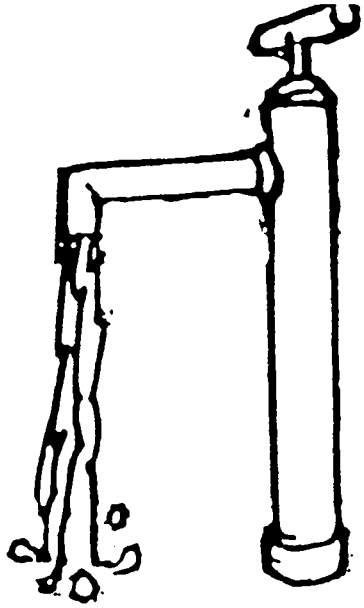
DRAFT

REPORT ON TRIAL
OF WAVIN HANDPUMP IN INDONESIA



PREPARED BY

DIRECTORATE OF WATER SANITATION

MINISTRY OF HEALTH

GOVERNMENT OF INDONESIA

AND

UNITED NATIONS CHILDREN'S FUND (UNICEF), JAKARTA, INDONESIA

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TRIAL OF WAVIN

Contents

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Figures and Annexes

Use of PVC components, light weight, and simple design makes the Wavin inump easy to install and dimantle for repairs. The only tool needed is a driver. Technical persons are not needed for this job and can also be by women. See picture above showing three women dismantling the pump.

Picture in the left side shows two caretakers connecting the pump rods to install back the pump after replacing the damaged rammie cord seals. Note that special pipe handling tool and technical persons are not required to install these pumps.

20 wavin handpumps installed in 3 villages, were found to be working inuosly with no breakdowns in the last 8 months of operation. Communities e developed faith on the reliability and efficency of these pumps.

Within few days of installation of each pump, communities started to e the large continous volume of water discharged for both upward and ward movement of the handle and the less energy they had to spend to fill ir bucket. They soon adopted to the new pumping stroke and found it ..ient and easy to operate.

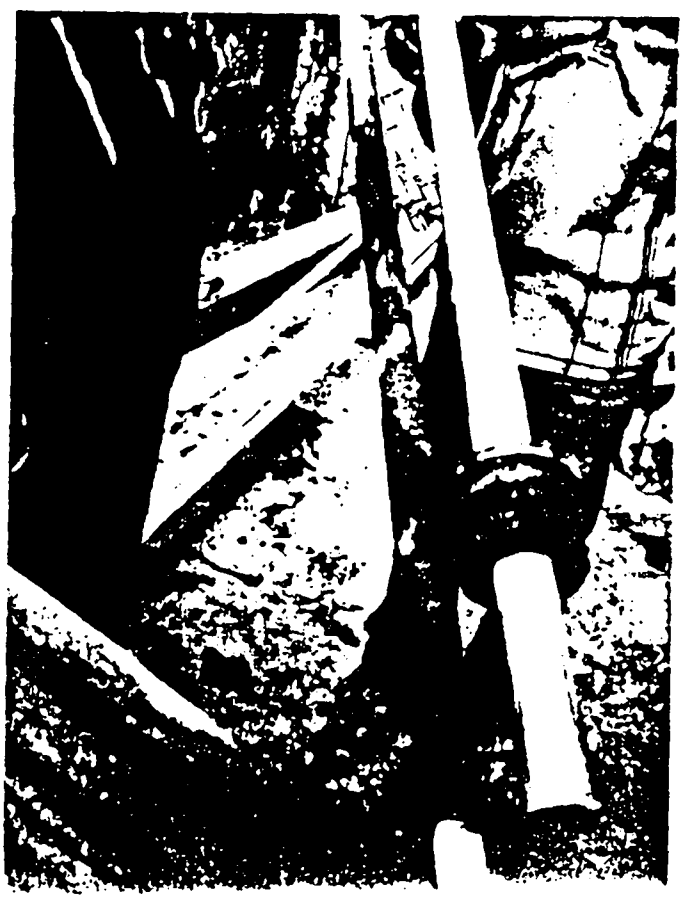
Light weight and simple design, allows the pump to be dismantled and -lled back in less than 30 minutes by two persons. The only tool required screw driver. Communities have replaced plunger seals, adjusted cylinder iston depths by themselves. So far, meantime between the breakdowns is to be practically zero.

Many of the 20 Wavin handpumps continued to function and discharge 500-600 millilitres per stroke , even after the rammie cord seal on the plunger were found to be completly worn out. Users felt the lowering of discharge after 6 months of operation but attributed it to the peak summer season because of which many dug wells in their village go dry or their discharge is reduced. They could hardly believe that the pump could still work without the rammie cord seal. Picture in the left side shows the piston of one of the 9 handpumps whose rammie cord seals were found to be completely worn out.

Picture below shows a caretaker fixing a new ramie cord seal on the
on from the bag of spares supplied. Some pump owners used wick of the
osene stove as substitute for ramie cord seal supplied.

After 8 months of usage, the centralisers were the only component on which visible wear and tear was observed. Centralizers from the top most pump rod and the rod following it, were found to be rubbing against the riser pipes. In three or four pumps these were found to loosen off from the epoxy joints. Also, the pump rods, riser pipes were found to be stained yellow with the deposition of iron oxide which could be cleared with some efforts (See picture in the left side).

cture in the right side
ws the corroded pump handle.



1. Introduction

Government of Indonesia choose construction of shallow and deep well handpump facilities as a major strategy to meet the demands of water supply in the rural areas. So far, some 450,000 shallow and 76,000 deep well handpumps are estimated to have been constructed since 1969 under the Government's programme in the rural areas.

An evaluation of the National Rural Water Supply and Sanitation programme in early 1987[1)], indicated that 35% of shallow and 43% deep well handpumps were not functioning. Poor performance of handpump has been identified as a major constraint to the provision of clean water in the rural areas.

The evaluation also indicated that a majority of deep well handpumps were never repaired once these brokedown because of the lack of special tools, spareparts and skilled manpower at the village level needed to repair and maintain these heavy pumps. These pumps were indicated to be not so suitable for the village level operation and maintenance (VLOM)

Directorate of Water Sanitation, Ministry of Health, in trying to identify village level operation and maintenance pump choose to field test 20 Wavin [2)] direct action plastic handpumps procured under the GOI-UNICEF co-operation. Field and laboratory tests of WAVIN pumps under the auspices of World Bank and United Nations has indicated to be promising VLOM Pump. Australian Development Assistance Board (ADAB), assisting the Government in the District of Lombok Barat, Nusa Tenggara Barat (N.T.B.) Province, field tested 15 Wavin pumps in 1985/1986 and provided inputs to Wavin Overseas for design modifications. The 20 pumps procured for GOI-UNICEF field trial are the modified improved versions. Wavin overseas and Wavin Indonesia (Wavin Duta Jaya) showed interest and participated in the field trial by training local Government staff, volunteers and caretakers of the handpump in the installation, operation and maintenance.

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1) Evaluasi Program - Inpres Air Bersih dan Sanitasi, Juni 1987

2) Wavin direct action handpumps are produced by Wavin Overseas

The 20 Wavin pumps were installed in 3 villages in the district of Purwakarta, West Java Province. The installation of facilities were completed in December 1987. This report describes the results of monitoring these 20 handpumps over the period January - September 1988.

Objectives :

2.1. General Objectives

The general objective of the trial of 20 Wavin positive direct action plastic handpumps is to determine if this type and design is suitable for village level operation and maintenance and is acceptable by the community.

2.2. Specific Objectives

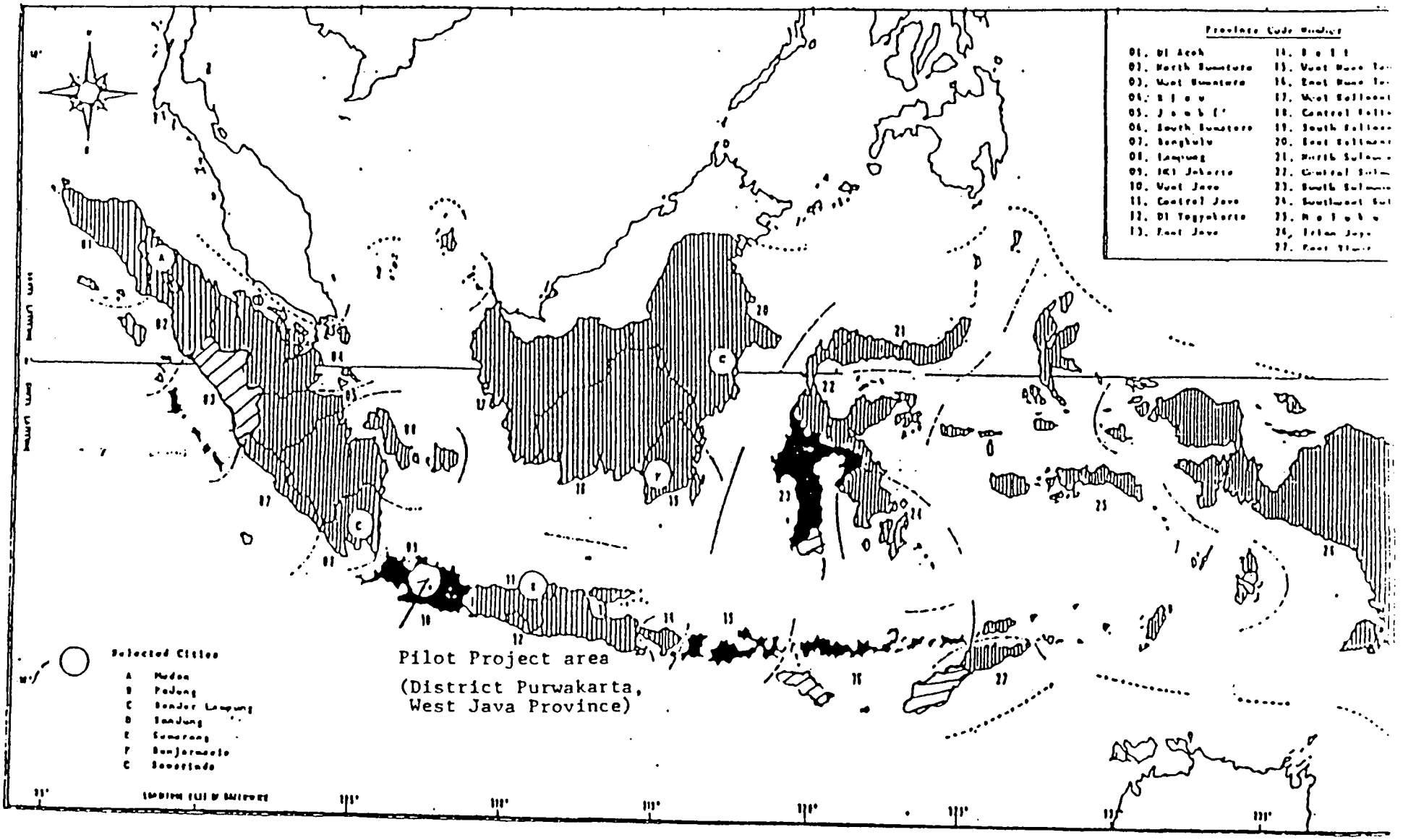
The specific objectives of the trial are to determine :

i) easiness in the installation of the pump.
ii) reliability of the pump i.e. frequency of break downs
iii) cost of installation, maintenance and repair
iv) suitability of available manpower at the village level in the installation, maintenance and repairs.
v) suitability of this pump as a community pump i.e. coverage, discharge and usage.
vi) social acceptability of the pump by the community.

Activities undertaken :

3.1. Area selection

Karya Mekar, Cibatu and Cilandak were the three villages selected in the sub-district of Campaka, district Purwakarta, West Java Province (See fig.1 for location map). Ground water in these villages are known to have higher levels of iron concentrations resulting in corrosion of metallic parts of the handpumps and especially the galvanized iron riser pipes giving the water from these pumps bad odour and taste. Many communities prefer to use water from open dug wells to the handpumps, especially for drinking and cooking purposes.


Pilot Project area
(District Purwakarta,
West Java Province)

However, due to large seasonal variations of the near surface water table aquifer, many dug wells, even those as deep as 10-12 meters go dry in summer. Several households cluster around the few handpump facilities and spend long time waiting to get their chance to collect water. Because of these conditions, it was decided that for this area, Wavin handpump will be more suitable as this pump is entirely made of PVC amd there will be no corrosion effects. Also, the shallow confined aquifer occurs at a depth of 15-20 m. with static water level in summer more than 7 m. These depths are ideally suited for the Wavin pump as they are beyond the maximum suction range of shallow well handpump and at the same time too shallow for the India Mark-II pump to work efficiently. It was decided that the villages of Cibatu and Cilandak each will receive 6 handpumps and the village of Karya Mekar 8.

3.2. Training of volunteers and caretakers :

The village volunteers training course was for 6 days which stressed on techniques of communication, information and motivation along with the technical aspects covering Operation and Maintenance of handpump facilities. From each village 5 volunteers were trained. 2 of them were handpump volunteers, 2 for construction of latrines and 1 from women group (PKK) for health educational and motivational activities.

Followed by this, a two day training course was organized for 20 handpump caretakers from the three villages, including the three volunteers trained earlier and the Sanitarian from the Health Centre. The trainees were taught installation, operation and maintenance of the Wavin pump by the Engineer from Wavin Duta Jaya. Two Wavin handpumps were installed during the period of the training course.

3.3. Community prepation and selection of location of handpumps

The community preparation phases started with the village level meeting (LKMD) where the sanitarian and the doctor from the sub-district Health Centre (Puskesmas) briefed the communities in the three villages about the objectives of the trial of 20 Wavin handpumps. A consensus was obtained from the village leaders for the trial.

In a second meeting with the communities, the locations of the handpump facilities were discussed and finalized. User groups for each handpump facility were identified and they inturn selected a caretaker who were later trained. Also, during this meeting, responsibilities of the communities in the operation and maintenance of handpump facility were discussed. Communities agreed to participate and provide land for the construction of handpump facility, manual labour at the time of drilling and installation of handpumps. A workplan was developed with their consensus. (See fig. 2 for locations of handpump and Annex 1 caretakers trained).

3.4. Drilling of handpump wells and pump installation :

The 20 Wavin pumps were installed on boreholes drilled using small trailer mounted rotary rig CTM-5000 and a portable drilling unit called Minuteman. 6 inches diameter boreholes were drilled with depths ranging from 17 - 29 meters and an average depth of 23.4 meters. PVC casing pipes of 4 inch diameter were installed with gravel pack. (See fig. 3 for construction details). On an average 6 days were spent to complete each facility of which 4.2 days were spent on drilling of borehole and 1.6 days to construct the apron (platform), clean the surroundings and install the handpump. (See Annex 2 for details)

FIG.2: MAP SHOWING THE SUB-DISTRICT OF PURWAKARTA WITH THE LOCATION OF 20 WAVIN HANDPUMPS

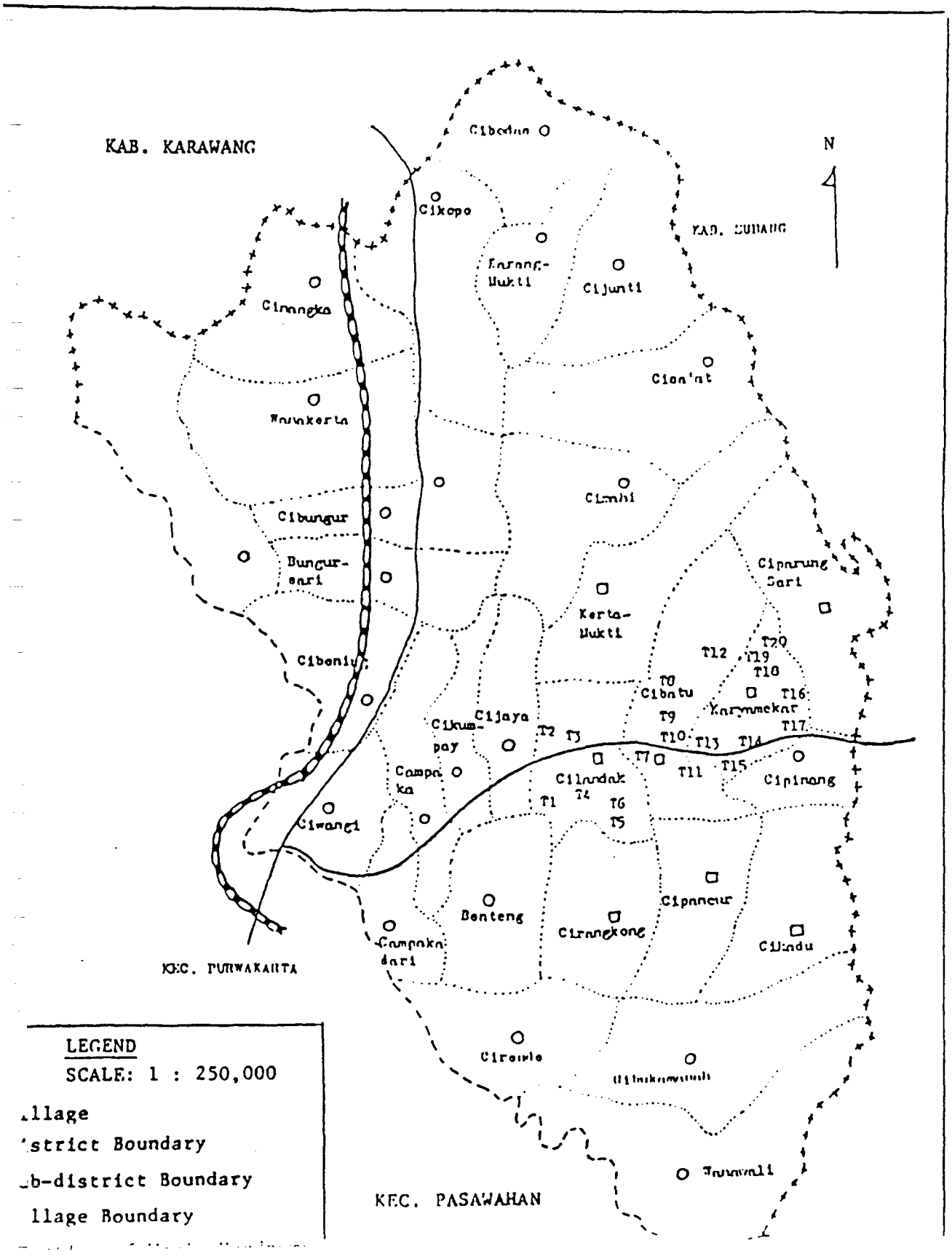
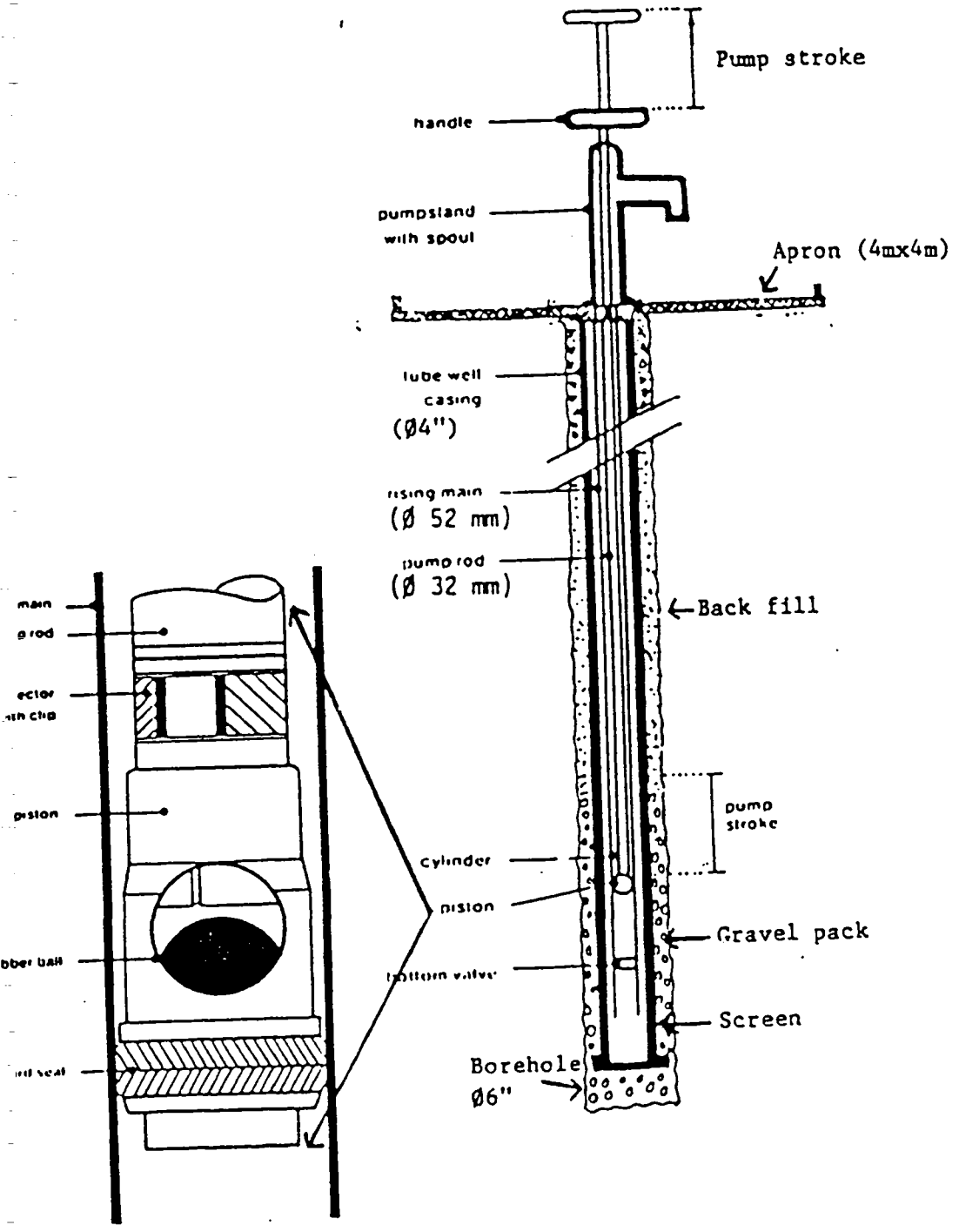


FIG.3: STANDARD WELL DESIGN, SHOWING THE INSTALLATION OF WAVIN HANDPUMP



In case of 4 boreholes, the drilling time was slightly more than average and was 6 days. In these cases, the minuteman rig had to be replaced by CTM-5000 to drill through the hard formations met at depths of 15-20 meters.

Village volunteers earlier trained in drilling methods, proved very useful. They did most of the drilling jobs under the supervision of sanitarians. All types of manual labour, like shifting the rig and equipment to the drill site, digging of mud pits, hauling water for drilling, sieving of gravel and sand, construction of platform and drainage were done by the communities.

The handpumps were installed by the trained volunteers assisted by the caretakers of that facility. After the completion of each handpump facility, they were checked by the sanitarians and tested for performance and accuracy of installation.

No difficulties were faced during installation of handpumps. Two persons could install the handpump (with cylinder around 17.5 m. depth) in about 1 hour time (See Annex 2 for details).

Monitoring

Monitoring phase was spread over a period of 8 months. 4 types of forms were used. Form 1 was used to collect data on the location, construction of borehole, handpump installation, construction cost and community participation. This was filled by the sanitarians after the completion of each facility. Form 2 is the check-list for the sanitarian to ensure that the handpump facility had been properly constructed before it is handed over to the user groups. Form-3 is the monthly inspection form filled by the village handpump volunteer to evaluate the functioning status, use and community perception on the

Form 4 covers similar aspects as form 3, but with more technical details. This form was filled monthly by the sanitarian.
The data of the 20 handpumps were compiled monthly and tabulated for analysis (See Annex 2,3,4).

Apart from the routine monthly monitoring by the sanitarians and caretakers, inspection were made by the staff of the Directorate of Water and Sanitation and UNICEF (WES) to evaluate the wear and tear of the handpump components and interview the user groups to assess community acceptance of this new type of pump. Data collected was used to evaluate :

(i) easiness to install the handpump
(ii) coverage and usage
(iii) breakdown and repairs
(iv) installation, repair and maintenance cost
(v) community acceptance

Results of trial :

5.1. Easiness to install the handpump :

The installation of WAVIN pump is easy, quick and can be done by village volunteers trained through a few hours of training course. Special pipe handling tools are not required except a screw driver. It takes 2 persons one hour to install the pump.

The pump design is simple and it is light in weight. Use of PVC pump rod and riser pipe/cylinder with threaded joints with simple locking mechanism enables to install them quickly and easily without using tools. Every section of riser pipe can be used as cylinder.

Because of this, critical adjustments to the pump rod to ensure proper plunger position is not required as it does not effect the stroke length and hence the discharge. The cylinder depth can be easily adjusted by either disconnecting or connecting a section of the riser pipe along with the pump rod.

5.2. Coverage and Usage :

The pump discharge is more than 1 litre/stroke which is nearly 3-4 times higher compared to many types of deepwell handpumps. The pump design enables a continuous flow of water as the pump discharges water both in the upward and downward movement of the pump rod. It was observed that the users (mostly women) were pumping on an average 36 strokes per minute with a discharge of 38 litres/minute (See Annex 2 for details).

The effective average coverage per handpump is around 55 persons or 11 households. The lowest coverage of 45 persons was in Desa Cilandak (pump no.2) and maximum of 61 persons in the village of Karya Mekar (pump no.17). However, household usage pattern over the three months of dry period in summer changed when some dug wells in the area went dry. The estimated average coverage per handpump increased to more than 20 households.

In the initial phase, by habit, water from most of the handpumps was not used for drinking and cooking purposes. After the health educational activities by sanitarian and cadres, communities started to use handpump water for drinking and domestic use. Still, water from of two handpumps (nos. 13 and 14 in desa Karya Mekar) are not used for drinking purpose because of high content of iron and or kaolin clay present in the aquifer imparting an unacceptable taste which they are not used too. Communities started to use pump no. 11 in desa Cibatu after it was shifted to a new location.

It is estimated that on an average, the pump usage is spread over a period of 7 - 8 hours each day of which nearly 5 hours are in the morning. Water needed for drinking and cooking is carried to the houses by buckets, while people come to the handpump for bathing, washing clothes and utensils. It is for this reason, the average period of time each pump is in use is relatively higher when compared to the average of 11 households using it.

5.3. Breakdown, Repairs and wear of components :

5.3.1. Breakdown and repairs :

During the 8 months of monitoring, no breakdowns have been reported. The only component replaced in most of the pumps was the ramie cord seal on the plunger. Communities have used wick meant for the kerosene stove to replace the ramie cord which is not available at the village level. With this approach of choosing a less reliable cotton wick to ramie cord, the meantime between failures (MBTF) has been reduced practically to zero hours. It was observed for the 9 handpumps dismantled for detail checking of each component that caretakers with the assistance of another person could in 10-15 minutes dismantle the whole pump with cylinders at depths of around 17 meters. Roughly it took them 20-30 minutes to clean the riser pipes and the pump rods and change the ramie cord seal. In another 10 minutes they installed the pump back. It was observed that when the cylinder depth is around 20 meters (pump no. 10), three persons were needed to lift the riser pipes as they were full of water.

Difficulties were experienced in opening the pump stand because of the rusted threads. However, caretakers solved this by using a wooden/bamboo pole as a lever to unscrew the pump base.

Communities are not so happy with the height of the spout. Pump installation design need to be changed to increase the height of the spout enabling bigger buckets to be used for the collection of water. Some users have adjusted spout position to near horizontal.

In all pumps, it was observed that people are using ropes to tie the handle bar to the pump body to prevent it to rise and stay up at ackwardly high heights when the pump is not used.

It was observed that some caretakers have opened the pump and made adjustments either to alter the cylinder and/or piston position . Some common errors noticed were in the assembling of components of pump rod and foot valve. The position of rubber bush and PVC spacer (pipe piece) on the pump rod were interchanged and the position of "O" ring for the foot valve was incorrect.

It was difficult for some of them to decide which of the two pipes they should use to assemble the foot valve and place it lower most in the riser pipe assembly.

The manual could not help them to solve these problems as the diagrammes and instructions for installation are not clear. The caretakers needed sanitarian guidance on this to install the pump.

However, is was felt that with an improved manual, the caretakers will have no difficulty to install and repair the pump by themselves.

5.3.2. Wear of individual components :

After 8 months of operation (September 1988), 9 handpumps (no. 5,6,7 from Desa Cilandak; 8 and 10 from Desa Cibatu and 16,18,19 and 20 from Desa Karya Mekar) were completely dismantled and each component visually inspected for wear and tear and effects of corrosion on metallic components. The following are the observations :

(i) Pump stand : The hot dip galvanised layer on almost all the handpump badly peeled off when they were received for installation. The pump body had to be painted immediately after installation. Four handpumps needed repainting of the spout. The threads at the base of the pump stand had rusted and difficulties were experienced in dismantling.

(ii) Handle bar and rod : For all handpumps, the handle bar became smooth with shining surface. But, handle rod showed signs of corrosion. It become rusty black and in two handpumps yellowish brown in colour.

(iii) Pump rod centralizers and cylinder lining : In alomost all the pumps opened, one or two pump rod centralizers at the middle of the rod came off because of poor epoxy joints. The centralizers especially on the top most and bottom most pump rod showed signs of rubbing against the cylinder wall. However, there was no sign of visible damage or abrasions. The inner walls of the cylinder and riser pipe were found to be smooth, except for one pump (no. 15) which showed signs of abrasions at the top section of cylinder lining. The centralizers seems to be helping in minimising buckling of pump rod during its downward movement.

There were no signs of wear or damage to the threads on the pins and sockets of the pump rods and riser pipes/cylinders. They could be opened and installed back easily.

(iv) Piston valve and foot valve :

Foot (bottom) valves of all the 9 pumps opened, were found to be leaking. Sections of the riser pipes above the static water levels were found to be empty indicating a leaking foot valve. Also, it was reported that water starts to flow after a few strokes (3 to 5) when the pumps are used after a gap of few hours. This was clearly observed early in the morning when pumps are started to be used after a time gap of whole night. It is suspected that the 'O' ring on foot valve is not so effective.

After placing the foot valve, the threaded pin of the lower drop pipe cannot be tightened completely into the female socket of the riser pipe. A gap of two thread still remains. The "O" ring used for this joint has no function.

There were no signs of wear on the spherical rubber ball valve of the piston and foot valve. The valve seats were also intack.

The shoulders housing the ramie seal on the plunger had some abrasions on one side though not very significant. These were noticed in three pumps (no. 5,6 and 18) where the pistons were placed at 17.5 m depth and in these pumps ramie cord seals were found fo be completely worn out.

(v) Ramie cord seals :

Handpumps continued to function and discharged between 500-600 milli litres per stroke with the ramie cord seals completely worn out.

The average discharge of 1 litre remained constant upto the end of 6th month indicating that by that time the ramie cord was still not worn out to the extent to cause lowering of discharge.
In the last two months users did find that the discharge was progressivelly decreasing, but they interpreted this was because of the peak summer seasons when they normally experience many dug wells either go dry or the discharge is reduced.

With the replacement of ramie cord seal, the discharge of one litre per stroke were again noticed. A bucket of 3 gallons (11.37 litres) could be filled in 11-12 strokes. Without the ramie cord seal it took 20-25 strokes to fill the same bucket.

(vi) Effect of corrosions : So far, data on chemical analysis on water samples is not available. However, high Fe levels in formation water are known. Because of this, in all the handpumps opened, handle rod, the pump body (inside walls) and the threaded portions of pump base and the foundation socket showed signs of corrosions. The pump rods and riser pipes when pulled out had a disposition of reddish yellow colour except in pump no. 10 it was blackish dark brown.

Pump nos. 13 and 14 the Fe content in water is high and hence people use it for washing and bathing only. People started to use pump no. 11 after it was shifted and installed on a new source.

11) Guide bush : The rubber guide bush showed no signs of wear except that in pumps no. 10, 7 and 20 they were observed to have become slightly hard probably because of the constant exposure to sun.

5.4 Construction, repair and maintenance cost

5.4.1. Cost of handpump facility :

The average cost of constructing Wavin medium-depth handpump facility was Rp. 900,878 or US$ 539 of which Rp.765,878 was spent as cost of handpump, riser pipes, casing pipes, screen and fittings; Rp.47,250 on local materials like fuel, cement, sand and gravel, etc; Rp. 59,200 as labour cost for drilling and apron construction and Rp. 28,550 for community preparation, monitoring and administration cost (See Annex 5 for details).

With each handpump serving 55 person, the cost per person for the provision of safe water is Rp.16,380 or US$ 9.8. The present cost of construction of shallow well handpump facility with suction type of facility is Rp.267,680 or US$ 160 and deepwell handpump is Rp. 930,355 or US$ 556.

5.4.2. Repair and maintenance cost :

The pump had no break-down in the last 8 months and no repair cost was involved. The only component changed once during this period is the ramie cord seal.

5.5. Community Acceptance :

Wavin pumps are very well accepted by the communities for its large volume of discharge, easiness to pump and its reliability. However, initially, communities were not so happy and thought that this new type of Wavin pump stroke is not so convenient and practical compared to the handle and lever system they were used to.

Reliability of the pump was doubted. They considered Wavin pump to be fragile (because of the PVC components) and expected a higher frequency of breakdowns compared to the heavy metallic pumps. Local Government officials at sub-district level accepted to install these PVC pumps with some reluctance for similar reasons mentioned above.

Within few days of installation of each pump, communities started to like the large continuous volume of water discharged for both upward and downward movement of the handle and less energy they had to spend to fill their bucket. They soon adapted to the new stroke of the Wavin pump and found it easy to operate and convenient. With no break downs in 8 months of operation, they think these pumps are reliable and can be maintained by them.

In the initial period of 1 to 2 months intense health educational activities were undertaken by the sanitarians and Kaders in these villages especially to built user group faith in the technology and use the water from these handpumps for drinking and cooking purposes.

nclusions :

) Wavin pump is acceptable to the communities as a true village level operation maintenance pump. Its continous large discharge on both the downward and upper movement of the pump handle enables less effort for a constant flow of 35 litres/minute.

) Wavin pump design is simple and its light weight allows installation of the pump quickly without the use of pipe lifting tools. Special skilled persons are not required for installation, repair and maintenance. An improved installation manual, with a few hours of training to the user group is adequate.

(iii) The pump design is reliable and needed no regular maintenance during the first eight months of installation. Repairs are few and can be attended by communities. The meantime between the breakdowns is practically zero with the provision of some spares.

(iv) With all in hole components from plastics, the effects of corrosion is reduced and the pump is ideally suited for areas with higher iron content. However, there is a need to improve the quality of hot dip galvanizing to the pump head parts.

(v) There is a need to study in-depth the causes for the leaking foot valve and if necessary improve its design.

(vi) There is a need to continue monitoring of these pumps for a period of at least 6 more months to evaluate the effects of fatigue on pump rods, wear of pump cylinder and piston.

(vii) There is a need to modify apron design recommended by Wavin or increase the height of the spout (at least 10 cm.) to enable use of bigger buckets.

(viii) There is a need to improve the installation manual with more clear figures and simple language that can be understood by the user groups.

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ANNEX 1

TABLE SHOWING THE CARETAKERS TRAINED FOR

THE MAINTENANCE OF WAVIN FACILITIES

NO.	VILLAGE	TOTAL OF HANDPUMP	HANDPUMP NO.	CARETAKER OF HANDPUMP	CARETAKERS ADDRESS	DATE HANDPUMP HANDED TO USER GROUP
1.	KARYA MEKAR	8	20	Atu/Sanam	Cicalung RT 11/III	2-01-1988
			19	Mansyur	Sukasari RT 08/III	23-12-1987
			18	E.Kosasih	Sukasari RT 08/III	30-12-1987
			17	Sarben	Cikuda RT 07/II	21-12-1987
			16	Endang	Cikuda RT 06/II	17-12-1987
			15	Darhum	Cikopo RT 01/I	6-01-1988
			14	Nata	Cikopo RT 03/I	8-01-1988
			13	Suhia	Cikopo RT 03/I	12-01-1988
2.	CIBATU	6	12	Acing	Mekarsari RT 05/II	4-01-1988
			11	Manan	Krajan RT 03/I	9-01-1988
			10	Ading	Krajan RT 01/I	26-12-1987
			9	Haer	Krajan RT 02/I	16-01-1988
			8	Saleh	Galayah RT 06/II	20-01-1988
			7	Daud	Sukamukti RT 07/III	22-01-1988
3.	CILANDAK	6	5	Dahlan	Margamukti RT 13/IV	13-01-1988
			6	U s d i	Margamukti RT 09/IV	18-01-1988
			4	Ita S	Bongas RT 05/II	23-01-1988
			3	Hidayat	Cisantri RT 03/I	28-01-1988
			2	Cawito	Cisantri RT 03/I	25-01-1988
			1	O d i h	Cisantri RT 01/I	27-01-1988

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Annex 2

INSTALLATION DETAILS OF 20 WAVIN PUMP BASED ON FORM I
FILLED BY SANITARIAN
DISTRICT: PURWAKARTA, SUB DISTRICT : CEMPAKA
Monitoring month: January 1988

Sanitarian: Carlos

	Pump No.	DESA CILANDAK						DESA CIBATU						DESA KARYA MEKAR									
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	AVERAGE
A	Borehole details:																					
1	Date drilling started	21/1	20/1	23/1	16/1	7/1	12/1	17/1	14/1	10/1	7/12	3/1	27/12	6/1	2/1	31/12	12/12	16/12	22/12	19/12	24/12	7/12
2	Date drilling completed	24/1	22/1	25/1	20/1	11/1	15/1	19/1	17/1	13/1	22/12	6/1	31/12	9/1	5/1	2/1	15/12	18/12	27/12	21/12	29/12	
3	Total time (days) taken for drilling	4	3	3	5	5	4	3	4	4	7	4	5	4	4	3	4	3	6	3	6	4.2
4	Type of drilling equipment used *	M	CTH	CTH	M	M	M	CTH	CTH	CTH	M/CTH	M	CTH	CTH	CTH	M	M	M	M/CTH	M	M/CTH	(84% 9 M 8 CTH 3 CMT/M
5	Total depth of borehole (m)	27	28	29	27	24	24	27	22	28	28	17	24	24	24	19	17.5	18.5	25	18.5	17	23.4
6	Diameter of borehole in inches	6	6	6"	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
7	Casing diameter	4"	4"	4"	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
8	Casing used (in meters)	12	20	16	12	20	20	20	12	12	12	8	16	20	20	10	17.5	18.5	16	18.5	8	15.43
9	Screen diameter	4"	4	4	4	4	4	4	4	4	4	-	4	4	4	4	4	4	4	4	4	4
10	Length of screen used (in m)	4	3	2	2.5	4	4	6	2	4	4	-	4	3	3	4 M	8I	8	4	8 M	2	4.18
B	Handpump Installation:																					
11	Time taken for installation of pump (hours)	3	3	3	2	2	2	3	2	2.5	2.5	2	2.5	2.5	2.0	1.5	2.5	2.0	2.5	3	3.5	2.45
12	Static water level (in m)	5	5	7	6	6	5	5	5	6	4	5	7	7	6	4	5	5	6	5	4	5.4
13	Depth pump cylinder installed	17.5	17.5	17.5	17.5	17.5	17.5	17.5	10	20	17.5	12.5	17.5	17.5	17.5	12.5	12.5	12.5	17.5	15	10	15.8
14	Quality of water **	C	C	C	C	C	C	C	C	C	C	M	C	NC	N.C	C	C	C	C	C	C	
15	No. of strokes per minute	40	40	30	40	40	40	36	40	40	40	30	30	34	24	41	39	30	36	36	34	36.0
16	Discharge per minute (liters/minute)	41	42	32	41	42	42	40	41	42	41	29	36	35	18	41	40.5	36	45	38	37	38
17	Discharge per stroke in liters	1.03	1.05	1.07	1.03	1.05	1.05	1.11	1.03	1.05	1.03	0.75	1.2	1.03	0.74	1.00	1.04	1.20	1.25	1.06	1.09	1.05
C	Construction Cost:																					
18	Material & fuel cost (in thousand Rp)	48.5	43.3	43.3	50.8	50.9	44.3	38.0	46.5	41.7	65.0	44.8	49.3	47.8	43.3	45.0	47.0	44.0	52.9	40.4	55.5	47.12
19	Labour cost for drilling (Rp. thousand)	42.0	42.0	42.0	52.5	52.5	42.0	42.0	56.0	56.0	73.5	42.0	70.0	56.0	56.0	31.5	42.0	31.5	63.0	31.5	63.0	49.35
20	Labour cost for pump installation	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	10.0	11.0	10.0	11.0	11.0	7.0	7.0	7.0	7.0	7.0	10.0	9.85
21	Total cost of installing facility (18 + 19 + 20)	101.5	96.3	96.3	118.8	114.4	97.3	91.0	113.5	108.7	148.5	97.8	129.3	114.8	110.3	83.5	96.0	82.5	122.9	78.9	128.5	106.32

* M - Minuteman rig
CTH - CTH 5000 rig

** C - Clear
M - Milky/not clear

Pump sequence no. Explanation	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12	Pump 13	Pump 14	Pump 15	Pump 16	Pump 17	Pump 18	Pump 19	P.
I.HANDPUMP STATUS																				
1. Is the handpump working? Yes -1 No -2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
2. If yes, How is the discharge? Large -1 Enough -2 Not enough -3	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
- Water quality Clear-1 Smelly-2 Salty-3 Muddy coloured-4 Clear with fine sand-5	1	1	1,2	1	1	1	1	1	1	1	1	1	4	4	1	1	1	1	1	
3. If not functioning, since when? Date/month/year	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
- Has it been reported: Yes -1 No -2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
- If yes, to whom? Volunteer -1 Sanitarian -2																				
4. Has the pump broken down during the last reporting period? Yes -1 No -2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
- Has it been repaired: Yes -1 No -2																				
5. Condition of handpump ? Still good -1 Spoiled -2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
- Handle: Still good -1 Spoiled -2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
- Guide bush: Still good -1 Spoiled -2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
- Pump body: Still good -1 Spoiled -2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
- Pump base socket: Still good-1 Spoiled-2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
- Spout: Still good - 1 Spoiled -2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
- Screw: Still good - 1 Spoiled -2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
III. EFFICIENCY OF HANDPUMP																				
1. Easiness for operation: Very good-1 Good-2 Allright-3 Not so easy-4 difficult-5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
2. Easiness to maintain: Very good-1 Good-2 Allright-3 Not so easy-4 Difficult-5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
3. Easiness to repair: Very good-1 Good-2 Allright-3 Not so easy-4 Difficult-5	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	
4. Social acceptance: Very good-1 Good-2 Allright-3 Not so easy-4 Difficult-5	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3	2	2	2	2	
5. Usage guidance: Very good-1 Good-2 Allright-3 Not so easy-4 Difficult-5	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	
6. General efficiency of handpump: Very good-1 Good-2 Allright-3 Not so easy-4 Difficult-5	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
IV. USAGE OF HANDPUMP																				
1. No. of persons using the pump: .....people	44	57	27	54	50	47	49	51	54	54	40	50	30	41	40	45	55	41	49	
2. Handpump water is used for: Drinking -1 Washing-2 Bathing-3 Cooking-4 All purpose-5	5	5	5	5	5	5	5	5	5	5	2,3	1,2	2,3	2,3,4	5	5	5	5	5	
3. Is there community participation for operation & maintenance? Yes-1 No-2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	

plan	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
I. HANDPUMP STATUS																				
1. Is the handpump working? Yes -1 No -2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2. If not, since when ? date/month/year	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- Has it been reported? Yes -1 No -2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
- Have attempts been made to repair it? Yes -1 No -2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- Who repair it? Sanitarian -1 Caretaker -2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3. Handpump can be used: Continuously-1 Only in the morning as water is less-2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4. Water quality: Clear-1 Muddy-2 Smelly-3 Salty-4 Clear with PVC debris-5	1	1	1	1	1	1	1	1	1	1	2	1	2,3	2	1	1	1	1	1,3	1
5. Water discharge : .....litres/minute	41	42	32	41	42	42	40	41	42	41	29	36	35	30	40	40,5	3,6	45	38	3
6. Has the pump been repaired since the last reporting period? Yes-1 No-2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
7. Condition of the pump body:	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Handle: Good -1 Damaged -2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Guide bush: Good -1 Damaged -2																				
- Pump body : Good -1 Damaged -2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Pump base socket: Good -1 Damaged -2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Spout: Good -1 Damaged -2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
- Bolt & nuts : Good -1 Damaged -2	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1
- Pump foundation	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8. Is the drainage in working condition? Yes -1 No -2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9. If no, since when? Date/month/year	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
- Is there any source of pollution within 15 m? Yes -1 No -2	2	1	2	2	2	2	2	2	2	1	2	1	2	2	1	2	2	2	2	2
- If yes, in what form? Latrines-1 Waste water pond-2 other-3	-	2	-	-	-	-	-	2	-	3	-	2	-	-	2	-	-	-	-	-
10. Condition of apron? Good-1 Cracked-2	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	2	1	1	1
II. U S A G E																				
1. No. of families using it: ....people	12/47	12/45	11/46	12/56	11/49	11/51	10/58	10/60	11/55	11/51	11/20	11/57	8/45	10/46	14/59	15/50	10/49	11/61	10/40	12/
2. Economic condition of users: High-1 Enough-2 Low-3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	-
3. Is there any organizational set up for repair ? Yes -1 No -2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4. Educational background of caretaker? Buta huruf-1 Primary School-2 SLTP -3 SLTA -4	2	4	4	4	2	2	2	2	2	2	3	2	4	2	2	2	2	3	2	2
5. Usage of water : Drinking-1 Cooking-2 bathing-3 washing-4 all purpose-5	5	5	5	5	5	5	5	5	5	5	5	5	3,4	3,4	5	5	5	5	4	5
6. Manner of user : Gentle -1 Rough-2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
III. MAINTENANCE																				
1. Easiness to operate: Very easy-1 Easy-2 Hard -3 Very hard -4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
2. Easiness to repair: Very easy-1 Easy-2 Hard -3 Very hard -4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Average of Cost of Construction of handpump facility with Wavin pump

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. Borehole and platform design :

(a) Borehole

(i) Average depth of completed borehole : 23.4 m
(ii) Borehole diameter : 6"
(iii) Casing and screen diameter (PVC) : 4" (screen fabricated locally from the 4" casing).
(iv) Average length of 4" casing used : 24 m.
(v) Average depth of cylinder : 15.4 m.
(vi) Average length of PVC riser pipe used : 15.4 m.
(vii) Type of ring used : Trailer mounted portable rotary rig (CTM - 5000) and portable drilling unit type minuteman.

(b) Apron

(i) Dimension of apron : 4 m x 4 m and 10 cm. thick.
(ii) Drainage length : 3 m.

I. Cost of construction of handpump facility :

(a) Cost of Wavin pump with accessories :

(i)	Wavin pump c/w materials for installation upto 11.6 m depth @ Rp.509,173	:Rp.509,173
(ii)	Cost of additional 4 m. of materials @Rp.18,185/m.	:Rp. 72,739
(iii)	24 meters of 4" up class PVC casing @Rp.7,110/m.	:Rp.170,646
(iv)	PVC reducer 4" x 3" @ Rp.3,950	:Rp. 3,950
(v)	PVC reducer 4" x 1 1/4" @ Rp.1,740	:Rp. 1,740
(vi)	Well screen 1 1/4" dia, 2.5 meters @Rp. 7,630	:Rp. 7,630
	Sub-total	:Rp.765,878 (US$457.80)

(b) Local material and fuel cost for constructing borehole with apron :

(i)	Fuel and oil	:Rp. 15,500	
(ii)	Cement 3 bags	:Rp. 12,500	
(iii)	Gravel 1/2 m3	:Rp. 7,000	
(iv)	Sand 1m3	:Rp. 6,000	
(v)	Bricks 250 ea.	:Rp. 6,250	
	Sub-total	:Rp. 47,250	(US$28.20)

(c) Labour cost

(i)	Drilling borehole	:Rp. 49,350	
(ii)	Apron construction and pump installation	:Rp. 9,850	
	Sub-total	:Rp. 59,200	(US$35.4)

(d) Cost for location selection, community preparation and monitoring :Rp. 28,550 (US$17.1)

Total Cost :Rp.900,878 - US$538.5
rounded to US$539 *

* Exchange rate : 1 US$ = Rp.1,673 (September 1988)

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