# The current status of small hydropower in Africa

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CSIR
our future through science

## Small hydropower in Africa

- Long history in Africa, however many systems have fallen in disrepair
- Recently several initiatives to revive hydro sector in Africa
- Very good understanding of technical issues involved
- Small hydropower can make a significant impact in rural areas of Africa

# Village hydro in Kenya




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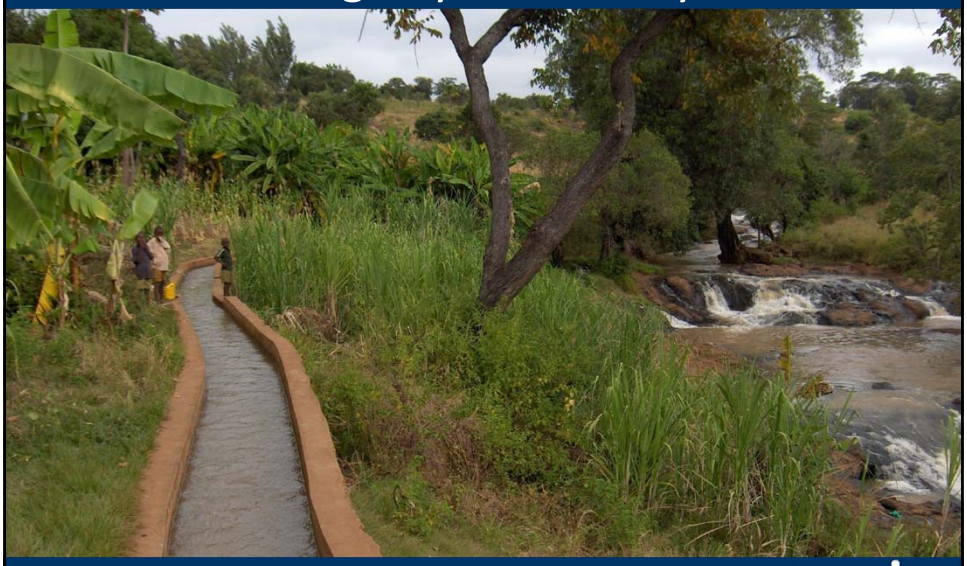




# Village hydro in Kenya

## Small hydropower in South Africa

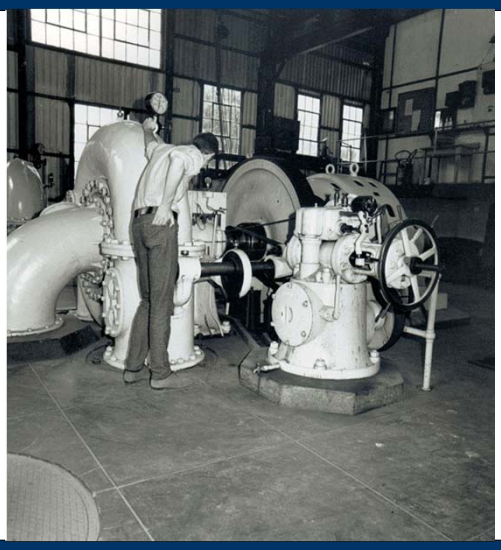
- First hydro station 300 kW on slopes of Table Mountain
- Pretoria served by hydro station on Pienaars river
- Many more examples, but with extension of ESKOM grid many were decommissioned



## Sabie hydro plant

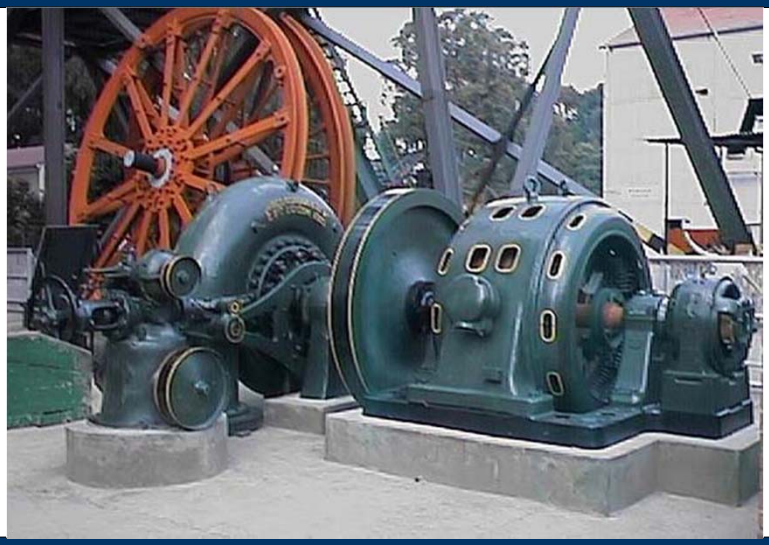
- at Sabie River Gorge, 14 kms downstream from Sabie
- installed capacity of 1.350 kW, made up of three 450 kW 600 kVA 750 rpm Francis turbines
- 64 m head
- provisionally started for testing in March 1927
- commercial operation started on 1 April 1928
- closure 5 November 1964

# Sabie hydro plant





# Sabie hydro plant



# Bethlehem hydro

The 7 MW Bethlehem two-facility hydro complex, near Bethlehem, South Africa:

- 3 MW Sol Plaatje
- 4 MW Merino, both located on the As River.

- Sol Plaatje semi-autonomously via remote monitoring, interconnected to the Bethlehem municipal power grid by 11 kV line
- Merino plant connected to the national Eskom transmission network through a dedicated 18 km 22 kV line.



# Bethlehem hydro

- Electricity from both hydro facilities sold to the Dihlabeng (Bethlehem) Municipality (~ 10 - 15 % of town's power)
- Development costs for the two-facility complex 100 million South African rand (US$13 million)

## Bethlehem hydro

Beyond Bethlehem, developer acquired rights to develop another 17.5 MW of hydropower, including:

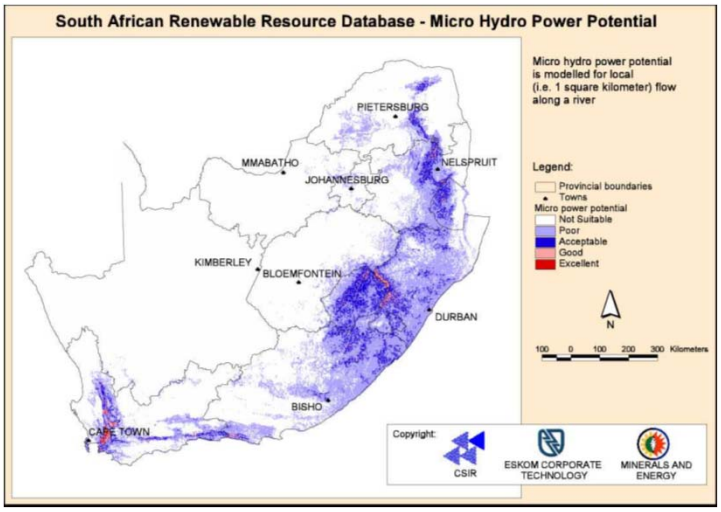
- 10 MW Botterkloof, installed at the Botterkloof Dam below the Lesotho Highlands;
- 4 MW Merino 2
- 3.5 MW Bivane, Kwazulu-Natal



## Other developments

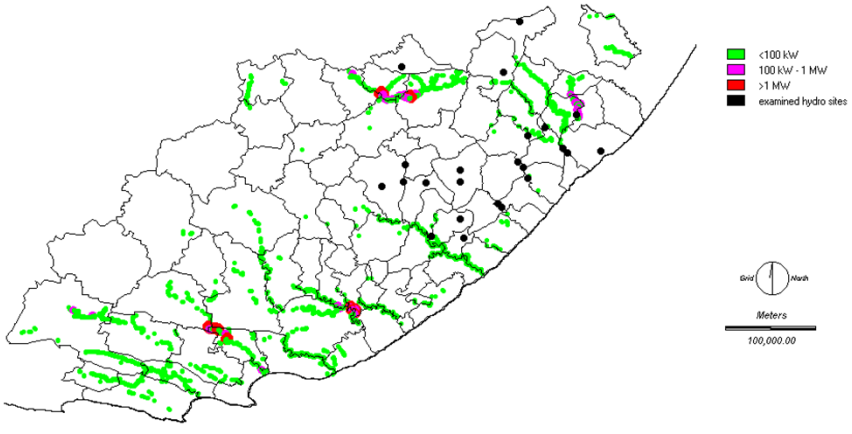
- Blue Crane Route Municipality (40 MW)
- Ethekwini water supply system
- Wellington hydro (320 kW in winter, 115 kW in summer)
- Others….

# Small hydropower in South Africa






# Small hydropower in South Africa



# Current status

- Very limited, scattered and often incomplete information
- Development of database, to be made accessible via hydro4africa.net
- Report GTZ / HERA



# Current status

*Table 2: Current situation of MHP development in selected SSA countries*

| Hydro power | Ethiopia | Kenya | Mozambique | Nigeria | Rwanda | South Africa |
|---|---|---|---|---|---|---|
| Total installed capacity | 662 MW | 677 MW | 2136 MW | 1983 MW | 27 MW | 653 MW |
| MHP potential | > 600 sites[6] | 3000 MW | Unclear | 277 sites, 734 MW | 333 sites, 96 MW | 5.5 MW (< 1 MW) |
| Existing MHP plants / installed capacity | Unclear | 3 - 60 (1-80 kW) | 6 (10-80 kW) | 7 SHP (1-10 MW) | 6 | 45 - 96 MHP[7] 8 - 35 MW (< 1 MW) |
| MHP plants under construction | 5 (7-200 kW) | Unclear | None | Unclear | 15 | Unclear |
| MHP plants planned | None | 20 | 3 (23-600 kW) | Unclear | 21 | Unclear |

Source: WEC 2007, GTZ Regional Reports 2009, interviews

## Recent developments - Lesotho

- 4 small hydroplants assisted by Norwegian and French development aid
  - Tsoelike, 400 kW (Qacha's Nek)
  - Tlokoeng, 570 kW (Mokhotlong )
  - Mantsonyane, 2 MW (Tsaba-Tseka)
  - Semonkong, 180 kW (Semonkong)
- Mphaki / Quthing (15 MW)

→ **technical design needs to be sound – resource assessment realistic and recent**



## Recent developments – UNDP GEF

Regional project in West Africa for 10 countries (Cameroon, Mali, Central African Republic, Democratic Republic of Congo, Gabon, Congo/Brazzaville, Rwanda, Equatorial Guinea, Togo & Benin)

- started with regional network
- plans for scale up
- 36 hydro plants in the region
- learning amongst participation countries

→ **ensure compatibility between (pre)feasibility studies and required information by developers**

## Recent developments - Rwanda

Rwanda – 11 hydroplants from 100 kW to 9.5 MW

- UNIDO initially village level management, but later private sector business management
- EnDev (DGIS/GTZ) pure private sector approach: 5 business consortia out of 20 proposals received. Due to requirements of financing banks most schemes will be grid-connected. (Conflict with donor requirements)

→ **key role for private sector in development and/or management of small hydropower**



## Recent developments – Greening Tea

Greening the Tea Industry in East Africa

- UNEP / GEF / EATTA / AfDB
- establish 6 small hydro demonstration projects in at least 3 countries + additional (pre)feasibility studies

→ **anchor client + inclusion of rural electrification component**

## Recent developments - PA

EU funded project "Catalysing Modern Energy Service Delivery to Marginal Communities in Southern Africa" by Practical Action in Malawi, Mozambique and Zimbabwe.

- 15 installations
- development of regional pool of micro hydro expertise including local manufacturing, standards, barrier removal

→ **integration of capacity building**



## Recent developments - GPower

Gpower Kenya

- NGO, developed Rural Energy Access Model
- from off-grid energy access to interconnected grid energy
- 11 small hydroplants
- local turbine production

→ **long term planning, integration with grid, part of larger development plan**

## Not so new – Tanzania village hydro

- part of larger research on sustainability factors of small hydro power development in Africa (CSIR / University of Twente)
- case study of three village level hydro plants to determine success factors
- plants developed by the Njombe Diocese Catholic Church Mission in collaboration with different donors:
  - Matembwe,
  - Mavanga and
  - Lugarawa village hydro scheme.



## Not so new – Tanzania village hydro

Common characteristics:

- developed in close collaboration with villagers concerned
- main use of power generated is for productive uses
- ownership models in which responsibility is shared with local community, mission and donor
- arrangements for technical support in place (either by installer under a contract or trained technicians)
- strict arrangements in place for payments, penalties for non-payment and re-connection after payment defaulting

## How to keep small beautiful

**Sustainability is not primarily a technical issue !**

**Increase sustainability through:**

- careful planning for technical capacity
- good institutional arrangements
- managerial capacity planning
- stakeholder involvement in all stages of development

**→adjust objective of the project (not to install an energy system, but to provide energy services)**



## How to keep small beautiful

- embed hydro development in national program for capacity building and industrial development
- ensure proper legislative and financial frameworks
- linkage with ongoing economic development
- include role for private sector in development and management

**→additional research on appropriate implementation models**

# Thank you

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**Updates on research at http://hydro4africa.net**

**More on microhydro at http://microhydropower.net**