The Impact of Selected Interventions on the Availability of Safe Drinking Water in Two Talukas of Beed District in Maharashtra

Institute of Health Management, Pachod (IHMP)
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THE IMPACT OF SELECTED INTERVENTIONS ON THE AVAILABILITY OF SAFE DRINKING WATER IN TWO TALUKAS OF BEED DISTRICT IN MAHARASHTRA

INSTITUTE OF HEALTH MANAGEMENT PACHOD (IHMP)
DISTRICT AURANGABAD, 431 121 MAHARASHTRA

Section – I

Technical Report

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INSTITUTE OF HEALTH MANAGEMENT, PACHOD

1. INTRODUCTION

The Safe Drinking Water Programme

The Institute of Health Management, Pachod, (IHMP) has been implementing a programme for the provision of Safe Drinking Water in two talukas (Georai and Beed) of Beed District since 1986-87. The aim of the programme was to ensure effective availability of safe drinking water. It was proposed to reconstruct and reactivate 658 damaged handpumps. A preventive maintenance system was proposed to be established along with a community based monitoring system for handpumps in the two talukas. Community education, training and organisation initiatives were planned in order to change water related community behaviour and generate community participation. The programme has been implemented for the last three years. A study was undertaken from October 1990 to January 1991 to determine the impact of the programme on availability of water. A brief description of the programme is presented.

1.1. District Profile:

Beed District is a part of the Marathwada region of Maharashtra, and is classified as drought prone. In 1985 rains had failed for the third consecutive year, and the drinking water situation was precarious. 350 out of 1214 villages in the district were being supplied water through tankers.

The main sources of drinking water in the district are sub-surface, bore wells on which handpumps or electric pumps have been fitted and open wells in some villages where the water table is high. By June 1987, there were approximately 3000 hand pumps in Beed District.

The maintenance of handpumps was not very effective due to the large number of handpumps that were in a poor condition and constraints such as long distances, bad roads and undulating terrain. Sample surveys conducted in 1986 indicated that out of 2700 handpumps in Beed District an estimated 1800 needed platform reconstruction, while approximately 500 more needed platform repairs. The Chief Executive Officer of Beed Zilla Parishad vide his letter ZP/WDS/482/85, dated November 15,1985 requested the Institute of Health Management, Pachod, to undertake a programme for providing Safe Drinking Water in two Talukas in coordination with the Zilla Parishad. Following this, the Institute received approval from the Rural Development Department, Mantralaya, vide letter No.GPPP/2496/CR 4542/41 dated 27th February 1987.

In 1985, the Institute trained 26 handpump mechanics cum masons in coordination with UNICEF, and in January 1986, 48 hand -pump mistries were trained, under the TRYSEM scheme, with the assistance of AFARM and UNICEF.

1.2. Georai Baseline Study 1986:

In November 1986, Georai taluka of Beed district was surveyed extensively and detailed information regarding the history and condition of all handpumps were collected. The results are presented in the Table I and Figure I given below.

Table I. Hand Pump Survey - Georai, November, 1986

No. of HP's	Status of handpumps			Condition of Platforms		
	Functional	Non-funct.	Seasonal	Good	Need repairs	Need Reconst.
200	103	84	13	7	75	118
%	51.5%	42%	6.5%	3.5%	37.5%	59%

The 103 functional pumps had an average discharge rate of:

- 12 strokes for water to start flowing, with a range of 1 to 68 strokes.
- 20 strokes were required to provide 3 litres of water, the range being 8 to 120 strokes.

The problems due to damaged platforms were two-fold:

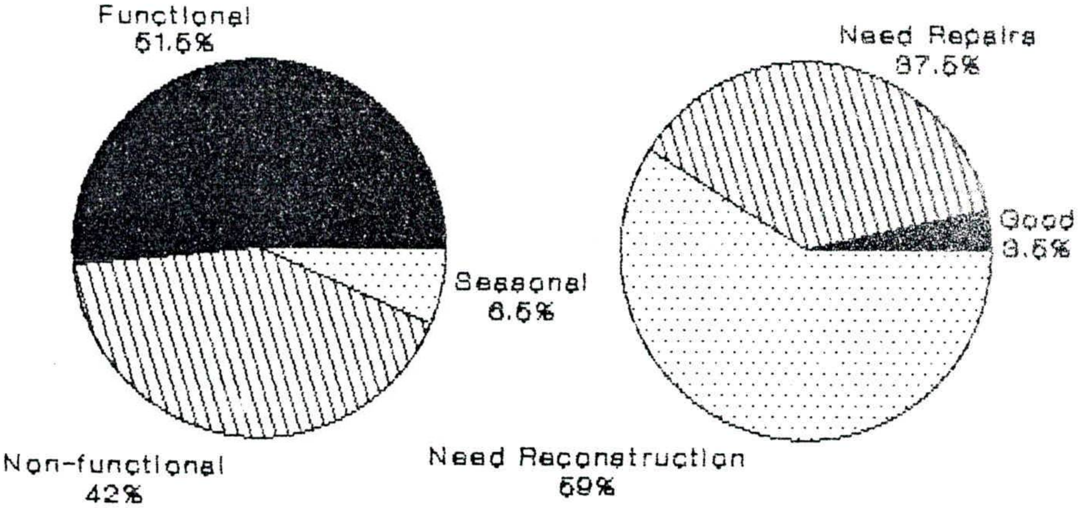
1) As the pump was not firmly anchored, the chances of pump breakdown were greater.
2) Since the concrete seal between the bore and the ground was broken, waste water had direct access to the water in the bore, resulting in contamination.

1.3. Proposed Programme:

The Institute of Health Management Pachod, decided to implement a Safe Drinking Water Programme with the following components:

1) Reconstruction of approximately 658 handpump platforms in two talukas of Beed District, viz., Georai and Beed.
2) Operationalise a preventive system of handpump maintenance in two talukas, viz. Georai and Beed.
3) Establish a community based handpump monitoring system for all the handpumps in two Talukas.

Fig.I. Condition of HPs at the Time of Baseline Survey, Georai



Status of handpump

Condition of platform

4) Monitor the remaining 3000 handpumps in the entire district through the Zilla Parishad.

5) Initiate a community education training and health organisation programme with the aim of changing individual and community water related behaviour, and generating community participation in the management of water sources.

6) Drill 100 new bores and install handpumps for villages and sub-groups of the population at greatest need.

7) To conduct research studies for developing a preventive maintenance model for handpumps:

a. To study the parameters for predicting pump breakdown to facilitate preventive maintenance.

b. To establish simple parameters for monitoring of rural drinking water supply programmes.

c. To study quantitatively the impact of reconstruction on the effectiveness of handpumps.

d. To study the contamination levels of reconstructed pumps as compared to existing handpumps.

e. To study the impact of chlorination of bores on potability of water and incidence of diarrhoea.

f. To study a feasible model of community participation applicable to an entire Taluka.

1.3.1. Reconstruction of Handpump Platforms:

The objective was to reconstruct and reactivate handpumps, and by providing stability, prevent break down of handpumps.

To provide handpumps with an effective concrete seal to prevent contamination with surface water and ensure a regular supply of 'safe' drinking water to the community.

The platform reconstruction work was done by a team of local youth trained by the IHMP. It involved dismantling the handpump, reconstructing the platform and re-installing it after seven days of curing.

1.3.2. A Preventive Maintenance System for Handpumps:

The survey conducted by the IHMP in Georai Taluka in November 1986 showed that out of 200 handpumps, 103 were functional (i.e. providing water, but were in need of regular maintenance), while 84 were non-functional (i.e. not providing water due to pump breakdown). A similar situation existed in other talukas of Beed District.

Data on 'pump discharge' for functional pumps showed that on an average, 12 strokes were required for water to start flowing from the pump while another 20 strokes were required to provide 3 litres of water. Studies indicated that after reconstruction and reinstallation, this average could be brought down to below 4 strokes for water to start flowing and another 12 strokes to provide three litres of water. However, to sustain this average at a district level required an effective monitoring and maintenance system.

The strategy of preventive maintenance of handpumps was conceptualized by the IHMP project team in 1985. It was felt that the discharge of handpumps, (the number of strokes required to start flow and fill a 3 litre bucket) measured at a regular periodicity, could be utilised for predicting their breakdown. The maintenance work could then be undertaken without allowing the pumps to become non-functional. The concept was called "Preventive Maintenance" since it was envisaged that break down of pumps could be prevented thereby increasing availability of water to the community. Based on this concept a proposal for the preventive maintenance of handpumps was submitted in 1986. The first research paper on field results of the preventive maintenance was presented in 1987.

The main objectives of the maintenance system were:

- To keep at least 80% of the pumps functional at an average pump discharge rate of four strokes for water to start flowing, and another 12 strokes to provide three litres of water.
- To keep at least 80% of the pumps functioning for a minimum of 25 days every month.

1.3.3. The Monitoring System for Handpumps:

A monitoring system with three essential components was established. The block level mechanic visits each handpump once a month. During his visit he measures the handpump discharge. This information is used for the preventive maintenance of handpumps.

The second component is the community reporting breakdown of their handpump.

Finally five individuals for each pump were selected from families living in the immediate vicinity of the pump. In case of pump breakdown, the volunteers post a pre-addressed postcard to inform the mobile maintenance unit. By ensuring prompt reporting of breakdown of pumps, it was aimed to reduce the average non functional period, again resulting in an increase in availability of water to the community.

The main objective of the monitoring programme was to develop an effective and replicable, monitoring system applicable at the district level. It was planned that an effective handpump monitoring system would complement the maintenance system.

Other objective was to reduce the interval between breakdown and repairs. The information collected by the monitoring system would be used to study the performance of the pump and predict pump breakdown with a view to preventive maintenance. The monitoring system would also form the basis of programme evaluation.

The IHMP was to, independently, establish the monitoring system along with maintenance of handpumps in 2 talukas viz., Georai and Beed, while the Z.P. was to introduce the same monitoring system in the remaining 5 talukas. The data collected by the Z.P., was to be received and processed by the IHMP in order to assess the performance of the monitoring system at the district level.

1.3.4. The Research Proposal:

The Safe Drinking Water Programme proposal included the following Research studies:

a) To study the parameters for predicting handpump breakdown to facilitate preventive maintenance.

The purpose of the study will be to establish whether a parameter like pump discharge can be effectively used for early diagnosis of pump breakdown. The data on pump discharge recorded by the monitoring system will be used for the study.

b) To establish simple parameters for monitoring of the programme. The development of simple monitoring techniques to facilitate programme evaluation at the district level is another research project to be carried out by the IHMP.

c) To study quantitatively the impact of reconstruction on the effectiveness of pumps. In this study, the pump discharge, the number of functional days and frequency of breakdown of reconstructed pumps will be studied as compared to that of pumps in need of reconstruction.

d) To study the impact of community participation on maintenance and monitoring of handpumps. There will be five VLVs with calendars for each pump. The purpose of the study is to examine the proportion of VLVs monitoring and reporting their handpump condition regularly through calendars.

e) To study the contamination levels of reconstructed handpumps as compared to pumps in need of reconstruction.

f) To study the impact of chlorination of bores on potability of water and incidence of diarrhoea.

The last two studies examine the contamination of handpump water at source and its relation to the incidence of diarrhoea.

2. EVOLUTION OF THE PROGRAMME

A survey was conducted to measure the functional status and discharge of handpumps in Georai Taluka in 1985, on the basis of which, the parameter for preventive maintenance was developed. A project proposal for the preventive maintenance of handpumps, utilising this parameter, was submitted in 1986.

The Baseline survey in Georai was conducted in October and November 1986. Simultaneously the training of Zilla Parishad and IHMP mechanics was undertaken in coordination with UNICEF and AFARM, Pune.

Reconstruction of handpump platforms was initiated in 1987. The preventive maintenance of handpumps began in 1988, in a phased manner. As handpumps kept getting reconstructed they were handed over to the IHMP for maintenance by the Zilla Parishad, Beed. All the pumps in Georai Taluka came under the preventive maintenance system of the IHMP only since July 1989.

After the reconstruction work was completed in Georai Taluka the reconstruction team moved to Beed Taluka. 160 handpumps were reconstructed in Beed Taluka. Simultaneously, preventive maintenance of handpumps was initiated in Beed Taluka.

However Z.P. mechanics were opposed to the idea of the district authorities handing over a second taluka to the IHMP.

The pumps reconstructed by the IHMP in Beed Taluka, were therefore, handed back to the Zilla Parishad. These handpumps have been under the conventional breakdown or corrective maintenance system of the Z. P. since the beginning of 1990.

The programme in Paithan Taluka of Aurangabad has been undertaken only since August 1990. A joint survey was conducted by the Institute of Health Management, Pachod (IHMP) and Zilla Parishad, Aurangabad in October 1990. The Paithan Taluka has been used as the control area for comparison in this study.

3. STUDY OF THE GEORAI SDW PROGRAMME - TECHNICAL COMPONENT

3.1. Research Objectives:

The present research is an attempt to study the impact of reconstruction and preventive maintenance on the functioning of handpumps. More specifically the objectives of the study are:

1. To estimate the point prevalence at the time of survey and period prevalence (of one month and one year) of functionality of handpumps.
2. To determine the efficiency of handpumps by measuring discharge performance.
3. To determine the effectiveness of handpump monitoring and maintenance system in terms of interval between breakdown and reporting and interval between reporting and repairs.
4. To study the impact of reconstruction, monitoring and maintenance on the increase in availability of water.

5. To determine the effectiveness of the handpump maintenance programme by studying the physical condition of handpumps.
6. To study the quality of the reconstruction of platforms through physical verifications.
7. To study changes in user habits related to utilization of handpumps.
8. To study the perception of community members regarding the monitoring and maintenance programme and the role of Village Level Volunteers (VLVs).
9. To determine the awareness of VLVs about their roles and responsibility in monitoring of handpumps and maintaining the cleanliness of handpump surroundings.
10. To study the performance of VLVs in monitoring and maintenance of cleanliness of handpump surroundings.
11. To review the processes involved in the implementation of the SDW programme to elicit policy guidelines for district level management of rural safe drinking water.

3.2. Methodology :

Four study areas were identified for this research. 187 handpumps out of a total of 318 have been reconstructed in Georai. Most of these reconstructions had been completed by July 1988. These pumps have been under the preventive maintenance system since then. This constituted the first study group of pumps which have been both, reconstructed and are under preventive maintenance. This group is referred to as the Georai-Reconstructed and Maintained (GEO-RM) study area in the text and tables.

The remaining 131 pumps in Georai constitute the second study group. These have not been reconstructed but have been under preventive maintenance since 1988. This group of pumps is designated as the Georai-Maintenance (GEO-M) study area in the text and tables.

The third group of 160 pumps in Beed Taluka were reconstructed in 1989-90, but have not been under preventive maintenance. Following reconstruction they were handed over to the Zilla Parishad and have been under conventional breakdown maintenance. In the study report these pumps are referred to as the Beed - Reconstructed (BEED-R) study area.

The fourth group consists of 325 pumps in Paithan Taluka which were neither reconstructed nor were they under preventive maintenance at the time of the study. They were being maintained under the conventional breakdown maintenance system which is being followed by the Z.P.s all over Maharashtra State. This group of handpumps constituted the control area and is referred to as Paithan-Control (PAI-C) study area in the report.

A random sample of 50 handpumps were studied from each group. Two users - one male and one female, were selected for each pump through a convenience sample, residing in the immediate vicinity of the pump. 100 users for each study group of 50 pumps i.e., a total of 400 users were interviewed. The same instruments were used for the study of condition of handpumps and availability of water and for interviewing users in all the four study areas.

For each of the randomly chosen 50 handpumps from GEO-RM and GEO-M areas, one VLV was conveniently selected and interviewed using the same instrument.

External investigators were employed for this research study. A three day orientation and training programme was arranged for them in co-ordination with AFARM, Pune.

Following their training in the technical aspects of handpump installation and maintenance they were given another two days orientation in research techniques by the IHMP staff. These external investigators were sent to the villages with instruments to be filled up after observing the handpumps in these 4 study areas. Any problems encountered in data collection were reviewed every day when the teams returned from the field.

Apart from comparison of these 4 groups of handpumps 100 randomly selected pumps from Georai Taluka were compared with an equal number of randomly selected pumps from the baseline survey (1986) to do a pre - post analysis.

3.3. Sampling Frame:

Dead pumps and those with fixed or fallen pipes were excluded from all the study areas since these handpumps can not be made functional. The remaining pumps were listed in each area for drawing a simple random sample.

3.4. Sample Size:

The sample size was estimated using the following method:

To compare the functionality of reconstructed and unreconstructed handpumps, with an expected proportion as 40% and an observed difference of 20% functionality which is significant at the 0.05 level. The sample size was calculated as:

$$n = \frac{2\ Z^2\ pq}{d^2} = \frac{2 \times (1.96)^2 \times 40 \times 60}{20^2}$$

$$= 46.1$$

$$\text{rounded to} = 50.$$

The sampling unit was a handpump. From the 4 study groups, i. e. reconstructed and maintained (Georai), only maintained

(Georai), reconstructed (Beed), and control area (Paithan), a sample of 50 handpumps were selected from each group, using simple random sampling. Two users and one VLV were selected for each of these handpumps using convenience sampling.

3.5. Instruments:

Three instruments were prepared for the research study:

Instrument 1. To determine the physical condition and functional status of the handpump through observation.

Instrument 2. To determine the functional status of the pump over the last one month and one year by interviewing the users. To study any change in users' awareness levels and their habits.

Instrument 3. To interview VLVs to determine their awareness levels and effectiveness as village level handpump volunteers.

Data collection by external investigators was supervised by 3 IHMP senior staff. The questionnaires were checked and edited every day. In case of missing or inconsistent information investigators were instructed to go back to the village to complete the questionnaire.

The information was entered into the computer on a daily basis. SPSS package was utilised for statistical analysis of the data. Descriptive statistics were calculated and Chi square test of association was done wherever necessary.

4. RESULTS

4.1. Comparability of Four Study Areas:

The quality of installation and monthly maintenance are not the only factors which determine the functional status of hand-pumps. Village, population, logistic and environmental charateristics are assumed to play a significant role in determining the functional status of handpumps.

The four study areas were compared with each other for the following variables to see if there was any significant difference between them:

1. Population of villages where sampled HPs were located.
2. No. of households in the villages.
3. Distance of HP from the village.
4. No. of water sources in the village.
5. Total number of handpumps in the village.
6. No. of seasonal HPs in each group.
7. No. of houses dependent on the handpump.

The results of the test of significance shows that except for one variable there was no significant difference between the four study areas. The 4 groups were comparable for 6 out of the 7 variables studied. (Refer Table II).

Table II. Comparability of 4 Study Areas

Variable		Study areas			
Village characteristics		GEO-RM	GEO-M	BEED-R	PAI-C
1.Popl. of villages where HP's sampled.	: <=1000	62	54	42	58
	: >1000	38	46	58	42
2.No. of H.H. in vill. with sampled HP:	: <=200	70	64	58	62
	>200	30	36	42	38
3.Distance of HP from village	:In or Near	98	90	96	94
	:Far	2	10	4	6
4.No of water sources In village with HP	: <=4	52	52	64	44
	: >4	48	48	36	56
5.Total no. of HPs in Village.	: <=2	32	46	52	52
	: >2	68	54	48	48
6.No.of Seasonal pumps in Sample	: Seasonal	10	6	14	6
	:Not seasonal	90	94	86	94
7.No. of Houses Dependent on HP	: <=50	74	52	60	78
	: >50	26	48	40	22

42% to 62% handpumps were located in relatively small villages with a population of less than 1000 in the 4 study areas. Similarly villages with less than 200 households ranged from 58% to 70%.

Handpumps located in or near villages ranged from 90% to 98% in the study areas.

36% to 56% villages had more than 4 water sources.

48% to 68% villages had more than 2 handpumps.

The number of seasonal handpumps ranged from 6% to 14% in the 4 study groups.

With respect to number of households dependent on each handpump, GEO-RM, and PAI-C were comparable, having 26% and 22% handpumps serving more than 50 households. They were significantly different from the GEO-M and Beed-R study areas which had 48% and 40% handpumps serving more than 50 households. $X^2 = 9.80$ $p < 0.05$.

4.2. Programme Impact:

The data was next analysed to determine the impact of reconstruction and preventive maintenance of handpumps on the functioning of HPs, on their efficiency and on availability of water to the community. Six impact or outcome variables were utilised for this purpose:

1. Functional status of HPs at the time of the study
   - point prevalence.
2. Efficiency of handpumps (point prevalence).
3. Proportion of functional HPs in last one month.
4. Proportion of functional HPs in last one year.
5. Interval between breakdown and reporting and reporting and repairs.
6. Pumps repaired on basis of low discharge and breakdown.

7. Estimation of increase in availability of water (litres per day).

4.2.1. Functional status of pumps at the time of survey:

Functional status of pumps at the time of survey, i.e. point prevalence was studied in the four study groups. A comparison of the 4 study areas provides evidence of the impact of reconstruction and preventive maintenance of handpumps on their functional status. (Refer Table III and Fig.II).

Table III. Handpump status at the time of study (Point prevalence)

Functional status	GEO-RM	GEO- M	BEED-R	PAI-C
HPs functional %	48 96%	45 90%	39 78%	19 38%
HPs not functional %	2 4%	5 10%	11 22%	31 62%
Total %	50 100%	50 100%	50 100%	50 100%

N=50 $\chi^2 = 55.224$ $p < 0.001$

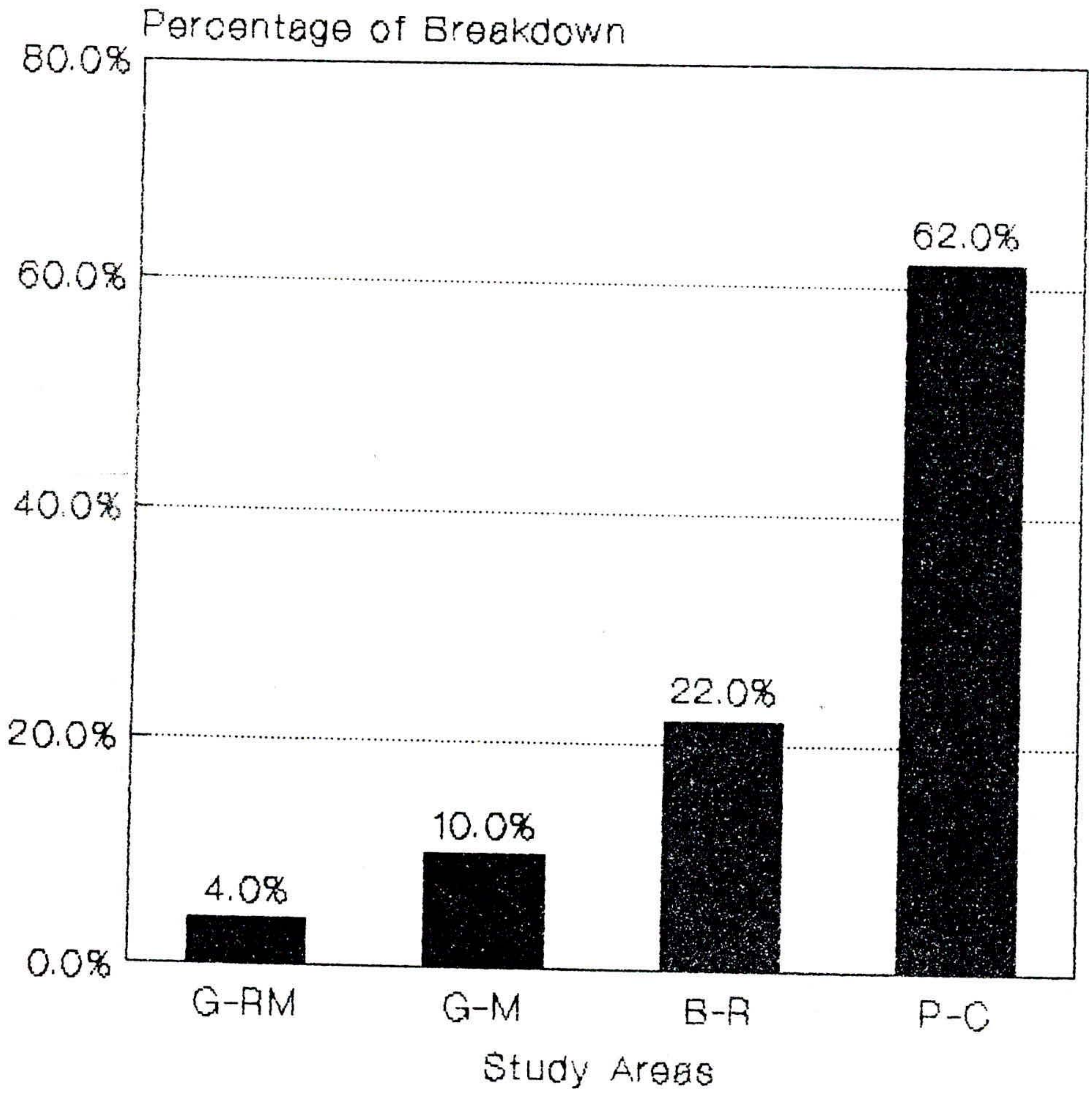
96% handpumps were functional in the GEO-RM study area where handpumps have been reconstructed and are under preventive maintenance since 1988.

90% were functional in the GEO-M study area where handpumps are under preventive maintenance but have not been reconstructed.

78% were functional in BEED-R where pumps have been reconstructed but are maintained under the conventional breakdown or corrective maintenance system.

38% pumps were functioning in the control area where no reconstruction has taken place and pumps are maintained through a breakdown or corrective approach.(Refer Fig. II).

Figure II. Breakdown Rate of Pumps in Four Study Areas at the Time of Study



G-RM - Georai Recon. & Prev. Maint.
G-M - Georai Prev. Maint.
B-R - Beed Recon.
P-C - Paithan Contrl.

4.2.2. Efficiency of handpumps - Discharge at the time of survey:

The efficiency of handpumps i.e., the number of strokes required to start the yield of water and fill a 3 litre bucket of water is an indication of the effectiveness of the monitoring and preventive maintenance systems. It is assumed that if HPs are maintained on basis of information on discharge rather than breakdown, a larger number would function efficiently. The parameter of HP efficiency being <= 4 strokes of handle to start yield of water and <= 12 strokes to fill a 3 litre bucket of water (Refer Table IV and Fig. III).

Table IV. Efficiency of functional handpumps

Handpump Discharge	GEO-RM	GEO- M	BEED-R	PAI- C
Total no. functional	48 96%	45 90%	39 78%	19 38%
<= 4\12	44 92%	42 93%	32 82%	10 53%
> 4\12	4 8%	3 7%	7 18%	9 47%

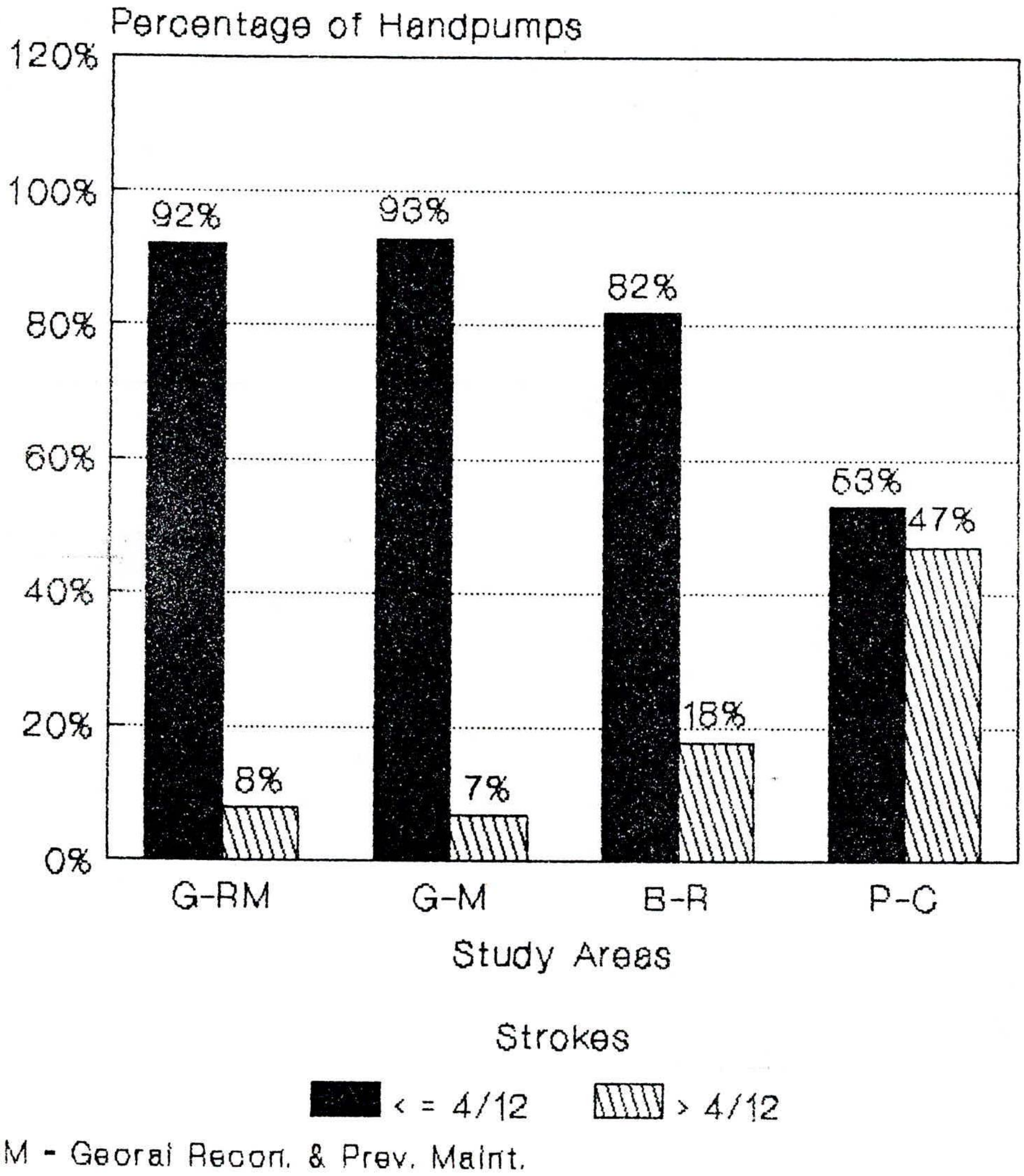
$X^2=19.75$ $p \le 0.001$

The proportion of pumps functioning inefficiently i.e., requiring more than 4\12 strokes to operate was 8% in the GEO-RM area, 7% in GEO-M area, 18% in BEED-R and 47% in the PAI-C areas. The difference between the study areas was statistically significant (refer Table IV).

4.2.3. Proportion of functional handpumps in the last one month:

The percentage of functional pumps in the last one month and one year is an indirect measure of the availability of water

Figure III. Efficiency of Functional Handpumps



G-RM - Georai Recon. & Prev. Maint.
G-M - Georai Prev. Maint.
B-R - Beed Recon.
P-C - Paithan Contrl.

to the community. It also indicates the quality of the maintenance programme over a sustained period of time. The concept of preventive maintenance suggests that a large number of handpumps will be repaired as soon as their discharge starts falling (i.e. greater number of strokes are required to yield water). With preventive maintenance it is assumed that breakdown of pumps will be prevented and each pump will be functional for a larger number of days in the month and in a year.

In one month a handpump is expected to provide water for all 30 days. In each study area 50 handpumps are ideally expected to provide 1500 functional days of water supply per month. As compared to this GEO-RM handpumps provided 1289 days, GEO-M 1275, BEED-R 990 days and the PAI-C area handpumps 444 functional days.

The average number of days that one handpump was functional in one month works out to 26 in the GEO-RM and GEO-M areas, 20 days in the BEED-R, and 9 days in the PAI-C areas.

Effective water availability in the four study areas was GEO-RM 86%, GEO-M 85%, BEED-R 66% and PAI-C area 30% respectively.

The proportion of handpumps functional for more than 25 days in a month was 74% GEO-RM area, 80% in GEO-M, 56% in BEED-R and 22% in the PAI-C study area. (Refer Table V and Fig. IV).

Table V. Percentage pump functional within last 30 days and average functional days per handpump per month

Functional days in one month	GEO- RM	GEO- M	BEED-R	PAI -C
Expected no. of functional days	1500	1500	1500	1500
Actual functional HP days	1289	1275	990	444
Average no.of functional days/HP	26	26	20	9
Effective water availability	86%	85%	66%	30%
Proportion HPs funct. >=25 days	74%	80%	56%	22%

N = 50 Handpumps (in each study area).

The difference in actual no.of functional HP days in 4 study areas was found to be significant ($p < 0.001$).

4.2.4. Proportion of functional pumps in last one year:

There was a significant difference in the proportion of pumps which broke down over a period of one year in the 4 areas. In the GEO-RM 62%, GEO-M 56%,BEED-R 88%, and PAI-C 96% handpumps broke down over a period of one year. Ideally 50 handpumps in each study area are expected to provide 600 functional months. As compared to this, pumps were functional in the four study areas as follows: GEO-RM - 10.7 months, GEO-M - 10.7 months, BEED-R - 9.1 months and PAI-C - 4.8 months.

The effective water availability in the four study areas was, GEO-RM - 89.4%, GEO-M - 89%, BEED-R - 76%, and PAI-C - 40%. The distribution of the proportion of pumps which functioned for more than 10 months in the year was 82% in the GEO-RM area, 84% in GEO-M, 62% in BEED-R, and 22% in the PAI-C study area. All the measures used for period prevalence of functionality indicated highly significant differences. (Refer Table VI and Fig V).

Table VI. Performance of pumps over a period of last one year and annual water availability.

Variables	Study Areas			
Functional Months in one year	GEO-RM	GEO - M	BEED-R	PAI- C
% Handpumps broke down last year	62%	56%	88%	96%
% HPs did not breakdown at all	38%	44%	12%	4%
Expected no.of funct. months 50x12	600	600	600	600
Actual no. of funct. months	535	535	455	240
Av. no. of funct. months/HP	10.7	10.7	9.1	4.8
Effective water availability	89.4%	89%	76%	40%
% pumps functioned >=10 months or 300 days	82%	84%	62%	22%

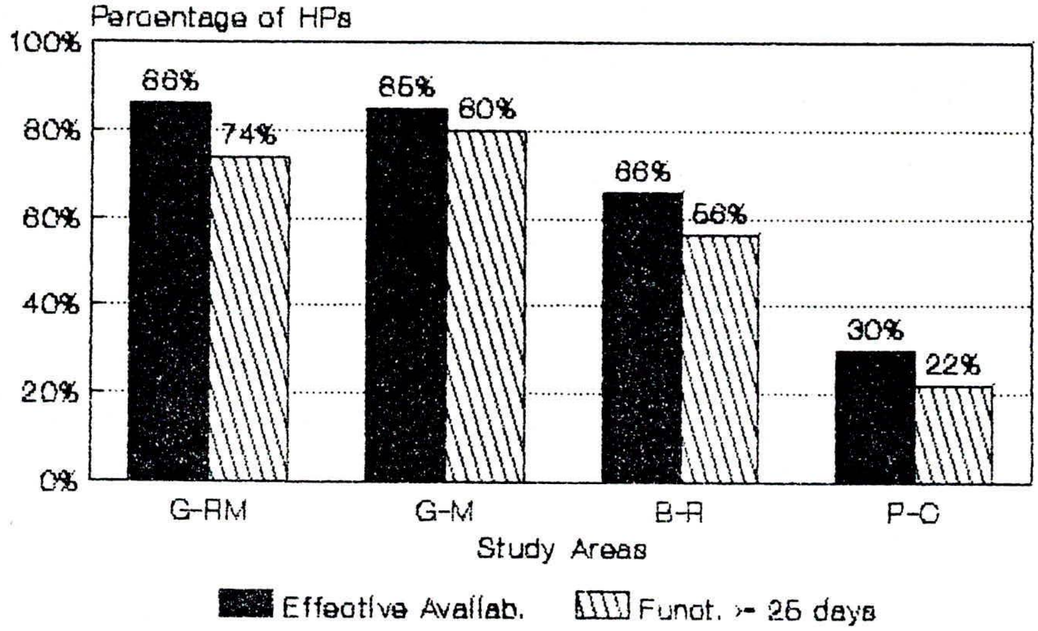
N = 50 hand pumps in each study area.

The variables, breakdown of handpumps and actual no.of functional months, have been used in the test of significance to see whether there is any significant difference between the 4 study areas. The results indicates that the difference is highly significant ($p < 0.001$).

4.2.5. Interval between breakdown and reporting and reporting and repairs:

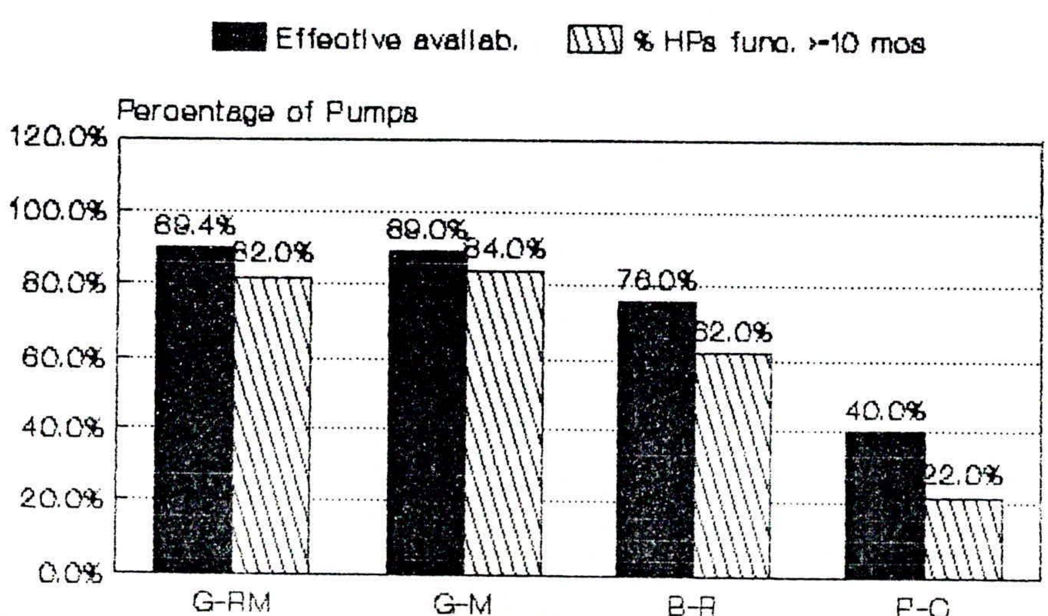
The next two variables i.e., interval between breakdown and reporting and between reporting and repairs are a reflection of the effectiveness of the monitoring system and the response of the maintenance unit. A convenience sample of 100 users living in the immediate vicinity of the 50 sampled handpumps were interviewed. They were asked if their handpump broke down over the last one month, within how many days of breakdown the information was sent and after what interval their handpump was

FigureIV. Performance of HPs in Last One Month & Monthly Water Availability



G-RM - Georai Recon. & Prev. Maint.
G-M - Georai Prev. Maint.
B-R - Beed Recon.
P-C - Paithan Contrl.

Figure V. Performance of HPs in Last One Year & Annual Water Availability



G-RM - Georai Recon. & Prev. Maint.
G-M - Georai Prev. Maint.
B-R - Beed Recon.
P-C - Paithan Contrl.

repaired. A comparison between the four study groups is presented in Table VII. The results have been presented by user response rather than by handpump.

Table VII. Interval between breakdown and information sent and reporting and repairs - User Response - 100 Respondents.

Variables		GEO-RM	GEO - M	BEED - R	PAI - C
Was HP non functional: in last one month	Yes	24	19	43	74
	No	76	81	57	26
If NF was information for repair sent	Yes	16 (67.0%)	13 (68.0%)	32 (74.0%)	20 (27.0%)
	No	8 (33.0%)	6 (32.0%)	11 (26.0%)	54 (73.0%)
If yes after how many days of breakdown was Info. sent	<=7 days	10 (62.5%)	5 (38.4%)	12 (37.5%)	3 (15.0%)
	8-15 days	3 (18.7%)	3 (23.1%)	9 (28.1%)	4 (20.0%)
	16-30 days	1 (6.3%)	4 (30.8%)	1 (3.1%)	7 (35.0%)
	Dont Know	2 (12.5%)	1 (7.7%)	10 (31.3%)	6 (30.0%)
After how many days of sending information was the handpump repaired	<=7 days	6 (37.5%)	3 (23.1%)	3 (9.3%)	1 (5.0%)
	8-15 days	5 (31.3%)	2 (15.4%)	7 (21.9%)	-
	16-30 days	1 (6.2%)	3 (23.1%)	8 (25%)	2 (10.0%)
	Not rep.	3 (18.8%)	5 (38.4%)	14 (43.8%)	17 (85.0%)
	Don't Know	1 (6.2%)	-	-	-

The data indicates that a much larger percentage of HPs was non-functional during last one month in PAI-C area (74 respondents) and BEED-R area (43 respondents) as compared to the GEO-RM and GEO-M study areas where 24 and 19 respondents reported breakdown of handpumps. On the other hand fewer individuals knew of information being sent to mechanics in PAI-C area as compared to other three areas. Whereas on an average the information was sent to mechanics sooner in GEO-RM and GEO-M areas as compared to BEED-R and PAI-C areas. This considerably reduced the interval between breakdown and reporting in the GEO-RM and GEO-M study areas as compared to the Beed-R and PAI-C areas (refer Table VII). Correspondingly the response of the mechanics to breakdown reports received was more expeditious in the GEO-RM and GEO-M areas as compared to BEED-R and FAI-C areas.

4.2.6. Handpumps repaired on the basis of low discharge and breakdown (Jan - Dec, 1990):

Table VIII. Handpumps Repaired on the basis low discharge and breakdown

Proj. Yr. 1990	Type of Maintenance				Total HPs Rep.	
Month.	Low discharge	%	Breakdown	%	Total	%
January	18	(58.0)	13	(42.0)	31	(100)
February	27	(62.8)	16	(37.2)	43	(100)
March	18	(58.0)	13	(42.0)	31	(100)
April	16	(64.0)	09	(36.0)	25	(100)
May	21	(60.0)	14	(40.0)	35	(100)
June	17	(50.0)	17	(50.0)	34	(100)
July	21	(60.0)	14	(40.0)	35	(100)
August	15	(52.0)	14	(48.0)	29	(100)
September	16	(55.2)	13	(44.8)	29	(100)
October	08	(44.4)	10	(55.6)	29	(100)
November	15	(42.9)	20	(57.1)	35	(100)
December	17	(58.6)	12	(41.4)	29	(100)
Total	209	(55.9)	165	(44.1)	374	(100)

(Ref. Annual Report 1990).

A total of 374 repairs were carried out over a period of one year, in Georai Taluka. Of these 209 (56%) were carried out on the basis of low discharge information collected by the Block Level Mechanic. The remaining 165 (44%) repairs were carried out on basis of breakdowns reported by the village level volunteers and community members. (Refer above Table).

4.2.7. Estimation of increase in availability of water (litres per day):

Average utilization of handpump	-	8 hrs./HP/day.
Water discharge per stroke	-	0.33 litres
Average no. of strokes/minute	-	40
Therefore, water availability/min.	-	13 litres.
Optimal water availability/HP/day (i.e., 13 x 60 x 8)	-	6240 lits.
Therefore, optimal water availability/ taluka/day	-	23,89,920 lits.
In Georai, water availability is 89 % of optimal, which is equal to	-	21,97,028 lits.
In Beed, water availability is 76 % of optimal	-	18,16,339 lits.
In Paithan, water availability is 40 % of optimal	-	9,55,968 lits.
Therefore, increase in water availability in Georai as compared to Paithan	-	11,71,060 lits.
Increase in water availability in Beed as compared to Paithan	-	8,60,371 lits.
Total increase in availability of water in Georai and Beed /day	-	20,31,431 lits.

4.3. Physical Condition of Handpump Assembly

The condition of the handpump bodies and the assembly above the ground level is an indication of the effectiveness of the regular maintenance programme undertaken.

The above ground level pump assembly was examined for evidence of worn-out or missing parts. Five crucial parts of the handpump body were observed, i.e., Inspection covers, Handle, Nuts, Bolts and Chain. The results for the 4 study areas are presented in Table IX and Figs. VIa and VIb .

Table IX. Condition of above ground handpump assembly in 4 study areas

Handpump parts observed	GEO-RM	GEO-M	BEED-R	PAI-C
1. Insp. cover missing	4%	2%	14%	28%
2a. Handle Broken	2%	6%	8%	8%
2b. Handle Missing	2%	4%	2%	16%
3. Nuts Missing	14%	10%	16%	44%
4. Bolts Missing	14%	10%	16%	48%
5a. Chain Broken	-	2%	8%	10%
5b. Chain Missing	2%	2%	2%	14%
5c. Chain Worn out	6%	2%	12%	60%

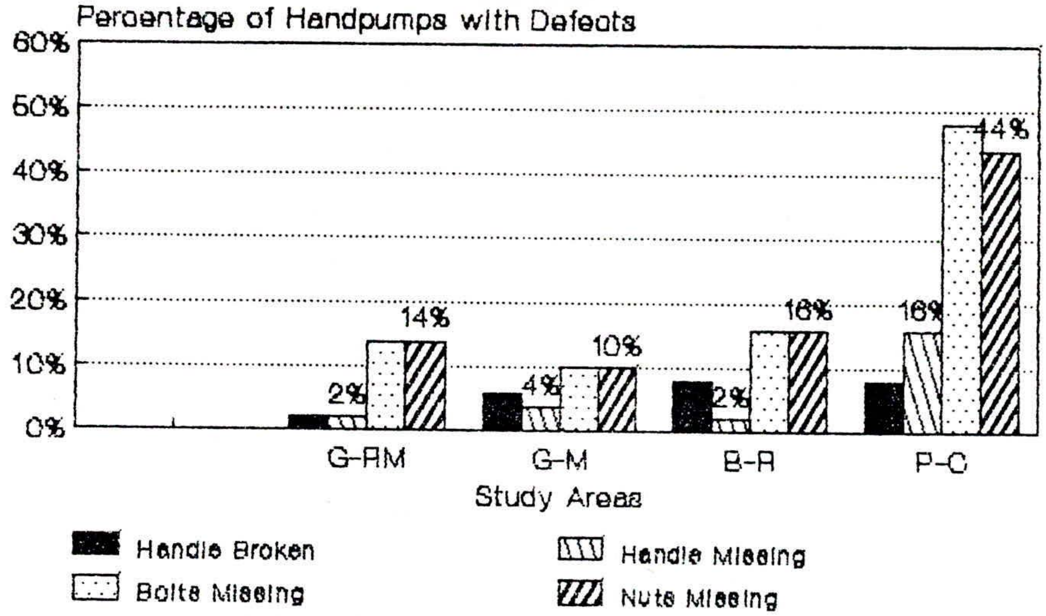
N = 50 handpumps.

A large number of handpumps in PAI-C were found with missing parts as compared to GEO-RM, GEO-M, and BEED-R areas. The maximum number of missing parts were nuts and bolts and worn-out chains.

4.4. Condition of Platforms and Drains

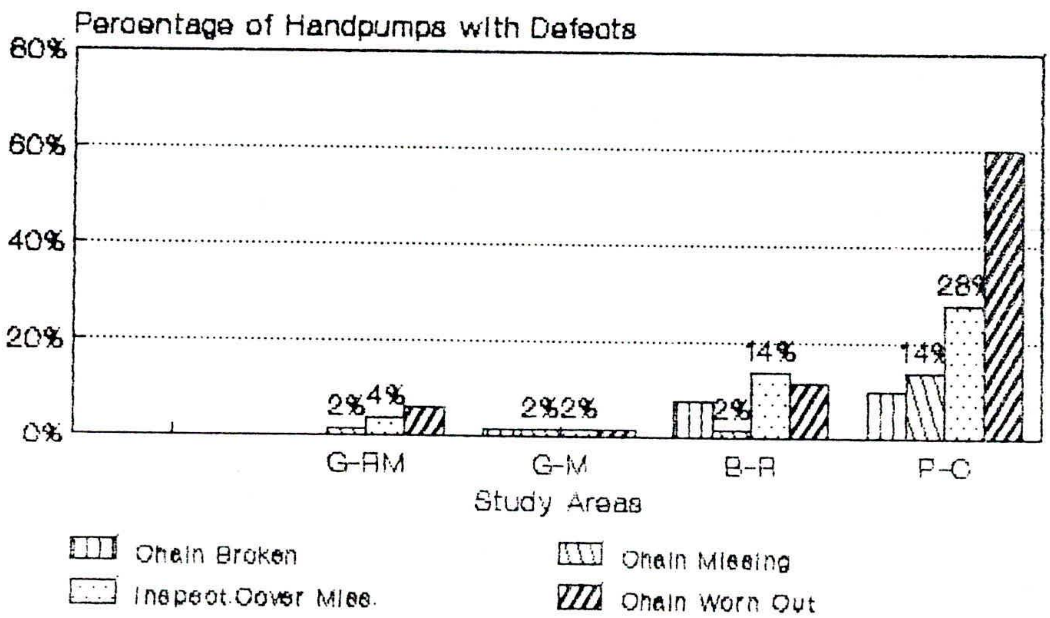
The condition of the platform and drain was examined to determine the impact of the reconstruction programme. Handpumps have been reconstructed in the GEO-RM and BEED-R study areas. They have not been reconstructed in the GEO-M and PAI-C areas. A comparison of the platform condition was made between the 4 study areas. The results are presented in Table X and Figs.VIIa, b & c.

Figure VI.a. Condition of Above Ground Assembly of Handpumps in 4 Study Areas



G-RM - Georal Recon. & Prev. Maint.
G-M - Georal Prev. Maint.
B-R - Beed Recon.
P-C - Paithan Contrl.

Figure VI.b. Condition of Above Ground Assembly of Handpumps in 4 Study Areas



G-RM - Georal Recon. & Prev. Maint.
G-M - Georal Prev. Maint.
B-R - Beed Recon.
P-C - Paithan Contrl.

Table X. Percentage of Handpumps with platform and drain in poor condition in 4 study areas

Platform and drain condition	GEO-RM %	BEED-R %	GEO-M %	PAI-C %
1. Platform condition - not optimal	24	30	44	88
2. Platform condition - cracked	2	6	24	50
3. Platform condtion - missing	-	-	2	4
4. Platform condition - ring formed	4	6	14	16
5. Platform rim - cracked	4	12	18	28
6. Platform rim - broken	4	2	20	56
7. Drain - missing	2	-	9	18
8. Drain - damaged	14	14	26	48

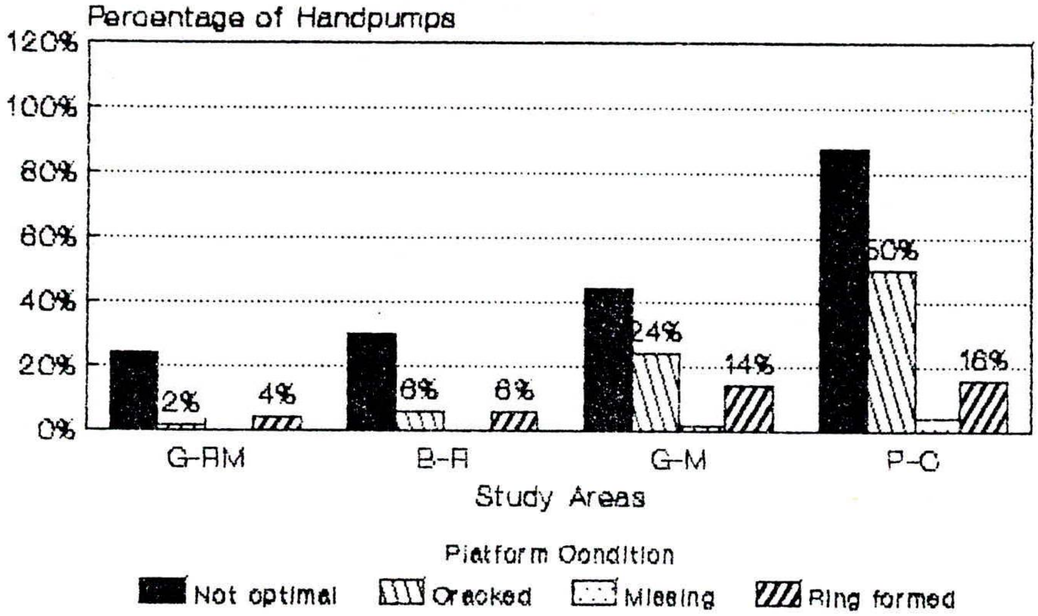
N = 50 handpumps.

A platform was considered not optimal if it had any shortcoming whatsoever.24 and 30% were found to be not optimal in the GEO-RM and BEED-R areas respectively as compared to 44% and 88% not optimal platforms in the GEO-M and PAI-C study areas. In the GEO-RM and BEED-R study areas where handpumps have been reconstructed, 2% and 6% handpumps had cracked platforms. In comparison, the GEO-M and PAI-C areas had 26% and 54% platforms either cracked or missing. 14% handpumps had damaged drain in each of the GEO-RM and BEED-R areas whereas 26% and 48% in GEO-M and PAI-C areas respectively.

4.5. Comparison of Georai Baseline (1986) with Present Research Findings (1990):

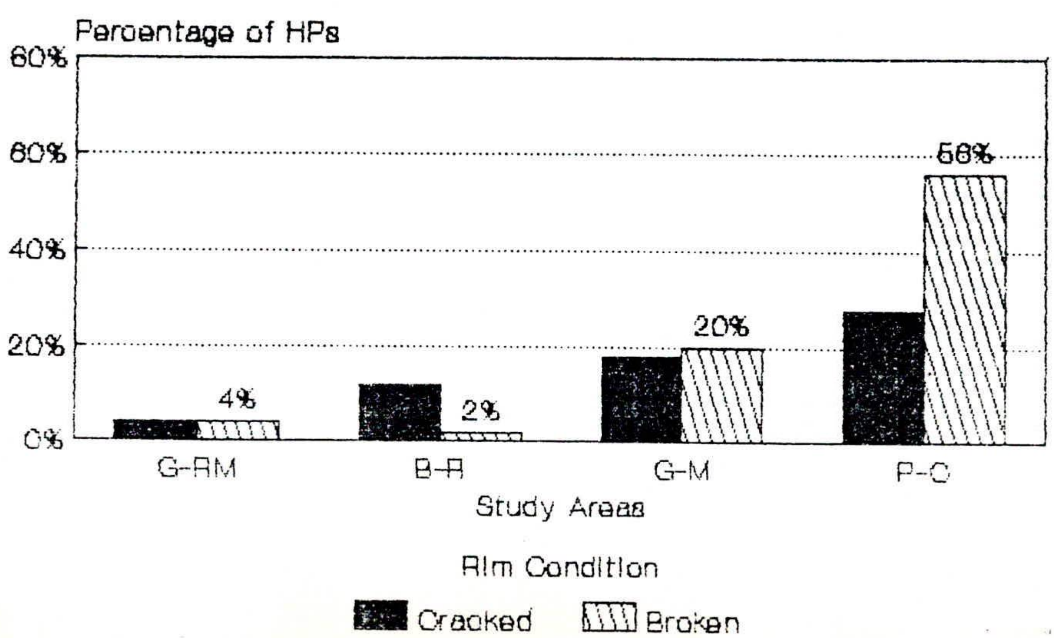
In November 1986 a baseline survey was conducted for 200 handpumps. 100 hand pumps were randomly selected from the 200 surveyed. This sample of 100 handpumps was compared to an equal number studied during the research study done in November 1990.

Figure VII.a. Percentage of HPs with Platform in Poor Condition



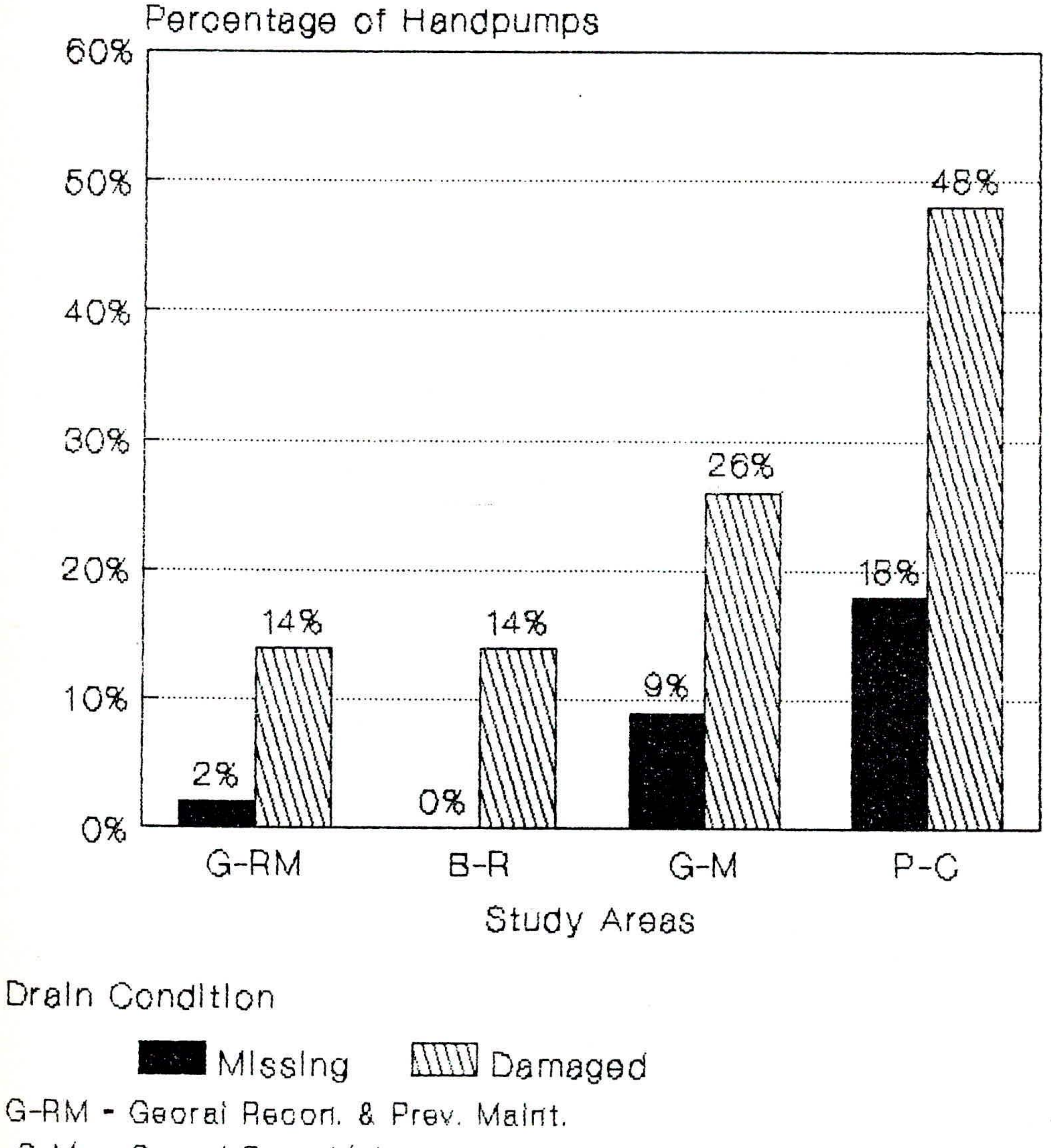
G-RM - Georal Recon. & Prev. Maint.
G-M - Georal Prev. Maint.
B-R - Beed Recon.
P-C - Paithan Contrl.

Figure VII.b. Platform Rim in Poor Condition



G-RM - Georal Recon. & Prev. Maint.
G-M - Georal Prev. Maint.
B-R - Beed Recon.
P-C - Paithan Contrl.

Figure VII.c. Percentage of HPs with Drain in Poor Condition



G-RM - Georai Recon. & Prev. Maint.
G-M - Georai Prev. Maint.
B-R - Beed Recon.
P-C - Paithan Contrl.

The result of this pre-post analysis is presented in Tables XIa, XIb and Figs VIIIa & VIIIb.

Dead and dry bores, and bores with fixed or fallen pipes were excluded from the listing of handpumps made for the baseline survey and research study before taking random samples of 100 handpumps from each list. The excluded handpumps represent bores that can not be reactivated or maintained.

Table XIa. Georai Pre-Post Analysis of Handpumps

Variable		Baseline Records November, 1986	Research Study November, 1990
Handpump Status	- Functional	55	93
	- Nonfunctional	45	7
Total		100	100
Handpump discharge	- <=4\12 (Optimal)	29 (53%)	86 (92%)
	- > 4\12	26 (47%)	7 (8%)
Total (only functional)		55	93
Platform condition	- Good	5	65
	- Bad	95	35
Total		100	100

Table XIb. Georai Pre-Post Analysis of Handpumps

Variables		Baseline	Research
Average functional days per Handpump per month	:	17	26
Handpumps functioned for < 25 days	:	21	16
Handpumps functioned for >=25 days	:	47	77
Non functional throughout the month	:	32	7
Average number of functional months per HP	:	7.6	10.7
HP functioned >=10 months	:	46	83
Pumps did not function throughout the year	:	15	2
Effective water availability /year	:	65%	89.4%
		n = 100	n = 100

A comparison of the Research findings with the Baseline data indicates that the proportion of functional pumps has increased from 55% to 93%.

In 1986 during the Baseline survey 5% of the platforms were in a good condition. This had increased to 65% in 1990. 187 of the existing 383 handpumps have been reconstructed over the last three years.

During the Baseline survey, 29% of the functional pumps had an optimal discharge of < = 4\12. During the Research study 92% handpumps had an optimal discharge.

The average number of days handpumps were functional in a month had increased from 17 days in 1986 to 26 days in 1990. The proportion of handpumps that functioned for more than 25 days per month increased from 47% to 77%.

The average number of months that handpumps were functional

Figure VIII.a. Georai Pre-Post Analysis of Handpumps

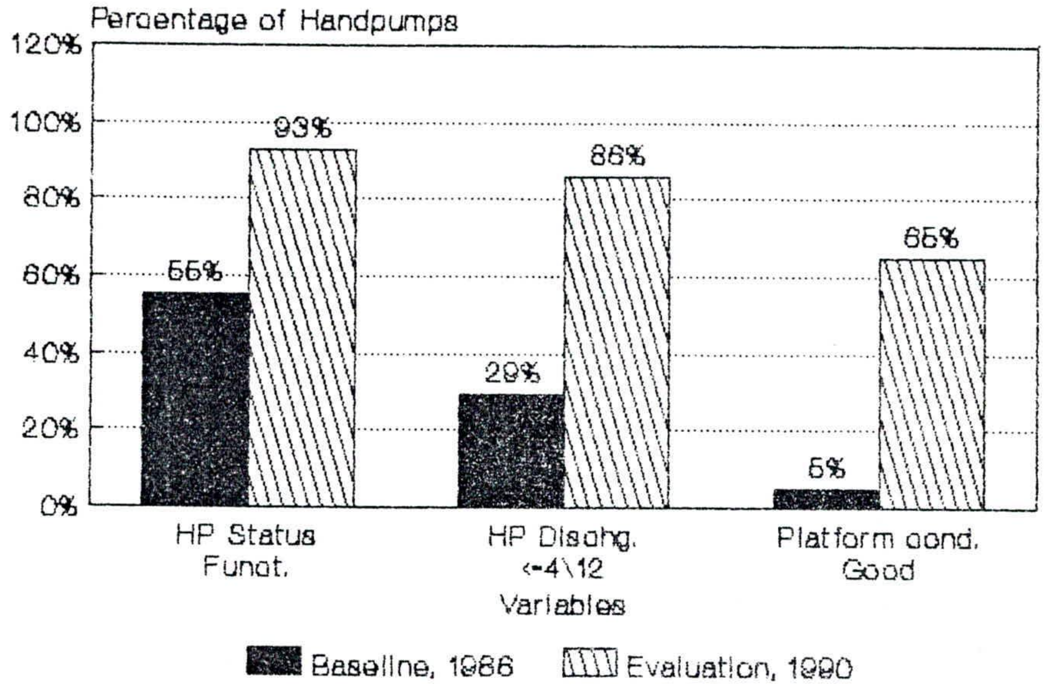
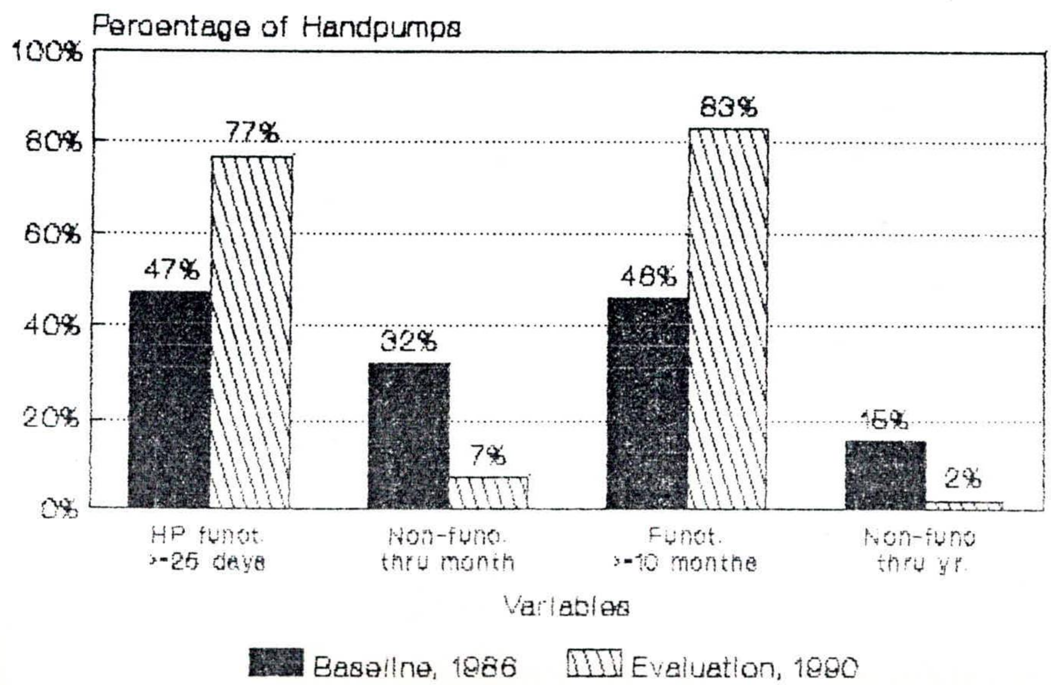


Figure VIII.b. Georai Pre-Post Analysis of Handpumps



over a one year period increased from 7.6 to 10.7 months. The proportion of handpumps functional for more than 10 months in a year increased from 46% to 83%. The percentage of handpumps that did not function through the year reduced from 15% to 2%. The effective water availability over a period of one year in the Taluka increased from 65% to 89.4%.

4.6. Analysis of Users' Habits - Observation at Handpump Site

4.6.1. Users' habits and their consequences:

Users' habits were observed at the pump site for the functional pumps. Indications of misuse or possible contamination with surface water were noted. In case there were cracks in the platform, ring formation around the pedestal, or if murram was eroded and there was slush in the immediate vicinity of the handpump, it was assumed that surface water contamination was possible. (Refer Table XII).

Table XII. Users' habits and their consequences

USERS' HABITS	GEO-RM %	GEO-M %	BEED-R %	PAI-C %
1. People using wrong strokes	71	69	74	95
2. People removing nuts and bolts	17	7	21	42
3. People breaking platform and rim	2	20	12	68
4. Children defecating near handpump	8	9	21	32
5. Murram filling not done	58	66	92	100
6. People throwing waste near handpump	50	56	46	53
7. Waste water and slush accumulation	54	69	87	68
Total no. of HPs (only funcl.) N	48	45	39	19

There is evidence that harmful users' habits are more prevalent in the PAI-C and BEED-R areas where there has been no health education initiative as compared to the GEO-RM and GEO-M study areas where several awareness camps have been organised. Significant differences are seen for 5 variables i.e., people using wrong strokes, removing nuts and bolts, breaking platform, children defecating near handpump, and community members filling murram around hand pump.

There is however, hardly any difference in users' habits of throwing waste near the handpump or allowing slush to accumulate near the platform in the four study areas.

4.6.2. Users' awareness of the Maintenance System:

Significant differences were noted in the users' awareness of the existing maintenance system for handpumps in the four study areas. (Refer Table XIII).

Table XIII. Users' awareness of the Maintenance System

Users' Awareness of Maintenance System			GEO-RM %	GEO-M %	BEED-R %	PAI-C %
1. Does some one maintain your handpump regularly	:	Yes	90	87	11	12
	:	No	10	13	89	88
2. Who maintains?	:	IHMP	75	82	-	2
	:	ZP	5	3	11	4
	:	Don't know	10	2	-	6
	:	No one	10	13	89	88
3. How often maintained	:	Weekly	-	4	11	-
	:	Fortnightly	14	6	-	-
	:	Monthly	65	73	-	2
	:	Less frequent	7	3	-	10
	:	Don't know	4	1	-	-
	:	Not maintained	10	13	89	88
4. If HP breaks down whom do you contact	:					
	:	Sarpanch	21	11	79	30
	:	Z. P.	9	21	18	13
	:	IHMP	48	47	-	-
	:	Don't inform	4	-	-	27
	:	N.A.	-	6	-	2
	:	Don't know	18	15	3	28

N = 100 Respondents.

90% respondents in the GEO-RM and 87% respondents in the GEO-M study areas said their handpump was regularly maintained as compared to 11% in Beed-R and 12% in the PAI-C areas. 75% to 82% users in the GEO-RM and GEO-M areas respectively said that the IHMP was maintaining their handpumps. 5% and 3% in the same two areas felt that the ZP was undertaking the maintenance of their pumps. In contrast, most respondents could not answer this question in the BEED-R and PAI-C areas. 11% in the BEED-R and 4% in the PAI-C areas said that the ZP was maintaining their handpumps.

4.6.3. Users' awareness of VLV role:

Village Level Volunteers exist only in the GEO-RM and GEO-M study areas. They were introduced by the IHMP in the Georai Taluka in 1988. 1790 VLVs are functioning in this Taluka at present.

100 users from the GEO-RM and GEO-M study areas were interviewed to determine if they were aware of the existence of VLVs in their villages. An attempt was made to find out if they knew the role of their VLVs. (Refer Table XIV).

Table XIV. Users' awareness of VLV role

Variables		Study Areas	
Users' awareness of VLVs role		GEO-RM	GEO-M
1. Is there a VLV in your village to take care of the HP :	Yes	81	77
	No	5	13
	Don't know	14	10
2. What does VLV do			
i) Fills Monitoring card:	Yes	12(15%)	23(30%)
	No	39(48%)	39(51%)
	Don't know	30(37%)	15(19%)
ii) VLV informs mechanics in case of break down:	Yes	11(14%)	15(20%)
	No	40(49%)	47(60%)
	Don't know	30(37%)	15(20%)
iii) VLV educates users about proper use of HP and cleanliness of its surroundings	Yes	29(36%)	43(56%)
	No	22(27%)	19(24%)
	Don't know	30(37%)	15(20%)

81% respondents in the GEO-RM and 77% in the GEO-M area were aware of the VLVs trained in their villages.

Out of 81 respondents in GEO-RM, 14% knew that the VLV informs IHMP mechanics in case of handpump breakdown and 36% said that the VLVs educate people in the village regarding proper use of handpump and the cleanliness of its surroundings, whereas in the GEO-M area, these percentages are 20 and 56 out of 77 respondents.

4.7. Analysis of VLV Data

Since VLVs are the basis of the community monitoring system, a KAP was conducted by external investigators to assess the effectiveness of their participation.

External investigators interviewed VLVs individually. At the time of the study all 100 VLVs were not available. A second attempt was made to interview those missed during the first round. In all 89 out of 100 VLVs could be interviewed and their behaviour observed.

4.7.1. VLV characteristics

Table XV provides some characteristics of the sampled VLVs.

Table XV. VLV Characteristics

Variable		Freq.	Percent.
Study area:	: GEO-RM	46	51.7
	: GEO- M	43	48.3
Type of VLV:			
Villager	: Male	48	
	: Female	16	
	: Total	64	71.9
Student	: Male	17	
	: Female	5	
	: Total	22	24.7
Leader	: Male	3	3.4
Duration - Functioned as VLV.			
	:< 1 month	1	1.1
	:1 - 3 months	7	7.9
	:4 - 6 months	8	9.0
	:7 - 9 months	4	4.5
	:10 - 12 months	16	18.0
	:13 - 18 months	12	13.5
	:19 - 24 months	7	7.9
	:> 24 months	32	36.0
	:Don't remember	2	2.1
		89	100.0

4.7.2. VLVs awareness of their role:

Table XVI presents results of VLV awareness regarding their role.

Table XVI. VLVS' Awareness of their Role

Awareness level of VLVs	Frequency	
Awareness of - one or more responsibility	80	90%
" " - role for reporting HP breakdown	63	71%
" " - role to keep HP surroundings clean	30	34%
" " - prevent children from defecating near the HP	14	16%
" " - Murram filling around platform	1	1%

90% VLVs were aware of at least one of their main responsibilities. 71% were aware that they were expected to report the breakdown of their handpump to IHMP mechanics.

34% felt they were expected to maintain cleanliness of HP surroundings. 16% felt they should prevent children from defecating near the HP, and only one respondent said he was expected to have murram filled around platform by community members.

There is an apparent difference in the VLVs' response regarding role in murram filling around platform as compared to observed VLV practices, 37 % VLVs were found to be getting murram filled with the help of community members (Refer Table XX). This discrepency is probably due to a poor probing during interviewing for awareness of several functions.

4.7.3. Level of awareness of VLVs:

The VLVs were interviewed to determine their awareness regarding water - borne diseases and their prevention, contamination of water and need for cleanliness of water source. Table XVII provides the level of awareness of the VLVs at the time of the study.

Table XVII. Level of awareness of VLVs

Awareness level of Village Level Volunteers		Freq.	%
1. Is it necessary to keep HP surroundings clean?	Yes	87	97.8
	No	1	1.1
	Don't know	1	1.1
1a. If yes, why?	To prevent contamination	77	88.5
	Don't know	10	11.5
2. What is safe water ?	Water without germs	35	39.3
	Don't know	54	60.7
3. Can illness be spread by water ?	Yes	80	89.9
	No	6	6.7
	Don't know	3	3.4
3a. If yes, how?	Due to germs	17	21.3
	Due to suspended matter	36	45.0
	Don't know	27	33.7
3b. Aware of waterborne diseases	Could state one WBD	36	45.0
	two	18	22.5
	three	4	5.0
	Don't know	22	27.5
3c. How can WBDs be prevented ?	Had information on prevention	61	76.3
	Don't know	19	23.7

Out of 89 VLVs, 61 had some information on prevention of water-borne diseases. These VLVs answered that WBDs could be prevented by keeping the handpump surroundings clean, by chlorinating water and by boiling drinking water etc.

4.7.4. VLV effectiveness related to monitoring:

The VLV's were interviewed regarding their role in monitoring the functional status of handpumps. The results are presented in Table XVIII.

Table XVIII. VLV effectiveness related to monitoring

Monitoring Tasks	Frequency	
Receive cards every month	79	89%
Return filled cards every month	79	89%
Is in-service training given by BLM	67	75%
Aware of role to report HP breakdown	83	93%

N = 89 VLVs

89% VLVs said they receive and fill handpump monitoring cards every month. 75% said that the BLM gives them in-service training during his monthly visit to the village. 93% were aware of their responsibility to report the breakdown of their hand pump.

4.7.5. VLV practices related to monitoring:

The practices of VLVs related to monitoring the handpump are given in Table XIX.

Table XIX. VLV practices related to Monitoring.

VLV's Reporting Breakdown of Hand Pumps		Frequency	
HP breakdowns		48	54%
Sent information for repair		40	83%
Who was informed	- IHMP	35	73%
	- Sarpanch, BDO or ZP	5	10%
	- Information not sent	8	17%

48 VLVs mentioned that their handpumps broke down at least once after they had become VLVs. Out of these 48 VLVs, 35 (73%) sent information for repairs to the IHMP, 5 (10 %) informed the

Sarpanch, Panchayat Samiti or Zilla Parishad. 8 VLVs (17 %) did not send any information.

4.7.6. VLV practices related to handpump surroundings:

VLV practices related to handpump and its surroundings were observed. These are presented in Table XX.

Table XX. VLV Practices Related to Handpump Surroundings

Practices	Frequency	
Keep HP surroundings clean	53	60%
Prevent misuse	22	25%
Prevent children from defecating near HP	11	12%
Cleans platform and drain	10	11%
Fill murram	33	37%

4.7.7. Observation of VLV Performance:

The investigators examined VLV cards to see how they were filled and noted the handpump and its surroundings. The findings are presented in Table XXI.

Table XXI. Observation of VLV performance by Investigators

VLV Performance		Frequency	
Condition of calendar during study	: Good	79	88.8%
	: Bad	3	3.4%
	: Card missing	7	7.8%
Reporting on calendar	: Completely filled	28	31.5%
	: Partially filled	48	54.0%
	: Not filled	13	14.5%
Surroundings of HP	: Clean	25	28.1%
	: Unclean	64	71.9%
Murram filling	: Present	36	40.5%
	: Absent	53	59.5%

The investigators examined the handpump monitoring calendars of the 89 VLVs. The condition of 79 (89%) calendars was good. 31.5% of the cards were completely filled, 54% were partially filled up, and 14.5% were blank.

28% of the VLVs were found to be involved in maintaining cleanliness of the HP surroundings, and 40.5% had murram filled around the HP platform.

4.7.8. VLVs Perception regarding the improvement of HP condition since they started functioning:

Finally the VLVs were interviewed regarding their perception of the IHMP programme. These are presented in Table XXII.

Table XXII. VLV perception regarding improvement of HP condition

VLV perceptions regarding improvent of HP condn.	Frequency	
VLV felt : HP condition has improved	18	20%
: Breakdown rate has reduced	9	10%
: HP surroundings are clean	6	7%

20 % felt that the HP condition had improved and another 10% felt that the breakdown rates had reduced since they became VLVs. These results are probably due to the fact that there has been a substantial attrition among VLVs and a large proportion have been recently appointed.

5. RESEARCH

5.1. Development of a Parameter for Preventive Maintenance of Hand-Pumps

The first research study undertaken by the IHMP was for the development of a parameter for measuring the discharge of hand-pumps, which could predict their breakdown. 400 pumps were surveyed and their discharge measured in 1986. The variation in discharge was as follows: 1 to 68 strokes (average 12) of the handle to initiate yield and 8 to 120 (average 20) strokes to fill a bucket of water. These pumps were opened to study the correlation between defective handpump parts and the first and second discharge rates. An effective parameter of discharge rate was developed - 4 strokes to start yield and a maximum of 12 strokes to fill a 3 litre bucket - as a cut off point, which has been used for developing a model of monitoring and preventive maintenance of handpumps in Georai Taluka.

5.2. Development of a Monitoring System for Handpump Maintenance

A substantial amount of research work has been done to develop, both a manual and a computerised Management Information System (MIS) for handpump maintenance. The system has been introduced in one Taluka with 192 villages (approx. 2,50,000 population). Beed District has 7 Talukas and both these systems are well tested and can be introduced in the entire district.

5.3. Study of Impact of Reconstruction on Functional Status of Handpumps

The first research paper presented on the SDW programme was on the impact of reconstruction on the functional status of hand-pumps. There is empirical evidence to suggest that the reconstruction of pumps, as per stipulated standards, reduces the breakdown rate from 45 % to 11 %. (Refer Paper presented on Preventive maintenance and monitoring of the hand pumps for providing safe drinking water; August 1987, V NAWDA Convention).

5.4. Study of Impact of Preventive Maintenance on Functional Status of Hand Pumps

The IHMP programme on Safe Drinking Water in Georai was based on the concept that preventive maintenance of handpumps would substantially reduce their breakdown, and increase water availability. The first research paper on this innovative strategy of handpump maintenance was presented at the NAWDA Convention in Hyderabad in 1987. The concept of preventive maintenance received a lot of attention and the IHMP was requested to continue a prospective study and present another paper in the next NAWDA convention. The second research study on this topic was undertaken in 1988-89 and the paper was presented at the NAWDA convention held at the SWTRC, Tilonia, Rajasthan. Subsequently the paper was published in the NAWDA Journal.

5.5. Research Studies in Information, Education and Communication (IEC) Related to Drinking Water

Several research studies have been undertaken by the IHMP on the impact of innovative IEC strategies on individual and community drinking-water-related behaviours. In the last 5 years CAPART has sanctioned grants to NGOs to conduct several thousand awareness camps for drinking water in rural areas. In order to provide guidelines for the conduction of such camps, the IHMP undertook a research study in 1988-89 on the impact of such awareness camps on users' habits. One paper has been published on this topic so far.

5.6. Study of Factors Influencing Community Participation in the Management of Rural Drinking Water Supply

The Georai Model of preventive maintenance of handpumps is largely dependent on the level of participation of the community. Since this programme is being implemented with replicability and up-scaling to the district level as its main criterion, an effort was made to study effective strategies for generating community participation on a large scale which would be applicable within the government infrastructure. Two research papers are nearing completion on this topic.

5.7. Research Studies in Progress

Several research studies are in progress and will be completed within the next 12 months. Some of these are listed below:

1. The variation of static ground water level over a period of one year and its impact on the functional status of handpumps.

2. The impact of reconstruction of handpump platforms on the incidence of water borne diseases.
3. The contamination level of water of reconstructed handpumps as compared to pumps with broken platforms and open wells.

The chlorination of bore wells and open wells could not be undertaken in the Georai project area due to the unavailability of bleaching powder on such a large scale.

Similarly it has not been feasible for the Institute to undertake water quality monitoring in the project area as proposed, due to lack of technology and trained man-power.

6. CREATION OF NEW WATER SOURCES IN GEORAI TALUKA

The IHMP had proposed to undertake the drilling of 100 bores and install handpumps in 'problem-villages' in 3 talukas of Beed District. This programme should have begun by initiating drilling of bores in Georai Taluka. A proposal was submitted to CAPART which had been sanctioned and finances remitted to the IHMP. While this proposal was being processed by CAPART another NGO based in Beed undertook drilling of bores and installation of handpumps in the district. Simultaneously, the government created 200 new water sources in Georai Taluka. The IHMP did not feel it necessary to create any more sources in the same taluka.

CAPART was, therefore, requested to approve a change of location for the creation of new water sources in Paithan Taluka in Aurangabad District. Getting the approval from CAPART took a long time. After receiving the approval for transfer of programme site, there have been administrative problems in requisitioning a rig and severe diesel shortages because of which the work on new bores and handpumps has not yet begun.

The villages for new sources have been identified and underground survey work initiated. The drilling of bores and installation of handpumps will begin as soon as the survey work is completed subject to the availability of diesel.

7. DISCUSSION

7.1. Study Design

The average number of handpumps in each taluka in the Beed District of Marathwada was approximately 200 in 1986-87. In the last three years large scale drilling work has been undertaken by the government, and the number of handpumps has almost doubled since then. This has important implications for maintenance since there has not been a concommitant increase in the number of mechanics employed by the Zilla Parishad to maintain handpumps.

In Maharashtra, drilling and installation of new handpumps is the responsibility of the Ground-water Survey and Development Agency (GSDA). After the work is completed, the installed handpumps are handed over to the Zilla Parishad for regular maintenance. The GSDA either gives the work of drilling and installation of handpumps to contractors or undertakes this work through its own rigs. Once the rigs are deployed the drillers are anxious to move on to the next site as soon as possible. The installation of handpumps, which if done according to specifications, is a full day's job. It also requires curing for 7 days. This aspect of the work is usually neglected, in which case the handpump platforms often develop cracks within months of installation.

The IHMP Safe Drinking Water Programme in Georai was undertaken to develop a model which would overcome some of these inherent problems. The assumption at that stage was that unless handpump platforms were reconstructed and brought up to a maintainable level, effective maintenance of handpumps would not be possible.

The second assumption was that if a parameter could be developed for monitoring the performance of handpumps rather than the incidence of breakdown, then a preventive maintenance system could be instituted which would reduce the number of breakdowns and the non-functional duration and thereby increase the water available to rural communities.

The research study therefore, needed to determine the impact of several dimensions.

a) The impact of reconstruction on the functioning of handpumps.

b) The impact of preventive maintenance on the performance of handpumps and availability of water.

c) The influence of the rapid increase in the population of handpumps and piped water schemes on their regular and effective maintenance.

The study design for the evaluation was formulated in order to be able to quantify the impact of these dimensions and different components of the programme. The total number of pumps in Georai Taluka is 403. Of these, 37 are dead, 7 have been converted into power pumps, and 41 are not maintainable due to fixed or fallen pipe lines. Out of 318 maintainable pumps, 155 were reconstructed, 31 new installations constructed, and 32 platforms repaired by the IHMP. Most of the handpumps installed prior to 1988 are thus reconstructed. Since all the pumps in Georai are under the preventive maintenance system of the IHMP, a comparison could be made between the impact of both reconstruction and preventive maintenance on 218 pumps and of preventive maintenance only on the remaining handpumps in Georai taluka.

160 pumps were reconstructed in Beed taluka, and handed over to the Zilla Parishad which undertakes only corrective breakdown maintenance of handpumps. A study of this group of pumps provided the opportunity to measure the impact of reconstruction on the performance of handpumps.

Paithan taluka was selected as a control area since the number of pumps in this taluka has increased substantially as in all other talukas of this region. The pumps are not reconstructed, and are being maintained under the conventional breakdown or corrective maintenance system. The second reason for the choice of the control area was for economic reasons, to reduce expenditure and time on travel. A comparison of these four areas provides the basis for quantifying the individual impact of the various interventions and strategies introduced by the IHMP.

7.2. Comparability of the Four Study Areas

It has been found that smaller villages and hamlets which are in interior locations and not connected by approach roads are at greater risk of neglect. These villages are more difficult to supervise and are usually unapproachable during monsoons. The largest number of such villages was in the GEO-RM area.

Handpumps located far away from the village are also at risk of being neglected. Here again the largest number of such handpumps was in the GEO-M area.

If there are a large number of water sources in a village the community has an alternative even if one or more water sources are not functioning. There is a risk, therefore, of non-functional handpumps, in villages with multiple sources, being neglected both by the community as well as the maintenance system. There was no significant difference in the number of such handpumps in the four study areas.

The non-functioning of handpumps can be due to a large number of seasonal pumps in an area. Even though there was no significant difference between the four study areas, the larger number of seasonal handpumps were in fact situated in the GEO-RM and BEED-R study areas.

The number of households or population dependent on a handpump determines the wear and tear that the handpump is expected to undergo. The study area where handpumps serve a much larger population can be assumed to be at greater risk of breaking down. The GEORAI-M and BEED-R had a larger number of handpumps providing water to more than 50 households, and were therefore, considered at greater risk. This was the only variable where the difference between the four study areas was significant.

7.3. Functional Status of Handpumps

The largest number of functioning handpumps were in the GEO-RM study area (96%). This is considered to be a result of both reconstruction and preventive maintenance. The impact of preventive maintenance in the absence of reconstruction also appears to be substantial. 90% of the handpumps were functional in the GEO-M area where pumps are under preventive maintenance but have not been reconstructed. Even though these handpumps are not reconstructed, they are newly installed over the last 2 years. The platforms of these pumps have broken down over this period and it is possible that the proportion of functioning handpumps may go down as these pumps become older.

The assumption that reconstruction of handpumps can improve their performance even in the absence of regular preventive maintenance is established from the results seen in the BEED-R area. 78% of the handpumps are functional after one year of reconstruction in this area. Only 11% community members and users in the BEED-R area said that their handpumps were being regularly maintained (Refer Table XIII). Despite lack of regular maintenance a large proportion of these handpumps have functioned since their reconstruction. In comparison only 38% handpumps were functional in the control area.

The efficiency of functional pumps in the GEO-RM and GEO-M areas was 92% and 93% respectively. The efficiency of reconstructed pumps in the BEED-R area has gone down to 82% since they have not been under regular preventive maintenance over the last one year. In comparison, only 53% pumps out of 19 functional pumps were efficiently functioning in the control area. The conclusion one can reach is that reconstruction does improve the efficiency of handpumps, but can be sustained only with regular preventive maintenance.

The average number of functional days per handpump per month, and the effective water availability are similar in the GEO-RM and GEO-M areas, and are substantially higher as compared to the BEED-R area. An interesting finding is that the proportion of handpumps functioning for more than 25 days in a month is highest in the GEO-M area (80%) as compared to the GEO-RM area 74%, BEED-R area 56%, and the PAI-C area 22%. (Refer Table V). These results refute the earlier assumption that handpumps can be efficiently maintained only if they are reconstructed. Regular preventive maintenance appears to have had a greater effect on the sustained performance of handpumps irrespective of whether they are reconstructed or not.

These findings were further substantiated when the performance of pumps over a period of one year was studied. (Refer Table VI). The non-reconstructed pumps in the GEO-M area performed equally well, and by some parameters, even marginally better than the reconstructed and maintained pumps in the GEO-RM areas. In both the areas the performance of handpumps was significantly better than the BEED-R and PAI-C areas.

7.4. Effectiveness of the Monitoring and Maintenance Systems

The users' response to the interval between breakdown and reporting, and between reporting and repair is an indication of the effectiveness of the maintenance system and community involvement in monitoring their water sources. For the handpumps that broke down over a period of one month, 67% to 74% users, in the GEO-RM, GEO-M, and BEED-R areas were aware of information being sent to mechanics for repair as compared to 27% in the PAI-C area.

The participation of community members can be expected only if they find that their needs elicit a prompt response. Despite the fact that there is no preventive maintenance system in the BEED-R area, the reconstruction work has increased the responsiveness of the users in monitoring and reporting HP breakdowns. The information was sent much more promptly, within one week in the GEO-RM 42%, G-M 26%, and BEED-R area 28% as compared to the PAI-C area (4%).

The proportion of pumps that got repaired within a fortnight of reporting was 46% in the GEO-RM area, 42% in the GEO-M area, 14% in the BEED-R area, and 8% in the PAI-C area. Since these figures are not from service records but were obtained through the interview of 100 users, they reflect the community perception of the effectiveness of the maintenance system.

7.5. Effectiveness of Handpump Maintenance

The physical condition of the handpump assembly above ground level is an indication of the effectiveness of the maintenance programme. How promptly worn out and missing parts are replaced, determines the prevalence and duration of breakdown of handpumps. The GEO-RM and GEO-M areas had fewer worn out or missing parts when compared to the BEED-R area, and there was a significant difference when compared to the PAI-C area. (Refer Table IX). However, a substantial number of nuts and bolts were missing in the GEO-RM and GEO-M areas also. Handpump nuts and bolts which are of a standard size are continuously removed by agriculturists for utilisation in their agricultural equipment. This problem can be solved more readily with appropriate technology rather than through investment in more effective monitoring, maintenance or community participation. No amount of community surveillance can stop one individual, in dire need, from removing these nuts and bolts, surreptitiously.

7.6. Effectiveness of the Reconstruction Programme

Reconstruction of handpump platforms has been carried out in the GEO-RM and BEED-R areas. The platform condition in these two areas is substantially better than in the GEO-M and PAI-C areas. In the GEO-M area where there has been no reconstruction work by the IHMP, platforms were in a much better condition than in the PAI-C area because all the unreconstructed pumps in the GEO-M area are only one to two years old. (Refer Table X).

7.7. Comparison of Georai Baseline Survey (1986) and Research Findings (1990)

The proportion of functional handpumps has increased from 55% to 93%. The proportion of handpump platforms in a good condition has increased from 5% to 65%. During the baseline survey 53% of functional handpumps were providing an optimal discharge as compared to 92% in 1990. (Refer Table XIa). There is a significant difference between the baseline and present research findings in all the parameters utilized for measuring the performance of handpumps over a retrospective period of one month and one year. The effective availability of water increased from 65% in 1987 to 89.4% in 1990. (Refer Table XIb). The data suggests that both reconstruction of handpumps and preventive maintenance have had a substantial impact in improving the performance of handpumps and availability of water to the community.

7.8. Analysis of Users' Habits

The data suggests that users' habits have improved to some extent in the G-RM and G-M areas. There is need for further educational efforts (Refer Table XII). There is also need for technological interventions to improve the handpump surroundings. Accumulation of waste water and slush around the pump platform is a health hazard not only in the transmission of water-borne diseases, but is also a breeding ground for mosquito larvae. In 1989 soak-pits were installed at several handpump sites. These soakage pits lasted for less than one year. Apart from user awareness a more effective system will have to be developed for waste water management especially for community water sources as the volume of water wastage is substantial.

The users' awareness of the IHMP maintenance programme was high and a substantially large number of users said that their handpump was being regularly maintained and that they report to the IHMP in case of handpump breakdown. (Refer Table XIII). The user satisfaction is an indirect measure of the effectiveness of the maintenance system.

A large number of respondents were aware of the existence of the Village Level Volunteers (VLVs) in their village. However, very few users were aware of the functions that the VLVs perform.

Since the VLVs are not given any monetary incentives it is imperative that deliberate action is taken by the IHMP to make their contribution known to the village communities. The appreciation of their role by their peer group could itself act as a strong symbolic incentive. (Refer Table XIV).

7.9. Effectiveness of the Handpump Monitoring System

The concept of preventive maintenance of handpumps is totally dependent on an effective monitoring system. The performance and functional status of handpumps needs to be regularly monitored and reported in order to facilitate timely maintenance. At the beginning of the programme it was envisaged that a block level mechanic would be required initially, to visit pumps on a monthly basis, till VLVs could be trained to take over this task. At the start of the programme, the BLM had to visit not more than 180 handpumps in a month. The maximum number of VLVs required was 940. Over the last 3 years the population of handpumps has almost doubled, and twice the number of VLVs had to be involved. The BLM was not only responsible for the independent reporting of handpump status and discharge, but he is also expected to train, support and supervise the 1795 VLVs that are now involved in the programme. The BLM has found it almost impossible to monitor all the handpumps, and distribute and collect calendars from all the VLVs on a regular basis. The transfer of responsibility from the BLM to independently functioning VLVs could not be effected.

The BLM has to visit 10 to 12 handpumps a day on a motor cycle. It involves up to eight hours of work inclusive of travel time. Invariably the BLM meets all five VLVs for the first few pumps that he visits. A large number of VLVs who are farmers or agricultural labourers are not available after 10 a.m. As a result, the BLM leaves the calendars with a neighbour or another family member. The floating population in Beed District is quite high. Especially during the sugarcane harvesting season, people migrate temporarily from their villages to seek employment in sugarcane fields or in sugar factories. This has resulted in a high attrition rate among village level volunteers. 64% of the originally selected VLVs discontinued functioning and had to be replaced. (Refer Table XV). Only 36% VLVs have been participating for more than 2 years.

Of the 89 VLVs interviewed during the study, 71% were aware of their monitoring role for reporting handpump breakdown. However, only a small proportion recognised their role in maintenance of cleanliness around handpumps and regular filling of eroded murram around platforms. It appears as though the respondents understood the question to mean - whether VLVs were carrying out these tasks themselves, rather than getting it done by the community members in their villages. (Refer Table XVI).

The results of observing VLV practices and questioning neighbours living in the vicinity indicated that a larger proportion of VLVs were in fact involved in the maintenance of handpump surroundings. (Refer Tables XX and XXI).

The awareness level regarding handpump surroundings and contamination of water was high, but there was not much awareness regarding water-borne diseases and their prevention. More effective health education messages and strategies need to be developed for increasing awareness on these topics. (Refer Table XVII).

The effectiveness of VLVs related to the monitoring of handpumps was very encouraging. However, since timely maintenance of handpumps can be undertaken only after receipt of information for all handpumps, the proportion of effectively functioning VLVs will have to be increased from 89% to 100%. (Refer Tables XVIII & XIX). The VLV practices related to handpump cleanliness and user habits need improvement as is apparent from Tables XX and XXI).

Two men, two women and one student were selected as VLVs for each handpump. Data is being analysed to determine which of these VLVs have functioned most effectively over the last three years in order to develop criteria for selection in future.

The perception of VLVs regarding the improvement of HP condition since they started functioning was very poor. It is apparent that VLVs need to be involved in participatory problem identification and evaluation of the programme.

7.10. Programme Implementation in Paithan Taluka of Aurangabad District

There were several constraints in implementing the programme in Georai Taluka of Beed District. The most obvious constraint was distance from Pachod which resulted in high travel, training and supervisory costs. Another obvious weakness of the Georai programme was that the drinking water supply programme was undertaken in isolation. It is now felt that drinking water supply and sanitation are so closely linked that an effective programme can be implemented only if it includes both these components.

For two years the IHMP attempted to implement the health education (CETHO) programme through its own manpower resources. It was soon realised that to bring about a measurable change in community behaviour, a large army of health educators and change initiators would have to be developed in a taluka with almost 200 villages. In Paithan taluka ICDS workers, school teachers and school children (child to adult health educators) are being trained in a systematic way. A well planned strategy of IEC has already been tested and is under implementation. Whereas in Georai taluka health education initiatives followed the technical interventions of handpump reconstruction and maintenance, in Paithan an awareness programme preceded the introduction of technology by at least 6 months.

It is proposed that the IHMP will undertake the reconstruction of 280 handpump platforms, maintain approximately 350 pumps over a period of 3 years utilising the preventive maintenance system. A demand and need based sanitation and waste water management programme is sought to be implemented in this taluka along with the SDW programme. An afforestion programme will be implemented through the village level volunteers and students in an attempt to sustain the ecological balance.

Programme implementation in Paithan Taluka started in August 1990. A situational analysis of drinking water sources in 186 villages was conducted. This was followed by a baseline survey of 326 hand pumps in the taluka. While the surveys were being conducted the CETHO team initiated the IEC programme. In September 1990 an orientation programme on safe drinking water was organised for village sarpanchs and gram sevaks. Training of ICDS supervisors, anganwadi workers, school teachers, and school children was undertaken in 1990. The reconstruction of hand pumps was initiated in October and approximately 40 hand pumps have been reconstructed and rejuvenated since then.

8. CONCLUSIONS

1. Reconstruction of handpumps is necessary to ensure effectively functional handpumps. The IHMP experience

indicates that 90% effectively functional handpumps can be ensured over a sustained period of time with timely maintenance There is , sufficient evidence to suggest that reconstruction of handpumps reduces the number of breakdowns in a pump and thereby the workload for the taluka level maintenance team. The greater advantage of reconstruction of handpump platforms is in the prevention of contamination of bores with surface water. Whereas the government has spent enormous resources on the creation of water sources, there is no budgetary allocation for the reconstruction of old handpumps. There is urgent need for a budget for the reconstruction of handpumps to make the work of the mobile maintenance units easier and to ensure safe and potable water. The budgetary requirement for creating one new source is sufficient for the reconstruction and rejuvenation of 15 to 20 broken down and non-functional handpumps.

However, reconstruction of handpump platforms could easily become a self perpetuating evil unless platforms for future installations are constructed as per stipulated specifications. In order to ensure this quality control it is possible to develop a team of trained local masons and mechanics (Private entrepreneurs) for each district. The job of constructing platforms for new installations as well as reconstruction of damaged platforms can be given to them. Payment can be made to them on a job basis subject to certification of quality by a reliable agency. NGOs can be effectively involved in supervision and certification of quality control.

2. The strategy of preventive maintenance of handpumps which was conceptualised by the Institute of Health Management, Pachod in 1986-87, has been adopted by some of the most prominent

agencies involved in rural drinking water supply programmes. There is sufficient evidence to substantiate the effectiveness of this strategy in improving the performance of the handpumps and increasing water availability to rural communities. The introduction of this strategy requires several important policy changes, which have been discussed in detail in the Paper on policy issues.

The realisation within the Govt. that it may not be possible to effectively maintain rural water sources (handpumps) through mechanics employed by the Zilla Parishads led to the experiment of training educated unemployed youth under the TRYSEM Scheme in Maharashtra in 1985-86. It was envisaged that these mechanics would undertake handpump maintenance and would be paid on a job basis if they ensured functional handpumps for more than 25 days in a month. The experiment was a failure because of opposition by the full-time Zilla Parishad mechanics. With the increasing population of handpumps and piped water schemes, the government should renew this effort, by restricting the responsibility of Zilla Parishad mechanics to maintenance of piped water schemes, and involving private entrepreneurs for the maintenance of hand-pumps.

To ensure sustained functioning of handpumps, payment needs to be made on basis of optimal functioning. Implicit in this is the need for a good monitoring and certification system which could link effective functioning of handpumps to the monthly remuneration of private entrepreneurs. Drinking water being such a basic and essential human need, the remuneration for sustained maintenance needs to be linked to outcome of performance of workers rather than activity.

3. The monitoring of performance of handpumps and other drinking water sources in rural areas needs to be strengthened. At present the monitoring of handpumps and drinking water sources is done by the net-work of mechanics who also are responsible for their regular maintenance. This is in contradiction to the basic principles of monitoring and control. There is need to develop a separate net-work for monitoring the performance of mechanics. Developing a community based monitoring system with the involvement of community representatives and possibly local NGOs will ensure the establishment of an effective information base.

4. Information collected for social welfare programmes are presently used only for the purpose of reporting performance rather than for management. There is need to develop a Management Information System (MIS) for the rural drinking water supply programme. Information is utilized by a diverse set of users at various levels for different management functions. The information system developed needs to take into account these levels of management and their information needs. The mere introductioon of a computer at the district will not bring about an appreciable change unless aggregation and utilisation of data for management is also facilitated at the village and block levels simultaneously.

5. There is urgent need for management training of government officials and technical staff involved in rural drinking water supply. There is need for special focus for material management training because of the technology intensive nature of this programme.

6. The Institute of Health Management, Pachod (IHMP) has convincingly demonstrated that the NGO sector can be effectively involved in the implementation of rural drinking water supply schemes. A large net-work of NGOs exist in the State of Maharashtra, who would be willing to get involved in the implementation of this programme. The government needs to look at this net-work as an important resource pool, whose services need to be better utilised for rural development.

At present there is no defined policy or strategy for the involvement of NGOs. Their involvement depends entirely on their own individual initiative at the local level. Long-term programmes are undertaken by NGOs only on basis of informal agreements made with the district level authorities. With the frequent transfer of district level officials the viability of such programmes cannot be ensured. The experience of the IHMP is a good example of the need for a mechanism for the formal engagement of NGOs in rural development programmes. The graph of the effective performance of the IHMP programme over a period of three years exhibits the widest possible variation dependent entirely upon the responsiveness of the Zilla Parishad authorities.

Over a period of three years the Chief Executive Officer of the Zilla Parishad changed 4 times. Since programme implementation was based entirely on an informal agreement with the Zilla Parishad, the effectiveness of the programme has been entirely dependent on the personal interest and perceptions of one individual. An effective rural programme cannot be sustained with such a fragile, ill-defined and informal mechanism of involving the NGO sector.

7. NGO involvement should be restricted to the implementation of innovative programmes which can demonstrate alternative strategies and solutions rather than undertaking the responsibility of government structures for the routine implementation of programmes. Alternatively NGOs can be involved in undertaking compliementary functions such as monitoring, supervision, health education and community participation which would strengthen programmes implemented by the government.

A. ORGANISATIONAL STRUCTURE (Reconstruction/Repair Programme)

COORDINATOR

Reconstruction Team

Mobile Reconstruction Unit (IHMP)	Supply Truck (Z.P.)
1 Superviror	1 Supply Supervisor
1 Driver-cum-Mechanic	1 Driver
1 Mechanic	
1 Mason	

B. ORGANISATIONAL STRUCTURE for the Maintenance and Monitoring System:

a.

CO-ORDINATOR

Mobile Maintenance Unit (500 pumps)	Taluka Level Unit (200 Pumps)
1 Mechanic	1 Block level mechanic
1 Driver-cum-mechanic	
2 Helpers	

VILLAGE LEVEL

(Five volunteers to each hand pump)

b. <u>Organisational Structure</u>

Co-ordinator

Block Level Mechanics
(One for 200 pumps)

Village Level Volunteers
five to a hand pump)

The monitoring programme will be implemented at the district level, viz., covering all 7 talukas in Beed District.

Georai Beed	< Monitoring System < Implemented by the < Institute of Health Management, < Pachod.
Majalgaon Ashti Kej Patoda	< Monitoring system < implemented by < Zilla Parishad, < Beed.