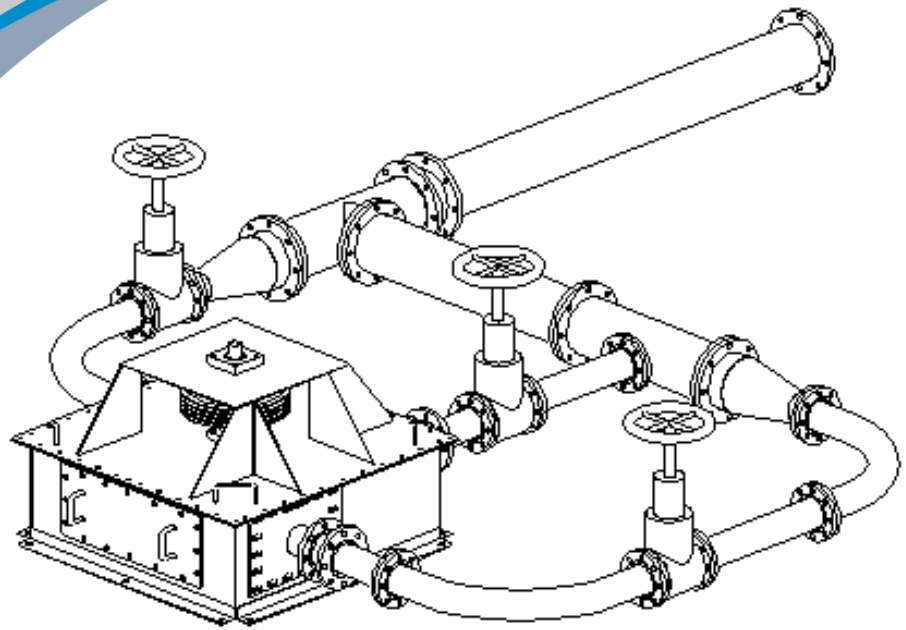
Catalysing Modern Energy Service Delivery to Marginal communities in Southern Africa (Grant agreement number 9.ACP.RPR.139/3)



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acp-eu energy facility

MULANJE MOUNTAIN CONSERVATION TRUST

KSM

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Basic Characteristics of Practical Action Schemes in this project

- Micro hydro schemes – scheme sizes vary from 16kW (Ngarura) to 88kW (Bondo)
- A product of flow and head
- All are run-off-river schemes
- Provide both mechanical and electric power
- Mechanical power for grind milling
- Forebay acts as a surge tank in all cases but 1 (Ngarura)
- Distribution system in all cases are decentralised grids
- All are community owned in one form or the other
- Canals – Unlined are common in Mozambique schemes; for Zimbabwe and Malawi all are lined
- Standards and common practice in the respective countries
- Two types of turbines – pelton and crossflow (based on head)

Sustainability and how will it be ensured
Technical Sustainability

- **Knowledge of the scheme is ingrained in community members during the construction of the scheme. Operation and maintenance trainings become easier to understand after the construction process.**
- **Operation and maintenance is done by community members who are trained by Practical Action and other stakeholders (Rural Electrification agencies and power utility companies)**
- **Technical Trainings of community members – Sengasenga video and book**
- **Linkages with local fabricators**
- **Community to community linkages and trainings enhance MHS concepts, give exposure of different conditions and build community to community support structures (communities in Dazi call for support from Chipendeke because the former were their trainers)**
- **Linkages with power utility companies and rural electrification agencies and other stakeholders**

Sustainability - Business Models

- **The Tariff Calculator**
- Gives business conditions that will attract investors to consider renewable energy as an investment option. how micro hydro schemes meet their operation and maintenance costs; in some cases, how it provides a return for investors.
- **Ownership and Management model**
- community based (company, cooperative, individual, trust)
- **Three tier pricing structure**
- social services (schools, rural health centres); HHs; commercial end-use activities
- A self subsidizing tariff structure which ensures viability of schemes
- Skew towards commercial consumers (end use activities) rather than consumption consumers (households and social services) – otherwise tariffs are high for households
- **Engineering the ability of households to pay**
- Prepayment Billing System – compliments of Conlog Systems, SA
- payment in the form of recurring commodities (agricultural produce). Linkages with commercial entities that utilise commodities as raw materials
- Consumer structured Tariffs (e.g. Seasonally).

Sustainability – Financial and Economic Models

- **Economic sustainability – how benefits of micro hydro schemes cascade to the general people in the community – electricity to households; electricity to the community (cleaner energy); new businesses and job creation.**
- **Investors – dividends; shareholding with share certificates and directorship status**
- **Financial sustainability – how micro hydro schemes can be financed (grant; equity; loan; reserves) – financing options for replicating, up-scaling or replacement.**
- **Finance for initial investment – grant : [sweat] equity**
- **Finance for O & M – tariffs mostly from non-consumption end-use activities**
- **Finance for expansion – Reserves made by company**
- **Decentralised Renewable Energy Fund**
- **Partnerships for sustainability**

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Certificate of Ownership

This certifies that
Zacharia Dinhira, ID. No. **75-034949 B 75**, **Josephine Murepa**, ID No. **75-008368 J 75** and **Ennia Dinhira**, ID No. **75-034976 F 75,** residing in Village **2A** in ward 22 of Mutare Rural District, having jointly contributed 14 days to the construction of Chipendeke Micro Hydro Scheme, are part owners jointly holding 0.4% stake.

SIGNED

Ernest Mupunga
Regional Director, Practical Action

Xavier Marchel
Ambassador—EU Delegation Zimbabwe

Lessons on Costs of MHS

- Locally available materials and community contribution of labour lowers costs by at least 25% of civil works
- De-silting tank adds about 10% to generation costs
- PVC penstock is cheapest at $27.00 per metre than GRP (Glass Reinforced Plastic) $140.00 per metre and steel ($160,00 per metre), in that order
- Locally fabricated turbines are cheaper than importing
- Peltons and crossflows are the cheapest and easiest for local manufacturers to fabricate, in that order
- Schemes with no transmission (step up and step down transformers) but only distribution are cheaper ($10,000 per km vs $25,000 to $30,000 per km)
- Prepaid metering systems can be designed for decentralised schemes
- Cost about $4,500 for the system (management system and vending system) and $14.00 per single phase metre and $70.00 for three phase meter (discounted prices for Practical Action from Conlog SA)
- Bill of Quantities (BOQs) are critical to avoid cost overruns

Lessons, Challenges and Achievements

- **Community mobilisation and buy in necessary for sustainability of schemes**
- **Gender mainstreaming is critical for sustainability**
- **Imparting technical capacity to partners needs for the lead agency to be hands on**
- **Involvement of other technical stakeholders crucial**
- **Challenges**
- **Some costs crucial for the sustainability of the schemes had not been included in the budgets at the start of the project (Community Energy Centre, Prepayment Systems, Connections to Business Centres)**
- **Cost overruns – contract rider approved**
- **Achievements**
- **Additional generating power of 209 kW against a target of 320kW installed from micro hydro systems which contributes to the share of renewable energy in the three countries (target to be reached by 2012). Expected total of 386 by December 2012**
- **One tool and business models for viability of micro hydro systems tested and operational (The Tariff Calculator).**
- **Rural electrification agencies buy-in into MH technology – REA modified mandate to extending small decentralised grids from national grid**

Planned/actual production, price of energy provided

Name of Scheme	Design Capacity (kW)	New / Rehab	Cost of Scheme (Euro)	Beneficiaries
Chipendeke (zw)	25	New	181,990 (18,340)	3930 (RHC,2011)
Dazi (zw)	20	New	93,101	928
Nyafaru (zw)	20	Rehab	41,945	5618 (RHC, 2007)
Ndiriri (mz)	27	New	41,515	645
Nerufundo (mz)	24	Rehab	12,941	1400 (est)
Bondo (mw)	88	New	480,000 (est)	10877
Nyamwanga (zw)	30	New	100,487 (est)	3797
Ngarura (zw)	16	New	35,962 (est)	5423 (clinic)
Hlabiso (zw)	30	New	144,000 (est)	3846 (est)
Chitunga (mz)	30	New	100,487 (est)	2502
Ndakada (mz)	25	Rehab	15,000 (est)	3564
Mwamuka (mz)	18	New	15,000 (est)	1050
Nguarai (mz)	25	Rehab	15,000 (est)	1420

Characteristics of each scheme

Name of Scheme	Design Capacity (kW)	Head	Flow (Gross Abstractable)	Turbine Type / No. of jets	Type of Power	Uses of Power
Chipendeke (zw)	25	41m	100l/sec (0.1m3/s)	Pelton ; 3 jets	Electrical	HH; end use, clinic, Primary school
Dazi (zw)	20	121m	30l/sec (0.03m3/s)	Pelton; 1 jet	Electrical	HH; end use, clinic, Primary school
Nyafaru (zw)	20	25.18m	150l/sec	Crossflow; 1 jet	Electrical	Primary and Secondary Schools, Boarding School facilities, clinic,
Ndiriri (mz)	27	88m	51l/sec (0.051m3/s)	Pelton; 1 jet	Mechanical *cum* Electrical	Grinding Mill, HH; end use
Nerufundo (mz)	24	69m	60l/sec (0.06m3/s)	Pelton; 1 jet	Mechanical	Grinding Mill
Bondo (mw)	88	51m	330l/sec (0.330m3/s)	Pelton; 3 jets	Electrical	HH; end use, clinic, Primary school
Nyamwanga (zw)	33	25m	200l/s	Crossflow; 1 jet	Electrical	HH; Community Energy Centre, clinic, Primary school
Ngarura (zw)	16	32m	100l/sec (0.1m3/s)	Crossflow; 1 jet	Electrical	HH; end use, clinic, Primary and Secondary Schools
Hlabiso (zw)	30	25m	200l/s (0.20m3/s)	Crossflow; 1 jet	Electrical	Cable Transportation to Nursery , Primary and Secondary Schools, clinic and business centre

The Cases Demonstrated in the project

- **Direct Penstock Approach – Nyamwanga; Ngarura , Hlabiso**
- **High head low flow – Dazi**
- **Mechanical *cum* Electrical Scheme – Ndiriri, Ndakada, Mwamuka and Nguarai**
- **Prepayment Billing System – Chipendeke**
- **Community energy centre – Chitunga, Nyamwanga, Bondo**
- **Electricity powered cable transportation for rural communities - Hlabiso**

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Completed weir and lined canal at Chipendeke, Mutare.

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Single Phase Prepaid Meters at Chipendeke, Mutare.

Coupling Arrangement of Generator, Turbine and grinding mill at Ndiriri, Manica.

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Hydro mechanically powered grinding mill at Ndiriri, Manica.

Dazi MHS in Zimbabwe demonstrates a high head and low flow scheme. Penstock is a PVC pipe buried underground.

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Steel Penstock above ground at Chipendeke MHS in Zimbabwe

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3 jet system at Chipendeke MHS in Zimbabwe.

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Pelton Turbine at Chipendeke, Mutare.

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Removing a 13year old cross flow turbine at Nyafaru MHS in Zimbabwe for rehabilitation.

River Chimedza polluted and heavily silted due to gold panning activities in the area, making a de-silting tank prerequisite for ensuring longer lifespan of electromechanical components

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Forebay and two desilting Tanks at Chitunga, Manica.

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Power House at Dazi, Nyanga.

No transformer required at Ndiriri and type of cable is simple

For Bondo – aluminium conductors which are more expensive and transformers

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Billboards and Direction Signs