Micro-Mini Hydropower (MHP) Best Practices & Productive Utilization in Pakistan

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MHP Potential in Pakistan

Over **3,000MW** of identified potential of MHP exists in northern Pakistan

Projects Installed: Over 860
Projects in Pipeline: ~600
Existing Known Information

MHP Projects Overview

**PEDO**
- 356 MHPs
- 12 Dist. KPK
- 7 Imp NGOs

**EU**
- 240 MHPs
- 07 Dist. KPK
- SRSP Imp NGOs

**CDM/PPAF/WB**
- 90 MHPs
- Gilgit, Baltistan & Chitral
- AKRSP Imp NGOs

**KfW-PPAF**
- 05 MHPs
- 3 Dist. KPK
- 3 Imp NGOs

**ADB-PEDO**
- 672 MHPs
- 19 Dist. KPK
- 7 Imp NGOs

**Many Others**
- Private NGOs
Development of Turbines

https://www.dropbox.com/preview/Public/Hydro_scout_guide_ET_may10.pdf?role=personal
# Selection of Turbines

<table>
<thead>
<tr>
<th>S.No</th>
<th>Classifications</th>
<th>Suitable head H (m)</th>
<th>Suitability based upon performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kaplan</td>
<td>1-16</td>
<td>Low head, big discharge passage, high efficiency and cost-effectiveness, suitable for canals &amp; nallas</td>
</tr>
<tr>
<td>2</td>
<td>Cross flow</td>
<td>5-80</td>
<td>Medium head, cost-effectiveness, medium efficiency.</td>
</tr>
<tr>
<td></td>
<td><strong>Tp-100 Pico Cross Flow</strong></td>
<td><strong>6-50</strong></td>
<td><strong>Suitable for low canal falls, small size</strong></td>
</tr>
<tr>
<td>3</td>
<td>Axial-flow (propeller)</td>
<td>2-18</td>
<td>Suitable for low head, larger discharge, but poor operating stability and medium efficiency.</td>
</tr>
<tr>
<td>4</td>
<td>Francis</td>
<td>10-150 m</td>
<td>Medium head, wide application range, good operating stability, high efficiency.</td>
</tr>
<tr>
<td>5</td>
<td>Turgo</td>
<td>20-300</td>
<td>Medium &amp; relatively high discharge passage, simple structure</td>
</tr>
<tr>
<td>6</td>
<td>Pelton</td>
<td>80-1100</td>
<td>Suitable for high head and small discharge, simple structure, wide range of high efficiency.</td>
</tr>
<tr>
<td>7</td>
<td>Kinetic</td>
<td>To use kinetic energy of flowing water with a velocity of &gt;2 m/sec.</td>
<td>No head, simple design, little civil work, suitable for canals remote areas, cost effective, easy operation/maintenance.</td>
</tr>
</tbody>
</table>

08/02/2018
Tp-100 (Pico Cross-Flow) Turbine Specification

- Runner Diameter : 100 mm
- Turbine Size : 275 mm x 295 mm
- Turbine Width (Bo) : 30 mm, 60 mm, 100 mm
- Minimum Head : 6 meter
- Efficiency : 70% (Laboratorium Test)
- Capacity : 500 - 2000 Watt

Manufacturing Cost : 39,000 Pak rupees

Manufactured by:
Hydrolink Engineering Equipment Company Pvt Ltd
www.heeco.com.pk

Supported by:
GIZ

Tp-100 With Different Runner Lengths (30mm, 60mm, 100mm)
Productive Uses of Renewable Energy (PURE)

**Definition**

Productive uses of renewable energy are interventions that increase economic conditions of communities such as:
- Agro-processing (grain milling)
- Skill-based cottage industrial activities (handicrafts, carpentry)
- Community based services (restaurants, tea-shops, mobile-charging)

**GIZ Support**

- Women Stitching Centres (WSC)
- Flour Mills

**GIZ Support in PURE**

GIZ provides advisory and technical support to AKSP in pilot projects to demonstrate productive utilization of electricity generated from MHPs to enhance economic activities in communities with emphasis on equal participation.

**Structured approach for PURE Implementation**

- Decide for PURE Implementation
- Set the cornerstone of PURE
- Analysis of local economic situation and potential for PURE
- Plan for PURE activities
- Implementation of PURE activities
- Technical support
- Facilitate access to finance
- Impact monitoring
  - Dissemination of lesson learnt and good practices

**Impacts achieved**

- Improving the living condition of women through income generation
- Women Stitching Centres (WSC) at Koguzai is serving as center for business and entrepreneurship development
- UNDP GEF PURE Project presently replicating WSC in other areas such as village Brep
- UNDP GEF is in the process of developing market linkages at Koguzai women stitching center for their products and enhancing capacity through local organizations.
200 kW Brep MHP load curves
Technical Assessment of MHPs Skardu
160 kW MHP Dapa Skardu

Dapa MHP 160 kW
(Katisho Valley)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbine Capacity</td>
<td>160 kW</td>
</tr>
<tr>
<td>Type</td>
<td>Cross flow</td>
</tr>
<tr>
<td>Generator Capacity</td>
<td>200 kVA</td>
</tr>
<tr>
<td>Control System</td>
<td>Manual (Hydraulic disconnected)</td>
</tr>
<tr>
<td>Households</td>
<td>150</td>
</tr>
<tr>
<td>Max Gene Capacity (tested)</td>
<td>125 kW</td>
</tr>
<tr>
<td>Currently operating at</td>
<td>54 kW</td>
</tr>
<tr>
<td>Surplus Elec.</td>
<td>70 kW</td>
</tr>
<tr>
<td>Production June 12 (Operational hours)</td>
<td>31,372 kWh (593 h)</td>
</tr>
<tr>
<td>Approach</td>
<td>2.5 hours drive from Skardu</td>
</tr>
<tr>
<td>Status</td>
<td>Operational</td>
</tr>
</tbody>
</table>
Common Issues Observed during MHP Assessment

- Control system not properly working: 41%
- Voltage & frequency fluctuation: 64%
- Insufficient installed capacity: 23%
- Not operational: 18%
- Transmission & distribution system issue: 14%
- Alignment & vibration issues: 27%
- Belts & pulley issues: 27%
- Civil structure issues: 36%
- Variation in the design parameters: 32%
Now Pakistan has the availability of reliable technology of turbines as first commissioning of T15 turbines carried out by SRSP in Kalash Valley Chitral Sept 2012.
Improved Quality T15 Cross Turbines 25%-30% better efficiency:
Over 270 (as of info Oct 2017- leading by Hydrolink Taxila and Mukhtiar Engg Mardan)
Total Cumulative Capacity: ~17MW
T15 Cross Flow Turbine Application Range

Coupling on turbine shaft

Reinforced design needed

Belt drive

https://www.dropbox.com/s/2mnitgx1my8q1c6/T15_en.pdf?dl=0
About 25 representative of PEDO will be trained on MHP performance evaluation for ensuring design quality.

Key Challenges:
- Implementation of testing and commissioning protocol
- Maintaining data logs and proper monitoring
- Facilities for MHP turbine testing or third party verification non-existing
- Project developers use low cost approach in purchase of MHP turbines
- Efficient turbines other than cross flow T15 not available in local market
- Productive utilization of available surplus electricity awareness etc
- Introduction of submersible turbines technologies for canals using kinetic energy from normal flow of water
GIZ Pakistan has developed documentaries on MHP and PURE

- Community based rural electrification through MHP in Northern part of Pakistan
  
  https://vimeo.com/124497455

- Innovation in traditional practices PURE activities supported by GIZ Pakistan
  
  https://vimeo.com/132408988

MHP best practices and O&M manual you can find lot of information from energypedia in the following links

https://energypedia.info/wiki/Portal:Hydro

MHP Development in Pakistan Article

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