UNITED NATIONS

ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC

Report on Advisory mission to Bangladesh on accelerated local manufacture of handpumps for rural water supply

Bangkok - Thailand
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This report was prepared by the principal mission member Mr. H.V. Krishnaswamy, a consultant engaged by ESCAP for this purpose. The opinions expressed here are entirely those of the consultant and they do not reflect the views of ESCAP-United Nations. The statistics cited in the report were obtained by the consultant through his discussions with the country representatives he met during his mission to the country.

This report is issued without formal editing.

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/3.5 Handpumps

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1. INTRODUCTION

1.1 Background information

1.1.1 Almost all the developing countries in the Asian and the Pacific regions, not to mention the countries of the African region, have, for decades, adopted the handpumps - both for shallow and for deep wells - as one of the facilities in their Rural Water Supply Programmes, for drinking and domestic needs of the rural millions. The importance of handpumps in providing the basic necessity of drinking water for the village and rural communities is getting increasing attention of planners all over the world. Serious efforts have been planned by the Governments in achieving the goals of the International Drinking Water Supply and Sanitation Decade (IDWSSD) programmes. Various United Nations bodies have also been involved in IDWSSD in assisting developing countries for the achievement of these goals.

1.1.2 The Inter Agency Task Force for Asia and the Pacific, Bangkok, at its meeting, opined that there perhaps was a need to accelerate the manufacture of handpumps for implementing rural water supply schemes in the ESCAP regional developing countries and requested ESCAP to initiate a project to assist these countries on assessment of handpump requirements and to improve and if necessary increase and/or accelerate their production.

1.1.3 The ESCAP Secretariat responded to this request by organising a roving advisory mission to selected member countries which indicated their willingness to accept the Mission to conduct a survey with emphasis on handpump manufacture and covering other points relating to handpump on procurement, quality control, installation and maintenance.

1.1.4 The Mission visited Dhaka, Bangladesh from October 27, 1985 to October 31, 1985.

/1.2 TERMS OF

1.2 TERMS OF REFERENCE OF THE MISSION

The Terms of Reference of the Mission, are attached to this report as Annex I.

1.3 COMPOSITION OF THE MISSION

The Mission comprised of the following member:

(i) Mr. H.V. Krishnaswamy, Consultant, ESCAP, Bangkok

1.4 PROGRAMME OF VISITS:

The Mission prepared a standard format for the collection of information during the visit to Dhaka, Bangkok.

The itinerary of the Mission was as follows:

27 October 1985
- The Chief Engineer, Department of Public Health Engineering (DPHE).
  The Superintending Engineer (Planning Circle), DPHE.
- WHO Programme Co-ordinator, Dhaka.

28 October 1985
- The Joint Secretary, L.G. Division, Ministry of LGRD & Co-operatives, Government of Bangladesh.

29 October 1985
- Executive Engineer, MOSTI & Stores Division
- Visit to 3 Handpump Manufacturers - ASB Engineering Works, Comilla Engineering, Essential Products Ltd.

30 October 1985
- Superintending Engineer, PHE, Stores Circle & Executive Engineer, PHE, MOSTI. Visit to handpump site

31 October 1985
- Final discussions with Chief Engineer, DPHE
- Visit to pump manufacturer - Mirpur Agricultural Workshop & Training School, Dhaka.

/1.5 PROCEDURE

1.5 PROCEDURE ADOPTED BY THE MISSION

At each place visited, a joint meeting was held with representatives of agencies concerned to explain the objectives of the Mission as well as to collect relevant data. As the time of each visit was brief, the information gathering was through discussions at the joint meetings at which the agencies dealing with rural water supply programmes, were represented. On the last day the Mission had a final joint meeting with the Chief Engineer, Department of Public Health Engineering, Dhaka.

1.6 SCOPE OF THE MISSION

1.6.1 In carrying out the Mission, the member concentrated on problem areas in handpump technology. These were not limited only to technical aspects of the handpumps but included procurement procedures, manufacture, installation and maintenance of handpumps, all of which are inseparable links in the ultimate objective of handpumps giving continuous supply of potable drinking water to rural people. At the same time, due attention was given to any successful experience of the country which might be used to advantage by other developing countries in the region.

1.6.2 The Mission did not limit itself to the present contract of the components of the programmes but used a comprehensive approach.

1.7 ACKNOWLEDGEMENTS

1.7.1 This Mission member is sincerely grateful to all officials who co-operated with him, answered patiently his questions and provided the required information. He also deeply appreciates all the kindness, courtesies and the warm hospitality extended to him, which made his stay in the Country a delightful experience.

2. GENERAL

2. GENERAL VIEWS AND RECOMMENDATIONS

2.1 Current practice

2.1.1 There is one Government agency i.e. Department of Public Health Engineering, which is responsible for implementing Rural Water Supply Schemes, throughout Bangladesh.

2.1.2 The shallow well handpump has been a major source of water supply for drinking and other needs of rural population.

2.1.3 In Bangladesh, power pumps and handpumps are extensively used for drawing ground water for irrigation. This has resulted in a serious situation of ground water table going down, depleting water for shallow tube wells. Thousands of shallow tube wells need to be replaced by deep set handpumps. But development of a deep set handpump is not complete.

2.1.4 In the manufacturers' works, quality control assurance and quality control methods are not compulsorily adopted. Jigs and fixtures are not used to the required degree. Records are not kept for rejected/accepted items. Endurance test and performance test on handpumps do not appear to be carried out.

2.1.5 The handpump is a machine and like any other machine, requires to be kept clean and parts periodically inspected for formation of rust, loose bolts and nuts and also for replacement of missing parts in time to prevent major breakdown. At the same time the handpump is a special type of machine, unlike others in a covered machine shop, open to regours of weather and subject to rough handling and continuous use by unskilled rural folk without any trace of technical knowledge or competence. Therefore it is all the more necessary to treat the handpump as an extra-ordinary machine and proper maintenance is of utmost importance. Also training programme on installation and maintenance of handpump, on a regular basis, at the level of village caretaker and supervisors and engineers, is a a must. There does not appear to be any Code of Practice for installation and maintenance of handpumps - shallow well, deep set tube well and deep well - at the national level, applicable uniformly throughout the nation.

/2.2 RECOMMENDATIONS:

2.2 RECOMMENDATIONS:

After reviewing the status and the need for a more comprehensive approach on handpump technology in Bangladesh the Mission recommends the following points.

2.2.1 At the moment it appears that there is not much need to increase the capabilities of manufacturing handpumps, as the manufacturers have indicated that their production capacities are much higher than the present demand as well as the projected demand, under the III Five Year Plan, for 1985-1990.

2.2.2 There is a need to identify one or two more handpump models for deep set tube wells which are required in great numbers to replace shallow well handpumps.

2.2.3 The quality control should be more vigourously pursued and insisted upon at the manufacturers' shops.

2.2.4 There is a need for the preparation, at national level, of codes of practice for installation and maintenance of different types of handpumps, giving step-by-step procedures with diagramatic sketches.

2.2.5 Standardised handpump training programmes for persons at various levels who are involved in the implementation of handpump schemes, should be periodically conducted.

3. REPORT ON BANGLADESH

3.1 General information:

3.1.1 About the country: Bangladesh has an area of 55,598 square miles. It is a flat country with predominantly alluvial soil. Most of the country has very shallow ground water table (10 feet to 25 feet) with large number of rivers and rivulets with heavy monsoon (average 100 inches annually). Unfortunately this boon brings about heavy flood damages every year during monsoon, one-fifth of the country

/remaining under

remaining under water after monsoon, for about three to four months. The country has 64 districts. The population of the country is about 98.1 million out of which 85.3 million live in rural areas.

3.1.2 General habits of local people in respect of utilisation of water for drinking and other domestic purposes:

3.1.2.1 The rural settlements are mostly scattered groups of houses surrounded by agricultural land. Some of these groups have one or two ponds and sometimes ring wells that provide water for drinking and other purposes, where there are no tube wells. The settlements that are situated along the river banks use river water for all purposes in absence of tube wells. The Government of Bangladesh had selected the provision of handpump tube-wells as the best possible solution for providing safe water to the people, taking into account the hydrogeological condition, settlement pattern and poor economical conditions of the people.

3.2 RURAL WATER SUPPLY SCHEMES

3.2.1 General:

3.2.1.1 At the time of partition of India in 1947, this part of India, which was then known as East Bengal, inherited a total of about 50,000 public wells. Since then, till liberation of Bangladesh by end 1971, in 24 years, a total of 135,000 additional wells were installed. Service levels vary quite considerably throughout the country. There is, therefore, the need for adopting different types of facilities to meet the needs of different areas, some of which are inexpensive and easy to implement and others are more costly and far more difficult to handle. The more significant facilities are (a) Shallow tubewellls, (b) Deepest handpumps, (c) Deep tubewells, (d) Very shallow shrouded wells, (e) Sand filters, (f) other systems like dug wells, gravity system for hilly area and very deepest wells for the Chittagong Hills and Barind Tracts.

/3.2.1.2 Shallow

3.2.1.2 Shallow tubewells are easy to sink and uses a shallow well handpump. This type of pump can only lift water from 7 metres below ground and not beyond. Such areas where water table is less than 7 metres below ground, throughout the year, represented 68 per cent of the country in 1980. It is anticipated that they will reduce in area to 53 per cent by 1990 and to 33 per cent by the year 2000. This dramatic reduction is being caused by the very large and increasing ground water and surface water extraction for agricultural purposes through power pumpsets and handpumps. The implication of this drop in water table is that very large numbers of existing shallow tube wells are going out of operation.

3.2.1.3 Deep set handpumps are used where water table is beyond 7 metres and upto about 30 metres. These pumps are expensive and require a mobile team for maintenance. Deep set area covered 15 per cent of the population in 1980, 20 per cent in 1985 and expected to rise to 30 per cent by 1990, and 50 per cent by the year 2000.

3.2.1.4 Deep tubewells go beyond 250 feet below ground level but static water table is within 7 metres. The casing pipe and strainer goes down to the bottom, whereas the cylinder is in the above-ground pump body itself, unlike in deepset handpumps. By 1985, the population coverage was about 38 per cent based on one well for 250 people, or 11.5 per cent based on one well for 75 people. Because of special skill required for sinking, the number of deep tubewells are limited. As the ground water table is going down, necessity has arisen to use deepset handpumps replacing shallow well handpumps, though deepset handpumps are costlier by 4 to 5 times the cost of the shallow pumps. Paucity of funds is the serious problem in the programme for replacement. In Bhola area which is an island of about 40 square miles there are about 600 wells working with handpumps and depths vary from 700 feet to 1200 feet. Island is surrounded by saline water and the pumps are shallow well. Static water level is near the surface. The soil here is clay mixed with sand upto about 700 feet.

3.2.1.5 The Department

3.2.1.5 The Department of Health was started in 1941 when it was called Bengal Public Health Engineering. After Bangladesh was born, Department of Public Health Engineering (DPHE), under the Ministry of Local Government, Rural Development and Co-operatives, became the agency for the implementation of the tubewell programme which includes construction of tubewells with handpumps, rapair and maintenance of all tubewells and handpumps, to ensure that safe water is available to the communities at all times. DPHE is responsible for supply of drinking water and sanitation all over Bangladesh except for Dhaka and Chittagong metropolitan cities. From 1973, the ground water table has been going down due to deviation of Farakka river water and also due to the extensive use of shallow wells for irrigation. It is already declared geographically that in one-fifth of the country, the water table has gone down from shallow to deep depths. The situation is deteriorating.

3.2.1.6 The Government target for the International Drinking Water Supply and Sanitation Decade is to reach a coverage of 77 per cent of the rural population. As per this target, there would be about one million tube wells fixed with handpumps in the country by 1990.

3.2.2 Procurement of handpumps by Government Agencies:

3.2.2.1 The total handpumps for shallow well, deep tubewells and deepset tubewells procured and installed by the Government agencies for Rural Water Supply Schemes, from the beginning upto end 1984, in Bangladesh, is as follows:

	Period	Shallow Tube Wells	Deep Tube Wells	Deepset Tube Wells	Total
1)	Pre 1972	196,110	7,530	750	204,390
2)	1972-1980	240,700	5,250	3,170	249,120
3)	1980-1984				
	i) New Wells	136,273	3,651	4,571	144,495
	ii) Resinking Wells	30,727	-	-	30,727
4)	1984-1985				
	a) New Wells	31,230	495	430	32,155
	b) Resinking Wells	12,861	-	-	12,861
	Total:	647,901	16,926	8,921	673,748

/3.2.2.2 UNICEF

3.2.2.2 UNICEF has assisted in the above programme since 1972 in the form of supply of pipes, strainers, pig iron, coke, cement, vehicles, etc. all of which were imported items. Pig iron and coke were imported to enable local foundries to manufacture handpumps. UNICEF also provided assistance for short term training of 100 Assistant Engineers, 500 Sub Assistant Engineers and 1600 Thana Tubewell mechanics and technical advice in planning, implementation and maintenance of rural watter supply schemes. The resinking of wells referred above relate to choked and damaged handpump tubewells, in order to improve the availability of potable drinking water in rural areas.

3.2.2.3 Shallow well tubewells with handpumps are also used for irrigation purposes. UNICEF started with about 90,000 shallow well handpumps for irrigation during 1975-1978. This project was found to be successful. Subsequently Bangladesh Agricultural Development Corporation (BADC) took over handpump projects for irrigation. BADC purchased 185,620 shallow well handpumps between 1979-1982 under USAID agency for irrigation, and closed it in 1982. Then, in June 1982, International Development Authority (IDA) came into the picture when IDA assisted hand tubewell project for irrigation plan, was taken up. Under this plan, 270,000 handpumps have to be installed out of which 140,000 have already been procured. The procurement of balance 130,000 numbers is expected to be done in 1985-86 and 1986-87. The project name is called MOSTI which stands for Manually Operated Shallow Tubewells for Irrigation. These programmes come under Bangladesh Rural Development Board (BRDB). In this programme, the role of DPHE is engineering side which includes procurement, manufacture of handpumps and controlling the quality, whereas the role of BRDB is distribution.

3.2.2.4 For the needs of drinking water, private bodies also directly buy and install shallow well handpumps. The number of handpumps installed so far in the country is estimated to be about 500,000 numbers.

/3.2.3 Future Plans

3.2.3 Future Plans involving handpumps for Rural Water Supply Schemes:

3.2.3.1 It has been proposed by the Ministry of Local Government that 70 per cent of the rural people should be covered for supply of drinking water during the Third Five Year Plan 1985-1990. The type of tubewells to be provided is as follows:

- Shallow tubewells : It is proposed tha- 10,000 wells per year are to be constructed for the Plan period. The total of 50,000 shallow tubewells fitted with handpumps, will cover, by 1990, approximately 80 per cent of the rural population, based on one well for 75 people.

- Deepset wells : To achieve 70 per cent coverage by 1990, it would be necessary to place nearly 412,000 wells which is found to be not possible. The handpump for this tubewell has not been fully identified, though the TARA pump has been developed which, however, has to be field proven and acceptable to rural communities. Further, production capacities for TARA pump manufacturing to meet the big needs of 80,000 pumps per year, as well as training needs in sinking technology and caretaker maintenance, have not been geared to. Therefore, DPHE estimates that upto 105,000 deepset handpumps could be placed by 1990, contingent on smooth administrative arrangements and availability of funds. The provision of 108,000 units by 1990 together with the existing 9,000 traditional deepset hand tubewells, cover about 19 per cent of rural population, very much short of the proposed 70 per cent. However, DPHE's projection is that by the year 2000, about 500,000 deepset pumps, representing 70 per cent coverage would have been placed.

- Deep tubewells : To achieve 70 per cent coverage by 1990 in areas covered by deep tubewells (based on one well for 250 people), about 15,000 additional wells with handpumps are needed. If the assumption is changed to one well for 75 people, the installation of 15,000 handpumps in 5 years from 1985 to 1990, would only cover 21 per cent of rural population.

- Resinking : It is proposed to resink a total of 100,000 wells during the Third Five Year Plan, to replace wells with handpumps which have choked and/or gone out of operation.

/3.2.3.2 The total

3.2.3.2 The total number of handpumps required by the Government Agency DPHE for fulfilling the targets of Third Five Year Plan 1985-1990 is summarised below:

Shallow Well Handpumps	50,000 Nos.
Deepset Handpumps	105,000 Nos.
Deep Tubewell Handpumps	15,000 Nos.
Resinking	100,000 Nos.
Total:	270,000 Nos.

On an average, about 54,000 handpumps are required per year for the next 5 years.

3.2.3.3 IDA assisted MOSTI project has to purchase about 130,000 Shallow well handpumps for irrigation in the two years 1985-86 and 1986-87. The per year requirement is therefore about 65,000 shallow well handpumps.

3.2.3.4 The public and consumers also, in addition to the above Government procurement, purchase handpumps directly from the manufacturers, which, on an average, can be assumed to be about 50,000 per year.

3.2.3.5 The approximate requirements of handpumps per year from 1985 onwards is:

DPHE purchase for rural water supply schemes	54,000 Nos.
For irrigation	65,000 Nos.
Public and consumers	50,000 Nos.
Total:	169,000 No.

3.3 Handpumps used in Bangladesh:

3.3.1 Tubewells fixed with handpumps, are the main sources of safe water for drinking and domestic use, in the rural areas of Bangladesh, where nearly 90 per cent of population live. Based on the projections given in Third Five Year Plan for achievement by 1990, for rural water supply under Government Schemes, there would be about one million tubewells fixed with handpumps in the country.

/Taking into

Taking into account the handpumps extensively used for irrigation and the installation of handpumps by private bodies, another one million handpumps would be in position by 1990. Perhaps the use of handpumps in such a gigantic scale in Bangladesh, is nowhere to be compared in any part of the world. The handpumps, therefore, plays a very significant and important role in the life-style of the population of Bangladesh. The type of handpumps used depend upon the depth of ground water availability. There are three types of handpumps used with the tubewells in Bangladesh: Shallow tubewell handpumps, deepset tubewell handpumps and deep tubewell handpumps.

3.3.2 Shallow tubewell handpumps:

Shallow well handpumps have been in use in Bangladesh for the past several decades. 'HYDARI' 'MAYA' are but a few types of handpumps traditionally manufactured from the various foundries in existence.

3.3.2.1 'New No. 6' handpump:

With the emergence of 'Bangladesh Pump No. 6', the historical pumps like 'HYDARI', 'MAYA' etc. went out of existence. No. 6 pump has undergone an improvement after taking into account the deficiencies and a revised version called 'New No. 6' handpump has now emerged. It is the most widely used manually operated shallow well handpump. The cast iron body is sturdy. The maintenance and installation procedure is easy. It can lift water from depths upto 7-8 metres. This pump is provided with a moment giving mechanical advantage to the operator and minimising the effort exerted by hand to lift water. The cylinder is incorporated in the cast iron body. It is the most common type in use all over the country. It is used both in wells in deep and shallow aquifer.

3.3.2.2 Rower Pump:

It is mainly made of PVC components. The pump is installed at an angle of 30° to the ground level and suitable for pumping in standing/sitting position. It is fitted with a surge chamber on the vertical stem near to the foot valve enabling a smoother pumping operation. These pumps are mainly in operation in the districts of Comilla, Mymensingh and Feni. This pump is not sturdy and subject to abuse.

/3.3.2.3 Treadle

3.3.2.3 Treadle Pump:

It is a double acting suction pump with two cylinders operated by the padding action of the legs. Treadle pumps are made for irrigation to draw water both from tubewell and surface water. They lift the water upto ground level only, the cylinders being dug down in the field. This type of pump is mainly in operation in the districts of Rangpur, Dinajpur and Bogra. The main components of pumps are mild steel for pumphead, bamboo for frame and treadles, and pipe. It can draw water from depths varying from 3 feet to 18 feet.

3.3.2.4 'No. 4 Pump':

They are used in very shallow wells and in salinity problem areas with very shallow potable aquifer (15' to 35'). The capacity is small to prevent salt water intrusion by rapid depletion of fresh water aquifer. This is used mostly in coastal areas.

3.3.3 Deepset Tubewell Handpumps:

These pumps are used when static water level is between 7 metres to 30 metres. The cylinder is placed below the ground while the pump body is above the ground.

3.3.3.1 DPHE Deepset Force Pump:

This pump consists of PVC cylinder submerged under water and fitted with brass made plunger assembly and mild steel connecting rods. The pump super-structure is a replica of cast iron No. 6 pump, through which the connecting rod of the deepset passes and joins the lever giving mechanical advantage to the operator of the pump. It is in wide use in many parts of the country. It can draw water from depth of maximum 50 feet. It has been used to a limited extent because of high price.

3.3.3.2 TARA Pump:

It is a new type of deepwell reciprocating force pump made of PVC components. TARA pumps operate efficiently at places where normal shallow suction pumps do not work, for suction lift exceeding 25 feet and upto 50 feet. TARA pump does not have a lever

/like DPHE

like DPHE deepset pump, for operation. The operator has to stand close to the pump structure executing up and down motion of the handle of the connecting rod. About 200 pumps have been produced on a trial basis and installed for the last three years. The final results of its usefulness from all aspects are yet to be made.

3.3.4 Deep Tubewell Handpump:

These are wells deeper that 250 feet but use suction-type No. 6 handpumps. The water table is within 7 metres. They are usually used in saline areas where wells need to go deep in search of fresh water aquifers. They are expensive and take much longer time to install than shallow tubewells. The cylinder of these handpumps is in the pump body above ground, same as New No. 6 Handpump, but the casing pipe and strainer goes down.

3.4 HANDPUMP MANUFACTURING FACILITIES IN BANGLADESH:

3.4.1 There are nearly 132 foundries in the country involved in manufacturing various items of cast iron, brass, aluminium including handpumps. About 20 foundries have been prequalified to supply handpumps to P.H.E. IDA assisted HTW Project, and also for UNICEF/DPHE programme. These 20 companies have a minimum capacity (without extra shifts and without working extra hours in the normal shift) to produce about 480,000 handpumps per annum. The list of important handpump manufacturers with their capacities is given below:

(a) Companies who manufacture 'Bangladesh New No. 6' Handpumps:

		Approx. annual capacity:
1.	Essential Products Limited, Dhaka	50,000
2.	Engineers, Wood Steel Industries Ltd. Dhaka	30,000
3.	Unique Metal Industries, Dhaka	40,000
4.	Bangladesh Light Casting, Dhaka	40,000
5.	General Engineering & Foundry Work, Dhaka	30,000
6.	Ideal Casting Limited, Dhaka	40,000
7.	Masood Engineering Works, Dhaka	20,000
8.	Mohammedi Engineering Works Ltd. Dhaka	20,000
9.	Universal Engineering & Foundry Works, Dhaka	30,000
10.	Comilla Engineering & Casting Ltd., Dhaka	20,000
11.	National Iron Foundry & Engg. Works, Khulna	40,000
	Total: (About)	360,000

	Approx. annual capacity:
(b) Rower Pump:	
1. Mirpur Agricultural Workshop & Training School (MAWTS), Dhaka (About)	7,500
(c) Deepset cylinder:	
1. Speedy Plastics Limited, Dhaka (About)	500
(d) TARA Pump:	
1. Mirpur Agricultural Workshop & Training School (MAWTS), Dhaka	Being developed

3.4.2 In addition to the above, the following Companies are in the approved list:

(1) A.S.B. Engineering Works, Dhaka
(2) Balaka Engineering, Bhairab Bazaar
(3) BECO Industries Ltd., Dhaka
(4) Comilla Co-operative Karkhana, Comilla (under Government control)
(5) Janata Machine Tools Ltd., Jessore
(6) Kajal Parvez Metal Industries, Dhaka
(7) Mita Steel Foundry, Dhaka
(8) Mukta Engineering Works, Pabna
(9) Northern Engineering Works & Industries, Dinajpur
(10) Rangpur Foundry Ltd., Rangpur
(11) Tejgaon Engineering & Construction Co., Dhaka

The Mission visited the factories of M/s. ASB Engineering Works, Comilla Engineering, Essential Products and Mirpur Agricultural Workshop.

3.4.3 ASB Engineering Works has a foundry making cast iron parts. The pumps made here are also sold tc Bazaar for general public. They manufacture No. 4 pump, Conventional No. 6 Pump, New No. 6 Pump marketed as 'LUNA' make. The quality is checked by DPHE through a consultant. DPHE supplies hard coke and pig iron to such specification to produce pumps of required standard. This Company manufactures centrifugal pumps and also handpump spare parts.

/3.4.4 Comilla

3.4.4 Comilla Engineering and Castings Company which has a foundry, makes New No. 6 pumps, manhole covers, centrifugal pumps and rerolling mills. Spare parts for pumps are also done here. When UNICEF orders for handpumps, all materials including pig iron, hard coke, piston rod, spring, washers, bolts and nuts are supplied by UNICEF. Only the labour is involved by the manufacturer. The quality is checked by the buyer.

3.4.5 Essential Products Ltd. makes Pump No. 6 of traditional design as well as new model. This company also makes lathes, drilling machines, oil expellers, etc. The Mission was informed that the capacity of this plant is to make 10,000 handpumps per month and that they have achieved 6,000/7,000 pumps per month. They have a Quality Control group who report directly to management. The price of pump varies with weight of the pump depending on market intake. The variation in pump weight is 10 to 15 lbs. The demand for pumps starts from October and stays upto March. Pig iron is imported from Brazil and coke from U.S.A., Australia and China.

3.4.6 The Mirpur Agricultural Workshop and Training School (MAWSS) has made some TARA pumps (the only Company that is making TARA pumps), ROWER Pumps, Animal drawn harrows, doors and windows, hand sprayers, and also a full fledged Automobile Workshop. The Mission was told by the Company that they have made only about 200 TARA pumps on trial basis which have been installed in the field under world Bank Project. These 200 pumps also have had modifications and changes as the present manufacture is restricted for trial purposes only. They have not gone into regular production. TARA pump uses 2" cylinder with a stroke length varying from 1-2 feet. It delivers 7 gallons per minute at an average 30 strokes per minute.

3.5 HANDPUMP REQUIREMENT VERSUS MANUFACTURING CAPACITY IN BANGLADESH:

3.5.1 The approximate requirement of shallow well handpumps, deepset handpumps and deep well handpumps, as envisaged for Third Five Year Plan (1985-1990) for Bangladesh both rural water supply and irrigation, is about 169,000 numbers per annum as detailed in 3.2.3.5. The capacity currently available with handpump manufacturers

/in the country

in the country, as detailed in 3.4.1 is about 480,000 handpumps per annum. The conclusion, therefore, is that the capacity adequately exists with the present manufacturers for production of handpumps to meet the present and future requirements of the Government of Bangladesh, as well as private buyers. However, the Mission would like to make here a special emphasis on the following point.

3.5.2 Bangladesh is experiencing an unfortunate phenomenon of ground water table going down and down in about one-fifth of the country due to surface water and ground water being continuously and increasingly extracted for irrigation. As a result, thousands of shallow well handpumps are not drawing any water for drinking and domestic needs of the rural millions. These pumps are, in thousands, becoming non-operative. It has already been mentioned earlier that the shallow well areas which is about 68 per cent of the country in 1980 is anticipated to reduce to 53 per cent by 1990 and to 33 per cent by the turn of the century (Year 2000). The implications are very critical. This means that shallow well handpumps have to be replaced by deepset handpumps, in hundreds of thousands. The huge cost aspect is one. But another important aspect is what deepset pumps to be used. No doubt TARA pump has been developed and is currently under field trial. Even if it proves successful, the capacity for manufacture has not been developed. At present there is only one manufacturer who has produced about 200 pumps since 1982.

3.6 PRESENT PRACTICE AND SITUATION IN VARIOUS LINKAGES OF HANDPUMP TECHNOLOGY FROM DESIGN, PROCUREMENT, MANUFACTURE UPTO MAINTENANCE:

3.6.1 For the shallow wells, the very popular and widely used handpump is 'New No. 6. The other types of pumps used are 'ROWER' and 'TREADLE'. For the deepset handpump, 'TARA' is emerging as the only handpump developed and tried. For the deep tubewell, the suction type No. 6 handpumps are used.

/3.6.2 The rural

3.6.2 The rural water supply schemes for the Five Year Plans of the Government of Bangladesh, are the responsibility of the one Government agency which is DPHE.

3.6.3 The continuous drawal of surface and ground water for irrigation by means of power and handpumps, is causing the water table in many areas, about one-fifth of the country, to go down. This is causing many of the shallow wells with handpumps becoming non-functional. These pumps need to be replaced by deepset handpumps.

3.6.4 In foundry technology for handpump manufacture, Bangladesh is very practical even though it may not be sophisticated.

3.6.5 New No. 6 Pump, though it may look crude, is satisfactory in performance. Further, it is very cheap in price. Installation of New No. 6 is a familiar technology that everybody knows.

3.6.6 In the handpump manufacturers' workshops, quality assurance/quality control checks may be made more vigorous. Jigs and fixtures are not used to the required degree. Records are not kept for rejected/accepted items. Endurance test and performance test on handpumps do not appear to be carried out.

3.6.7 Maintenance of handpumps has been a big problem. There is high rate of choking. This is attributed partly to tubewell construction and partly to handpumps.

3.6.8 TARA pump has emerged at present as the only deepset handpump, with a future, which has been taken into account by UNICEF and DPHE. As understood by the Mission during discussions, DPHE would be considering TARA pump for rural water supply besides its uses for irrigation projects. (World Bank assisted Hand Tubewell Project II). This project has a target for a total of 400,000 handpumps to be installed for irrigation within 5 years. The apportioning of this total is made up as 200,000 Nos. of New No. 6, 95,000 Nos of ROWER, 95,000 Nos of TREADLE and 10,000 Nos. of TARA pumps. This means installation of 2000 TARA pumps a year. Discussion with DPHE has revealed that they have no objection in accepting TARA pump for irrigation @ 2000 pumps a year. However, the programme for

/Third 5 Year

Third 5 Year Plan for Rural Water Supply is under finalisation. Specification for TARA pump has not been drawn so far, The manufacturers have not been developed. The field trial of TARA pump does not appear to be a total acceptance by the user villagers. In the socio-economic studies report by DPHE-UNICEF-DANIDA in 1984, field study made on TARA pump has been mentioned.

According to this report:

- Children find it more difficult to use the TARA pump than the 'traditional' handpump:
- More men are apparently helping with water drawing from the TARA, than is normally the case. In the rural areas it is a common feature for women to draw the water from the handpumps as men are busy with their avocations.
- TARA pumps were not used more for bathing and laundry purposes, when they were installed with facilities for these purposes.
- The villagers complained of suffering from various types of physical pain caused from pushing the hard rod of the TARA pump.
- The handle of the pump rises up high which may cause accident.

These observations make one to conclude that (1) TARA pump is difficult to use, (2) women shy it away from using this pump, (3) TARA pump has to be still accepted by villagers of all group and physical structure.

From the design aspect, TARA pump would not present difficulty upto 12 metre depth. Beyond 12 metre, buoyancy becomes difficult and this pump may present lot of problems. For such deep well purposes, lever operated handpumps which give mechanical advantage could be used. For instance, India Mark II deep well handpumps, which are proven in the field, may be a good pump for development in Bangladesh.

/3.6.9 Numerous

3.6.9 Numerous sample surveys have been undertaken to assess the number of inoperative tubewells in the field. In the recent survey conducted by DPHE/WHO in 1984, district-wise status of handpumps in all the 64 districts, was analysed which is summarised as follows:-

	Total:	Choked up:	% of the total:
Shallow Tubewells	571,447	50,278	8.9
Deep Tubewells	17,256	2,379	13.7
Deepset Handpumps	9,931	1,489	15

The tubewell may get choked up because of the construction constraints or partly because of the inflow of sand which may be too fine for the screen size. The handpump may also break down because of manufacturing defects. In both cases, water does not flow from the handpump. The Mission was given to understand that the problem lies more with the tube well than with the handpump.

3.6.10 The installation and maintenance of handpumps for Rural Water Supply Programmes are the responsibility of DPHE. As per the present maintenance procedure, one person from the village is appointed as a caretaker after the construction of the tubewell complete with a handpump. Spares for the pumps are purchased by DPHE and issued to tube well mechanics who are regular employees of DPHE. Each mechanic is responsible for repair and maintenance work in about 3-4 unions in close liaison with the Caretaker of each well. The spares are issued free of cost so that the mechanics can replace wornout or defective parts of pumps, without any charge to the Caretaker or other beneficiaries. The mechanics are to account for the parts taken by returning the wornout or defective parts to DPHE Sub Divisional Engineers at Thana level. In the tubewell programme, communities participate in the construction of the tubewell by way of financial contributions (by the beneficiaries) equivalent to 75 per cent of the cost of labour for constructing the tubewell and fixing the pump. However, the communities do not participate in the repair and maintenance of the handpump, which are also critical links in providing continuous supply of potable water. Pilot projects were

/conducted by

conducted by DPHE/WHO/UNICEF wherein the cost of spares were recovered from the Caretakers while the repair was done by tubewell attendants who were appointed one for each union. The principle was to involve people's participation in maintenance of handpumps. The project results proved beneficial. The fresh proposals based on the successful pilot project results are under the consideration of the Government of Bangladesh.

3.6.11 Among the parts of the pumps, the most used for replacement are the rubber seat valve followed by bolts and nuts, PVC bucket, G.I. screw, the plunger, the piston rod.

3.6.12 The sanitation conditions, especially in the rural areas, are far from desirable. Effect of poor sanitation practices has far more serious effect on the water quality and in turn on the availability of safe water for domestic purposes. If the prevailing situation continues due to lack of financial and other reasons, most of the shallow ground water assumed to exist as the potential source of domestic water supply, will not be fit for the purpose. The Government has to treat in more depth the impact of improper or lack of sanitation on domestic water supply. Diarrhoea due to polluted water consumption is a major killer of children under 5 years. Diarrhoea cum malnutrition, in addition to death, can affect the physical and mental development of the child. The continued predominance of diarrhoeal disease in Bangladesh has been the effect of non-development of rural sanitation.

3.6.13 The standardisation and specifications to an extent, are being practised in the case of shallow tubetwll handpumps, for purchases made by Government Agencies and UNICEF only.

3.6.14 The common problems, with conventional pumpheads, encountered at site were:-

- All moving parts were found to be poorly matched;
- Tolerances and fits were excessive allowing the handles and fulcrums to wobble sideways;
- Guide pillars were not truly vertical, and pivot pins were not truly horizontal.

4. RECOMMENDATIONS

The comments and recommendations this Mission is making, is based on what the Mission is able to observe and discuss with different agencies involved in procurement and production of handpumps, during the short visit. Therefore, the recommendation is based not on any indepth study of the handpump production or other activities connected with handpumps.

The recommendations have been discussed with the Chief Engineer, DPHE, Government of Bangladesh and presented herebelow:

4.1 The manufacturers have indicated that their production capacities are much higher than the present demand and that they had not faced any problems in the past to meet this demand. Further, the facilities, equipment and skills seemed adequate enough to meet the targetted Third Five Year Plan requirements by Department of Public Health Engineering, for implementing rural water supply programmes, as well as for irrigation and Public/Private demands. At the moment, it appears that there is not much need to accelerate the capabilities of manufacture of handpumps.

4.2 In view of the ever increasing use of ground water for irrigation for the last several years, a serious situation has arisen in the ground water table going down in about one-fifth area of the entire country. This has resulted in the shallow well handpumps becoming inoperative and in dire need for resinking to use deepset handpumps. The development or the manufacture of deepset handpumps, has not taken place to the required level. UNICEF/World Bank assisted TARA pump has, however, been developed and a few hundred numbers installed in the field for trial purposes. While the preliminary results seem to be encouraging, other important steps to be followed are (a) the pump to be finally proven in the field and accepted by the community, (b) finalisation of the standards and quality control techniques, and (c) development of several manufacturers. The Mission recommends that in view of the large quantity of deepset handpumps required in future, development of one or two types of pumps other than TARA pumps, which have proved in the field in other countries, may be taken up in Bangladesh.

/4.3 Research

4.3 Research and development (R & D) activities on handpumps are presently existent to carry out, on all types of pumps, study of the suitability, economy, local conditions and social acceptance. The dimension of these activities need to be widened and should put much emphasis on the anthropometric measurements and ergonomic studies as well as the cost effectiveness of the new pumps.

4.4 The Mission recommends the following points to be particularly looked into, during the manufacture of handpumps.

4.4.1 The manufacturer should have a separate quality control wing with personnel exclusively manning this wing, independent of production personnel, and answerable directly to the Chief Executive. This department must maintain complete documentary records separately for accepted/rejected parts, and should be responsible for checking and ensuring quality standards from raw material stage upto final assembly of handpumps. Buyer should insist on manufacturers to prepare quality assurance manuals and quality control procedure during manufacture and inspection which should also cover documentation procedures. Required checking gauges and measuring instruments should be used by the manufacturer.

4.4.2 The manufacturer should be insisted upon by the buyer to use the jigs and fixtures at the manufacturer's shop in order not only to increase the production rate but make it possible to use less skilled labour, to improve dimensional accuracy, to improve assembly and for interchangeability of parts.

4.4.3 The chemical composition of pig iron used for casting will be within an acceptable range to facilitate good casting. The recommended chemical composition is:

- Carbon : 3.2 per cent to 3.5 per cent
- Silicon : 2.1 per cent to 2.3 per cent
- Manganese : 0.6 per cent to 0.9 per cent
- Phosphorus : 0.2 per cent maximum

High phosphorus content can cause brittleness and has low resistance to impact which can cause breakage and is difficult to machine resulting rougher cylinder wall and poorer tolerances. Therefore,

/phosphorus

phosphorus content is especially critical. A periodic chemical analysis of the pig iron should be provided by the supplier and verified by chemical analyser before the pig iron is accepted.

4.4.4 Foundry coke should also be purchased to specifications. The recommended specification is:

		Weight by per cent:
- Fixed carbon	:	88.0 minimum
- Volatile matter	:	1.0 minimum
- Ash content	:	12.0 maximum
- Sulphur content	:	1.0 maximum

The caloric content should average 2500 million BTU per short Ton. Coke should be covered in storage and protected from moisture.

4.4.5 Brinel Hardness of the casting should be from 179 to 229 BHN. The tensile strength of the castings produced should be 14 Tons per square inch (24 kg. per sq. mm).

4.4.6 The grade type, size and distribution of graphite flakes and the structure of the matrix shall correspondingly be (Grade 14, Type I and Size 3-5.

Distribution and Micro Structure : A, lamellar/pearlite. Ferrite, if present, shall not exceed 10 per cent.

4.4.7 The manufacturer of castings shall issue test certificates with every batch of their supply and also test bars for tensile, transverse and impact tests. The test certificate shall indicate

- Delivery challan and date
- Purchase order number and quantity
- Part number and description
- Heat number/batch number, quantity per heat, heat-wise chemical composition, tensile, hardness, transverse values on representative samples. The hardness values should indicate the number of samples checked from each heat/ batch and the location of hardness testing.
- Micro structure report
- Identification for each heat/batch

/4.4.8 Final

4.4.8 Final inspection details to be looked into on the castings are:

- Visual inspection
- Dimensional checks
- Casting defects like blow holes, cracks, rough castings
- Hardness
- Chemical composition
- Tensile strength
- Transverse and impact tests

4.4.9 It should be ensured that the valve seats must be smoothly finished and without blemish. The fabrication of valve assembly parts should be done with care for satisfactory operation. It should be ensured that the cast iron cylinder inside wall (in which the plunger operates) smoothness should be almost that of extruded brass cylinder. This increases longer life for cup washers.

4.4.10 Plunger rods should be from mild steel rods and not from flats.

4.4.11 Tolerances should be minimised at all pinned connections not only to prevent excessive wear at those points but to reduce wear and damage to other parts that may result from poor alignment and wobbling.

4.5 The Mission recommends the following points to be noted for installation and maintenance of handpumps:

4.5.1 A code of practice for installation and maintenance of standardised shallow well and deepwell handpumps should be prepared, at the national level, giving step-by-step procedures with diagramatic sketches. Proper formats should be maintained giving statistical data of installation and maintenance of each handpump. This information is crucially important not only from statistical point but to get feedback information for research for continually improving the design aspects and standards of handpumps.

/4.5.2 Lack of

4.5.2 Lack of feedback from maintenance to engineering and procurement personnel, inadequate record keeping, little analysis - for example - of the most common failures - all these factors dwarf the research and development of handpumps. The recommended maintenance information manual is given in Annex II - Sheets 1 to 8.

4.5.3 Proper storage of pumps and components is a must. Proper painting, protection of machined portion against rust and protection of leather against mildew are necessary.

4.6 The Mission recommends the following points to be noted for training programmes on handpumps:

4.6.1 The training programme for installation and maintenance of handpumps should be regularly conducted by the agency responsible for the implementation of the rural water supply schemes. The programmes should broadly cover:

- Education of local people on the importance of handpump in their day-to-day life.
- Training in actual pump installation and dismantling in the field with step-by-step procedures. This is an excellent means of 'on-site' training.
- Instructing in how the handpump works, the more common causes of failures, and their corrections.
- Importance of Public Health in the construction of platforms and maintaining clean surroundings around the pump.

4.6.2 The training should make available the samples of handpumps used locally, with tools to dismantle and reassemble them. A collection of broken or worn out parts is also useful for demenstration purposes.

4.6.3 The training should be imparted to the village Caretaker as well as to the local supervisors and engineers of the Government agency who is responsible for installation and maintenance of handpumps.

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ANNEX I

Advisory mission on accelerated local manufacture of hand pumps for rural water supply

TERMS OF REFERENCE

The mission will carry out its activities within the framework of the following terms of reference:

(a) To visit selected countries and, within each country, to visit the relevant hand pump manufacturing facilities as recommended by the concerned national government agency. The duration of the visit in each country shall be between five and seven days inclusive of international travel involved.

(b) To carry out detailed discussion with concerned government agencies and with the management of each manufacturing facility visited about overall national hand pump requirements (both short - and medium-term) and the existing production capability both at the national level and at the level of the individual plants visited by the mission. Also to discuss the nature and extent of production problems both nationally and at the specific plant level.

(c) At each manufacturing facility visited, to discuss any problems related to technical, management and manufacturing processes. Also, to discuss plans and potential for plant upgrading, increased production and improved quality including financial implications.

(d) To recommend appropriate changes for improvements in technical, management and manufacturing methods and in quality control.

(e) To recommend appropriate measures to increase production of hand pumps and spare parts.

(f) To recommend appropriate measures to improve occupational health, and also safety features in each manufacturing facility visited.

/(g) To identify

(g) To identify elements and scope for appropriate technology transfer and for technical co-operation among developing countries in the region.

(h) To prepare a consolidated report for each country visited with specific recommendations for each plant visited. The report should be prepared within one month of completion of the visits.

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ANNEX II

WATER SUPPLY - INFORMATION CHARTS ON HANDPUMPS

RECOMMENDED MAINTENANCE INFORMATION MANUAL

FORM 1 : WELL AND PUMP CHART

(A) REFERENCE:

A1. Identification Code [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]
State District Serial No.

A2. Water Point Location
(a) Taluk _____ (b) Village _____

A3. Form completed by _____ (b) Date _____

A4. Form checked by _____ Date _____

(B) WELL CONSTRUCTION :

B1. Well Type : Drilled / Dug

B2. Static Water Level : (a) Below G.L. _____
(b) Date _____

B3. Yield of well _____ Litres/minute

B4. Depth of well _____ Metres

B5. Remarks : _____

_____

Sheet 2

(C) WATER QUALITY:

(a) Conductivity _____

(b) pH _____

(c) Total solids _____

(d) Total iron _____

(e) Chloride _____

(f) Sulphates _____

(g) Salinity _____

(h) Any other information _____

(D) PLATFORM CONSTRUCTIONS:

D1. Attach sketch

D2. Position of end of handle from operation level

(a) Top of stroke _____ mm

(b) Bottom of stroke _____ mm

D3. Drainage _____

D4. Remarks _____

_____

_____

Sheet 3

(E) PUMP

E1. Manufacturer ..... Pump Description .....

E2. Installation (a) Date .....
(b) Time taken .....
(c) Installed by:
(Agency)

E3. Dimensions:

	Material	Diameter	Unit length	No. of length
(a) Rising main				
(b) Rods				
(c) Cylinder				

E4. Placement of cylinder
(from G.L.) ..... m.

E5. Pump lever ratio .....

E6. (a) Max stroke ..... mm.

(b) Max swept volume..... litres

E7. Seal Material .....

E8. Any problem encountered during or immediately after installation ?

Yes No

Specify .....

.....

Sheet 4

E9. Observed faults of
Pump (Manufacturing defects) .....

E10. Remarks .....

.....

(F) HABITAT :

F1. Approximate population
of village/Habitat :

F2. No. of House holds :

F3. Source of water supply in
the area:

(a) Drilled Well/Dug well
with hand pumps :

(b) Taps

(c) Power pumps :

F4. Estimated population
using this pump :

F5. Village pump caretaker(s) Yes No

F6. Remarks .....

.....

Sheet 5

FORM 2 - SITE INSPECTION

State | District | Serial No.

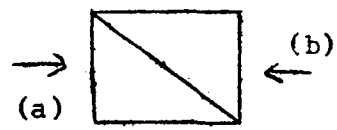
Form completed by:.....

Date	Static water level	Well depth	Performance*	Volumetric efficiency**	Condition of		Preventive Maintenance (Details)	Cause for Break down	Repairs carried out
					Pump	Surroundings			

* No. of strokes to give 12 litres rate of pumping. Rate of pumping:

** Actual discharge in litres in 40 strokes ÷ 12.66 (a) 40 strokes per minute

(b) 60 strokes per minute



Sheet 6

FORM 3 REPAIR AND MAINTENANCE REPORT

A. Reference :

A1. Identification code: ☐☐ ☐☐☐ ☐☐☐☐☐☐

State District Serial No.

A2. Form completed by ..... A3 form checked by .....

Date .....

B. Sequence of Events :

B1. Reason for intervention : Breakdown ☐

Poor performance ☐

Scheduled maintenance ☐

B2. Nature of failure .....

.....

B3. Dates (a) Failure occurred .....(b) Failure reported.....

(c) Failure inspected.....(d) Repair completed.....

B4. Failure reported (a) By whom .....(b) To whom.....

B5. Failure inspected (a) By whom .....(b) Action taken .....

Sheet 7

C. Repair (Specify on site or in workshop)

C1. Description of Repair

C2. Parts replaced(Description and Qty.)

C3. Tools used for repairs (specify standard and special tools)

C4. Time taken to do repairs (man hours)

C5. Repair carried out by

(a) Engineer/Supervisor .....nos.

(b) Skilled man power .....nos.

(c) Unskilled .....nos.

C6. Assistance from Villager: Yes/No

If Yes specify type of assistance .....

C7. Type of vehicle used .....

C8. Total distance travelled
by vehicle for completing repairs .....

C9. Description of corroded, worn, damaged or broken parts
(add sketch or photograph if necessary) .....
.....
.....

C10. Remarks .....
.....
.....

Sheet 8

A. REFERENCE

A1. Identification code [ ] [ ] [ ] State District Serial No.

A2. Form completed by:..... Date:.....

A3. Form checked by: ..... Date:.....

A4. Date of Repair .....

B. MAINTENANCE COST :

B1. Cost of part replaced (as reported in Form 3, C2)

Qty.	Part replaced (from form 3, C2)	Unit cost	Total Cost
	Total cost of parts		

B2. Transportation cost: .....

B3. Direct labour charges.....

B4. Indirect cost (overheads).....

B5. Total cost (B1.+B2.+B3.+B4.).....

ANNEX III

DHAKA - PERSONS MET

I. FROM THE GOVERNMENT OF BANGLADESH:

1) Mr. Azizul Huq, Joint Secretary (Administration)
2) Mr. M.H. Khan, Chief Engineer, DPHE
3) Mr. M.A. Karim, Superintending Engineer/Planning
4) Mr. S.A.K.M. Shafique, Superintending Engineer (PHE) Stores Circle
5) Mr. Rezaul Karim, Foundry & Quality Control Consultant
6) Mr. Mohammed Khurshed Alam, Executive Engineer
7) Mr. A.K.M. Abdul Sattar, Executive Engineer, Stores Division
8) Mr. Mohammed Matiar Rehman, Executive Engineer (PHE)
9) Mr. Shahnewaz Choudhury, S.D.E. (Q.C.)
10) Mr. M.A. Motaleb, S.D.E. (PHE) Stores Division
11) Mr. Naquib Hasan, SDE, Tendering and Procurement
12) Mr. M.D. Abdur Rahman, Assistant Engineer (Village Sanitation, Div. 2)

II. HANDPUMP MANUFACTURERS:

1) Mr. Abdus Salam, Chairman, M/s. ASB Engineering Works
2) Mr. Khurshed Ahmed, Managing Director, M/s. Comilla Engineering Works
3) Mr. Mirza Mesbahuddin, General Manager, M/s. Essential Products Ltd.
4) Mr. Faruque Chowdhury, Commercial Manager, M/s. Essential Products Ltd.
5) Mr. Ikramullah, Project Manager, M/s. Mirpur Agricultural Workshop and Training Centre

III. UNITED NATIONS ORGANISATIONS:

1) Mr. Colin Glennie, Chief of Water and Sanitation, UNICEF
2) Dr. N. Abeyesundere, WHO Programme Co-ordinator
3) Mr. Stanislav P. Szabo, Advisor, W.H.O.
4) Mr. K.M. Minnatullah, National Sanitary Engineer, W.H.O.

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