HUMAN & ANIMAL POWERED WATER-LIFTING DEVICES FOR IRRIGATION

Introduction

This technical brief outlines the main types of human and animal water-lifting devices used for irrigation. A separate technical brief is available on human powered water lifting for domestic and community water supply.

Human and animal powered water lifting devices have been traditionally used in irrigation in a number of places around the world. Many of the technologies applied today have been used for thousands of years. Recent developments have concentrated on increasing the efficiency of water lifting by combining ease of use with higher water delivery.

Human physical power output is between 0.08 – 0.10 horsepower (hp) or 0.06 - 0.075 kW whereas traction animals have a physical power output of between five and ten times this amount. For example, a pair of bullocks has a physical power output of around 0.8 hp or 0.6 kW and can lift water from depths of 30 metres or more. Hence, animals can pump more water in a shorter time, making irrigation more efficient and more productive.

This technical brief provides guidance on the key criteria that needs to be taken into account when selecting a human or animal powered water lifter and discusses the applicability of the different types of water lifter to specific local conditions.

Selection Criteria for Human- or Animal- Powered Water Lifters for Irrigation

Table 1 provides a summary of the technical, financial, economic, institutional and social questions that need to be answered when selecting a human or animal powered lifting device for irrigation:

Figure 1: Traditional surface water lifter in Bangladesh
Photo: Practical Action.
## Technical Aspects:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Key Questions</th>
<th>Important Points to Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lift height and yield</td>
<td>How much water is required for irrigation purposes?</td>
<td>Water lifting requirements depend amongst other things upon the climate, the crop and the area to be irrigated. The capacity of water lifter varies from around 0.5 m to more than 100 m.</td>
</tr>
<tr>
<td></td>
<td>How high does the lifter have to raise the water?</td>
<td></td>
</tr>
<tr>
<td>Soil Conditions</td>
<td>What are the local soil conditions?</td>
<td>Where there is very rocky soil a borehole will usually need to be drilled to reach the groundwater.</td>
</tr>
<tr>
<td></td>
<td>Can you access water the water easily i.e. surface water or hand-dug well or is drilling required?</td>
<td></td>
</tr>
<tr>
<td>Operators</td>
<td>Is the lifter suitable and acceptable to the people who will operate it?</td>
<td>The choice of water lifter should take into account which group of people are tasked with water lifting for irrigation. It is important to determine if average and maximum handle forces required are realistic for the proposed user.</td>
</tr>
<tr>
<td></td>
<td>Is the operation ergonomic (comfortable to use) and realistic for the group responsible for irrigation?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Are there health and safety considerations, such as dangerous machinery?</td>
<td></td>
</tr>
</tbody>
</table>

## Financial and Economic Aspects:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Key Questions</th>
<th>Important Points to Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Cost</td>
<td>What is the initial cost of the water lifter?</td>
<td>Using a water lifter for irrigation increases efficiency and productivity and can ensure the generation of additional income. For instance families that introduced a treadle pump for irrigation were able to generate between US$100 and 500 additional income each year.</td>
</tr>
<tr>
<td></td>
<td>Does the village have sufficient funds or is a loan required?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>How soon will the community be able to pay back the loan/ recover this investment?</td>
<td></td>
</tr>
<tr>
<td>Material and Manufacturing Costs</td>
<td>Can the lifter be manufactured using local skills and materials?</td>
<td></td>
</tr>
<tr>
<td>Operating Costs</td>
<td>What is the operating cost of the lifter?</td>
<td>It should be noted that although it may only be necessary to irrigate crops for some of the year, traction animals will need to be maintained all year round. It is therefore important to determine other tasks that will be undertaken by the animal and ensure that the timing of these task do not conflict.</td>
</tr>
<tr>
<td></td>
<td>Does the village have sufficient manpower/animal power to operate the lifter for all the time it is needed?</td>
<td></td>
</tr>
<tr>
<td>Maintenance Costs</td>
<td>What is the cost of maintaining/ repairing the lifter?</td>
<td>Maintenance is an integral part of lifter management. For more complicated designs, it is important to carry out preventative maintenance. Serious problems can be avoided by undertaking regular inspections and servicing of the mechanical parts. Wear and tear will be less severe this way and any problems will be solved before they cause major damage.</td>
</tr>
<tr>
<td></td>
<td>Are the skills to maintain/ repair the water lifter available locally?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Are spare parts available and affordable?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>How often is the lifter likely to need maintenance and/or repair?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>How long will repairs take and what will the villagers do in the meantime?</td>
<td></td>
</tr>
<tr>
<td>Life expectancy</td>
<td>How long is the lifter expected to last before it has to be replaced?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>How resistant is the lifter to vandalism or abuse?</td>
<td></td>
</tr>
<tr>
<td>Institutional and Social Aspects</td>
<td></td>
<td>The lifter should be suitable for Village Level Operation and Maintenance (VLOM) or Management of Maintenance (VLOMMM). This reduces the reliance of villagers upon large institutions to sustain the water supply.</td>
</tr>
</tbody>
</table>

### Household/Community

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Key Questions</th>
<th>Important Points to Note</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Is there a community organisation capable of overseeing operation, maintenance and management of the device and the water?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Will the users be instructed how to use and look after the device?</td>
<td></td>
</tr>
</tbody>
</table>
Types of Human- and Animal-Powered Water Lifters

Human and Animal Powered Water Lifters can be split into two categories: those designed to lift surface water and those designed to raise groundwater.

- **Surface Water** is present in depressions, lakes, rivers, reservoirs, and oceans.
- **Groundwater** flows or seeps downward through the earth filling up the spaces between soil, sand and rock to form a saturated zone. The upper surface of this saturated zone is called the “water table.” The “water table” may be just below the surface like a spring or oasis or it may be over 100 metres down. The only way to get access to this water is by digging and/or drilling.

Surface Water Lifters

Surface water lifters are generally the simplest form of human and animal water lifters because the water is readily accessible and does not need to be raised more than a few metres.

Swing basket

The swing basket is made from cheap materials like woven bamboo strips, leather, or iron sheet to which four ropes are attached. Two people hold the basket facing each other, they dip the basket into the surface water and the basket is lifted by swinging it and emptied into an irrigation channel from which point the water flows to the fields. This lifter can be used at depths of up to 1.2 m. Typical flow rates of 60 to 80 l/min are obtained at depths of 0.75 m.

Advantages

- Simple, inexpensive technology which can be locally made and maintained.
- Easy to operate by both adults and children

Disadvantages

- Limited to lifts of less than 1.2 m
- Limited water yield 60-80 l/min suitable for small fields
- Low efficiency (10-15%) big human effort with significant water spillage

Shadouf (Picottah)

The basic shadouf consists of a rope, pole, bucket and counterweight and is capable of lifting water up to 4 metres.

The counterweight can be just a heavy rock, but in the more advanced picottah design, one person guides the bucket while the other acts as a moving counterweight (Figure 3). It is generally used for lifting water from unlined wells, streams or ponds for irrigating small fields. Approximately 60 litres/min can be lifted from a depth of 2 to 3 metres.
Advantages | Disadvantages
---|---
A relatively inexpensive traditional technology which can be locally made and maintained. | Limited to lifts of less than 4 m
Easy to operate | Limited water yield, 60 l/min suitable for small fields
Relatively efficient (30-60%) |  

**Dhone**
The dhone consists of a trough made from a wooden log or iron sheet; closed at one end and open at the other. The trough is mounted on a suspended pivoted lever to produce a see-sawing gutter or dhone which operates at relatively low lifts of up to 1.5 m. The trough is lowered into the water by exerting pressure using a rope or the foot of the operator until the closed end is submerged in water. Upon releasing pressure the trough comes to its original position and the water is delivered to the irrigation channel. Typical yields of 80-160 l/min can be obtained from the dhone between 0.3-1.0 m.

**Paddle wheel (Chakram)**
The paddle wheel is only suitable for low water lifts of up to 0.5 metres and it is mostly used in coastal regions to irrigate paddy fields.

Small paddles are mounted on a horizontal shaft, which rotates in a close fitting concave trough, pushing water upwards. The operator walks directly on the rim of the paddle wheel, turning it so that it continuously and steadily scoops up water and deposits it into the irrigation channel.

The paddle wheel is not particularly efficient because a lot of water lifted flows back around the edges of the blades and hence it is not used extensively. However it is simple to build and install in situations where a lot of water needs to be lifted through a small height. A paddle wheel with 12 blades can lift 300 litres/ min at depths of 0.5 metres.
**Advantages** | **Disadvantages**
---|---
Traditional technology which can be locally made and maintained. | Limited to lifts of less than 0.5m
Water yields of approximately 300 l/min for lifts of 0.5 m | Not very efficient (20-50%), lots of backflow

**Persian Wheel (Raha)**
This device consists of an endless chain of buckets typically with an individual capacity of 8-15 litres mounted upon a drum and submerged in water to the required depth. The drum is connected to a toothed wheel held in a vertical plane by a long shaft usually kept below ground level. The vertical toothed wheel is geared with a large toothed horizontal wheel connected to a horizontal beam. This beam is yoked to a pair of animals. The animals move in a circle to turn the drum and raise the water. Water is released when the bucket reaches the top.

The average discharge rate from a Persian wheel is about 160-170 litres/min from a depth of 9m with one pair of bullocks. The Persian wheel can be used to raise water from a depth of up to 20 m but its efficiency is reduced at depths below 7.5 metres.

![Persian Wheel Diagram](image)

**Figure 6: Animal Driven Persian Wheel**
Source: *Water Pumping Devices*

A variety of all-metal improved Persian wheels have been built. Their smaller diameter reduces the extra height the water needs to be lifted before it is tipped out of the containers, and also reduces the well diameter that is necessary.

**Advantages** | **Disadvantages**
---|---
A relatively inexpensive traditional technology which can be locally made and maintained. | The design means that water is raised above the point of discharge before falling into the collection channel.
Easy to operate | Animals need to be maintained all year even when irrigation is not necessary.
Lifts water up to 20 m but most efficient at depths of less than 7.5 m. Water yields of approximately 160-170 l/min for lifts of 9 m | Medium efficiency (40-70%)
Archimedes screw
The Archimedes screw consists of a helical screw mounted on a spindle which is rotated inside a wooden or metallic cylinder. One end of the cylinder is placed at an angle of 30 degrees and submerged in the surface water source. When the handle is turned water is trapped in the cavities and raised to the level of the irrigation channel as shown in Figure 7. Although this design looks quite complicated, it is fairly easy to build using local materials and is readily transportable. It can also be adapted to be driven by animals as shown in Figure 8. The Archimedes screw typically raises water from depths of 0.2 - 1.0 metres at a rate of 250-500 litres/ min.

**Advantages**
- A relatively inexpensive traditional technology which can be locally made and maintained.
- Transportable and easy to operate
- Low to Medium efficiency (30-60%)
- Water Delivery of 250-500 l/min for lifts of 0.2-1.0 m

**Disadvantages**
- Limited to lifts of up to 1.2 m.

Groundwater Lifters
The following section presents the main types of human and animal powered devices used for lifting water from shallow and deep wells for irrigation purposes.

Rope and Bucket (Mohte, Charsa, Pur)
The simplest and cheapest method of lifting groundwater remains a rope and bucket in a wide, shallow well. This type of well can operate up to a depth of 100 metres, although they rarely exceed 45 metres. The rope and bucket lifter can be operated by humans or animals. Human operated rope and bucket lifters typically raise 10-15 litres/min from depths of 10-15 metres whereas an animal water lifter can raise 150 litres/min from 15 metres. In the animal driven rope and bucket lifter, the rope attached to the bucket is passed over a pulley and fixed to the animal. The animal is driven down on an earthen ramp sloped at an angle of 5-10 degrees in order to lift the water.

A self-emptying container or mohte can be used in place of the bucket as shown in Figure 8. The system consists of a leather container, shaped like a funnel. The container can typically hold...
between 100 to 150 litres. This arrangement can discharge about 130 litres/ min at depths of up to 9 metres.

The rope and bucket lifter can also be adapted to include two buckets which are raised and lowered alternately. In this case the pulling animal moves in a circular path and with the help of central rotating lever, rope and pulley arrangement the buckets move up and down. Each bucket has a carrying capacity of up to 70 litres. The buckets have a hinged flap at the bottom, which acts as a valve. Guide rods are provided in the well to control the movement of the buckets. The buckets are automatically filled and emptied during operation. This device can lift about 230 litres/min from depths of up to 5 metres.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple technology which is inexpensive to build and maintain.</td>
<td>Water Delivery from Human Operated Rope and Bucket Water Lifter is limited to 15 l/min.</td>
</tr>
<tr>
<td>Can be operated at depths of up to 100 m.</td>
<td>Animals need to be maintained all year even when irrigation is not necessary.</td>
</tr>
<tr>
<td>Water Delivery from Animal Operated Rope and Bucket Water Lifter of over 200 l/min for double bucket system</td>
<td>Relatively low efficiency for traditional human and animal operated designs (10-40%)</td>
</tr>
</tbody>
</table>

**Shallow-Well Piston Pump**

A **reciprocating suction pump** has a plunger or piston which moves up and down in a two-valve closed cylinder. As the plunger moves upward it forces water out through the outlet valve and at the same time draws water into the cylinder through the inlet valve. Moving the plunger down brings it back to its starting position.

The reciprocating suction pump has the pump cylinder situated above ground or near the surface. Pulling up the plunger lowers the atmospheric pressure in the cylinder (creates suction) causing the atmospheric pressure outside the cylinder to push the water upwards. The main limitation of this pumping method is that the atmospheric pressure difference between the inside and outside of the cylinder is only large enough to raise water up to a maximum of 7m from the water table.

A large piston diameter will give water delivery of 24-36 litres/min at a depth of 7 metres. Most designs have a maximum usage of around 50 people/day, which makes them less appropriate for irrigation purposes than for household water supply.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relatively simple maintenance (main pump components positioned above ground)</td>
<td>More expensive than most basic/traditional irrigation methods.</td>
</tr>
<tr>
<td>Large piston diameter gives water delivery of 24-36 litres/min at 7 m depth</td>
<td>Limited to wells of less than 7 metres in depth</td>
</tr>
<tr>
<td>Medium to high efficiency (60-85%)</td>
<td></td>
</tr>
</tbody>
</table>

**Treadle pump**

A type of suction pump designed to lift water from a depth of 7 metres or less. The treadle
pump has a lever pushed by the foot to drive the pump. Because leg muscles are stronger than arm muscles, this design is less tiring to use than other human powered water lifters. Most of the parts can be manufactured locally hence the treadle pump is relatively simple and inexpensive to build. The treadle pump can lift up to 100 litres/min at depths of around 4 m.

The introduction of the treadle pump for irrigation has been shown to have a positive impact on household income. In Bangladesh, a simple treadle pump costs around US$20 but this investment allows families to generate US$100 additional income annually. In Africa where treadle pumps cost between US$50-80 additional income rises to between US$200 – 500 each year.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple and inexpensive construction</td>
<td>Limited to wells of less than 7 metres in depth</td>
</tr>
<tr>
<td>Less intensive operation (foot operated)</td>
<td></td>
</tr>
<tr>
<td>Maintenance uses local skills and materials</td>
<td></td>
</tr>
<tr>
<td>Water delivery of up to 100 litres/min at 4 metres depth</td>
<td></td>
</tr>
<tr>
<td>Use leads to generation of US$100-500 additional income per year for rural households in Africa and Asia</td>
<td></td>
</tr>
</tbody>
</table>

**Rower**

The rower pump is a simpler and cheaper version of the traditional reciprocating suction pump. The pump is set at an angle of 30° and water is lifted through a rowing action. The long piston stroke ensures fast water delivery of up to 90 litres/min at 4 m depth.

Its simple design means it can be easily manufactured and maintained using locally available skills and materials.
Advantages | Disadvantages
---|---
Cheaper construction than most reciprocating suction and lift pumps | Limited to wells of less than 7 metres in depth
Maintenance using local skills and materials | 
Long piston stroke gives water delivery of up to 90 litres/min at 4 metres depth | 

**Chain / Rope and Washer Pump (‘Pater noster’)***

These pumps have been used in China and Europe for many centuries. The pump consists of an endless chain or rope on which washers are mounted at intervals. The endless chain usually passes over two drums. The upper drum is above the top of well to which axle and handle is attached for operation. The chain with disc passes through a pipe which extends downward from the top of well to about 0.6 to 0.9m below the surface of water. As the chain rotates the discs trap the water in the pipe and carry it to the surface where it is discharged in a trough.

Although in theory it is possible to construct a vertical chain and washer pump to raise water to any height, most do not exceed 35 metres. At this depth the average yield is calculated as 10 litres/min. However, rope pumps more commonly operate at depths of up to 10 m with a water yield of 40 litres/min. The rope pump can be adapted to be operated by a horse and will raise 60 litres/min from a 20 m well.

Chain/Rope and washer pumps require less maintenance than other equivalent pumps. Their simple design means that repairs can often be done by users and require few spare parts. Models can use parts that incorporate commonly available materials such as PVC pipe, rope, and old car parts.

The main disadvantage of this type of pump for irrigation is that since this is not a pressurised system it may take time to receive water from the well with the water falling back to the level of the bottom of the well when not in use.

A variation of this design is called the "dragon-spine" pump, which lies at a shallow angle to the horizontal. In this case, lifting height is rarely more than 6 metres. However, the design is very flexible and can easily be adapted to circumstances.

Advantages | Disadvantages
---|---
Relatively cheap, and easy to manufacture (for wells down to 35 m rope pumps are five times cheaper than piston lift pumps.) | Operation limited to depths of up to 35 m. Initial water delivery is relatively slow at greater depths. Frequent simple maintenance required
Maintenance uses local skills and materials | Medium to high efficiency (50-80%)
Comparison of human- and animal- surface water and groundwater lifting devices

Table 2 provides an assessment of the different technologies considered in this technical brief.

<table>
<thead>
<tr>
<th>Type</th>
<th>Power Source</th>
<th>Manufacture</th>
<th>Investment Cost</th>
<th>Maximum Lift (m)</th>
<th>Typical Flow Rate (litres/min)</th>
<th>Typical Lift (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SURFACE WATER</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swing Basket</td>
<td>Human</td>
<td>Basic</td>
<td>Low</td>
<td>1.20</td>
<td>60-80</td>
<td>0.75</td>
</tr>
<tr>
<td>Shadouf / Picottah</td>
<td>Human</td>
<td>Basic/Traditional</td>
<td>Low-Medium</td>
<td>4.00</td>
<td>60</td>
<td>2-3</td>
</tr>
<tr>
<td>Dhone</td>
<td>Human</td>
<td>Basic/Traditional</td>
<td>Low-Medium</td>
<td>1.50</td>
<td>80-60</td>
<td>0.30-1.00</td>
</tr>
<tr>
<td>Paddle Wheel</td>
<td>Human</td>
<td>Basic/Traditional</td>
<td>Low-Medium</td>
<td>0.50</td>
<td>300</td>
<td>0.50</td>
</tr>
<tr>
<td>Persian Wheel</td>
<td>Animal</td>
<td>Traditional</td>
<td>Low-Medium</td>
<td>20</td>
<td>250-280-160-170</td>
<td>3-9</td>
</tr>
<tr>
<td>Archimedeanean Screw</td>
<td>Human</td>
<td>Traditional/Industrial</td>
<td>Medium-High</td>
<td>1.5</td>
<td>250-500</td>
<td>0.2-1.0</td>
</tr>
<tr>
<td><strong>SURFACE WATER AND GROUNDWATER</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rope and Bucket</td>
<td>Human</td>
<td>Basic</td>
<td>Low</td>
<td>100</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Animal</td>
<td>Basic</td>
<td>Low</td>
<td></td>
<td>100</td>
<td>150</td>
<td>15</td>
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<tr>
<td>Mohte</td>
<td>Animal</td>
<td>Basic/Traditional</td>
<td>Low-Medium</td>
<td>100</td>
<td>130</td>
<td>9</td>
</tr>
<tr>
<td>Double Bucket</td>
<td>Animal</td>
<td>Basic/Traditional</td>
<td>Low-Medium</td>
<td>100</td>
<td>230</td>
<td>5</td>
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<tr>
<td>Suction piston</td>
<td>Human</td>
<td>Industrial</td>
<td>Low-Medium</td>
<td>7</td>
<td>24-36</td>
<td>7</td>
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<tr>
<td>Treadle</td>
<td>Human</td>
<td>Basic/Traditional</td>
<td>Low-Medium</td>
<td>7</td>
<td>100</td>
<td>4</td>
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<tr>
<td>Rower</td>
<td>Human</td>
<td>Traditional</td>
<td>Low-Medium</td>
<td>7</td>
<td>50</td>
<td>4</td>
</tr>
<tr>
<td>Chain &amp; Washer Pump</td>
<td>Human</td>
<td>Basic/Traditional</td>
<td>Low to Medium</td>
<td>35</td>
<td>40-10</td>
<td>10-35</td>
</tr>
<tr>
<td>Animal</td>
<td>Basic/Traditional</td>
<td>Low to Medium</td>
<td></td>
<td>35</td>
<td>60</td>
<td>20</td>
</tr>
</tbody>
</table>

Table 2: Comparison of Different Types of Human- & Animal- Powered Water Lifting Devices
References and resources

- **Human-Powered Handpumps for Water Lifting** Technical Brief Practical Action
- **Treadle Pumps** Technical Brief Practical Action
- **Low Lift Irrigation Pumps** Technical Brief WEDC
- **Maintaining Handpumps** Technical Brief WEDC
- **Handpumps** Technology Note WaterAid
- **VLOM pumps** Technical Brief WEDC
- **Smart Water Solutions: Examples of innovative low cost technologies for wells, pumps, storage, irrigation and water treatment**, Netherlands Water Partnership, 2006

Organisations

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The IRC International Water and Sanitation Centre (IRC) facilitates the sharing, promotion and use of knowledge so that governments, professionals and organisations can better support poor men, women and children in developing countries to obtain water and sanitation services they will use and maintain.

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The Netherlands Water Partnership (NWP) is an independent body set up by the Dutch private and public sectors. They nationally coordinate water activities overseas and provide relevant information regarding these activities.
Practica Foundation
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The Practica Foundation aims to facilitate research, development and commercial application of technology in the field of water and energy in developing countries. Technologies include:
- Rope pump
- Motorized rope pump
- Volanta pump
- Treadle pump

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SKAT is an independent resource centre and consulting company. It is committed to sustainable development in developing countries and countries in transition.

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Website: http://www.lboro.ac.uk/well/
WELL is a resource centre which aims to promote environmental health and well being in developing and transitional countries. It is managed by the London School of Hygiene and Tropical Medicine (LSHTM) and the Water, Engineering and Development Centre (WEDC), Loughborough University for British & Southern NGOs working in water & sanitation.

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1211 Geneva 27
Switzerland
Tel: +41 22 791 21 11
Fax: +41 22 791 3111
Website: http://www.who.int
Manufacturers (This is a selective list, not implying endorsement by Practical Action.)

**Bombas de Mecate S.A.**  
Technology Transfer Division,  
P.O.Box 3352, Managua, Nicaragua.  
Telefax: 00-505-8566692  
E-mail: ropepump@ibw.com.ni  
Website: [http://www.ropepump.com](http://www.ropepump.com)  
Manufacture different types of rope pump.

**Consallen Group of Companies**  
P.O. Box 2993, Sundury, Suffolk, CO10 0TY,  
United Kingdom  
Tel/Fax: +44 (0)1787 881115  
E-mail: dvallen@compuserve.com  
Website: [http://www.consallen.com/](http://www.consallen.com/)  
Specialists in Rural Water Supply & VLOM Handpumps

**Monoflo Incorporated**  
16503 Park Row, Houston, Texas 77084,  
U.S.A.  
Tel: +1 281 599 4700  
Fax: +1 281 599 4733  
E-mail: inquire@monoflo.com

**Prodorite (Pvt) Ltd**  
21 Leyland Road, Arbennie Industrial Sites,  
PO Box 2887, Harare  
Zimbabwe  
Tel: +263 4 663691/4  
Fax: +263 4 663696  
Products include hand pumps for wells, water storage tanks, Blair vent pipes and sanitary pans

**SWS Filtration Ltd.**  
The Bakers Chest, Hartburn, Morpeth,  
Northumberland NE61 4JB,  
United Kingdom  
Tel +44 (0)1670 772214  
Fax +44 (0)1670 772363  
E-mail: swsfilt@dial.pipex.com  
Website: [http://www.swsfilt.co.uk/](http://www.swsfilt.co.uk/)  
Manufactures of Rower and other low-technology pumps

**H.J.Godwin Ltd.**  
Quenington, Cirencester, Glos, GL7 5BX,  
United Kingdom  
Tel +44 (0)1285 750271  
Fax +44 (0)1285 750352  
Deep-well and shallow-well pumps

**Mono Pumps Limited**  
Martin Street, Audenshaw, Manchester M34 5DQ, England, United Kingdom  
Tel: +44 (0)161 339 9000  
Fax: +44 (0)161 344 0727  
E-mail: info@mono-pumps.com  
Website: [http://www.mono-pumps.com/](http://www.mono-pumps.com/)  
Producers of helical rotor and piston lift device

**Steelman Industries**  
Shanti Dham, Kankarbagh Main Road, Patna (Bihar) - 800 020,  
India  
Tel: +91-612-352530  
Fax: +91-612-352872  
E-mail: manraw@hotmail.com  
Produce the following handpumps: India Mark II, India Mark III, India Mark IV, Rawman shallow & force handpump, Rawman special Lift & force VLOM handpump

**Van Reekum Materials bv**  
P. O. Box 98, 7300 AB Apeldoorn,  
The Netherlands  
Tel: +31 55 533 54 66  
Fax: +31 55 533 54 88  
E-mail: info@reekum.nl  
Website: [http://www.vrm.nl/](http://www.vrm.nl/)  
Producers of a range of pumping equipment
This technical brief was produced by Jane Olley for Practical Action, November 2008.

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E-mail: inforserv@practicalaction.org.uk
Website: http://practicalaction.org/practicalanswers/

Practical Action is a development charity with a difference. We know the simplest ideas can have the most profound, life-changing effect on poor people across the world. For over 40 years, we have been working closely with some of the world’s poorest people - using simple technology to fight poverty and transform their lives for the better. We currently work in 15 countries in Africa, South Asia and Latin America.