SOCIAL AND TECHNICAL FEASIBILITY STUDY OF IRON REMOVAL PLANTS IN PHULBANI

For

UNICEF
Orissa Office

By

AIMS RESEARCH
Bhubaneswar
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ACKNOWLEDGEMENT

A lot of problems beset the supply of safe drinking water to people in rural areas. Installation of Iron Removal Plants (IRP) is a significant effort towards solving some of these problems. We are thankful to UNICEF, Bhubaneswar Office, for giving us the opportunity of being associated with such a venture. We express our gratitude particularly to Mr. Vinod Alkari, Chief of Office and to Mr. Dipak Roy, Project Officer, WES. Mr. Dipak Roy gave constant constructive suggestions right from the beginning of field work to the end of the study.

The Executive Engineer, RWSS, Phulbani Division Mr. Sahu, the SDO, G. Udayagiri Mr. S.K.Das and their staff need special mention. They were extremely cooperative during the entire study period. We thank them for this. The NGOs involved in IRP construction in Phulbani, especially SMS, BSS, and PRDATA extended their valuable help also in terms of giving information through several rounds of discussions. We are extremely grateful to them.

AIMS Research
Bhubaneswar

1. Background

1.1 Phulbani has been one of the priority areas for UNICEF Orissa Office for provision of potable drinking water to the people. After identification of high iron content in ground water as the main problem affecting use of ground water in Phulbani district by a team of experts from National Environmental Engineering Research Institute (NEERI) in 1986-87, UNICEF has been concentrating on development and adoption of a suitable model of Iron Removal Plant (IRP). After continuous interaction of experts from UNICEF and Rural Water Supply and Sanitation (RWSS) with that of DANIDA Drinking Water Mission in Orissa (which developed the initial model of IRP in Orissa), a ferro cement version was developed and adopted for use in Phulbani district. Initially, these IRPs were constructed by RWSS Phulbani Division, but later NGOs were also involved in the venture. About 150 IRPs have already been constructed, and UNICEF commissioned a study to assess the feasibility of construction of these IRPs on a wider scale in Phulbani district.

2 Objectives

2.1 The basic objectives of the study were :

- To assess and enumerate current use pattern of tubewells on which Ferro Cement Iron Removal Plants have been installed.
- To compare this use with that of selected control cases, i.e., tube wells with iron content of comparable levels.
- To measure the quality and quantity of treated water.
- To assess and comment on technical performance parameters such as durability of structure, in particular, various joints and water retaining structures.

- To assess the maintenance requirements across the two broad variations in design:
  - → Rectangular / Circular
  - → Raised water tanks / those with gland nuts.

- To document current practices of maintenance, including cases where community is performing the back-washing operation.

- To assess competence of NGOs to undertake construction of IRPs on a large scale.

- To identify major logistic problems which, when solved, can help take the initiative to a large scale.

- To conclude as to whether such plants need to be and can be replicated, specifically in the context of increased use.

3. Methods

3.1 Both qualitative and quantitative methods were used to gather information from users, executing agencies, as well as for technical assessment. Besides assessment of physical condition, survey of user households, focus group discussions with users as well as individual interviews with NGO and RWSS functionaries were also carried out. About 27 IRPs were covered in the study.

4. Technical Assessment

4.1 Technical assessment was based on 25 IRPs of which 21 were in working condition. No serious deviation from the approved design was seen, while measuring the physical dimensions of various parts of the structure. The overall workmanship was found to be good, especially in G.Udayagiri block where the structures were found to be strong and durable. Minor leakages were observed, especially in the stuffing box, tank walls, and

inlet pipe. Poor physical condition of some IRPs was found to be a result of both bad workmanship and misuse by the people.

4.2 Regarding the functional aspects, handle operation was found to have problems in few cases due to wearing out of cup washer. Delayed flow was observed in many instances, mainly due to use of smaller outlet pipe, and leakage in aeration tray and stuffing box. Wrong placement of the holes in the aeration chamber reflected inadequate understanding of the design. Sludge deposits was found in many tanks, indicating absence of regular maintenance. The highest and lowest output of water recorded were 42 litres and 5 litres, respectively.

4.3 Water was found to be mostly yellowish in colour, without any marked odour. Floating debris was found in some instances, as also suspended solids. IRP water in most cases had no taste while only a few had metalic taste. Water quality was found to be more alkaline in nature than acidic. Iron content in water coming out from the IRP was found to be mostly less than 1.0 mg/l. Very few instances of iron content of more than 1.0 mg/l was observed. Excessive iron content of more than 3.0 mg/l was observed in a single case.

5. Pattern of use of water

5.1 IRP water is being used for drinking(96%) and cooking by most people. But a substantial proportion of people use it for washing utensils and for bathing too. But people do not exclusively depend on the IRPs for drinking water and also use other sources like "*Chuan*" and open wells. Taste, smell, and the distance of IRP were reported to be the main reasons for not using it. Compared to IRP water, water from hand pumps without IRPs was reported to be used mainly for other purposes and less for drinking (16%). People (16%) also found the IRP water to be dirty / muddy and having kasa/iron taste. Three basic problems were reported in IRPs - leakage in the plant, low level of output, and difficulty faced by women in operating the handle in the raised tank model

5.2 Most of the people understood that IRP was meant to filter dirty water and provide clean water for drinking and cooking. The concept of "iron" in ground water was found to be not well understood by most people.

5.3 In most cases, sharing of water sources by different social groups was observed. Besides IRP, traditional water sources are also shared, but usually one caste group uses the source after the other. No clear trend in selecting a source of water was found among the people, who use water from various sources as and when required. Proximity of source is often the major deciding factor for water use. People do not have any strong preference for any particular source for drawing water for drinking / cooking purposes, and consider water from IRP, open wells, and "Chuan" to be equivalent in cleanliness and purity.

6. Maintenance

6.1 Maintenance mainly involves periodic backwashing and sludge removal from filter bed and aeration tray. Regular maintenance was observed in less than half of the cases. The RWSS retains the responsibility of backwashing in most cases, but it not able to do it regularly. Records of maintenance was observed in only 4 locations.

6.2 Maintenance is being done by people on their own in few cases after training from RWSS. People have acquired simple tools to carry out backwashing operation. The Users' Committee is yet to generate involvement among the people. The RWSS, however, has prepared an easy to comprehend manual in oriya language to help people in backwashing operation. RWSS functionaries reported being handicapped by heavy workload, coupled with understaffing and shortage of vehicles. IRPs located in accessible areas are the ones neglected the most.

7. Involvement of NGOs

7.1 Three NGOs, viz. PRDATA, Srusti Mahila Samiti and Banabari Seva Samiti have been involved in IRP installation. Most of the construction work is over, only commissioning remains to be done. NGOs stated carrying out survey to assess needs of the community prior to IRP construction. NGOs involved people from the nearby villages in construction work to generate a sense of belongingness among them for the IRPs. Women especially were involved to ensure regular use of IRP water by them.

7.2 Training to the NGO personnel have been imparted with the assistance of UNICEF and RWSS. Detailed drawings for construction and maintenance have been given to them. The technical assessment of IRPs constructed by NGOs revealed some deviations

from the specified design while the overall construction was found satisfactory. However, some reorientation of the masons is required to ensure proper understanding of the design which is felt lacking at few places. Overall, the NGOs were found to be competent enough to undertake the construction of IRPs on a larger scale.

8. Conclusions and Recommendations

8.1 Based on the findings, it was observed that there is a need to install more IRPs to increase the use of hand pump water for drinking. Construction of IRPs on a larger scale by RWSS and NGOs was also judged to be possible, considering their performance. Thus it was concluded that IRPs are feasible in the district of Phulbani.

8.2 Several problems affecting quick construction of good quality IRPs, mainly logistical problems were identified. Stuffing box for connecting IRPs to hand pumps and gravels for use in filter bed were reported to be not available readily. Cost overruns due to increase in price of some materials, and due to additional expenses on masons who have to stay out in the villages during construction was reported.

8.3 Some recommendations were made to facilitate improvements in the quality of IRPs and to increase the use of IRP water by people for drinking. These recommendations include :

- Additional training to masons involved in construction, closer supervision by engineers, and provision of detailed construction manual.
- Support to NGOs in procuring gravel for filter bed
- Training and motivation and provision of manuals to users for carrying out regular maintenance, and activation of the Users' Committee to facilitate the same
- Motivational campaigns among people to promote water from IRPs as only safe water, to be used for drinking only.

ABREVIATIONS

AIMS	-	Asian Information Marketing & Social Research
BSS	-	Banabasi Seva Samiti
DANIDA	-	Danish International Development Agency
FGD	-	Focus Group Discussion
IRP	-	Iron Removal Plant
NEERI	-	National Environmental & Engineering Research Institute
NGO	-	Non Government Organization
PRDATA	-	Phulbani Rural Development Technology Agency
RWSS	-	Rural Water Supply and Sanitation
SMS	-	Sristi Mahila Samiti
UNICEF	-	United Nations Childrens' Fund

CONTENTS

CHAPTER - I INTRODUCTION

1.1 Background

1.1.1 In the State of Orissa, one of the major reasons for low use of ground water provided through large number of hand pumps has been problems associated with water quality-specifically high salinity in tube wells in coastal Orissa and high iron content in the hilly regions. This problem of occurrence of iron in ground water is fairly widespread in India, particularly in the Chota Nagpur Plateau which has rich iron deposits.

1.1.2 The DANIDA Drinking Water Project in Orissa, which was specifically designed to solve the problem of drinking water in the saline belt in the coastal districts, made systematic efforts to address the problem of iron too. The basic principle of removal of dissolved iron involved aeration and consequent oxidation of water, during which the dissolved iron which occurs in the form of ferrous oxide (FeO) gets oxidised to ferric oxide (Fe2O3); the latter being insoluble can be easily filtered out through specially made iron removal plants.

1.1.3 Provision of potable water to people in Phulbani district has been one of the priorities of UNICEF in Orissa. Towards this, efforts have been made to promote the utilization of ground water. According to investigations made by a team of experts from National Environmental Engineering Research Institute (NEERI) at Nagpur, in 1986-87, the water quality problem in Phulbani is mainly that of excess iron. In 1994-95, UNICEF, Orissa Field Office interacted with the DANIDA Technical Advisors for development of Iron Removal Plants (IRPs) and using the early versions of the DANIDA model, improved upon it by developing a Ferro Cement Version. Since then, the Phulbani Division of RWSS has been constructing IRPs in the district and simultaneously improving on the design to make it easier for maintenance. The Phulbani Division also adopted one of the

later versions of IRP developed in the DANIDA Project which was provided with a pre-settling chamber. In this design, generally referred to as 'rectangular version' there is a much reduced load on the filter medium and therefore the back washing and maintenance load is also substantially reduced. This rectangular version can also handle water with a higher iron content (upwards of 5 mg/l).

1.1.4 Around 150 IRPs have been constructed in five blocks of Phulbani. Three NGOs in Phulbani have also been involved in construction of IRP. It has been estimated that about 2000 IRPs are to be set up in the district. Before such a venture is attempted, UNICEF wanted a feedback regarding the social & technical feasibility of the IRPs in the district. Towards this, a social and technical feasibility study of Iron Removal Plant in Phulbani district of Orissa was commissioned by UNICEF to AIMS Research.

1.2 Objectives

1.2.1 The basic objectives of the study were :

- To assess and enumerate current use pattern of tubewells on which Ferro Cement Iron Removal Plants have been installed.
- To compare this use with that of selected control cases, i.e., tube wells with iron content of comparable levels.
- To measure the quality and quantity of treated water.
- To assess and comment on technical performance parameters such as durability of structure, in particular, various joints and water retaining structures.

- To assess the maintenance requirements across the two broad variations in design:
  - → Rectangular / Circular
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- To document current practices of maintenance, including cases where community is performing the back-washing operation.

- To assess competence of NGOs to undertake construction of IRPs on a large scale.

- To identify major logistic problems which, when solved, can help take the initiative to a large scale.

- To conclude as to whether such plants need to be and can be replicated, specifically in the context of increased use.

1.3 Methodology

1.3.1 Methods

Considering the scope of work, both qualitative and quantitative methods were used. The methods used and the respondents for each method are mentioned below :

- **Observation of IRPs :** A sample of IRPs of various designs was observed closely based on a checklist. Physical examination of various parts was carried out. Dimensions of the structures were measured. Functioning of various parts was observed by operating the pump. Volume of output of water was measured and quality of water was also tested.

- **Discussion with key informants for village level data :** Discussion was held in the nearest village where hand pump / IRP was covered. A village schedule containing information on all sources of water near the village, their

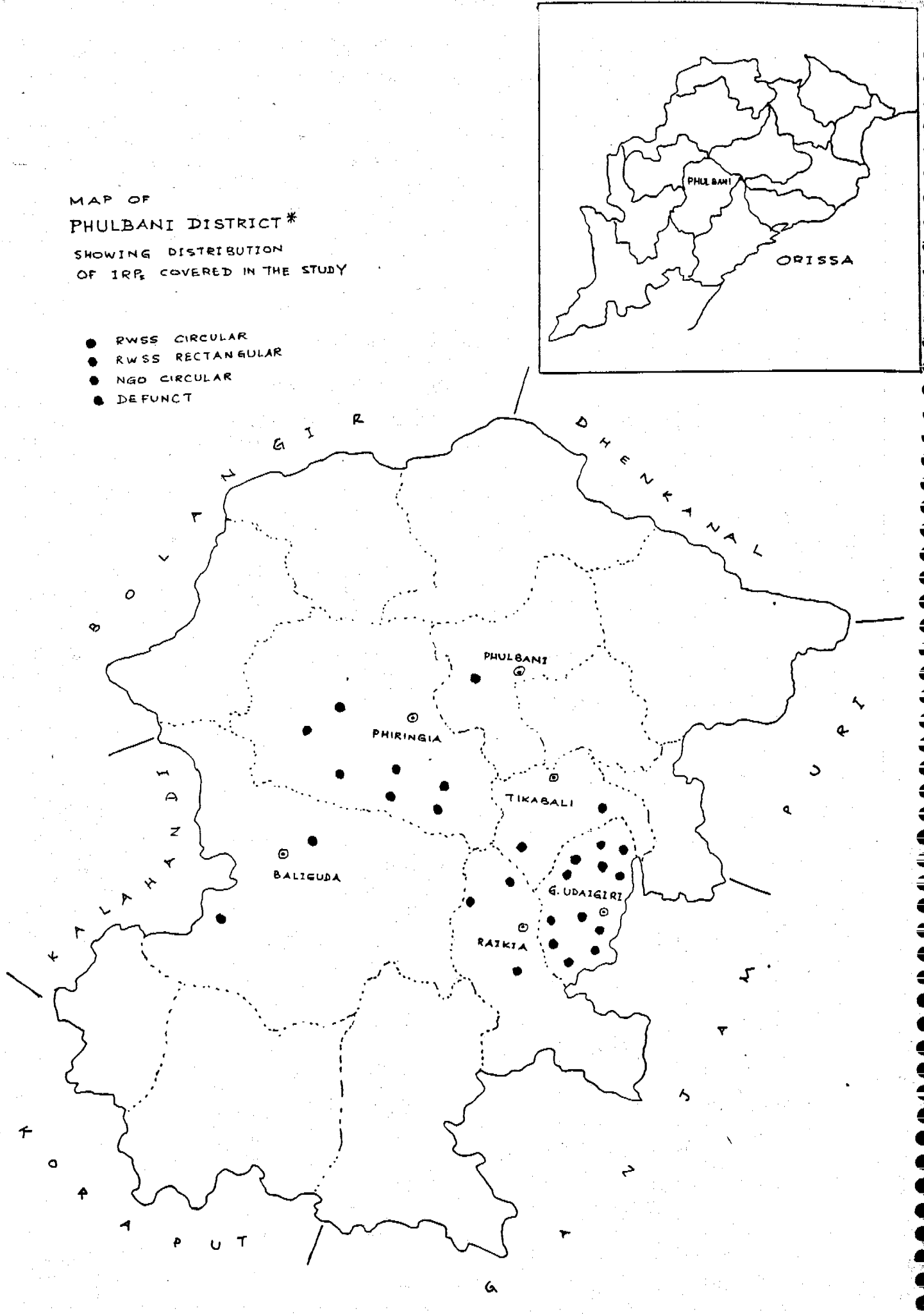
distances, and the number of households using each source for various purposes was filled up after detailed discussions with key informants in the village. The composition of the village with regard to various social groups was noted.

- **Survey of households :** Some household members in each village nearest to the selected hand pumps and IRPs were interviewed with the help of structured formats, regarding the pattern of use of the hand pumps for various purposes, their opinion on the suitability of hand pumps and IRPs, and the water yielded by it. The pros and cons of the IRPs / HPs and the reasons for use and non use were also probed.

- **Focus Group Discussion with community :** Focus Group Discussions were organised separately for women and men of various social groups in selected villages to investigate the qualitative aspects of pattern of use, reasons for selection of water source for various purposes, and opinions regarding hand pumps/IRPs by the community.

- **Depth interview with functionaries of RWSS :** RWSS functionaries at various levels, involved in installation and maintenance of hand pumps and IRPs were interviewed on various aspects of construction, maintenance, and problems therein.

- **Discussion with NGO leaders and members with the help of semi-structured formats :** This was done to assess various aspects of competence of the NGOs involved in IRP construction. The performance of NGOs in construction of allotted IRPs was thereby assessed, and their role in mobilising the community for maintenance was investigated.


MAP OF
PHULBANI DISTRICT*
SHOWING DISTRIBUTION
OF IRPs COVERED IN THE STUDY
RWSS CIRCULAR
RWSS RECTANGULAR
NGO CIRCULAR
DEFUNCT
PHULBANI
ORISSA
BOLANGIR
DHENKANAL
PHULBANI
PHIRINGIA
TIKABALI
BALIGUDA
G. UDAIGIRI
RAIKIA
KALAHANDI
PURI
PURI
* ERSTWHILE ADMINISTRATIVE DIVISIONS

1.3.2 Sample

27 Hand Pumps with IRPs were covered in the study. However, pattern of use was studied for 21 IRPs, whereas detailed physical evaluation was done for 25 IRPs. 19 IRPs were covered both in technical assessment and in the survey, 2 IRPs only for the survey, and 6 IRPs only for technical assessment. Coverage of IRPs of various dimensions was as follows:

Block	Circular		Rectangular		Total
	Stuffing Box	Raised HP Tank	Stuffing Box	Raised HP Tank	
Phulbani	1	-	-	-	1
Phiringia	7	-	-	-	7
G.Udayagiri	4	4	3	1	12
Tikabali	1	-	-	1	2
Raikia	1	-	2	-	3
Baliguda	2	-	-	-	2
Total	16	4	5	2	27

A list of all the IRPs covered is given in Annexure I.

- **Survey of Households :** 10 households were selected from each of the 21 villages closest to the 21 selected hand pumps with IRPs. Thus for 21 hand pumps with IRPs - 210 households were covered. 20 hand pumps were also selected with iron level comparable to those where IRPs have been done - and 10 households were selected from each of the 20 villages nearest to the selected hand pumps, thus 200 households were covered.

Selection of households from within the village was done using random method.

- **Focus Group Discussions :** 12 FGDs were conducted. Eight FGDs were done in villages nearest to eight selected IRPs. Following categories of respondents were covered.

Particulars	SCs	STs	Total
Men	2	2	4
Women	2	2	4
Total	4	4	8

Four more FGDs were done in villages using hand pump water without IRPs with following break up :

Particulars	SCs	STs	Total
Men	1	1	2
Women	1	1	2
Total	2	2	4

- **NGOs** : There NGOs involved in construction of IRPs were studied.

- **Interview with RWSS functionaries** : Functionaries at various levels, involved in the installation of IRPs were interviewed. The sample covered is as follows :

Functionaries	Nos.
Executive Engineer	1
Asst. Engineer	2
Junior Engineer	4

- **Summary of Sample**

Hand pumps with IRPs	27
Hand pump without IRPs	20
Households	410
FGDs	12
NGOs	3
RWSS functionaries	7

1.4 Field Work Organization

1.4.1 The field work was organized in two phases. In the first phase, survey of households were done in villages closest to the selected IRPs. All discussions with group of users /non-users, functionaries of the RWSS and NGOs were done in this phase also. Two teams led by 2 professionals and each assisted by a group of 4 investigators were involved in the task. The physical assessment was also done in this phase with the help of an expert in this area.

1.4.2 The second phase of the field work was necessitated as during the first phase substantial number of IRPs constructed by NGOs could not covered due to non-commissioning. The second phase covered some more IRPs constructed by NGOs.

1.5 Report Structure

1.5.1 The report has been presented in six chapters. The Introductory chapter briefly states the background of the issue under study, along with the methodology followed and sample covered. The technical assessment report has been given in the second chapter. The third chapter discusses in detail the usage pattern of IRPs and the reasons for its non-use. The fourth chapter outlines the existing maintenance system and the problems thereof. The competence of NGOs regarding construction of IRPs has been examined in the subsequent chapter. The sixth and concluding chapter brings out the chief problems encountered and suggests broad recommendations for improving the condition of IRPs and to optimise the utilization of the IRPs.

CHAPTER - II TECHNICAL ASSESSMENT

2.1 Background

2.1.1 For a IRP to function properly, it is necessary that various parts and components should be made to a particular dimension and should be in good functional condition. The physical condition and technical aspects of the IRPs were assessed during the study with the help of an expert with a long experience in design and construction of IRPs. This technical assessment was done for 25 IRPs. Of the 25 IRPs examined, 21 were in running condition while 4 were defunct. The defunct IRPs were taken up for studying the reasons for breakdown and / or non-use. The distribution of 21 IRPs in running condition is as follows :

Table No : 2.1
Distribution of IRPs Across Different Blocks

Block	IRP Type				Total
	CIRCULAR		RECTANGULAR		
	Stuffing Box	HP Tank Raised	Stuffing Box	HP Tank Raised	
Baliguda	2	Nil	Nil	Nil	2
Phiringia	6	Nil	Nil	Nil	6
G.Udayagiri	2	4	2	1	9
Tikabali	1	Nil	Nil	1	2
Raikia	Nil	Nil	2	Nil	2
Total	11	4	4	2	21
G.Total	15		6		21

Thus, in total 15 Circular and 6 Rectangular IRPs were covered. Of the 15 Circular ones 11 had stuffing box arrangements while 4 had HP tank raised. Of the 6 Rectangular designs, 4 had stuffing box arrangements, and 2 had the HP tank raised.

2.1.2 The coverage of the 21 IRPs according to the agency involved in construction (RWSS and the NGOs) is as follows :

RECTANGULAR PLANT

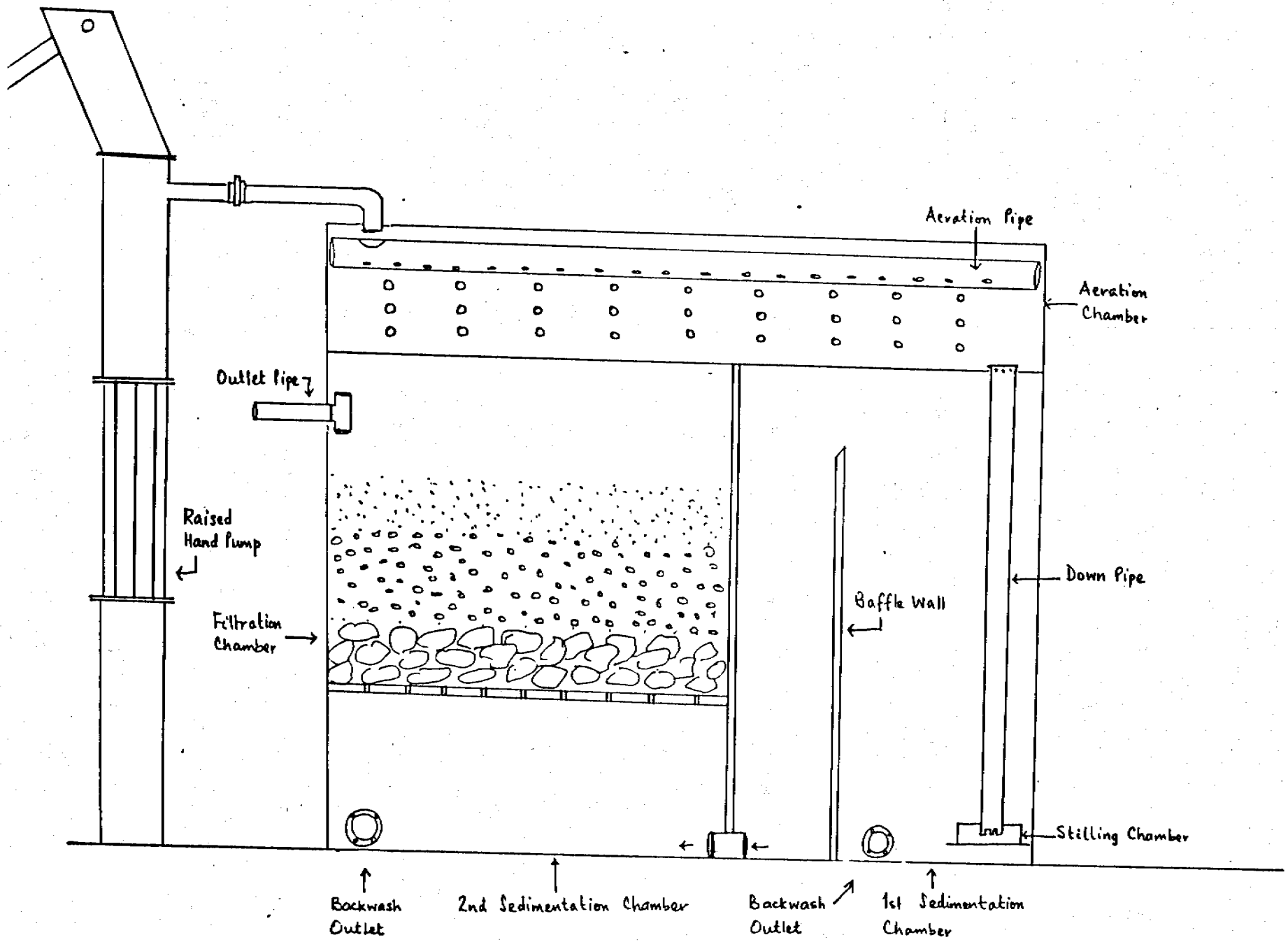


Table No : 2.2
Distribution of IRPs by Agencies involved in Construction

Block	RWSS		NGO		Total
	Circular	Rectangular	Circular	Rectangular	
Baliguda	Nil	Nil	2	Nil	2
Phiringia	3	Nil	3	Nil	6
G.Udayagiri	5	3	1	Nil	9
Tikabali	1	1	Nil	Nil	2
Raikia	Nil	2	Nil	Nil	2
Total	9	6	6	Nil	21
G.Total	15		6		21

Thus, of the 21 IRPs 15 were constructed by RWSS and the rest 6 by NGOs. None of the NGOs have, however, constructed any IRP in the blocks of Tikabali and Raikia. All the IRPs constructed by NGOs are of the circular type.

2.1.3 The defunct IRPs were also examined to study the reasons for breakdown and / or non-use. These 4 defunct IRPs were distributed across 3 blocks.

Table No : 2.3
Reasons for Non-Use of Defunct IRPs

IRP Location	Type of IRP	Reasons for Breakdown
Masiripada (Phiringia)	Circular	• Not used due to low output - later misused and damaged and pipes stolen
Sanagadu (Phulbani)	Circular	• Not used as filter media was jammed - Repaired subsequently but people refused to use, stating that water doesn't get filtered.
Kalinga (G.Udayagiri)	Circular	• Not used due to leakage in tank - later damaged.
Raikola (G.Udayagiri)	Rectangular	• Not used due to leakage in various places - later damaged.

2.2 Design of IRP

2.2.1 There are 2 types of IRPs in use in Phulbani district - Circular and Rectangular. The Circular version of IRP consists of 3 basic parts, i.e., the aeration chamber, the sedimentation tank, and the filtration tank. The water from the hand pump is pumped into the aeration chamber. The aeration pipe which is fixed horizontally on the aeration tray has small holes/slits at the sides and through it, water gets

evenly sprinkled in the aeration tray. The aeration tray is filled with ballast / granite which helps the water to spread out further. The purpose is to increase the surface area of water in contact with air. This helps in converting the ferrous oxide (FeO) dissolved in the water into ferric oxide (Fe_2O_3); the latter being insoluble can be removed. Thus after aeration is complete, water moves down to the sedimentation tank through the help of a pipe (down pipe). Water gets collected in the tank and the suspended particles settle at the bottom. With the gradual rise in water level, the water is filtered into the filtration chamber just above it which is lined with proper media of gravel and sand. The filtered water comes out of through the outlet pipe for use as clean water with highly reduced iron content.

2.2.2 The rectangular version of the IRP is different from the circular one both in terms of design and performance. This has two pre-settling tanks instead of one. While the basic principle of water trickling through the aeration pipe to the settling tank remains the same, the down pipe doesn't pass through the filtration tank to the settling chamber as in case of circular plants. The down pipe allows water to accumulate in the first settling chamber which is connected to the second settling chamber which is right under the filtration tank. The wall which separates the two settling chambers is known as the baffle wall. Water overflows the baffle wall of first settling chamber and gets collected in the second chamber and finally passes through the filter chamber. The rectangular version is more efficient in terms of removal of iron, but is more difficult to construct.

2.3 Adherence to Specified Design

2.3.1 The degree of adherence of the IRPs to the broad design was noted. Serious deviations were not seen, except in Raikia block where the baffle wall of the 2 rectangular IRPs have been raised, obstructing the flow of water from one

sedimentation tank to another. This is responsible for causing some head loss in the plant, contributing to less water discharge.

2.3.2 Physical Dimensions of IRP : The physical dimensions of various parts and components of IRPs were measured to verify their adherence to the specified design. However, in two locations at Podapada and Bandhagada (IRPs constructed by Srusti Mahila Samiti), except the aeration chamber no other dimension could be measured as they were sealed.

- Circular IRP Diameter and Height : The specified diameter and height of the Circular IRPs are 1200 mm and 1050 mm, respectively. It was observed that all the 15 Circular IRPs had a diameter slightly less than 1200 mm. Similarly the height of the IRPs were also slightly less than the specified measurements.

- The Aeration Tank : In Circular types, the specified size of the aeration tank is 1050 mm x 300 mm x 400 mm while in rectangular types the length is more, i.e., 1670 mm. All the Circular IRPs had aeration tanks of the specified length and height. Only the breadth of the tank had minor deviations, being slightly more (20 mm) than the specified breadth. In case of rectangular ones, only the height of the aeration tank was found to be to specified dimension, while the length and breadth are slightly more.

- Sedimentation Tank : The settling or sedimentation tank could be measured only in case of Rectangular IRPs as in Circular ones it is sealed. The specified dimensions are 925 mm x 700 mm x 1150 mm in size. None of the IRPs had the settling tank of the specified dimensions.

- Filtration Tank : The Filtration tank of only rectangular designs were measured and it was found that none of the IRPs had a tank of the specified size of 925 mm x 925 mm x 1050 mm. However, the deviations were very minor in nature.

2.4 Physical Condition

2.4.1 The physical condition of IRPs was assessed on the basis of the strength and durability of the structure, workmanship and quality of plastering, and the nature and rate of leakage at various places.

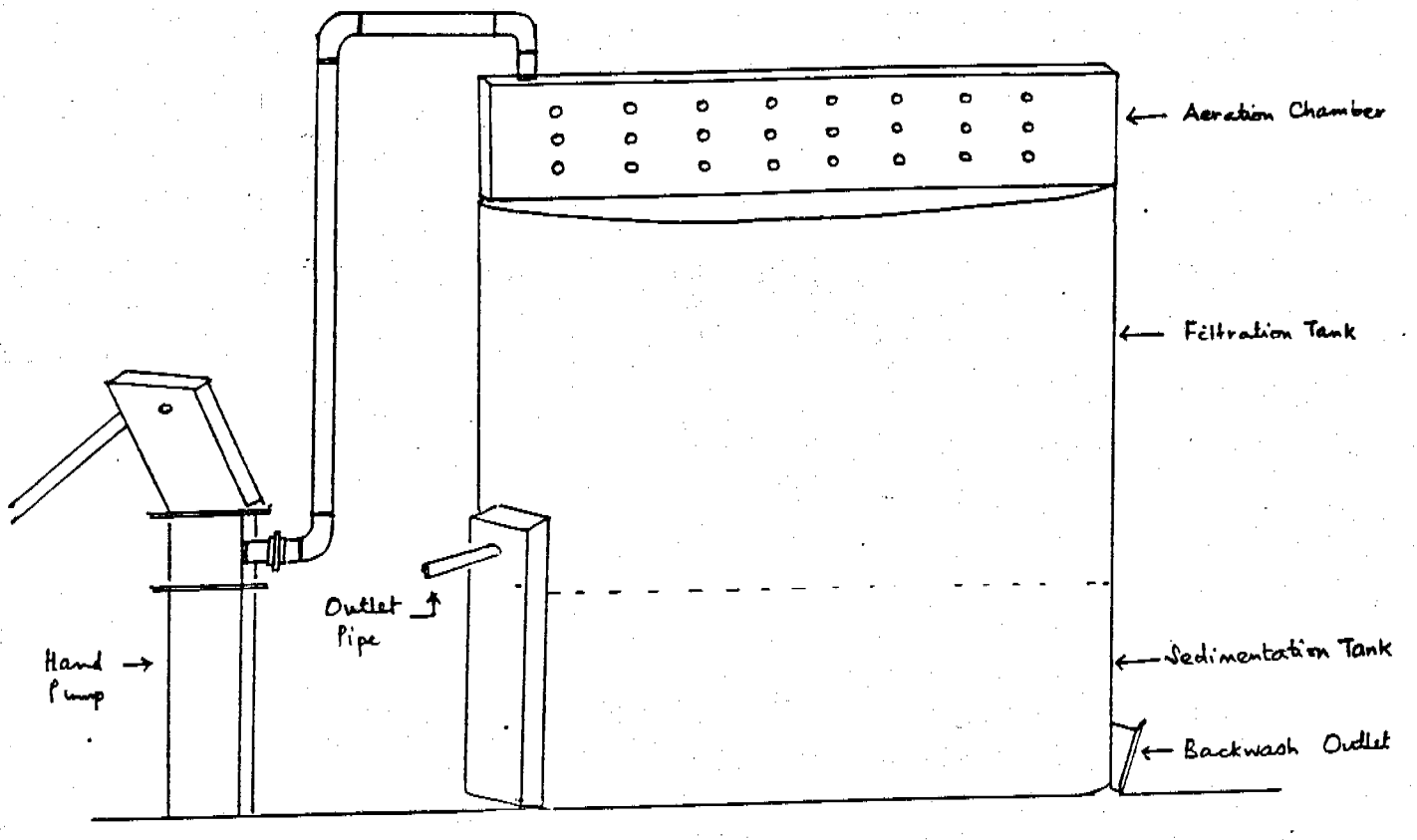
2.4.2 Strength : The structure was found to be strong and durable in most cases (17). Only in 2 cases (both in Raikia block) the structure appears weak. These two are rectangular design constructed by the RWSS. In both the cases, cracks were observed on the structure.

2.4.3 Plastering / Workmanship : Workmanship was observed to be good in most IRPs. It was found to be poor in three cases, two in Raikia block and at one place in Phiringia block. Workmanship was observed to be relatively good in G. Udayagiri.

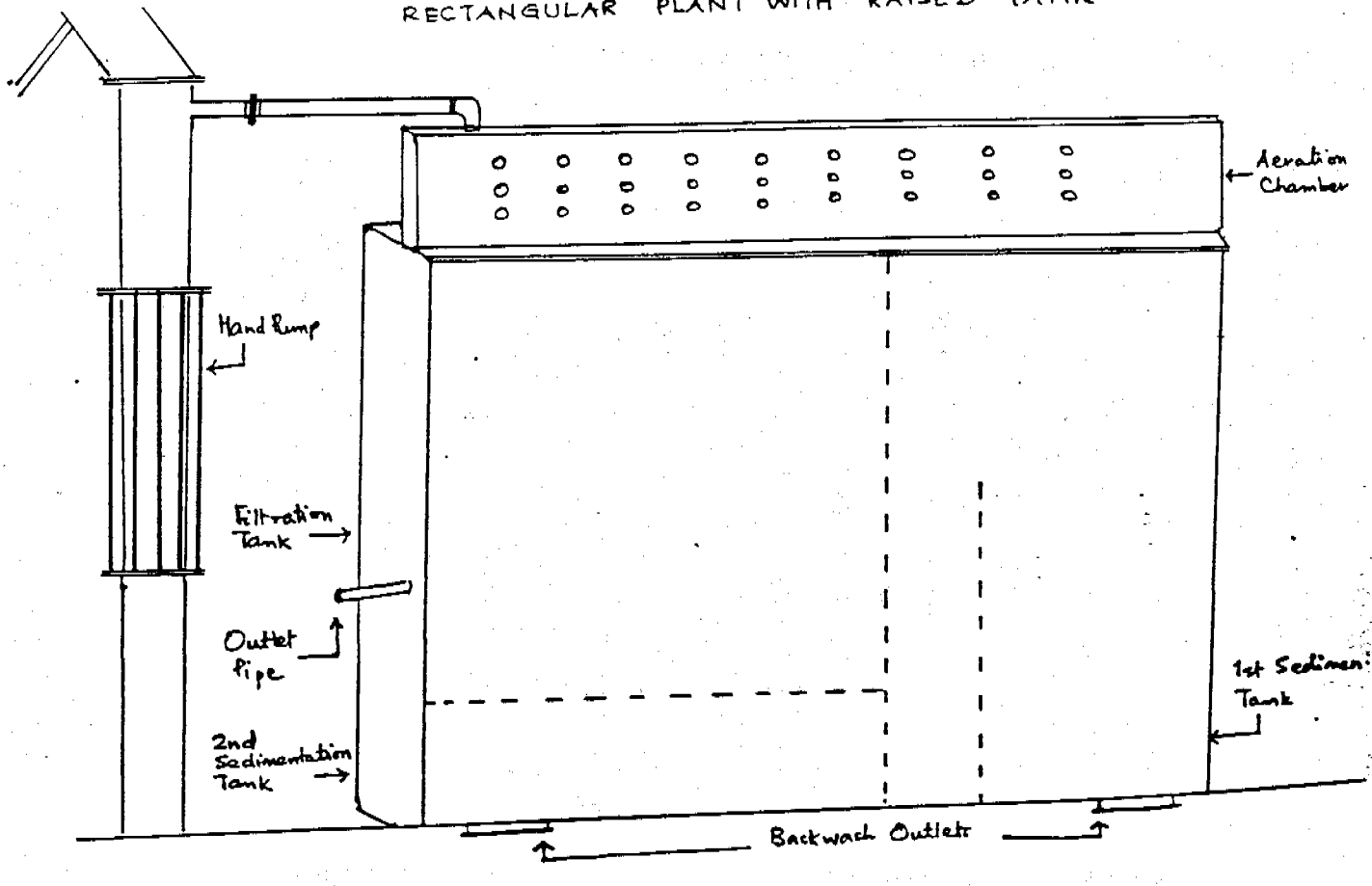
2.4.4 Leakage : Leakage is vital to the overall performance of the plant, as the output level goes down due to heavy leakage. Leakage can occur at various points, i.e. in stuffing box, in the connecting pipes (inlet and outlet), and in the wall of the structure. During observation, leakage was observed in all such points. Leakage in stuffing box was observed in 12 cases, eight circular and four rectangular ones. Of these the rate of leakage was found to be heavy in 5 cases, moderate in 4, and very less in 3 instances. In most cases where the stuffing box was found to be leaking, the gland packing was found to be worn out.

Leakage in the inlet pipe was found in about 10 cases, the reason being the slanting placement of the aeration pipe. Outlet pipe was found leaking in 7 cases, and in most cases the opening was found to be cracked due to misuse by the people.

CIRCULAR PLANT WITH RAISED TANK



RECTANGULAR PLANT WITH RAISED TANK



Leakage in the tank wall was observed in 6 cases. Most of the rectangular ones (4) were found to be having minor leakage on the tank wall, mainly due to bad workmanship.

2.5 Functional Aspects

2.5.1 Some aspects of functioning of the IRPs were observed, mainly the working of the handpump handle, and rate of flow of water.

2.5.2 Handle Operation : In about 7 cases it was found that the handle was rather difficult to operate. The most common reason for this was found to be the wearing of the cup washer. In one case, the handle bearing was found to be crushed.

2.5.3 Delayed Flow : Delayed flow was observed in 17 IRPs. In few cases, the delay was so marked that output reading had to be taken after 80 strokes of the handle. Easy flow was observed in 3 cases (all NGO constructed new IRPs). One IRP at Baliguda could not verified as the outlet pipe was missing.

Several reasons were found for the delayed flow. The main reasons are as follows :

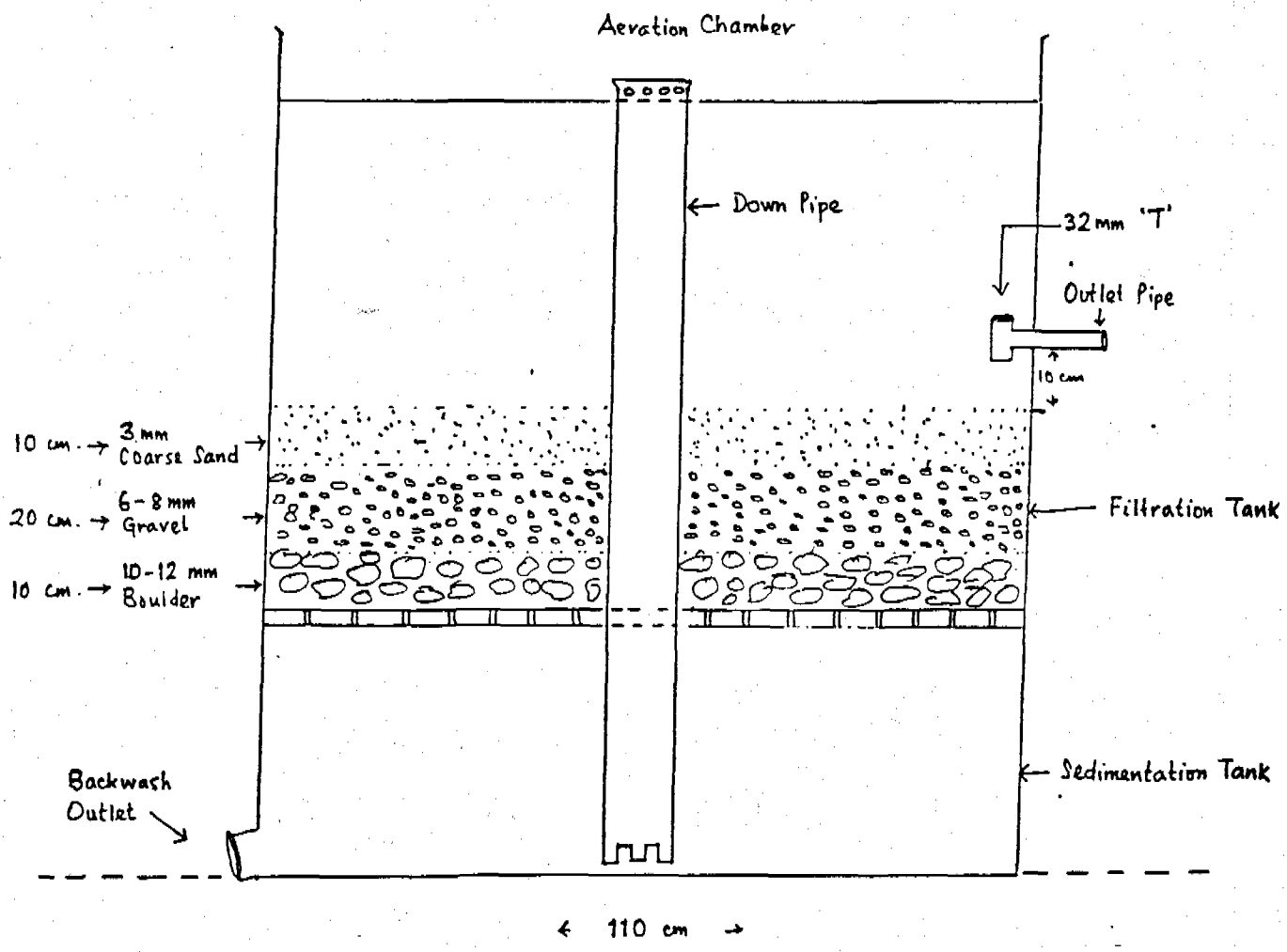
Table No : 2.4
Reasons for Delayed Flow

Reasons for Delay	Circular	Rectangular
Smaller out let pipe	10	6
Head Loss	10	5
Leak in Aeration Tray	8	4
Leak in Stuffing Box	6	4

} → is reduced flow

Headloss was found to be a major factor in delayed flow, which occurs basically due to improper media packing and lack of maintenance. The headloss was observed in all rectangular designs and most circular ones and was recorded as varying from 35 cm (highest) to 19 cm (lowest).

CYLINDRICAL PLANT (Sedimentation & Filtration Tanks)



2.6 Attachment Of 32 mm 'T' and Tap at Outlet

2.6.1 None of the 21 IRPs observed had either the specified 'T' or tap attached at the outlet. One IRP at Phiringia could not be checked for presence of the 32 mm 'T' as it was sealed. The 'T' is supposed to be attached vertically to the inner side of the outlet spout. The purpose of the 'T' is to increase flow at the outlet and to check floating impurities from the output. The tap is to check water loss from the tank when water pumped in is more than the amount used.

2.7 Aeration Chamber

2.7.1 The aeration chamber was examined to check for filling of proper media (ballast). The proper media consists of granite ballast ranging from 25 mm to 50 mm. In size. In few cases, the chambers were found to be empty. Improper media (pebble) was found in six cases. The improper size of the media (10-12 mm) sometimes causes choke in the aeration tray, consequently leading to water impounding in the chamber and overflow through the tray holes.

As regards the design of the aeration chamber, certain deviations were observed. The holes on the aeration chamber wall were found to have been made in three rows (as specified), but the last row is placed so low in few IRPs that during pumping some water oozes out of the chamber. Some of these holes have been made rather indiscriminately.

2.8 Filter Bed

2.8.1 The filter bed was examined to assess the correct depth of the media, its size, and to look for possible sludge deposits. The specified media depth is around 40 cm. Except in cases where the filter bed could not be verified (3 cases), in about 14 cases the media depth was found to be as per the design.

The media size specified is 10 - 12 mm boulder at the bottom followed by 6 - 8 mm gravel and 3 mm coarse sand. In most cases the media size was found to be as per specification.

Presence of sludge deposit was observed in 18 IRPs, while 3 IRPs could not be verified as the tank was sealed. Sludge deposit was observed to be mostly moderate or heavy, whereas in 3 cases the sludge deposit was found to be scanty.

Table No : 2.5
Extent of Sludge Deposit in Filter Bed

Sludge Deposit	SHAPE			IRON CONTENT			
	Circular	Recta-ngular	Total	< 1.00	1.0 - 3.0	> 3.0	Total
Heavy	5 (33.3)	3 (50.0)	8 (33.3)	5 (35.7)	2 (28.5)	1 (50.0)	8 (38.0)
Moderate	4 (26.7)	3 (50.0)	7 (28.6)	5 (35.7)	2 (28.5)	-	7 (33.0)
Scanty	3 (20.0)	-	3 (14.3)	-	3 (42.8)	-	3 (14.5)
Not verified	3 (20.0)	-	3 (23.8)	2 (28.6)	-	1 (50.0)	3 (14.5)
Total	15	6	21	12	7	2	21

2.9 Backwash Outlet

2.9.1 The specified diameter of the backwash outlet is 5 inches. A backwash outlet of lesser dimension does not help in proper cleaning of the tank. It was observed that most of the IRPs had the backwash outlet of the specified diameter except one IRP (constructed by Sristi Mahila Samiti at Podapada in Phiringia). Two IRPs could not be verified as the backwash outlet was buried in the ground and was not visible at all. Both these IRPs have been constructed by Sristi Mahila Samiti.

The effective discharge of backwash also depends on the relative positioning of the backwsh pipe and the plant. It was observed that due to faulty positioning in about 3 cases, water accumulates near the outlet. About 5 cases were observed where backwash discharge was below ground (soakpit).

2.10 IRP Performance

2.10.1 Given the basic purpose of the IRP to provide iron free water, the quantity and quality of water was examined to assess the performance of the IRPs.

2.10.2 Quantity of Water : The standard way of measuring water output is by finding out the quantity of output after 40 strokes of the handle. Since in most of the IRPs water output was relatively less after 40 strokes, the output was measured after 80 strokes. The highest output recorded after 80 strokes was 42 litres as against the lowest of 17 litres.

Table No : 2.6
Water Output

Quantity	SHAPE		Total
	Circular	Recta-ngular	
>5 Litre	1 (6.7)	-	1 (4.8)
11-20 Litre	3 (20.0)	5 (83.0)	8 (38.0)
21-30 Litre	10 (66.7)	-	10 (47.6)
> 30 Litre	-	1 (17.0)	1 (4.7)
* Not verifiable	1 (6.7)	-	1 (4.8)
Total	15	6	21

* Outlet broken

Water output is found to be mostly within 11 to 30 litres. Output has been exceptionally high, i.e., more than 30 litres, in a single instance of a rectangular design.

2.10.3 Water Appearance and Colour : The hues inherent within the water itself arise due to the presence of colloidal substances and materials in solution. In natural water, colours are imparted by humic acid, fulvic acids, metallic ions, suspended matter, phytoplankton, weeds, etc. In the 21 IRPs covered, water was found to be clean and colourless in 7 places while it was yellowish in colour at the rest 14 places. Odour of water was assessed on physical smell of water at the outlet. Based on this, it was observed in most cases (18) water is odourless. Marked odour was found in 3 cases, of which 2 cases were of rectangular type.

2.10.4 Other Impurities : In water quality tests, other impurities, such as suspended solids and floating debris were found. The extent of occurrence of such impurities was also observed.

Table No : 2.7
Presence of Impurities in Water

	Plenty	Some	Few	Total
Suspended solids	3	7	1	11
Floating Debris	4	5	-	9

Suspended solids were observed in 11 out of 21 cases. Most of these IRPs had iron content of about 1.0 - 3.0 mg/l. Floating debris were observed in 9 cases.

2.10.5 **Taste of Water :** Water at outlet was tasted by the expert by taking a sip as well as by asking the people about the taste of water. In about 6 cases the water was found to be of "iron" or "metal" taste. In rest of the IRP, water was found to have no taste.

2.10.6 pH Level : pH (Potentia Hydrogen) refers to a scale of intensity of acidity or alkalinity. This is regarded as a measure of concentration of H+ ions (Hydrogen Ions). pH level 7 indicates neutral water. The concentration below pH 7 is acidic and above pH 7 is alkaline in nature. Usually pH of natural water is about 7.

Water is about half of the cases was found to be acidic, whereas the other half was found to be alkaline.

Table No : 2.8
pH level of IRP Water

pH Levels	Circular	Rectangular	Total
<7	8	2	10
7	-	-	-
>7	7	4	11
Total	15	6	21

pH level was nearly 8.0 in G. Udayagiri, Raikia block while it was less than 6.0 in Phiringia and Phulbani. Baliguda showed a very high alkalinity of water, being ore than 12.0

2.10.7 Iron content : Iron, occurs in all natural waters both in oxidized (ferric) as well as reduced (ferrous) forms. In anoxic reducing environments, like ground waters, most of the iron is found in ferrous state (as ferrous bicarbonate under alkaline condition). Under aerobic conditions the ferrous state (ferrous bicarbonate) quickly gets oxidized to ferric state (ferric hydrocide, a brown insoluble substance). Iron, when present in water in concentration greater than 1 mg/L impacts a typical metallic taste. From aesthetic considerations, excess iron (> 1.0 mg/L) has to be removed form potable water. Iron Content measured at the outlet after filtration is as follows :

Table No : 2.9
Iron Content in IRP Water

Iron Content (Mg/L)	Circular	Rectangular	Total
< 1.0	10	5	15
1.0 - 3.0	4	1	5
> 3.0	1	-	1
Total	15	6	21

It was observed that of the 21 IRPs, 15 had an iron content much less than the permissible limit of 1.0 mg/L . Of the 6 Rectangular IRPs, only 1 had an iron content more than 1.0 mg/L . Iron Content was found to be over 1 mg/L in 5 cirlcular IRPs, and in one of these cases it was found to be even more than 3 mg/L .

CHAPTER - III PATTERN OF USE OF WATER

3. Background

3.1 The water use pattern of the people was assessed through various methods. A detailed survey was conducted covering sample households both in villages where there were IRPs and where there were no IRPs. Besides, Focus Group Discussions were conducted with men and women separately to assess their water requirements, their use pattern, and priorities in selection of a source of water.

3.2 Awareness About IRP

3.2.1 Before asking people about their use of IRP water, their awareness regarding IRPs was observed. Almost all the respondents (99%) were found to be aware about the plant and only 1 percent were found to be ignorant about it.

3.3 Use of IRP Water

3.3.1 IRP water is basically meant to be used for drinking and cooking. The survey findings indicate the varied purposes of the use of IRP water. Besides a large proportion of people using IRP water for drinking and cooking purposes, a large proportion also use it for washing of utensils, washing clothes, and bathing. Using of IRP water for drinking was found to be subsequently high where iron content is below 1 mg/L, and less in cases where iron content is more.

Table 3.1
Pattern of Use

Purpose	Use (in %)
Drinking	96
Cooking	91
Washing Utensils	72
Washing Clothes	29
Bathing	29

3.3.2 The reason for the use of IRP water for purposes other then what it is meant for is its easy accessibility to people. Those women who used to wash utensils near the hand pump earlier continued to do so even after the establishment of IRPs. Washing clothes and bathing was found to be low mainly due to low output of water. Moreover, RWSS functionaries were also reporting to be urging people not to use IRP water for purposes other than drinking and cooking.

All the people who reported using IRP water for drinking do not use it regularly or exclusively for the purpose, and also use water from other sources for drinking purpose. About 49% of people also depend on open wells and about 27% on "*Chuan*" for drinking water, besides IRP.

3.4 Reasons For Non-Use Of IRP Water

3.4.1 Those who did not use IRP water mentioned various reasons. Taste and smell are mentioned as reasons for non-use in few cases. These are likely in IRPs which have not been backwashed for a long time. Distance of IRP was also reported to be affecting its use to some extent, with the availability of other water sources nearby. Besides, other reasons mentioned by people during the course of the discussions include low water output, perceived good quality of chuan water, strain involved in drawing water through IRP, and barring of use by some upper caste people staying near the IRP in few villages.

Table 3.2
Reasons for Non-Use of IRP Water

Reasons	Persons (%)
Taste	2
Smell	1
Distance	1

3.5 Problems with IRP Water

3.5.1 Those who did not use IRP water as also those who did, found specific problems in the water. About 16% of the people found the water to be having some problem or the other. About equal proportion (7%) of people mentioned

IRP water being dirty/muddy in appearance and tasting of iron (or 'kasa'). Only 2% of the people found the water to be having a film of oily substance on its surface. More people reported problem in case of circular compared to rectangular IRPs, and more where iron content is over 1 mg/L.

Table 3.3
Problem with IRP Water

Problems	Persons (in %)
Dirty / Muddy	7
Iron / Kasa Taste	7
Oily	2

3.6 Perceived Function of IRP

3.6.1 The people were asked to mention the purpose of setting up of IRPs in their village. IRPs are generally termed as 'filter' by the people. They understand that the hand pump used to yield "dirty water", which was brownish or reddish in colour. (The concept of "iron" in ground water is not well established among the people). Hence, the function of the IRP is to remove the "dirt" from the water and to provide clean water for drinking and cooking.

People expressed a marked change in quality of water (for the better) from the handpump after installation of the IRP. Nearly 98 percent of the people perceived this change in water quality.

3.7 Problems with IRP

3.7.1 Various problems with the IRP - both in design and in construction - were pointed out by the users. Leakage as a problem was mentioned by 35% of the people. Leakage is usually from the gland packing in the hand pump. It was also observed by the technical team that most leakages was due to wearing out of gland packing. About 20% mentioned less water output as a problem. This is also caused to some extent by leakage and is also corroborated by the findings

from the technical assessment which gave various reasons for low water discharge. More people reported low output as a problem with rectangular IRPs.

Table 3.4
Problems with IRP

Problems	Persons (in %)
Leakage	35
Out put	20
Problem for women in operating raised tank models	12

3.7.2 The raised tank handpump models of IRPs poses a problem for women who are used to normal position of handpumps. About 12% of the respondents, (constituting about 42% of respondents in villages which had IRP of raised tank model-6 IRPs) mentioned this as a problem. In focus group discussions, too, women stated this as a problem in use.

3.8 Use Of Water with Iron Content (Without IRP)

3.8.1 About 200 people in 20 villages where no IRPs have been provided were also interviewed and covered in the survey. The use pattern of the hand pump without IRP gave a different picture than the ones with IRPs. Use of water with higher iron content in villages where the handpumps have not been provided with IRPs is found to be mostly for washing utensils and clothes, and bathing, whereas a very small proportion use it for drinking or cooking. The low percentage of people using this water for cooking and drinking is supported by the fact that about 65% use open wells and 45% use chuan for such purposes.

Table 3.5
Use of Water with Iron Content

Purpose	Use (in %)
Drinking	16
Cooking	16
Washing Utensils	49
Washing Clothes	29
Bathing	25

3.9 Reasons for not using water with Iron

3.9.1 The heavy iron content in the hand pump water discouraged its use. People mentioned various reasons for not using such water. Smell of iron (or metal) is a major determining factor in use of handpump water in villages without IRPs. Additionally, the taste (31%) of water and its appearance (26%) have also contributed to its non-use. Distance (6%) is not a major factor and is mentioned by a smaller proportion of people.

Table 3.6
Reasons for Non-Use of Handpump Water

Purpose	Persons (in %)
Smell	47
Appearance	26
Taste	31
Distance	6

3. 10 Social Factors affecting use of IRP

3.10.1 The access to water sources, especially IRP, and the subsequent sharing of water by members of different caste groups, depends largely upon the type and numbers of caste groups staying nearby. It was seen that of about 21 cases where there is an IRP, almost all the sites were surrounded by clusters of more than one caste group, with the exception of one IRP which had only a single caste habitation. In most cases sharing of water source by various castes was observed. Division of water sources based on caste was found relatively more in Raikia and Phulbani blocks. IRP was found to be shared by mainly three basic caste groups, i.e., the SCs and STs, and General Caste people (GC). Where there is scarcity of water, even traditional sources like 'Chuan' are shared by different caste groups. Though the sources are shared by the caste groups, members of two different caste groups never use the water source simultaneously, but one after the other.

3.11 Preference for different sources of water

3.11.1 The preference for different water sources for different purposes was found to be rather mixed. No clear picture emerges regarding selection of a particular source. Most of villages have more than one source. The sources may be shared by all caste groups. If there are more than one chuan in the village, usually there is caste-wise division in its use.

3.11.2 The selection of different water source was found to be dependent mainly on the 'proximity' of various sources to different groups of people. People usually go to the nearest available water source whenever the need for water arises. Selection of source is also determined by the habits and preferences of women, who are mostly involved in procuring water for the household. Since women use 'chuan' for bathing, they also carry its water back home for drinking and cooking.

3.11.3 There is no strong preference for underground sources of water among majority of the people and water from these sources are not perceived to be specially suitable for drinking. People feel that drinking water can be collected from all sources having 'clean water'. A small proportion of people were found to be aware of the 'germ' theory and the consequent suitability of pure water yielded by deep tubewells for drinking. Most people perceive that water which has no taste, no smell, or has no visible (suspended) particles or colour, and looks clean, is clean and pure and is suitable for drinking by people. Based on this, water from "*Chuan*" , open walls, and river / stream is considered "clean" and suitable for drinking, except in rainy season when the water looks muddy and dirty.

CHAPTER - IV MAINTENANCE

4.1 Background

4.1.1 For efficient functioning, IRPs have to be maintained regularly, which mainly involves back-washing of the iron particles and impurities trapped in the filter media and deposited as sediments, and removal of sludge from the aeration tray and from over the filter media. Information regarding the process and status of maintenance was obtained from various sources. Sludge deposit in the aeration chamber and filter bed indicate the status of maintenance of IRPs. Records of maintenance, whenever these are being kept, were consulted. Additional evidence was collected from the community members as well as from the functionaries of RWSS.

4.2 Status Of Maintenance

4.2.1 Data regarding this issue was obtained from various sources. Regarding the executing agencies, since the NGOs have installed the IRPs very recently (and it is not yet time for maintenance), information was obtained form RWSS functionaries only. There was mixed response on the issue, and maintenance was reported to be done regularly in only less than half of the cases. In most cases, maintenance was done regularly in the initial phase after installation of IRPs. Of these, in case of 4 IRPs the maintenance process was demonstrated to the people and they have taken over the responsibility of maintenance. In such cases, maintenance is done by people regularly. In other cases, the RWSS retains the responsibility of backwashing, but is not able to carry it out regularly.

4.2.2 Data regarding the dates when maintenance operation was carried out by the RWSS staff was consulted wherever records of maintenance are available. Written records regarding maintenance was available for 4 plants only, viz. Tetnuliguda, Talarimaha, Bhanjapadar, and Kurumungia. Even for these 4

plants, only date of maintenance have been recorded without any reference to qualify of water. The dates revealed that maintenance was carried out earlier once in every 2 months, but recently it is being carried out more infrequently, varying from 3 to 6 months.

4.2.3 Information regarding the regularity of maintenance was also collected from the community. People were found to have been given the responsibility of maintenance in 4 cases, and reported carrying it out regularly. In most of the other places, people reported that maintenance is being done by RWSS people vary infrequently. At the some places people reported that when the water quality deteriorates, they themselves carry out the maintenance process.

4.2.4 Observation of the sludge deposits in the aeration and filtration chamber, carried out during technical assessment, indicates the status of maintenance of IRPs. Of the 18 IRPs in which the condition of the filter bed could be observed, the extent of sludge deposit was found to be heavy in 8 cases, moderate in 7 and scanty in 3. Six of the ten plants with scanty or moderate deposits are the ones which have been recently installed. Of the rest 12, in four sludge has been removed by people during maintenance. This indicates that maintenance is being carried out regularly in about one-third of the plants.

4.3 People's Involvement in Maintenance

4.3.1 At present, backwashing in most places is being done by RWSS. Initially RWSS was doing it on its own in all villages, but keeping in mind the simplicity of the backwashing procedure, it trained people in some villages in the backwashing operation. In some villages people confirmed that they have been given demonstrations by RWSS functionaries on how to do backwashing. People were found to have obtained simple tools like 'wrench' and 'pliers' in two places to help them in backwashing operation. Regarding the timing of backwashing, people reported that when they feel that dirty water is coming out from the IRP they judge that it is time for backwashing. At places, the people stated that they

also remove the sludge deposit from the filter bed. In village where people are doing backwshing, it was found that 2 to 3 people have volunteered and have taken over the responsibility. These people usually belong to households which are situated close to the IRPs and use the IRP water regularly for various household needs.

4.3.2 A Users' Committee, comprising of representatives from the participating funding and executing agencies and at least 2 users from the villages with IRPs was found to have been formed in G.Udayagiri block but was reported to be not functioning regularly. The responsibility of coordinating the maintenance process through the Users' Committee earlier given to CART(a NGO), has now been handed over to PRDATA. No concrete plan, however, has been drawn as to how the activities of the Users' Committee would be carried out.

4.3.3 Keeping in mind the involvement of the of the community in maintenance, a easy to comprehend, detailed manual in oriya language has been made available by the RWSS to help the people. Besides explaining the various parts and functions of the IRP, it gives a detailed account of the steps to be followed for proper maintenance of the IRP.

4.4 Problems in proper Maintenance

4.4.1 This aspect was also discussed with the functionaries of RWSS. As reported by them, heavy workload of the functionaries, who mostly remain busy in maintaining the hand pumps in a working condition, was reported to be the main problem. This was reported to be further compounded by the distances of the IRPs and the difficult terrain to be covered to reach the IRPs. Shortage of vehicles for reaching these IRPs was reported. Overall, maintenance of IRPs was not found to be one of the priorities of RWSS functionaries. Another factor which hampers the efficiency of the backwashing operation, viz. absence of adequate slope at the floor level, was noted in some IRPs during technical assessment.

CHAPTER - V INVOLVEMENT OF NGOs

5.1 Background

5.1.1 Different aspects of the involvement of NGOs in construction and maintenance of IRPs was studied in detail. Discussion was held with the functionaries of various NGOs to get an understanding of their capability as regards availability of skilled manpower and know-how, and the situation regarding construction and maintenance till date. Their participation in training camps and their mode of implementation of the alloted IRPs was also studied. The problems faced in the field were also discussed.

5.2 Installation of IRPs by NGOs

5.2.1 Three NGOs have been assigned the task of constructing the IRPs, viz. PRDATA in G.Udayagiri block, Srusti Mahila Samiti in Phulbani, and Banabasi Seva Samiti in Balliguda. Of the total alloted IRPs, the NGOs have been able to install most of them, but the commissioning part remains to be done. Recently, however, in Raikia Block 20 IRPs have been allotted to an NGO - Sahitya Sansad. Construction activity by this NGO is yet to start.

NGOs	Allotted IRPs	Completed IRPs	* Commissioned
SRUSTI MAHILA SAMITI	15	15	11
PRDATA	35	23	1
BANABASI SEVA SAMITI	20	9	5

* These Figures indicate IRPs commissioned uptill 2nd Dec,1997.

5.3 Assessment of feasibility of alloted IRPs

5.3.1 Prior to taking up the construction work, the NGOs made an attempt to assess whether the IRPs would gain acceptance among the people or not. For this, they conducted house to house survey in the villages in the vicinity of the proposed IRP site. The survey aimed at finding out people's water needs and the use

pattern of the available water sources, both traditional and modern. It also aimed at finding out whether the availability of water from hand pumps did not meet the requirements of the people due to high iron content. Finally, the reaction of the people to iron removal plant were recorded. The pressure on the pump by various users was also assessed. Thus, the actual need for the IRPs at the selected sites was found out by the involved agencies before embarking upon the construction work.

5.4 Community Participation in Construction

5.4.1 As reported by the NGOs, participation of the people in construction of the IRP also ensures its use by them later on. The fact that some people from the village were involved in the construction process gives the fellow villagers the feeling that the IRP belongs to them. This participation in construction also ensures that the people get involved in maintenance operations as well.

5.4.2 The masons involved in construction of IRPs belonged to the NGOs, and they were assisted in the construction work by labourers from the village near the IRP sites. Shrusti Mahila Samiti involved female labourers from the village to make the women folk aware about the IRP. Since it is the women in the household who usually fetch water for cooking and drinking purposes, their involvement encouraged other women of the village to use the IRP. During construction, villagers were also asked by the NGO functionaries to come to the site and observe how the construction is being done so that they will have an idea about its functioning.

5.4.3 The Users' Committee : A Users' Committee has been organized at the block level in G.Udayagiri block, comprising of selected users from villages where IRPs have been installed, and representatives from NGO, RWSS, and UNICEF. The activities of the Users' Committee was previously being coordinated by an

organization named CART. Recently, however, PRDATA has been given the responsibility of organizing the Committee meetings and coordinating its activities. The primary objective of this Committee is to coordinate the maintenance of the IRPs and to motivate people for its regular use for drinking only. Only one or two meetings of the Committee have been organized.

5.5 Training and Technical Expertise

5.5.1 Provision was made to ensure that the NGO personnel involved in the construction are properly trained in various aspects of construction of the IRP. Training to personnel of various NGOs' who have been assigned the task of construction was organized by UNICEF, with technical assistance from RWSS. In each NGO, masons were trained in various aspects of construction such as design, materials to be used, and in the construction process. The number of masons in the NGOs who received training is as follows :

NGOs	No. of Trained Masons
Srusti Mahila Samiti	4
PRDATA	19
Banabasi Seva Samiti	5

5.5.2 Training was organized in phases. Initially two workers from PRDATA, the coordinating NGO for IRPs in Phulbani, underwent training organised , United Artists' Association (UAA) in Ganjam, in 1995. In May 1997, a training programme was organized in which five masons form PRDATA, two from SMS and three from BSS were trained. In October 1997, another training program was organised and was attended by 14 masons from PRDATA, two from SMS and two form BSS. All NGO participants were given construction and maintenance manuals with detailed designs.

5.5.3 Training in maintenance has also been imparted to the NGO functionaries by RWSS. A detailed literature in Oriya language has been prepared by the RWSS for distribution among the NGO functionaries to aid in backwashing operation. The entire backwashing process has been outlined blow by blow in this manual.

5.6 Quality of construction

5.6.1 Quality of construction and technical soundness of 6 IRPs installed by NGOs was examined during the technical assessment. All the 6 IRPs were found to be of the circular type. Deviations from the specified design was noted in some of these. One of the deviations is the use of 4 inch backwash outlet which reduces the backwashing performance to some extent. Aeration pipe has not been placed properly in some cases, as a result of which water oozes out at the point of entry. The holes on the aeration tray have been made rather indiscriminately which allows water to escape through it, reducing the discharge level. The structure of the plants was found to be strong and well plastered, except a single instance of tank wall leakage. Even considering these minor deviations from specifications, the overall performance of the plant as observed from the output level, was found to be good.

5.7 Competence of NGOs

5.7.1 The capacity of the NGOs was assessed in terms of possession of trained manpower, their ability to manage construction activity in the alloted villages while providing for participation of the people, and the quality of the IRPs constructed by them. The NGOs have managed to construct the IRPs within the cost and time alloted to them. They have secured the participation of the villagers in construction activity. The overall quality of the IRPs constructed by them is found to be good. However, there seems to be inadequate understanding of some aspects of the design, resulting in deviations which reduces the volume of output to some extent. There is a need for reorientation training of the masons involved in the work. Overall, the NGOs involved in installation of IRPs are found to be competent enough to carry out construction activity on a larger scale in their area of operation.

CHAPTER - VI CONCLUSION AND RECOMMENDATIONS

6.1 Background

6.1.1 Based on the study of different aspects of IRP, certain conclusions regarding the construction of IRPs in Phulbani have been drawn. Some problems, mainly logistical in nature, were identified during the study and are presented here. Several recommendations which can improve the performance of IRPs have also been suggested.

6.2 Conclusions

6.2.1 The preceding chapters focused on different aspects of the IRP. Based on the analyses carried out in these chapters, it can be concluded that the executing agencies, both RWSS and NGOs, have demonstrated their ability to carry out construction of IRPs of various designs within the specified time and budget while providing for participation by the people, in spite of some logistical problems in the sourcing of some raw materials. Minor variations in structure from the specified design was found in some cases but these have more negative effects on the volume of output than on the quality of water. Lack of regular maintenance in most cases, however, affects the quality of water more. In spite of these constraints, the quality of water obtained from IRIP is found to be relatively good - in most cases the iron content is less than 1 mg./L. There is a marked improvement in the quality of water after installation of IRPs, as perceived by the people. Almost all the people reported using water from IRPs for drinking at some time or the other. In comparison, though a smaller proportion use it regularly, water from hand pumps without IRPs is used for drinking by a small proportion of people only. However, access to multiple sources of water by most people results in use of IRP water even for other purposes such as bathing, washing clothes, washing utensils, etc., by those staying in close proximity to IRPs, where as the access of others gets limited and

consequently people also use water from other perceived clean sources like *"Chuan"* and open well for drinking. There is a lack of realisation among most people that water from IRP is the only safe source for the purpose of drinking.

6.2.2 Based on the competence of executing agencies to install IRPs of reasonably good quality within the specified cost and time, and considering the quality of the water as observed during technical assessment, it can be concluded that IRPs can be replicated on a larger scale. Considering the comparatively higher use of water from IRP for drinking compared to water from hand pumps without IRPs, it an be concluded that IRPs need to be installed on a larger scale. Thus, based on the need for and the capacity already built for installation of IRPs, it can be concluded that IRPs are feasible in the district of Phulbani.

6.3 Problems

6.3.1 The NGO functionaries and the RWSS functionaries involved in installation of IRPs were asked regarding the main problems faced by them which results in delay in installation of IRPs. The various problems mentioned by them are :

i. One of the raw materials - gravels for use in filter bed - is available only at Kandapur near Athagarh (in Cuttack District) and some of the materials at Bhanjanagar in Ganjam) and has to be transported. The problem is compounded by the increase in transportation cost and use of extra labour required for cleaning and grading of gravels.

ii. Stuffing box is not readily available, which delays commissioning. An industrial house in Bhubaneswar is the manufacturer of these products. But they have to depend on workers from Calcutta to galvanize them.

iii. The NGOs complained of rise in price of various items such as steel rods, PVC pipes, cement, and moreover, rise in wage rates which resulted in their spending more than the estimated and sanctioned amount.

iv. Trained masons are few and they have to stay on at the site for a few days. This further increases the expenses as along with the per day charges of Rs. 80/- per mason, the charges for food which averages to Rs. 50/- per day is added.

v. Some NGOs mentioned about the need for more supervision time from RWSS, which was felt lacking. Additionally, more help and cooperation was sought by the NGOs from RWSS.

vi. A peculiar problem during construction was reported in few places, mainly in Phulbani and Raikia blocks. When the IRP construction work was taken up in a village where there were more than one caste groups, the caste group staying further away usually disrupted the work by damaging it. Though this problem is not severe, yet it acts as an impediment for the construction work.

6.4 Recommendations

6.4.1 Based on the observations made during the study and after discussions with various role players involved in installation of IRPs, certain suggestions are being made regarding some steps to be taken which will result in a better physical structure and quality of water, and will also lead to greater use of water from IRPs for drinking by the people.

1. Support to ensure adherence to design : Since at many places minor deviations from the specified design were observed, it was apparent that there has been some communication gap between the trainers and the trained. It is appropriate to suggest the following :

   - Additional training to masons involved in construction
   - Closer supervision of construction initially
   - Provision of a detailed construction manual

Support to NGOs for procuring gravel and stuffing box : NGOs involved in the construction work had one major problem, i.e., procurement of gravel and stuffing box. A system has to be developed for the easy supply of these items to avoid delays in construction.

3. Appropriate training / demonstration to people for maintaining IRP : Lack of regular maintenance was observed to be a major factor affecting water quality and quantity. Keeping in mind the shortage of staff and other organisational problems with RWSS, it is suggested to develop a community based maintenance system and to hand over the responsibility of maintenance to the people.

4. Orientation / motivation to people and promotion of IRP water as safe. As most people do not differentiate between underground and surface water as sources of clean and safe water, there is a need to promote the use of hand pump and IRP water as safe for drinking.

5. Motivation to people to use IRP water for drinking only : Bathing, and cleaning utensils and clothes by some people near the IRP was observed which limit the access of others to collect IRP water for drinking. Thus there is a need to motivate people to give priority to IRP water for drinking only. There is also a need to strengthen the Users' Committee to facilitate this process.

ANNEXURE - I

Sl. No	Name of IRP/Location	Block	Working or Defunct	Purpose for which Covered	
				Technical Assessment	Assessment for Use
1.	Sanagadu	Phulbani	Defunct	√	√
2.	Sitikapati	Phiringia	Working	√	√
3.	Majhipada	Phiringia	Working	√	√
4.	Manipadara	Phiringia	Working	√	√
5.	Bandhagada	Phiringia	Working	√	√
6.	Masiripada	Phiringia	Working	√	
7.	Masiripada	Phiringia	Defunct	√	
8.	Podapada	Phiringia	Working	√	√
9.	Gahana	Tikabali	Working	√	√
10.	Tentuligada	Tikabali	Working	√	√
11.	Sugudabadi	Raikia	Working	√	√
12.	Petapanga	Raikia	Working	√	√
13.	Damba	Raikia	Working		√
14.	Jobedi	G. Udayagiri	Working	√	√
15.	Dungi Pada Sahi	G. Udayagiri	Working	√	√
16.	Kilakia	G. Udayagiri	Working	√	√
17.	Kurumingia	G. Udayagiri	Working	√	√
18.	Raikola	G. Udayagiri	Defunct	√	√
19.	Nilungia	G. Udayagiri	Working		√
20.	Dugudi Bhanjapadar	G. Udayagiri	Working	√	√
21.	Katingia	G. Udayagiri	Working	√	√
22.	Sanadakpala	G. Udayagiri	Working	√	√
23.	Talarimaha	G. Udayagir	Working	√	√
24.	Dungi Talarimaha	G. Udayagiri	Working	√	
25.	Kalinga	G. Udayagiri	Defunct	√	
26.	Banabasipalli	Baliguda	Working	√	
27.	Dandapadar	Baliguda	Working	√	

ANNEXURE - II

CHAPTER - II

Quality of Plastering

Plastering	SHAPE		Total
	Circular	Rectangular	
Smooth	14 (9.3)	4 (66.7)	18 (85.7)
Slightly Uneven	1 (6.7)	2 (33.3)	3 14.3)
Total	15	6	21

Structural Condition

	SHAPE		Total
	Circular	Rectangular	
Not Crack	15 (100.0)	4 (66.7)	19 (90.5)
Cracked	-	2 (33.3)	2 (9.5)
Total	15	6	21

Ease of Handle Operation

Operation	SHAPE		Total
	Circular	Rectangular	
Difficult	6 (40.0)	1 (16.7)	7 (33.3)
Easy	9 (60.0)	5 (83.3)	14 (66.7)
Total	15	6	21

Delay in Flow

Flow	SHAPE		Total
	Circular	Rectangular	
Delayed Flow	11 (73.3)	6 (100.0)	17 (81.0)
Easy Flow	3 (20.0)	-	3 (14.3)
Not Verified	*1 (6.7)	-	1 (4.7)
Total	15	6	21

* One IRP at Balliguda could not be verified as the outlet pipe was missing.

Ballast Quantity in Aeration Chamber

Quantity	SHAPE		
	Circular	Recta-ngular	Total
Adequate	4 (26.7)	-	4 (19.1)
Inadequate	-	-	-
Empty	7 (46.7)	2 (33.3)	9 (42.8)
Improper	4 (26.6)	2 (33.3)	6 (28.6)
Not verified	-	2 (33.3)	2 (9.5)
Total	15	6	21

Condition of Stuffing Box

	SHAPE		Total
	Circular	Rectangular	
Not Leaking	3 (27.3)	-	3 (20.0)
Leaking	8 (72.7)	4 (100.0)	12 (80.0)
Total	11	5	15

Leakage in Tank Wall

	SHAPE		Total
	Circular	Rectangular	
Not Leaking	13 (86.7)	2 (33.3)	15 (71.4)
Leaking	2 (13.3)	4 (66.7)	6 (28.6)
Total	15	6	21

pH Level of Water

Level	SHAPE			IRON CONTENT			
	Circular	Recta-ngular	Total	< 1.00	1.0 - 3.0	> 3.0	Total
< 7.00	8 (53.3)	2 (33.3)	10 (47.6)	7 (50.0)	3 (50.0)	-	10 (47.6)
7.00	-	-	-	-	-	-	-
>7.00	7 (46.7)	4 (66.7)	11 (52.4)	7 (50.0)	3 (50.0)	1 (100.0)	11 (52.4)
Total	15	6	21	14	6	1	21

Circular IRP Diameter

Size	SHAPE	Total
	Circular	
>1200mm	-	-
1200mm	-	-
< 1200mm	15 (100.0)	15 (100.0)
Total	15	15

Aeration Tank

	Size	Circular	Rectangular	Total
Length	> 300 mm	15 (100.0)	-	15 (73.7)
	300mm	-	-	-
	<300mm	-	6 (100.0)	6 (26.3)
Height	>400mm	-	-	-
	400mm	15 (100.0)	6 (100.0)	21 (100.0)
	<400mm	-	-	-

Sedimentation Tank

	Size	Rectangular	Total
Length	>925mm	5 (83.0)	5 (83.0)
	925mm	-	-
	<925mm	1 (17.0)	1 (17.0)
Breadth	>675mm	5 (83.0)	5 (83.0)
	675mm	-	-
	<675mm	1 (17.0)	1 (17.0)
Height	>1050mm	6 (100.0)	6 (100.0)
	1050mm	-	-
	<1050mm	-	-

Filtration Tank

	Size	Rectangular	Total
Length	>925mm		
	925mm	-	-
	<925mm	6 (100.0)	6 (100.0)
Breadth	>925mm		
	925mm	-	-
	<925mm	6 (100.0)	6 (100.0)
Height	>1050mm	6 (100.0)	6 (100.0)
	1050mm	-	-
	<1050mm	-	-

Thickness of Wall

In mm	SHAPE		Total
	Circular	Rectangular	
>35	-	-	-
35	-	-	-
<35	14 (93.3)	6 (100.0)	20 (95.2)
Not Verifiable	1 (6.7)	-	1 (4.8)
Total	15	6	21

Backwash Outlet (Diameter)

In Inches	SHAPE		Total
	Circular	Rectangular	
> 5	-	-	-
5	12 (92.3)	6 (100.0)	18 (94.7)
<5	1 (7.7)	-	1 (5.3)
Total	13	6	19

Presence of 32 mm T in Tank

	SHAPE			IRON CONTENT			
	Circular	Rectan - gular	Total	< 1.00	1.0 - 3.0	> 3.0	Total
Present	-	-	-	-	-	-	-
Absent	14 (93.3)	6 (100.0)	20 (95.2)	13 (92.9)	6 (100.0)	1 (100.0)	20 (95.2)
Not verified	* 1 (6.7)	-	1 (4.8)	1 (7.1)	-	-	1 (4.8)
Total	15	6	21	14	6	1	21

* Not verifiable as tank sealed

Presence of Tap in Tank

	SHAPE		Total
	Circular	Rectangular	
Present	-	-	-
Absent	15 (100.0)	6 (100.0)	20 (100.0)
Total	15	6	21

Discharge of Backwash

	SHAPE		Total
	Circular	Rectangular	
Into Soak Pit	-	-	-
Drain	2 (22.2)	-	2 (14.3)
Flows Away	5 (55.6)	5 (100.0)	10 (71.4)
Accumulate	2 (22.2)	-	2 (14.3)
Total	9	5	14

Odour of Water

	SHAPE			IRON CONTENT			
	Circular	Recta-ngular	Total	< 1.00	1.0 - 3.0	> 3.0	Total
Marked	1 (6.7)	2 (33.3)	3 (14.3)	2 (14.3)	1 (16.7)	-	3 (14.3)
Odourless	8 (53.3)	4 (66.7)	18 (85.7)	12 (85.7)	5 (83.3)	1 (100.0)	18 (85.7)
Total	15	6	21	14	6	1	21

Presence of Suspended Solids

	SHAPE			IRON CONTENT			
	Circular	Recta-ngular	Total	< 1.00	1.0 - 3.0	> 3.0	Total
Absent	6 (40.0)	4 (66.7)	10 (47.6)	9 (64.3)	1 (16.7)	-	10 (47.6)
Present	9 (60.0)	2 (33.3)	11 (52.4)	5 (35.7)	5 (83.3)	1 (100.0)	11 (52.4)
Total	15	6	21	14	6	1	21

Extent of Suspended Solids

	SHAPE			IRON CONTENT			
	Circular	Recta-ngular	Total	< 1.00	1.0 - 3.0	> 3.0	Total
Plenty	1 (11.1)	2 (100.0)	3 (27.3)	1 (20.0)	1 (20.0)	1 (100.0)	3 (27.3)
Some	7 (77.8)	-	7 (63.6)	3 (60.0)	4 (80.0)	-	7 (63.6)
Few	1 (11.1)	-	1 (9.1)	1 (20.0)	-	-	1 (9.1)
Total	9	2	11	5	5	1	11

Presence of Floating Debris

	SHAPE			IRON CONTENT			
	Circular	Rectan -gular	Total	< 1.00	1.0 - 3.0	> 3.0	Total
Absent	10 (66.7)	2 (33.3)	12 (57.1)	9 (64.3)	3 (50.0)	-	12 (57.1)
Present	5 (33.3)	4 (66.7)	9 (42.9)	5 (35.7)	3 (50.0)	1 (100.0)	9 (42.9)
Not verified	-	-	-	-	-	-	-
Total	15	6	21	14	6	1	21

Extent of Occurrence of Floating Debris

	SHAPE			IRON CONTENT			
	Circular	Rectan-gular	Total	< 1.00	1.0 - 3.0	> 3.0	Total
Plenty	1 (20.0)	3 (75.0)	4 (44.4)	2 (40.0)	2 (66.7)	-	4 (44.4)
Some	4 (80.0)	1 (25.0)	5 (55.6)	3 (60.0)	1 (33.3)	1 (100.0)	5 55.6)
Total	5	4	9	5	3	1	9

Taste of Water

	SHAPE			IRON CONTENT			
	Circular	Rectan-gular	Total	< 1.00	1.0 - 3.0	> 3.0	Total
Metal	4 (26.7)	2 (33.3)	6 (28.6)	3 (21.4)	3 (50.0)	-	6 (28.6)
No taste	11 (73.3)	4 (66.7)	15 (71.4)	11 (78.6)	3 (50.0)	1 (100.0)	15 (71.4)
Total	15	6	21	14	6	1	21

Reason for difficulty in Handle Operation of HP

	Cup Washer Worn Out	Leak in Rise Pipe	Pump in Breakdown condition	Handle Bearing Crushed	G.Total
Circular	5 (33.3)	1 (6.7)	-	1 6.7	15 (100.0)
Recta-ngular	1 (16.7)	-	-	-	6 (100.0)
Total	6 (28.6)	1 (4.8)	-	1 (4.8)	21 (100.0)

Reasons for Delayed Flow

	Stuffing Box Leak	Aeration Tray arrest	Leak in Aeration	Head Loss	Small Outlet Pipe	Absence of 'T'
Circular	6 (40.0)	6 (40.0)	8 (53.3)	10 (66.7)	10 (66.7)	10 (66.7)
Recta-ngular	4 (66.7)	2 (33.3)	4 (66.7)	5 (83.3)	6 (100.0)	5 (83.3)
<1.00	7 (50.0)	5 (35.7)	9 (64.3)	12 (85.7)	13 (92.9)	12 (85.7)
1.00-3.00	3 (50.0)	3 (50.0)	3 (50.0)	3 (50.0)	3 (50.0)	3 (50.0)
> 3.00	-	-	-	-	-	-
Total	10 (47.6)	8 (38.1)	12 (57.1)	15 (71.4)	16 (76.2)	15 (71.4)

Leakage in Inlet & Outlets

Place of Leakage		Circular	Recta-ngular	Total
Inlet	Leaking	6 (40.0)	4 (66.7)	10 (47.6)
	Not Leaking	9 (60.0)	2 33.3)	11 (52.4)
Outlet	Leaking	4 (26.7)	3 (50.0)	7 (33.3)
	Not Leaking	11 (73.3)	14 (66.7)	14 (66.7)

Size of Media Used in Filter Chamber

Media Size	SHAPE			IRON CONTENT			
	Circular	Recta-ngular	Total	< 1.00	1.0 - 3.0	> 3.0	Total
As per Specification	9 (60.0)	5 (66.7)	14 (61.9)	9 (64.3)	4 (50.0)	1 (100.0)	14 (61.9)
Not as per Specification	4 (26.7)	-	4 (19.1)	1 (7.1)	3 (50.0)	-	4 (16.1)
Not verified	2 (13.3)	1 (33.3)	3 (19.0)	3 (28.6)	-	-	3 (19.0)
Total	15	6	21	13	7	1	21

ANNEXURE - III

CHAPTER : III

Awareness about IRP

	SHAPE		Total
	Circular	Rectangular	
Know	148 (98.7)	59 (98.3)	207 (98.6)
Don't Know	2 (1.3)	1 (1.7)	3 (1.4)
Total	150	60	210