



Pumping

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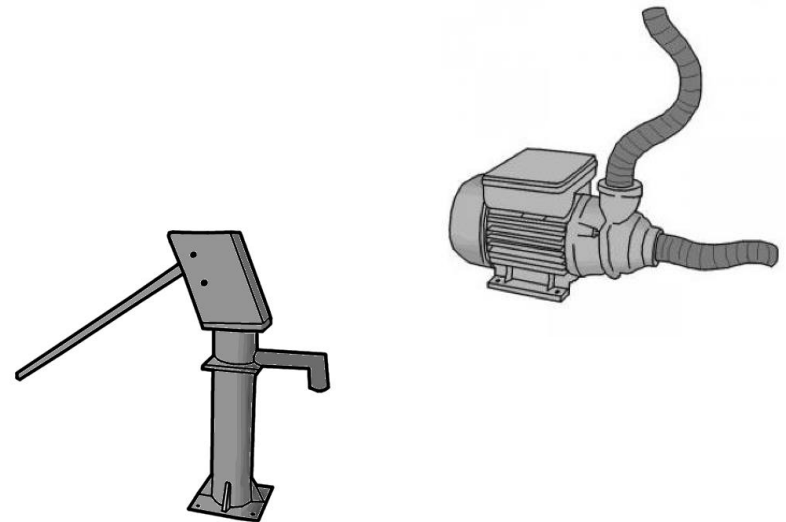
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Depending on the initial situations and respective local circumstances, there is no guarantee that single measures described in the toolbox will make the local water and sanitation system more sustainable. The main aim of the SSWM Toolbox is to be a reference tool to provide ideas for improving the local water and sanitation situation in a sustainable manner. Results depend largely on the respective situation and the implementation and combination of the measures described. An in-depth analysis of respective advantages and disadvantages and the suitability of the measure is necessary in every single case. We do not assume any responsibility for and make no warranty with respect to the results that may be obtained from the use of the information provided.



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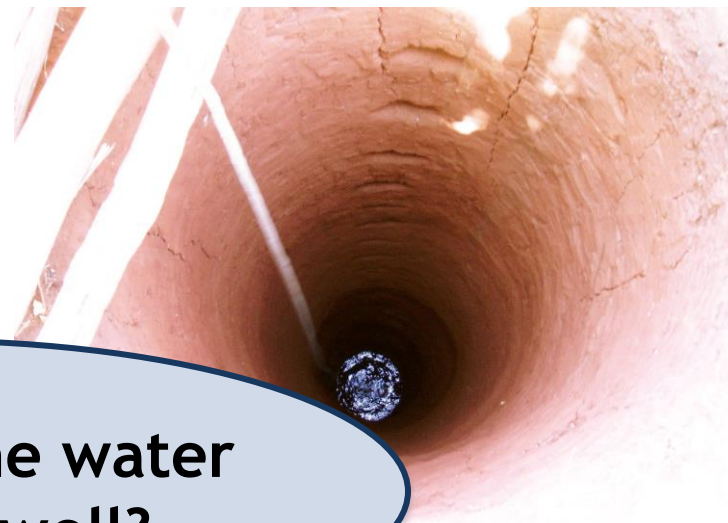


1. Introduction

Groundwater Withdrawal from Wells



Source:
http://1.bp.blogspot.com/_B50r50WKTs4/S_mRsi_vvmI/AAAAG_YU/F7BIKK2AlPQ/s1600/IMG_7501.CR2.jpg



Source:
<http://journeytosasiga.files.wordpress.com/2008/04/p40300291.jpg>

How to get the water
out of the well?



Source: <http://hiprojects.files.wordpress.com/2009/07/well-depth-lg.jpg>

1. Introduction

Groundwater Withdrawal from Wells by Means of Buckets or Pumps



Pumps



Source: IWMI (n.y.); NE (n.y.); WATER CHARITY (n.y.); BAUMANN (2011)



Rope & Bucket

Source:
<http://www.flickr.com/photos/foodforthe poor/6100218694/sizes/z/in/photostream/> [Accessed:
17.05.2012]

2. How Can Pumps Optimise my Local Water System?

Benefits

A dug or drilled well equipped with a pump can improve a community's water supply system substantially.

Increased
performance

Many low-cost and
low-tech pumps
available

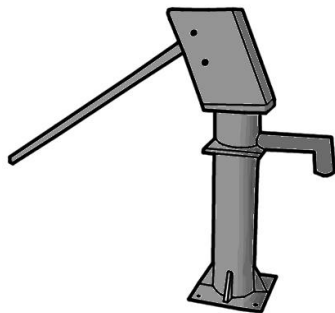
No surficial contamination
(opening is sealed if a
pump is installed)



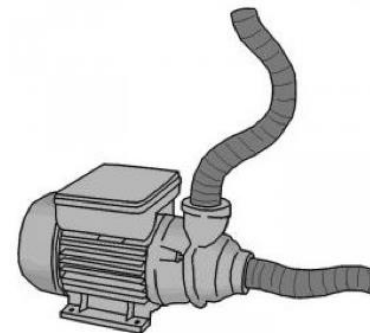
Source: BAUMANN (2011)

3. Different Types of Pumps and their Characteristics

Manual vs. Mechanised Pumping



**Manual
Pumping**



**Mechanised
Pumping**

3. Different Types of Pumps and their Characteristics

Manual Pumping

Type	Manufacture	Investment Costs	Village Level Operation and Maintenance (VLOM)	Low-cost option available	Max. Lift Height [m]	Typical Lift Height [m]	Typical Flow Rate [l/min]
SHALLOW WELL PUMPS							
Suction/Piston/Plunger pump (cylinder is above water table)	Industrial	Low to medium	Yes	Yes (e.g. No. 6 pump)	7	7	24-36
Rower pump/ low-lift pump	Traditional	Low to medium	Yes	Yes	7	4	50
Treadle pump (foot pump)	Basic/ Traditional	Low to medium	Yes	Yes (e.g. pedal pump)	7	4	100
Chain / washer / 'pater noster' (rotary) pump	Basic / Traditional	Low to medium	Yes	Yes	6	6	80
DEEP WELL PUMPS							
Direct action / direct drive/ reciprocating lift / high-lift pump (cylinder is below water table)	Traditional/ (Industrial)	Medium to high	Yes	Yes (e.g. EMAS, Tara)	12	12	15-26
Rope (rotary) pump	Basic / Traditional	Low to medium	Yes	Yes	35	10	40
Deep-well diaphragm pump	Industrial	Medium to high	No	No	70	45	20
Helical rotor / progressive cavity pump	Industrial	Medium to high	No	No	100	45	16
Deep-well hand / lift / piston pump	Industrial	Low to high	Depends on design	Yes	100	45	11-17

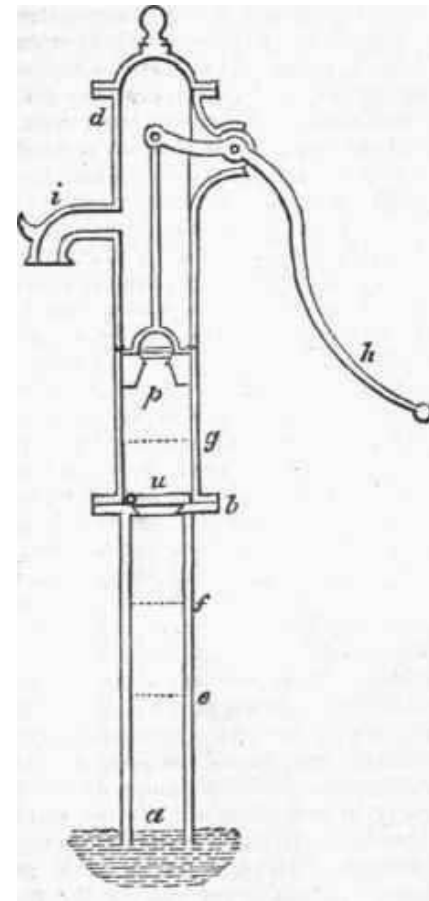
Source: OLLEY (2008)

3. Different Types of Pumps and their Characteristics

Example: Manual Pumps - Suction/Piston/Plunger Pump



Source: BAUMANN (2011)

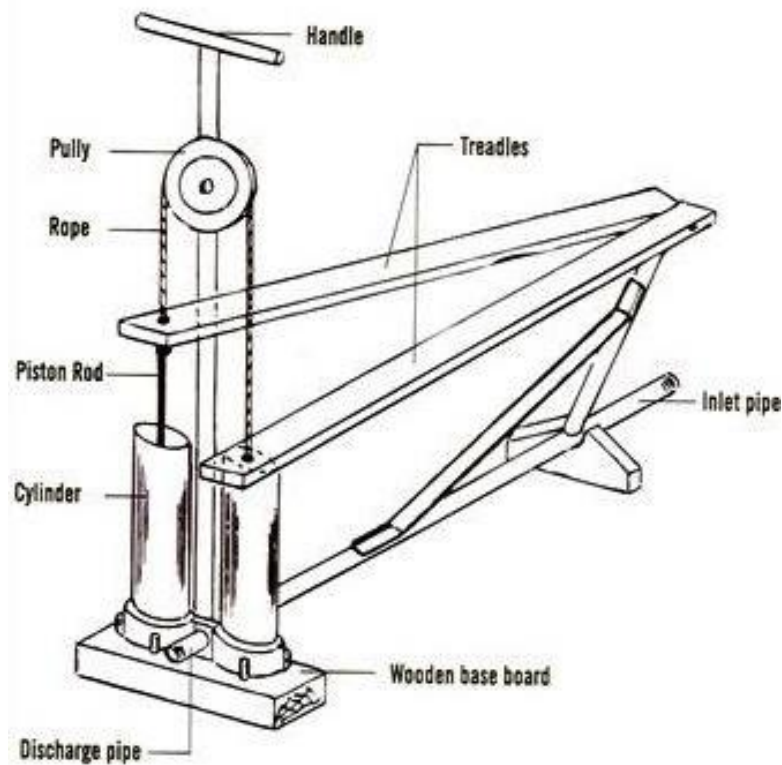


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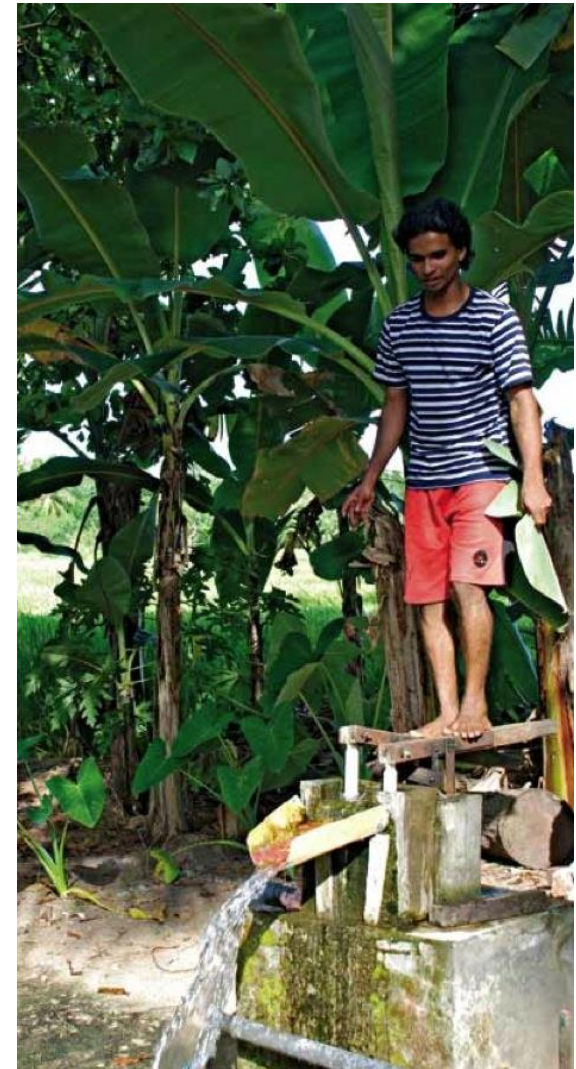
<http://chestofbooks.com/crafts/mechanics/Engineer-Mechanic-Encyclopedia-Vol2/images/Common-Pump-Or-Suction-Pump-243.jpg>

3. Different Types of Pumps and their Characteristics

Example: Manual Pumps - Treadle Pump



Source: <http://product-image.tradeindia.com/00072160/b/0/Treadle-Pump.jpg>



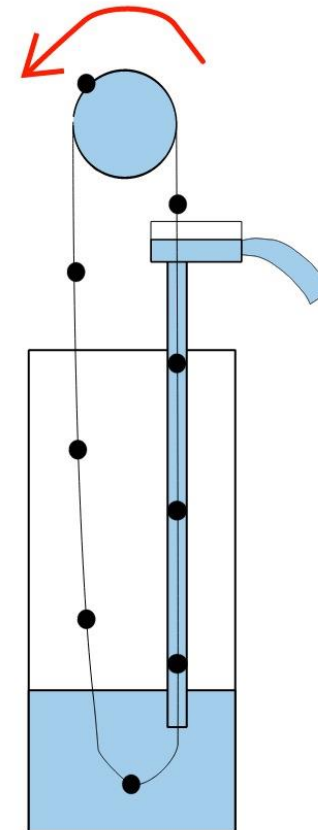
Source: W3W (2011)

3. Different Types of Pumps and their Characteristics

Example: Manual Pumps - Rope Pump



Source: BAUMANN (2011)



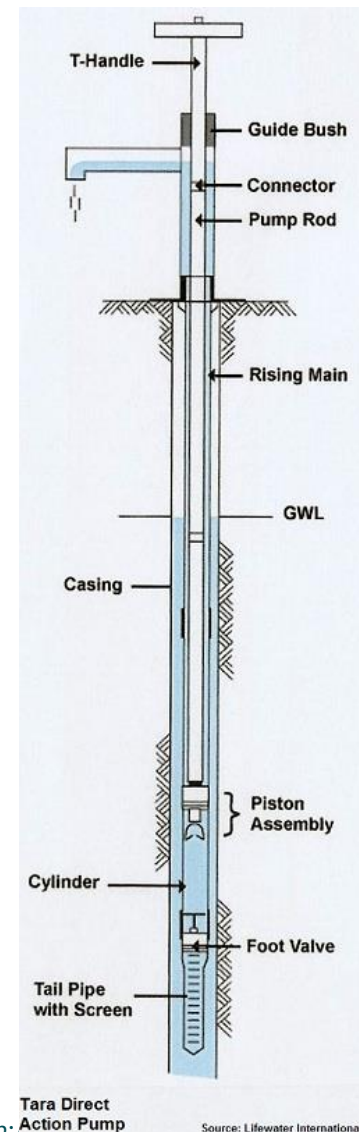
Source: https://upload.wikimedia.org/wikipedia/commons/e/ec/Rope_Pump.svg

3. Different Types of Pumps and their Characteristics

Example: Manual Pumps - Deep Well Piston Pump



Source: APPROPRIATE PROJECTS (n.y.)

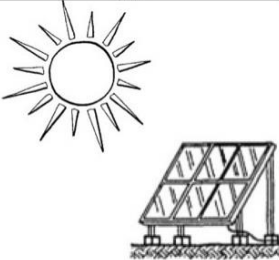


Tara Direct Action Pump
Source: <http://laymen.com/images/pumpoperationtara.jpg>

Source: Lilewater International

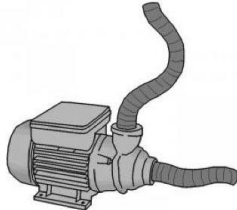
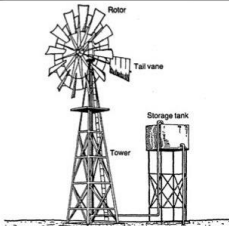
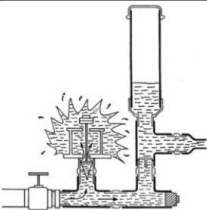
3. Different Types of Pumps and their Characteristics

Mechanised Pumping 1/2

Power Source Type			Principle
Electricity (Motor)	Grid		- Centralised power plant produces and distributes electricity via power grid - Electricity drives a pump
	Solar / Photovoltaic (PV)		- Solar panels produce electricity (AC/DC) - Electricity drives a pump
	Diesel Generator		- Fuel-driven engine produces rotation - Rotation is transformed to electricity - Electricity drives pump

3. Different Types of Pumps and their Characteristics

Mechanised Pumping 2/2

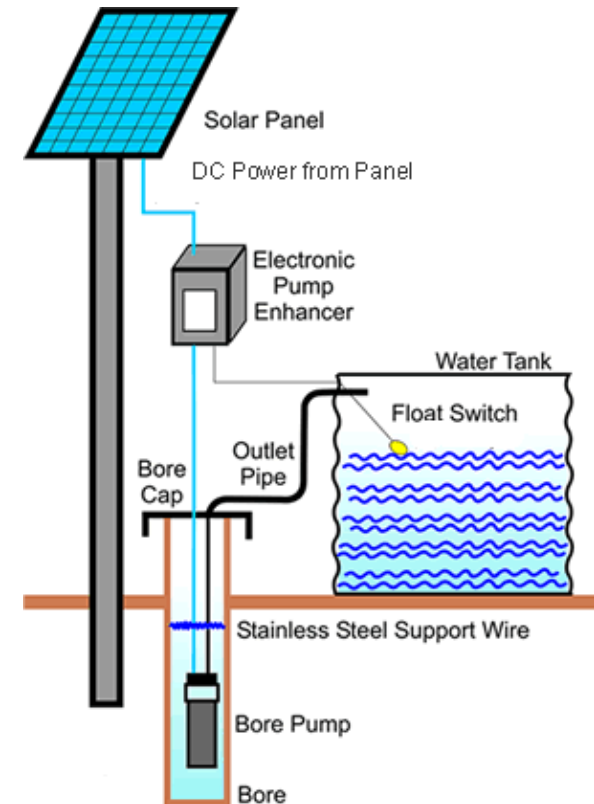
Power Source Type		Principle
Fuel (diesel, petroleum) (Engine) (Alternatively bio-mass/gas/coal)		• Fuel-driven engine produces rotation • Rotation directly drives a pump
Wind power		• Wind mill produces rotation • Rotation directly drives a pump
Animal-driven		• Animals produce rotation • Rotation directly drives a pump
Gravity/Hydro power		• Hydraulic ram

3. Different Types of Pumps and their Characteristics

Example: Mechanised Pump - Solar Pump



Source: NE (n.y.)



Source:
http://climatetechwiki.org/sites/climatetechwiki.org/files/images/extra/solar_pump.gif

3. *Different Types of Pumps and their Characteristics*

Example: Mechanised Pump - Diesel Pump



Source:
http://img.diytrade.com/cdimg/482442/2911310/0/1162781521/Diesel_water_pump.jpg [Accessed: 23.05.2012]



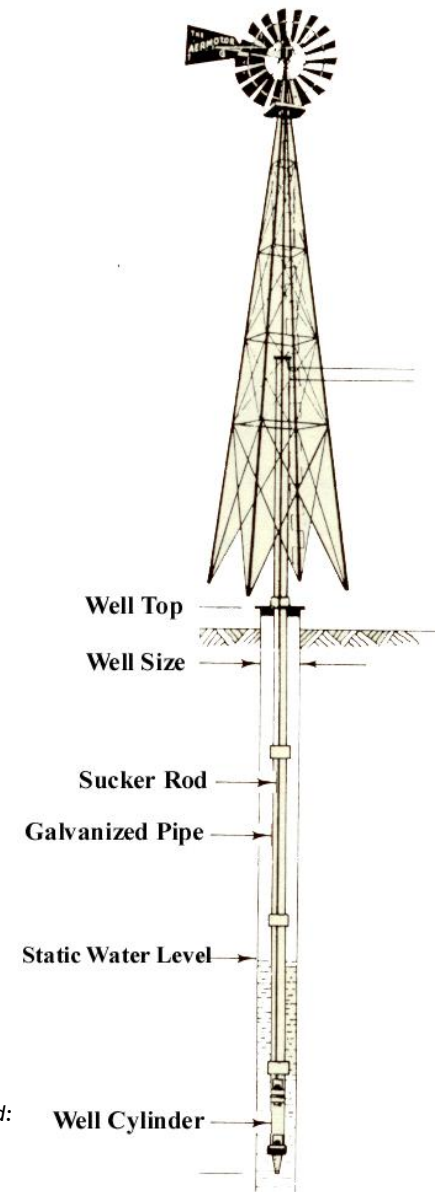
Source: IWMI (n.y.)

3. Different Types of Pumps and their Characteristics

Example: Mechanised Pump - Wind Pump



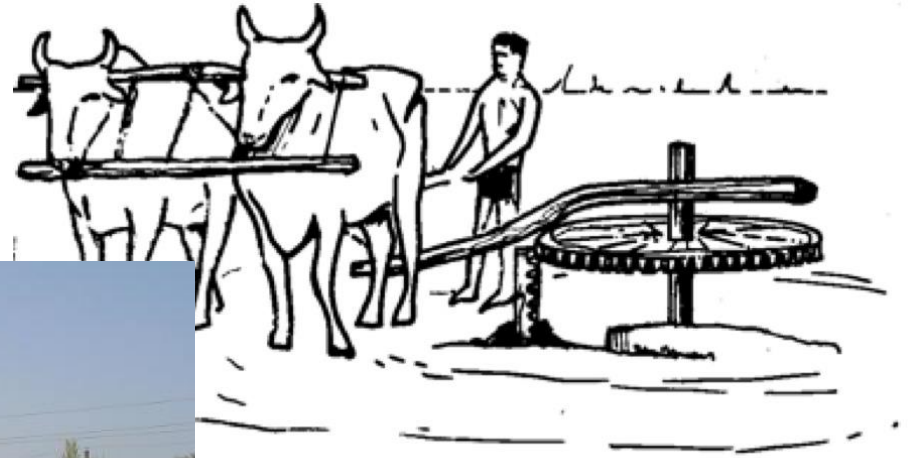
Source: NSP (n.y.)



Source: <http://www.windmill-windmills.com/windmill-system.gif> [Accessed: 23.05.2012]

3. *Different Types of Pumps and their Characteristics*

Example: Mechanised Pump - Animal-driven Pump



Source: OLLEY (2008)

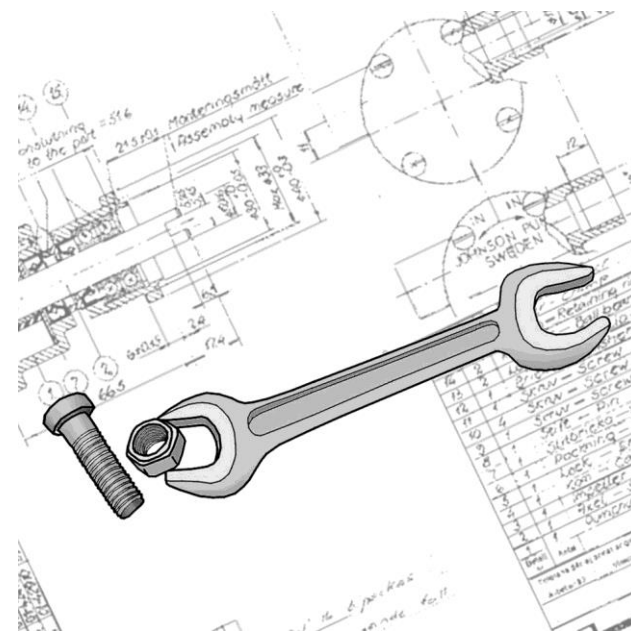


Source: http://2.bp.blogspot.com/_zHuWL7vjmBA/S92EzCZS-2I/AAAAAAAAAco/1s8oqDGkP2A/s1600/EnRouteGounaSohaq9.jpg [Accessed: 09.05.2012]

4. Operation and Maintenance

Maintenance - The Key Factor in every Pump Project

- Every pump system rises and falls with the community's ability for maintenance.
- **Manual pumps**, particularly the low-cost options, require **very frequent maintenance**. A community operating a human-powered pump has to be able to find a way to organise O&M.
- Most **mechanised pumps** need **frequent maintenance**. As many parts are moving, lubricants and spares need to be available at all times. Maintenance requires skilled workers or professionals depending on the system.



5. Applicability

Manual Pumps

- Manual pumps mainly suit **small, rural communities with limited access to power sources, financial resources and rather low water requirements.**
- Many different pump types have been developed, suiting a broad variety of local conditions.
- All in all, manual pumps are a **very promising water-lifting technique and capable to significantly improve a water supply system** and, hence, the livelihood of a local community.

5. Applicability

Mechanised Pumps

Recently, manual pumps are strongly promoted and many good technologies have evolved. Yet, **the use of mechanised pumps can be appropriate:**

- If a **high performance** is required (e.g. urban or large community drinking water supply, communities with only one drilled well, which require water for additional needs such as cattle and irrigation);
- If a **storage and distribution** system is necessary;
- If the **source of energy** (usually electricity) is relatively inexpensive and reliable, and if the availability of **spare parts**, skills, lubricants and fuel is ensured;
- In areas where the only available water is **deep-lying groundwater**;
- In **emergency situations** (e.g. rapidly expanding refugee camps).

UNICEF (1999); ROARK et al. 1989)

6. *Advantages and Disadvantages*

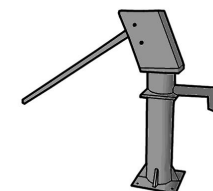
Manual Pumps Put in a Nutshell

Advantages:

- Independence of power sources (e.g. diesel, electricity)
- Adequate discharge capacity to meet the domestic water requirements and small-scale irrigation
- Low-cost options for most pump types available
- Most simple hand pumps can be maintained by appropriately trained local
- Empowerment of women, children and small farmers
- Safety is increased (no direct access with buckets and ropes)

Disadvantages:

- Appropriate and very frequent maintenance is vital
- Disproportional increase of effort to lift water with increasing depth
- Discharge capacity too low for large communities



6. *Advantages and Disadvantages*

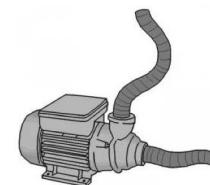
Mechanised Pumps Put in a Nutshell

Advantages:

- Very high performance
- Need for storage tanks if supply depends on availability of wind, sun or if engines/motors are not available continuously
- Independent operation at remote sites (only diesel)
- Less labour-intensive/less physical effort
- Safety is increased (no direct access with buckets and ropes)

Disadvantages:

- Generally expensive in acquisition, operation and maintenance
- Fuels, noise and fumes can pose a health risk, can pollute groundwater and the environment.
- Availability electricity or fuel, spares and lubricant required
- Extensive use (high performance) can cause wells to fall dry
- Very frequent and professional maintenance is vital



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