 output: actual location of potential hydropower projects
  - Preliminary estimate of the site key features and layout
  - Existence of major constraints
  - Time consuming exercise
Small Hydro Resource Mapping: Our approach

Stage 3: Field validation

- Integral part of the identification process and critical
  - Validation of the key features assessed during stage 2
  - Confirm (or not) the technical feasibility of the project

- Important in context where:
  - Data is sparse
  - Uncertainties are high

- Selection process prior to site visits (budget constraint)

- Stage 3 output: ground-validated potential hydropower sites
  - Ground-validated preliminary estimates of the site key technical and economic features (including access and type of connection)
  - Proposed scheme layout
Small Hydro Resource Mapping: Our approach

Stage 4: Delivery of the Atlas and associated outputs

- Spatial database (GIS) of the hydropower sector (various formats)
- Hydropower Atlas
- Detailed project sheets (reconnaissance studies) for the visited sites
- Prefeasibility studies
- Hydropower Atlas and associated GIS are operational tools for energy planning
- Training and capacity building
## Small Hydro Mapping: Comparative overview

### Stage 1: Data collection & screening

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<th>Existing sites</th>
<th>Topographic data</th>
<th>Visited sites</th>
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<td>360 (inventory only)</td>
<td>100</td>
<td>Topo maps</td>
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<td>Burundi</td>
<td>161</td>
<td>30</td>
<td>Idem Rwanda + Digital Elevation Model</td>
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### Stage 2: Desk-based analysis prioritization

- Atlas document
- Database
- Project sheets

### Stage 3: Field-based validation

- Atlas document
- Project sheets
- Recommendation for the rehabilitation of the existing sites
- 4 prefeasibility studies

### Stage 4: Production of the Atlas

- Atlas document
- Project sheets
- Priorization and ranking (MCA) of the 20 most promising sites for short-term development
- 4 detailed prefeasibility studies

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**Notes:**
- SHER
- GIS
- MCA
- BOQ
Small Hydropower Mapping

Improvement of our approach over time and experience


- Rwanda
- Burundi
- Tanzania
- Madagascar

Spot measurements
- Hydrology

Hydrology
- Hydrological model at the country / region / catchment scale
- Use of satellite-based data
- Installation of monitoring stations

Scope of Work and Outputs
- Focus on RoR (Pico) and Micro Hydro
- Potential sites only

- Existing & Potential sites
- From a few kW to the largest projects
- Geospatial planning and prioritization
- Economic analysis
- Capacity building
- Integration of hydropower into the energy sector

Field data
- Knowledge of the sites / projects

Multidisciplinary Team (geological reconnaissance, socio-environmental context, topographical surveying by drone/satellite, access, connection, etc.)
Conclusions and Perspectives

Africa has a huge largely untapped hydropower potential but faces major challenges

- Hydrological data is often sparse and or outdated
- Climate change
- Increasing suspended sediment load
  - Deforestation
  - Agricultural practices
  - Mining activities
  - Increased human pressure on the environment
- Un-coordinated planning and development (IWRM)
- Need for refurbishment and upgrade
- Financial close-out of projects (access to funding)
- Robustness of the business plans
- High upfront costs for hydropower development
Conclusions and Perspectives

Rwanda : the way forward ?

■ Update of the existing Hydropower Atlas
  • Updated data and context (population, grid, socio-economic, hydrology, ...)
  • Updated tools and approach
    o Extended scope of work to cover pico hydro
    o New potential micro/small sites
  • Geospatial planning and prioritization of projects
  • Operational tools for master planning and integration of other RE
  • Carry on with prefeasibility studies for top priority projects

■ Importance of IWRM

■ W4Gr has already contributed
  • Water permits mechanism
  • Identification of pico hydro sites in the Upper Nybarongo catchment
Thank you

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