Small Hydropower Resource Mapping Experience & Perspectives

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Dr. Quentin GOOR

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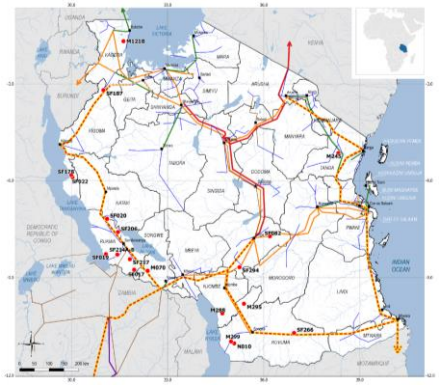
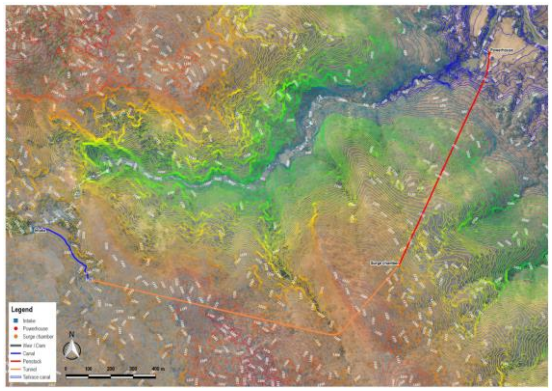
Outline

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





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Various needs and contexts

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

Country	Area [km²]	Pop. [million]	Pop. density [hab. / km²]	Approx. installed capacity (share of hydropower)	Period of the Study	Beneficiary (source of funding)
Rwanda	26 338	12.0	456	156 MW (~50%)	2006-2007	Ministry of Energy (CTB-BTC)
Burundi	27 834	9.8	354	57 MW (~89%)	2011	Ministry of Energy (CTB-BTC)
Tanzania	945 087	49.2	52	1583 MW (~34%)	2013-2017	REA (World Bank – ESMAP)
Madagascar	587 040	22.9	36	160 MW (~30%)	2014-2017	Ministry of Energy (World Bank – ESMAP)
Vanuatu	12 200	0.27	23		2016-2017	Dept. of Energy (World Bank)

Also site identification / mapping at the region and/or catchment scale in DR Congo, Angola, …

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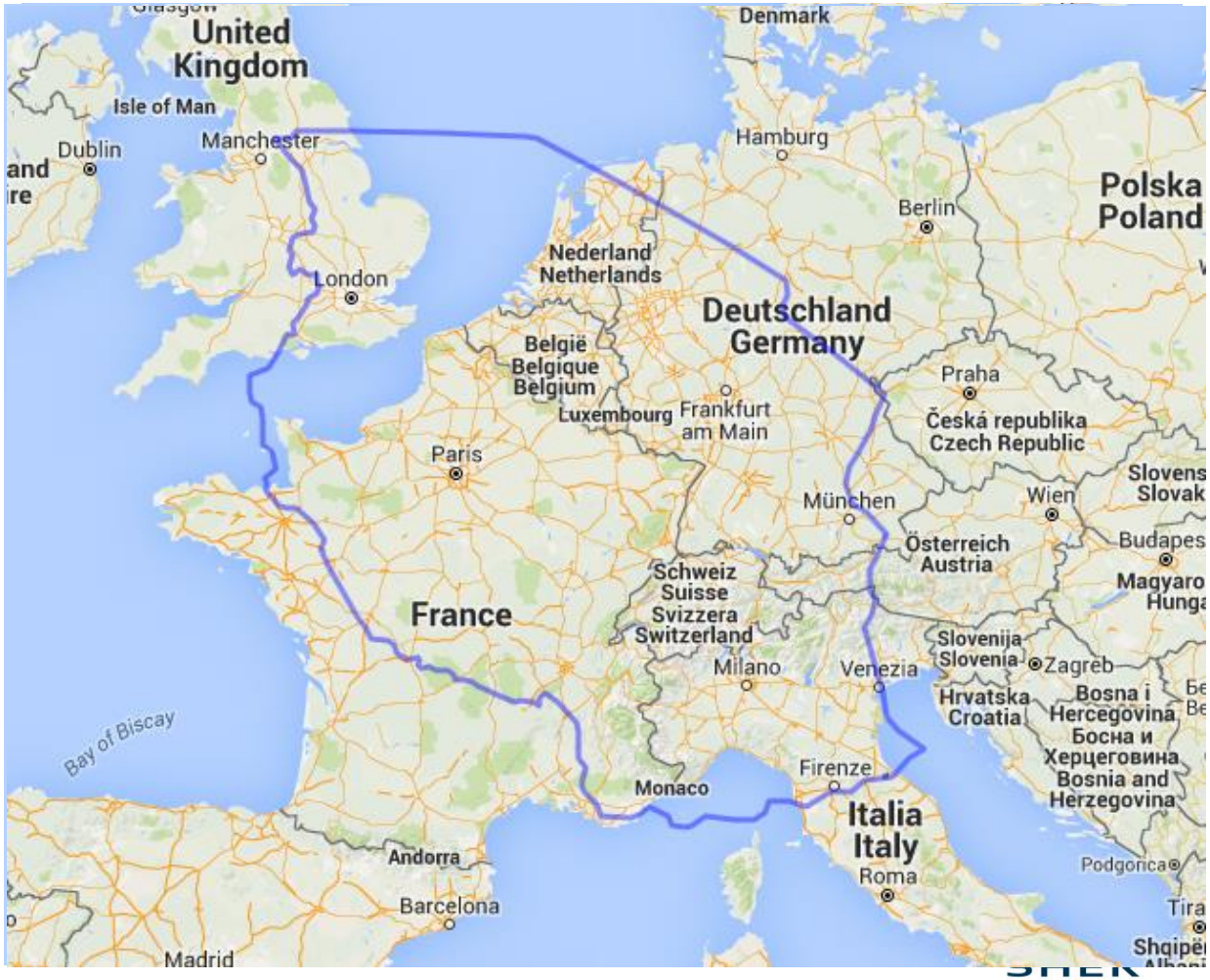
A few case studies in hydropower mapping

Different contexts and scales to handle

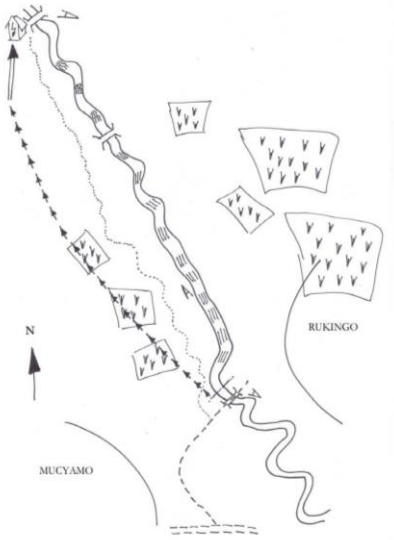
Country	Area [km²]
Rwanda	26 338
Burundi	27 834
Madagascar	587 040
Tanzanie	945 087
Vanuatu	12 200 (80 islands)

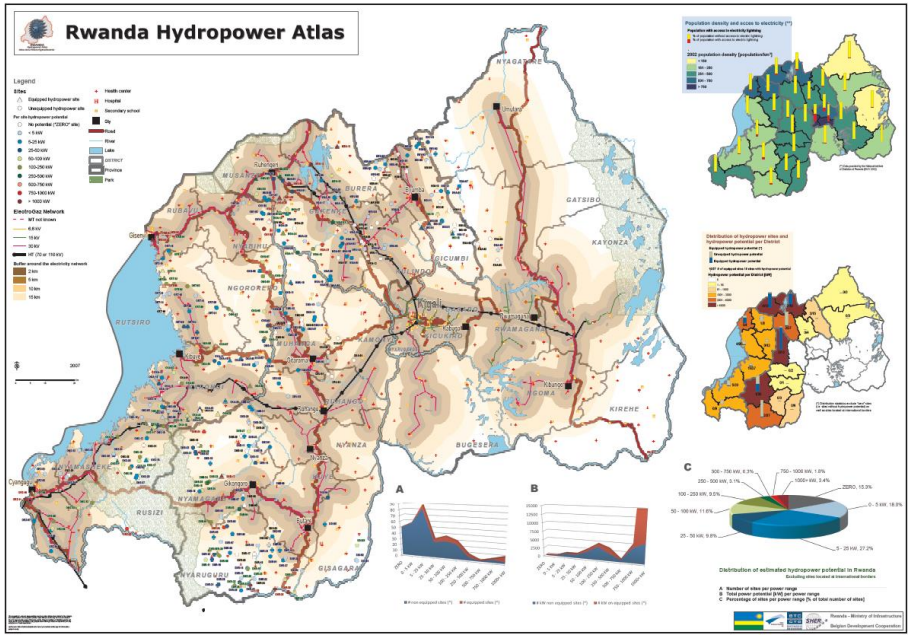


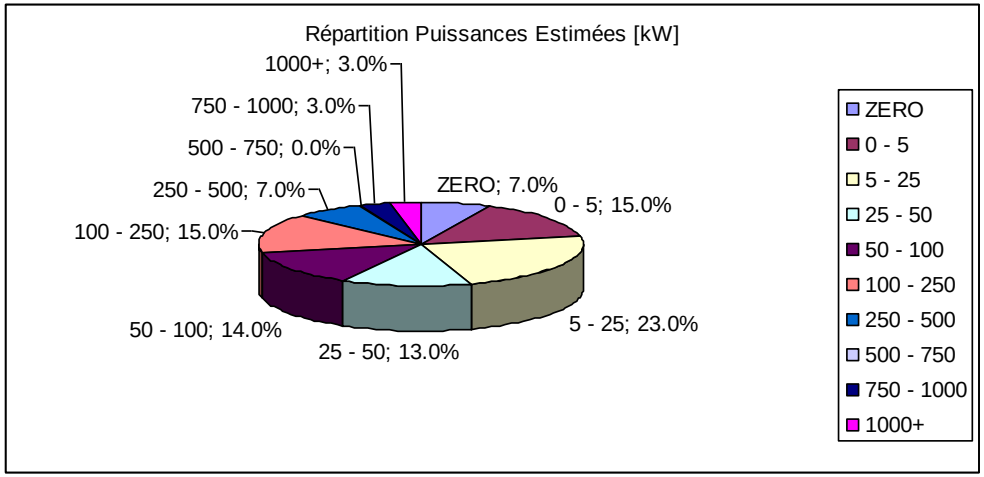
Rwanda Hydropower Atlas

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







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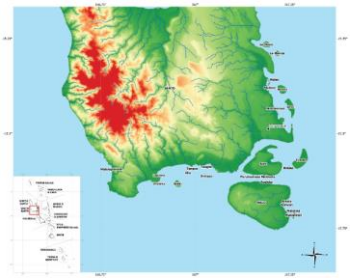
Small Hydro Resource Mapping: Our approach

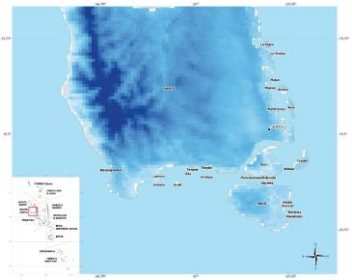
Stage 1: Data collection and Screening phase

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

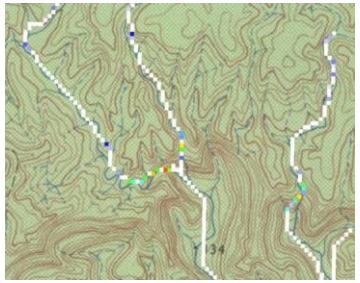


Gridded topographic data

+



Gridded rainfall data



- 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

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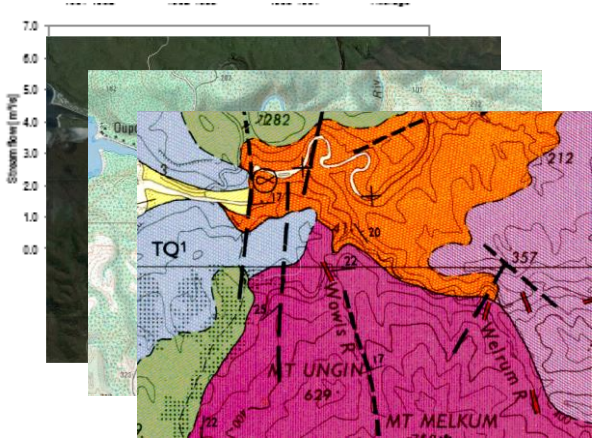
Small Hydro Resource Mapping: Our approach

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

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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

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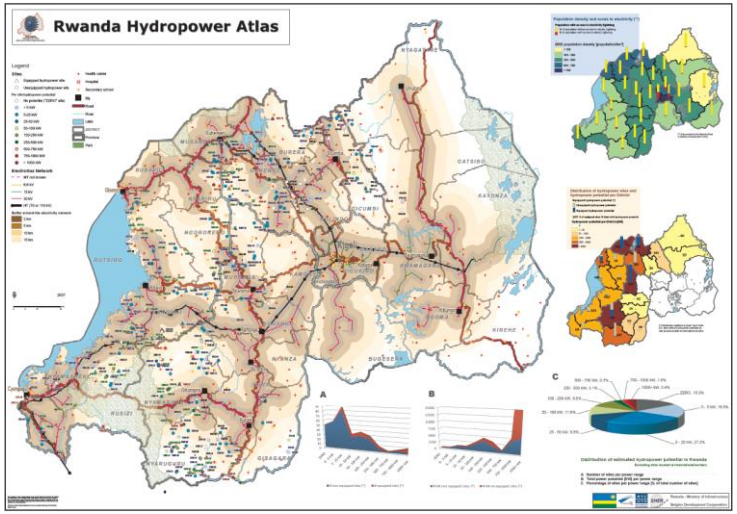
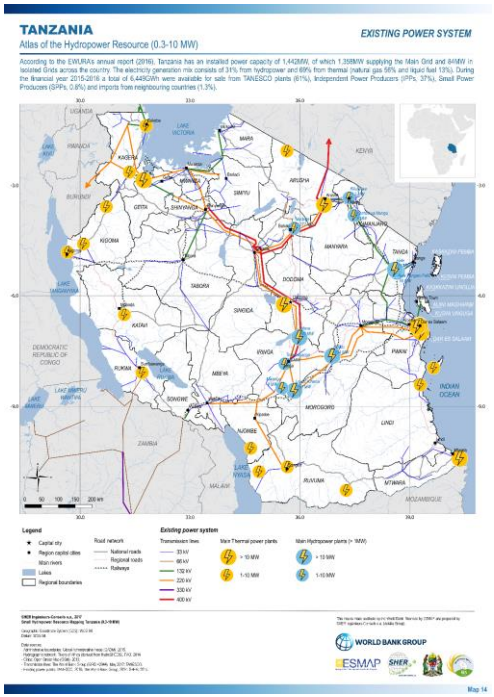
Small Hydro Resource Mapping: Our approach

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





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Small Hydro Mapping: Comparative overview

Stage 1 : Data collection & screening → **Stage 2 :** Desk-based analysis priorization → **Stage 3 :** Field-based validation → **Stage 4 :** Production of the Atlas

Rwanda (0.1 - 1MW)	Potential sites : 360 (inventory only)	▪ Topo maps ▪ Spot flow measurements	Visited sites : 100	▪ Atlas document ▪ Database ▪ Project sheets
Burundi	▪ Potential sites : 161 ▪ Existing sites : 30	▪ Idem Rwanda ▪ + Digital Elevation Model ▪ + Hydrological model	Visited sites : ▪ 161 potential ▪ 30 existing	▪ Atlas document ▪ Project sheets ▪ Recommendation for the rehabilitation of the existing sties ▪ 4 prefeasibility studies
Tanzania (0.8 - 10 MW)	▪ Potential sites : 455 (174 new from SHER) ▪ Existing sites : 46	▪ Idem Burundi ▪ + Satellite-based rainfall data ▪ + Topographic surveying	Visited sites : ▪ 77 potential ▪ 46 existing	▪ Atlas document ▪ Project sheets (preliminary design, BOQ, geology, socio-envi, energy and economic performance) ▪ GIS ▪ Priorization and ranking (MCA) of the 20 most promising sites for short-term development ▪ 4 detailed prefeasibility studies
Madagascar (1 - 20 MW)	▪ Potential sites : 1300+ (517 new from SHER) ▪ Existing sites : 13	▪ Idem Tanzania	Visited sites : ▪ 40 potential ▪ 13 existing	

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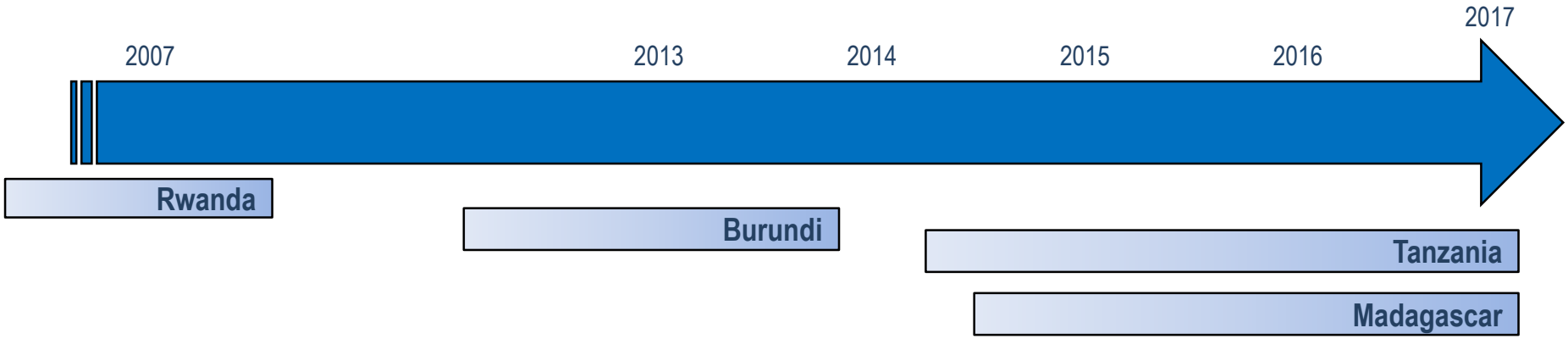
Small Hydropower Mapping

Improvement of our approach over time and experience



Spot measurements	**Hydrology**	▪ Hydrological model at the country / region / catchment scale ▪ Use of satellite-based data ▪ Installation of monitoring stations
▪ Focus on RoR (Pico) and Micro Hydro ▪ Potential sites only	**Scope of Work and Outputs**	▪ Existing & Potential sites ▪ From a few kW to the largest projects ▪ Geospatial planning and priorization ▪ 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

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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
    - *Extended scope of work to cover pico hydro*
    - *New potential micro/small sites*
  - Geospatial planning and priorization 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

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Thank you

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Your Partner for Hydropower Development

Contact :

Dr. Quentin Goor
SHER Hydropower and Water Resources
goor@sher.be

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