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## TECHNOLOGICAL OPTIONS FOR LOW-COST WATERSUPPLY IN LOW WATER TABLE AREAS OF BANGLADESH

A working paper prepared by:  
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 Consultant, SDC

### 1. INTRODUCTION

The general mass in rural areas, all over the world, mainly depend on handpumps for their safe drinking water. A handpump is any simple water lifting device, powered by human energy and is used in rural village drinking water supplies.

Various types of handpumps are used in different low water table areas of Bangladesh. These are:

- NR.6 SUCTION PUMPS
- DEEPSET TARA PUMPS
- DEEPSET MOON PUMPS
- DEEPSET BANGLA PUMPS
- TREADLE PUMPS (NORMAL AND DEEPSET)
- LOCALLY PRODUCED IMPROVISED DEEPSET PUMPS

Except for serial no. 1, which is a shallow tubewell suction pump, all other pumps are deepset pumps. This Nr.6 handpump is widely used all over the country. Even in most of the low water table (LWT) areas of Bangladesh, in rainy season the ground water table rises and the Nr.6 pumps (shallow tubewells) perform well for about 10 months in a year. Only for 2 to 3 months in a year, during the draught period, these Nr.6 handpumps become ineffective due to lowering of ground Water Table (WT) below the capacity of suction pump.

In certain parts of 'Barendra Area' in Rajshahi division, in the northern Bengal, sinking tubewell for drinking water is very difficult. The areas include the entire area of Sapahar, Patnitola, and Porsha thanas and certain parts of Neamatpur and Manda thanas of Naogaon district, Gomastapur and Nachol thanas of Nawabganj district, Tanore and Godagari thanas of Rajshahi district. Only source of drinking water in these areas are open dug-wells or ring-wells. Some of these are excavated and provided for the local people free of cost by CARITAS-Bangladesh, a local NGO. In dry season the water level falls very low and it becomes extremely difficult for the villagers to collect drinking water manually from these open wells.

## 2. NR. 6 SUCTION PUMP

This is most commonly used handpump in Bangladesh and is available all over the country.

Total Head capacity of suction pump is 25 ft.

Total Head,  $H_t = H_s + H_d + z$

where  $H_s$  is Suction Head  
 $H_d$  is Delivery Head  
 $z$  is the frictional, bend and other losses

This type of suction pump is capable of lifting water from a depth of 22 ft. below ground level. This means in the areas where the WT is above 22 ft. and until the WT falls lower than 22 ft. in LWT areas, Nr.6 handpumps work well and effectively.

### Parameters for Nr.6 Handpump (at 22 ft. lifting head):

Energy	:	3.08	Kcal/min
Discharge	:	17.07	Lit/min
Efficiency:		11.00%	

Cost of a normal Nr.6 pump, with 1.5" dia. PVC pipe (approx. 100 ft.), Cast Iron (CI) pump head, including drilling/ installation and platform construction varies from Tk. 2,500 to 4,000.

## 3. TARA PUMPS

The growth of minor irrigation, particularly after 1980s caused large abstraction of ground water for irrigation. This lowered the ground water table in many areas rendering many tubewells fitted with suction mod handpumps inoperable, particularly in dry months. To sustain continued watersupply to the rural people necessity of a deepset pump (Tara) was felt. Tara pump was initiated at Mirpur Agricultural Works and Training School (MAWTS) in 1982 and was commercialized by UNICEF in 1986. This deepset direct action was designed to extract water form a deeper depth of upto 50 ft.

### Parameters for Tara pump at 50 ft. head:

Handle force required	31 Kg-f (for down-stroke)
	35 Kg-f (for up-stroke)
Input	97 watt (1 HP = 0.746 KW)
Efficiency	58%

There are different versions of Tara pump.  
These are:

- Tara
- Mini Tara (conversion of existing 1.5" dia. suction pumps)
- Tara-II (improved version of standard tara pumps)
- Super Tara (improved version of standard tara pumps)
- Tara-dev (improved version of standard tara pumps)

Recent studies have classified different spares of Tara Pumps in the following 3 categories:

i) Fast wearing spares:  
Leather Cup-seal  
Piston flap-valve  
Rubber 'O' ring  
Foot valve, Flap Valve

ii) Medium wearing spares:  
Wing check nut  
Top connector  
Piston plate  
Follower plate  
Washer  
Bottom connector  
Handle retainer  
Top guide bush

ii) Slow wearing spares:  
Other than those mentioned in 2 categories above

Total Head capacity of different Tara pumps are as follows:

MINI TARA PUMPS	Total Head capacity is 50 ft.
SUPER TARA PUMPS	Total Head capacity is designed for 80 ft.
TARA-DEV PUMPS	Total Head capacity is 100 ft.- 150 ft.

Cost of a standard Tara pump with 2" dia. PVC pipes (Approx. 200 ft.), 1.5" pump-rod, all pump accessories, steel pump-head, including drilling/ installation and platform construction is around Tk. 13,000 to 15,000.

A sketch of the Standard Tara Pump is enclosed as Annexure-I.

#### 4. MOON PUMP

'Moon pump' is designed for extracting ground water in LWT area. It is a deepset pump similar to Tara pump. In this handpump, 3" dia. PVC cylinder is used for boring well. A piston rod of 0.5" dia. steel is used (instead of 1.5" dia. pump rod as used in Tara pumps), for placement of foot valve at the bottom end of the 3" dia. PVC cylinder. Beyond that level 1.5" dia. PVC pipes are lowered and filter and sand trap is placed there.

The Dutch government assisted "18 District Towns Watersupply, Drainage and Sanitation Project" (18 DTP), being executed by DPHE, has installed many 'Moon pumps' in several districts, including in Naogaon and Manikganj.

The estimated cost of a moon pump with 3" and 1.5" dia. PVC pipes (200 ft.), pumphead assembly of standard Nr.6 pump, and other accessories, including boring/ installation of pipes and pump and construction of platform is Tk. 12,000. This amount is very near to the estimated cost of a Tara pump.

A sketch of the Moon Pump along with the estimated cost, prepared by the project office, is enclosed as Annexure-II.

*(More details about this 'Moon Pump' is to be gathered from the Project Director, DPHE 18-DTP office in Dhaka and field visits in some of the 18 district towns of the project.)*

## 5. BANGLA PUMP

'Bangla Pump' is also a deepset pump designed for LWT areas. It is similar to the Moon Pump to certain extent and uses the same Nr.6 handpump head for lever action, instead of direct action pump as used in Tara pumps. There are some design changes, which is given in the sketch enclosed with this report.

The 'Bangla Pump' is developed by one Mechanical Engineer Mr M Maqbul Hossain, with his associates, in 1991. It is understood that 5 Bangla pumps have been installed in Savar/ Gazipur area and are functioning.

A performance evaluation of Bangla pump was done by its developer on 5 Bangla pumps installed in 5 public places for about 2 years, from May 1993 to April 1995. But no external independent evaluation is available.

The Grameen Trust has supported Mr M M Hossain financially for further development and improvement of this Bangla Pump. Mr Hossain has made a presentation of his subject in Grameen Trust in April 1995. Bangladesh University of Engineering and Technology (BUET) has been entrusted by the Grameen Trust to conduct an endurance test of the pump. The result of this test is still awaited.

The Grameen Trust intends to order 100 Bangla pumps from Mr Hossain for Grameen Bank group members, which will also serve as field testing of the pump. However, this order has also not yet been finalized.

It is understood that a Bangla Pump with all its fittings will cost around Tk 6,000 to 7,000 only. However no detailed estimate could be obtained.

A sketch of the Bangla Pump, as prepared by the developer Mr.Hossain, is enclosed as Annexure-III.

(Further details about this 'Bangla Pump' is to be gathered from the Grameen Trust, Dhaka and from the developer of the pump Mr M M Hossain in Mirpur, Dhaka, and also from field visits of some installed projects in Savar/ Gazipur area. The BUET may also be contacted for information on endurance tests.)

## 6. TREADLE PUMPS

Treadle Pumps are developed in Bangladesh in 1979, mainly for manual irrigation purposes in shallow WT areas. The twin cylinder pumphed with a bamboo or PVC tubewell was introduced by an international NGO, the Rangpur Dinajpur Rural Services (RDRS). This was commercialized by another NGO, the International Development Enterprise (IDE). This is a very cheap and effective manual pump and is very easily operatable by simply treading with two feet only. This technology has been exported from Bangladesh to neighboring countries like Vietnam by IDE.

### Parameters for Treadle pump (at 22 ft. lifting head):

Energy :	3.23	Kcal/min
Discharge :	33.60	Lit/min
Efficiency:	16.00%	

Although the Treadle pump is basically designed for agricultural purpose, the water from this pump is also used for drinking purpose in many places.

### 6.1 Deepset Treadle Pumps

With lowering of ground water table in many areas of Bangladesh, there had been high demand for deepset treadle pumps. IDE has taken steps so that the Treadle pumps may be used in LWT areas. In 1992 IDE has produced a deepset Treadle pump for use in LWT areas and they have been carrying out R&D activities in this regard.

At present there are 7 deepset treadle pumps in operation in low water table areas in Savar and Joydevpur area. But with increased depth, the energy requirement for operation has increased and the discharge has reduced. At present the operating deepset treadle pumps are operated by hired labour or by motor pumps.

The R&D work is still going on for achieving an acceptable solution. Bullock-driven pumps are also in the R&D programme of IDE, on which work is going on. IDE has an R&D field of their own in Belabo thana in Narsingdi district, about 70 KM away from Dhaka. In their R&D field, IDE has demonstration pumps. Deepset treadle pumps are in operation there, as the water table in the area is 35 ft. below the ground level.

IDE is using private mechanical workshops for catering the need of their R&D works, such as making of special threads, shafts etc.

A simple sketch of the Treadle Pump is enclosed as Annexure-IV.

*(Further details about this 'Treadle Pump' is to be collected from the IDE office in Dhaka and also from field visits of some installed projects in Savar/ Gazipur area and in their R&D field in Narsingdi district.)*

#### 7. IMPROVISED LOCALLY PRODUCED DEEPSET PUMPS

Local tubewell mechanics or mistries, in collaboration with local private workshops/ manufacturers, have installed many deepset handpumps in many parts of the LWT areas of the country. These sets are relatively much cheaper and are functioning to some extent.

During our field visit in Manda bazaar in Naogaon district, we have met mistries who claims that their installed improvised deepset hand pumps, which costed the owner only Tk. 6,000, are functioning well for last 3 years. We found more than 18 local private shops who are selling spare for deepset handpumps and arranging for installation and repair/ maintenance of the same through local mistries. The local DPHE Sub-Asst. Engineer accompanied us in the visit to local private shops.

During our field trip in Natore district town in November 1995, we met several private shop owners who sell Tara spares and spares of locally produced installed deepset handpumps. They also arrange for installation of such pumps. We also met one private entrepreneur, who is producing improvised deepset hand pumps at his workshop near Natore town. He informed us that a pump for a depth of 200 ft. costs about Tk. 4,000 only.

We also inspected one installed an improvised deepset hand pumps at a residence in Natore town, which is functioning well for last one year. This meeting was organized by courtesy of Natore IDE office.

No reliable monitoring or performance evaluation of such pumps are available. As such more information on these pumps should be collected and a systematic performance and endurance tests as well as acceptability of pumps should be carried out.

*(For obtaining more details about these 'Deepset Pumps', the manufacturers in concerned towns should be contacted and more information should be gathered from the installer mistries and the users. Also field visits must be carried out at installed sites in different LWT districts.)*

## 8. ALTERNATE POSSIBILITIES OF DRINKING WATER IN LWT AREAS

The users of Water and Sanitation facilities should be treated as customers and not as beneficiaries. A customer should have the option to choose from available range of products/ services. Therefore further alternate technological options should be searched for the LWT areas of Bangladesh, specially for the dry season.

Action research may be initiated for the following two and other possibilities for the purpose.

### 8.1 Use of Irrigation Pump Water

Specially during the dry season, the mechanized deep tubewells operate for irrigation of agricultural fields. Possibilities should be studied to use a small fraction of this water to use for drinking and other domestic purpose by the rural population.

Some infrastructural facilities to bring this water to the village cluster and storage of the same require some investment cost. The distribution and maintenance may be managed by community participation.

### 8.1 Use of Bucket Pump and Water Chain Pump in Ring Wells

In Barendra Area many open Ring wells are available which are provided by some NGOs. These open wells are susceptible to contamination. Also during dry season the WT goes further down and it becomes more difficult to lift water manually.

The Bucket Pumps and Chain Pumps are normally designed for shallow depth wells. However, R&D may be carried out to make these suitable for existing open wells and newly dug open ring wells. The wheels of such Bucket Pumps and Chain Pumps may be redesigned for driving by bulls or other animals.

In such cases also, the distribution and maintenance of water systems should be managed by community participation.

*(For detailing of these options more information should be gathered and study by experts will be required.)*

## 9. COST COMPARISON

For arriving at reliable cost comparison of different options, detail study of different design options and collection of more detail information regarding various parameters is necessary.

The information required are:

- Design of Pump/ accessories
- Materials used
- Dimensions of pipes and other materials
- Types and quality of materials used
- Water Table of installation area
- Depth of boring/ drilling
- Soil types and condition
- Method of drilling/ installation  
and many other factors.

However, for information only, a very rough cost information is given below:

Number 6 Suction Handpump	Tk. 2,000	-	4,000
Treadle Pump	Tk. 600	-	1,200
Deepset Treadle Pump	Tk. 3,000	-	5,000
Local (Deepset) Pump	Tk. 3,000	-	6,000
Bangla Pump (Deepset)	Tk. 6,000	-	7,000
Moon Pump (Deepset)	Tk.11,000	-	12,000
Tara Pump (Deepset)	Tk.12,000	-	14,000

#### 10. PERSONS MET FOR THE REPORT

The following is list of some of the persons met in connection with preparation of this report.

Mr Fariduddin A Mia, Supdtg. Engineer, Planning Circle, DPHE, Dhaka  
Mr Zahurul Haque, Supdtg. Engineer, DPHE, Rajshahi  
Mr Mohammad Abul Bashar, Executive Engineer, DPHE, Rajshahi  
Mr Mohammad Mohiuddin, Executive Engineer, DPHE, Naogaon  
Mr Abdul Kader, Sub-Asst. Engineer, DPHE, Naogaon Sadar Thana  
Mr Mostadar Rahman, Executive Engineer, LGED, Rajshahi  
Mr Deepak Bajrachariya, Chief WES, UNICEF, Dhaka  
Mr Dauda Wurie, Project Officer, WES, UNICEF, Dhaka  
Mr Haroon Ur Rashid, Consultant, RWSG-SA of UNDP & WB, Dhaka  
Mr Abdul Motaleb, Coordinator, HTMP, RWSG, Rajshahi  
Mr Shakil Ahmed, Project Asst. (Monitoring) HTMP, RWSG, Rajshahi  
Mr SMA Rashid, Director, NGO Forum for DWSS, Dhaka  
Prof Syed M Hashemi, Project Director, PRPA, Grameen Trust, Dhaka  
Mr Hasinur Rahman, Production Manager, MAWTS, Dhaka  
Mr Kamrul Hossain, Manager NGO Coordination, IDE, Dhaka  
Mr Mominul Islam, Asstt. R&D and Training Manager, IDE, Dhaka  
Mr Terence Cardoza, Regional Manager, IDE, Natore  
Mr Sakhawat Hossain, NGO Coordinator, IDE, Natore



## 11. REFERENCES

The following is list of some books and reports consulted in connection with preparation of this report.

1. 'Hand Pumps', (A handbook, technical paper series by UNEP and WHO), International Reference Centre for Community Watersupply, The Hague, Netherlands, May 1977
2. 'The Treadle Pump', (A book on manual irrigation for small farmers), by Alistair Orr, ASM Nazrul Islam and Gunnar Barnes, Rangpur Dinajpur Rural Services (RDRS), Dhaka, July 1991.
3. 'Mini Tara and Tara', (Tests report), By John Keen, CA Research and Testing Centre, Milton Keynes, UK, July 1995
4. 'Bangla Deep Well Pump', (Seminar presentation paper), by M Maqbul Hossain, Grameen Trust, Dhaka, April 1995
5. 'Treadle Pump Based Irrigation for CDP Crops', (Presentation paper) by Md. Harun-ur Rashid, CEA/CDP, Dhaka, August 1994
6. 'Study to Forecast Declining Groundwater Level in Bangladesh', (Study report for UNICEF and DPHE), by E P C and Mott MacDonald Ltd. U K, June 1994

## 12. ANNEXURE

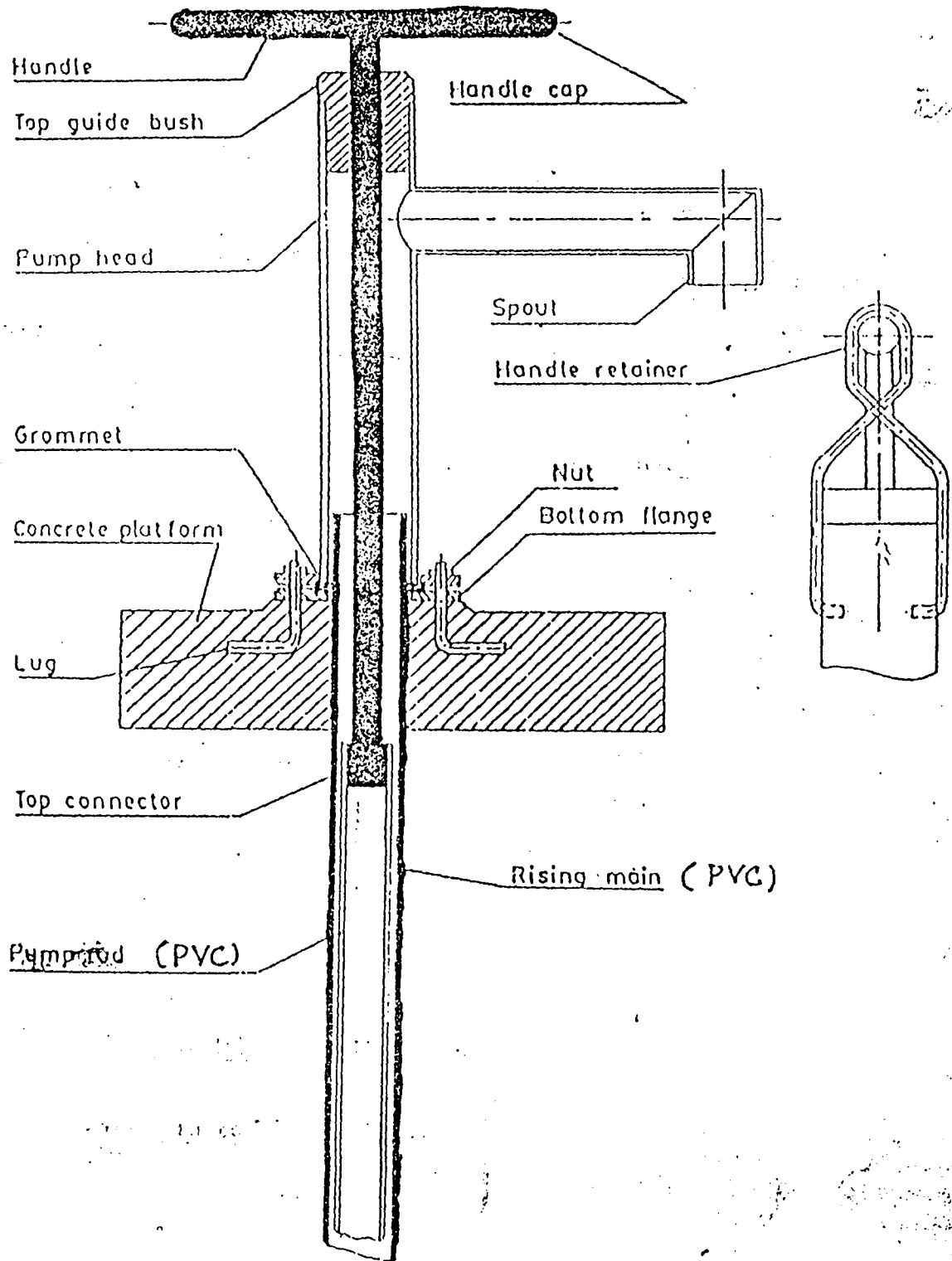
The following Annexure are included in end of this report for elaborating some of the aspects described in the main report.

- |              |   |
|--------------|---|
| Annexure-I   | A sketch of the Standard Tara Pump.               |
| Annexure-II  | A sketch of the Moon Pump and the estimated cost. |
| Annexure-III | A sketch of the Bangla Pump.                      |
| Annexure-IV  | A simple sketch of the Treadle Pump.              |
| Annexure-V   | Sketches of the Bucket Pump and Chain Pump.       |

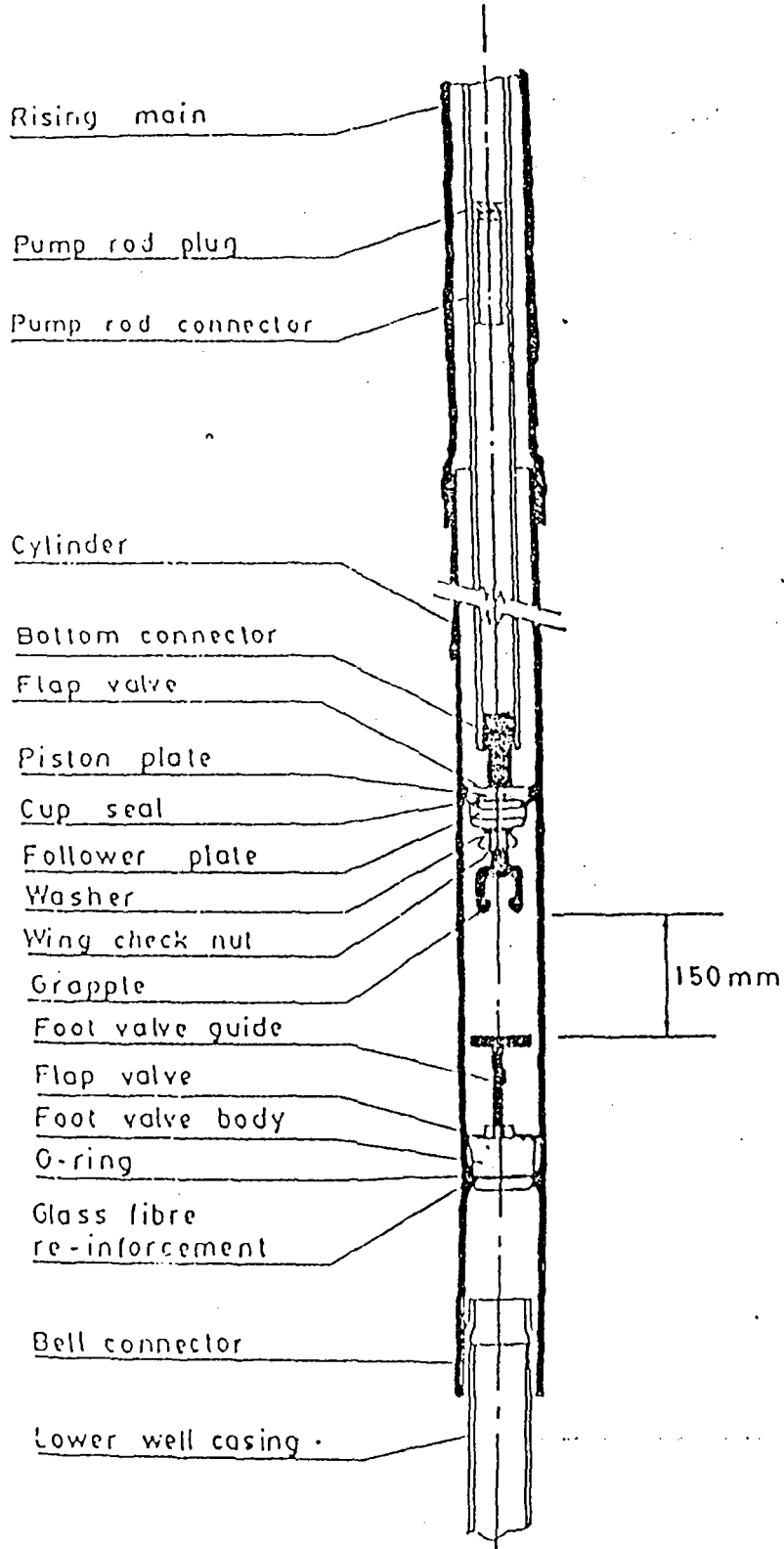
RI\LWT-PUMPS

ANNEXURE-I  
A SKETCH OF THE STANDARD TARA PUMP

TARA PUMP SYSTEM DRAWING  
(STANDARD MODEL)

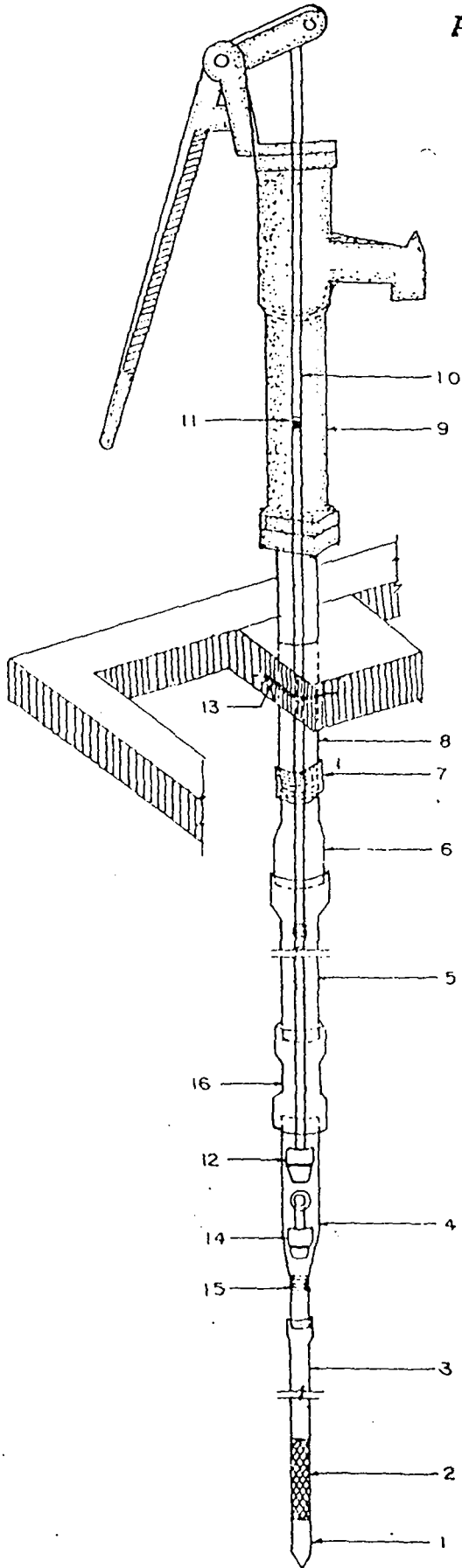


TARA PUMP SYSTEM DRAWING  
(Standard Model)



ANNEXURE-11

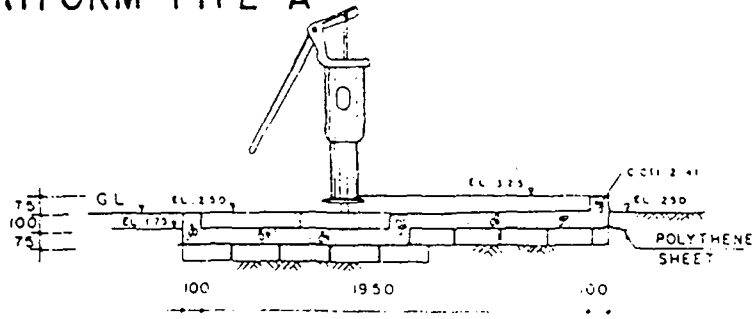
A SKETCH OF THE MOON PUMP  
ALONG WITH THE ESTIMATED COST



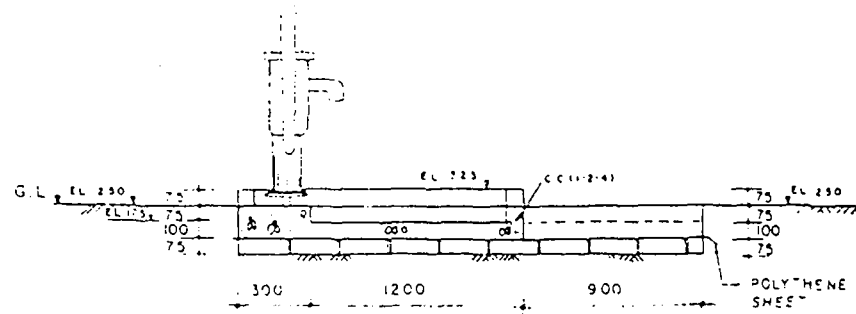
MOON PUMP.		
DESCRIPTION OF MATERIALS		
SL.NO	ITEM	QUANTITY
1.	38 mm $\phi$ PVC SAND TRAP.	0.76 m
2.	38 mm $\phi$ PVC STRAINER.	4.00 m
3.	38 mm $\phi$ PVC PIPE.	57.75 m
4.	75 mm x 38 mm $\phi$ PVC CYLINDER	2.00 m
5.	75 mm PVC PIPE	3.00 m
6.	75 mm PVC MALE ADAPTOR	0.15 m
7.	75 mm G.I. SOCKET	1 SET.
8.	75 mm G.I. PIPE	0.5 m
9.	HAND PUMP NO-6 WITH 75mm THREADED BASE.	1 NO.
10.	13 mm PISTON ROD	6.50 m
11.	13 mm THREADED SOCKET (50mm)	2 NO.
12.	PISTON ASSEMBLY WITH GRAPPLE.	1 SET.
13.	13 mm M.S. BAR 0.15 m LONG	4 NO.
14.	FOOT VALVE ASSEMBLY	1 SET.
15.	38 mm PVC NIPPLE 150mm LONG	1 NO.
16.	38 mm PVC STRAIGHT COUPLING	1 NO.

DUTCH AIDED 18 DTP, DPHE.			
MOON PUMP			
DATE	DESIGNED BY	CHECKED BY	SCALE
14-10-96	AT.	MALLIK	NOT TO.

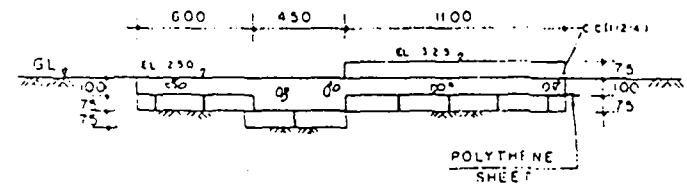
PLATFORM TYPE-A



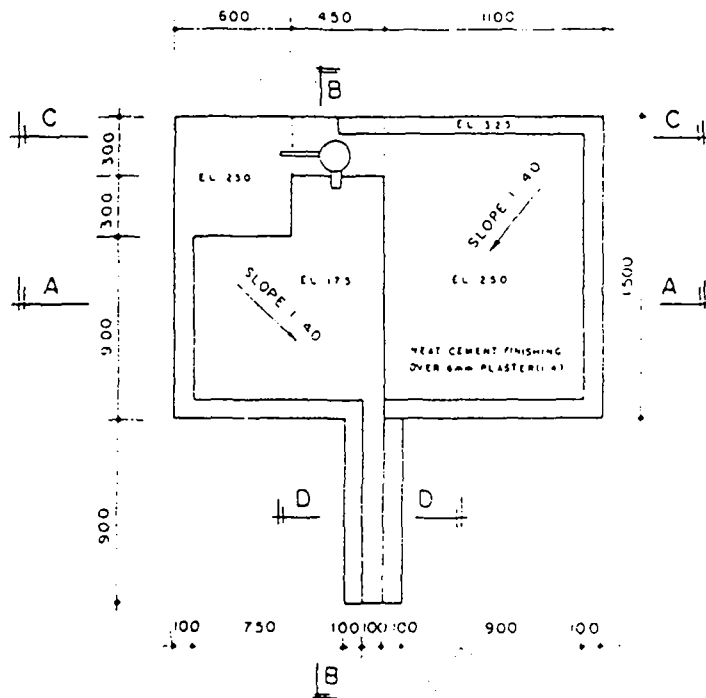
SECTION A-A



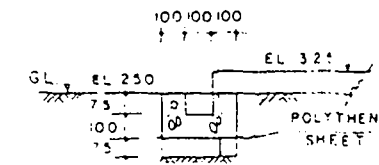
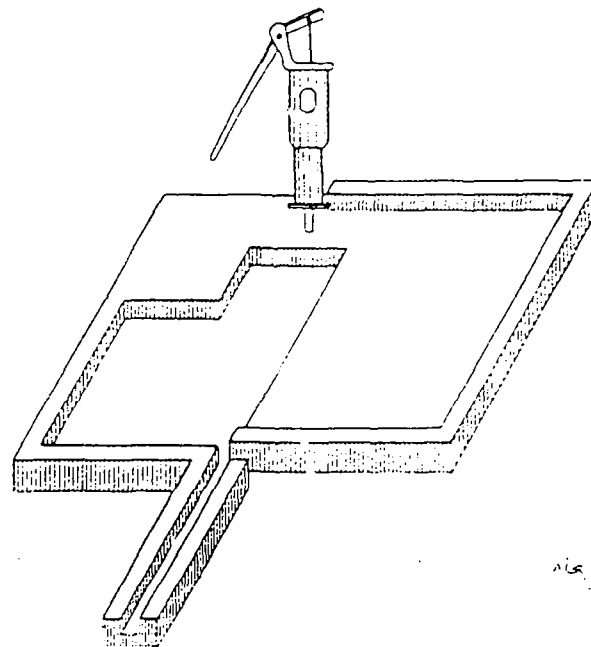
SECTION B-B



SECTION C-C



PLAN



SECTION D-D

*Handwritten notes:*  
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 14/10

Dimensions are in mm

DPHE 18 DISTRICT TOWNS WATER SUPPLY  
 DRAINAGE & SANITATION PROJECT  
 TWO FOLD PLATFORM FOR NO. 6 PUMP  
 SCALE: 1:25 | DESIGNED BY: J.R. GUAR...  
 DATE: 09.06.93 | DRAWN BY: MANU...

**Detail Estimate for Installation Hand Tube well  
(Moon pump) at Manikganj Pourashava under 18 DTP.**

Average depth = 67.00m

Fund Type: 18 DTP, RPA, Category B

Sl. No.	Item of work	Qty.	Unit	Mat. Rate Tk.	Lab. Rate Tk.	Mat. cost Tk.	Lab. cost Tk.	Total Tk.
01	Transportation of moon hand pump tube well's, const. materials, equipments, tools & plants, boring pipes etc. including supplying to the work site, const. of the derrick & dismantling the same, cleaning the site on completion of the work, etc. all complete as per specifications and direction of the E/C.	1	L.S	0.00	130.00	0.00	130.00	130.00
02	Boring by using required dia G.I. pipes and other equipments capable of drilling up to the required depth by water jet system or sludge method or any other suitable approved method through all sorts of strata, protection of caving by supplying and installation of necessary casing pipe collection of soil samples at every 3m interval & every change of strata and preserve the soil samples for analysis, withdrawal of boring and casing pipes, etc. all complete as per specifications & direction of the E/C.							
	a) From 0m to 7m	7	p/m	0.00	42.00	0.00	294.00	294.00
	b) From 7m to 37m	30	p/m	0.00	35.00	0.00	1050.0	1050.0
	c) From 37m to 67m	30	p/m	0.00	40.00	0.00	1200.0	1200.0
03	Supplying and lowering 75mm PVC/G.I. 38mm PVC pipes, PVC robe screens up to the desired depth including supplying, fitting & fixing pump head assembly, handle assembly, piston assembly, bottom connector, foot valve assembly, m cylinder assembly, straight coupling, solvent cement etc. all complete as per specifications & direction of the E/C.							
	a) <u>pump head assembly pump no. 6, RFL heavy duty.</u>	1	each	870.00	27.00	870.00	27.00	897.00
	b) <u>Piston assembly &amp; bottom connector</u> Bottom connector bush, flap valve, piston plate, Leather cap seal, flower plate, washec, wing check nut, grapple, 13mm H.S. bar (6.50m)	1	set	340.00	35.00	340.00	35.00	375.00
	c) <u>Foot valve assembly</u> foot valve Guide, foot valve body, o ring	1	each	63.0	5.00	63.00	5.00	68.00
	d) 75mm dia G.I pipe (2 side threaded)	0.5	p/m	480.00	50.00	240.00	25.00	265.00

**Detail Estimate for Installation of Hand  
Tube well (Moon pump) at Manikganj under 18 DTP.**

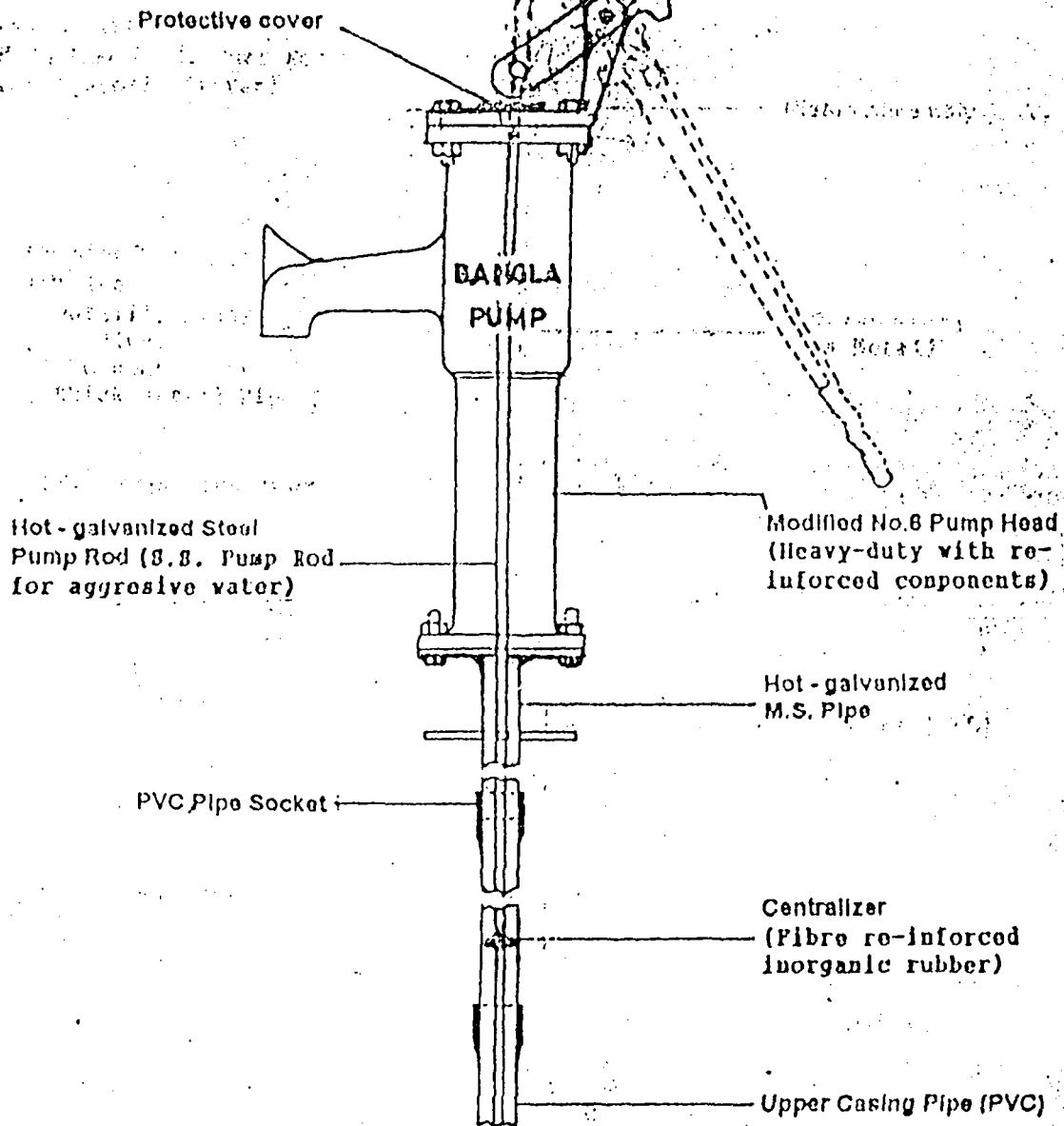
Average depth = 67.00M

Fund Type: RFA

Sl No	Item of work	Qty.	Unit	Mat. Rate Tk.	Lab. Rate Tk.	Mat. cost Tk.	Lab. cost Tk.	Total Tk.
	e) Cylinder assembly (2m)	1	each	260.00	22.00	260.00	22.00	282.00
	f) 13mm coupling socket	2	each	11.00	2.00	22.00	4.00	26.00
	g) 75mm PVC pipe, B class	3	p/m	80.00	16.00	240.00	48.00	288.00
	h) 38mm PVC pipe, D class	57.74	p/m	55.00	5.50	3175.70	317.57	3493.27
	i) 38mm PVC robo screen of recommended slot size	4.00	p/m	90.00	9.00	360.00	36.00	396.00
	j) 38mm PVC sand trap with cap	0.76	p/m	55.00	9.00	41.80	6.84	48.64
	k) 75mm PVC male adppter (0.15m) , Lira	1	each	66.00	12.00	66.00	12.00	78.00
	l) Solvent cement (50gm tube, Japan)	1	each	0.00	84.00	0.00	84.00	84.00
	m) 75mm G.I Socket	1	each	82.00	10.00	82.00	10.00	92.00
	n) 13mm socketed G.I grapple hook for lifting foot valve	1	each	45.00	10.00	45.00	10.00	55.00
	o) 75mm PVC straight coupling	1	each	66.00	12.00	66.00	12.00	78.00
04	Complete development of the well by continuous pumping for at least 12 hrs. or until water is completely sand & turbidity free at a satisfactory yield etc. all complete as per specification & direction of the E/C.	1	L.S	0.00	150.00	0.00	150.00	150.00
05	Construction of 1:2:4 cement concrete tube well platform including supply of 19mm down graded first class picked jhama brick chips, sand of FK 1.6 free from clay and other organic matter fresh portland cement (4 bags), casting in place, finishing, curing including supply of formwork, etc. all complete as per specifications, drawings and direction of the E/C.	1	L.S	0.00	2400.0	0.00	2400.0	2400.00
Estimated cost for one HW						5871.50	5878.41	11749.91

Note : a) Materials cost means cost of departmental supplied materials.  
b) Labour cost means Contractor,s materials cost and Labour cost.

**ANNEXURE-III**  
**A SKETCH OF THE BANGLA PUMP**

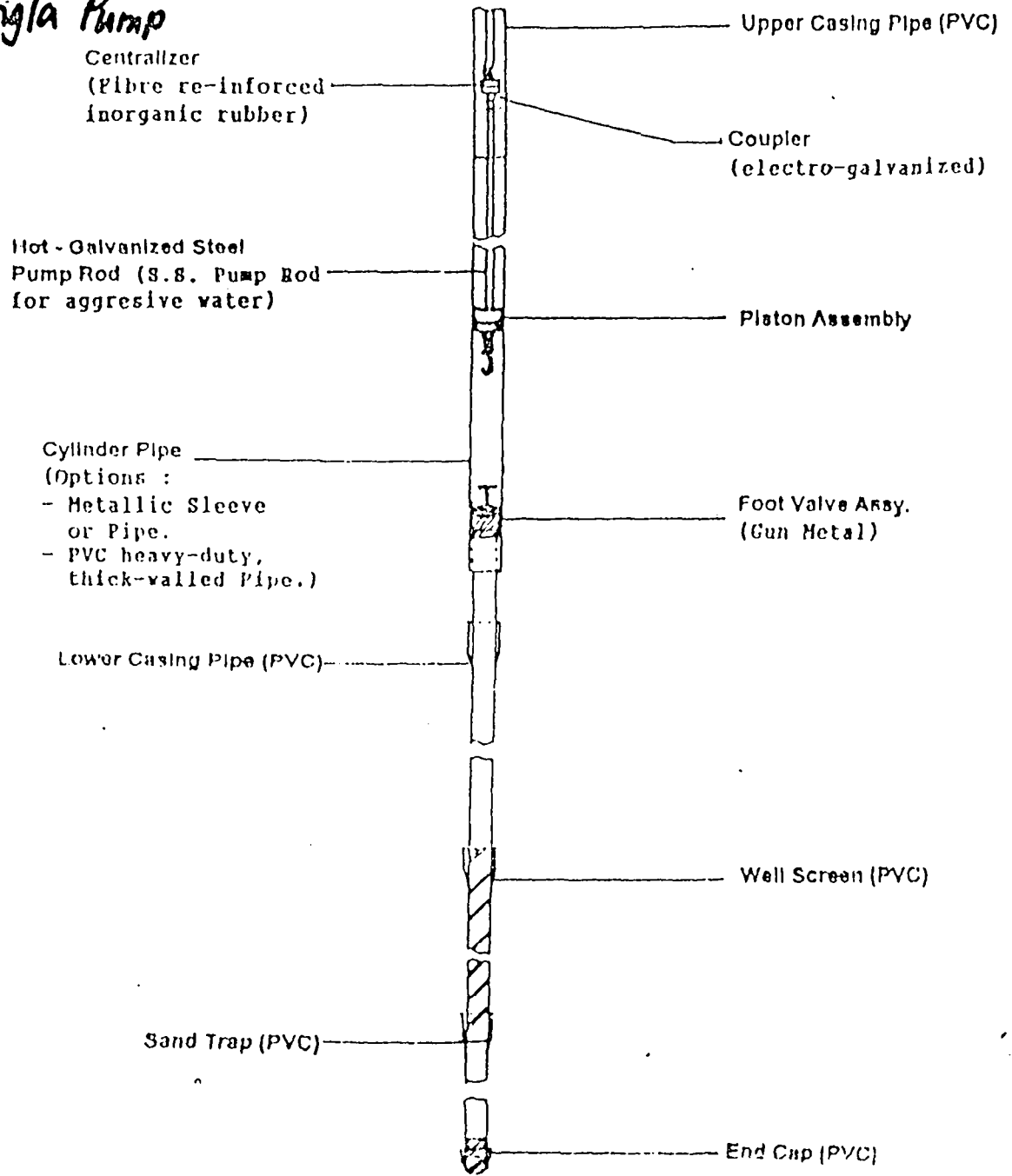


Material	Scale	Bangla Deep Well Pump	
		Pump Assembly	
Designed by	M.M. Hossain	Drawing No.	Date
Drawn by	M. Haque		

*M. Haque*



# Bangla Pump

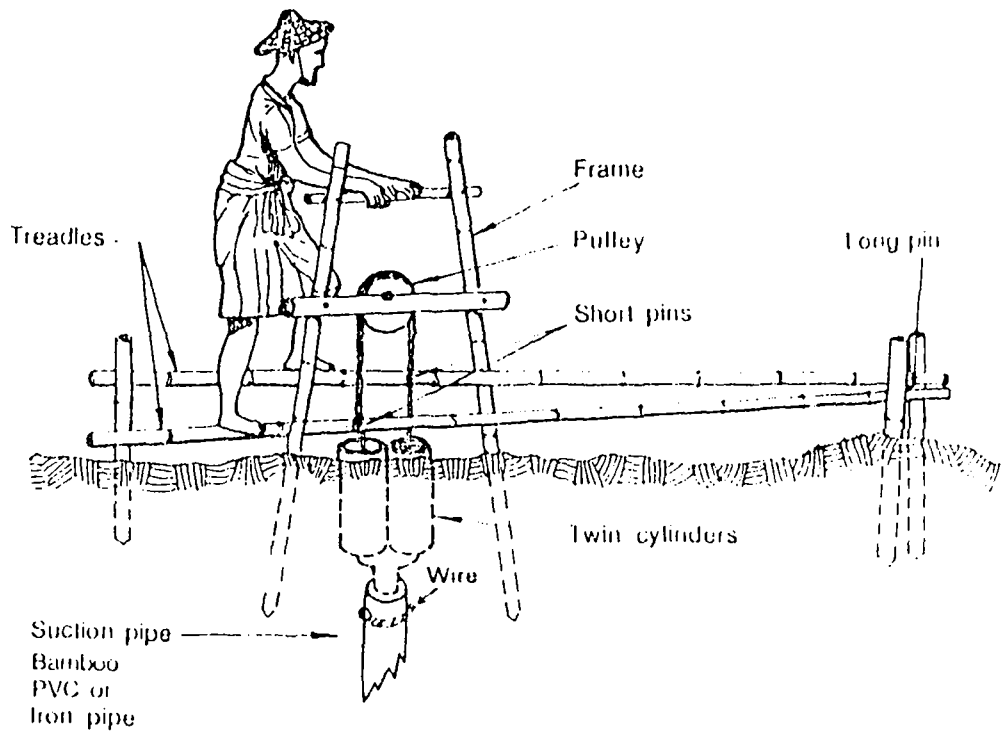


Material	Scale	Bangla Deep Well Pump	
		Pump Assembly	
Designed by	M.M. Hossain	Drawing No.	Date
Drawn by	M. Haque		

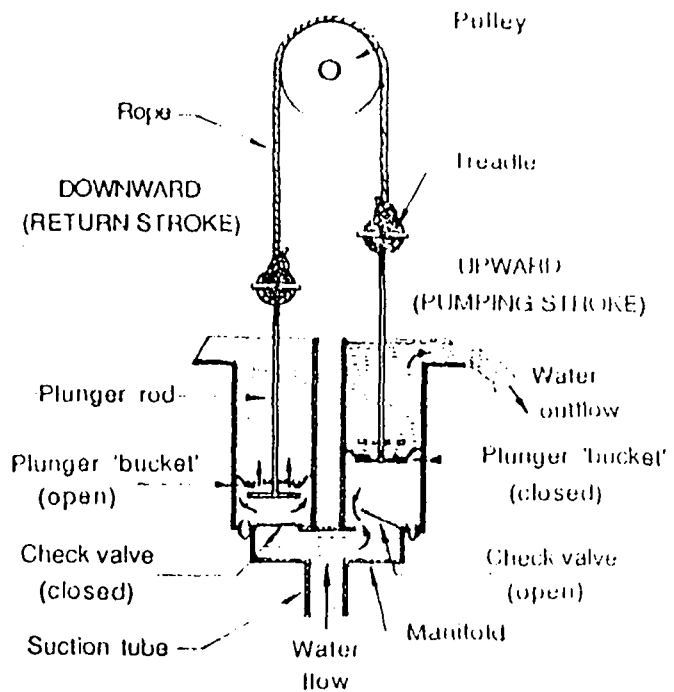
ANNEXURE-IV

A SIMPLE SKETCH OF THE TREADLE PUMP

SUPERSTRUCTURE

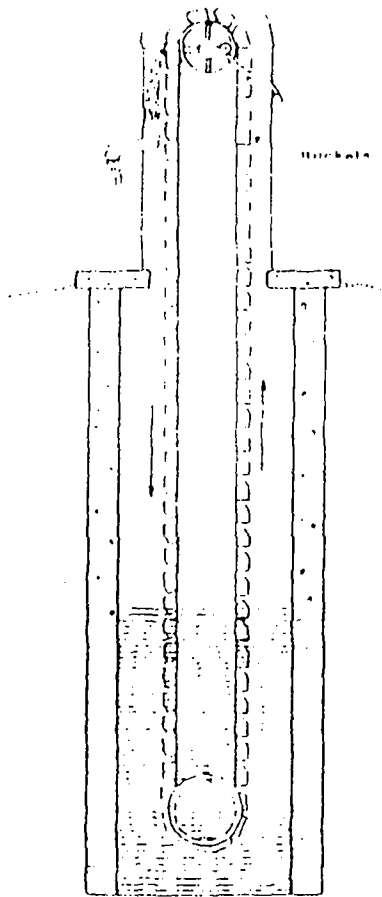


PUMPHEAD

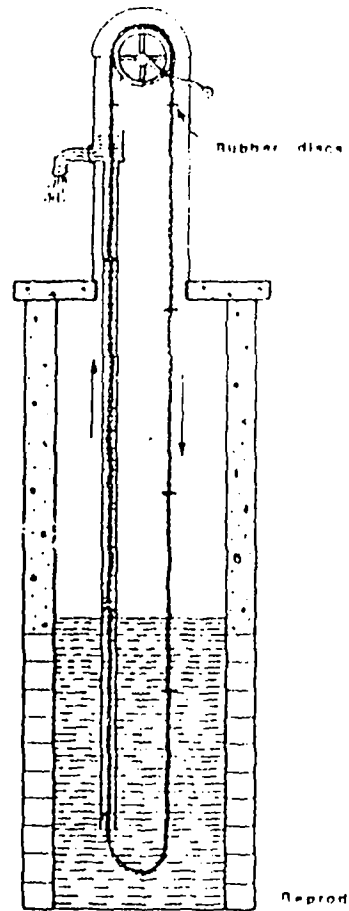


: Schematic diagram of treadle pump superstructure and pumphead

ANNEXURE-V  
SKETCHES OF BUCKET PUMP AND CHAIN PUMP



BUCKET PUMP



CHAIN PUMP

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