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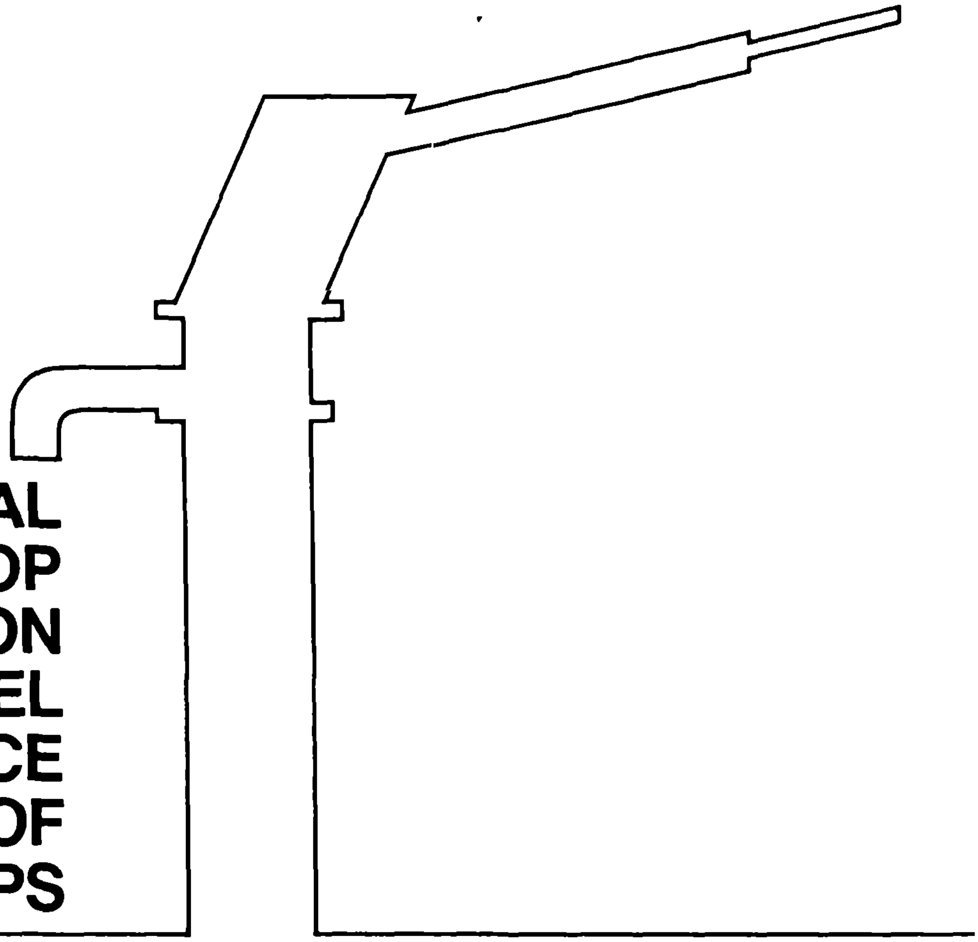

NATIONAL WORKSHOP ON VILLAGE LEVEL MAINTENANCE OF HANDPUMPS

Sponsored by DANIDA
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Convened by The Department of Rural Development,
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INTRODUCTION

The Government of India is firmly committed to the objective of trying to achieve the target of the International Drinking Water Supply and Sanitation Decade, which is to provide safe drinking water to all the peple by 1990. With the assistance of the State Governments, 2,27,000 villages out of the total of 5,75,000 villages have been identified as "problem villages". These constitute 39 percent of all the villages in the country. A "problem village" is one where there is no water source; or where the nearest source is more than 1.6 kms. away; or where water is available at a depth of over 15 metres; or where existing sources are contaminated either bacteriologically (e.g. guineaworm, cholera, typhoid) or chemically (e.g. fluoride, iron, brackish).

The magnitude of the task of providing potable water to these 2.27 lakh villages, and the enormous cost involved, exclude the possibility of any centralised distribution systems such as exist in urban areas. Alternatively, it was decided to drill borewells, wherever feasible, and to fit them with handpumps.

The rate at which handpumps are being installed has accelerated very rapidly in the last few years. While this is a welcome phenomenon, the problem of maintaining these handpumps in good working condition has assumed special importance.

Research and development in the production of handpumps has reached a stage where the present generation of handpumps are cumbersome and therefore, difficult to maintain at village level. They require a high degree of mechanical skills which are not easily available at village level. They are easily susceptible to damage by misuse and overuse.

There is much scope for improvement in handpump design to make them lighter and simple enough to be maintained by village artisans who have some skills such as cycle repairing, blacksmithy, carpentry etc.

However, apart from the technological problems associated with handpump maintenance, there are considerable sociological problems which have not received sufficient attention. Even if the technical problems are overcome, the rural drinking water supply programme will continue to limp along unless the sociological environment is improved to ensure the proper procurement, storage, use and general management of water. Inherited practices and local attitudes which are not conducive to good water management need to be addressed if the ultimate objective of the programme is to be achieved, viz. improvement in the health status of the people.

In an attempt to ensure the smooth functioning of the handpumps which have already been installed, several "systems" have been tried out in different parts of the country. A 3-tier system in Tamil Nadu; a modified 3-tier system in Andhra Pradesh; and a 2-tier system in Orissa.

A voluntary organisation in Rajasthan claims that a locally developed, village based training system has reduced dependence on the government's machinery to ensure the maintenance of handpumps.

Public controversy - sometimes acrimonious - has raged over the relative merits of the different systems.

The time seemed opportune to bring together the proponents of the different systems in a "colloquium" or discussion group to examine dispassionately the strengths and weaknesses of the different maintenance systems, and to arrive at practical recommendations to improve the rural drinking water programme.

DANIDA took the initiative of proposing to the Department of Rural Development of the Government of India, the idea of having a national workshop on village-level maintenance of handpumps. DANIDA offered to bear the expenses of such a workshop and to undertake the responsibility for its organisation. As the nodal agency of the Technology Mission, the Department of Rural Development, Ministry of Agriculture, enthusiastically supported the idea and agreed to act as the convenor of the Workshop. It invited the most affected States to send representatives to the Workshop.

UNICEF, which has been involved with the rural drinking water supply programme for many years, and has an impressive record in the development of norms for the manufacture, quality control, installation and maintenance of handpumps, readily agreed to co-sponsor the Workshop.

On the 6th April, 1988, the "National Workshop on Village-level Maintenance of Handpumps" was formally inaugurated by Dr. Harnam Singh, Commissioner of Nagpur Division, Maharashtra. Mr. T.G. Shankaran, Additional Advisor to the Department of Rural Development, Government of India gave the keynote address outlining the policy of the Government of India with regard to the rural drinking water supply programme.

About ninety-five people participated in this Workshop. They represented State Governments which are implementing the rural drinking water supply schemes: Andhra Pradesh, Assam, Gujarat, Karnataka, Tamil Nadu, Uttar Pradesh and Maharashtra; voluntary agencies; manufacturers of handpumps and parts; inspection agencies, and the Bureau of Indian Standards. (See Annexure 1 for list of participants). UNICEF was well represented by its officers from Andhra Pradesh, Uttar Pradesh, and Maharashtra, North India Office and the Regional Office for South Central Asia. SIDA (the Swedish International Development Agency) and DANIDA were the Bilateral Agencies present. The DANIDA supported projects in Orissa, Karnataka, Madhya Pradesh, Kerala and Tamil Nadu were also represented.

This was the first time ever that such a cross-section of implementing agencies, bilaterals, manufacturers, inspecting agencies, voluntary agencies and others had come together to deliberate on the problems of rural drinking water supply - more specifically through handpumps - and to propose strategies to overcome these problems.

The Workshop served as a common forum for the exchange of experiences and for reflection on the lessons learnt from the variety of such experiences from different parts of the country.

The Workshop also provided the opportunity to the participants to establish communications among themselves, which will hopefully lead to future collaboration on a continuing basis.

The Workshop provided the opportunity to clarify the perceptions of the various participants of the objectives, strategies and operational methods of the different agencies: official, bilateral, voluntary, international.

Above all, the Workshop created a friendly atmosphere for cordial discussions in a spirit of co-operation and mutual support. The participants discovered that they were all working towards the common objective of providing safe drinking water and sanitation to the rural areas; they were not in competition with one another, but they were cooperators in a common cause.

Some representative presentations were made in the plenary sessions in the mornings by State Government implementing departments, voluntary agencies, and bilaterally assisted projects. Manufacturers described the continuing research and testing on improved handpump designs to develop a truly "Village Level Operation and Maintenance" (VLOM) handpump.

The afternoon sessions were devoted to in-depth discussions on issues in small groups. There were five discussion groups made up of between 18 to 20 persons.

The group discussions centered around important issues such as the ability of village communities to take over full responsibility for the maintenance of handpumps; the training needs ofvillagers (specially of village women) to enable them to take over from the government departments the responsibility for the operation and maintenance of handpumps; the identification and training of villagers - specially women - to enhance their leadership abilities as a means of ensuring community participation in the rural drinking water supply programme; the training needs of junior engineers and assistant engineers of public health engineering departments to enable them to become effective agents for the transfer of technical knowledge and skills to village mechanics; the development of communication and training methods to enhance community involvement in the programme, etc.

The discussions in small working groups proved to be very fruitful and stimulating. The reports of these group discussions were presented to the plenary sessions at the end of the day. The main ideas which emerged from the discussions are outlined in the "Summary of Conclusions and Recommendations".

Since some of the Papers which were presented at the Workshop will be of interest to a wider audience, and since the Summary of Conclusions and Recommendations might stimulate thinking and action along the lines envisaged in the Workshop, we thought that it would be useful to publish these in the form of a Report of the Workshop. While we would like to express our thanks to all those who submitted papers, we offer our apologies for not being able to incorporate all the papers in this Report. This is no reflection on the quality of the papers. The constraints of space and size of the Report were determining factors.

Our thanks are due to the Department of Rural Development, Ministry of Agriculture, Government of India for its cooperation and unhesitating support to our efforts.

UNICEF has been a very dependable partner. Its advice and suggestions have been valuable.

We thank the various State Governments for deputing their officers to this Workshop. We hope that their participation will enhance their own effectiveness and contribute beneficially to their ongoing programmes.

The manufacturers and Inspecting Agencies listened very carefully to the views expressed by the implementing bodies and the voluntary agencies. We trust that the Workshop will contribute to their efforts to develop more appropriate handpumps and to ensure quality spare parts which will make the task of maintenance easier.

The voluntary agencies have a special talent to serve as promoters and catalysts. Their presence in such large numbers at this Workshop augurs well for the success of the programme. We are grateful for their participation.

We would like to extend our special thanks to the Director and the Staff of NEERI whose efficient administrative support was indispensable for the success ofthe Workshop.

New Delhi, May 1988.

Averthanus L. D'Souza,
Consultant & Chief Rapporteur.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

The DANIDA supported National Workshop on village-level maintenance of handpumps, which took place at the National Environmental Engineering Research Institute(NEERI), Nagpur from April 6th. to 8th., 1988, brought together about 95 delegates from all over India. They represented a cross-section of agencies involved with the implementation of the rural drinking water supply programme in the country - government departments such as the PHED, PRED, GSDA, TWAD, GWSSB, etc.; voluntary agencies; manufacturers of handpumps and spare parts; inspection agencies; UNICEF, SIDA and Danida projects.

The Government departments which are implementing rural drinking water schemes with assistance from Bilateral Agencies shared their experiences about the handpumps maintenance programme. Voluntary Agencies presented case studies of their experiences with the use of different kinds of handpumps, and their experiments with the training of village artisans to become handpump mechanics. Manufacturers of handpumps explained the progress which they have made in designing VLOM handpumps. By using working models, they demonstrated the Improvements made in the designs.

Presentation of Position Papers were made in plenary sessions, after which the participants broke up into smaller working groups to discuss issues in greater depth.

The main issues on which the discussions focussed were:

* the possibility of delegating entire responsibility for handpump maintenance to the village communities.

* the ability of village communities to assume the responsibility for maintaining handpumps.

* the need to involve women as community leaders to ensure proper maintenance of handpumps as well as to motivate users to make the best use of safe drinking water provided by the handpumps.

* the need to train handpump mechanics from among village artisans such as cycle repairers, blacksmiths, etc.

* the need to create general awareness in villagers about the health benefits resulting from the use of safe drinking water and proper disposal of waste.

* the need to train Assistant Engineers and Junior Engineers to become trainers of village mechanics and to serve as channels for the transfer of technical knowledge and skills.

There was remarkable consensus on the need to delegate to the village communities the responsibility for the maintenance of handpumps. The discussions revealed, however, that villagers will accept this responsibility only if they feel a sense of ownership of the handpumps. At present their perception is that the handpumps belong to the Government, which is therefore, also expected to maintain them. In order to change this perception, the Workshop recommended that the village communities be involved in the handpump programme from the very beginning - the planning of installations, the selection of sites, the choice of handpumps, the identification of village mechanics to be trained as handpump mistries etc. Since women are the principal managers of water and bear the major burden of collection and use of water, the Workshop urged that influential women be identified and trained to function more effectively as community leaders.

It was recognized that school teachers and children are good resources for the communication of information and ideas about the beneficial results of the use of safe drinking water, proper storage of water, sanitary disposal of waste and good environmental sanitation. It was recommended that teachers and students be mobilized as promotors of the health movement, of which the preventive maintenance of handpumps forms an important component.

It was unanimously recognized that providing leadership training to village women, including skills in communications, can have a very positive impact.

Discussions in the Workshop revealed that concerted efforts need to be made in three areas in order to realize the ideal of village level maintenance of handpumps.

* community involvement in the programme.
* training of Assistant Engineers and Junior Engineers as trainers of village mechanics.
* development of improved handpumps to facilitate village level maintenance by handpump mistries.

The Workshop recommended that manufacturers of handpumps intensify their research to design appropriate VLOM handpumps which will lessen dependence on engineers for their maintenance and repair. These handpumps should be safe for operation by children, simple enough to be maintained by women, and capable of being repaired by village mechanics who already have skills in repairing bicycles and similar machines. Spare parts should be available easily and cheaply, and should be replaceable without much effort. The design should be such as to require simple tools which can be carried on bicycles on village roads.

The Workshop recognized that some progress had been made in the development of VLOM handpumps, but after working experience with several models and critical analysis of their performance, the Workshop was of the opinion that there was still much scope for improvement both in the design as well as in the quality of handpumps.

On the software side, the Workshop recommended that village communities be associated with the rural drinking water supply programme right from the start, in a way that they become consciously aware of their ownership of the installations in the fullest sense and of their responsibility to keep the installations in good order. The villagers should have a say in the selection of sites, in the identification of mechanics to be trained as handpump mistries, and in the formation of committees to supervise the maintenance of the handpumps. The Workshop was aware that this was a slow and difficult sociological process, but that it was indispensable for the eventual success of the programme. It was emphasized that the involvement of the community should include the weaker sections effectively, and should not be limited only to the elected bodies, which often do not represent the entire village community.

Motivation programmes and training in leadership skills are indispensable to promote community participation. The Workshop strongly recommended the setting up of village level "water committees" to supervise the programme at village level. These committees can be entrusted with the responsibility of supervising the work of the handpump mistry, deciding on the fees to be paid to the handpump mechanic, deciding on the levy to be charged from the users of the handpumps to cover the cost of maintenance, and, in general, to assume the responsibilities for the water supply programme in the village.

The Workshop was of the opinion that Assistant Engineers and Junior Engineers who are more closely in contact with villagers have greater opportunities to serve as educators and trainers, provided they are willing to accept this challenge. Assistant and Junior Engineers should not function merely as technicians who repair installations; they should facilitate the transfer of technical knowledge and skills to the villagers. Recent experiences showed that Engineers are not comfortable in the role of teachers and trainers. Their own education has been limited to technical skills.

The Workshop recommended that Assistant Engineers and Junior Engineers be given additional training in community organization and communications to enable them to become more effective communicators of technology. They need to be sensitized to the social and cultural context in which the rural drinking water supply programme is being implemented. They need to become aware of socio-economic realities in the villages - specially the needs of village women. The additional training to be given to A.Es and J.Es will enable them to become effective in technology transfer and to support the village handpump mechanics who will assume the primary responsibility for the maintenance of the handpumps.

The identification, selection and training of village mechanics forms a very important component of the programme to delegate responsibility for handpump maintenance to the local community. The Workshop strongly recommended the intensification of training courses for self-employed mechanics from the villages.

In order to achieve the targets of the International Drinking Water Supply and Sanitation Decade, efforts are being intensified to increase the installation of handpumps in villages. The Workshop was aware of the fact that an increase in the total number of handpumps installed would result in a corresponding increase in the need to maintain these installations in working condition . Since the problems of maintenance are more complex in relation to the installation of handpumps, it was recommended that efforts to set up effective maintenance system be stepped up with greater vigour. For the maintenance systems to become viable, the Workshop recommended that additional attention be paid to the following:

Mobilization of local resources:

To lessen the dependence of the villages on the government services which are already overloaded, it is necessary to transfer full ownership of the handpump installations to the village communities. This can be formalized by a ceremonial handing-over of a certificate of ownership. Through intensive education, the villagers need to be made aware of their responsibility to maintain the handpumps in working order. In order to do this, they have to identify local artisans who can be trained as handpump mistries/ mechanics. They have also to contribute financially to the upkeep of the installations and the wages of the mistries.

Intensification of training programmes:

In order to upgrade the available technical/mechanical skills in the villages, and to reduce the dependence on the services of engineers from government departments, well-planned and effective training programmes should be undertaken at village level, or for a group of villages.

Change in strategy of official agencies:

Instead of concentrating on the provision of hardware and engineering services, as is being done at present, official agencies should actively seek and encourage the participation of voluntary agencies in the rural drinking water supply programme. Voluntary agencies have developed special skills in community organization, health education and motivational programmes, which can be harnessed by official agencies. Official attitudes need to be changed to bring about effective participation by voluntary agencies.

Incorporation of socio-economic cells in departments:

Existing departments of State Governments which are responsible for the rural drinking water supply programme should induct qualified sociologists and economists into the departments to ensure that the sociological and cultural aspects of the programme are not neglected. In many Bilaterally assisted projects, where socio-economic cells have been set up, there is clear evidence that they have proved to be beneficial.

Involvement of women:

Since women are the principal managers of water, and have to bear the brunt of the burden when water is not easily available, they should be induced to assume greater responsibility in the decision making process. Leadership training for women can help to increase their confidence and their communication skills. In the selection of caretakers, women should be given the first priority. Even in training programmes for handpump mechanics, efforts should be made to select and train women, wherever possible.

Payment by users:

Corresponding to the transfer of ownership of the handpumps to the village communities, is the responsibility of maintenance of the installations. Collection of a cess for the water should be the responsibility of the local "water committee" or the panchayat. This recovery of the costs of maintaining the handpumps will not only solve the financial problems associated with maintenance, but will reinforce the sense of ownership of the handpumps by the villages.

Preventive maintenance:

It is evident that wherever an effective maintenance system has been set up, with emphasis on preventive maintenance and regular inspection of all handpump installations, the frequency of breakdowns has been substantially reduced, and the life of the handpumps has been increased. The upgrading of local technical capabilities, supported by a good maintenance system, can ensure constant, uninterrupted supply of clean drinking water to the villages. Preventive maintenance should be given as much (in fact, more) importance as the installation of handpumps.

GENERAL OBSERVATIONS

The participants of this Workshop expressed great satisfaction about the process and the contents of the Workshop. They were able to share experiences and ideas in conducive atmosphere, and suggested that a similar Workshop be organised in future to review the progress made in the rural drinking water supply programme in the light of the recommendations coming out of this Workshop. As a modification of this suggestion, it was recommended that regional workshops be held prior to the next national Workshop.

HAND PUMP MAINTENANCE PROGRAMME IN ANDHRA PRADESH

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I take pleasure in presenting this paper on this occasion on behalf of Panchayati Raj Engineering Department, Government of Andhra Pradesh.

1.0 INTRODUCTION:

Andhra Pradesh is one of the major states of the Indian Union having a geographical area of nearly 2.77 lakhs square Kms. According to 1981 census the total population of the state is 53.54 million. There are 27,379 Revenue villages. Apart from this there are 37,864 hamlets in the State. About 77% of the population of the state (i.e.,) nearly 40.98 million lives in rural areas.

1.1 ANDHRA PRADESH - "MARK-II STATE":

Deep bore wells fitted with India Mark-II hand pumps to be most helpful for meeting the drinking water requirements. The speed in execution, simplecity in operation and economical - makes the provision of hand pump for drinking water purpose as a first choice. The population of hand pumps is increasing day by day and today there are 1,40,183 hand pumps installed in rural areas alone all over the state catering to the basic drinking water need of the rural lot in Andhra Pradesh. Andhra Pradesh stands first in hand pumps strength among all states in the country. All the old sub-standard hand pumps about 20,000 are rejuvenated with India Mark-II hand pumps. NOW, ANDHRA PRADESH IS A "MARK-II STATE". It is planned to provide about 20,000 bore well hand pumps before 1990 to cover left over problem villages to achieve the goal of International Drinking Water Supply and Sanitation Decade.

2.0 MAINTENANCE OF HAND PUMPS:

Maintenance of hand pumps is an important and vital aspect of Rural Water Supply Programme in Andhra Pradesh. Effective maintenance of hand pumps goes a long way in successful provision of clean and safe drinking water. Hand pump programme without a effective maintenance structure is incomplete. Maintenance is a tangible requirement and the question should be how it should be structured. The

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question is whether it should be responsibility of the Government or the community or both. Certainly it is the responsibility of both agencies.

2.1 THREE-TIER MAINTEANCE SYSTEM:

The Three-tier system was initially proposed in Andhra Pradesh at the advent of the programme in late 70's. Its pattern is as shown below.

1. District level - one mobile team for 500 hand pumps.
2. Block level - one pump mechanic for 50 hand pumps.
3. Village level - one caretaker for each hand pump.

This system worked well in the initial stages when the number of pumps were low. But, with the population of pumps gradually increased touching a figure of 400 to 500 in the Block requiring 8 to 10 mechanics at the middile-tier at the Block level, the system proved to be un-economical and expensive. The Government of Andhra Pradesh is providing an amount of Rs. 360/- per hand pump per annum for the maintenance of hand pumps which is not sufficient under three-tier system and ultimately adopted the feasible two-tier system.

2.2 VIABLE SYSTEM - TWO-TIER SYSTEM:

In order to reduce the number of inoperative hand pumps to serve the rural population effectively, after careful examination the Government of Andhra Pradesh has accepted vide Memo No. 46630/RWS-I/83-1, Dated 9-2-1985, to implement the viable two-tier system of hand pump maintenance in Andhra Pradesh. One of the reasons for adopting this system is the increase in number of hand pumps at Block level which is beyong capabilities of the pump mechanics since the major repairs require lifting of pipes, rods etc., for which atleat two or three persons more are required. Thus, leading improper maintenance thereby causing public suffering. Two-tier system is an improved system on three-tier system by despencing the middle tier of three-tier system and decentralising the teams to the Block level. This system is more economical and effective to reduce down time of hand pump. The maintenance duties are shared between the village caretaker and the Block level mobile team.

2.2.1 MOBILE TEAM AT BLOCK LEVEL:

The hand pump mobile team consisting of five persons stationed at Block Head Quarters acquiped with special tool, standard tools, complete spare parts etc., is incharge for maintenance of 500 hand pumps. Besides, the team is also responsible for installation of hand pumps on new bore wells in its jurisdiction. Decentralising the team at the Block level reduces the travel distances and therefore the expenditure on fuel and wear & tear of the mobile vehicle can be minimised. The well equiped team attends all types of major and minor repairs effectively than the Block mechanics and check hand pumps periodically which facilitate to minimised the down time of the hand pump.

2.2.2 HAND PUMP CARETAKER AT VILLAGE LEVEL:

The 2nd tier of the new maintenance system i.e., the village caretaker is essential for the success of the entire system. The village caretaker is a volunteer and receives no payment from the Government but his position carries some prestige. Unless the mobile team at Block level is informed promptly when a hand pump breaks down, repairs will be delayed and the maintenance system will not function as intended. The success of any Government programme depends on the percentage of community participation. Suitable village youth (Men or Women) is being selected by the Inter-Departmental team and trained for two days as hand pump caretaker. Women are give preference while selection as they are the users of hand pumps. He/she attends preventive maintenance to hand pump, reports hand pump break down to authorities, educate the villagers on importance of safe drinking water and proper operation of hand pump and maintain hand pump log sheet. The community participation not only result in better care and timely upkeep of the pump but also stimulate related activities such as health education and the proper use of water including economy in maintenance cost. So far 38,586 caretakers are trained in all the districts of Andhra Pradesh out of which, 2,800 are women caretakers.

3.0 SUCCESS OF TWO-TIER SYSTEM IN ANDHRA PRADESH:

Government of Andhra Pradesh while adopting the Two-tier system, as decided to implement this system in three phases. Initially, it is started in 6 districts under first phase. During 1985, State Government has procured 26 vehicles and UNICEF supplied some more. With the existing and new vehicles sufficient mobile teams could be constituted in three distrist and partially in other three districts.

3.1 The two-tier system will be extended to all distrists in Andhra Pradesh in 2nd and 3rd phases. To cover entire state 280 vehicles are required for constituting required number of mobile teams, with the existing pump mechanics. Out of this, 135 vehicles are existing in the state. Proposals were submitted to the state Government for procurement of additional vehicles. Though the initial cost of purchasing vehicles for constituting teams is more, the system is very much effective and also economical in the long run.

3.1 In the three districts so far covered fully, the results are very much encourasing. Under this system, it is found that 92 to 97 percentage of hand pumps are in working condition at any given time. Based on the field experience and feed back the comparision on working of hand pumps before and after the implementation of two-tier system is given below.

COMPARISION OF HAND PUMPS IN WORKING CONDITION BEFORE AND AFTER TWO-TIER SYSTEM INTRODUCED.

Sl No.	Name of the District.	No.of handpumps in the Dist. excluding condemned hand pumps.	No.of handpumps in working condition.	% of hand pumps in working condition.
I.	As on 1.2.86 (before two-tier system was introduced)			
1.	Kurnool	6338	5056	79.77
2.	Mahabubnagar	5936	4698	79.14
3.	Ranga Reddy	4440	3263	73.49
II.	As on 1.2.87 (after two-tier system)			
1	Kurnool	6786	6648	97.97
2.	Mahabubnagar	6659	6128	92.00
3.	Ranaga Reddy	4851	4670	96.27

Thus, it can be seen from the above comparision that the hand pumps in working condition is arround 75% before two-tier system was introduced. It can also be seen that working condition of the hand pumps is increased 20% after two-tier system is introduced. The success of two-tier system goes a longway in effective implementation of Rural Water Supply Programme in Andhra Pradesh.

4.0 HAND PUMP DEMONSTRATION PROJECT IN ANDHRA PRADESH:

This project is started on 1.2.88 in selected district Rangareddy of Andhra Pradesh, with UNICEF assistance for Research & Development of India Mark-II hand pump. Under this project about 30 VLOM (Village Level Operation and Maintenance) and 30 modified India Mark-II hand pumps will be installed in the selected villages. A well equiped special team is constituted for effective monitoring the project. The major part of the monitoring exercise will include the need to assess the users reaction compared to the standard India Mark-II and more importantly to assess the possibility of adopting simpler maintenance proceedures and system. UNICEF is also assisting in supply of extra deep well India Mark-II hand pumps to install on bore wells where in the static water level as gone below 40 metres.

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HAND PUMP MAINTENANCE SYSTEM IN TAMIL NADU

The maxim of 'Tamil Veda' states that the world and the life systems will not exist without water.

In the last part of this 20th century, our country, particularly the southern part of India is facing a crisis on the water front. In the last three successive years Tamil Nadu is continuously reeling under drought. The water crisis has resulted due to various factors. Particularly as a result of increased urbanisation of green lands, forest has started to recede, giving way to the onslaught of the concrete jungle. This has changed the seasons, rains have become scarce, and due to the ground water being exploited the underground water level has started to go down by several hundred feet.

In this critical hour, the Deep Bore Hand Pump of India Mark II has come as Gods' grace to the thirsty mankind. I am not exaggerating when I say that Tamil Nadu was able to tide over the last three very bad drought years only because of India Mark II Hand Pump. Therefore it has become a necessity that this gift of God, i.e. India Mark II Hand Pump should be properly maintained.

With this in view, Tamil Nadu Government has adopted certain measures in order to see that the drinking water supply is maintained uninterruptedly in Rural areas.

Historical Background

In 1976, Tamil Nadu Water and Drainage Board took over the Rural Water supply system in Tamil Nadu. They were put incharge of the installation of Deep Bore India Mark II Hand Pumps, construction of Over Head Tanks and errection of Power Pumps. On the advice of UNICEF, a three-tier system was introduced with a Fitter Mechanic at Block level, a Mobile Team headed by an Assistant Engineer at Divisional level and an Assistant Executive Engineer at the district level.

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Because the public was not fully involved, and due to inadequate financial allocation, the maintenance system did not work as successfully as one would wish.

To solve this problem the Government entrusted the 3-tier maintenance system to the Directorate of Rural Development, which has a vast network of field staff at the grass root level, coupled with the involvement of local bodies namely the Panchayats and Panchayat Union. In 1983, the entire maintenance system was transferred to Rural Development department from Tamil Nadu Water and Drainage Board. Tamil Nadu Water and Drainage Board was allowed to continue with the installation and errection of India Mark II Hand Pumps and construction of Over Head Tanks with power pumps.

Maintenance System

In 1985, a manual of Instruction for the Maintenance of Hand Pumps was brought out by the Directorate of Rural Development for guiding the field staff.

For the maintenance of uninterrupted water supply, it is essential to see that the repairs to the broken down hand pumps are attended to, on an emergency footing. Within a period of 24 hours to 48 hours, the breakdown should be set right and the Hand Pumps made to function. But numerous Hand Pumps are spread out in hooks & corners of Blocks. Hence a quick reporting system from the village level to the Block level and Divisional level is necessary.

For this purpose, a volunteer care taker for each Hand Pump is identified and nominated. Great importance is attached to the selection of this caretaker, since he is the vital link between the Hand Pumps and the Block level mechanic. A literate village youth (either man or woman - now we are stressing on the selection of woman caretaker) in the age groups of 20 - 30 year, who is a daily user of the Hand Pump water and is service minded, who is free from any contagious disease and is generally acceptable to the local villagers, is selected by the Block Development Officer, given 2 days training in the know-how of the working of the Hand Pumps and is supplied with a double ended spanner for the purpose of tightening the bolts and nuts of the Hand Pump head. He is supplied with stamped cards for quick reporting to the Block Development Officer, when there is a breakdown.

Reporting System:

In Tamil Nadu, elaborate attention has been given to prompt rectification. Each Hand Pump is numbered with code numbers, indicating the district number, Block (i.e. Panchayat Union) number, the village number and the Hand Pump number. On just seeing the Hand Pump code number it is possible to locate the Hand Pump anywhere in Tamil Nadu. Block Map for Hand Pump and Master Register for the Hand Pumps are maintained at the Block Development Officer's office.

When a Hand Pump breaks down, the caretaker reports the fact immediately to the Block Development Officer's office through a post card or in person. The report is recorded in the Register for Breakdown handpumps on the same date by the office Manager. Each day evening the Register is shown to the Block Fitter Mechanic for noting down the particulars. Every day Block Development Officer too check up the Register, reviewing the previous reports and the action taken by the Fitter Mechanic in restoring the functioning of Hand Pump.

Instructions have been issued from the Government to all the Block Development Officers and Fitter Mechanics that minor repairs should be rectified within 48 hours from the time of receipt of the complaint and in respect of Major repairs, remedial action should be taken within seven days time limit. This system of repairing is named by the Government as "Seven Day Formula".

For major repair, if it is beyond the Fitter Mechanic capability the Mobile Team at the Divisional level is informed. Here also, the recording is made in the complaints Register.

The Government have given direction that on a fixed day, every week, the Divisional Development Officer will conduct a critical review of the maintenance. Besides the Block Development Officers and their Fitter Mechanic, the Divisional Mobile Team, the Assistant Engineer, Tamil Nadu Water and Drainage Board of that region, the Assistant Engineer of the Tamil Nadu Electricity Board will have to attend the Divisional Development Officer's review meeting.

At district level the District Collector will conduct a critical review once in every fortnight and sent his report to the Director of Rural Development. The Director of Rural Development reviews the state level maintenance performance every fortnight and send his report to Government.

This critical review at various level has yielded the desired effect and it may be noted that in the last three years the repair pendency have been kept within 2%. At any point of time 98% of the India Mark II hand pump as well as the Power Pumps have been kept functioning throughout Tamil Nadu.

The Government have issued detailed guidelines for the method of procurement of quality controlled spare parts.

Recently, we have introduced Preventive Maintenance system which involve a periodical check up of the Hand Pump and timely replacement of worne-out parts, thereby increasing the life span of the Hand Pump.

On an average, there are 150 Deep Bore Hand Pumps in each Block and about 1000 Hand Pumps at Division Level.

The Block Fitter Mechanic should inspect all the Hand Pumps once in two months, check up the working condition, and rate of discharge of water, and apply greese to the chain. His inspection route (Route Map) will be available at Block Development Officer's office and at Divisional office. The Hand Pump caretaker and the Village Panchayat President will be aware of the fixed date of the visit of the Fitter Mechanic. Similarly, the Divisional Mobile Team also have been entrusted with the preventive maintenance system in respect of deep bore well Power Pumps in addition to their attending on the major repairs of the Hand Pumps.

Since this system has been recently introduced, we are waiting for the feed back.

It is found that a Fitter Mechanic can attend to repair of 100 Hand Pumps. Since there is only one Fitter Mechanic employee on regular service in the Block Development Officer's office, it may be beyond his capacity to attend on Hand Pumps exceeding 100 numbers. In such cases, the Block Development Officers have been authorised to engage locally available Plumbers as additional Fitter Mechanics on job piece rate basis, for every 30 Hand Pumps over and above 100 Hand Pumps. The job piece rate is fixed every year by the District Collector.

The additional Fitter Mechanics are engaged on contract. we have arranged to impart training in fitter trades to the Village educated youths or mechanics through 'TRYSEM' (Training of Rural Youth for Self Employment) under Integrated Rural Development Programme. This also helps in solving employment problem of a few village youth.

Since the ground water table is receding to the depth of 200 to 400 feet in various parts of Tamil Nadu where there is acute drought, the present India Mark II Hand Pumps are becoming inadequate. Therefore we have addressed 'UNICEF' to supply heavy Duty India Mark II Hand Pumps.

On an average the cost of replacement of spare parts for India Mark II works out to Rs. 450/- per year. The Government allots a provision of Rs. 250/- per pump on an average. The balance amount is met from the local bodies funds.

The 3-tier system is quite successful in Tamil Nadu and it is needless to state that the involvement of the village volunteer and the Village Panchayat President in the maintenance of Hand Pumps is the most important factor.

PARTICULAR REGARDING THE HAND PUMPS/POWER PUMPS AS ON 15.3.88.

I.	No. of Hand Pumps		90,641
	i) Deep Bore Hand Pumps	58,132	
	ii) Shallow Hand Pumps	32,509	
II.	No. of Hand Pumps under Repair:		
	i) Permanently damaged	215	
	ii) Temporary failure due to drop in water level.	173	
	iii) Required Flushing	83	
	iv) Mino repair	599	
	TOTAL		1,070
III.	No. of Hand Pumps functioning:		89,571
	Percentage of repair		0.9%
IV.	Total No. of Power pumps:		17,801
	i) Jet	6,621	
	ii) Centrifugal	9,368	
	iii) Submersible	1,812	
V.	No. of Power Pumps under repair:		529
	i) Motor Pumps/Pipelines etc.	296	
	ii) Source failure	233	
VI.	No. of Power Pumps Functioning		17,272
	Percentage of repair		1.7%

"TWO-TIER MAINTENANCE SYSTEM IN ORISSA"

*Raj Kumar Daw and
Sanjay Kumar Khatua

During Phase-I of the Danida assisted Orissa Drinking Water Supply Project, a II-Tier Maintenance System for hand pumps was established as a Research and Development activity. Initially the system was established during Aug 86 to May 87 in the two blocks of Delang and Rajkanika, and subsequently in June 1987 in the third Phase I block Chandbali as well.

The maintenance system was based on the assumptions that:

- village artisans such as blacksmiths, cycle mechanics and carpenters, who can be trained as hand pump mechanics, exist in sufficient numbers to man a localised maintenance system.
- many of these artisans are under-employed in their trade and therefore willing to take up hand pump maintenance as supplementary activity.
- the existing social network between the artisans and their customers will facilitate communication related to hand pump maintenance and repairs.

To test these assumptions a survey of village artisans was carried out by the Socio-Economic Division of the Project in 1985. The survey documented that skilled artisans exist in sufficient numbers, and that they were willing to undergo training and work as hand pump mistries. Subsequently a comprehensive two-part training course on hand pump maintenance and repairs was conducted for selected artisans by the Training & Maintenance Division and the Socio-Economic Division.

Village artisans trained in hand pump maintenance and repairs, and equipped with the necessary tools and spareparts constitute the first tier of the system, and is referred to as Self Employed Mechanics (SEMs). Each SEM is supposed to be responsible for the maintenance of about 20 hand pumps.

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At block level, the second tier consists of one PHED Junior Engineer (JE) and a repair crew, who assists the SEMs in the block with repair work when necessary, issues spare-parts, and monitors the performance of the SEMs and the hand pumps by conducting regular meetings and field visits.

General Findings:

Among the objectives defined in the formulation of the II-Tier Maintenance System, the following have been fulfilled so far:

- SEMs have been trained and equipped to undertake all tasks related to maintenance and repair of hand pumps in three blocks.
- The SEM's routine preventive maintenance has been found to contribute significantly to a reduction in the incidence of breakdowns of India Mark II hand pumps.
- The communication between villagers and SEMs appear to function as assumed, since there is no significant time gap between the breakdown of hand humps and their repair. This conclusion is supported by monitoring data, which do not show reports of pump breakdowns over long periods.
- Villages have been motivated to some degree in accepting a resident local artisan in his new role as SEM. This acceptance, however, is fragile and only exists as long as the SEM (and by implication the maintenance system as such) is capable of rectifying problems when they occur. Thus, villagers will also hold the SEM responsible for rectification of problems such as low yield or water quality problems, which neither he nor the maintenance system is presently capable of rectifying.
- A viable system of remuneration for the SEM's services has been established through local banks.

- Though it was observed during June 1987 that the objective of allotting about 20 hand pumps per SEM was not achieved, this has been achieved by February 1988. On an average each SEM has been allotted 19 pumps. There are, however, cases where an SEM has less than 10 hand pumps. In such cases the motivation of the SEM is reduced, since his income becomes too low to form an attactive supplement to his original trade.

The following objectives have not yet been fulfilled:

- Bottle necks in the supply of spareparts, administrative, and technical support from the 2nd tier (Junior Engineer at the block level), are not yet fully removed in this system.

- The 2nd tier at the Block level has not yet fully developed the capability to take on the responsibility as the first line of administration of the maintenance system. Reporting and control of the maintenance system is therefore weak. Lack of motivation and familiarity with maintenance of hand pumps on the part of the JEs appear to be the main reason for this.

- Apart from reporting breakdowns to the SEM, villagers are not yet sufficiently motivated to actively assist the SEM in his maintenance and repair activities.

- No specific steps have been taken so far to organise some form of community contribution towards maintenance of hand pumps. A study of the feasibility of establishing a community payment system for hand pump maintenance has been carried out. Any activities by the project in this regard will depend on the conclusion of the report, but the preliminary findings of the study are not encouraging with regard to the establishment of a user payment system.

Specific findings:

- The majority of artisans identified as SEMs by SED are village blacksmiths. The other artisans who have become SEMs are cycle mechanics.

- Initially a total of 70 artisans were identified in the two Blocks, 59 were selected for training and 48 finally commissioned as SEMs.

- Training of selected artisans was done in two phases with group of about 10 artisans at a time at field locations.

- Training material and curricula, considering literacy and comprehension levels of artisans, were formulated specially for this purpose.

- The first phase of training prepared SEMs for undertaking preventive maintenance of pumps. The second phase taught them all aspects of major and minor repairs. Record keeping needs was an integral part both training phases.

- Commissioning of SEMs after training included execution of contracts between the Project and the SEMs, handover of bicycles and tools, and handover of pumps given to the SEMs for maintenance.

- Due to the low number of pumps in SEMs' operational areas and the delayed procurement of tools and bicycles, commissioning of SEMs and allotment of pumps had to be postponed on many occasions.

- Monitoring data on the SEMs performance show that regular, preventive maintenance is carried out by almost all SEMs.

- News about pump breakdowns reach the SEM through various channels of the "informal reporting system" and most repairs are attended to within the following day.

- SEMs are able to maintain their own records with few exceptions only. Illiterate SEMs seek assistance from literate family members or neighbours.

- A system of direct transfer of remuneration from the project to the SEM through local banks has been established.

- A system of direct transfer of remuneration from the project to the SEM through local banks has been established.

- The 2nd Tier has been made responsible for technical checks of completed pumps and their handover for maintenance to the 1st Tier, the SEMs.

- The 2nd tier has also been made responsible for field monitoring of the performance of the SEM through monthly meetings and field visits for repair and monitoring, supply of spareparts, technical back-up to the 1st Tier and maintenance of records at Block level.

- The Maintenance system has been monitored with the intention of creating a data base for the evaluation of all its components.

- Another purpose for monitoring the system was to continuously identify bottlenecks occuring and introduce consequent changes to improve the system.

- The monitoring methodology included interviews with SEMs, their responses to questionnaires, monthly meetings at block level with the Junior Engineer and Socio-Economist and recording of maintenance data in registers and log sheets.

- The frequency of major repairs for India Mark-II handpumps have been generally low. Minor repairs have generally been limited to replacements of nuts and bolts.

- The frequency of breakdowns of Inalsa Suction pumps has been high. This has severely strained the supply of necessary spareparts, because of a high failure rate of one particular component.

Replicability:

Since the II Tier Maintenance System has been established as a research and development activity, its viability and replicability requires consideration.

- The selection and training of village artisans as SEMs has provided the basis for an adequate organisational framework for establishment of a maintenance and repair system in the context of the Orissa Drinking Water Project.

This, however, has only being and will only be the case to the extent that two preconditioned are fullfilled:

This, however, has only been and will only be the case to the extent that two preconditions are fulfilled:

- The second tier must be trained, equipped and motivated to render the necessary support functions to the first tier in the form of training, assistance with complicated repair operations, supply of spareparts, and monitoring. The performance of the second tier in these aspects has not been adequate during the period when the II Tier Maintenance System has been tried out as a research and development activity. There is no reason to assume that it will perform better, if it is instituted as a regular feature within PHED, since there will then be less scope for the flexibility and ongoing adjustments, which have ensured the relative success of the system as a research & development activity.

- The quality of the tubewells must be such, that their performance in terms of yield and water quality do not jeopardise the maintenance and repair tasks, which the SEMs are supposed to perform. Villagers are not familiar with the intricacies of tubewells and hand pumps, and will hold the SEM and other persons associated with the maintenance system responsible for any fault which occurs with the installation. To the extent that such problems occur, and they have been found to increase with time, the SEMs will find themselves incapable of performing their role and will gradually loose the confidence of the villagers on which the future success of the system rests. Therefore it is imperative that resources and manpower are allocated, be it within or outside the maintenance system, to carry out ongoing rectification and redrilling of installations which are affected by yield and water quality problems.

Provided the two conditions outlined above are fulfilled the II Tier Maintenance System can be replicated under the circumstances which prevail in the coastal belt of Orissa.

- The central feature of these circumstances is a high population density coupled with a high number of pumps within a limited geographical area. This enables a single SEM to service about 20 pumps and to provide him with an income form this work which makes the effort worthwhile.

- At the same time the area which he has to cover is so small, that the time required to perform the role as SEM does not prevent him from pursuing his original trade.

Where conditions comparable to these do not exist the II Tier Maintenance System tried out under the Orissa Drinking Water Supply Project may not be feasible.

RECOMMENDATIONS

- The identification and selection of individual SEMs demands a lot of time. In the future, initial information and motivation meetings should take place for a group of artisans at a central location at a time.

- The limitation of selecting blacksmiths and cycle mechanics only as SEMs, should be further relaxed in Blocks where such artisans are fewer in number. In such cases the choice of potential SEMs should also include motivated, literate youth and other mechanics having a fixed work place.

- The major responsibility of conducting the training was borne by SED with TMD sharing the responsibilities to a lesser degree. This had advantages in terms of close communication between the Socio-economists and the artisans and disadvantages in terms of a weak contribution by Junior Engineers in their unfamiliar role as trainers.

- Training and orientation of Junior Engineers in their new role as trainers is a necessary prerequisite for successful establishment of the system in future.

- If the present payment system is to continue, TMD has to take over the responsibility of its administration in order to demonstrate its viability within the normal funding frame-work of PHED.

- A more systematic reporting of the follow-up action taken by the 2nd Tier after receiving reports of problems from the 1st Tier at Monthly Meetings needs to be established. It will then give an indication of the extent to which the 2nd Tier is able to fulfil its supportive role to the 1st Tier.

- Follow-up action on SEMs' reports about water quality problems to the 2nd Tier needs attention. This activity was not initially foreseen as the task of the 2nd Tier, and needs the direct attention of the Project.

- Monthly meetings involving all SEMs in a Block, the Junior Engineer, the Socio-economist and the JEs crew have served the dual purpose of monitoring the performance of the II-Tier system, and monitoring the performance of handpump installations of the project. Monthly meetings should be given high priority in the monitoring of the system. However, monitoring data emerging from monthly meetings need to be supplemented by periodical monitoring of each individual SEM's performance.

- At present the records maintained by the 2nd Tier do not give a clear picture of repairs carried out. New records have been designed so that accurate timely data can be available in future.

- The record keeping system for spare parts is very inadequate, and conclusions regarding the consumption of spareparts remain tentative.

- Monitoring data on the SEMs performance show that regular, preventive maintenance is carried out by almost all SEMs.

- Detailed data analysis from the maintenance data of Delang indicates that valuable insight can be gained from close monitoring of the maintenance system. Such information can indicate areas of weakness, utilization of spare parts, frequency and nature of problems with installations, and the pattern of gradual deterioration of installations with time. This data base can be strengthened and refined to yield much more information. Therefore, though the data collection needs may seem very elaborate, it is undoubtedly yielding some of the desired results, and should be refined further into a useful management tool.

Editor's Note

This is only the summary of the Paper presented by the Danida Project Directorate, Bhubaneshwar.

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DECENTRALISED THREE TIER HANDPUMP MAINTENANCE SYSTEM IN CHANDRAPUR DISTRICT OF MAHARASHTRA

*BY VISHWAS JOSHI

INTRODUCTION

In Maharashtra, like most other States in the country, the three tier handpump maintenance system was introduced in 1978.

The three tier handpump maintenance system with a handpump caretaker for each handpump at village level, a block level mechanic for every 50 installations and a mobile team for every 500 installations at district level is structured to suit local administration.

However, what was agreed on paper was not put into practice, and inspite of assistance from the Government and International Organisations and groups, the handpump maintenance programme continues to be far from satisfactory in many states. The results of status survey of the handpump installations organised by UNICEF in five states in 1985, indicated that on an average 75% of the handpumps remain idle at any given time, for want of repairs.

Three tier handpump maintenance system and the associated Weak points

The successful operation of the three tier handpump maintenance programme required the planning, organisation and assured financial and administrative support. In the initial years, the scheme suffered due to lack of financial and administrative support from the respective Governments. The system thus suffered the following drawbacks.

1. The required number of skilled hands were never appointed for the want of funds.

2. Although the number of handpump installations increased every year, additional vehicles required as per norms were never provided by the State until recently.

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3. For the want of suitable manpower, preventive maintenance was not practised and the handpumps were serviced and repaired only on the basis of breakdown reports.

4. The required number of handpump caretakers were never appointed, for the want of funds and trainers to train handpump caretakers, and due to disinterest of the Officials and administrators.

5. In the absence of village level handpump caretaker, the breakdown reports seldom reach the maintenance department on time, therefore the communication gap between the users and the maintenance team continues to exist.

6. In the absence of suitable monitoring system, the status reports prepared by the department continued to present an "All well picture".

On the other hand, the number of the handpump installations continued to increase by leaps and bounds as the speed of the Rural Water Supply Programme accelerated with the declaration of the International Drinking Water and Sanitation Decade 1981-1990.

As the quantum increased, many Government departments adopted the policy of hiring contractors on turnkey basis, to undertake the drilling and handpump installation job. The entry of hundreds of drilling contractors led to the deterioration of the quality of work. The RWS Programme soon became a game of numbers rather than being a programme implemented for providing safe and adequate water to those who needed it the most.

In the meanwhile, the pressure on the maintenance system continued to increase. In due course of time, the maintenance structure created to look after a few hundred handpumps per district crumpled under the increasing work load.

During the year 1985, in Maharashtra, the ratio of mobile maintenance team to the handpump installations was 1:1150. The three tier maintenance system thus became ineffective and outdated even before it was properly implemented.

Identification of the problem

The problem associated with the handpump maintenance programme is that of reaching the services to remote villages. Today there are an average of 2,783 handpump installations per district and about 10,000 powerpump installations in the state. The monitoring and maintenance of such a large number of installations from the district Headquarters has become difficult if not impossible. Further, it is observed that in the absence of preventive care and maintenance by the actual users, the mobile teams are busy with repairs organised on fire fighting basis and carried out on war footings.

The borewell handpump programme is carried out in phases and involves professionals of various disciplines. It goes without saying that the quality of the work done in say Phase I will affect the quality of the work to be done in the subsequent phases. The handpump maintenance programme is the last phase of the RWS Programme. The first phase being Ground water investigation and site selection, and the second phase being water well drilling and pump installation.

The evaluation of the maintenance system is always done in terms of percentage of working handpumps at any given time, without realising the fact that many of the problems associated with the handpump maintenance have been passed down to the maintenance department from the phase I and II, due to lack of supervision and quality control, on a one time activity like drilling and platform construction.

Since the scope of the work of the maintenance department does not include drilling and initial installation of the handpump, solutions to problems associated with the handpump maintenance programme can not be searched in isolation, simply by restructuring the maintenance system.

Thus separate efforts must be made to improve the quality of the work done during phase I and Phase II.

The Genesis of the Modification

The Genesis of the modified three tier handpump maintenance system is based on the following objectives.

1. To provide preventive maintenance facilities to all handpump installations at regular intervals and thereby reduce the frequency of failures and major breakdowns.

2. To create a breakdown reporting system, in accordance with the local communication facilities to enable the benefeciaries to report breakdowns without a time lag.

3. To reallocate maintenance facilities within the reach and within the control of the beneficiaries, to reduce the number of non functional days and to overcome the delays caused due to the non availability of transport facilities.

PROJECT AREA

Chandrapur is one of the several tribal districts of Maharashtra. The main constraint in the development programme of the district are the remotely located villages, many of which are not accessable for the best part of the year. Therefore, in the absence of suitable communication facilities, it becomes very difficult to provide these villages even with the basic services and to maintain the facilities provided, under the MNP (minimum need programme) such as a village handpump.

The only alternative to improve the situation is to establish a (maintenance) system design to incorporate effective preventive measures, and facilities to attend to the common breakdown repairs locally and thereby reduce the dependance on any outside help to the minimum.

A handpump maintenance programme designed on the above principles was introduced in Chandrapur district in January 1987 as a modification of the existing three tier handpump maintenance system.

INFRASTRUCTURE OF THE DECENTRALISED HANDPUMP MAINTENANCE SYSTEM

There are ten blocks in the Chandrapur district. For the purpose of the handpump maintenance programme, each block is further subdivided into a number of zones. A cluster of 8 to 10 villages is grouped to form a zone. A zone is made up on the basis of existing communication facilities such as Postal services, common market place and a road to make sure that all villages in the zone can be approached from the zone headquarters. The ten blocks of Chandrapur district are subdivided into 70 zones on the above basis.

First Tier :

A village handpump mechanic(VHM) is appointed for each zone. He is stationed at the Zone headquarters. His duties and responsibilities include preventive maintenance and breakdown repair of both the above and below ground assembly parts.

Prior to their appointments, the VHMs are thoroughly trained to undertake preventive maintenance, and breakdown repairs by the Deputy Engineer (Handpump) GSDA, Zilla Parishad. The VHMs are also briefed on how to keep records of handpump maintenance activities and to file weekly progress reports.

Following the completion of the training and at the time of his appointment at the zone headquarters, he is provided with a tool kit (Appendix I) a set of spares (Appendix II) and a detailed list of the handpump installations (Appendix III).

The village handpump mechanic is instructed to visit the handpump installations in his zone regularly and send weekly reports of his visit and the repairs carried out to the Block Development Office in a format (B). For his service, the VHM is paid @ Rs. 15/- per pump on the basis of the certificate issued by the Sarpanch and verified by the Deputy Engineer. The VHM is supposed to repair the pump within 7 (seven days) from the date of failure. If the pump remains unattended to for more than 7 days, no payment is made to the VHM for the particular pump and a fine of Rs. 30/- is deducted from his wages.

Second Tier

At Block Level, a Sub-Engineer (Mistry Grade II) is appointed to supervise the work done by the VHM. The responsibilities of the Sub-Engineer include the following.

1. Supervision of work done by the VHM, and to organise the repairs of handpump not attended by the VHMs.

2. Distribution of and reimbursement of spares to VHM.

3. Compiling weekly and monthly progress reports for the Block Office on the basis of reports received from the VHMs.

4. Preparation and verification of the Pay bill for the VHMs in the block.

5. Organising and supervising platform rejuvenation work.

6. Any other work related to the handpump maintenance programme, as directed by the Deputy Engineer (Mech) Handpumps.

Third Tier

The Deputy Engineer (Mech) handpump GSDA, Zilla Parishad is the overall in charge and acts as the coordinator for all activities related to the handpump maintenance programme in the district. His activities include the following:

1. Selection and training of the VHMs

2. Creation of zones and zone headquarters for the purpose of organising decentralised handpump maintenance programme and appointing the VHMs for each zone and informing the Village Panchayat and Block Division Office about the appointment of the VHMs covering their area.

3. Providing toolkits and spares to the VHMs (procurement).

4. Monitoring the work of handpump Mistry Grade II

5. Compiling monthly progress reports on the basis of reports received from the VHMs and Block Office.

6. Verification of Pay bills of VHMs on the basis of weekly and monthly progress reports received from the Block Office.

7. Organising repairs of the handpump installation not attended to by the village handpump mechanic.

8. Allocating new handpump installations to the respective zone.

9. Appointment of new VHMs for the dropouts.

The decentralised three tier handpump maintenance system as described above has been operating in the Chandrapur District for the last 15 months.

Table 1 is the progress report showing the status of the handpump and powerpump installations under the RWS Programme for the week ending February 20th, 1988. The details such as the number and percentage of working handpumps, number of breakdown reports received and the number of handpumps repaired etc are also provided in the table.

Before the modified decentralised system was put into operation, each Gram Panchayat was informed about their responsibilities towards the village handpumps by way of a circular issued by the Chief Executive Officer.

A printed book consisting of instruction of the operation of the modified three tier handpump maintenance programme including the list of the villages and the list of handpumps installed in each village alongwith the code number of each installation were provided to all the Gram Panchayats and BDOs. The Gram Panchayats have been instructed to provide casual labour to the VHM as and when required for the below ground assembly repairs.

Finance :

Since the system has been in operation only for the last 15 months, as yet efforts have not been made to work out the cost. However, details of the financial arrangements are provided as under:

1. The training of the VHMs are organised using funds made available under TRYSEM programme.

2. A tool kit and a set of spares and a bicycle (optional) was provided to each VHM at subsidised cost by arranging loan facilities through nationalised banks.

The VHMs are paid for their work by the Zilla Parishad from the Water Fund created at the District Level. The Payments are done by the BDO, on the basis of bills verified by the Deputy Engineer. To avoid delay, a sum sufficient enough to cover payment of two months estimated cost on the basis of the total number of pumps in the block is provided to the BDO as advance. During 1987-88, an estimated Rs. 4,25,000 will be required to pay the wages of the VHMs. The State Government provides 80% as grant in aid towards the district water fund. The remaining 20% funds are contributed by the Zilla Parishad from its own reserves.

Observations:

1. The VHMs (70 Nos) were trained in two batches in 1986, well in advance before implementing the modified decentralised handpump maintenance system.

2. Presently, 7 VHMs are under training. They will be appointed as the work load increases when new installations are added. The training is thus an ongoing activity.

3. The discussion with the VHMs revealed that most of the VHMs had no source of regular income, prior to their appointment as VHM.

4. The average monthly remuneration received by the VHM, exceeds the average monthly income of semi/unskilled labour, engaged on other works such as road and building construction, forestry and agriculture.

5. On an average most VHMs put in about 12 to 15 man days to complete their assigned duties including preventive maintenance and repairs of handpumps allocated to their respective zones. However, only some VHMs use their newly acquired skill and available man days to supplement their income by undertaking jobs like plumbing and installation and repair of Bio-gas plants.

6. On an average, each VHM is allocated 32 handpumps (the minimum and maximum number of handpumps allocated being 26 and 39 respectively. The VHMs have requested for more equitable allocation.

7. The monthly remuneration received by the VHMs vary from Rs. 390/- to Rs. 585/-.

8. Imposing a fine of Rs. 30/- for not attending repairs to the handpumps within the stipulated period of 7 days appears to be harsh, but the Deputy Engineer incharge insists that this will help to ensure that the VHMs put their maximum effort to keep that handpump working.

9. Most VHMs reported that the repairs are undertaken the same day, if the handpump is found to be out of order on the day of the visit, or within the next 2 days if the breakdown report is reported to them prior to their next scheduled visit.

10. The average monthly instalment for repayment is Rs. 100/-, but many VHMs reported that they pay as much as Rs. 150/- per month as they want to repay the loan as early as possible.

11. It was observed that most of the VHMs appointed in Chandrapur are in their early 30s and many of them belong to the Schedule Tribes.

12. Some VHMs complained about the quality of tools (pipe clamp) and spares (lip cup washers) and the fact that they have to pay to keep spares in ready stock with them.

CONCLUSION AND RECOMMENDATIONS

The Modified decentralised three tier handpump maintenance system implemented in Chandrapur district appears to have achieved a satisfactory level of efficiency. The system is properly planned supervised and managed.

It appears that most of the VHMs have taken up the work as an assured source of monthly income. Socially, the controlling factors appear to be low average monthly income and high unemployment rate in the rural area of the district. These two factors should be properly evaluated.

The Modified III Tier decentralised handpump maintenance system appears to be a suitable alternative to the existing three tier system. The system helps to eliminate problems such as non availability of transport, communication gap between users and the maintenance department, and provides for preventive maintenance and breakdown repair and services at village level within the reach of the benefeciaries or actual users.

The other important aspect of this system is it provides for modification without disturbing the existing infrastructure, and it retains an involvement of the various officials to suit local administration. Thus with suitable modifications to take care of socio economic factors discussed above, the modified decentralised III tier handpump maintenance system can be tried in other areas of the State or country.

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APPENDIX I

LIST OF TOOL KIT PROVIDED TO HANDPUMP MECHANIC

1.	Self locking clamp		1 No
2.	Pipe Wrench	24"	3 Nos
3.	Pipe Wrench	18"	2 Nos
4.	Pipe wrench	12"	1 No
5.	Hammer	½lb	1 No
6.	Hacksaw frame		1 No
7.	Screwdriver	12"	1 No
8.	Flat B. file	12"	1 No
9.	"D" Spanner	17 x 19 mm	2 Nos
10.	Ring Spanner	17 x 19 mm	2 Nos
11.	Crank spanner	17 x 19 mm	1 No
12.	Adjustable spanner	6"	1 No
13.	Tap set	12 mm	1 set
14.	Die set	12 mm	1 set

Note : Total Cost of tool kit = Rs. 1,800/-

APPENDIX II

LIST OF SPARES PROVIDED TO THE HANDPUMP MECHANIC

1.	Chain	3 Nos
2.	Sockets (rod)	12 Nos
3.	Nut bolts	12 Nos
4.	Chain nut bolts	6 Nos
5.	Upper Valve Guide	3 Nos
6.	Foot Valve Assembly	3 Nos
7.	Sealing rig	12 Nos
8.	Check valve retainer	3 Nos
9.	Check valve guide	2 Nos
10.	Cupwasher	12 Nos
11.	Upper valve Assembly	3 Nos
12.	Spacer	3 Nos
13.	Yoke body	3 Nos
14.	Axle pin/bearing set	1 No
15.	Folower	2 Nos
16.	Rubber seal for upper valve	12 Nos
17.	Rubber seal for lower valve	6 Nos

Note: Total cost of providing spares = Rs. 1800/-

APPENDIX III

BOREWELL HANDPUMP INSTALLATION MUSTER

Name of Mechanic : Mr. M.T. Meshram   Block : Bhrampuri

Zone Headquarters : Bhandara

Sr. No.	Village	Total No. of pumps	Pump Number *
1.	Bodhada	3	BHB 354/1,2,3
2.	Bandra	6	BHB 340/1,2,3,4,5,6
3.	Mudza	1	BHB 359/1
4.	Halda	2	BHB 353/1,2
5.	Baradkinhi	2	BHB 338/1,2
6.	Chichgaon	2	BHB 339/1,2
7.	Chichkheda	1	BHB 344/1
8.	Gagalwadi	5	BHB 336/1,2,3,4,5
Total No of Villages = 8; Total No of Handpumps = 22			

* BHB 354/1,2,3

- BH - Code for Block Bhrampuri
- B - Alphabetical code for zone
- 354 - Census code number for village
- 1,2,3- Serial number of the handpump installation in the village.

NOTE : The Borewell Handpump Installation Muster is kept at the Gram Panchayat Block Division Office and is updated from time to time.

Appendix

The Staffing Pattern of the Modified Decentralised Three Tier system as on February 1988

1.	Deputy Engineer (Mechanical) Handpumps	- Officer-in-charge
2.	Junior Engineer (Mechanical Supervisor	- 1 No
3.	Sub-Engineer (Mistry Grade II)	- 11 Nos
4.	Handpump Mechanics (Block Mechanics)	- 8Nos
5.	Village Handpump Mechanics (at zone)	- 70 Nos
6.	Mobile Handpump Maintenance Teams	- 4 Nos
7.	Mobile Platform rejuvenation teams	- 1 No
8.	Handpump Mechanics (one per mobile team)	- 4 Nos

TABLE I

KEY REPORT ON THE STATUS OF HANDPUMP AND POWERPUMPS INSTALLED UNDER THE RWS PROGRAMME UPTO 20.2.1988, IN THE DISTRICT OF CHANDRAPUR

Block	Total No of Handpumps	Working Handpumps & %age	Handpumps under repairs	No of Handpumps repaired during the week	Total No of Powerpumps	No of Functioning Powerpumps	No of non-functioning Powerpumps	No of Power pumps repaired during the week	No of Village Mechanics	Av No Of Pumps per VHM
Chandrapur	92	83 - 90.2	9	--	18	9	3	--	3	31
Mool	305	286 - 92.18	24	2	16	12	4	--	8	38
Gondpipri	238	234 - 98.73	3	14	12	9	2	--	9	26
Barora	157	142 - 96.81	5	6	14	13	1	--	6	26
Bhadravati	88	86 - 97.72	2	5	14	12	2	--	3	29
Chimur	329	314 - 95.44	15	4	32	23	9	1	10	33
Bhramapuri	241	246 - 9[illegible].0	5	1	11	8	3	--	8	31
Nagbhide	232	221 - 98.70	3	10	20	16	4	11	7	33
Shindewahi	237	231 - 97.46	6	3	12	7	5	--	7	34
Rajura	305	274 - 89.83	31	--	26	24	2	--	9	39
Total	2236	2133 - 95.40	103	45	170	133	35	2	70	Av. 32 HPs pwe VHM

[A]

C O M P L A I N T   R E G I S T E R

(To be maintained at the Block and District Office)

ate	Name of the Village	Complaint registered by	No of the broken handpump	Date since the pump is not functioning	Nature of the failure	Name of the person allocated for repairs	Date of repairs carried out	Remarks

[B] MONTHLY REPORT ON PREVENTIVE MAINTENANCE AND HANDPUMP REPAIRS

Month ____________

.ame of the Gram Panchayat ______________________

lock ______________________

Zone ______________________

Sr No	Pump No.	Location	Date of failure	Date of repairs	No of Non-functional days during the operating month	Date of visit of Handpump Mechanic I II	Unsolved Problems or complaints if any	Remarks

____
Mechanic
Name and Signature

____
Sarpanch
Name and Signature

Format 'C'

MONTHLY WAGES FOR HANDPUMP MAINTENANCE AND REPAIRS

MONTH ____________ 19

Block ____________

Zone ____________

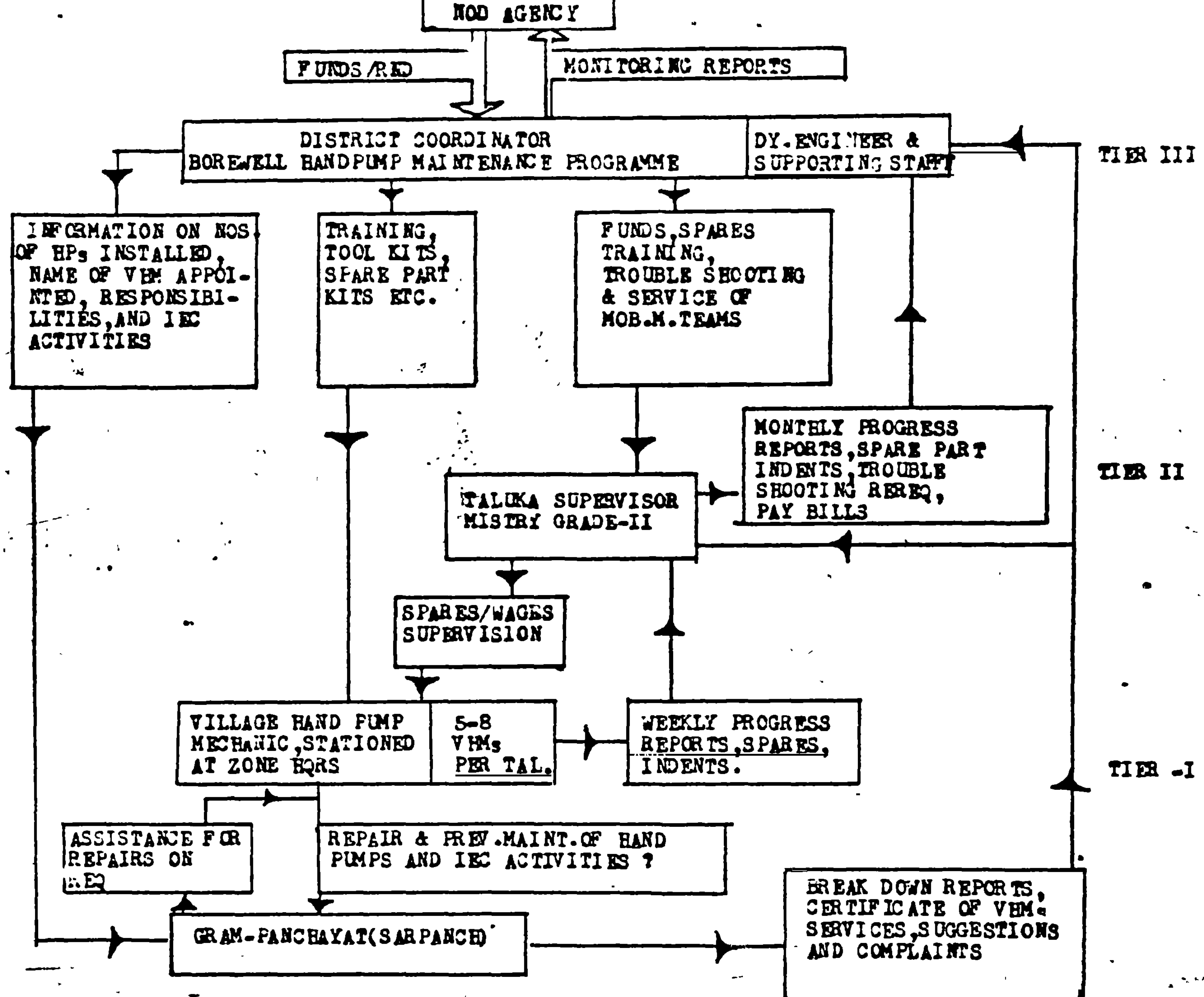
Name of the Mechanic ______________________________

Sr No	Name of the Village	Pump No.	Date of Installation or repairs	No of non-functional days during the month	Recommended for payment of wages Yes/No	Wages in Rupees	No of days the pump was out of order	Wages Sanctioned by the Dy Engineer	Remarks

Mr ______________________ Handpump Mechanic of __________ Zone shoul be paid Rs ____________ Rupees ____________ against ____________ No of pumps @ of Rs __________ Per pump, as his wages. An amount of Rs __________ should be deducted from h wages , as the ____________ pump was non functional for more than seven days

____
Deputy Engineer

____
Mechanic



SCHEMATIC DIAGRAM OF MODIFIED DECENTRALISED III TIER HAND PUMP MAINTENANCE SYSTEM

INDIA MARK-II AND DECENTRALISED MAINTENANCE

*T. Kanagarajan

INTRODUCTION

"M A R K - I I" Yes! it is a household word because of the change it has brought about in the people's living, particularly in the rural areas. This Mark-II, the Miracle pump has broken the barriers of caste and creed by meeting the basic essential human need - "Safe Drinking Water" I wonder whether there is any other single equipment that has caused such a tremendous change in the rural areas, that too, at a very low cost. This pump has played a key role in the Rural Water Supply programme during the international Drinking Water Supply and Sanitation decade.

HISTORY OF HANDPUMPS

We are all aware of Dempster pump, Double guide pump, conversion head, Sholapur pump, Jalna pump, Bangalore pump, Vadala pump, etc. which were used during late sixties and early seventies under the India Rural Water Supply programme. A survey carried out by UNICEF in 1972 on these old generation pumps revealed the fact that about 75% of them were not functioning at any given time. This was mainly due to:

- Sub-standard cast iron handpumps
- Too many fast wearing parts
- Lack of standard design
- Lack of inter-changeability of the parts
- Inability to withstand community use or abuse.

As you all know, most of these defects have been overcome in the India Mark-II Handpump which was developed by UNICEF, in coordination with certain voluntary agencies, based in Maharashtra, Richardson & Cruddas a Govt. of India undertaking, MERADO (CSIR unit), Madras and Tamilnadu Water Supply & Drainage Board by end 1976. The Mark-II Handpump can be operated even by a small child, work for longer hours and lift water from deeper levels.

NATIONAL DEEPWELL HANDPUMP

UNICEF, by assigning quality control agents, has been able to qualify 43 manufacturers in India to produce over

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*Project Officer, UNICEF, Hyderabad, A.P.

1,50,000 quality India Mark-II handpumps annually and spare parts according to the ISI 9301 - 1984 design accepted by Indian Standards Institution. The handpump installation have been greatly improved with continuous training specially developed tools and equipments. The maintenance of handpumps, which is the last, but the most vital component of the entire rural water supply programme, was possible, manageable and viable with India Marg-II. All the state Governments in the country are procuring Mark-II pumps with ISI mark and pre-delivery inspection by independent agencies like CA or SGS and installing over the Borewells. Thus India Mark-II has become the only "National Deepwell Handpump" in the world. These pumps designed, developed and manufactured in India are presently exported to over 35 countries.

INTRODUCTION OF MARK-II IN THE FIELD

UNICEF began providing India Mark-II pumps for rejuvenating the existing borewells with broken down pumps. The purpose was to convince the State Governments that the India Mark-II was a better handpump and that by standardising one pump (firstly through rejuvenation, secondly installing over all new borewells), it would be possible to build up systems for maintenance of these handpumps.

HANDPUMP MAINTENANCE

A National Conference was conducted by Government of India and UNICEF on Deepwell Handpumps from 10 to 13 July 1979 at Madurai in Tamilnadu in which representatives from various state Governments participated. All the participant states agreed to introduce a three-tier system of Handpump maintenance which was one of the 25 recommendations of the Confernece. Though many states claim to have established a three-tier system, actually none of the states have established fully. The main reason why the system has not resulted success in all places, as achieved in selected areas is the lack of seven 'Ms'.

Money
Manpower (skilled, trained)
Mobility (for mechanics/teams)
Materials (spares, tools and equipments)
Management (resources)
Maintenance (Preventive and cost effective)
Motivation (among villagers)

This is also confirmed in the sixth five year plan.

SURVEY ON INDIA MARK-II HANDPUMP

UNICEF assigned 'Operations Research Group' (ORG) to carry out a survey on the installation, maintenance and functioning of India Mark-II handpumps. ORG carried out the survey from July to December 1985 in the states of Bihar, Uttar Pradesh, Rajasthan, Andhra Pradesh, Tamilnadu and Madhya Pradesh. Totally 4840 handpumps were surveyed in 154 villages spread over 18 districts in six states.

The overall picture is encouraging, i.e. 80% of the pumps were found to be in working condition. This is a clear dramatic reversal of the situation that existed in 1972, when 75% of the old generation handpumps were noted to be out of order. You will appreciate that the maintenance systems, both 'preventive' and 'curative' should be geared up with the provision of basic facilities.

TWO-TIER MAINTENANCE SYSTEM

Experience has shown that Piped Water Supply schemes originally designed for urban areas and adapted for village application were found to be too expensive to construct, operate and maintain on a nation-wide basis. Therefore more and more developing countries started implementing the RWS programme through drilled borewells, fitted with Handpumps.

During 1981 to 1984, many states started drilling borewells and installing handpumps on a massive scale. In 1984, each block in Andhra Pradesh started having about 400 borewell handpumps.

Therefore, it was thought of decentralising "district" mobile maintenance teams to "block" levels. Thus each block mobile maintenance team will look after 500 handpumps or all the pumps in the block for maintenance as well as instal pumps over the new borewells.

THREE VS TWO TIER SYSTEMS

Level of Operation

Level of (Tier) of operation	III tier system	II tier system
DISTRICT	One mobile team for 500 pumps.	---
BLOCK	One mechanic for 50 pumps	One mobile team for 500 pumps
VILLAGE	One caretaker for each pump	One caretaker for each pump.

PHYSICAL REQUIREMENT FOR 1000 HANDPUMPS

DESCRIPTION	III tier system	II tier system
	(District level)	(Block level)
Mobile Maintenance teams (2) (Personnel 5x2 = 10)	10	10
Trucks	2	2
Block Mechanics	20	-
Caretaker	1000	1000

ANNUAL FINANCIAL REQUIREMENT FOR 1000 HANDPUMPS

	DESCRIPTION	III tier system Rs.	II tier system Rs.
I.	Personnel - Mobile team Rs. 800 per person per month for 10 persons (2 teams at one for 500 pumps).	96,000	96,000
II.	Trucks Rs. 35,000/- and Rs. 25,000/- per truck for two trucks (at one for 500 pumps per team) three and two tier systems respectively.	70,000	50,000
III.	Block level mechanics at Rs. 800/- per person per month for 20 mechanics (at one mechanic for 50 pumps)	1,92,000	-
	TOTAL	3,58,000	1,46,000

Therefore the annual maintenance cost of each pump under three-tier and two-tier are Rs. 358/- and Rs. 146/- respectively.

The expenditure on training caretakers and cost of spare parts remain same in both systems. Based on the experience we can include Rs. 134/- per pump for spare parts. Thus the total cost on maintenance under three and two tier is Rs. 492/- and Rs. 280/- respectively.

TWO TIER EXPERIMENT IN ANDHRA PRADESH

The advantages of a two-tier system compared to three-tier are:

- Less manpower
- Less expensive
- Lesser travel distances
- Lesser fuel/wear and tear of vehicle
- Quality work
- Faster repairs
- And above all, minimum down time for the handpumps.

The system worked well. Convinced by the encouraging results of the system, Govt. of Andhra Pradesh divided the 22 rural districts into 3 phases to establish the first tier.

The State Government, for the first time, with its own funds, procured 26 trucks for handpump programme during 1986, formed teams and established the first tier of the two-tier system fully in the six districts under Phase I.

They propose to buy about 81 more trucks with Government funds to fully establish the first tier in the 5 and 11 districts under second and third phases respectively. UNICEF would continue to support their attempt by providing some more trucks.

EXPERIENCE IN KARNATAKA

Public Health Engineering Department in Karnataka was motivated by the viability of the two-tier system implemented in Andhra Pradesh. Based on the request of the Chief Engineer, PHE, UNICEF provided adequate trucks and demonstrated the advantages of the system in Bidar district during 1985. Anticipating the increase in the number of Borewell Handpumps, the Government of Karnataka decided to extend the system to cover the entire state. Therefore, the State Government with its own funds procured 44 tractors and 29 trucks from 1985 to 1987. Following the lines of UNICEF and Government, DANIDA also provided 13 and 40 trucks to four districts assisted by them. Thus, Karnataka has become the only state which has fully established the first tier i.e. one Mobile team at each of the 175 block headquarters. Due to the availability of sufficient teams and trucks, it is practically found that the teams are installing handpumps over the new borewells, in addition to attending to the maintenance.

ROUTE MAP SYSTEM

Many states are doing "repair maintenance" i.e., repairing the pump after breakdown. Due to the availability of adequate teams and mobility for them, PHE Karnataka, under two-tier system, has been able to implement a "ROUTE MAP SYSTEM" to attend to "Preventive Maintenance" also which has been neglected by most of the states. Under this system, the mobile teams follow a fixed schedule and attend to "preventive" as well as "curative maintenance". It is found that due to the teams attending to preventive maintenance, the incidence of curative maintenance has come down considerably.

SECOND TIER AT VILLAGE LEVEL

Andhra Pradesh and Karnataka States have trained over 40,000 and 7,000 women and men selected by the villagers as caretakers, who are attending to the preventive maintenance of the pumps. They are reporting the pump breakdowns through pre-stamped, pre-addressed post cards. They are encouraged by the fellow villagers' appreciation and support for their voluntary service in providing people's basid felt need - Safe Drinking Water.

MAINTENANCE BY VILLAGERS

Mark-II has gained the confidence of millions of Indian villagers and given them hope of getting continuous supply of safe drinking water. If this is to become a long-term solution and all the benefits of safe drinking water are to accrue, then a higher density of handpumps will be required along with other basic services and villagers themselves will take on an increasing responsibility towards maintenance of handpumps.

It is ultimately necessary that the villagers contribute towards the cost of repairs to the pumps and carry out repairs by themselves. The ideal solution is a pump that can be maintained by the users themselves. But unfortunately, the present India Mark-II Handpump structure needs minimum four trained persons to carry out major repairs which involves riser pipes, rods, special tools and equipments. Meanwhile, efforts are made to decentralise the Two Tier System further to village levels.

Perhaps when the VLOM Mark-II pump (Village Level Operation and Maintenance) is installed, it can be repaired by two well trained villagers with minimum tools, efforts, time and cost. This would be the most economically viable and truly community based maintenance. Ofcourse, at that time, the role of village caretakers could be vital to carry out major repairs and they will be less dependent on the handpump teams. Yes, the technology could be further simplified and demystified. Let us all join together and bring THAT DAY closer and true!.

Where there is a will, there is a way!

THE STORY OF INDIA MARK II DEEPWELL HAND PUMP

*S.R. Alagarsamy; Ashraf Ali; K. Muralidharan;

The India Mark II Deepwell Handpumps, after its development and marketing since 1977 not only has revolutionised the Rural Water Supply Programmes of India and other third world countries, but also has created history over the last ten years and is one of the very few Indian products that have found world wide acceptance in preference over handpumps manufactured by almost every industrialised nation. The India Mark II pump has thus become world renowned. It is rightly said that it is a MIRACLE PUMP which has made tremendous changes in the life style of millions of rural masses. It is, therefore, natural to know more about its origin and development. Hence, this presentation.

In the early 1960's the Jalna based Church of Scotland Mission have been using handpumps of local make which were cast iron copies of European and American handpumps. These were primarily meant for family use rather than community purposes and hence breakdown very frequently. By the end of 1960's the Jalna pump was improvised into an all steel handpump which was based on single pivot instead of the multi pivot handle of cast iron pump. Further, the handle pivot of the pump incorporated a bearing with chain link which in turn was jointed to the connecting rod. This ensured proper alignment and the connecting rod was kept in tension at all times without reversal of stresses. Thus, the life of rods could be prolonged. With the above improvement and advantages, these pumps could find an important place and within a few years there were hundreds of these pumps in the villages of Maharashtra (India).

Thereafter, the American Mission Project at Wadia, Maharashtra improved upon the Jalna Pump. The improved version was known as the 'JALWAD' pump. Although the design was almost the same as Jalna pump, it was more accurately made and also more durable than the Jalna pump.
These pumps proved to be a vast improvement over the cast iron models produced in India at that juncture.

*Richardson & Cruddas (1972) Ltd., Madras.

In the early 1970's the Shollapur Well Service, Maharashtra designed a handpump which was similar in many ways to the Jalna Pump. The Shollapur Pump was however more professionally engineered and accurately manufactured on jigs and fixtures. Further, the Shollapur pump contained a completely new pivot arrangement which prevented the lateral movement of the bearing which in turn ensured long term bearing life. In addition, to the above, the Shollapur pump incorporated the additional features viz. a roller chain which operates over a quadrant. The pump had a pedestal which fits the bore well casing pipe to help ensure an effective sanitary seal.

Later AFARM (Action for Agriculture Renewal in Maharashtra) copied the Shollapur design and started introducing the same. By 1974 several thousand Jalna, Jalwad and Shollapur pumps had been installed within and around Maharashtra. At this stage, a spot survey carried out by UNICEF in Tamil Nadu indicated that atleast 75% of the handpumps were broken down at any given time, the reason being that the pumps were made without any standard drawings and hence the interchangeability of parts was difficult. The flange to flange arrangement did not posses rigidity. The pipe was jointed directly to body through a nipple and reducer which did not last. The threads in the body were quickly worn out and the handle was not sturdy as it was made of hollow pipe. The mechanical advantage was less and the pump required frequent replacement on account of high breakdown. Further, the effort required to operate these pumps were high.

In order to develop a fool proof pump, the Government of India and WHO organised a handpump workshop in Bangalore wherein several recommendations with regard to new design were proposed based on the design of the Jalna pump of cast iron construction. However, these Bangalore pumps never went into production. Work was also initiated on a deepwell cylinder of non metallic component, for a lower cost than the brass cylinder, which were common at that time. These cylinders were tested in laboratory by MERADO which subsequently failed during test.

Under the circumstances, it was felt necessary for development of an improved handpump and a programme of rejuvenation. This was the beginning of the WORLD FAMOUS INDIA MARK II DEEPWELL HANDPUMP. From this moment onwards Richardson & Cruddas started working on the development in close association with UNICEF and MERADO. The Shollapur handpump was taken as base for development.

The main features of India Mark-II Pump are :-

i) A modular three part design viz. head assembly, water chamber and stand which made installation and repair easier. The pedestal provides a convenient base for mounting a new head design or a power pumps.

ii) The pump does not have any compound curve except the quardrant which can be easily bent and radiused.

iii) The pedestal was increased from four to six inches to accommodate a six inch casing pipe which was then common.

iv) The pipe handle was replaced with a solid bar handle which could counter balance the weight of the connecting rod and make it possible for young children to operate with ease.

v) The pump incorporated a number of design features to make it easier to maintain and prevent tampering.

With the above modifications and improvements in the pump, efforts were put in simultaneously for development of an efficient cylinder assembly so that the complete unit could be tested concurrently. The cast iron handpump cylinders introduced by UNICEF many years earlier was considered for adoption after necessary modification in India Mark II Pumps. This was twelve-inch brass lined cast iron cylinder, which was shorter, cheaper and more durable than the all-brass cylinders which was common at that time.

After the development of India Mark II pump, twelve test pumps with Shollapur cylinders of a ball valve type were put in for field trials for one year in Coimbatore, Tamilnadu State, from October 1976 to October 1977. All these pumps worked excellantly well under heavy use. However, there were certain minor shortcomings in regard to mechanical advantage and durability of certain components, which were subsequently improved by incorporating heavy duty handle stops, flange gussets and longer handles, which in turn could provide greater mechanical advantage.

Major design & construction features of India Mark II Pumps :

The major design and construction features of India Mark II Pump is as follows :-

Component :	Feature :
Handle Assembly :	- Solid bar handle to counter balance the weight of connecting rods.
	- Chain Linkage for gravity return of piston.
	- Quadrant and chain for perfect alignment of connecting rod.
	- Washer for preventing wetting of chain.
	- Sealed ball bearing.
Head Assembly :	- Flange mounting of water tank.
	- Sturdy mild steel box with handle pivot.
	- Inspection cover with a single bolt.
	- Heavy duty handle stop to safeguard rough use and resulting in no damage.
Water Tank	- Flange mounting to pump-stand
	- Angled spout preventing ingress of debris.
	- Heavy duty riser pipe holder raised above the spout to prevent ingress of debris to cylinder.

Pumpstand :

- Flange mounting at the top to accommodate alternative pump-heads including power pumps.
- 6 inch ID pipe of pump stand fitting over bore well casing pipe to ensure sanitary seal by preventing infiltration of polluted water to well.
- Angle iron legs for ensuring a firm bond to the concrete base.

Connecting Rods:

- Electrogalvanised mild steel bars of 3 metre length for easy handling.
- Welded couplings for easy installation and maintenance.

Cylinder Assembly:

- Low cost brass lined cast iron assembly to protect life of bucket washer.
- Chrome tanned leather washers
- Rubber seated valve puppets for effective sealing.

PERFORMANCE OF INDIA MARK II DEEPWELL HANDPUMPS :

The performance of India Mark II Deepwell Handpumps were characterised for the following :-

i) Water table Vs Pumping Force
ii) Water Table Vs Discharge rate
iii) Pumping Strokes Vs Discharge Rate
iv) Head Vs. Mechanical Efficiency.

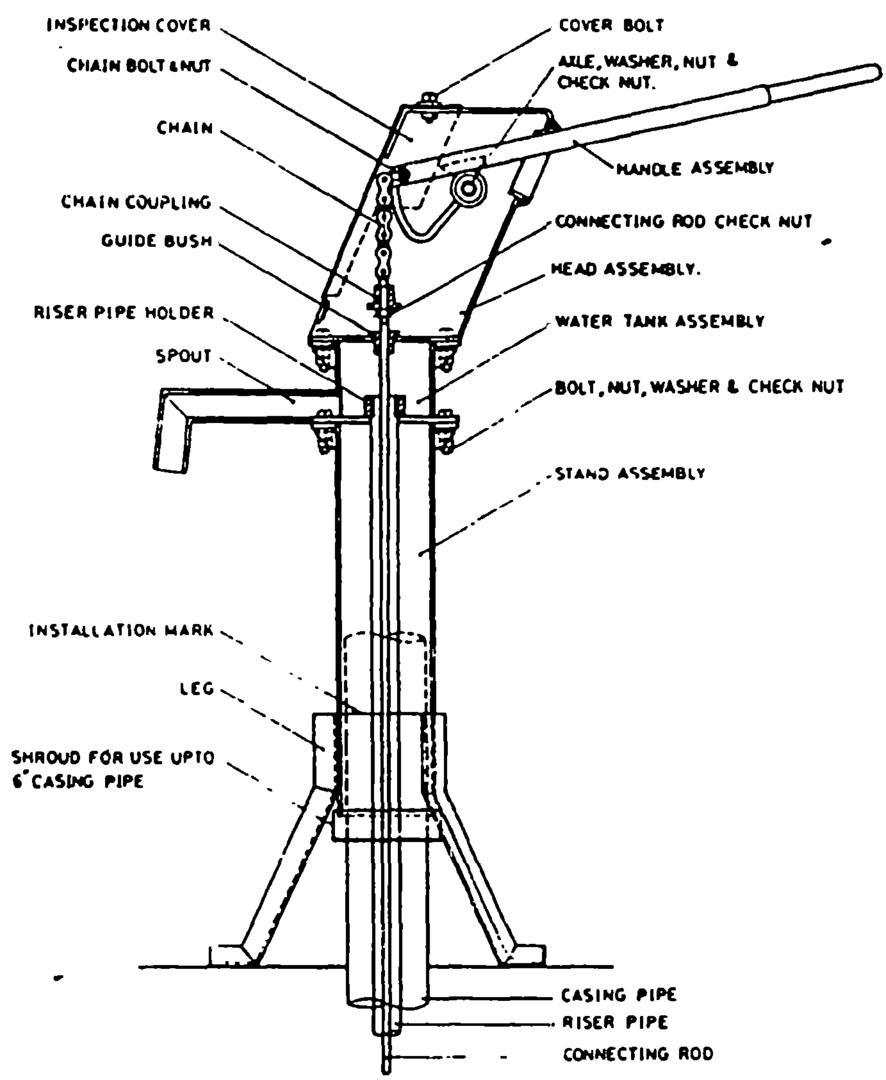
The results are shown in the following figures (attached):

FIGURE I : Depth of water Table Vs. Pumping Force

FIGURE 2 : Water Table Vs. Discharge Rate

FIGURE 3 : Discharge Rate Vs. Pumping Stroke

FIGURE 4 : Mechanical Efficiency Vs. Pumping Depth.



SECTIONAL DETAILS
OF PUMPHEAD ASSEMBLY

RICHARDSON & CRUDDAS (1972) LTD
(A GOVT OF INDIA UNDERTAKING)
23 RAJAJI SALAI, MADRAS - 600 001

Figure 1

DEPTH OF WATER TABLE VS PUMPING FORCE OF 2.5" CYLINDER

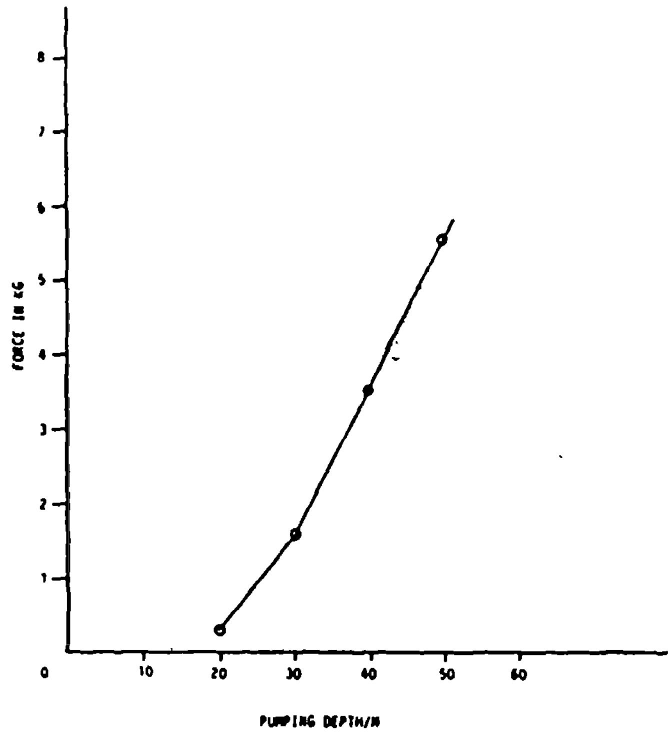


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Figure 2

WATER TABLE VS DISCHARGE RATE

INDIA MARK II DEEPWELL HANDPUMP WITH 2.5" CYLINDER

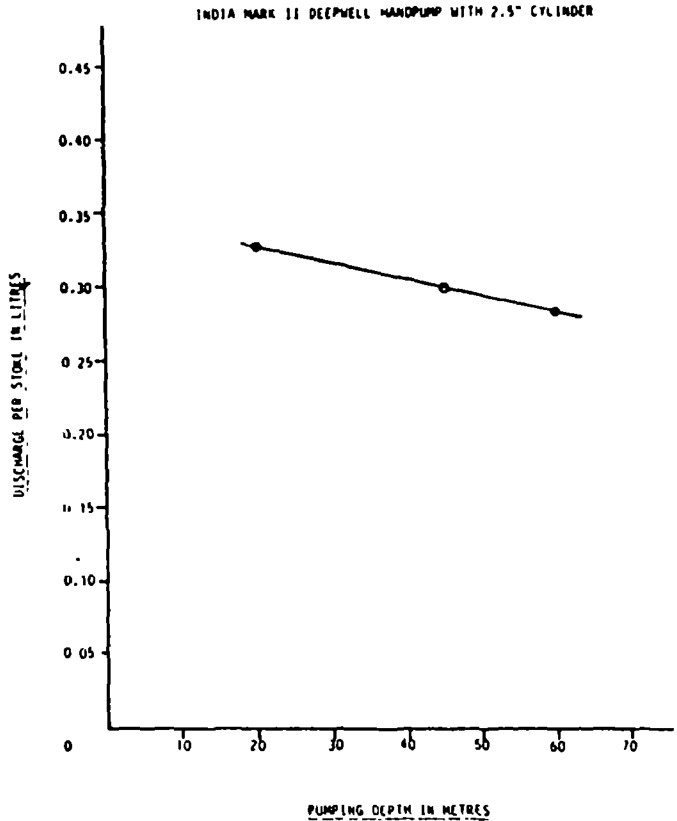

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Figure 3

DISCHARGE RATE VS PUMPING STROKE

INDIA MARK II DEEPWELL HANDPUMP WITH 2.5" CYLINDER

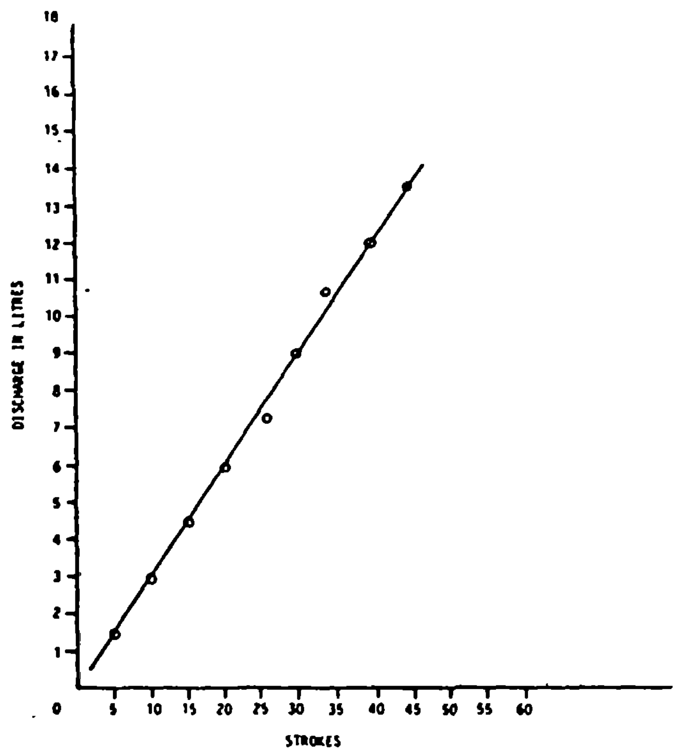

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Figure 4

MECHANICAL EFFICIENCY VS PUMPING DEPTH

INDIA MARK II DEEPWELL HANDPUMP WITH 2.5" CYLINDER

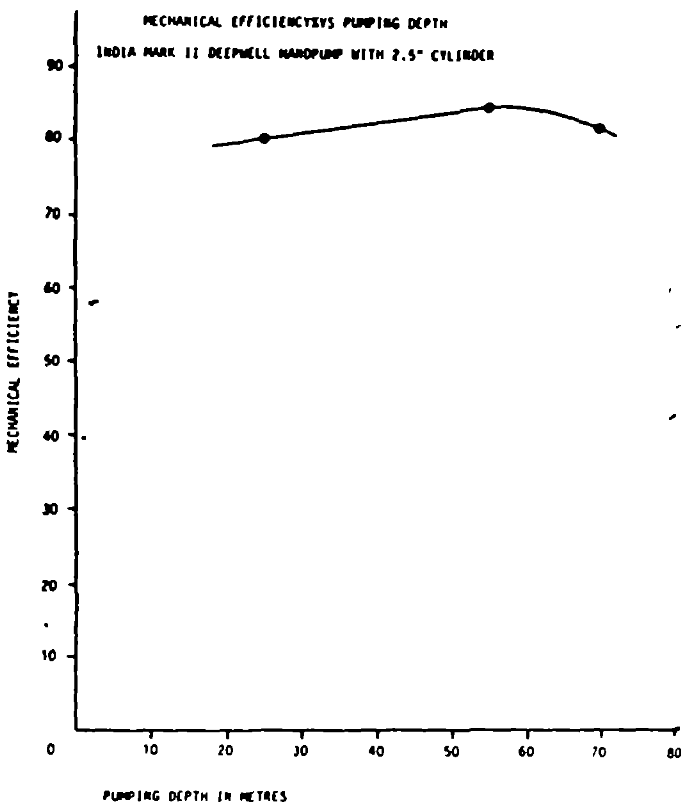

TABLE I

ABSTRACT OF ODA HANDPUMPS LABORATORY TESTING, FINAL REPORT, JANUARY 1981

Rating: 1 Poor, 5 Very Good

CODE	Manufacturer (Country of origin)	Model	Deep Shallow	Ex-Factory Cost per pump	Type of pump	Ease of Maintenance & repair	Hours	Failures	Results of Endurance Test: Performance	Reliability	Wear
A	Vergnet (France)	Hydro-pompe Type AC 2	Deep	421.7 (complete to 50m)	Foot-operated hydraulic operation, diaphragmatic hose	4	1317 7000	Significant wear in pedal rod guide pedal rod guide worn right through	Acceptable low efficiency	Fairly good	
B	Mono (England)	ES 30		370.4 (complete to 10m)	Hand-operated rotary, helical screw type operation	2		No failures occured (However continual oil leakage from gearbox)	Poor	Very good	
C	Climax (England)	Not Stated	Deep	730.9 (complete to 21m)	Hand-operated flywheel-lift pump	1	1323	Water leaking from pumpstand inspection covers. 1355 Handle fractured	Good	Very good	Likely to be minimal
D	Godwin (England)	W1 HS1	Deep	865.5 (complete to 21m)	Hand-operated geared lift pump	1		No failures occured	Adequate	Excellent	
L	ABI (Ivory Coast)	Type M	Deep	358.3 (Excl. pipe & rod)	Hand-operated lift pump	2		No failures occured	Good	Good in test but sharp metal/metal stops may cause field problems	Unlikely to cause problems
F	GSW (Beatty) (Canada)	1205	Deep	163 (Excl. pipe and rod)	Hand operated lift pump	2		No failures occured	Fairly good	Quite good	
G	Monarch (Canada)	P3	Deep	359 (complete to 30m)	Hand operated lift pump	2	2772 3692	Wooden handle loose. Pump rod top guide bush worn through	Good	Quite good	
H	Consallen (England)	D5	Deep	296.8 (complete to 20m)	Hand-operated lift pump	3		No failures occured	Quite good	Very good	
I	India (India)	Mark II	Deep	240 (complete to to 30m)	Hand-operated lift pump	2		No failures occured	Fairly good	Excellent	Unlikely to be a problem

It is seen from the figures noted above that the force required varies from 0.35 to 4.5 kgs. for pumping depth of 20 metres-45 metres, the discharge per stroke is found to vary from 0.33 to 0.3 litres for pump depth of 20 metres to 45 metres. Accordingly, the discharge varies from 1.5 litres to 12 litres for a stroke of 5 to 40. It is generally taken that 40 strokes a minute is considered as the best average thus, the India Mark II will give 12 litres per minute.

The mechanical efficiency varies from 79% to 82% for a pumping depth of 70 metres. Generally, the average pump depth for India Mark II standard pump is 45 metres. Thus the mechanical efficiency is found to be of the order of 85%.

The consumer association and Research Laboratory, U.K. had undertaken an extensive testing programme of the available deepwell handpump in the year 1982/83. Out of eleven types of deepwell pumps tested the India Mark II Deepwell handpump has shown very satisfactory performance in all respects for its price (Table I) enclosed.

As on date there are more than a million handpumps in operation in India and these pumps are exported to more than forty countries.

During the course of its manufacture and development in the field certain further developments were undertaken which includes the nitrile rubber washer in place of chrome tanned leather washer and special tools for pump installation and maintenance. The nitrile rubber washer could help increasing the life of cup washer which required replacement once in six months. The special tools eliminated the use of trypod and reduced the number of people required for installation and maintenance. All these developments have been undertaken by International agency such as UNICEF, WORLD BANK and Richardson & Cruddas.

Further Development :

In order to make use of this pump for greater water depths further development programme was initiated wherein certain incorporations were made as per following details:-

The basic features of these pumps are same as Standard India Mark II Pump with following modifications :-

(a) 40mm square handle instead of 32mm square in standard pump.

(b) Counter weights are provided depending upon the depth at which the cylinder is placed.

(c) Tapper pins, are provided for easy fixing of counter weights.

(d) Three cup washers are provided for long life.

(e) Additional foot valve with strainer is provided for better performance at extra depth.

(f) The pump is supplied with synthetic rubber washers having high wear resistance.

However, same special tools of standard pumps are required for erection and repairs of these pumps.

With the above modifications the extra deepwell pumps were developed and employed for greater water depths. These extra deepwell pumps are used both in India and abroad. In India the deepest bore is for the depth of 80 metres in Belgaum, Karnataka State. Perhaps, the first deepest pump in the world is in Nigeria for a water depth of 90 metres.

Having developed the world famous India Mark II Deepwell and Extra Deepwell Pumps, now the effort is made for improving the same to arrive at VLOM Pump which will be ideally suited for Village Level Operation and Maintenance wherein the riser pipe need not be removed, for replacement of cup washers. The pumps are expected to be very simple for maintenance as it requires few ordinary tools which can be carried on cycle and the repairs can be attended to with the help of an additional person.

FUTURE HAND PUMP OF INDIA

*M.R.M.ASHRAF ALI

The India Mark II Hand Pump with modification and use with open top cylinder are suitable for operation at shallow well and deep well, wherein the removal of the riser pipe is avoided for change of cup washers, thus reducing the maintenance time by 75%.

The open top cylinder hand pump is a village level operation and maintenance level pump (VLOM) with extractable check valve. The salient features of the VLOM hand pump are as follows:-

1. The pump is specially designed and constructed to facilitate village level mechanics to attend to repairs with ease and comfort.

2. Trouble free operation

3. Repairing requires only one village level mechanic and a helper.

4. Requires four simple tools which can be carried easily for repair work.

5. The time involved to change worn out washer is only 30 minutes (maximum)

6. Does not involve removal of riser pipe to change washers.

7. With the modified construction involved in these pumps, the handle assembly need not be removed during repairs.

8. Lifting of connecting rod is easy as the movement of upper valve is arrested with help of push rod thus avoiding lifting of water column.

The basic design of & VLOM pump is same as standard India Mark II with following modification :-

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*Senior Project Engineer, M/s Richardson & Cruddas (1972) Ltd., Madras.

1. Short and small size handle assembly made 25mm square for deep well, with or without 'T' bar.

2. The head is supplied with a hole of 75 mm at the bottom instead of guide bush. An additional 6 mm plate is supplied with guide bush welded.

3. The water tank is fitted with coupling to suit 65 mm NB GI riser pipe (medium class).

4. 63.5 mm ID cast iron cylinder with brass liner fitted with bottom cap to suit check valve and top cap to facilitate extraction of plunger and check valve assemblies for repairs without lifting the riser pipe main ('65 mm GI). The rod used is same as in India Mark II Standard Pump.

5. The pump is supplied with synthetic rubber washer having high wear resistance.

For 30 metre depth installation of standard pump, the time taken to change the worn out cup washer is about 2 hours as the riser pipe is to be removed.

In the case of VLOM Pump the washer can be replaced within 30 minutes and without much strain as the riser pipe need not be removed.

Comparative benefit ratio of standard and OTC (VLOM) India Mark II Hand Pumps.

S.No	Description	Quantity:	India Mark Standard HP	India Mark (OTC) HP
1.	Hand Pump assembly	1 No	2100	2300
2.	32/65 mm GI pipe (medium)	30 M	1550	3100
3.	Installation		125	250
	Total		3775	5650

Difference in cost of installation : Rs. 1875/-

It has been observed with 80 experimental pumps in Coimbatore where 32 GI pipe is used the failure of GI riser is increasing after the 3rd year in use due to crack formed on the pipes by the rubbing action of the rod couplers and due to the use of wrench and lifting spanners on the pipe which invariably leave marks, damaging the galvanizing resulting in reduced life of riser pipe, thus it may be necessary to replace all the pipes after three to four years according to the borewell condition to reduce the number of repairs and downtime especially in aggressive ground water. The large diameter riser pipe used in OTC hand pump has more wall thickness and provides a greater margin against corrosion moreover as the 65 NB GI pipe is not removed after the initial erection it will definitely last more than double the life time compared to that of 32 mm NB GI pipe. For eight years of operation the money value of both the pipes are equalled.

During maintenance the labour charges involved for change of cup washer in Standard Pump is Rs. 60/- and that of OTC pump is Rs. 20/- assuming on an average the washers are changed twice in a year the saving per year is Rs. 80/- on OTC pump and thus in eight years it is Rs. 640/- which justifies the initial investment on pump and pipes which gives a great advantage of working with comfort with few simple tools after the initial erection. In case of breakdown the village mechanic himself can rectify without waiting for mobile unit and investment on heavy tools is also avoided. As the time required to rectify is less, more pumps can be attended without loss of time, thus this would definitely decentralise the maintenance system in favour of village maintenance.

<u>List of tools required for OTC hand pump</u>:

(a)	Connecting rod holding devices	: 1 No	Total weight of tools is six kgs.
(b)	Rod coupling spanner	: 1 No	
(c)	Crank spanner 17/19	: 2 Nos	
(d)	Connecting rod lifter	: 1 No	
(e)	Lifting adopter	: 1 No	

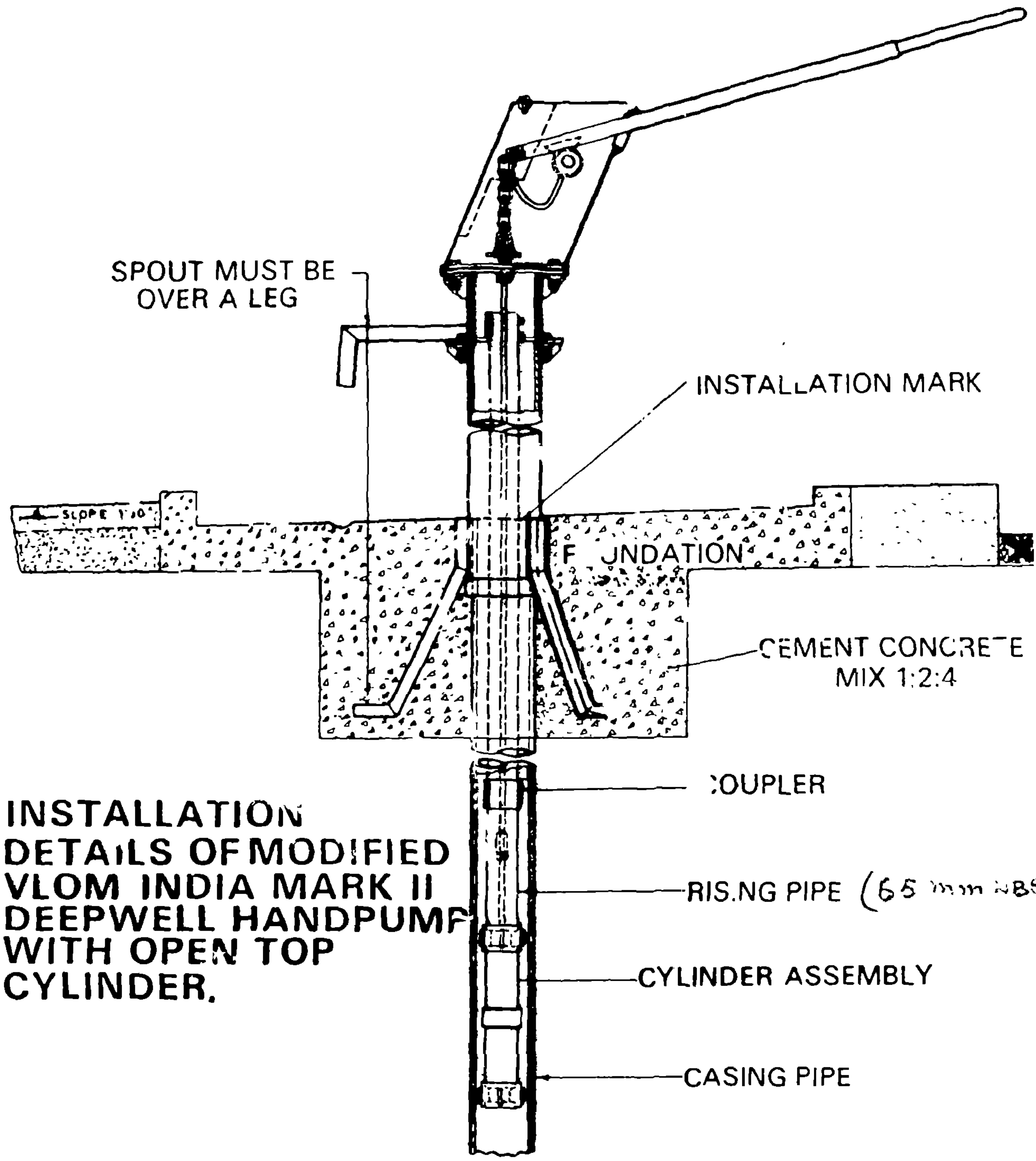
SEQUENCE OF OPERATION FOR REMOVAL OF PISTON AND CHECK VALVE IN OTC HAND PUMP

1. Remove inspection cover
2. Remove nylock nut and bolt on chain

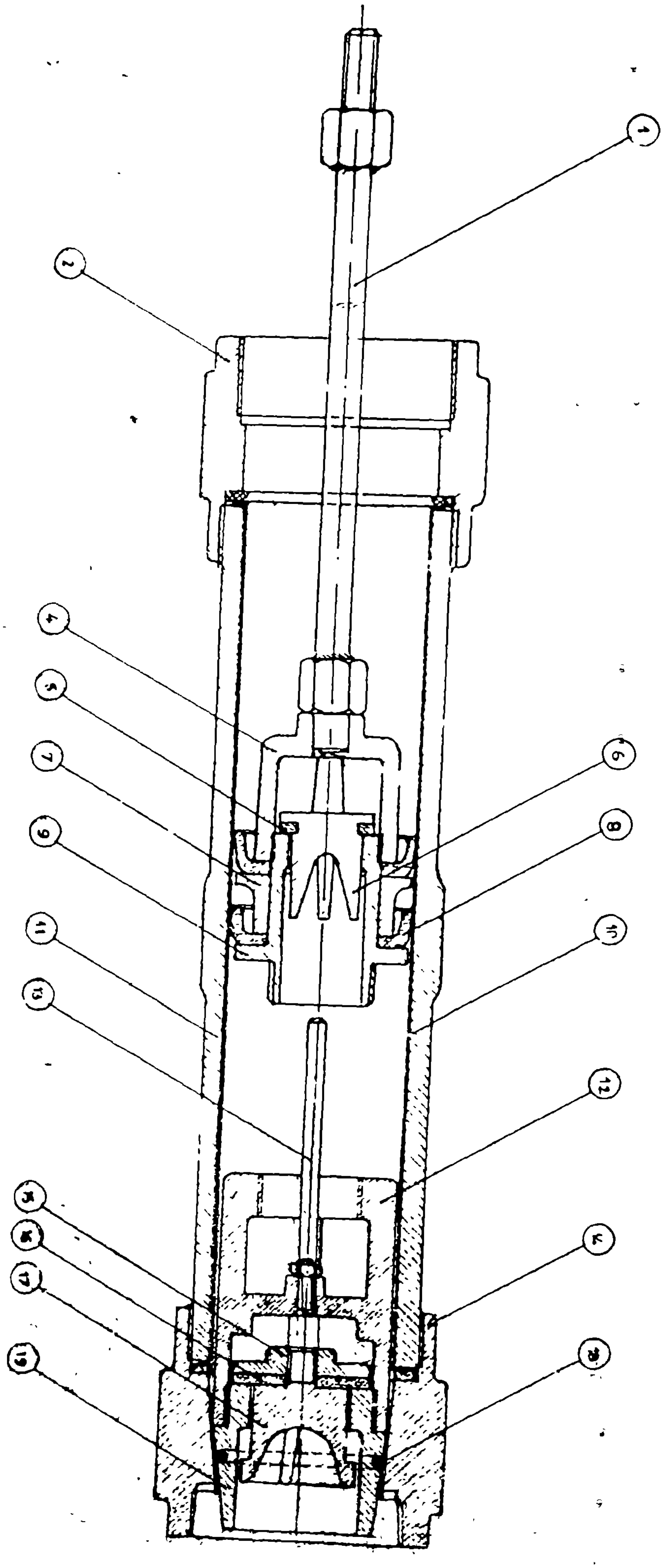
3. Remove flange bolts on the head
4. Remove head with handle
5. Lift chain with help of screw driver
6. Lift third plate and install rod vice below it
7. Remove chain, lock nut and the third plate
8. Fit the rod lifting tool to connecting rod
9. Hold rod lifting tool and remove rod vice
10. Lower rod, so that the plunger is resting on the check valve at the bottom of the cylinder
11. Press rod down with rod lifting tool and turn it in clockwise direction, so that the follower of the plunger gets engaged with internal threads of check valve body
12. Pull the connecting rods up firmly, with two people, so that check valve 'O' ring disengages from the lower cylinder cap.
13. Now pull up and remove connecting rod one after another using rod vice and spanner. If the lifting is hard the check valve body might not have got engaged with the follower.
14. When plunger comes up check whether the check valve has also come up.
15. While refixing after repairs thread check valve body with follower of plunger very loosely, with one or two threads only as it has to be separated after fixing the check valve assembly to the bottom cap of cylinder.

The open top cylinder VLOM hand pump have been developed in close co-operation with World Bank and UNICEF and have been tested in the World Bank field test centre at Coimbatore,which is truly a village level operation and maintenance pump which would thus decentralise the maintenance system.

The trial batch of above pumps are in use in 'DANIDA' project of Orissa, 'NETHERLANDS' project at Uttar Pradesh, 'UNICEF' projects at Madhya Pradesh, Maharashtra and Bihar.



INSTALLATION DETAILS OF MODIFIED VLOM INDIA MARK II DEEPWELL HANDPUMP WITH OPEN TOP CYLINDER.



Part No	Description	Material
20	CHECK VALVE SEAT	GUN METAL
19	O RING	RUBBER
18	CHECK VALVE GUIDE	GUN METAL
17	RUBBER SEATING (BOTTOM)	RUBBER
16	RUBBER SEAT RETAINER	GUN METAL
15	REDUCER CAP	CAST IRON
14	PUSH ROD WITH CHECK NUT	STAINLESS STEEL
13	CHECK VALVE BODY	GUN METAL
12	CYLINDER BODY	CAST IRON
11	BRASS LINER	BRASS
10	EXTENDED FOLLOWER	GUN METAL
9	PUMP BUCKET	NITRILE RUBBER
8	SPACER	GUN METAL
7	UPPER VALVE GUIDE	GUN METAL
5	RUBBER SEATING (TOP)	RUBBER
4	PLUNGER YOKE BODY	GUN METAL
3	SEALING RING	LEATHER
2	TOP COUPLER	CAST IRON
1	PLUNGER ROD	STAINLESS STEEL

WOMEN AND WATER SUPPLY

*Anuradha Gadkari.

Environment encompasses a very large arena with multi-disciplinary intigrated factors, a very significant one being "Human Behaviour Pattern" relating to many puzzles facing the planners engaged in environmental development and management. These puzzles vary as :

1. Water supply system not being used by people for whom it is meant.

2. Difficulties in maintenance of existing water supply system and

3. People's resistance to use the provided facility.

Such undersirable situations arise due to varied problem such as :

1. KAP (Knowledge, attitudes and practice) of community including the beliefs with respect to health, and ranking of health and other priorities.

2. Assumptions that underline the design and mode of presentation of the amenity viz. water supply, sanitation to the community.

3. Technology.

This makes it necessary to study the community for prevailing habits, taking into account the consumers' perspectives. And it is with this background that women as actual users, managers of household chores, educators of children, protectors of family health and acceptors and agents of change need a great deal of consideration in any water supply or sanitation programme to ensure the maximum beneficial utilization of the programme by the community.

Present Status

Despite their important and multiple roles women are not adequately involved in water and sanitation activities. They are often excluded from planning and implementation of water and sanitation projects. The programmes do not take into consideration the cultural context and level of knowledge of communities while planning the technologies and

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also these technologies are not cognizant of women's needs and interests. This results in an apathy on the part of the woman limiting or at times even nullifying their participation in the programmes.

However, as a result of some observations and thinking during the International Water Supply and Sanitation Decade as well as the ongoing Water Technology Mission, Women's role by way of their contribution to health and development is being recognised. And this has necessitated the planning of strategy to involve women in water supply and sanitation projects for their effective participation.

The problems

In developing countries girls and women are the traditional water drawers and carriers besides being the maximum users of water being responsible and actual doers of all household chores. Women spend 4-8 hours a day drawing, carrying, managing and using water. During draughts or in areas where water scarcity is frequent like in hilly areas of Madhya Pradesh women have to walk up and down the hills for miles. Thus scarcity of water which is a big problem affects the women most, starting from the high drop out rate of girls in the school at an early age to reducing their creativity and productivity by way of better quality of domestic management, child care or income generating work at a later age. Water scarcity problem has its manifestations in the urban area also. Even big cities like Bombay and Delhi have 5000-6000 public standposts, but the consumers who had 7-8 hours in 1970, were served only for 2-3 hours in 1975, the supply hours varying from anywhere in the early mornings to late nights resulting in loss of working hours and energy, which could be used for more purposeful jobs for the family.

Another important problem related to water is pollution or water quality. As noted in Integrancy "Task Force on Women and Water" Report in 1983, by virtue of their domestic functions regularly in touch with water (which is often polluted) women are particularly vulnerable to water related diseases, which according to estimation of WHO accounts for 80% of all sickness and diseases in the developing world. Besides this women are also very potential agents in the spread of these diseases by virtue of their involvement in all household chores, washing, cooking, bathing children etc. During drought also women face the problem of providing water to the family and limited sources may cause problem as to the quality of water.

Women's role

Thus the women's role in water and water related programmes is very obvious suggesting that the women should be viewed as primary agents to use any new water systems.

The data world over reveals that although the number of successful rural water and sanitation schemes is much smaller than that of those failed or achieved only limited success, there is increasing evidence that the users' perference approach combined with community participation is a viable strategy. The hidden participants accepting or rejecting a new water supply or sanitation technology are often WOMEN. Thus it is imperative that women be educated and motivated to accept the new water source made available to them, if the water supply project is to be successfully operated. To do this it is necessary to view women as :

- The acceptors and users of the new water facility.
- The managers for better utilisation and for training the members of households in water conservation and
- The change agents particularly with reference to behaviour promoting acceptance of new source of water by the community ensuring the maximum benefits.

What needs to be done?

It is necessary to provide such amenities which would strengthen women to participate in a water supply project in an effective way deriving maximum benefit. These amenities would be :

1. In order to check the drudgery felt by women, domestic water sources should be improved. They should be closer to homes. The water carrying devices should be so designed that maximum amount of water be carried at one time without much physical strain.
2. The technologies such as hand pump should be easy to be understood, handled and maintained by women.
3. Women should be educated through formal and nonformal programmes regarding :

- Water purification
- Water storage
- Water disposal practices
- Water borne diseases and preventive measures to control them.

4. Since more consumption of water creates problem of adequate supply, and disposal of waste water water conservation consciousness and awareness about water as a scarce resource should be evoked amongst women through education.

Women and Hand Pumps

Thus like in any other water supply project, "Hand Pumps" project to be successful would also need women's effective participation and this can be achieved only if the hand pumps are appropriate to their needs and abilities for maintenance and operation both in terms of quality and quantity. The various factors in which women need to be involved, considered and thought of are :

1. The decision about the number of standposts and their locations taking into consideration the social and psychological needs of the women as well as physiological and engineering commitments. Such a consideration would not lead the women to avoid use of standaposts due to crowding and rushing to an alternative nearby source like a public well which may not be clean, as is observed in many projects.

2. Designing of the handpumps such that they are easy to handle, operate and maintain. At many instances handpumps are avoided on the plea that they are too heavy and cumbersome to operate for women.

3. Formal and non-formal Training Programmes taking into consideration minute details such as posture while operating the handpump, the method of strokes etc. Since the women would use the handpump maximum they would be among the first to notice the defects. they should be made aware of the types of defects, that would arise and the process for getting the repairs done such as whom to report, etc.

4. Need to keep the surrounding of the handpumps clean and to see that the handpumps are firm in base and not damaged by children while playing. Women can also be encouraged to plant some small flowering plants around so as to avoid dirtying the surrounding, and stagnation of water causing mosquitoe breeding etc.

5. Health education programmes for women to make them understand that handpump water is the safe protected water and has no alternative such as nearby pond or well where women may prefer to go on the assumption that water collection is easier. The concept of Faecal oral cycle of pathogens causing gastro-intestinal diseases should be explained to the women with the help of slides, charts, film shows, flash cards, slogans and talks in the formal and non-formal meetings.

The health education should also include methodology of storage and handling of water such that water does not get contaminated before it is used. Preference of wide mouthed vessels for water storage, proper cleaning, covering of vessels with lids, and drawing water with handled mugs or jars are very important tips for women to ensure the quality of water for domestic use.

It is also worthwhile that women should be made the primary focus of users' education in such programmes with a view to train them as health promoters. Wherever culturally feasible women should also be trained in technical and managerial aspects such as revenue collection. This would require choosing enlightened, influential women from the community and training them as caretakers for the purpose of ensuring continued interest of the women in the project.

Conclusions

Projects that only provide services to the people without considering and involving them often fail. To avoid such a situation, women's participation in water supply project is a basic requisite as women are the primary users, managers of household chores, providers of family health care and acceptors and agents of change in the community. With effective participation of the women in the project, hand pump management in the rural areas should become much easier with maximum desired benefits.

REFERENCES

1. Anuradha Gadkari
Role of women in water supplies,
J IWWA, XVIII No. 1, 49-52, 1986.

2. Anuradha Gadkari et al.
Health education programme in a water supply
Project - A case study.
J IWWA XIX 17-27, 1987.

3. Women's issues in water and sanitation,
Attempts to address an age-old challenge.
IDRC - 236.

4. Participation of women in water supply and
sanitation - roles and realities.
Christine Van Wijk - Sijbesma. Tech. Paper 22.
Int. Ref. Centre for Com. Water Supply and
Sanitation, They Hague, The Netherlands, 1985.

5. Mathew Jagmohan
Drinking water for rural masses,
Yojana, 30(8), 17, 1986.

6. Water for villagers.
Gramin Vikas Newsletter 1, (10) October 19

7. Participation of women in water supply and
sanitation - roles and realities.
22, Technical Paper Series. IRC, UNDP, The Hague,
The Netherlands, Sept. 1985.

8. Women's issues in water and sanitation.
Attempts to address an age-old challenge.
IDRC - 236 C. Proceedings series.

THE HAND-PUMP MISTRY

*SANJIT(BUNKER)ROY

When high-powered engineers put their heads together over any scheme involving people and skills they do not understand, appreciate or accept, invariably the outcome is that a simple idea is made to look complicated, extravagantly expensive and terrifying technical. When the exposure of these engineers to the problems of the rural areas are limited to brief excursions in comfortable cars and jeeps, they are hardly likely to be in any position to come up with any worth while solutions on the acute problems of maintenance of hand pumps in the rural areas. These exercises may be useful for providing jobs to unemployable engineers, for companies making trucks and jeeps and India Mark II hand pumps, and for technocrats interested in building empires for themselves in their department: but they are useless for the ultimate user of the hand pump the women and men who need water most, whose ideas on the subject are, of course, incidental.

The UNICEF- designed three-tier maintenance system of repairing and maintaining hand pumps was approved by technocrats of all State Governments in the National Conference on Deepwell Handpumps in Madurai (July 1979) where UNICEF was prepared to provide funds worth millions of dollors for equipment and training (no wonder State Government adopted it). The three-tier system is supposed to work as follows:

Tier One: A village level hand pump caretaker. He is selected by the Government. He works free of charge (the other name for it is shramdan). He is trained periodically. He is given some spanners to keep nuts and bolts tight. He is supposed to keep the foundation clean.

Tier Two: The Block level inspector-cum-mechanic from the Public Health Engineering Department)PHED).His duty is to check regularly 50 hand pumps and carry out minor repairs above ground. If and when the hand pump assembly has to be taken out the District Maintenance Team has to be summoned. He has no transport provided to him.

Tier Three: A District Mobile Mainteancne Team (One for every 500/600 hand pumps) consisting of 5 men (driver, mechanic, two helpers and a mason) who work under the surpervision of a Junior Engineer. This team is supposed to attend to all major and minor repairs.

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The fact that UNICEF could only think of a limited function for a caretaker and make him work free while others drew salaries and daily allowance and glorify his role as an example of'community participation' not only reflects the limited experienceof these experts, but also their ignorance of the skills available in India villages.

It would have been too much to expect engineers to criticise themselves and admit that the three-tier designed by UNICEF was actually designed for their own convenience. It was a typical urban solution to a rural problem. It took the rural people- the barefoot mechanics of the world- to point out how absurd and flawed the system was, because it was based on false presumptions. The three-tier system presumed the rural people had no skills worth the name and that urban skills had to be 'imported' from outside the area. It presumed the rural people had no knowledge and experience and it required someone with paper qualifications to repair and maintain a India Mark II hand pump. May have eyes but they do not see : If they had only looked around in the villages they would have noticed illiterate men repairing electric and disel pumps and tractors and agricultural implements - much more sophisticated than a hand pump- and all making a living out of it.

The idea of the Hand Pump Mistri (HPM) grew out of discussions with the users of the water and the hand pumps. It incorporated several practical ideas:

- it identified rural youth from economically poor backgrounds with mechanical aptitude whose skills could be upgraded through training.

- it used the government scheme of TRYSEM to impart training to village youth for a period of three months.

- it involved banks to give them credit for special tools so that they could be self-supporting in due course.

- it placed people in villages within easy access of the community, made the HPM accountable to the community of users instead of giving him a government job.

- it responded to the acute unemployment problem among rural youth, made them feel useful in the village by giving them a service to perform and be rewarded with monetary incentives in the process.

- Most important of all, the placement of competent HPMs reduced government expenditure, influence and control and handed over the repair and maintenance of hand pumps to the community.

When it was first introduced in Ajmer District on a small scale, UNICEF supported the first training programme. However, when plans were being made to replicate it in the whole State of Rajasthan and replace the defunct three-tier system, there was stiff opposition from the UNICEF and the PHED engineers, who felt this demystification of technology in the repair and maintenace of hand pumps was going too far. We were trusting the skills of the community far too much. It was beyond their comprehension that a HPM could do the job of a caretaker, a block mechanic and 90% of the work of a District Maintenance Unit. If it had not been for the support of generalist administractors of the State Government, the technocrats and the international experts would never have let the HPM replace the three-tier system.

In Ajmer District, the profiles of 71 HPMs were studied in depth. What was unique about the HPMs was the fact that they came from such humble, modest and poor backgrounds the very stuff rural India is made of, and what they are capable of doing at nominal cost to the Government. Now for the classification under some significant categories:

Occupational Status	Agricultural labourers	51
	Famine workers	8
	Blacksmiths	2
	Cyclerepair shops	2
	Barbers	1
	Electrical	1
	Pan shop	1
	Grocer	1
	Vegetable vendor	1
	Sweets vendor	1
	Mason	1
Age group	18-25	49
	26-30	14
	31-35	6
	Over 35	2
Income other than from repair and maintenance work (Rs/month)	50-100	30
	101-150	31
	151-200	10
	Over 200	none

Educational qualifications	Upto V std.	29
	VI to VII	35
	VIII to X	6
	10 +	1
Land holding	Landless	19
	Marginal (upto 5/bighas)	34
	Small (6-12.5 bighas)	16
	Over (12.5 bighas)	2

Here are some profiles:

Satish Chandra Purohit is an HPM from Srinagar Panchyat Samiti. Born 1951. Went to school for the first 15 years. He had to drop out because he had to help his father on the farm. Later, he worked as a cleaner on a truck on the national highway, then as a mason and afterwards as a part-time motor mechanic. He now looks after 30 hand pumps with in a radius of 5 km from his village.

Sharee Khan is from Pisangan Panchayat Samiti. Studied till VII standard. Worked as a cleaner on a truck, then as a coolie near the railway station. Now a HPM, he looks after 40 hand pumps.

Ayadan Kumar is from Jethana village from Pisangan Panchayat Samit. Studied till X standard, owns 6 bigas of land. Father is a potter. When he is not repairing hand pumps he works on his plot of land and helps his father during the busy season.

Kailash Chandra from Kharwa village, Masuda Panchayat Samiti. Studied till VIII standard, owns 2 bighas of land and belongs to a scheduled caste. Looks after 30 hand pumps.

Amar Bal Bhambi comes from Loharwada village, Srinagar Panchayat Samiti. He was too poor to carry on his studies after the VIII Standared. Worked in a lime kiln, then went back to his village working as a labourer in famine relief works and in other rich farmers'fields. Now a HPM, he looks after 48 hand pumps.

Satyanarain dropped out of school after the VIII standard and started helping his father who is a dyer. Worked for three and a half years in a cotton mill in Ahmedabd, and was thrown out after the fell ill. He returned to his village, and now looks after 36 hand pumps.

Shankar Lal comes from village Sursura in Silora Panchayat Samiti. He had no land. He works as a barber. He has four brothers and two sisters. His family's monthly income is about Rs. 200/- Given this opportunity of looking after 40 hand pumps he had some additional income, which is desperately needed in the family.

These are ordinary profiles of extraordinary people, who have so much to contribute to this country by way of knowledge, experience and practical skill even though by conventional standards, society had no place for them. What is important to notice in the HPM scheme is that all of them have a stake in the scheme working.They come from poor families in the village. They are answerable to the community of users of hand pumps. This is, perhaps, the only opportunity they will have to earn some self respect in the village. It gives them an identity and establishes their credibility by providing a vital service. Most important he comes from the village, has roots there, and has no choice but to stay.

Unlike the three-tier system, where the caretaker is dependent on the Block mechanic, who is in turn dependent on the mobile maintenance unit, the HPM is independent and 90% self reliant.

The three-tier system does not take the community into confidence, whereas the HPM cannot work without community support. A comparison on the socio-economci implications of the two systems is interesting (See table below).

Whilst any sensible person with common sense cannot but concede the distinct advantages the one-tier system has over the three-tier system from the socio-economic comparison, it is on the technical side that engineers feel they have a point- which is far from true. The hand pump may be a twenty first century marvel in technology in terms of quality design and utility for a basic need, but there are very few components or parts that cannot be changed by the HPM given the proper training. What can the HPM do ? What tasks can be perform without any assistance ? The accompanying table will show :

Socio-Economic indicators	Three-tier system	One-tier system
Cost/Hand pump/ year to maintain	Rs.500-600/- hand pump/year.	Rs.150/-hand pump/ year Rs.50 for spare parts extra/h.p/year.
Tools & Equipment	Trucks, jeeps, trailors, heavy repair equipment, special tools etc.	Cycle, special tools.
Educational Qualifications	Mechanical Degree Holder: ITI Diploma.	IV-X standard class pass, primary school level adequate.
Personnel	Additional Chief Engineer, Superintending Engineer, Executive Engineers, Assistant Engineers, Block Mechanics, Caretakers, lower staff.	IV-X standard class pass, primary school level adequate. HPM at the village level.
Training	No long-term training programme at any level. Only short term orientation courses for engineers and caretakers.	Three months field training under TRYSEM regular in service training.
Community participation	Marginal at the caretaker level only.	HPM identified and selected by the community:priority given to SC/STs below poverty line.
Community Accountability	None. Answerable only to Government.	The users have the right to recall the HPM and send someone else for training if his work is poor.
Community Resources	No use.	The use of village knowledge resources & skills are total in the HPM.
Institutional Finance	No provision. Tools are given free to caretakers.	HPMs take a loan from the nearest back of Rs.2500/- for special tool. Subsidy of 50% if the HPM is a scheduled caste.

The one-tier system is, however, not without problems. By far, the biggest threat to it not being given a chance to work is the breed we call the Educated Man. The EM, who knows every thing, because he has a paper qualification.The EM, who think he is indispensable because he represents an organisation that has money and power- to do more harm than good, because he is convinced that the rural poor are illiterate, primitive and inferior and that is why the rural areas need him desperately. This arrogance is noticed the moment there is a move to give greater responsibility to the rural people, as in the one-tier system. All the field problems in the one-tier system can be traced to the EM not prepared to accept the fact that the HPM can actually perform this task. To name a few:

The selection of HPMs for training under TRYSEM has been incorrect. Instead of choosing one person that the community may have identified, the office of the District Rural Development Agency (DRDA) has sent 5 HPMs from the same village for training. Naturally, confusion,

The bank manager does not sanction the loans to the HPM since the HPM is semi-literate and he would rather support the engineer.

HPMs have a complete set of special tools that they need practice in but in many cases PHED engineers have made their own list in many districts and given it to the HPMs to repair hand pumps. When they cannot do it they report back and say the HPM scheme is a failure.

In spite of fully trained HPMs being placed, the PHED have placed a Block fitter with no practical experience, who acts as a glorified babu passing their bills (or not passing them) when he should actually be in the field actually be in the field assisting them in repairing hand pumps.

In Ajmer District, the HPMs have got together and registered the first Cooperative of its kind in India. Out of the eight Blocks of Ajmer District they are prepared to take the responsibility of identifying HPMs, give them training, monitor their own performance and disburse funds according to the hand pumps that are working. They are prepared in this way to look after 2000 hand pumps in these Blocks. The Rajasthan Government is prepared in principle to service their hand pumps through this cooperative. If successful, it could solve a major problem of the State Government engineers notwithstanding.

TECHNICAL COMPARISON

Description of Fault	Three-tier system		One-tier system	
	Category Major/ Minor	Responsibility Major/Minor	category	Responsibility
1.Above Ground(Mechanical)				
- Tightening of nuts and bolts (flange nuts and others)	Minor	Caretaker	Minor	HPM
- Replacement of nuts & bolts	Minor	Block Fitter	Minor	HPM
- Service of bearing or replacement	Minor	District Maintenance Unit (DMU)	Minor	HPM
- Repairing of chain or replacement	Minor	DMU	Minor	HPM
- Rethreading connecting rod(above the ground)	Minor	DMU	Minor	HPM
- Replacement of any other part above the ground if required.	Minor	DMU	Minor	HPM
2.Foundation Work				
- Repairing of Platform	Major	DMU	Minor	HPM Does it with the help of the community.
- Construction of new platform, if required.	Major	DMU	Minor	HPM
3.Below Ground(Mechanical)				
- Disconnecting of delivery pipes	Major	DMU	Minor	HPM
- Rethreading of pipe	Major	DMU	Minor	HPM
- Disconnection of connecting rod (CR)	Major	DMU	Minor	HPM
_ Rethreading of CR below the ground.	Major	DMU	Minor	HPM
- Any other repair in pipe/CR	Major	DMU	Minor	HPM
-Every kind of cylinder repair	Major	DMU	Minor	HPM
- Fishing of whole assembly (party.fully)	Major	DMU	Minor	PHED(but many times HPM has taken it out himself).

- Taking out whole assembly (suck in tree roots/wrong site selection).	Major	DMU	Minor	PHD (HPM has often taken out whole assembly with locally available materials).
- Bore hole development work air flushing.	Major	DMU	Minor	PHED with HPM and Dist. drilling team.

OUTLINE FOR UNICEF SUPPORT FOR VILLAGE BASED MAINTENANCE SYSTEMS

*Esa Ovaskainen

The fast speed of providing new handpump installations necessarily sets a respective demand for increasing the maintenance capacity. This demand can be met by decentralising the maintenance organisation and implementing users participation in realistic terms.

Community involvement and education activities in a handpump programme should not be only discussed in connection with the maintenance of handpumps but should start from planning, technology and site selection and include participatory education on water use related aspects. Community involvement should cover more than involvement of individuals from villages or village level government. It should mobilize all the beneficiaries in water and sanitation activities. It should improve peoples knowledge and change their attitude and practice if necessary. Community management of maintenance could be applied with any of the maintenance systems.

Practical and realistic users participation can be implemented through simple methods, but to be successful it needs Chief engineers, Executive engineers, Assistant engineers, Junior engineers, Block level officers, NGOs, Voluntary agencies etc. which are commited to the idea. The development of village based maintenance systems requires patience and an enormous amount of work. The idea must be sold to the beneficiaries themselves and if the salesmen do not believe in it, there will be no deal with the villagers.

There is a nation wide need for development of a social communication strategy for all levels to facilitate carrying the necessary messages to the beneficiary level. UNICEF has been requested by GOI to go ahead with a KAP (Knowledge, Attitude, Practice) study on improved water supplies and sanitation. The study will cover 8 states. (West Bengal, Manipur, Uttar Pradesh, Gujarat, Andra Pradesh, Tamil Nadu, Madhya Pradesh, Rajasthan).

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*Handpump Co-ordinator, UNICEF.

The findings and recommendations of this study will be used to develop a comprehensive information, education, communication/mobilisation strategy. A consultant has already been selected to carry out the KAP study and the duration of the work will be about 9 months. However, the communication needs of today have to be met through the best possible way immediately.

Standardization of pumps spare parts and maintenance tools:

The India mark II standard deepwell handpump is manufactured all over India. It is remarkable that pumps used in Tamil Nadu have fully interchangable components with pumps in Rajasthan. Spare parts and components procured from qualified manufacturers are of controlled quality.

The Bureau of Indian Standards approved India Mark II deepwell handpumps for the national standard in 1979. The standard was revised in 1984 and 1986 with minor changes. During recent years the development of the India Mark II pump has been aimed strongly at VLOM -applications.

All desired changes for the standard are first carefully studied. UNICEF follows the following procedure when proposing new specifications for BIS standards.

I. RESEARCH AND DEVELOPMENT UNICEF/UNDP/WB Co-OPERATION IN COIMBATORRE AREA.

II. DEMONSTRATION AND LARGE SCALE TESTING OF TESTED PRODUCTS. UNICEF/UNDP/WB CO-OPERATION IN 4 DEMONSTRATION AREAS. (PLUS SMALL SCALE DEMONSTRATIONS IN COIMBATORE AND UDAIPUR).

III. CO-OPERATION WITH BIS. FEED BACK FROM OTHER PROJECTS AND PROGRAMMES. RECOMMENDATIONS FOR NEW STANDARDS.

The availablility of standard spareparts at the village level needs to be improved as the village based maintenance systems are developed. District collector's offices and private agencies, can play an important role in sparepart distribution. Price control and quality control need to be developed. DGS &D rate contracts can be utilized for price controls. If the component manufacturers could get an BIS-licence for manufacturing spare parts, the spare parts availability at the village level could improve. For the time being there are not enough resources with the BIS to go ahead with this idea.

An important area for standardization relates to maintenance tools. UNICEF is cooperating with several manufacturers in this respect. The tools are presently difficult to transport and it is recommended that for village based systems the tools should be available in the village itself. On the other hand efforts are made in developing a complete set of tools that can be easily transported by bicycle. For instance the Solapur Well Services has been developing bicycle trailers that can carry pipes and correcting rods.

Quality Control

UNICEF maintains a list of " qualified" manufacturers. A company wishing to be included in this list must go through the following procedures.

1. NEW SUPPLIER NOT ENCOURAGED (DUE TO EXCESS IN-COUNTRY CAPACITY)

2. VENDOR QUESTIONNAIRE SENT ASKING DETAILS AND PHOTOGRAPHS OF JIGS, FIXTURES, ETC.

3. WORKS INSPECTION BY A CONSULTANT

4. COMPANY APPROVED

   SMALL TRIAL ORDER IS PLACED TO DETERMINE FIRM'S POTENTIAL

5. PRE-DELIVERY INSPECTION BY A CONSULTANT

6. COMPANY TO OBTAIN BIS LICENCE IS ; 9301 -1984

7. IF BIS LICENCE OBTAINED, FIRM MOVES TO LIST OF QUALIFIED MANUFACTURERS

In 1987, thirtyseven companies were included in the list of qualified manufacturers. On state governments requests UNICEF, along with two consulting companies, provided quality control for state government procurement from these companies, UNICEF support for quality control is a temporary measure. Arrangements have been made for making BIS -inspections mandatory.

This would gradually enable states to dispense with UNICEF authorized inspections. The availability of high quality spare parts at the village level seems to be a "bottle-neck". There is no guarantee to obtain quality inspected spare parts except procuring them from qualified manufacturers. Again the question of issuing BIS - licences for component manufacturers can be discussed.

Monitoring of handpumps

The Department of Rural Development has been undertaking a Concurrent Evaluation of Rural Water supply since October 1986. 24 reputed academic/technical institutions have been involved in data collection and 36 districts are covered monthly so that the whole country would be covered over a year.

A major study on performance of India Mark II pumps, financed and supervised by UNICEF was completed in 1986 and the results are presented in the Operation and Research Group (ORG) report 1986. Some findings of the ORG report are given later in this report.

Development of Management information system is one of the important objectives of the GOI Technology Mission. National Industrial Development Corporation (NIDC) has been carrying out a system study at the general level. As for rig monitoring GOI and UNICEF have had an extensive co-operation. Arrangements have been made for carrying out a detailed system study on handpump monitoring information needed for planning of the handpump programmes at different levels from grass roots to central government.

A basic requirement for monitoring is numbering system of handpumps. Trials on systematic monitoring have been made by introducing card index system. The present thinking is that the system should be created at District Block and at village level and it is being implemented for the time being in some selected districts. At Block level it serves operational activities and at District level as an information base. As soon as the computerized monitoring system is established, the District level would be computerized. At village level it would inform the communities details about their pumps and progressively make them responsible for operation and maintenance. A local institution should be established or activated in connection with introducing the village level data base. Also a formal agreement on village level ownership of handpumps should be signed in this connection. There should also be a formal agreement between the panchayat-committee and handpump mistry and caretaker.

The present status of the handpump programme in India.

The status of the handpump programme two years ago is presented in the survey of Operations Research Group, report 1986. The survey covered 18 districts in six states. The findings of the report are briefly as follows.

POSITIVE FINDINGS

- 80% OF THE PUMPS WERE IN WORKING ORDER
- 88% PUMPS HAD FIRM PEDESTALS
- 84% PUMPS HAD PLATFORMS CONSTRUCTED
- 92% PUMPS WERE WITH PLATFORMS AND DRAINS
- 90-92% PUMPS WERE ACCEPTED AS THE SOURCE FOR DRINKING AND COOKING PURPOSES.

NEGATIVE FINDINGS

- 16% PUMPS WERE INSTALLED WITHOUT A PLATFORM
- 20-26% PUMPS WITHOUT DRAINS
- ACCUMULATION OF WATER WAS AROUND 69% OF THE PUMP SITES.
- COMMUNITY PARTICIPATION WAS LACKING
- 72% OF REPORTED FAILURES WERE UNATTENDED FOR MORE THAN ONE MONTH
- 28% COULD NOT BE REPAIRED DUE TO THE ABSENCE OF SPARE PARTS OR SPECIAL TOOLS
- PREVENTIVE MAINTENANCE DID NOT EXIST ANYWHERE DESPITE THE PRESENCE OF HANDPUMP MECHANICS.

According to the ORG report about 80% of the pumps were found in working condition against 25% in 1972. This indicates that a reasonable level of sustainability has been achieved. The disasterous condition of pumps in 1972 has largely been overcome. However there is clear understanding that the present maintenance system have to be developed and village based maintenance system have to be implemented.

Comments on different maintenance approaches

When the three tier maintenance was first introduced, the density of handpumps was quite low. Over the years, the number of pumps installed has increased rapidly and it became necessary to take measures towards decentralizing the maintenance approach. For example the mobile team originally based at the District level could no longer take care of the increasing number of repairs in numerous different blocks. Some State Governments have decided to transfer the operations of the mobile team to the block level itself resulting in a two tier approach, even though the three levels still exist. It may therefore be confusing to continue speaking of a three tier system as originally envisaged since the emphasis from one level to another has changed.

Since UNICEF was originally involved in the development of the three tier system, in an early effort to form a handpump maintenance system, some State Governments refer to three tier as the UNICEF system". This is erroneous and detracts from the efforts made by the individual State Governments to create sustainable improved quality supply systems. The two tier maintenance system has found different forms in different areas. Village level activities are at present in a process of rapid development. In some places there is a tendency to organise and institutionalize community level activities. Panchayat Committees or sub-committees especially formed for water and sanitation activities both with, or without a caretaker are responsible for community involvement and village activities. In some areas the caretaker is more or less independent and has to bear the village level responsibility on his own.

It is the level of interest of the caretaker and/or the Panchayat members that defines how well organised are the water and sanitation activities including maintenance.

Mr.Kanagarajan, UNICEF South East India Office states:

"PHED, Karnataka has introduced a "Route Map System" wherein the Handpump teams follow a fixed schedule and check the Handpumps in the villages in a routine circuit and attend to "preventive" or "curative" maintenance depending on the condition of the pumps. This system is working very well in 3 districts of Karnataka.

In Rajasthan , a "Handpump Mistry System" under TRYSEM is implemented in which a villager nominated by the community is given intensive training for 6 months on Handpump installation and maintenance. After the training, bank loans are arranged and tools are supplied to the "Mistry". The Gram

Panchayats employ the Mistries to repair the pumps. The Mistry receives Rs.250/- per pump annually, and is in charge of about 35 pumps within a small area.

Thus the different states are adopting various maintenance systems to suit the local conditions with the basic and ultimate objective of providing a continuous supply of safe drinking water to the villagers."

Village Based Maintennace

The present stage of the India Mark II handpump technology may not yet permit a complete village level responsibility for maintenance which would be an ideal situation. All community activities are presently supported by Government organised mobile maintenance teams. Thus back-stopping at the Government level is still seen as an imperative component of maintenance.

Although this condition is true it should not be used as an excuse and obstacle in the way of developing village based systems. As the village based system is developed it can gradually reduce the importance of the centralized back stopping system and even replace the centralized system altogether. As new VLOM technology applications are developed maintenance will be easier, no matter what type of maintenance system is used.

On the other hand the villages may be more seriously interested in taking the maintenance responsibility if the mobile team support is not easily available. Some experiences in other countries indicate that after withdrawing the centralized support, villagers first let the water supply collapse, but as they discover that the mobile team is not coming any more, they start their own maintenance. It may be true that villagers are not given an adequate chance and necessary facilities for implementing handpump maintenance on their own.

Adequate training of village based mechanics and provision of necessary tools for sure can reduce the importance of the back up system. The back up system should be needed only in crisis situations and for activities like fishing of down the hole components, transportation of pipes, borehole maintenance etc.

Village based maintenance systems are implemented in many countries in different socio-economical conditions. Usually, issues like womens participation, forming of water committee, i.e. establishing a local institution, cost recovery, village ownership of pumps etc are emphasized. All these issues should be given due importance according to local conditions. Also village-specific conditions should be taken into account.

Community participation should be implemented from planning to correct maintenance and water use, as village based maintenance is developed. Community participation should finally involve the whole community and not only individuals like Caretaker, Mistry, Sarpanch etc. A local institution should be established or activiated to Manage the village level maintenance operations.

Handpump Technology

Based on programme requirements, attempts have been made to develop a family of India Mark II pumps. The family would include.

1. EXTRA DEEPWELL INDIA MARK II
2. STANDARD INDIA MARK II
3. VLOM INDIA MARK II WITH OPEN TOP CYLINDER
4. LOW LIFT INDIA MARK II, SOLID LINK CONNECTION HENDLE/PUMPRODS
5. LOW LIFT INDIA MARK II -SOLID LINK SUCTION PUMP
6. OTHERS, FOR INSTANCE LIFT PUMP FOR PUMPING WATER TO ABOVE GROUND RESERVOIRS

The extra deepwell pump has been already extensively field tested and a standard specifications for it is expected to be ready by mid 1988. The technical history of the India Mark II since the first standard in 1979, and the areas of technical development where UNICEF is co-operating with various agencies and manufacturers are presented in Annex. I.

UNICEF, in co-operation with UNDP/WB, Richardson & Crudas and some other manufacturers and agencies have been involved in the development of open top cylinder pump since 1979. The India Mark II VLOM - pump has now been field tested by the Coimbatore research and development project for over 4 years. A final report on the coimbatore results is being jointly prepared by UNICEF and UNDP/WB and it is expected to be ready by June 1988. For this meeting, UNDP/WB has prepared a separate report on the results of the Coimbatore project. Some areas like cost anlysis will be completed only when preparing the final report.

GOI has requested UNICEF to go ahead with low lift pump developments with Merado co-ordination. The list of activities included in the 1988 programme is as follows.

1. Survey on community acceptance of direct action low lift pumps.
2. Improvement of the laboratory testing unit at MERADO premises in Madras and initiating laboratory testing of lowlift handpumps in India.
3. Monitoring and demonstration of different types of low lift pumps in the field. (Direct action, suction, Solid link etc.)
4. Further development of low lift pumps based on the laboratory and field testings and also further development of low lift pumps through R & C and other manufacturers.
5. Developing computerised data processing of monitoring activities and further documentation of the results obtained.
6. Initial recommendations for standard low lift pumps by the end of 1988 aiming at a standardisation of the pumps by the end of 1989.

UNICEF Strategy in handpump maintenance

The UNICEF strategy in handpump development, installation and Maintenance as per Plan of Operations 1985-89 states the following:

UNICEF will continue to assist in strengthening the maintenance systems, through expanded training programmes, provision and promotion of tools, trucks and spare parts. Non-government agencies will be identified and supported to help increase the number of village handpump caretakers who are trained to spread the message regarding the relationship between safe drinking water, hygiene and health and to report handpump breakdowns. Health guides, Boy Scouts, school teachers, and other village leaders will also be involved in performing these village level functions. UNICEF will continue to play an important complementing role in making village-based handpump maintenance a reality.

As far as the development of the maintenance system is concerned the strategy has been reviewed in the following forms.

Draft Strategy for UNICEF support for Handpump Maintenance

(Subject to revision according to continuous monitoring)

I. Advocacy with the State Government to develop/operationalise a village/community based appropriate Handpump maintenance system. The system should be in line with Government policy and focus on a well defined and officially institutionalised participation and involvement of communities in the process of maintenance of Handpumps. The role of women and children should be focussed adequetely. Supporting activities and implementation models according to GOI policy recommendations stating : "It would be advantageous to choose two or three alternative systems of handpumps maintenance including Rajasthan system on a pilot scale for a period of two to three years prior to the final selection of the system to be used all over the state."

II. UNICEF will mainly support the community based maintenance systems implemented by State Governments in line with the GOI policy guidelines.

III. UNICEF assistance will be with village based activities such as training village functionaries (technicians, caretakers) provision of training and educational materials for community members, voluntary groups and village functionaries.

IV. Development and promotion of VLOM pump technology will continue

V. UNICEF supports establishment of socio-economical cell at state level and in connection with demonstration activities at block level to promote community participation including womens participation.

VI. UNICEF assistance will be for software items under Govt. sponsored village level HEALTH EDUCATION CAMPAIGNS (IEC activities).

VII. UNICEF will provide support for village based activities and UNICEF will also provide assistance for back up of these systems when necessary including vehicles for IEC, motivating and training activities and in exceptional cases for maintenance back up.

Conclusions:

1. UNICEF is supporting state governments efforts to create viable handpump maintenance systems. UNICEF is especially concerned with the development of village based maintenance systems. Training of village level functionaries (caretakers and mechanics) is given a priority. The village based mechanics should gradually reduce the importance of a heavy back stopping system . Village based motivators and caretakers training should continue along with the training of mechanics. This would guarantee undertaking the preventative mechanical and sanitary maintenance and non delay reporting of faults to the mechanics.

2. Community involvement should be promoted from the planning to safe water use practices. The whole community should participate and not only individuals. The training of motivators/caretakers, establishment and activating of local institutions, use of drilling and installation groups, voluntary organizations, NGOs, etc in community education is to be promoted. A comprehensive social communication strategy is expected to be ready in one years time. However, the communication needs of today have to be met in the best possible way immediately.

3. Village level management of maintenance is to be promoted. Formal agreements with villages and maintenace staff including commitments from villages and mechanics/mistries, ownerships aspects etc. should be signed. As soon as the basic commitment of GOI to provide safe drinking water is accomplished, cost recovery for maintenance could be a part of the village commitment.

4. The villagers may be willing to take maintenance, the responsibility if back up services are not easily available. Villages should first of all be encouraged to take care of maintenance themselves. Some experiences from other countries show that after discovering that the back up services are not coming, villagers actively take part in maintenance functions. It is seen in India that in areas where there is no alternative water source communities are willingly participating in handpump maintenance. Education on not using alternative

polluted water sources should continue.

5. The development of VLOM technology for pumps and tools will make any maintenance system easier and move reliable. Specially good results are expected from village based systems. It is very difficult to define what is appropriate technology for the village level. Any technology is appropirate provided necessary conditions at village level are met. The conditions required at village level become easier to fulfill if simple technology is available.

6. Technology development in terms of standardization is entering a new phase with the introduction of standards for the India Mark II family, Special attention is given to the development of low lift pumps. Preparations have been made for close cooperation with Merado BIS, UNICEF and different agencies on this respect.

7. Many of the aspects discussed in this paper need political decisions. A Policy framework on community participation, including the establishment of local institutions, making agreements on ownership, cost recovery and many other aspects is needed. Cooperation with politicians and planners would improve the understanding of commitments given to and required from beneficiaries.

Annexure - 1

INDIA MARK-II HANDPUMP DEVELOPMENT IS : 9301

The first revision of IS : 9301 appeared in 1982 and incorporated the following improvements :

- Water tank gussets
- Thicker front cover
- Larger drain
- Longer plunger rod 300 to 450 mm
- Hot dipped galvanizing of all above ground assemblies

The second revision was published in 1984 which contains the following further improvements:

- Stainless steel axle
- Solid handle stop gussets
- Larger diameter spout 40 mm dia
- Connecting rods with hex couplers at each end
- Revised configuration for pedestal legs

An amendment to IS : 9301-1984 specifications was made in 1986 with the following changes :

- Bearing single shielded, packed with litium based grease
- Chain assembly to be boiled in graphite grease for better anticorrosion.
- Telescopic stand assembly to suit 175 NB borehole casing.

An BIS meeting on handpumps was held in 1987. There will be further amendments in IS: 9031 after receiving and handling comments on the minutes of this meeting.

A FEW AREAS FOR FURTHER DEVELOPMENT OF INDIA MARK II PUMPS, MAINTENANCE TOOLS, PLATFORMS AND DRAINS

1. Improvement of the above ground parts of the pump

1.1 Imroved design of legs

It has discovered that a large number of India Mark II pedestals get loose in a few months after the installation. This can be prevented bv improving the quality of platform construction and also by improving the design of the pedestal legs. The size and the dimensions of the legs could be optimized to gain adequately strong pedestal installation.

1.2 Improved handle design

If the bearing gets loose in the bearing housing it leads to a wear of the bearing housing and the whole handle needs to be replaced. The preliminary tests of T-bar handles have been carried out with some positive feedback. The bearing housing designs and the T-bar application can be improved.

1.3 Study on the effects of overload on the bearings and design of shock absorbers in the pumphead.

The handle movement is limited by the upper and lower edge of the bracket. When the pump is operated the handle tends to hit the edge of the bracket causing a shock effect in the bearing. The considerable, occassional overloading of the bearing leads to a bearing damage and could be controlled by proper shock absorber design.

1.4 Improvements in the bracket and front cover design

The bracket design is quire open at the moment and offers an opportunity to drop unhygienic items into the head assembly. There is also a chance that children would damage their fingers in the open bracket. The design could be improved in this respect.

The front cover could be modified to make the village level preventative maintenance more easy.

1.5 New bearing design

The life time of the bearings is reduced due to loss of lubrication during time. A conventional bearing with grease nipple could be better than the sophisticated bearings.

Plastic bearings have been previously tested with poor results in India Mark II pumps. It should be studied if the present development within the plastic bearings offers any advantages compared with the ball bearings.

1.6 Improved design of bolt and nut housings

Many of the major breakdowns in the pump originates from loose pedestal connection or loose bolts and nuts. It is also often discovered that the lock nuts are missing in the pump heads in the villages. For the time being anybody can remove a nut from the pump. The bolt and nut housings could be designed in an appropriate manner to improve the situation.

2. Use of plastic and rubber components in the deep well cylinder (standard and open top-cylinder)

The plastic components in deepwell cylinders would provide significant reductions in the maintenance cost of pumps. They are light and durable and would make the maintenance easier. The following plastic components could be designed and tested:

1) foot valve housing
2) foot valve
3) plunger valve spacer
4) plunger valve seat
5) plunger valve
6) buckets.
7) cylinder lining

3 Further development of a sand trap and development of pressure equalizer

One of the biggest problems in the pump cylinder is the limited age of buckets. Partly this is due to fine particles in the water. Good results have been achieved with a sand trap previouslv developed by SWS. With small design changes the life time of the sand trap could be extended. On the other hand, the pressure shock on the buckets is damaging them. A constant pressure in the cylinder could be created by a pressure equalizer and definitely improve the lifetime of the cylinder components.

4. Improvement of rod connections and development of a rod guide

The threaded joints require some tools and skill for maintenance and are easily damaged. Non threaded connections are used for instance in Afridev pump. A suitable non threaded connection could be designed for India Mark II.

A technical comparison of check nut and welded hexagonal or round coupling parts could be made, bearing in mind the existing experience from the field.

A rod guide/centralizer would reduce the uncontrolled movement of underground parts and thus improve the durability of cvlinder parts, sand trap, pump rods and riser pipe.

5. Development of plastic riser pipes with rod guides to be used with open top cylinders

Use of plastic riser pipes would be a major improvement in the present pump designed due to the following reasons :

- plastic is a low cost solution
- plastic is a non corrosive material
- plastic is a light material, easy to transport. easy to lower down and lift up from the borehole.

6. Improvements in handpump tool designs, design concepts of improved platform and drains

The pipe clamps and pipe lifters tend to damage the galvanizing of the riser pipes and ruin the corrosion resistance of the pipes. A redesign of these tools could improve this situation.

A winch would be needed for maintaining wells with very deep water table. Also some improvements in the platform design should take place, which would require redesigning of the platform shuttering.

FIELD TESTING OF INDIA MK II STANDARD AND OPEN TOP CYLINDER VERSIONS IN COIMBATORE DISTRICT, TAMIL NADU.

*W.K. JOURNEY

BACKGROUND

1. In late 1983 the government of Tamil Nadu, the UNDP/World Bank Water Decade Program and UNICEF undertook a joint project to field test the India Mark II deep well handpump and experimental variations of certain components. Two versions of the India Mk II deep well hand pump were tested under conditions of actual use in Coimbatore district. One of the versions was completely standard (according to the 1984 revision) and the other differed from the standard in two major respects:

(a) The rising main was 2 1/2 inch nominal diameter, through which extractable pumping elements (piston and footvalve) could be removed without removing the rising main; and

(b) The guide bush was incorporated into an intermediate flange located between the drive head and water chamber, to allow quick removal of the drive head.

2. A test sample of about fifty standard pumps was installed. Figures 1 and 2 show the actual size of the samples for both versions of the pump over the test period of over four years. A sample of about twenty OTC pumps was installed and monitored for over two and one half years. Maintenance was carried out by a repair team of four, supervised by a monitoring engineer, who recorded the nature of the service call, the type of repair (if any), the spare part installed (if any) and the elapsed time of servicing.

3. Data from the field is still being analysed on a modified spreadsheet program (Lotus, Release 2), using a Microcomputer. Below are the main points of some of the preliminary conclusions.

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* Regional Project Officer
UNDP/World Bank Water Decade Programme April 1988.

SUMMARY OF PRELIMINARY CONCLUSIONS

MAINTAINABILITY

4. The open top cylinder version of the pump is easier to service than the standard version, particularly for repairs to the below ground components.This is because it is easier to take apart and reassemble and requires fewer tools and less labour. This fact is indicated by lower average values for "active repair time" (the amount of time in man hours spent from beginning the repair until the pump is again in working order). Figure 3 displays a comparison of the average active repair time per pump for the standard and OTC test pumps over five consecutive semiannual intervals (2 1/2 years). The difference between the two ranges from more than double to more than quadruple, with the OTC showing the lower values. The mean of active repair time for the standard pumps over five semiannual reporting intervals was 2.2 hours per six months, while the mean for the OTC pumps was 0.8 hours per pump. The major conclusion which can be drawn from this evidence is that the OTC version is likely to be maintainable by a bicycle mobile mechanic for most repairs, including seal replacement, backed up by a conventional mobile maintenance team for major repairs, such as rising main failure or pump rod breakage.

AVERAGE FREQUENCY OF REPLACEMENT OF PARTS

5. Figure 4 shows that for the standard pumps the piston seals were the most frequently replaced component until the sixth semiannual interval, when they were outnumbered by cylinder replacements. The frequency of rising main replacement shows a steady increase throughout the test period of eight semiannual intervals.

6. Figure 5 shows that for the OTC pumps the piston seals were likewise the most frequently replaced component, followed by the O-ring of the footvalve assembly, which was not secure on the earlier footvalve design. Over a test period of five semiannual intervals, replacement of rising main pipes was much lower for the OTC pumps (showing a mean 0.25 per pump) than for the standard pumps (showing a mean of 1.16 per pump). The working hypothesis is that the more frequent removal and refitment of the smaller diameter pipes of the standard pumps (primarily for seal replacement) results in accelarated corrosion. Included in the working hypothesis

is the observation that the larger diameter pipes are thicker and will take longer to corrode through, especially considering the lesser amount of handling required compared to the standard version, and that less abrasion between the pump rod and the inner surface of the rising main occurs as a result of greater clearance.

7. Figure 6 compares the frequency of replacement of seals and rising main pipes for the standard and OTC versions of the pump. It can be seen that average frequency of seal replacement for the two models is marginally different, with the OTC seals showing slightly lower values and an inconsistent trend (showing mean values of 2.60 and 1.99). The trend for the frequencies of rising main replacement is about the same for the two models, but with consistently lower values for replacement of OTC (2 1/2 inch diameter GI) rising main pipes (showing mean values of 0.99 and 0.17).

8. According to the present stage of analysis, the working life of vegetable tanned leather and rubber piston seals are comparable, i.e., not significantly different. However, seals of both materials appear to last longest as the first generation, with each succeeding generation of replacements needing replacement sooner than its predecessor. However, since the analysis is complicated by a number of variables (differences in pumping head, water quality, surface finish of the cylinder), it is not yet possible to draw definite conclusions.

COST OF OPERATION

9. Figures 7 and 8 show the average spare parts cost per test pump for the standard and OTC models. It can be seen in Figure 7 that rising main replacement costs predominate, ranging on the order of Rs. 75 per pump except for the first and final semiannual reporting intervals. Handle replacement costs were second to rising main costs for the standard pumps, while handle costs were the major contributor to operating costs for the OTC test pumps, followed by cylinder replacement costs. However, rising main replacement costs for the OTC pumps were insignificant.

10. Figure 9 compares the average operating costs (spare parts + labour) of the standard and OTC versions over the comparison period of five semiannual reporting intervals. Average operating costs for the standard pumps are higher (showing a mean of Rs. 148 per semiannual interval) than the

OTC pumps (showing a mean of Rs. 79.4). Spare parts costs are consistently more than labour costs for both versions of the pump, but spare parts costs are greater for the standard specification than for the OTC. As the pumps grow older, the difference increases.

11. This evidence indicates that :

(a) The extra investment cost of 2 1/2 inch diameter GI rising main is offset by lower recurrent costs across the board;

(b) The OTC version of the pump approaches the ideal of village level maintenance, with the expectation of drastically reduced down time and a higher quality of service. This conclusion will be verified in demonstration projects in the near future in four states.

Fig.1

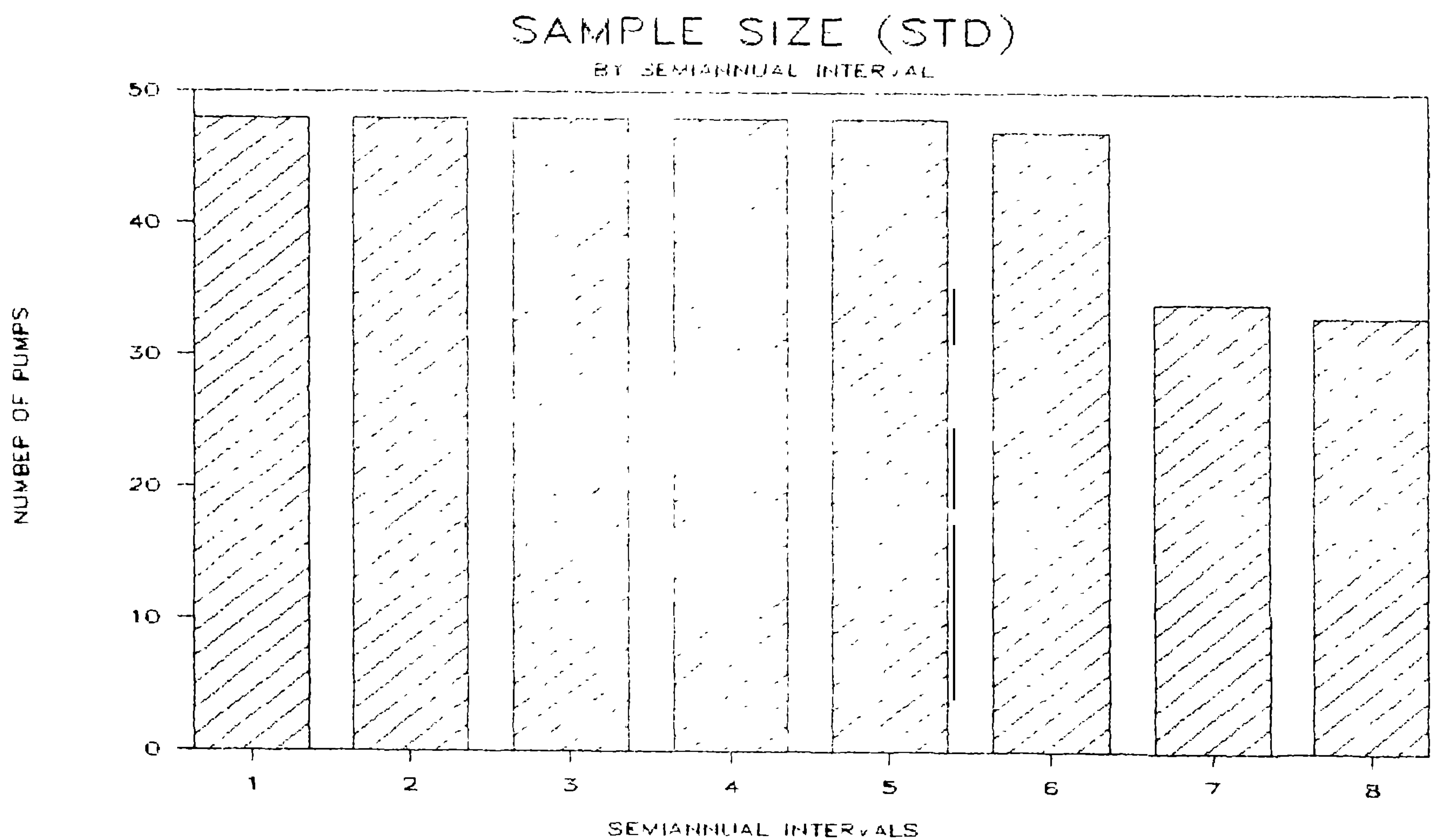
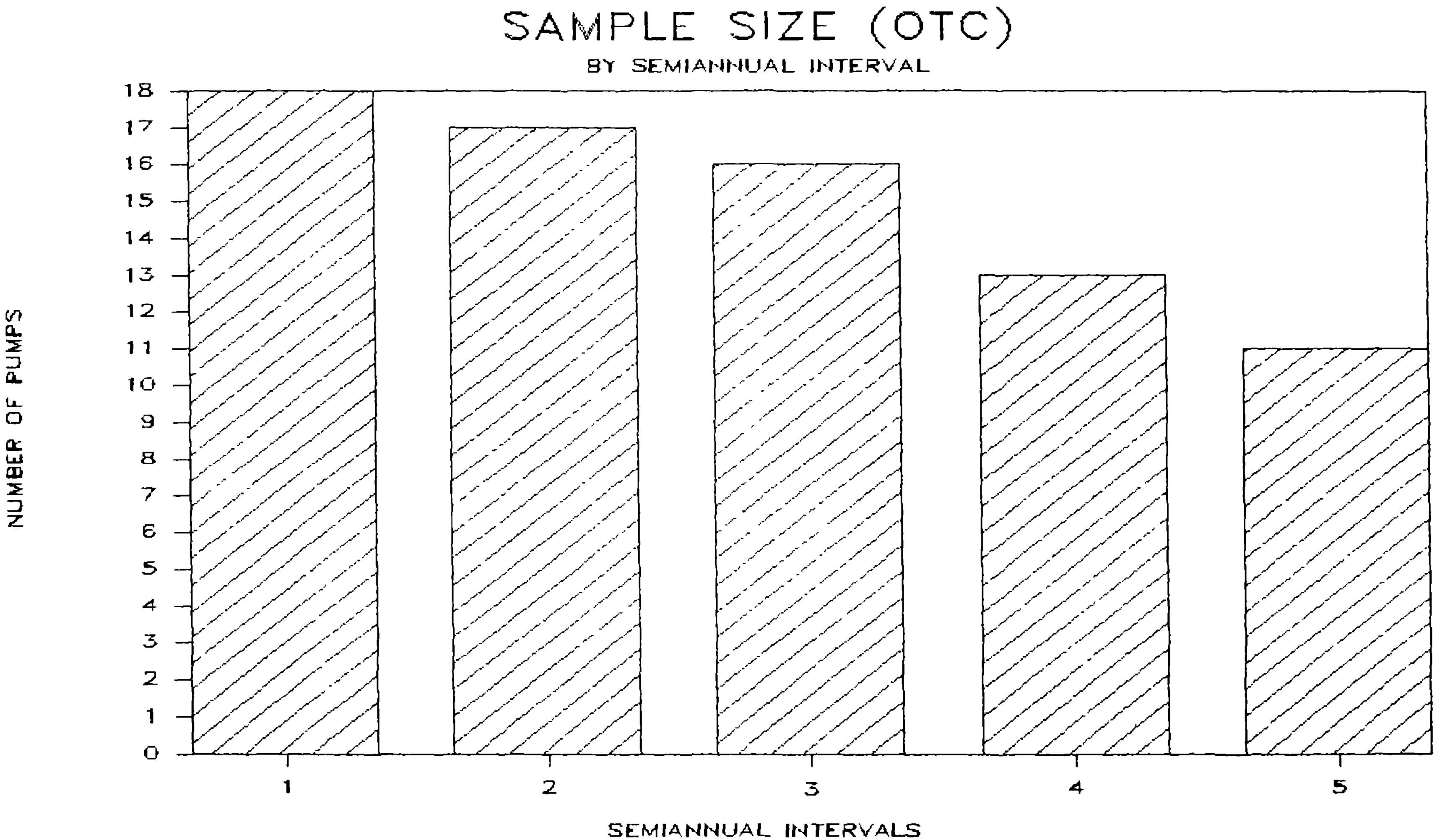
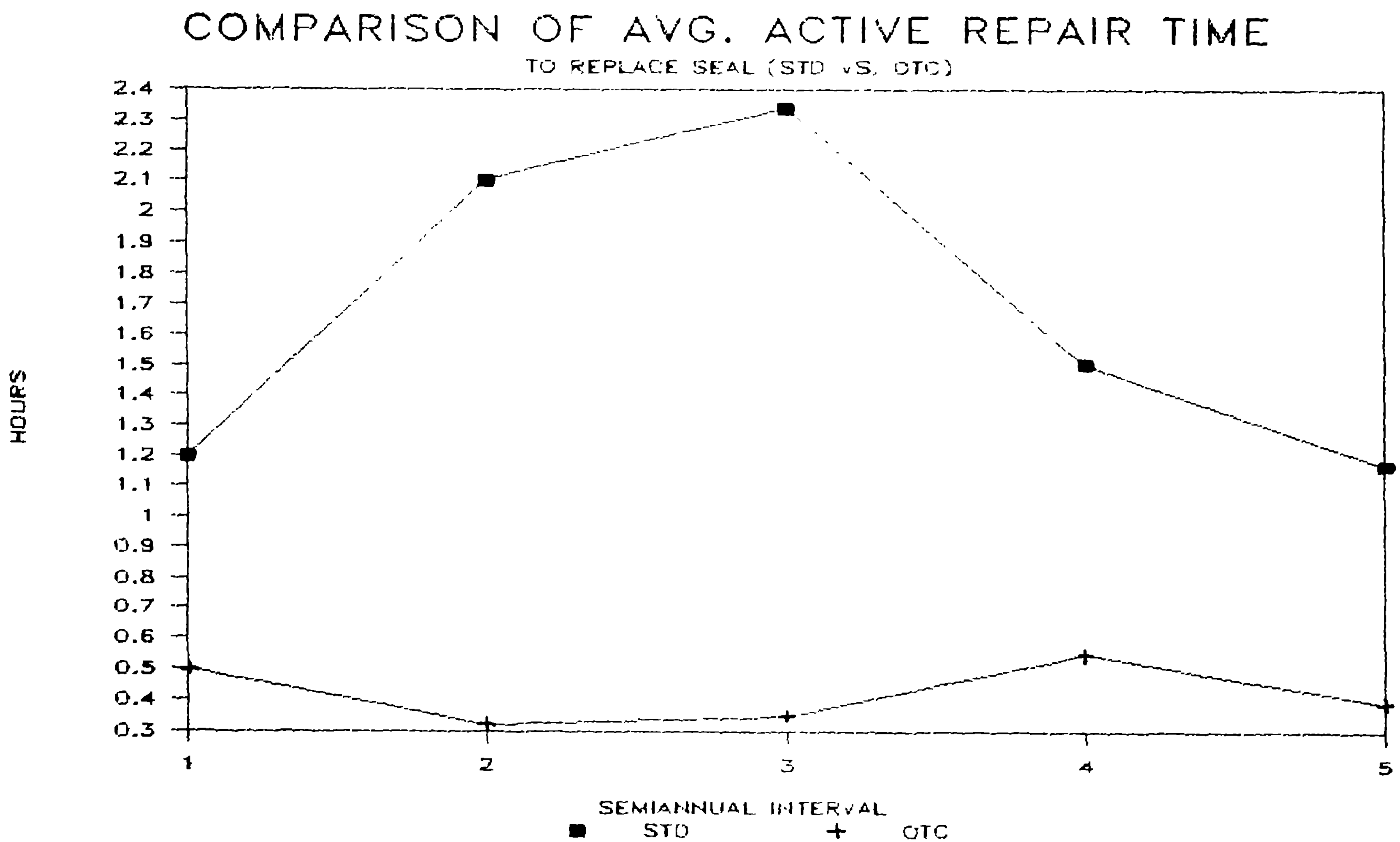

SAMPLE SIZE (STD)
BY SEMIANNUAL INTERVAL
NUMBER OF PUMPS
0
10
20
30
40
50
1
2
3
4
5
6
7
8
SEMIANNUAL INTERVALS

Fig.2



SAMPLE SIZE (OTC)
BY SEMIANNUAL INTERVAL
NUMBER OF PUMPS
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
1
2
3
4
5
SEMIANNUAL INTERVALS

Fig.3



COMPARISON OF AVG. ACTIVE REPAIR TIME
TO REPLACE SEAL (STD vS. OTC)
HOURS
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
1
2
3
4
5
SEMIANNUAL INTERVAL
STD
OTC

Fig.4

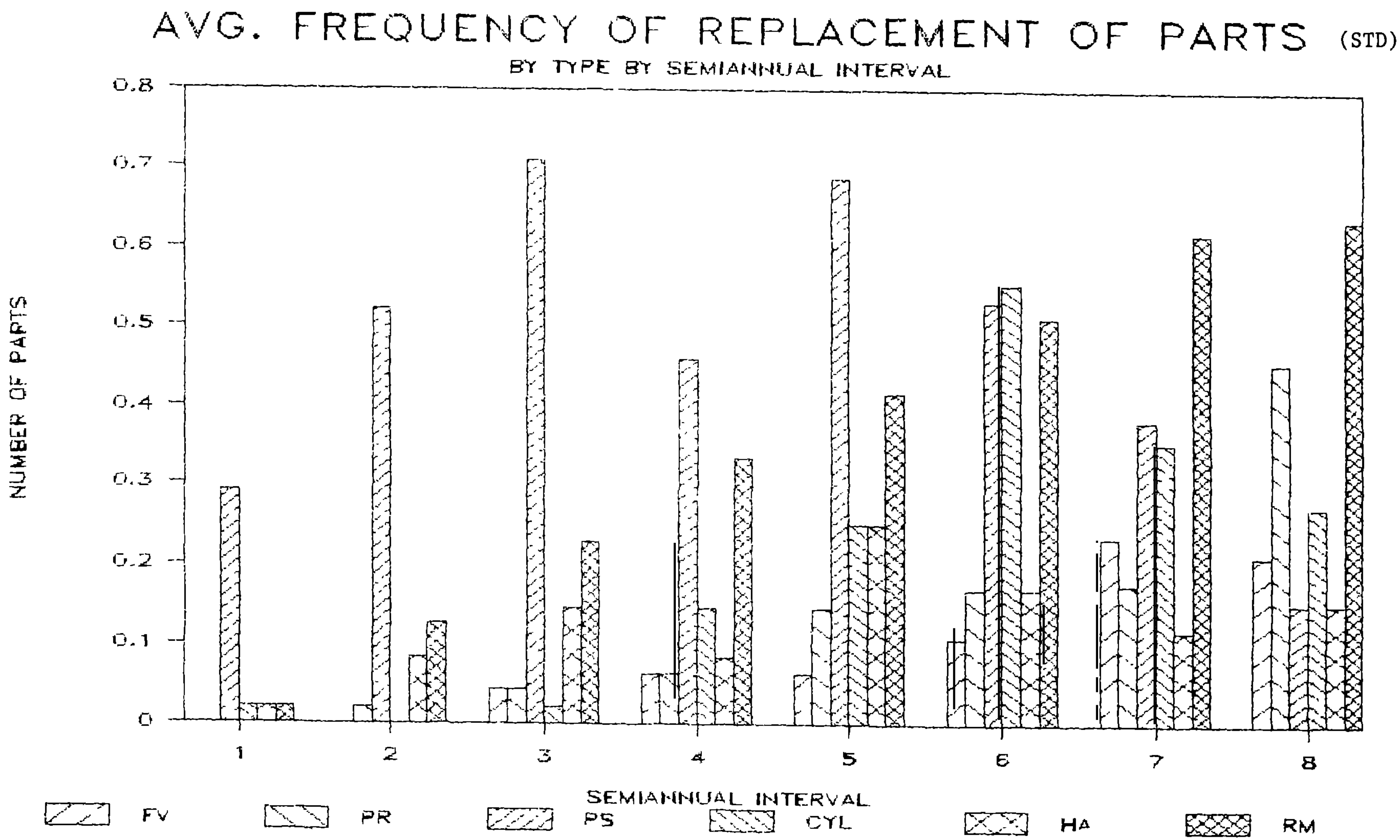

AVG. FREQUENCY OF REPLACEMENT OF PARTS (STD)
BY TYPE BY SEMIANNUAL INTERVAL
NUMBER OF PARTS
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
2
3
4
5
6
7
8
SEMIANNUAL INTERVAL
FV
PR
PS
CYL
HA
RM

Fig.5

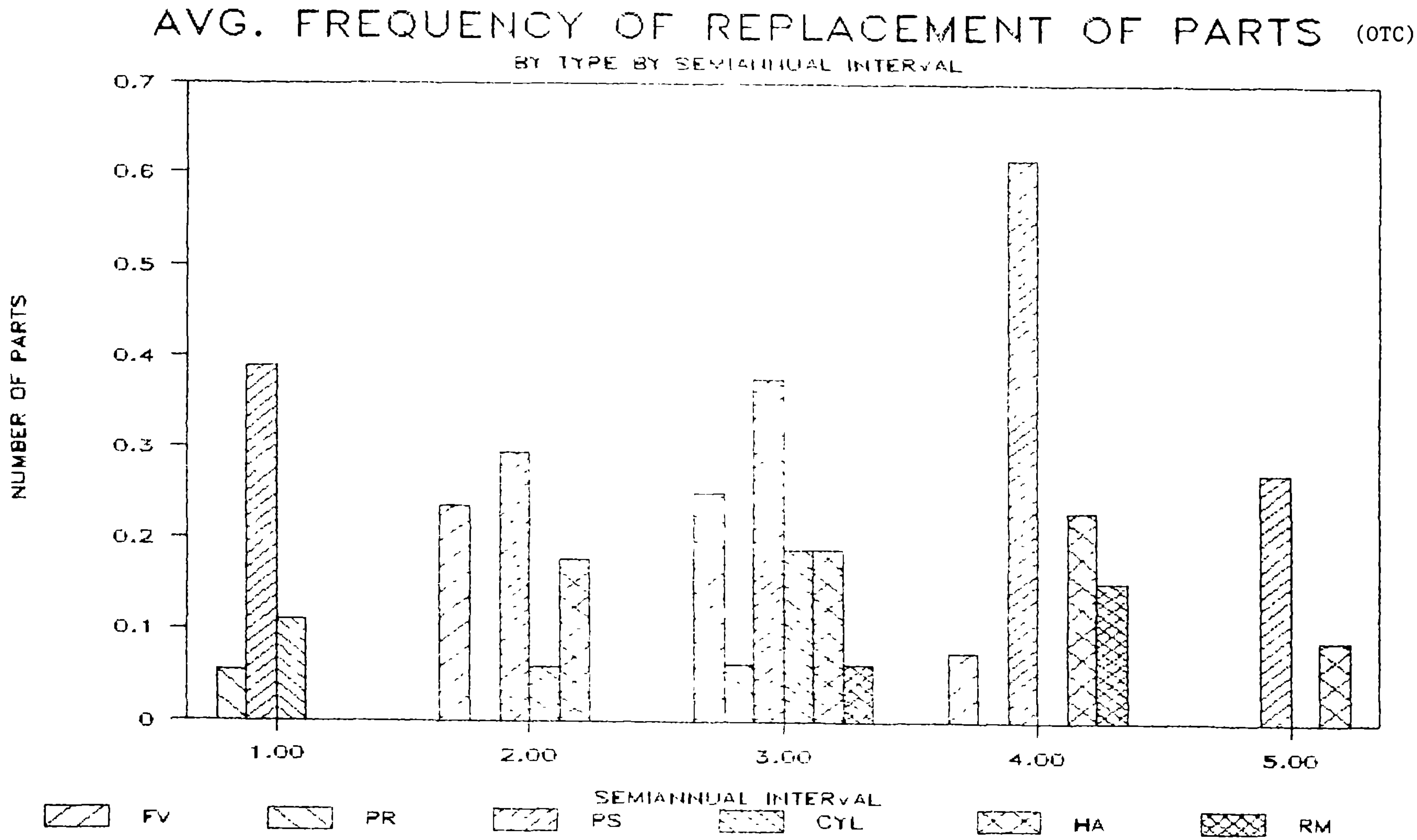

AVG. FREQUENCY OF REPLACEMENT OF PARTS (OTC)
BY TYPE BY SEMIANNUAL INTERVAL
NUMBER OF PARTS
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1.00
2.00
3.00
4.00
5.00
SEMIANNUAL INTERVAL
FV
PR
PS
CYL
HA
RM

Fig.6

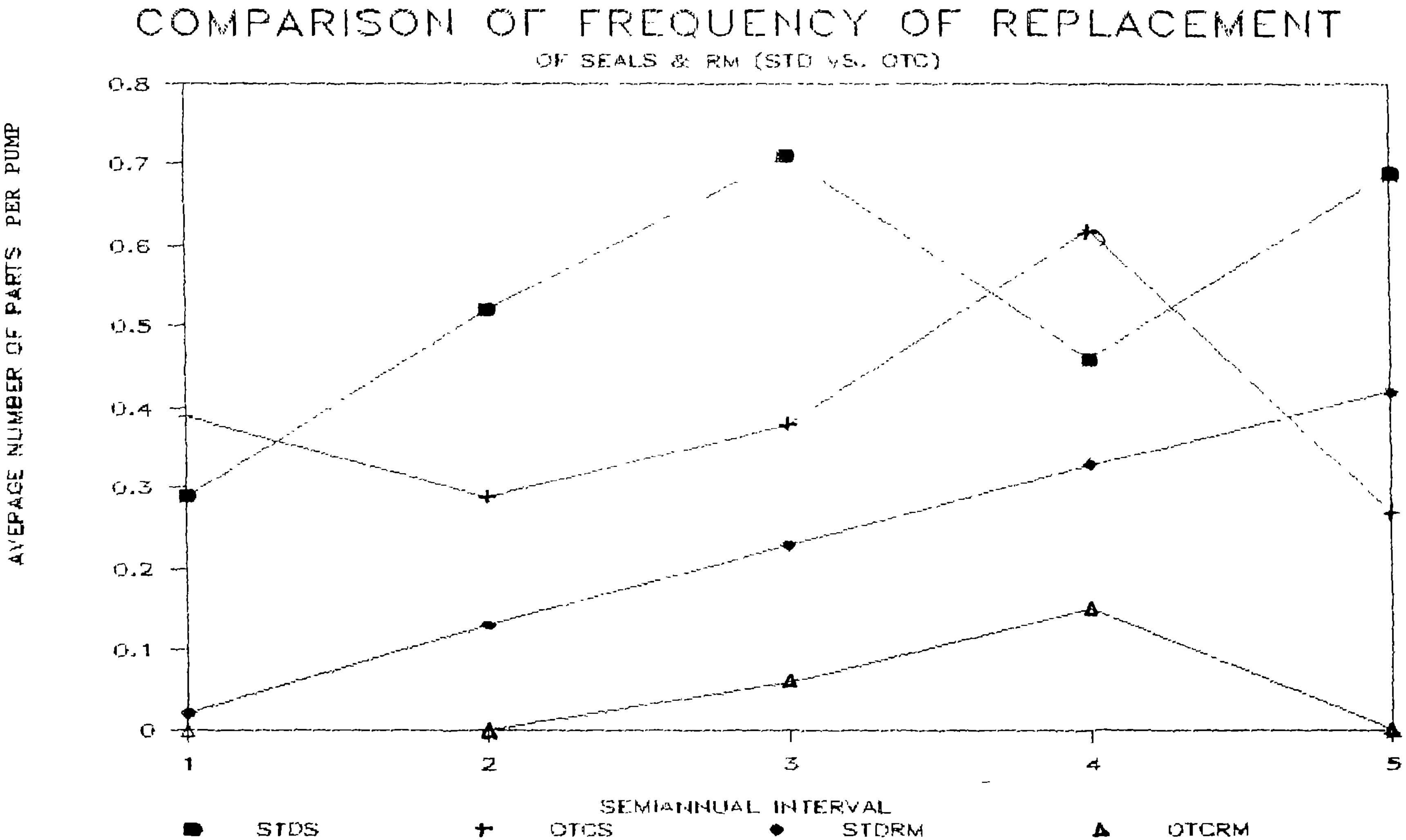

COMPARISON OF FREQUENCY OF REPLACEMENT
OF SEALS & RM (STD VS. OTC)
AVERAGE NUMBER OF PARTS PER PUMP
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
2
3
4
5
SEMIANNUAL INTERVAL
STDS
OTCS
STDRM
OTCRM

Fig.7

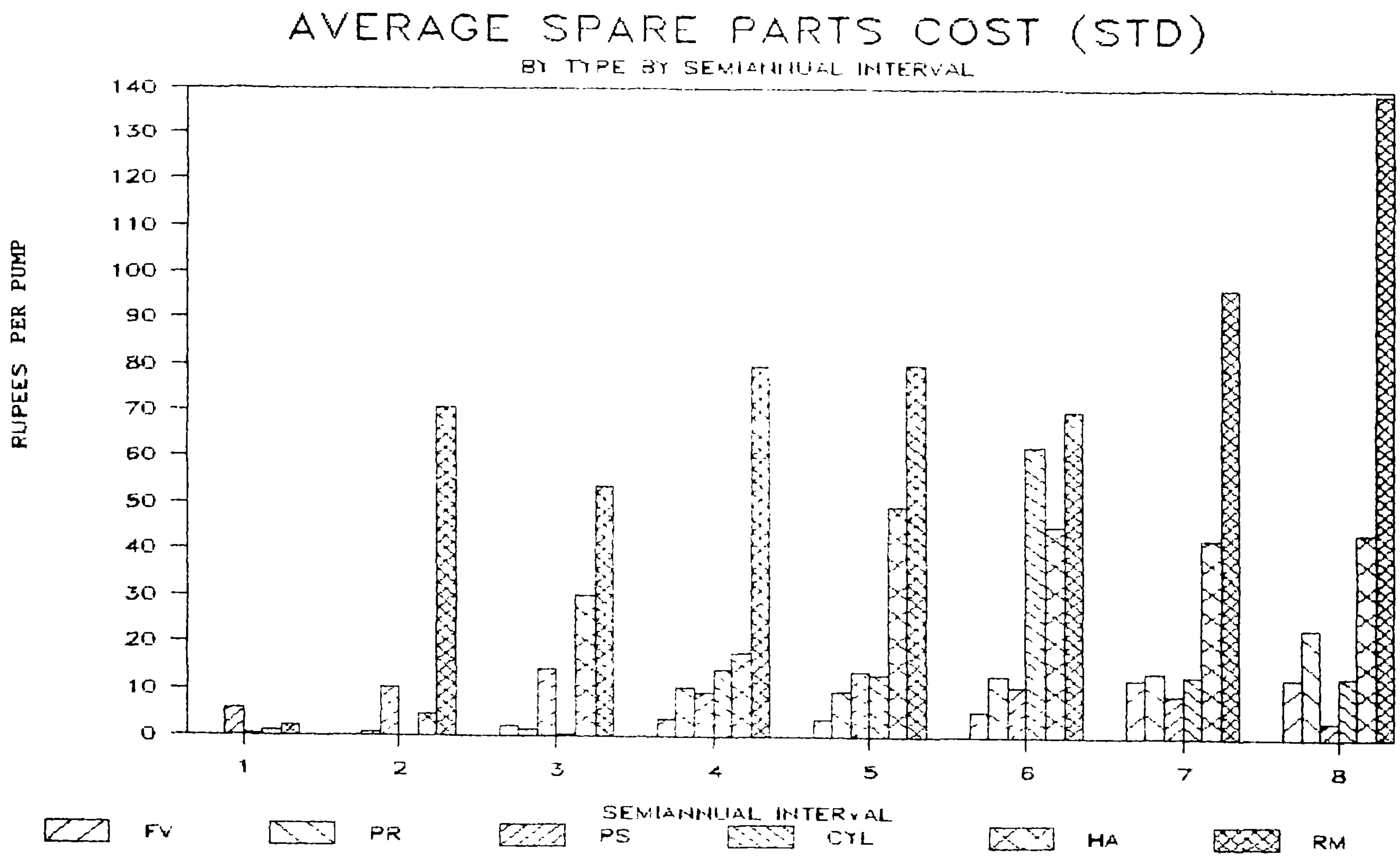

AVERAGE SPARE PARTS COST (STD)
BY TYPE BY SEMIANNUAL INTERVAL
RUPEES PER PUMP
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
SEMIANNUAL INTERVAL
FV
PR
PS
CYL
HA
RM

Fig.8

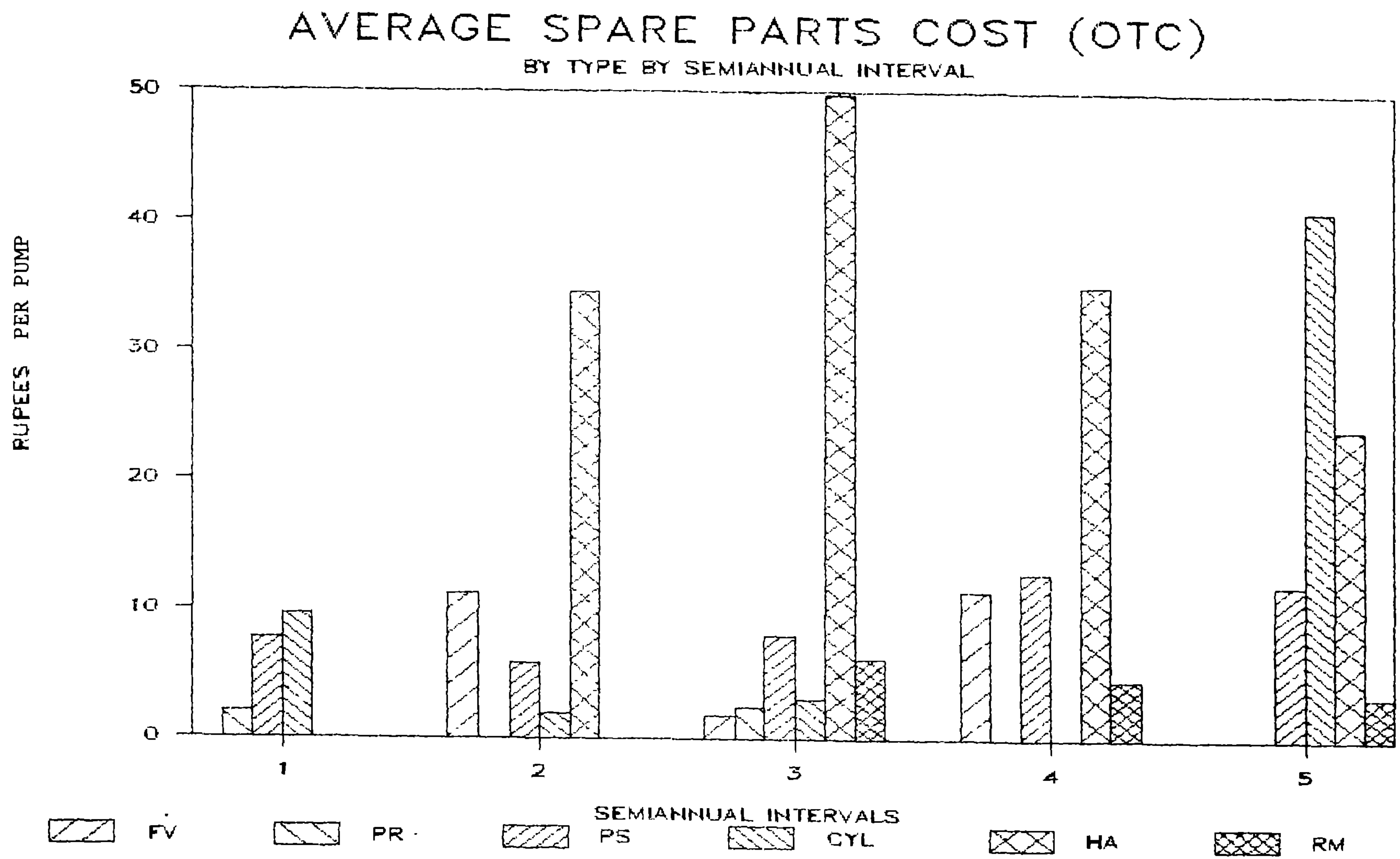
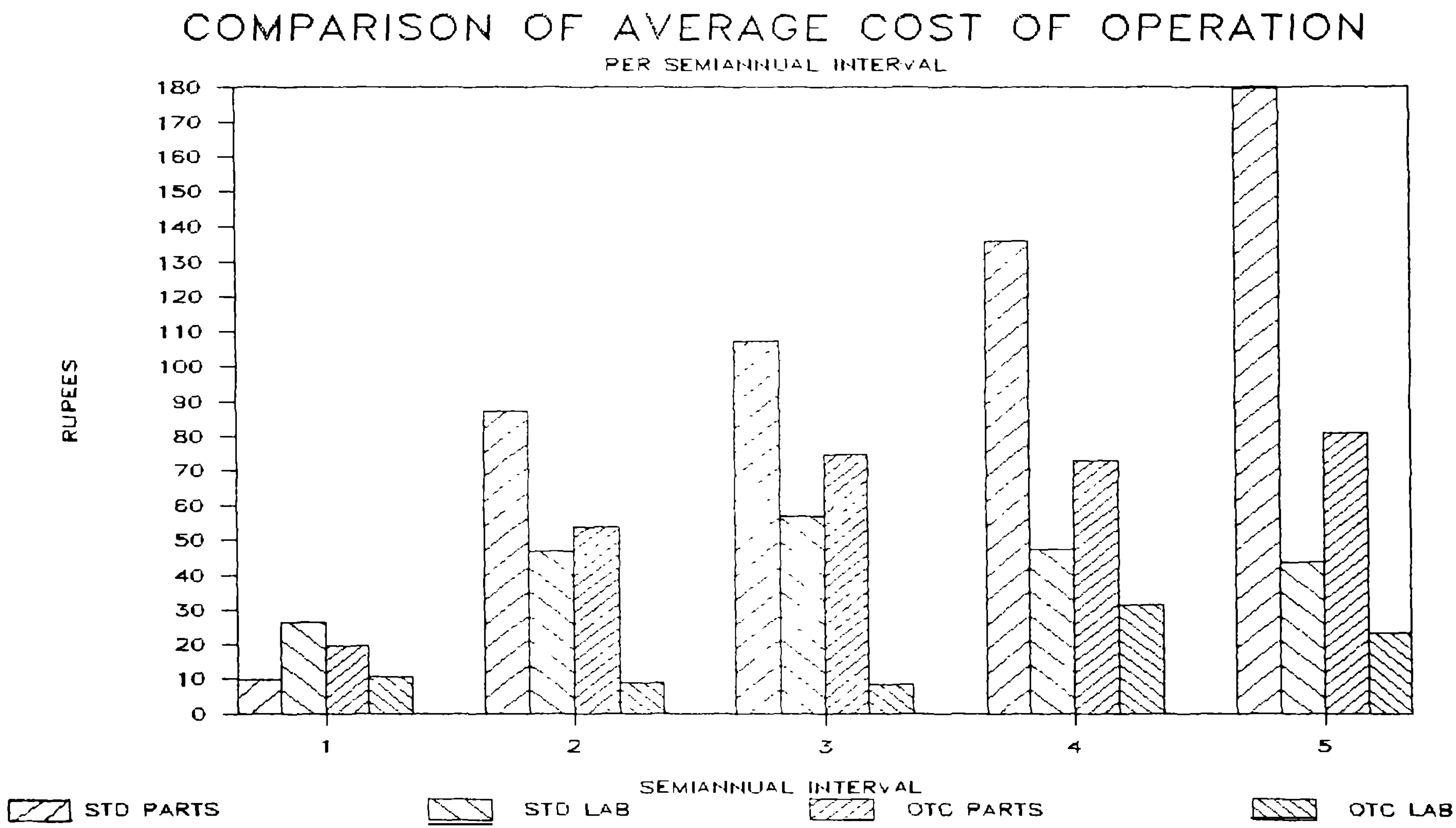

AVERAGE SPARE PARTS COST (OTC)
BY TYPE BY SEMIANNUAL INTERVAL
RUPEES PER PUMP
0
10
20
30
40
50
1
2
3
4
5
SEMIANNUAL INTERVALS
FV
PR
PS
CYL
HA
RM

Fig. 9


COMPARISON OF AVERAGE COST OF OPERATION
PER SEMIANNUAL INTERVAL
RUPEES
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
SEMIANNUAL INTERVAL
STD PARTS
STD LAB
OTC PARTS
OTC LAB

DESIGN, OPERATION AND MAINTENANCE OF WATER TREATMENT PLANTS WITH REFERENCE TO IRON REMOVAL FOR RURAL WATER SUPPLY

V.P. DESHPANDE*

INTRODUCTION

The Government of India has launched five major Technology Missions for achieving expeditious results for improving the situations in rural areas. The Water Technology Mission emphasizes the need to have low cost technological solutions for rural water supplies with special consideration being given to problem villages. The problems with rural water supply are mainly due to the presence of high concentrations of iron, fluoride, salinity, brakishness, bacterial contamination and problems related to operation and maintenance in rural areas. The activities of water technology mission are mutifold and involves coordination of various agencies, State Governments and local bodies.

Installation, operation and maintenance of hand pumps and iron-removal plants plays a vital role in achieving the goal of providing safe and hygienic drinking water to rural masses. In the present paper, an attempt has been made to describe the treatment and maintenance aspects of rural water supply schemes with special reference to iron removal from drinking water having a hand-pump connection.

NEED FOR WATER TREATMENT TECHNOLOGIES

The provision of adequate and safe drinking water to growing population of rural and urban areas has been a challenging problem due to limited financial resources. The technology which is appropriate in a developed country, becomes inappropriate in developing country due to economic considerations. There are problem of poor operation and maintenance of rural water supply schemes.

The use of conventional treatment methods of water purification based on rapid sand filtration following sedimentation has not always turned out to be justified either economically or from health stand point of view.

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In this context, it has become necessary to develop new treatment methods which are economically viable, technically feasible, scientifically sound and socially acceptable especially for rural areas.

RURAL WATER SUPPLY - MAJOR SOURCE

For the rural water supply, the main source of water is normally from bore wells or tubewells. The borewells of 100 mm dia and 150 mm dia are constructed upto a varying depth between 45 and 90 meters below ground level, depending on the elevation of ground water table. With the help of a hand pump, it is possible to provide drinking water to 250 persons at the rate of 40-45 litres per capita per day. A bore well yielding more than 450 litres per hour are considered suitable for installation of power pumps. The benefits derived from tubewells are i) the water coming from the underground rocky strata is normally free from bacterial contamination, ii) tubewells start repaying almost from the same day they are commissioned, iii) the deeper acquifers can be found in almost all villages and are last to suffer in the drought conditions, iv) the space required for the tubewell is small as compared to open dug well, v) the cost of operation and maintenance is quite reasonable.

The tubewells drilled upto 1974 weer fitted with low quality handpumps which broke down frequently. Due to this unreliability, the hand pump tubewells as a water supply system did not function satisfactorily. Following the lead from a voluntary agency in Sholapur (Maharashtra), UNICEF researched, developed and supported the manufacture of a sturdy reliable tubewell hand pump which by 1978 became known as the India Mark II hand pump.

PROBLEM VILLAGES AND RELATED PROBLEMS

The problem villages conform to the following criteria:

i) Those which do not have a source of water within a radius of 1.6 km. or within a depth of 50 m

ii) Those where the sources of water are endemic to water borne diseases

iii) Those where sources of water suffer from excessive chemical or toxic constituents.

In India out of 5,12,000 villages, more than 2,30,700 villages had been identified as problem villages having no source of water supply. Over 41,800 villages were provided with drinking water during 84-85. The total number of villages with at least one source of water supply rose to 1.90 lacs.

The problem of excessive concentrations of iron falls in the category III of problem villages. Studies conducted on water quality assessment of tube well waters have shown that the water contains excessive concentrations of iron varying from 1-15 mg/1. These groundwater sources are therefore required to be abstracted and treated for the removal of dissolved impurities namely iron.

The presence of iron in water is undesirable owing to production of discoloration, turbidity, deposit and taste. Iron bearing waters have an astringent, metallic and bitter taste. Water containing iron is unsuitable for culinary use because it causes brown-coloured deposition on the vegetable during washing and cooking. Iron may be originally present in water derived from the source or be acquired from metals with which the water subsequently comes in contact. Many a times, iron is associated with free carbon dioxide.

Though iron is essential for the nutrition and healthy development of most plants, animals and man, it's excessive concentration in water is not desirable. Ministry of Health, Government of India and Indian Standard Institution have suggested the permissive and excessive limits of 0.3 and 1.0 mg/1 respectively. There are 2900 villages/hamlets in India which have a problem of excessive iron.

In view of the high concentration of iron in water, treatment of water for removal of this constituent from water is essential.

APPROPRIATE TECHNOLOGY FOR IRON REMOVAL

Appropriate Technology is of utmost importance in rural water supply. In view of the limited finances available and the problems related to management of schemes, a technology suitable to local conditions is always desirable.

In rural areas, the population is very small and poor. For the low density population, piped water supply is costly and due to non-availability of trained personnel, operation and maintenance becomes difficult. These thoughts have been given due consideration while designing the iron removal plants.

For the design of iron removal plants, complicated designs involving mechanised treatment units have been fully avoided which in turn resulted in low initial costs and ease in operation and maintenance.

IRON REMOVAL PLANTS

The unit for rural water supply for the removal of iron consists of tray-aeration, sedimentation, filtration and disinfection. The schematic treatment flowsheets for hand-pump with iron removal units are shown in figures 1 and 2.

Aeration ensures oxidation of iron from Fe(II) to Fe(III) and removal of dissolved carbon-dioxide. The precipitates formed during oxidation would be settled in sedimentation tank and during filtration, the flocs would be entrapped. The water sprinkling system (for aeration) above trays is about 1.2 - 1.5 m (4-5 feet) above the delivery spout of the hand pump. The whole system works on batch basis such that the treated water starts flowing as soon as hand pump is in operation.

One of the main problem faced during design and installation, is the ability of hand pump to give free continuous discharge at a required height of 1.2 to 1.5 m. To ensure adequate discharge from the hand pump, the elevation of the delivery spout has to be increased and this has been done by elevating the platform on which hand-pump is installed. Due to the increased height of platform, the height of delivery spout gets automatically increased with the result that required quantity of water starts flowing to the treatment plant as soon as hand pump is operated.

One of the possibility to tackle this problem is to increase the delivery head by way of incorporating certain modifications in the body of hand-pump itself. One such modification in the upper-most portion of hand pump by providing extra bush and gasket has been tried by UP Jal Nigam in Mirzapur district.

MAINTENANCE AND MANAGEMENT

The key to the success of rural water supply schemes is proper operation and maintenance. In order to derive optimum benefits and to get the desired results from the system, proper operation and maintenance and it's management is of vital importance. Since the treatment plants are connected to hand-pump/bore wells, the operation and maintenance for the system has to be considered as a complete system. Proper maintenance of hand pump and treatment units are inter related and dependent on each other.

Operation and maintenance is a stage of the project wherein the completed assets are handed over to the local bodies for maintenance. In some cases, the maintenance part is looked after by Public Health Engineering Departments and Water Boards. The assets of water supply schemes completed with best engineering inputs often remain as monuments due to lack of proper maintenance. It is, therefore necessary to plan the policies of O & M for water supply schemes. Training is also an essential and critical input for O & M programme.

The operation and maintenance of iron removal plant is simple. After installation of the plant, about 300 litres of water has to pass through the units. A person can then operate the hand pump and get the iron free water from the tap. The iron-precipitate settled in a settling tank, can be removed once in 15-20 days depending upon the initial concentration of iron in raw water. The filter media from the top layer of 8-10 cms can be scraped manually, cleaned in a bucket by hand-shaking and replaced again. The gravel, limestone or stone media in tray aerator has to be replaced once in a year or so. The unit sizes, cost economics and inventory of manpower etc. are given in tables 1, 2 & 3.

TABLE 1: Unit Sizes for Iron Removal Plant
Population - 250

a) Tray aerator 2 Nos., 600 mm x 600 mm x 300 mm
Media - Calcite/marble/coke of size 25 - 40 mm

b) Sedimentation tank - 1.3 m x 1.3 m x 0.75 m

c) Sand filter - size - 1.6 m x 1.6 m
Sand size - 0.3 - 0.45 mm depth - 0.3 m

TABLE 2: Cost economics for iron removal plant (including hand pump installation)

Population	:	250
Water demand	:	10 m^3/d @ 40 lpcd
Capital Cost	:	Rs. 1.70 litre or Rs.1700/m^3 (including hand pump cost)
O & M Cost	:	Rs. 6.16/m^3/d includes

a) Depreciation @ 5%
b) Annual Interest @ 12% p.a.
c) Maintenance @ 5%
d) Cost of chemicals
e) Staff
f) Contingencies

TABLE 3: Inventory of Manpower and Equipment for a population of 250

Manpower	:	1 Supervisor @ 1000 pm 1 Helper @ 600 pm
Pipe Size	:	a) Inlet pipe to tray aerator - 100 mm b) Sludge pipe - 75 mm c) Distribution - 25 mm
Valves	:	25, 75 and 100 mm size.

The preventive maintnance of 1 hand pump consists mainly of tightening the nuts and bolts of the top-head, the water chamber and the pedestal flanges. Greasing of the chain is required to be done once in a week.

The overall maintenance system works of three levels which are related to each other. These are village, block and district level maintenance. Since these are co-related with each other, coordination and interaction between them is essential.

VILLAGE LEVEL O & M

The PHED can select a team of 3 members from a village, the team leader being Gram Pradhan or Sarpanch. The Public Health Engineering Department can educate the team members about the upkeep of treatment units and handpump. The basic techniques of emergency minor repairs can be explained to the village level workers. The importance of protected water source and cleanliness should be taught to the villagers. Necessary spare parts and tools can be kept with the team for emergency repairs. Since the maintenance of iron removal is easy, the operations like desludging the settling tank, washing of sand and replacing it, can be done at regular intervals. A record register can be maintained indicating the breakdowns and repairs for major repairs, the village committee should contact the Block Development Officer who has a mechanic under his control. The block level mechanic should carry tools and furnish technical guidance for repairs.

It should be realised that unless the basic techniques of repairsing the hand pumps and treatment units are acquired by the village level workers, the efforts and investments made earlier cannot give desired results and success of the scheme.

BLOCK LEVEL O & M

The Block Development Officer should have one ITI trained mechanic cum inspector and he should be given a task of maintenance of atleast 10-15 hand-pump and iron removal plants. There can be number of such mechanics depending on the quantum and magnitude of work. The inspector cum mechanic should inspect the sites and assess the working condition of hand-pump and treatment units. If he anticipates any major breakdown or repair, he should inform to the executive engineer or concerned higher official. The mechanic should have necessary spare parts and tools with him for attending minor repairs.

DISTRICT LEVEL O & M

In each district, there should be atleast one separate division headed by an executive engineer. The junior engineers should be given O & M work of blocks in the jurisdiction. Under each junior engineer, there should be a team of atleast 5-6 mechanics and fitters who can attend the major breakdowns and repairs as well assist the block-mechanic and village team whenever the pump and plant need repairs. The team of mechanics should carry the tools and spare parts in their vehicle to do the major repairs.

DECENTRALISATION IN O & M PROGRAMME

Increasing the role of subordinate staff is decentralisation. The heads of the Public Health Engineering Departments or Water Boards can give more responsibilities to the subordinate staff as far as O & M of rural water supply schemes is concerned. It has been conclusively proved that bottom-up planning can work. A decentralised O & M programme means the rural organisation has to get associated with Public Health Engineering Departments who are responsible for drinking water supply in a state. An integrated approach can solve the problem and ensure better health to the population, the programme may be incorporated into the block programmes. These changes have to be backed by strong support from the State and Central Government Departments who have to take steps to ensure co-ordination and co-operation.

COMMUNITY PARTICIPATION

The community participation is very crucial for effective implementation of water supply scheme. Without the active participation and involvement of the community, the water supply scheme will become disused and will deteriorate soon. Voluntary and willing community participation "is a must" for proper maintenance of rural water supply schemes.

CONCLUSIONS

1. The ground water being one of the major source of rural water supply, is likely to contain excessive concentrations of iron. There is a need to provide adequate treatment which is low in capital cost and operation and maintenance is easy.

2. The operation and maintenance of iron removal plant should be treated as an integral part of hand-pump maintanance programme. Proper arrangements should be made to train the villagers in all aspects of maintenance and repairs of handpump and the treatment plant. Community participation plays an important role in the success of programme. The village population need to be educated in making them aware of the benefits of treated water.

3. If the yield of tube well is more, electrically operated pump can be installed on bore well for continuous iron-free water supply. The villagers should bear the cost of electricity charges.

4. Sufficient stock of chemicals like bleaching powder, spare parts and tools should be available at village level for emergency minor repairs. Proper co-ordination of all the levels of O & M programme is of vital importance.

5. Decentralised O & M should be given due importance on rural water supply schemes so as to channelise the maintenance programmes. The existing system for maintenance of rural water supply systems should be further modified and incorporated in all states.

6. A water testing laboratory having facilities for routine parameter's analysis should be set up at district level and water samples from the pumps/ plants be collected at regular intervals for testing so as to check and maintain quality.

REFERENCES

1. Rakshit R.N. "Development of Groundwater Resources for Drinking Water Supply in the rural water areas of Maharashtra State". JIWWA VOL. IX NO. 4, pp. 315-321, 1977.

2. Gadkari A.D. "Groundwater Potential in Drought Prone Areas of Maharashtra".

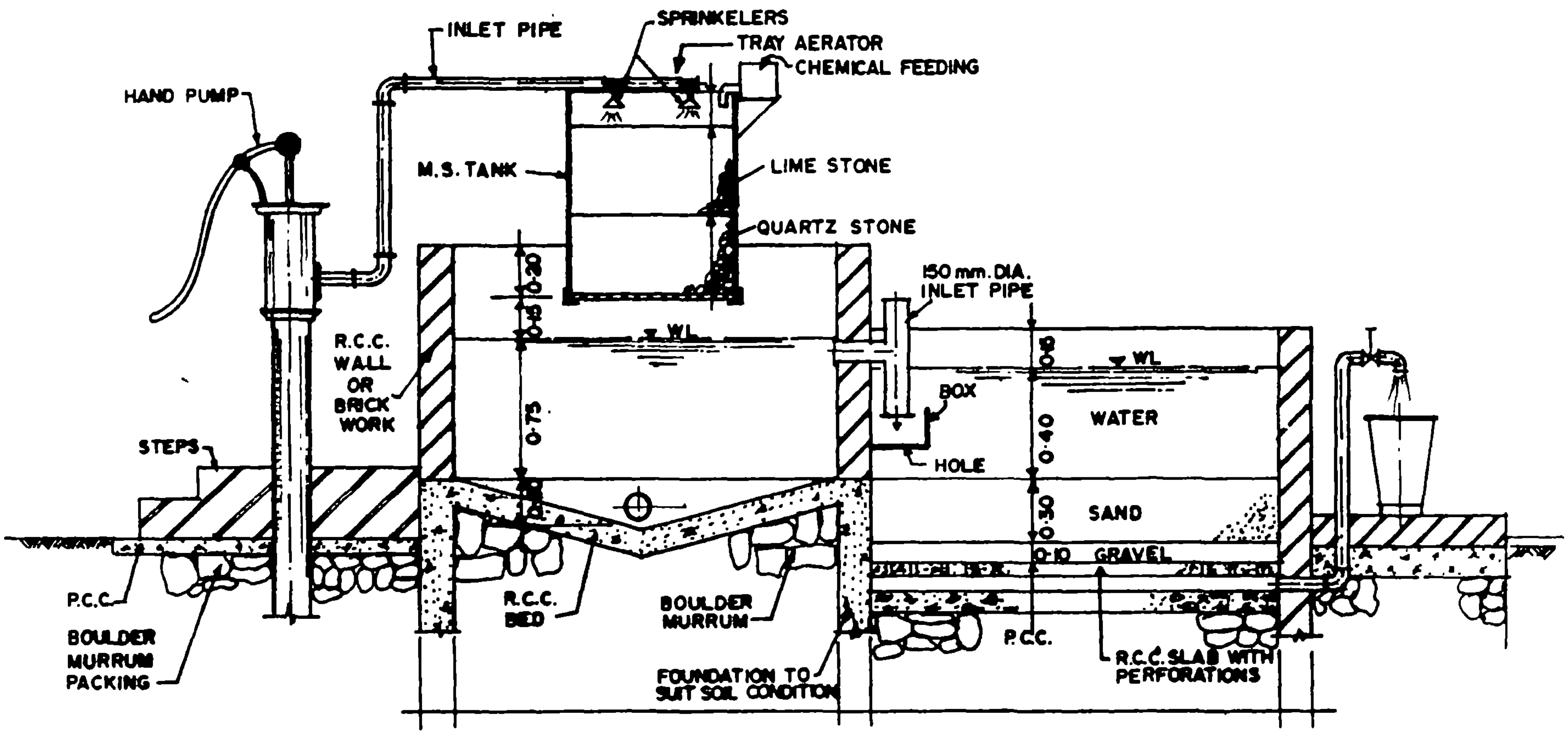
3. Ali M.M. "Performance and Maintenance of India Mark II Hand Pump in Rural Areas". Presented at All India Seminar on Rural Water Systems Execution, Maintenance and Management, Lucknow, Nov. 24-25, 1985.

4. Chaturvedi A.C. - "Rural Water Supply in 80's" Presented at All India Seminar on Rural Water Supply Systems - Execution, Maintenance and Management, Nov. 24-25, 1985, Lucknow.

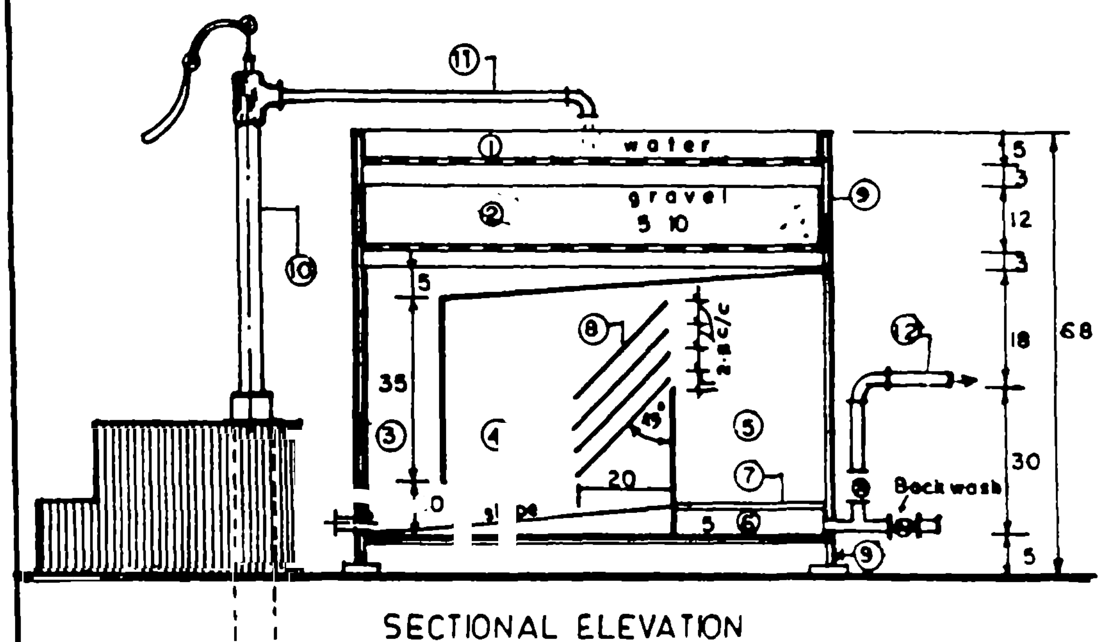
5. Vasavada B.J. "Project Management". JIWWA Vol. XVI No. 2 , pp. 197-200, 1984.

6. "Small Community Water Supplies". Technical Paper series, No 18, IRC, Aug. 1981.

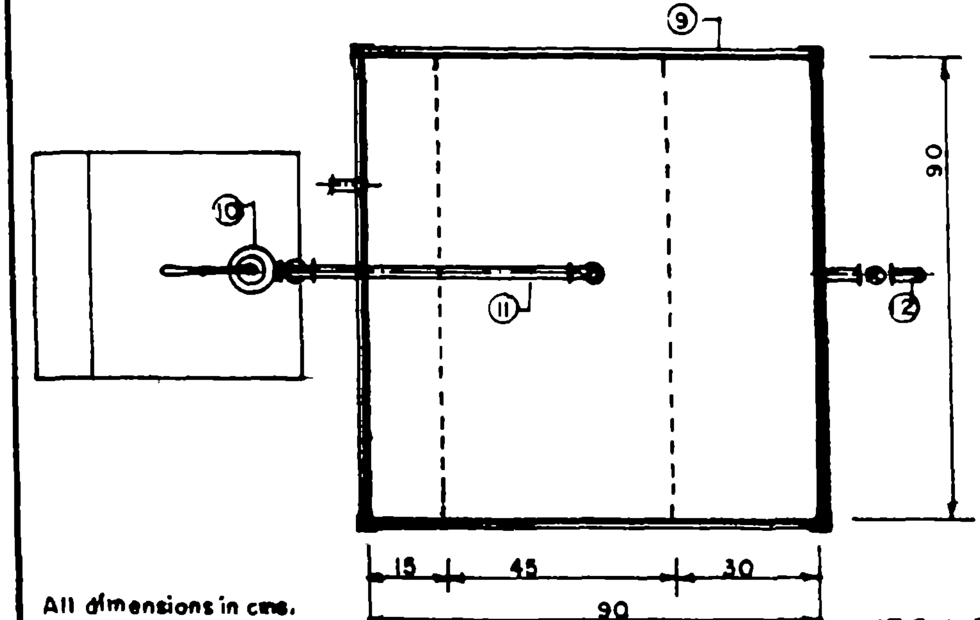
7. Chickannaiyappa. "Community Participation - Maintenance of Water Supply Schemes". JIWWA, Vol. XVI, No. 1, 1985.



SECTIONAL ELEVATION



SECTIONAL ELEVATION



All dimensions in cms.

PLAN

SPECIFCATIONS

(1) SPRAY TRAY		G I. SHEET, 18 GAUGE, 90x 90x5, PERFORATED BOTTOM OF 30 mm ø HOLES AT 2 cm C/C
(2) AERATION CHAMBER		——do—— size: 90x90x35
(3) COLLECTION CHAMBER	"	90 x 15 x 35
(4) SETTLING CHAMBER	"	90 x 45 x 35
(5) FILTER CHAMBER	"	90 x 30 x 40
(6) FILTER WATER CHAMBER	"	90 x 30 x 5
(7) PERFORATED PLATE	"	90 x 30 x 0.2, 30 mm Ø holes at 2 cm c/c
(8) PLATE SETTLER	"	90 x 28 x 0.2, 4 Nos. inclind at 45° at 2.5 cm c/c
(9) M.S. Angle iron Frame with support	"	35 x 35 x 6
(10) BORE WELL HAND PUMP		
(11) RAW WATER INLET PIPE	"	50 mm ø
(12) TREATED WATER INLET PIPE TO STAND POST	"	50 mm ø

IRON REMOVAL PLANT FOR HAND PUMP
(CAP: 5 Lit/min)

NEERI NAGPUR

DEFLUORIDATION OF WATER

* W.G.Nawlakhe

INTRODUCTION

Fluorine is so highly reactive that it is never encountered in its elemental gaseous state except in some industrial processes. It occurs notably as fluorspar, CaF_2; cryolite, Na_3AlF_6; fluorapatite, $3Ca_3(PO_4)_2.Ca(F,Cl)_2$. These fluoride minerals are nearly insoluble in water. Hence, fluorides will be present in ground waters only when conditions favour their solution.

Fluoride, although beneficial when present in concentrations of 0.8-1.0 mg/L, has been associated with mottled enamel of the teeth when present in potable waters in concentrations in excess of 1.5 mg/L. Skeletal fluorosis has been observed at concentrations beyond 3 mg/L.

DENTAL FLUOROSIS

The assessment of dental fluorosis is particularly important in areas where the natural fluoride content of the water supply is high. The most widely used criteria for the assessment is that developed by Dean.

Normal: The enamel presents the usual translucent semivitriform type of structure. The surface is smooth, glossy, and usually of a pale, creamy white colour.

Questionable: The enamel discloses slight aberrations from translucency of normal enamel, ranging from a few white flecks to occasional white spots, with a tendency to form horizontal striations.

Very Mild: Small, opaque, paper-white areas are scattered irregularly over the tooth but involving less than 50% of the tooth surface.

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Mild : The white opaque areas in the enamel of the tooth are more extensive, but still involve less than 50% of the tooth.

Moderate: All enamel surfaces of the teeth are affected and surfaces subject to attrition show marked wear. Brown stain is frequently a disfiguring feature.

Severe: All enamel surfaces are affected and hypeplasia is so marked that general form of the tooth may be affected. The major diagnostic sign of this classification is the discrete or confluent pitting. Brown stain are widespread and teeth often present a corroded appearance.

SKELETAL FLUOROSIS

Ingestion of 20-80 mg F per day or more through water over a period of 10-20 years results in crippling and severe osteosclerosis. Calcification of certain ligaments is usually associated with at least 10 mg/L of fluoride in drinking water, which renders the movement of the joints difficult.

DEFLUORIDATION OF WATER

The Ministry of Health, Government of India, has prescribed 1.0 and 2.0 mg/L as permissive and excessive limits for fluorides in drinking water.

Occurrence of excess fluoride bearing waters was reported by many researchers in Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamilnadu and Uttar Pradesh.

NEERI has been working on defluoridation since 1961. Defluoridation is achieved either by fixed bed regeneration or by precipitation and complexation precesses. Materials like clays, minerals, ion-exchange resins, activated carbons, activated alumina, sulphonated coals and serpentine were tested for removal of excess fluorides from water.

In-situ, chemical treatment with lime, magnesium salts, iron and aluminium salts were also studied. Only those materials were examined which gave encouraging trend on bench-scale. These include ion-exchange resins, saw-dust carbon, coconut-shell carbon, defluoron-1, carbion, magnesia, serpentine and defluoron-2. Ion-exchange resins, saw-dust carbon, defluron-1 magnesia and serpentine did not prove useful beyond bench-scale.

Pilot plant studies were performed using carbion at Gangapur in Rajasthan. Two full scale plants were installed using Defluoron-2 at Municipal Corporation, Nalgonda, and Central Training Institute, Hyderabad.

NALGONDA TECHNIQUE FOR DEFLUORIDATION

Boruff, Kempf, Scot, Culp and Stoltenberg studied alum coagulation for defluoridation. But they did not consider it a practical solution and did not follow it up.

Defluoron-2, activated alumina, and magnesia processes were found to be successful in removal of excess fluoride from water; but the regeneration of the medium, control of operation and maintenance of plant required skilled operation which was not available at places where the problem exists.

NEERI, in 1974, evolved a method of alum coagulation for defluoridation to overcome these problems. Realising the potentiality of alum coagulation, probe findings were presented on test waters of 400 mg/L alkalinity and fluoride concentrations ranging between 2.4 and 16.4 mg F/1. The studies on alum coagulation were further continued on waters with alkalinities in the range of 80-1070 mg/L and fluoride ranging between 3.05 and 10.50 mg F/1; and a new method called as 'Nalgonda Technique was evolved for defluoridation of water. Nalgonda Technique is so simple and adaptable that even illiterate persons make use of it at village level. The method comprises addition, in sequence, of bleaching powder, sodium aluminate or lime and aluminium sulphate or aluminium chloride or a combination of these two and is followed by flocculation, sedimentation, and filtration. The doses of chemicals depend upon the contents of fluoride and alkalinity in the raw water. Table-1 indicates the doses of alum required to obtain permissive limit of fluoride in water at various alkalinity and fluoride levels.

Nalgonda Technique for defluoridation of water can be applied when : (i) there is no acceptable alternate low fluoride source, (ii) dissolved solids are below 1500 mg/L, (iii) total hardness is below 250 mg/L and (iv) alkalinity of the water is sufficient, though it is equally effective for waters having more TDS and hardness than the limits mentioned above.

TABLE-1 Alum doses required to obtain permissive limit of Fluoride in water at various alkalinity and Fluoride levels.

Test Water Fluorides, mg F/1.	Test Water Alkalnity, mg $CaCO_3$/L							
	125	200	300	400	500	600	800	1000
2	143	221	273	312	351	403	468	520
3	221	299	351	403	507	520	585	767
4	*	403	416	468	559	598	689	936
5	*	*	507	598	689	715	884	1010
6	*	*	611	715	780	936	1066	1200
8	*	*	*	*	988	1118	1300	1430
10	*	*	*	*	*	*	1508	1690

NOTE: Not possible to treat due to low alkalinity. Can be treated by increasing the alkalinity.

MECHANISM OF DEFLUORIDATION BY NALGONDA TECHNIQUE

Nalgonda Technique is a combination of several unit operations and processes incorporating rapid mixing, chemical interaction, flocculation, sedimentation, filtration, disinfection, and sludge concentration to recover water and aluminium salts. (Fig-1).

Rapid Mix: It provides through mixing of alkali, aluminium salts and bleaching powder with the water. The chemicals are add just when the water enters the system.

Flocculation: Flocculators provide subsequent gentle agitation before entry to the sedimentation tank. The flocculation period permits close contact between the fluoride in water and polyalumenic species formed in the system. The interaction between fluoride and aluminium species attains equilibrium.

- The chemical reaction involving fluorides and aluminium species is complex. It is combination of polyhydroxy aluminium species complexation with fluoride and their adsorption on polymeric alumino hydroxides (floc). Besides fluorides, turbidity, colour, odour, pesticides and organics are also removed. The bacterial load is also reduced significantly. All these are by adsorption on the floc.

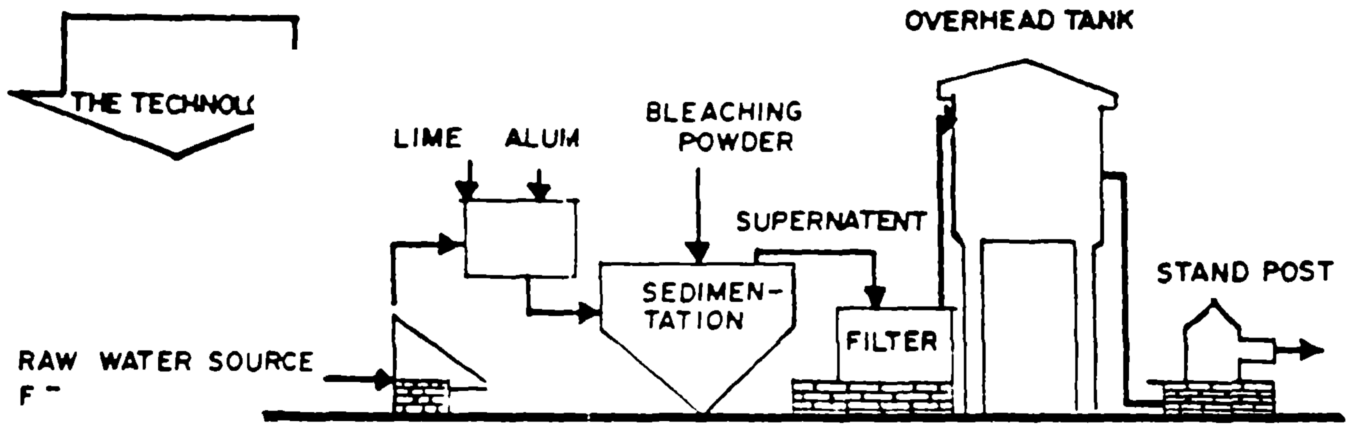
- Lime or sodium carbonate ensures adequate alkalinity for effective hydrolysis of aluminium salts, so that residual aluminium does not remain in the treated water.

- Simulteneous disinfection is achieved with bleaching powder and also keeps the system free from undesirable biological growths.

Sedimentation: It permits settleable floc loaded with fluorides, turbidity, bacteria and other impurities to be deposited and thus reduce concentration of suspended solids that must be removed by filters.

Filtration: Rapid gravity sand filters are suggested to receive coagulated and settled water in these filters and unsettled gelatinous floc retained on the filer bed.

Disinfection and Distribution: The filtered water collected



DEFLUORIDATION

THE PROCESS

- FLUORIDE IS REMOVED BY ADDING ALUM AND LIME IN SPECIFIED DOSES DEPENDING ON THE RAW WATER FLUORIDE AND ALKALINITY CONCENTRATIONS.
- BLEACHING POWDER IS ADDED TO ACHIEVE DISINFECTION SIMULTANEOUSLY
- CHEMICAL REACTIONS TAKE PLACE AND FLOCCULATION OCCURS BY SLOW STIRRING
- FLOC IS ALLOWED TO SETTLE QUIESCENTLY.
- SLUDGE CONTAINING REMOVED FLUORIDES FROM WATER IS DRAINED
- SUPERNATANT DEFLUORIDATED WATER IS AVAILABLE FOR CONSUMPTION

in the storage water tank re-chlorinated with bleaching powder and distributed as per adoptable community water supply practice.

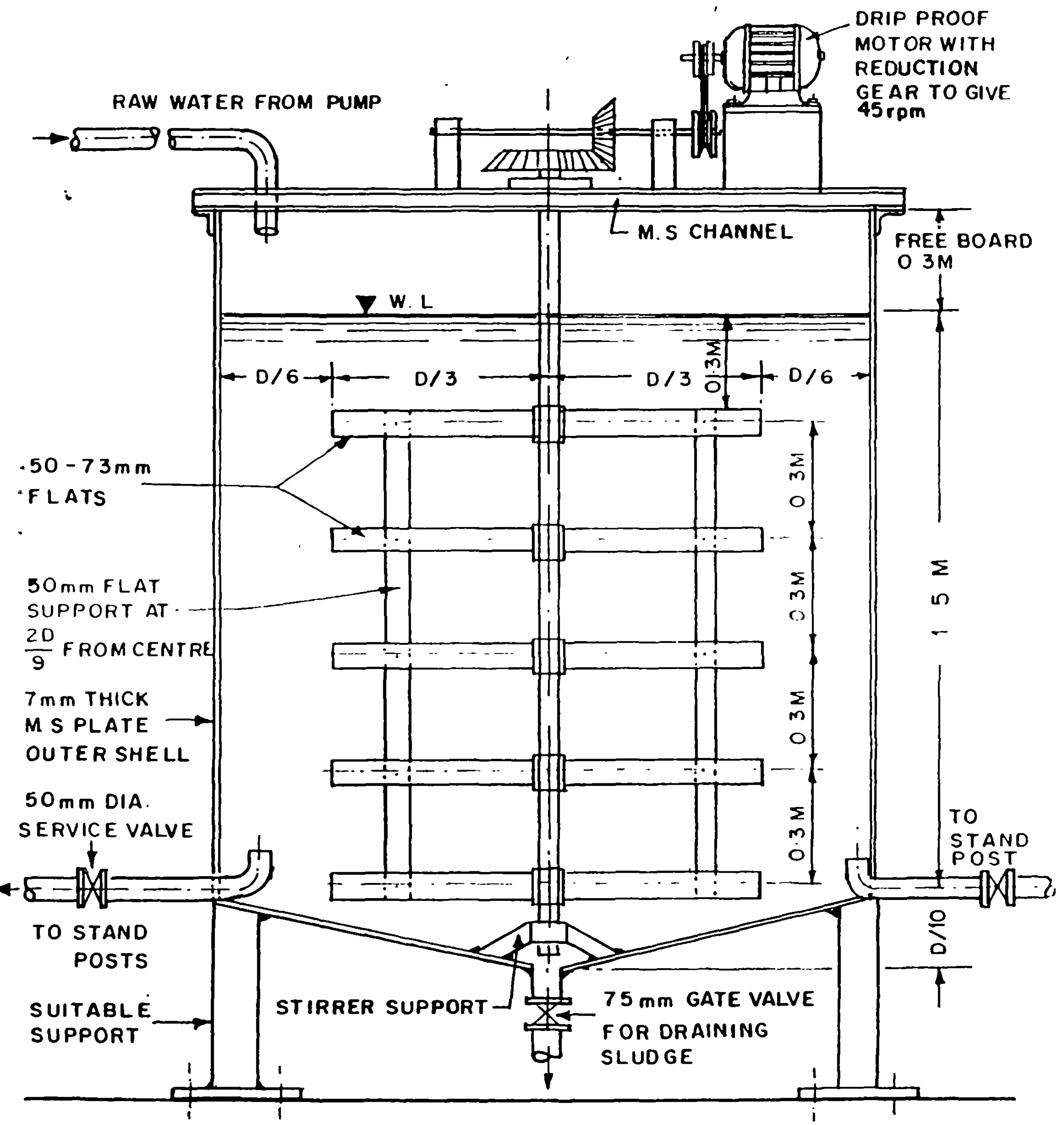
DOMESTIC TREATMENT

Nalgonda Technique can be applied at domestic level by using a container (bucket) of 60 L capacity with a tap 3-5 cm above the bottom of the container. The raw water taken in the container is mixed with adequate amount of lime, bleaching powder and aluminium sulphate solution, depending upon its alkalinity and fluoride content. Lime solution is added first and mixed well with water. Alum solution is then added and the water stirred slowly for 10 minutes and allowed to settle for nearly one hour and is withdrawn. The supernatant which contains permissible amount of fluoride is withdrawn through the tap for consumption. The settled sludge is discarded. A series of bucket experiments were conducted using fluoride water collected from wells in Rajasthan and Andhra Pradesh(Fig-2). Approximate volumes of alum solution for treatment of 40 litres of test water to obtain 1 mg F/1 at various fluoride and alkalinity levels are given in Table-2.

TABLE-2: DOMESTIC DEFLUORIDATION

Approximate Volume of alum solution (Milli litre) required to be added in 40 litres test water to obtain permissive limit (1 mg F/L) of fluoride in water at various alkalinity and fluoride levels.

Test Water Fluoride	Test Water Alkalinity, mg $CaCO_3$/L							
mg F/L	125	200	300	400	500	600	800	1000
2	60	90	110	125	140	160	190	210
3	90	120	140	160	205	210	235	310
4		160	165	190	225	240	275	375
5			205	240	275	290	355	405
6			245	285	315	375	425	485
8					395	450	520	570
10							605	675



FILL AND DRAW TYPE DEFLUORIDATION PLANT
BASIS: 40 lpcd DOMESTIC WATER

Preparation of Alum Solution: Weigh 1000 gm Alumina Ferric (commercial alum - IS:299-1962) and dissolve in water to make it ten litres solution in a plastic carboy. One mililitre of this solution contains approximately 100 milligrams alum. Keep the solution stoppered to prevent evaporation of water.

Bleaching Powder (fresh quality): approx. 120 milligrams per 40 litres water.

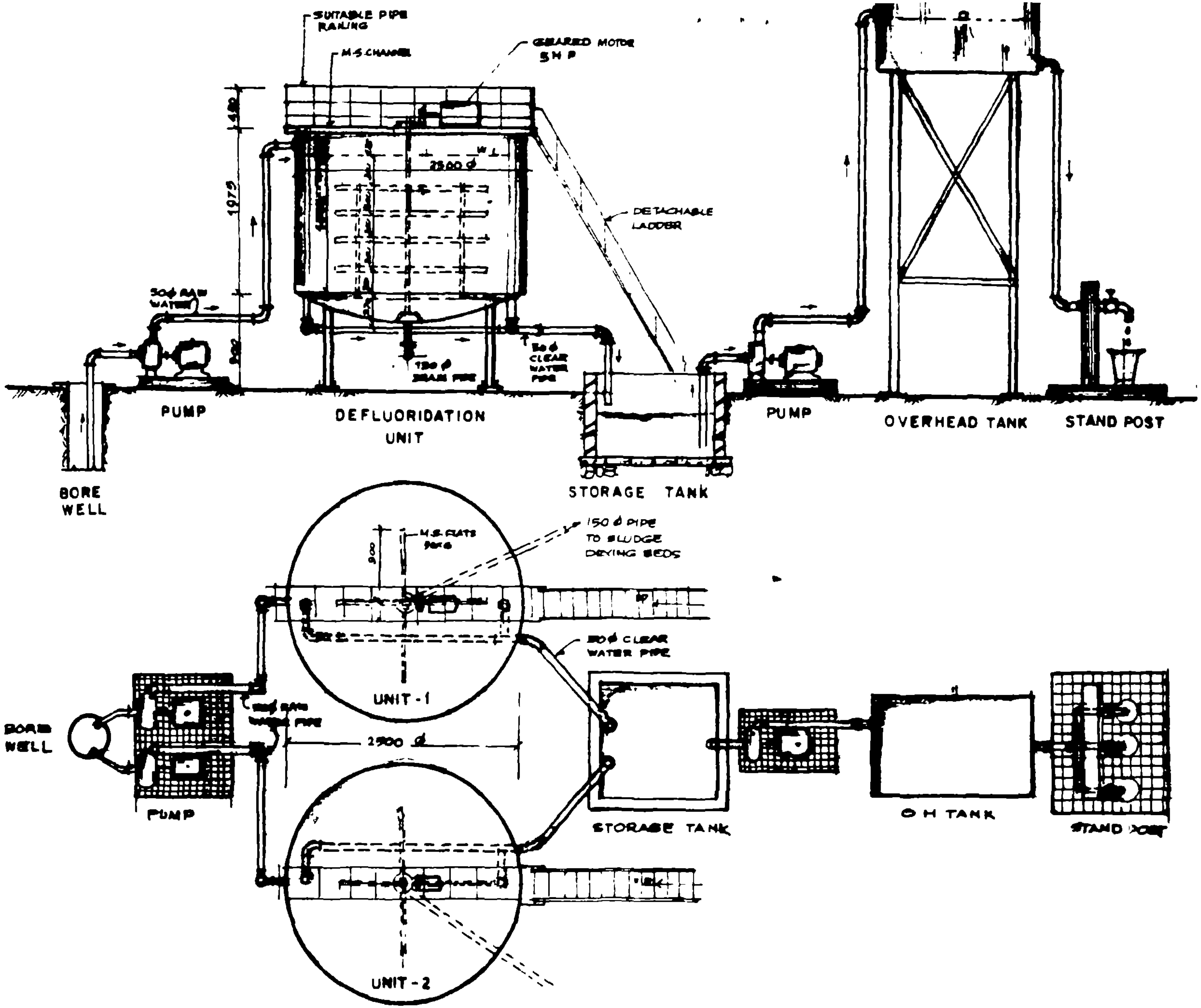
FILL-AND-DRAW TYPE DEFLUORIDATION FOR SMALL COMMUNITY

This is a batch method for communities upto 200 population. The plant comprises a hopper-bottom cylindrical tank with a depth of 2 m equipped with a hand operated or power driven stirring mechanism. Raw water is pumped or powered into the tank and required amounts of bleaching powder, lime, and alum added with stirring. The contents are stirred slowly for 10 minutes and allowed to settle for two hours. The defluoridated supernatant is withdrawn and supplied through standposts. Settled sludge in discorded. Plant dimensions for 'Fill-and-Draw Type Unit' are given in Table 3 (Fig-3).

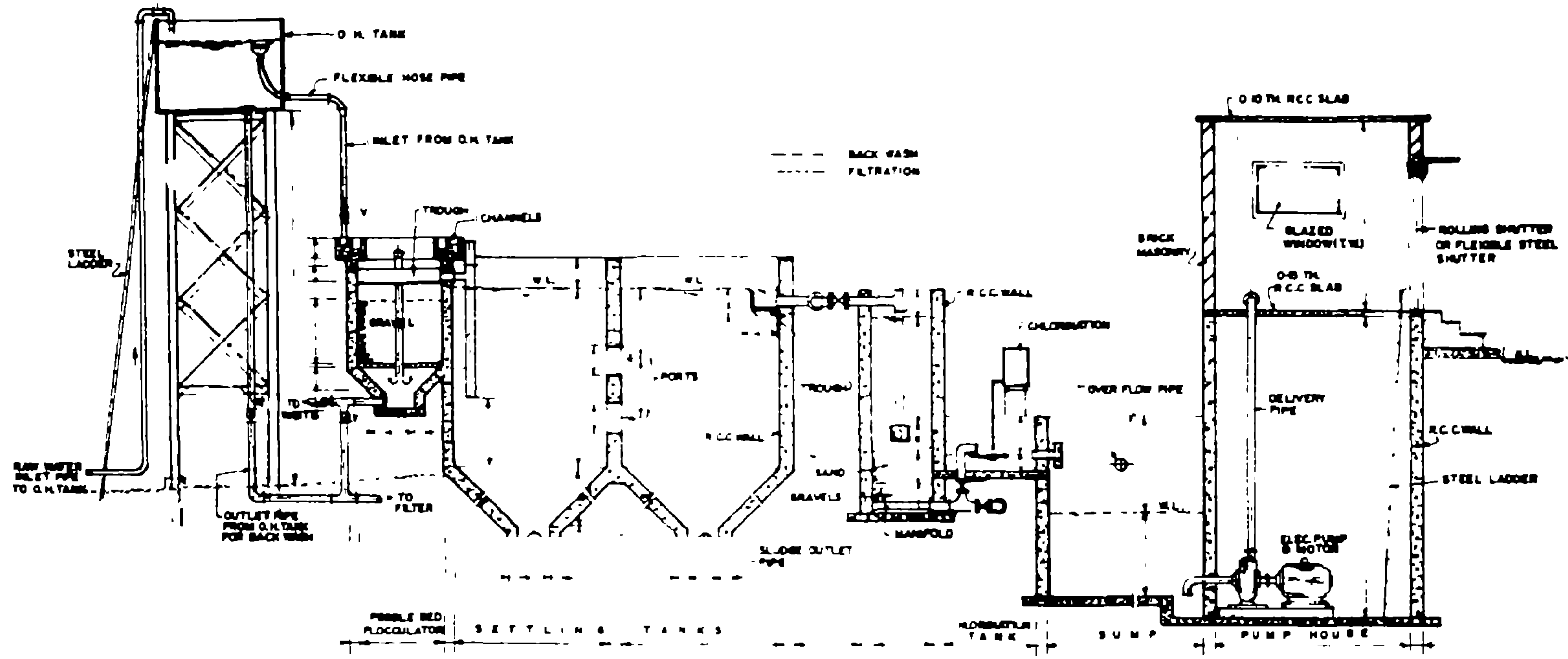
TABLE-3: Plant Dimensions for Fill-and-Draw Type Defluoridation Plant for population range 50 to 200.

Water depth	1.5 m
Free Board	0.3 m
Depth of Sludge Cone	D/10, where D is the diameter
Shaft Diameter	50 mm

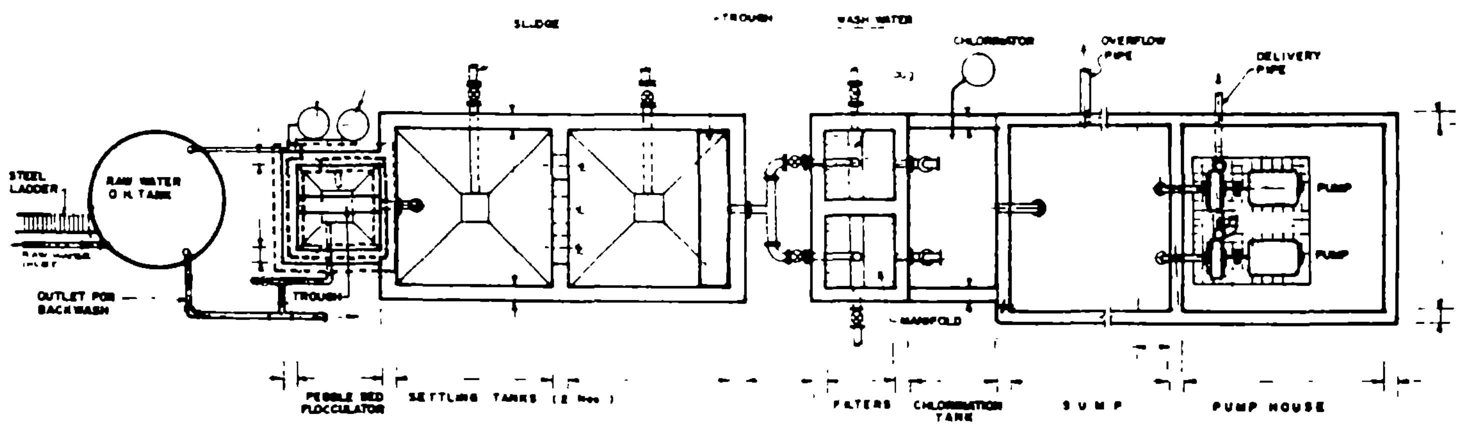
Population	Water volume(m^3)	Plant diameter(m)	Suggested Hp for Motor
50	2	1.30	1.0
100	4	1.85	2.0
200	8	2.60	2.0



FILL & DRAW DEFLUORIDATION SYSTEM FOR RURAL WATER SUPPLY



SECTIONAL ELEVATION



LAYOUT PLAN

The notable features are:

i) With a pump of adequate capacity the entire operation is completed in 2-3 hours and a number of batches of defluoridated water can be obtained in a day.

ii) The accessories needed are few and these are easily available (these include 16 L buckets for dissolving alum, preparation of lime slurry or sodium carbonate solution, bleaching powder and a weighing balance).

iii) The plant can be located in the open with precautions to cover the motor.

iv) Semi-skilled labour can perform the function independently.

FILL AND DRAW TYPE FOR RURAL WATER SUPPLY

The Fill-and-Draw Type vertical Unit comprises cylindrical tank of $10 m^3$ capacity with dished bottom, inlet, outlet and sludge drain. The cylindrical tank will have sturdy railings, etc. Each tank is fitted with an agitator assembly consisting of: (i) 5 HP drip proof electric motor; 3 phase; 50 Hz; 1440 RPM with 415 V+6% voltage fluctuation, and (ii) gear box for 1440 RPM input speed with reduction ratio 60:1 to attain an output speed of 24 RPM, complete with downward shaft to hold the agitator paddles. The agitator is fixed to the bottom of the vessel by sturdy, suitable stainless steel supporting bushings.

The scheme comprises tanks of $10 m^3$ capacity each, a sump well and an overhead reservoir. A system with two units in parallel for treating water for 1500 population @ 40 lpcd is shown in Fig.4. The treated water collected in a sump is pumped to an overhead tank, from where the water is supplied through stand posts.

CONTINUOUS OPERATION SYSTEM FOR RURAL WATER SUPPLY

There are an estimated 8700 villages in India which have problem of excessive fluoride in water. Rural water supply scheme using Nalgonda Technique intends to treat raw water for villages and includes channel mixer, pebble and flocculation, sedimentation tank and sand filter. The scheme is gravity operated except the filling of the overhead tank and delivery from the treated water.

Treatment Units	POPULATION							
	Nos.	Dimensions	Nos.	Dimensions	Nos.	Dimensions	Nos.	Dimensions
Raw water Balancing Tank (6 hrs. holding) (diameter x depth)	1	14.45 m^3 3.00 x 2.00	1	28.90 m^3 4.00 x 2.30	1	57.50 m^3 5.00x2.95	1	144.50 m^3 7.00x3.80
Channel Mixer with Baffles, Square,		1.40 x 1.40		2.00 x 2.00		2.85x2.85		3.20x3.20
Channel Length	1	11.2	1	16.0	1	22.7	2	25.6
Flocculator Pebble bed (pb) Square, hopper	1	1.40 x1.40 x 1.80 (1.2 m pb + 0.6 m cone)	1	2.00 x 2.00 x 1.80 (1.2 m pb + 0.6 m cone)	1	2.85 x 2.85 x 1.80 (1.2 m pb + 0.6 m cone)	2	3.20x3.20 c 1.80 (1.2 m pb + 0.6 m cone)
Setting tank Hopper	2	2.30 x 2.30 x 4.00 (3.0 m st.ht. + 1.0 m cone	2	3.10 x 3.10 x 4.50 (3.0 m at.ht + 1.5 m cone)	2	3.60 x 3.60 x 4.50 (3.0 m st.ht. + 1.5 m cone)	2	5.70x5.70 x 5.80 (3.0 m mt.ht. + 2.8 m cone)
Gravity Filters	2	1.00 x 1.00	2	1.00 x 1.00	2	1.40 x 1.40	2	2.30 x 2.30
Clear Water Sump	1	3.00 x 3.00 x 3.00	1	4.00 x 5.00 x 3.00	1	4.00 x 10.00 x 3.00	1	5.00x10.00 x 3.00

The capacities of the chemical dosing tanks for populations 500, 1000, 2000, and 5000 are given in Table 4.

TABLE-4: Capacities of chemical dosing tanks

	ALUM TANK		LIME TANK	
Population	Capacity Litres	Dosing Rate ml/min	Capacity Litres	Dosing Rate ml/min
500	100	210	10	21
1000	200	420	·20	42
2000	400	840	40	84
5000	1000	2100	100	210

Strength of Solutions: Alum - 10% (W/V)
Lime - 1% (W/V)

The sizes of all units, viz. overhead tank, channel mixer, pebble bed flocculator, sedimentation tank, sand filter, and underground treated water storage tank are given in Table 5 and are based on the design considerations as mentioned above, for these populations.

FULL SCALE PLANT AT KADIRI

A defluoridation plant, based on Nalgonda Technique, with capacity of 2270 m^3/d is commissioned at Kadiri in Andhra Pradesh in 1980 for supplying defluoridated water to the whole Township. The average fluoride concentration varied from 4.1 to 4.8 mg F/1 in the raw water and 0.70 to 1.20 mg F/1 in the treated water. The alum dose requirement of Kadiri water worked out on average as 494 mg/L. Cost analysis of Kadiri Water Supply Scheme was carried out with and without defluoridated component. The cost per m^3 water at Kadiri was Rs. 0.53 without defluoridation, and Rs. 1.15 with defluoridation. The additional expenditure was only Rs. 8.03 per year at 35 lpcd consumption (1981 cost basis: present cost will be approximately double).

NATIONAL DEFLUORIDATION CAMP AT AMRELI (GUJARAT)

National Defluoridation Camp was organised by NEERI at Amreli in Gujarat under 'Water Technology Mission' programme in collaboration with Gujarat Water Supply and Sewerage Board. The Camp was aimed at training the representatives of the participating agencies of various States afflicted with the problem of excess fluorides in drinking water. The activities of Camp programmes included (i) Lecture and discussion sessions, (ii) demonstration of defluoridation technology at the Camp site, (iii) visit to fluorosis affected villages, (iv) demonstration of Nalgonda Technique under field conditions, (v) evaluation of water quality and fixing the dose of chemicals for the identified sources and (vi) public meeting and demonstrations at important places.

In all, 49 samples from Lathi and Liliya talukes of Amreli District were analysed for some physico-chemical parameters. The fluoride contents varied between 0.4 and 9.8 mg F/1. Out of these, 37 samples contained excess fluoride above 1.0 mg F/1.

Gujarat Water Supply and Sewerage Board has commissioned Bhasan Group of Villages Water Supply Scheme in 1982. The scheme is based on fill-and-draw type defluoridation units based on Nalgonda Technique. The scheme supplies defluoridated water to Bhesan, Sonaliya and Bodia villages with populations of 626, 1380 and 431 respectively (1981 Census). The units were installed by the Board on the basis of know-how of Nalgonda Technique without taking any expert advice from NEERI during its installation stage. This effort is really commendable. This also indicates the simplicity of Nalgonda Technique.

COST CONSIDERATIONS

Cost estimates for all these operations are given in Table 6 and Table 7, and relate to the population equivalent at various water consumption rates in lpcd for designed flow rates. The present design was done keeping in view 70 lpcd in desert areas (40 for human beings and 30 for cattle). Table 8 indicates the capital cost at various flow rates and population equivalents at water consumption rates of 30, 40, 50, 60 and 70 lpcd.

TABLE 6: COSTESTIMATES FOR DEFLUORIDATION UNITS (NALGONDA TECHNIQUE)

Population	Design Flow (m^3/d)	Capital Cost: Total Cost (Rs.)	Capital Cost: Total Cost (Rs./m^3)	O and M (Running Cost): Total Cost Rs./day	O and M (Running Cost): Total Cost Rs./m^3
500	38.5	1,22,000	3169	227+(0.0588 C+0.22)	5.90+(0.0015C+0.0057)
1000	77.0	1,58,000	2052	295+(0.1175C+0.44)	3.83+(0.0015C+0.0057)
2000	154.0	2,10,000	1364	336+0.2350+0.88)	2.18+(0.0015C+0.0057)
5000	385.0	2,92,000	758	472+(0.5872C+2.2)	1.226+(0.0015C+0.0057)
	-	-	-	$Y_1= P_1+(m_1C_1+A_1)$	$Y_2+P_2 + (m_2C_2+A_2)$

NOTE :

Y = Total O and M cost
P = Energy Cost including depreciation*, interest** and manpower***
C = Alum Dose, mg/1
A_1 and = Cost for bleaching powder
m_1G_1 and m_2C_2 = Cost+ of alum and lime

* Depreciation = 5% of capital cost
** Interest = 12% per annum
*** Refer Table 3
\+ Refer Table 3

For 5 mg F/L and 500 mg/L alkalinity, C= 690 mg/L alum.
The Cost estimates for defluoridation units for this water quality can be calculated from the above table by substituting C = 690 mg/L alum.

TABLE 7: POPULATION SERVED BY THE DESIGNED PLANT AT VARIOUS RATES OF WATER SUPPLY.

Design Flow m^3/d	Population to be served at stated Rate of supply LPCD				
	70	60	50	40	30
38.5	500	583	700	875	1166
77.0	1000	1166	1400	1750	2332
154.0	2000	2333	2800	3500	4666
385.0	5000	5833	7000	8750	11666

TABLE 8: CAPITAL COST AT VARIOUS FLOW RATES (m^3/day)

Flow rate m^3/d	Total cost Rs.	Cost Rs/m^3	Equivalent population at stated Rates of Water Supply, LF				
			30	40	50	60	70
30	110000	3550	910	682	545	454	389
40	132000	3000	1212	909	727	606	519
50	138000	2600	1515	1136	909	757	649
.60	145000	2300	1818	1364	1091	909	779
70	155000	2150	2121	1591	1273	1060	909
80	167000	1930	2424	1818	1454	1212	1039
100	173000	1700	3030	2273	1818	1515	1299
200	211000	1120	6060	4545	3636	3030	2597
300	260000	900	9091	6818	5454	4545	3896

Annexure 1.

NATIONAL WORKSHOP ON VILLAGE LEVEL MAINTENANCE OF HANDPUMPS

AT NEERI NAGPUR 440 020

APRIL 6th to 8th 1988.

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ANNEXURE - 2

NATIONAL WORKSHOP ON VILLAGE LEVEL MAINTENANCE OF HANDPUMPS

NEERI, NAGPUR 400 020

April 6th. to 8th., 1988

TIME TABLE

Tuesday

April 5th. 18.00 to 20.00 Registration of delegates at Hotel BLUE MOON, Central Avenue

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Wednesday

April 6th. Theme: HANDPUMP MAINTENANCE (CASE STUDIES)

08.00 to 09.00	Registration of delegates at NEERI
09.00 to 09.45	INAUGURATION Welcome Address (DANIDA) Welcome Address (UNICEF) Welcome Address (NEERI) Inaugural Address Dr.Harnam Singh Commissioner, Nagpur Keynote Address Mr.T.G.Shankaran Addl.Adviser, Dept.of Rural Devl., G.O.I. Introduction to the Workshop - purpose of the Workshop - dynamics of the Workshop - objectives of the Workshop
09.45 to 10.00	Tea
10.00 to 10.30	"An Appraisal of Problems; Rural Drinking Water Supply Through Handpumps in Maharashtra". - Dr. M.A. Ghare, NAWDA.
10.30 to 11.00	"Role of Women in Water Supplies" - Dr. Anuradha Gadkari, NEERI.
11.00 to 11.30	"UNICEF's Role in Handpump Maintenance" - Mr. Esa Ovaskaien, UNICEF

11.30 to 12.00	"Village Level Operation and Maintenance of India Mark II Open Top Cylinder Handpumps" - Satish C. Raghu, ELC, Betul.
12.00 to 13.00	General Discussions on the presentations.
13.00 to 14.00	Lunch Break
14.00 to 16.00	Group Discussions
16.00 to 16.15	Tea
16.15 to 17.30	Plenary Session to receive reports of the groups.

Thursday

April 7th. Theme: CAPACITY OF IMPLEMENTING AGENCIES AND VILLAGE COMMUNITIES TO MAINTAIN HANDPUMPS

(Training, Communications & Organization)

09.00 to 09.30	"Training For Development - facilitating community change." - Ms. Meena Kataria, ACORD.
09.30 to 10.00	"Involvement of Women in The Maintenance of Handpumps" - Mr. Om Prakash, CORT.
10.00 to 10.15	Tea
10.15 to 11.00	"The Orissa Experience in Village Level Maintenance of Handpumps" - DANIDA, Orissa Project.
11.00 to 11.30	"What Can a Handpump Mistri Do?" - Mr. Bunker Roy, SWRC,Tilonia.
11.30 to 12.00	"The 2-tier Maintenance System in Andhra Pradesh - A Case Study" - Mr. Kanagarajan,UNICEF, Hyderabad.
12.00 to 13.00	Discussions on the presentations.
13.00 to 14.00	LUNCH BREAK
14.00 to 16.00	Group Discussions.
16.00 to 16.15	Tea
16.15 to 17.30	Plenary Session to receive reports of the groups.

Friday

April 8th. Theme: RELEVANT TECHNOLOGIES FOR VILLAGE LEVEL OPERATION AND MAINTENANCE OF HANDPUMPS

09.00 to 09.30	"Norms for ensuring quality of handpumps and spare parts." -Mr. S. Chandrasekharan (Bureau of Indian Standards)
09.30 to 10.00	"Handpump Maintenance Systems" - Mr. K.B. Erry, INALSA.
10.00 to 10.15	Tea
10.15 to 11.00	"UNICEF's Involvement in Handpump Designs." -Mr. Esa Ovaskainen, UNICEF
11.00 to 11.30	"Future Handpump of India." -Mr. M.R.M. Ashraf Ali, Richardson & Cruddas Ltd.,
11.30 to 12.00	"Alternative Handpump Designs" - Mr. Raj Kumar Daw, DANIDA, Orissa.
12.00 to 13.00	Discussions on the presentations.
13.00 to 14.00	LUNCH BREAK
14.00 to 16.00	Water Treatment Systems compatible with Handpumps. "Iron Removal systems" - Mr. V.P. Deshpande, Scientist, NEERI, Nagpur. "Fluoride Removal Systems" - Mr. W.G. Nawalakhe, Scientist, NEERI, Nagpur.
16.00 to 16.15	Tea
16.15 to 17.30	Valedictory Session.

N.B. THIS IS A TENTATIVE TIME-TABLE AND IS SUBJECT TO CHANGE.

SWEDISH EMBASSY
Development Cooperation Office
NEW DELHI

1988 04 27

A Runeborg/ss

Anna Runeborg's Report from the National Workshop on Village level maintenance of handpumps, 6 - 8 April, 1988 at NEERI Nagpur

Background

DANIDA organized and supported a National Workshop on Village based maintenance of Handpumps in collaboration with GOI/DRD and UNICEF, 6 - 8 April 1988 at NEERI, Nagpur.

Participants were around 100 representatives from Central and State Governments, voluntary agencies, bilateral donors, UN Agencies and manufacturers of hand pumps.

The enclosed programme describes what issues were taken up, Annex I.

Proceedings will be available in the month of May 1988.

Some highlights

The first day the participants were split up into 5 working groups discussing the following issues :

1) How to involve village communities in planning, implementation and maintenance of handpumps. Problems? Possibilities?

2) How to ensure women's participation in maintenance of handpumps.

3) Socio-economical constraints in community participation.

4) Cultural factors effecting community participation.

5) Selection criteria of handpump caretakers/mistries

6) How to "empower" the caretakers/mistries.

The second day the issues were :

1) What kind of training is necessary to enable village communities to assume responsibilities for handpump maintenance, technical and social?

2) What communication and leadership training needs are there at the village level?

3) What training methods can be used fully and effectively to enhance community ability to maintain handpumps ?

4) Training needs of junior and assistant engineers to be able to support the village mechanic i.e. "Handpump mistry" or "self employed mechanic, SEM".

Lot of discussion took place in the working groups. I will only highlight some of my observations which I found to be of special interest.

Involvement of women as hand pump caretakers and mechanics.

Despite the fact that the majority of the participants were men (only 4 women) there was a heartening consensus of the need to involve women in all aspects of the water sector. E.g. consensus was reached on selecting women as a first priority as handpump caretakers.This is valid for II-tier systems which contains a H.P. caretaker at village level and a mobile H.P. maintenance team with mechanics from the block level.

In Andra Pradesh the Chief Engineer and Chief Secretary have issued a government decree in February 1988 that all H.P. caretakers to be selected from now on, shall be women, (according to UNICEF's representative Mr. T. K. Kanagarajan, Hyderabad). In a Karnataka District supported by DANIDA, the District Collector (woman) has given a condition that all caretakers selected and trained must be women. (Unfortunately, the District Collector in question proved to be "too effective" in combatting corruption etc. which caused her transfer. DANIDA and the district officials are continuing on the same path, however).

Only some year(s) back this attitude among government officials and departmental engineers would have been unthought of. Development in respect of realizing women's needs and capabilities is definately progressing. This ofcourse partly depends on the realization that the economics of a water programme, especially in maintenance, will not work out without people's participation in the long run. Also, maintenance is neither glamorous nor "income-generating" for the engineers. Nevertheless some definite positive changes can be noted in the general attitudes of policy-makers and implementors in this respect.

When it came to discussing women as h.p. mistries (mechanics) consensus was not to be reached. However, the issue was being discussed. I will try to give some of the arguments against and for it.

	Against	For
1.	Women are not coming forward (always staying behind in village meetings)	Women are not asked, supposed or expected to come forward, which they might do if they were seriously consulted.
2.	Women are not strong enough	Women can pound, work in the fields, carry head-loads so they can also be a mechanic
3.	A woman cannot lift up a pump on her own	Nor can a man. He needs assistance from others. Also the woman can get help from other women or villagers.

	Against	For
4)	A woman cannot take on 30-40 handpumps (as in the H.p mistry scheme in Rajasthan) since it involves walking, travelling too far.	The scheme can be revised and the h.p's reduced to say 7-8 and the remuneration to be reduced accordingly. Even Rs.100/month would be a welcome (additional) income for a woman.
5)	A woman cannot bicycle	Why not? Or if she has only 7-8 h.p's she can walk 2-3 kms.
6)	A woman cannot carry the heavy tools along	She doesn't always need to carry all of them along with her. When needed she can ask for assistance from fellow women or men if required.
7)	The time is not ripe for women h.p. mistries, (mechanics)	Who says so? Has someone asked the women in question? Has someone tried it out in a pilot project?
8)	—	Women are found to be more responsible, concerned and conscientious in respect of caring for the water sources for obvious reasons (less drudgery etc)
9)	Women can often/not read or write very well or at all	That is true. So educate them. And total literacy is not a must for all jobs.
10)	A woman is not technical as opposed to blacksmiths, bicycles repair-men, barbars, landless labourers, tea shop wallahs	All h.p. mistries need to be trained. Why should e.g. a blacksmith's wife be less technically oriented than a barbar or a landless farmer?

If there is a will there is a way is, in essence, what is too often stated in all government, UN, bilateral, voluntary agencies' documents and strategies. But when is the will going to be proven at the grassroot level if the woman are not ever even asked if they want to be involved.

Some cautious voices were heard saying that the women will be even more overloaded with work and the men can relax even more when their women are taking on this job as well. I feel, however, we should leave this to the women to decide. They should obviously always have the choice to join on their own - not be forced to do it.

One-two-or three tier system

I am afraid that any universal answer to what kind of maintenance system, be it 1-2 or 3 tier system, is the optimal one was not given nor could it be expected. That India is vast with many different regional characteristics, which demands various solutions, was again the obvious conclusion.

As representative for the I-tier system, Mr. Bunker Roy spoke about the H.p. mistri scheme in Rajasthan which can be labelled I- or rather I½ tier (see encl). It is definately village based but has its problems which are mainly due to the rigid hierarchical Indian government system with its inherent prejudices against the "people" and their capabilities. Also it is not conducive to the engineers' ego to admit that a villager can do the same job as them

Mr. T. K. Kanagarajan from UNICEF Hyderabad, famous for his work with H P caretakers, has now changed from propagating a III tier system to advocating a II tier system. A II-tier system with HP caretakers at village level (women!) and mobile blocklevel mechanic is now being introduced in A.P in a phased manner. Also Karnataka is taking up the II-tier system. Mr. Kanagarajan, however, stated that the future aim would be to arrive at a I-(or 1½)-tier system but not until the new VLOM (Village level operated and Maintained) pump is being introduced on a large scale).

Mr. B. Joshi from UNICEF, Pune, described what he called a modified III tier system which is introduced in Maharashtra. To me this system seemed very complicated but might be the one most suitable to the Maharashtra set-up.

Mr. Raj Kumar Daw from DANIDA's Orissa project informed about their H P maintenance system with self-employed mechanics (SEM) which can be labelled a 1½ tier system.

In summary, the "struggle" is going on on two levels 1) to find better solutions and to refine existing systems; 2) to debate which is the best system. This debate which was very loud and almost bitter some years back has now become more reconciliant and realistic. It seems as if the representatives of the various camps have realised that it is not an easy question with self-evident solutions. Lot of training, awareness raising (on all level and simpler appropriate technology techniques are needed (e.g. VLOM Pump) as well as respect for various cultural, gender and regional characteristics before true village level based h.p. maintenance systems can be introduced in India.

Women and Water Supply

Two lectures on women in water supply and maintenance were given (see encl).