SUSTAINABLE SOLAR WATER PUMPING FOR IRRIGATION IN BANGLADESH

Md. Sakil Ibne Sayeed
Project Director
Solar Photovoltaic Pumping for Agricultural Irrigation Project (SPPAI)
Bangladesh Rural Electrification Board (BREB)

Robert Foster
SPPAI Team Leader
Sheladia Associates

Md. Mushfiqur Rahman
SPPAI Deputy Team Leader
Sodev

June 24, 2020

Solar 20/20 Conference
American Solar Energy Society
Bangladesh is to an agricultural based economy which contributes about 20% of the national GDP. More than 70% of Bangladesh’s population and 77% of its workforce live in rural areas. 87% of rural households rely on agriculture. In Bangladesh about 60% land is suitable for cultivation, of which 90% land is dependent on irrigation. Currently there are more than 1.4 million diesel-run pumps for agricultural irrigation, consuming about 0.9 million tons of diesel per year to run these pumps at a subsidized rate, while emitting more than 31 million tons of CO₂ per year. In addition, there are more than 350,905 grid connected electricity driven irrigation pumps. During the peak irrigation season 2,000 MW of power demand is solely required for running the electricity operated pumps which is provided at a subsidized rate to farmers. A significant amount of subsidy shall be reduced if a portion of diesel & electricity driven pumps could be replaced by solar irrigation pump gradually.
Potential of Solar Irrigation Pump

Irrigation Pumps (1.4 Million)

Electricity driven irrigation pumps (350,905 Nos.)

Up to October 2019, IDCOL has approved 1,630 solar irrigation pumps of which 1,323 are already in operation with a cumulative capacity of about 32 MWp.

In 2011-12, to introduce irrigation through solar energy, BREB installed 40 Solar Powered Irrigation Pumps with the support from KOICA and CCTF (Total Capacity 239 kWp).

There are a few hundred more irrigation pumps installed by BADC & BMDA.

BREB is implementing “Solar Photovoltaic Pumping for Agricultural Irrigation Project” (SPPAI) funded by GoB, ADB and BREB to install 2,000 solar irrigation pumps at 10 PBS area (Total Capacity 19.3 MWp) to reduce the pollutants emitted by diesel driven pumps, reduce seasonal grid power peaks during irrigation season and promote SWPs as the most ecological solution to meet the country’s irrigation needs.
SPPAI Background

- Solar PV Pumping for Agricultural Irrigation (SPPAI) is a subproject of the Asian Development Bank’s (ADB) Power System Efficiency Improvement Project.
- The Bangladesh Rural Electric Board (BREB) is the Executing Agency under the Power Division, MoEMR with project support provided by Sheladia, Sodev and IPE Global.
- The project is financed by GoB (US$4.69M), BREB (US$0.202M) and ADB (US$45.442M). Where US$20M from Asian Development Bank as LOAN, US$22.442M GRANT from Scaling Up Renewable Energy Program of the Strategic Climate Fund, and US$3M output-based aid grant from the Clean Energy Financing Partnership Facility to buy down cost of Solar Irrigation Pumps (SIPs) for farmers.
- 2,000 Solar Irrigation Pumps (SIPs) are planned to be installed by the end of 2022 (~19.3 MWp) due to project delays as a result of the COVID-19 global pandemic.
## Traditional Diesel Pumps

- ~1.4 million diesel irrigation pumps in country
- e.g., 3 HP pump irrigates ~15 bigha (5 Acres).
- Irrigation season is ~6 months/year
- Requires about 307 liters per year for 15 bigha
- Diesel fuel is 65 Taka per liter - US$0.78/liter
- Irrigation cost for 15 bigha is ~US$235/season
- Selling pumped water @ ~US$35/bigha
- Net revenue for 15 bigha x US$35/bigha = US$530/- per season.

### Diesel surface centrifugal pump at Singair Manikganj

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Low initial investment</td>
<td>1. High operating cost</td>
</tr>
<tr>
<td>2. Portable</td>
<td>2. High maintenance</td>
</tr>
<tr>
<td>3. Easy maintenance due to developed local technicians and spare parts</td>
<td>3. Extra labor for transportation of fuel</td>
</tr>
<tr>
<td></td>
<td>4. Air and sound pollution.</td>
</tr>
<tr>
<td></td>
<td>5. Manual operation</td>
</tr>
</tbody>
</table>
Traditional Electric Pumps

• ~350,000 traditional electric pumps in Bangladesh
• Electricity tariff is BDT 4.0/kWh (US$0.047/kWh) and a 20% Rebate is provided from GoB at the year end. Considering the rebate, tariff rate become BDT 3.20/kWh.
• Irrigation period is all together 6 months and total cost of irrigation is BDT 6,000/year.
• Selling water at BDT 1,500/- per bigha.
• Net revenue is 15 bigha x BDT 1,500 = 22,500/- per year

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Low initial investment</td>
<td>1. Manual operation</td>
</tr>
<tr>
<td>2. Portable</td>
<td>2. Load shedding required during the daytime power peak, irrigation pumps can only operate evening and night</td>
</tr>
<tr>
<td>3. Easy maintenance due to developed local technicians and spare parts</td>
<td></td>
</tr>
<tr>
<td>4. Low operating and maintenance costs</td>
<td></td>
</tr>
<tr>
<td>5. Subsidized electric tariff in Bangladesh</td>
<td></td>
</tr>
</tbody>
</table>
National Policies

- Guidelines for Net Energy Metering in Bangladesh 2018
- Draft Guideline for Grid Integration of SIPS 2020
- All renewable energy equipment's and related raw materials in producing renewable energy equipment's will be exempted from charging 15% VAT.

Further Considerations:

- GoB subsidized diesel fuel ~30%
- GoB subsidized electricity tariff for irrigation ~US$0.047/kWh
SWP System Components

PV Array
Well and Pump
Controller/ Inverter
Water Storage
Submersible Centrifugal Pumps

- Relatively high water volumes at higher TDH (10-60m)
- Long life (>15-25+ years)
- Low maintenance
- High cost
- Often Water lubricated
- More secure from theft
<table>
<thead>
<tr>
<th>Type of PV Water Pump</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| Submersible centrifugal | • Simple, with one moving part.  
• Regular maintenance not required.  
• Efficient at high flow rates or low lift.  
• Good tolerance for moderate amounts of sand and silt.  
• Most conventional, widely available. | • Poor efficiency at low volumes (<30 liters per minute) or high lift.  
• Capacity is reduced disproportionately at low speeds (in low-sun conditions).  
• Impellers can fill with sediments and may require periodic cleaning. |
| Helical rotor, submersible or surface | • Simple, with one moving part.  
• Regular maintenance not required.  
• Highly efficient at low flow rates (4-50 liters per minute).  
• Maintains full lift capacity at all speeds.  
• Good tolerance for moderate amounts of sand and silt. | • No major disadvantages. |
| Diaphragm, submersible or surface rotary vane | • Relatively low initial cost.  
• Efficient at very low flow rates (4-20 liters per minute).  
• Maintains full lift capacity at all speeds. | • Requires preventive maintenance.  
• Poor tolerance for sand and silt.  
• Requires filtration (rotary vane pump). |
| Surface centrifugal | • Relatively low cost.  
• Efficient for low lift and high flow rates.  
• Easy to inspect and maintain due to surface location.  
• Good tolerance for moderate amounts of sand and silt. | • Suction limit is about 6 meters or less.  
• Requires priming (filling the intake).  
• May be damaged by running dry if it loses prime. |
SWP Lessons Learned
Bangladesh Field Assessments
BREB, PBS, Sheladia/Sodev

Solar Gaon, IDCOL Project
Biral, Dinajpur
Singair, Manikganj

PV 5.16 kW\textsubscript{p}
3.7 kW sub pump
INTECH inverter
300 l/min

INTECH Inverter
BREB, Rajshahi
KOICA SIP Project Findings

• About half of the KOICA SWPs no longer functioned after 7 years mostly due to inverter failures and theft.
• Pumps were generally undersized to meet farmer irrigation needs with irrigated coverage of ~2 acres. Farmers can irrigate ~1 acre land during Boro season and max. 2 acres during Aman season. This is insufficient for many farmers who may want to irrigate up to ~8 Acres.
• Inverter housed in a plastic IP 20 grade VFD which is not a real SWP inverter and pump delivery is only 300 l/min which could draw maximum 100,000 liter of water/day. Minimum need is ~65,000 liter/day of water to irrigate 0.3 acres of rice.
• Owners have no motivation to repair SIPs since they are undersized and they do not know who can repair. Owners want a larger SIP to irrigate more acreage.
• PV module mounting structure, RCC base and the tube well are over designed.
• Submersible centrifugal pump 7.5kW (10HP)
• 14.4 kWp Chinaland PV array.
• Installation cost BDT 3,500,000.
• Irrigates 72 bigha (24 Acre) from 25 farmers.
• SWP leased for BDT 60,000/year to farmer who sells water to the other farmers for BDT 2000/bigha.
• Farmer’s Revenue is 72 bigha x BDT 2,000= BDT 144,000/-
AVA SWP Project
Setabganj, Dinajpur

- Submersible centrifugal pump 10HP (~7.5kW)
- 11.84 kWp x-Si PV array.
- Irrigated land covered is 60 bigha (~20 Acre) for corn, mangos, and bananas.
- Project ran for 3 years and stopped in 2018 due to failure of an AC circuit breaker in a DC source circuit
- SWP is leased to a local farmer for BDT 40,000/year. The farmer sells irrigation water to other farmers for BDT 190/bigha.
Solar Gaon SWP Project
Biral, Dinajpur

- Submersible centrifugal pump 20HP (~15 kW)
- Powered by oversized 30kWp PV array using Poly-Si
- Total land irrigated is 48 bigha (~16 Acres)
- Main crops grown are Boro and Aman rice.
- Solar Gaon sells farmers water for BDT 2,000/bigha
Common SWP Technical Issues in Bangladesh

• Many existing Bangladesh SWPs have technical issues related to poor design and poor installation which can cause performance failures that lead to end-user dissatisfaction.

• Undersized SWP systems. Many installers do not have adequate knowledge on sizing SWPs based on soil type, head and cropping pattern. Result is insufficient water for the required irrigation area.

• SWP system voltage crash on hot days.

• Other basic design issues
  • No bonding and grounding
  • Inadequate or no overcurrent protection
  • Poor wiring
  • No MPPT on VFD inverters
• Vegetation growing up over array
• Clods of dirt and plants from farmer weeding with hoes or from birds can shade entire cells and create module hot spots and potential failures
Improper Wiring

- Undersized wires – high voltage drops
- Indoor wire used outdoors – insulation deteriorates
- No fuse protection
- Fire & electrocution hazard
- Poor workmanship

Farmer’s had sense to come back and mounted wire thrown on ground by installer onto poles

Solar Gaon, IDCOL Project Biral, Dinajpur
No Bonding or Grounding

- No path to ground
- No ground fault protection
- Electrocution hazard often in muddy rice paddies
- Susceptible to lightning damage

Solar Gaon, IDCOL Project
Biral, Dinajpur
Inadequate or No Overcurrent Protection

- No string fuses in some arrays
- No surge protection devices (SPD) on DC and AC side is required to protect Inverter, PV modules and Pump from lightning and other surges.
- Both string fuses and SPD ensure safety and longer life

AVA-IDCOL project
Biral, Dinajpur

Solar Gaon
DC terminal blocks with no OC protection
VFD Inverters Impacts No MPPT

- Many SWP inverters use simple VFDs designed for 3 phase industrial induction motor applications and not for variable solar power generation.
- Good system reliability requires proportional integral-derivative (PID) controller synchronisation which varies the frequency and supply voltage for the motor.
- If VFD operates in variable set-point mode, must have MPPT
- Use of VFD no MPPT: Pump starts late in the morning and stops early in the afternoon
- Frequently turns on & off with passing clouds
- Requires oversized PV array ~2X
- Shortens inverter life span
- Inefficient operation
- Less water pumped
Inappropriate AC Circuit Breakers in DC Circuits

- Use of AC CBs in PV DC source circuits
- AC CBs are not rated for DC circuits
- Can result in frequent malfunctions
- Not safe: fire and electrocution hazard
- Use listed DC components in DC circuits.

AVA Development Society, IDCOL project, Setabjanj, Dinajpur
Quality SWP Installations
Barind Multipurpose Development Authority (BMDA)
Godagari, Rajshahi
Four Government Funded Projects
MPPT VFD inverter
DC string fuses
AC CBs
Bonded and Grounded
Pre-paid Meter
BMDA 15HP 20.4 kWp Surface Pump
BMDA 20.16 kWp Surface Centrifugal - Rajshahi
BMDA SWP System Costs

- BMDA installed ten pilot 11 kW (15HP) centrifugal surface SWPs in 2016. Based on good results, BMDA installed more surface centrifugal SWPs and owns >107 SWPs installed around Rajshahi, Chapai Nawabganj and Naogaon.

- SWPs are 11kW (15 HP) Surface Centrifugal & Vertical Inline Type with discharge Max. 200 m$^3$/hr. PV Capacity: 20.4 kWp (300Wp x 68). Water pumped from rivers, ponds and canals mostly for rice irrigation.

- Installed Cost of SWP System: BDT 2,400,000 (US$1.38/Wp) and 1500 m 10” PVC Buried Pipe: BDT 700,000. Total: BDT 3,100,000.

- BMDA owns the pumps and sells water to farmers via a prepaid meter. Farmers use prepaid cards and are charged BDT 180/hour (US$2.12/hr).

- BMDA is highly satisfied with its 107 Irrigation SWPs and plan to install SWPs
## SWP Business Models

### Comparison between BREB and IDCOL Business Models

<table>
<thead>
<tr>
<th></th>
<th>BREB</th>
<th>IDCOL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ownership Model</strong></td>
<td>Field level Farmers</td>
<td>NGO or Company</td>
</tr>
<tr>
<td><strong>Financing Model</strong></td>
<td>About 20% to 30% overall grant and rest amount is loan without interest.</td>
<td>20% Equity, 30% Loan and 50% Grant. Loan interest rate is 6% to 7%</td>
</tr>
<tr>
<td><strong>Loan Tenure</strong></td>
<td>10 Years</td>
<td>8 years</td>
</tr>
<tr>
<td><strong>Procurement Process</strong></td>
<td>International Competitive Bidding</td>
<td>RFQ</td>
</tr>
<tr>
<td><strong>Awareness</strong></td>
<td>BREB Conducting extensive awareness building program among all the field farmers</td>
<td>Limited to NGO and Company</td>
</tr>
<tr>
<td><strong>Common design to fit all</strong></td>
<td>BREB formulated a table of pump design based on typical water head and Irrigation Cycle, which is open to all. So any farmer can select his/her own pump.</td>
<td>No such design available for end users</td>
</tr>
<tr>
<td><strong>Open Price Idea</strong></td>
<td>BREB disclosed possible prices of each model of pump after extensive market analysis. This is also open to all farmers.</td>
<td>Not Open to public</td>
</tr>
<tr>
<td><strong>Cost benefit</strong></td>
<td>BREB demonstrated possible cost benefits of using solar pump in its promotional material so that any user can see its feasibility.</td>
<td>Not open to public</td>
</tr>
</tbody>
</table>
Example PV Grid Tied Monthly Energy Generation kWh

Dinajpur Monthly SWP PV 10.8 kW
Plant Energy Production kWh

~ 5 PSH annual average

~13,080 kWh per year or ~US$615 value at US$0.0476/kWh bulk rate
SPPAI Grid-Tied SWPs

- Multipurpose uses like rice threshing, husking, cold storage are not feasible for stand-alone SWPs PV arrays unless everything is operated from an expensive battery bank.

- Bangladesh grid electricity coverage is ~94% and expansion plans are for 100% within the next ~year.

- Integrating SWPs with the grid allows farmers sell excess electricity to the utility is a competitive advantage for SWPs.

- The excess generated energy from the SWP PV array can feed electricity when pumps are idle or off irrigation season. This ensures maximum utilization of the PV array throughout the year.

- Excess energy sold back to the grid helps offset farmer monthly SWP loan payments and reduces the risk of loan default.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Pump System Capacity (kW)</th>
<th>Installed PV Module Capacity (kWp)</th>
<th>Nominal Land Coverage (Bigha)</th>
<th>No. of Electricity Export Days</th>
<th>Expected Generation @ 4.0 Peak Sun Hours (kWh/m²/day)</th>
<th>Income from Energy Export @ Bulk Rate BDT 4.057</th>
<th>Cost of Irrigation from Electric Pump @ BDT 2000 per Bigha</th>
<th>Total Income and Savings (BDT)</th>
<th>Instalment Amount (BDT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>2.2</td>
<td>4.3</td>
<td>18</td>
<td>245</td>
<td>4,214</td>
<td>17,096</td>
<td>36,000</td>
<td>53,096</td>
<td>39,525</td>
</tr>
<tr>
<td>2.</td>
<td>4</td>
<td>7.6</td>
<td>28</td>
<td>245</td>
<td>7,448</td>
<td>30,217</td>
<td>56,000</td>
<td>86,217</td>
<td>58,990</td>
</tr>
<tr>
<td>3.</td>
<td>5.5</td>
<td>10.8</td>
<td>39</td>
<td>245</td>
<td>10,584</td>
<td>42,939</td>
<td>75,000</td>
<td>120,939</td>
<td>90,185</td>
</tr>
<tr>
<td>4.</td>
<td>7.5</td>
<td>14</td>
<td>50</td>
<td>245</td>
<td>13,720</td>
<td>55,662</td>
<td>100,000</td>
<td>155,662</td>
<td>115,345</td>
</tr>
<tr>
<td>5.</td>
<td>11</td>
<td>20.4</td>
<td>62</td>
<td>245</td>
<td>19,992</td>
<td>81,108</td>
<td>124,000</td>
<td>205,108</td>
<td>156,570</td>
</tr>
</tbody>
</table>
BREB SPPAI Public Awareness Program

- Stakeholder consultations
- Seminars and workshops
- Brochure
- Newspaper ads
- YouTube Videos
- Local Dish Network
- TV video spots
- BREB SPPAI Facebook page

Comilla PBS SPPAI farmer meeting 2019
### SPPAI Project Brochure for Farmers

**Table 3: Details of Solar Panels by Size and Efficiency**

<table>
<thead>
<tr>
<th>Panel Size (sqm)</th>
<th>Panel Efficiency (%)</th>
<th>Energy Generation (kWh)</th>
<th>Cost (Tk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0</td>
<td>0.8</td>
<td>3,000</td>
<td>30,000</td>
</tr>
<tr>
<td>5.5</td>
<td>0.75</td>
<td>5,750</td>
<td>57,500</td>
</tr>
<tr>
<td>7.5</td>
<td>0.7</td>
<td>7,500</td>
<td>75,000</td>
</tr>
<tr>
<td>10.0</td>
<td>0.65</td>
<td>10,000</td>
<td>100,000</td>
</tr>
<tr>
<td>15.0</td>
<td>0.6</td>
<td>15,000</td>
<td>150,000</td>
</tr>
</tbody>
</table>

**Table 4: Details of Solar Panels by Size, Efficiency, and Cost**

<table>
<thead>
<tr>
<th>Panel Size (sqm)</th>
<th>Panel Efficiency (%)</th>
<th>Energy Generation (kWh)</th>
<th>Cost (Tk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0</td>
<td>0.8</td>
<td>3,000</td>
<td>30,000</td>
</tr>
<tr>
<td>5.5</td>
<td>0.75</td>
<td>5,750</td>
<td>57,500</td>
</tr>
<tr>
<td>7.5</td>
<td>0.7</td>
<td>7,500</td>
<td>75,000</td>
</tr>
<tr>
<td>10.0</td>
<td>0.65</td>
<td>10,000</td>
<td>100,000</td>
</tr>
<tr>
<td>15.0</td>
<td>0.6</td>
<td>15,000</td>
<td>150,000</td>
</tr>
</tbody>
</table>

**Table 5: Comparison of Solar and Conventional Power**

<table>
<thead>
<tr>
<th>Panel Size (sqm)</th>
<th>System Installed (kW)</th>
<th>Annual Energy Generation (kWh)</th>
<th>Cost (Tk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0</td>
<td>3</td>
<td>2,700</td>
<td>27,000</td>
</tr>
<tr>
<td>5.5</td>
<td>5.5</td>
<td>7,750</td>
<td>77,500</td>
</tr>
<tr>
<td>7.5</td>
<td>7.5</td>
<td>10,500</td>
<td>105,000</td>
</tr>
<tr>
<td>10.0</td>
<td>10.0</td>
<td>15,000</td>
<td>150,000</td>
</tr>
<tr>
<td>15.0</td>
<td>15.0</td>
<td>22,500</td>
<td>225,000</td>
</tr>
</tbody>
</table>

**Notes:**
- The data presented above is for illustration purposes only.
- Actual installation and energy generation may vary based on specific conditions.
- Costs and efficiency may be subject to change based on market conditions and technology advancements.
সৌর বিদ্যুত চালিত পাষ্পের মাধ্যমে কৃষি সেচ

বাংলাদেশ সরকার কৃষক ভাইরের সার্বিক উদ্যোগের বিষয় বিবেচনায় করে কৃষকদের মাধ্যমে বিশেষ অনুদান দিয়ে কম মূল্যে সৌর পাষ্প চালনায় প্রচেষ্টা করেছেন। এই প্রক্রিয়ার অংশ হিসেবে সরকার এই উদ্যোগ সাফল্যের আন্তর্জাতিক বাংলাদেশ প্রতিষ্ঠান মাধ্যমে ১০টি টেরামাইল সমষ্টির আওতায় বিভিন্ন উপজেলাসমূহে ২০০০টি সৌর সার্বমানবিক পাষ্প স্থাপনের কার্যক্রম শুরু করেছে।

ছক ১: স্বাভাবিক পাষ্প প্রাক্করণের বিবরণ

<table>
<thead>
<tr>
<th>প্রক্রিয়ার সার্বমানবিক পাষ্প সাইজ (কিলো/আকাশ ক্ষমতা)</th>
<th>পাষ্পের মূল্য</th>
<th>নাভিক</th>
<th>মূল্য বিশ্লেষণ পাষ্প সন্নাটন লাইন</th>
<th>পাষ্প প্রাক্করণের বিন্যাস (কিলো/আকাশ ক্ষমতা)</th>
</tr>
</thead>
<tbody>
<tr>
<td>২.২/৩.০</td>
<td>৪.৩</td>
<td>৬ ইফিকা</td>
<td>৮০ ফুট</td>
<td>৬০০ ফুট</td>
</tr>
<tr>
<td>৪.০/৫.৫</td>
<td>১.৬</td>
<td>৬ ইফিকা</td>
<td>৮০ ফুট</td>
<td>৮০০ ফুট</td>
</tr>
<tr>
<td>৫.৫/৭.৫</td>
<td>১০.৮</td>
<td>৮ ইফিকা</td>
<td>১০০ ফুট</td>
<td>১৪০০ ফুট</td>
</tr>
<tr>
<td>৭.৫/১০</td>
<td>১৪.০</td>
<td>১০ ইফিকা</td>
<td>১২০ ফুট</td>
<td>১৬০০ ফুট</td>
</tr>
<tr>
<td>১১.০/১৫</td>
<td>২০.৫</td>
<td>১২ ইফিকা</td>
<td>২০০ ফুট</td>
<td>২০০০ ফুট</td>
</tr>
</tbody>
</table>

বিন্দু: উপরাও তালিকাটি বাংলান প্রকল্পের নিয়ম অনুযায়ী পরিবর্তন হতে পারে।

সবার পাষ্পের সরকারের প্রস্তাব

• একটি/বিচারকের দ্বারা উইজডজ প্রকল্প করা হয়ে থাকাতে পারে।
• পাষ্পের মালিকানার প্রশ্নে অলঙ্কারের প্রশ্ন হয়।
• এই প্রক্রিয়ার কার্যক্রমের জন্য জমিবাহী একজন ব্যবহারকে কারিগরি প্রশ্নের মাধ্যমে দক্ষ করার নেতৃত্ব দেবেন, যেন তিনি দ্রুততম সময়ে সবগুলো লিখে পারেন।

ছক ২: বোকা/ইন্ডার ধানের আগে সৌর বিদ্যুত চালিত পাষ্প সাইজ নির্দেশনা তালিকা

<table>
<thead>
<tr>
<th>পাষ্প সাইজ (কিলো/আকাশ ক্ষমতা)</th>
<th>জমির পরিমাণ (বিটার)</th>
<th>জমির পরিমাণ (বিটার)</th>
</tr>
</thead>
<tbody>
<tr>
<td>৩.০</td>
<td>২০ ফুট</td>
<td>২০ ফুট</td>
</tr>
<tr>
<td>৫.৫</td>
<td>২০ ফুট</td>
<td>২০ ফুট</td>
</tr>
<tr>
<td>৭.৫</td>
<td>২০ ফুট</td>
<td>২০ ফুট</td>
</tr>
<tr>
<td>১০.০</td>
<td>২০ ফুট</td>
<td>২০ ফুট</td>
</tr>
<tr>
<td>১৫.০</td>
<td>২০ ফুট</td>
<td>২০ ফুট</td>
</tr>
</tbody>
</table>

বিন্দু: উপরাও তালিকাটি প্রণয়নের অনুমানিক, যা জমির ধানে ও ফসলের ভিত্তিতে সাহায্য পরিবর্তন হতে পারে।
Solar PV Pumping for Agricultural Irrigation Project, BREB

Posts

Solar PV Pumping for Agricultural Irrigation Project, BREB
May 4

Community

No Rating Yet

1 person likes this
2 people follow this

About

+880 2-8900152
www.reb.gov.bd
Public & Government Service
Opens at 9:00 AM
Closed Now

Page Transparency

Facebook is showing information to help you better understand the purpose of a Page. See actions taken by the people who manage and post content.

Page created - May 5, 2020
Gender Implementation Issues

- >90% of farms owned by men
- ~3% of interested farmers are women

### Interested Male and Female Farmers for Solar Irrigation Pumps

<table>
<thead>
<tr>
<th>Name of PBS</th>
<th>Total Farmers</th>
<th>Total Farmers</th>
<th>Male #</th>
<th>Male Percent</th>
<th>Female #</th>
<th>Female Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thakurgoan</td>
<td>778</td>
<td>760</td>
<td>98%</td>
<td>18</td>
<td>2%</td>
<td></td>
</tr>
<tr>
<td>Dinajpur</td>
<td>519</td>
<td>443</td>
<td>85%</td>
<td>76</td>
<td>15%</td>
<td></td>
</tr>
<tr>
<td>Rangpur</td>
<td>400</td>
<td>392</td>
<td>98%</td>
<td>8</td>
<td>2%</td>
<td></td>
</tr>
<tr>
<td>Bogra</td>
<td>783</td>
<td>776</td>
<td>99%</td>
<td>7</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td>Naogoan</td>
<td>728</td>
<td>725</td>
<td>96%</td>
<td>3</td>
<td>4%</td>
<td></td>
</tr>
<tr>
<td>Gopalgonj</td>
<td>80</td>
<td>79</td>
<td>99%</td>
<td>1</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td>Faridpur</td>
<td>86</td>
<td>85</td>
<td>99%</td>
<td>0</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Madaripur</td>
<td>128</td>
<td>125</td>
<td>97%</td>
<td>3</td>
<td>3%</td>
<td></td>
</tr>
<tr>
<td>Feni</td>
<td>68</td>
<td>67</td>
<td>99%</td>
<td>1</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td>Comilla</td>
<td>128</td>
<td>124</td>
<td>96%</td>
<td>4</td>
<td>4%</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3,698</strong></td>
<td><strong>3,576</strong></td>
<td><strong>97%</strong></td>
<td><strong>122</strong></td>
<td><strong>3%</strong></td>
<td></td>
</tr>
</tbody>
</table>

Source: Sodev Survey, Oct. 2019
SPPAI SWP Design Improvements Over Common Design and Installation Practices

SPPAI pump sizes ranging from ~2.2 to 11 kWp

• Listed PV modules & proper array orientation and tilt
• Balance of Systems (BOS)
  • MPPT VFD Inverters (ac pumps)
  • Grounding and Bonding
  • Overcurrent Protection on both DC and AC circuits
• Cyclone Resistant Mounting Structure
• Appropriate Cables
• Avoiding “voltage crash” on hot sunny days
SWP Global Market Trends

- SWP total system costs have dropped by 2/3 over past 20 years.
- SWP off the shelf capabilities have grown to 150+ kWp and will double again in next 5 years.
- SWP global sales are >150,000+ systems/year.
- SWP is rapidly gaining popularity as the pumping technology of choice for thousands of farmers & ranchers.
- By the end of this decade SWP sales will be millions of systems per year globally.