INTERNATIONAL INSTITUTE FOR INFRASTRUCTURAL, HYDRAULIC AND ENVIRONMENTAL ENGINEERING.

COMPARATIVE STUDY ON OPERATION AND MAINTENANCE SYSTEMS OF RURAL PIPED WATER SUPPLY SCHEMES IN ANDHRA PRADESH STATE, INDIA.

K.K.N.Kumar

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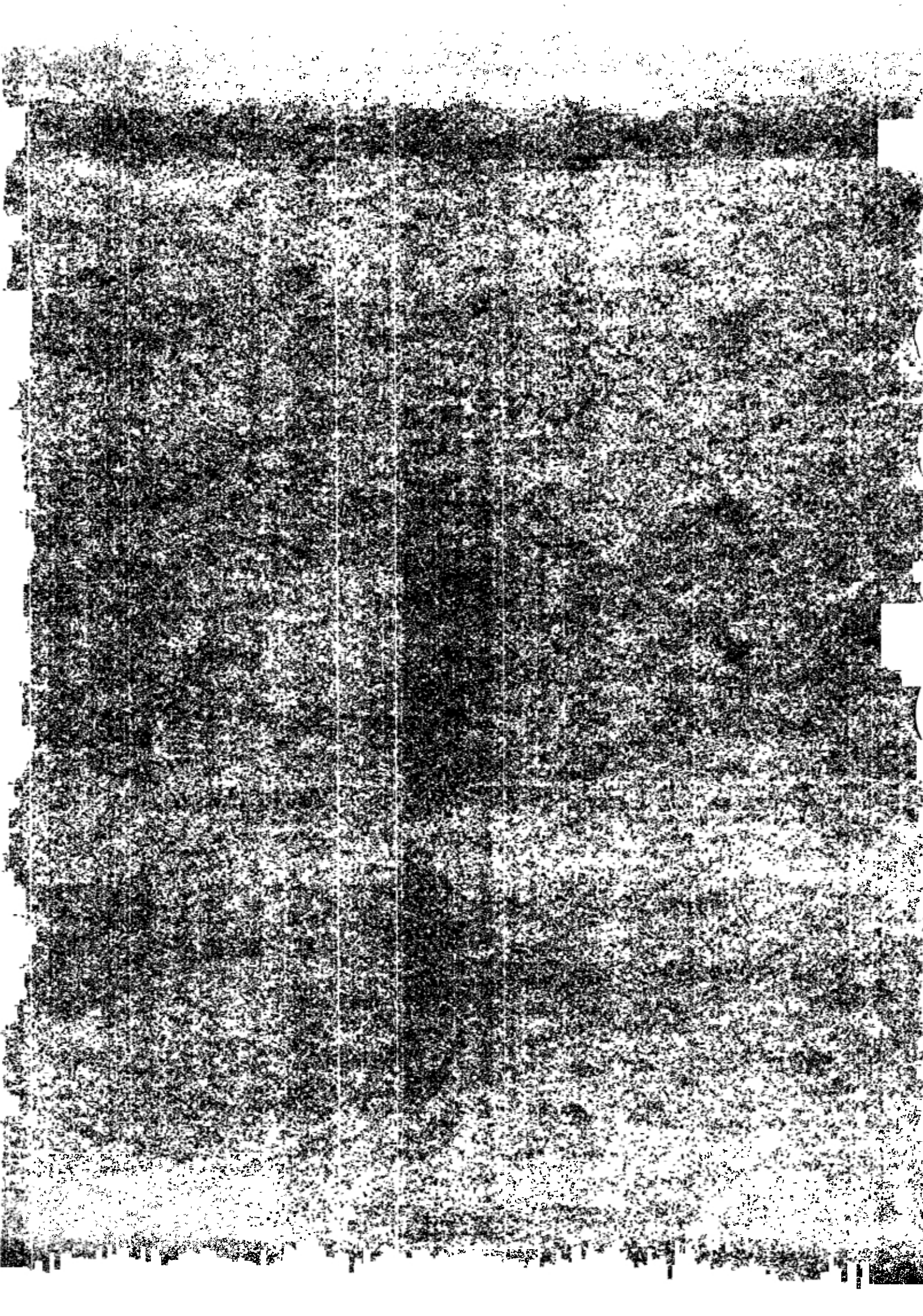

COMPARATIVE STUDY ON OPERATION AND MAINTENANCE SYSTEMS OF RURAL PIPED WATER SUPPLY SCHEMES IN ANDHRA PRADESH, INDIA

Master of science thesis

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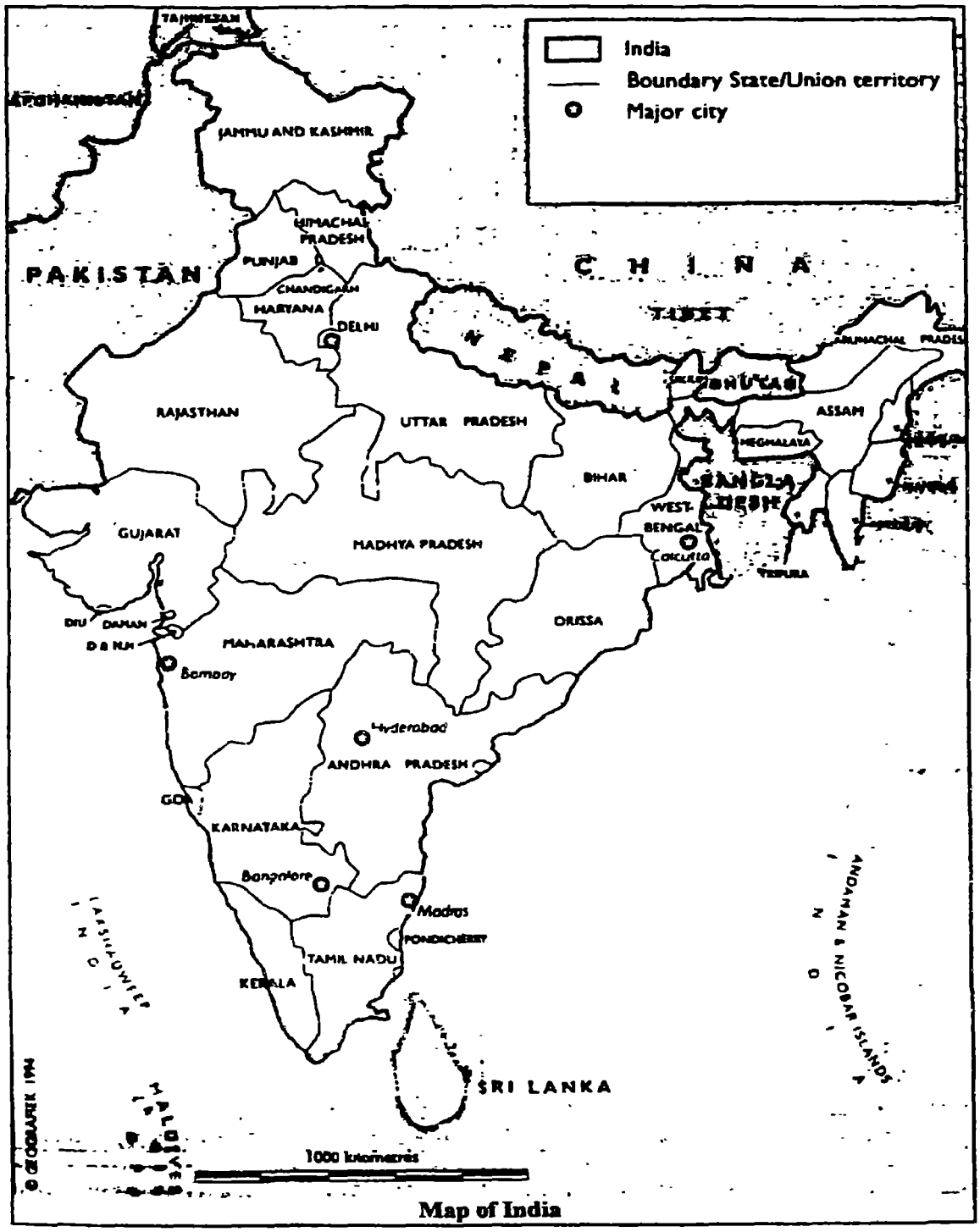
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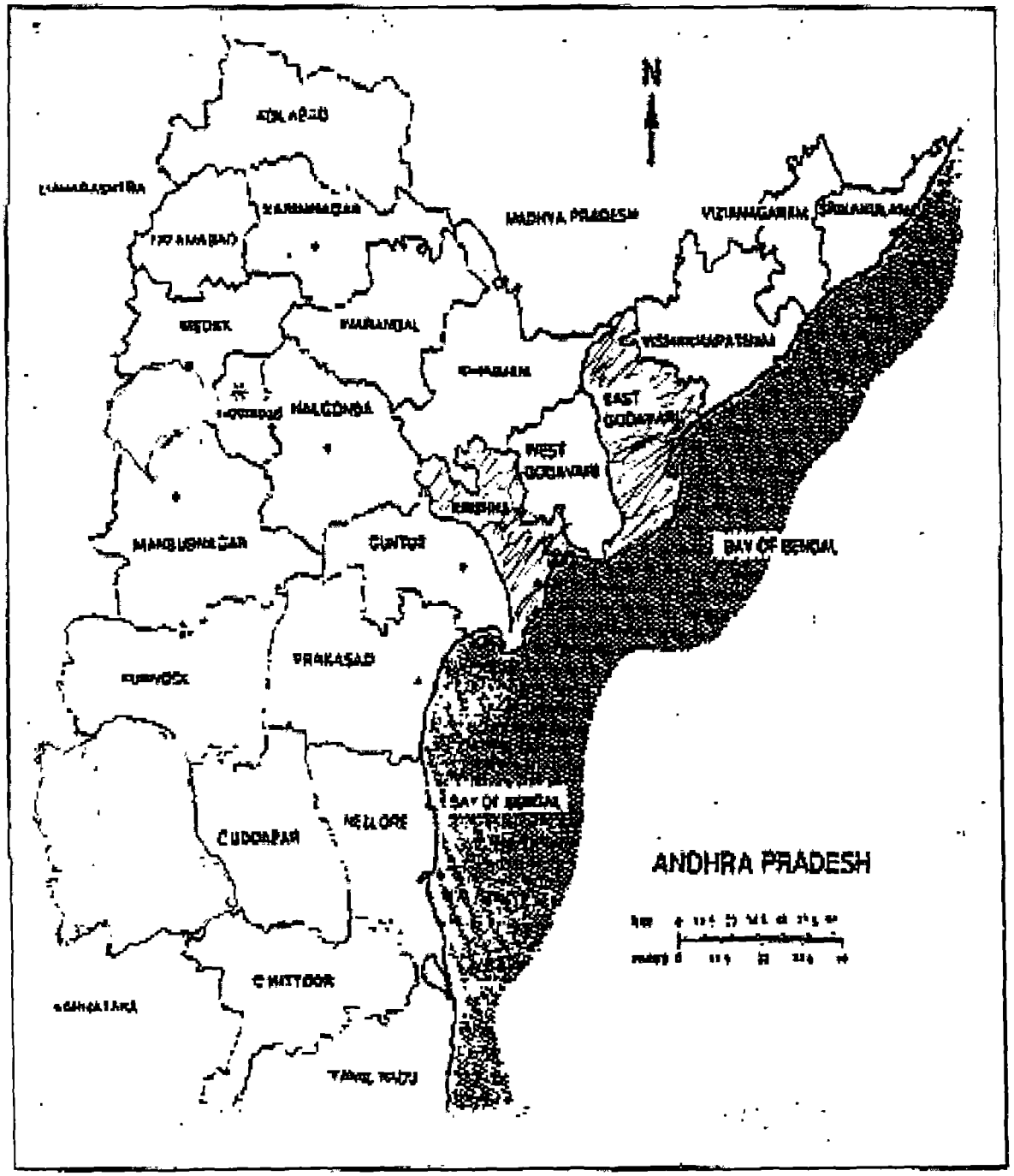
Map of India



Map of Andhra Pradesh showing the study areas

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K.K.N.Kumar,
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SUMMARY

Water is the basic need of mankind. No life can survive without potable water. Drinking water supplies in developing countries are receiving increased attention. Poor water supply and sanitation services continue to be critical problems in rural areas of developing countries despite considerable efforts to improve and expand access. According to Government of India policy, local bodies should be made responsible for the operation and maintenance of the system installed, with technical guidance from Government agencies.

In Andhra Pradesh State, rural and urban water supplies are managed by two different Engineering departments namely PRED and PHED for rural and urban schemes respectively. Based on the Govt of India policies, the Govt of AP has handed over the individual piped water supply schemes i.e. PWS and MPWS schemes after construction to the GP(local body) for O&M. The O&M of CPWS schemes for a group of villages is maintained by the PRED. Now one recent proposal i.e. handing over of the CPWS schemes to the GP is under consideration of the Govt of AP. Hence, the present study was intended to review the present performance of the maintenance system of the PRED and GP. The main study objectives are to learn about the organisational set-up of PRED and GP, to compare the performance of these two set-ups and to suggest the possibilities to improve the performance on the O&M of piped water supply schemes.

The methodology consists of literature work and three months field work in AP. The literature work was carried out at IRC, Hague and IHE, Delft. Some literature was collected from the PRED offices. Two districts in the coastal region of AP where there is more use of piped water supply schemes with treatment are selected for the present study. The study was carried out in 6 Schemes i.e. 3 PWS and 3 CPWS schemes. Opinion from 222 households was obtained. The personnel involved in the O&M of the schemes were interviewed and the performance of the schemes was observed in the field visits.

The study reveals that in both the systems there are no specific policies and guide lines for the staffing, supervision and monitoring and high degree of centralisation in PRED. There is a shortage of O&M staff in both the systems and there are no trained operating staff and the knowledge base of the operators and supervisory staff on slow sand filtration is poor in both systems. The preventive maintenance in PRED schemes is low and in GP schemes very poor. The GP schemes are more financially sustainable than the PRED schemes and there are no house service connections and no water tax collection in the PRED schemes and the recovery of the O&M in GP schemes is good. The overall performance on the maintenance of the schemes by the two systems is poor.

To improve the present system, the study recommends the following:

- Recruitment of the immediate adequate staff for the O&M with attractive salaries
- Setting of the guidelines for supervision and monitoring processes
- Proper training should be given to the operating as well as to the supervisory staff
- cost recovery should be implemented in PRED and the level of water supply should be increased.

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List of Abbreviations

AE	Assistant Engineer
AEE	Assistant Executive Engineer
AP	Andhra Pradesh State
ARWS	Accelerated Rural Water Supply Programme
CE	Chief Engineer
CPWS	Comprehensive Protected Water Supply Scheme
Dist	District
Dy.EE	Deputy Executive Engineer
Dy.CE	Deputy Chief Engineer
E.G.Dist	East Godavari District
EO	Executive Officer
GOI	Government of India
GP	Gram Panchayat
Govt	Government
HRD	Human Resources Development
IRC	International Reference Centre
IDWSSD	International Drinking Water Supply and Sanitation Decade
MNP	Minimum Need Programme
MPWS	Mini Protected Water Supply Scheme
O&M	Operation and maintenance
PC	Planing commission
PHED	Public Health Engineering Department
PRED	Panchayat Raj Engineering Department
(PR) RWS	Panchayat Raj Rural Water Supply Engineering Department
PR	Panchayat Raj Regular Engineering Department
PWS	Protected Water Supply Scheme
RGNDWM	Rajiv Gandhi National Drinking Water Mission
SE	Superintending Engineer

Structure of the Report

The thesis report contains seven chapters including this introduction chapter. The second chapter describes the problem identification and the study objectives. The third chapter consists of the literature review. In this chapter literature about operation and maintenance of schemes, indicators for the evaluation of the scheme performance etc., is reviewed. Chapter four describes the methodology adopted in the study. The fifth chapter consists of the results, describing the results obtained in the field research In chapter six the results are discussed. Finally, the seventh chapter presents the conclusions and recommendations of the study.

Chapter-1

INTRODUCTION

This chapter describes in general the history of the rural water supply program in India and it describes the national policies and strategies and then it describes the rural water supply in the State of Andhra Pradesh.

Water is the basic need of mankind. No life can survive without potable water. Drinking water supplies in developing countries are receiving increased attention. Poor water supply and sanitation services continue to be critical problems in rural areas of developing countries despite considerable efforts to improve and expand access.

Operation and maintenance of water supply systems of small communities have been neglected in the past in a great number of developing countries. According to the World Health Organisation, it is estimated that 30-60% of the existing water supply systems are not operational, which has an important impact on the well being of concerned (IRC, 1995).

Government and External Support Agencies, as well as local communities, are more and more concerned about the importance of integrating operation and maintenance components in the planing, implementation, management and monitoring of project activities, since operation and maintenance is a key factor of sustainability.

Professionals in the sector are also realising that operation and maintenance is not just a technical issue. It also encompasses social, gender, economic, institutional, political, managerial and environmental aspects (IRC, 1994).

For effective operation and maintenance of water supply schemes, motivation, good management, funds and manpower must be present. In other word operation and maintenance management should be sound both in technical, social and institutional aspects.

1.1 Water Supply Scenario in India

1.1.1 Background:

India is a country with a population of 846.3 million (as per 1991 census) living in around 3500 towns and about 600,000 villages. 75% of the population live in rural areas.

During the pre and immediate post independence era, villages were traditionally dependent on conventional water sources such as open wells, village ponds, rivers, streams, canals etc., for their requirement of water for drinking, bathing, washing and all other purposes including provision of water for animals.

The available conventional water sources are contaminated by open defecation, domestic activities, agricultural run off etc., and these pose serious health hazards.

Being a tropical country, the summer in India is especially severe. Most of the surface sources dry up during the summer.

Therefore, the Government of India has taken up an ambitious programme to provide a safe and reliable drinking water supply to rural areas by tapping ground water through tube wells and hand pumps.

With the growing demand, enhanced frequency of drought and contamination of surface sources in certain areas, water supply schemes based on ground water source and river/ lake water source (with conventional treatment plants) were extensively taken up by the Government.

1.1.2. Evolution of the Water Supply and Sanitation Programme

In India, the National Water Supply and Sanitation Programme was introduced by the Union Ministry of Health in September 1954 during the First five-year Plan (1951-1956).

Form the First to the Third five-year Plans and upto the Annual Plans (i.e. 1951-1969), the Water Supply and Sanitation Schemes focused on construction and renovation of wells, and installation of shallow hand pumps. The State government agencies executed this work with contribution / cost sharing from local bodies as well as communities. After construction, local bodies and communities maintained the systems.

The total investment made in the sector from 1951-1969 was approximately 1287 million Indian Rupees (Rs), and the coverage of rural population with water supply was 5.7 % in 1970.

The seventies marked a turning point in rural water supply programmes in India. With the breakthrough of the India Mark II hand pump technology, together with technological developments in drilling and pumping methods, the tapping of deep aquifers became possible.

A Centrally sponsored scheme of Accelerated Rural Water Supply (ARWSP) was launched in 1972. At the State level, rural water supply was included in the Minimum Needs Programme (MNP) in 1974-75, with the aim of achieving greater coverage and facilitating a higher flow of financial resources.

1.1.2.1 Development in the Eighties

The International Drinking Water Supply and Sanitation Decade (1981-1990) which spanned the eighties had its origin in the resolution from the United Nations Habitat Conference in 1977, followed by the Resolution in the UN General Assembly in 1990. The united Nations conference recommended that each country should develop national plans and programmes

for water supply and sanitation giving priority to the schemes of the population which require great attention.

In August 1985 the subject of rural water supply and sanitation was transferred from the Ministry of Urban Development to the Department of Rural Development with the objective of securing implementation of the programme and their integration with other rural development programmes.

1.1.2.2 Rajiv Gandhi National Drinking Water Mission

The National Drinking Water Mission was launched as one of the 5 social mission in the year 1986. The mission has since been renamed as Rajiv Gandhi National Drinking Water Mission (RGNDWM). Government of India continues to give highest priority to rural water sector through the activities of the Mission.

1.1.3 Policies and Strategies of Government of India

The following paragraphs describes the policy of the Government of India on the identification of problem villages, norms of providing water supply facilities and coverage etc.

1.1.3.1 Problem villages

According to Government of India the following criteria were established for the identification of priority villages for drinking water supply:

- those villages which do not have an assured source of water within a distance of 1.6 kms or within a depth of 15 mts. (in hilly areas, villages where water sources are available at an elevation difference of more than 100 mts. from the habitations)
- those where the available water contains excessive salinity, iron, fluoride or other toxic elements, or
- those where diseases like Cholera or Guinea worm are endemic.

1.1.3.2 Norms of providing water supply facilities are as follows:

Bore well with hand pump	for every 200-250 population
Mini Protected Water Supply Schemes	for villages having 1000 to 1500 populations
Protected Water Supply Schemes	for villages having more than 1500 population
Public stand post	one for every 200 people

1.1.3.3 *Water Supply Coverage in India*

Year (as on 31st March)	Total Rural Population (in million)	Rural Population Served (in million)	Percentage of Rural Population Served
1951	299	6	2.0
1961	360	14	3.9
1971	439	26	5.9
1981	525	162	30.8
1991	627	463	73.8
1996	692	564	81.5

As on 1st April, 1996 there were still 75782 not covered (N.C.) habitations, 331648 partially covered (P.C.) habitations, while the remaining 9.11 Lakhs habitations are fully covered. In terms of population coverage, the figure stands at 81.5% with large regional and state variations. For instance, the coverage is as low as 44.8% in Kerala and as high as 100% in Maharashtra State (Biswas, 1996).

One of the major reasons for poor access of communities to safe drinking water is lack of effective operation and maintenance, as a result of which many schemes have fallen into disrepair and no longer provide the services for which they were constructed. Because of this, the actual coverage levels of safe water in India may be lower than statistics would suggest.

1.1.3.4 *Funds for Water Supply Schemes*

The constitution of India has a two-tier government, one at the centre and the other at the state level (Economic Review 1994).

The federal constitution of India provides for water supply and sanitation as a state subject and therefore the states are vested with the constitutional right on the planning, implementation and cost recovery of water supply and sanitation projects. The central government formulates policy guidelines and provides technical assistance where needed. The central government provides considerable direct grant assistance for the water supply and sanitation in rural areas.

In general, rural water supply schemes are being funded by Government of India (GOI) under both the Accelerated Rural water supply (ARWS) program and the Minimum Needs Program (MNP). Some of the schemes are being executed with State Government funds.

The Royal Netherlands Government, under the bilateral assistance program has been

providing financial support to the Government of India, since 1979 for implementation of rural water supply schemes in the areas where the ground water contains an excess level of fluoride.

1.1.3.5 Operation and maintenance

According to Planning commission report, GOI, 1992, much importance was not given to operation and maintenance of water supply projects in the country. Under the 8th five year plan (1990-1995), the approach to the water supply sector has taken into account the following guidelines given in the New Delhi Declaration, which were adopted by the UN General assembly in December 1990.

- Organisational reforms, promoting an integrated approach and including changes in procedures, attitudes and behaviour and the full participation of women at all levels.

- Community management of services, backed by measures to strengthen local institutions in implementing and sustaining water supply and sanitation programs.

The Government of India is emphasising the following aspects regarding operation and maintenance.

- Private sector efforts for construction and maintenance of drinking water projects should be encouraged and mobilised to the maximum extent feasible.
- Local bodies should be made responsible for the operation and maintenance of the system installed, with technical guidance from Government agencies.

For O&M activities, which form such a crucial but often neglected element of water supply schemes, it has been estimated by the Government of India that Rs 9000 million/annum is required for sustaining the assets created during the last couple of decades, whereas the current allocation for O&M is hardly Rs 2250 million.

However, a year before the Mission was launched, for the first time ever a maximum of 10% of the plan funds under Minimum Need Program was allotted for O&M for the RWS system. In the subsequent years (1981-1989), a similar allocation was also made in Accelerated Rural Water Supply Program (ARWSP).

1.1.3.6 Water Supply Agencies

The Public Health Engineering Department (PHED) is the most principle agency at the state level for planning and implementation of water supply and sanitation programmes in India. In some states, statutory Water Supply and Sanitation Boards have taken over the functions of the PHEDs. The basic objectives for creation of WSSBs have been to bring in the concept of commercialisation in the water supply and sanitation management and more accountability.
In some states, the Panchayat Raj Engineering Department (PRED) implements Rural water supply and sanitation programs whereas Urban water supply and sanitation are looked after

by the PHED only.

1.2. Rural water supply in Andhra Pradesh State:

1.2.1 General

Andhra Pradesh State is 5th largest state in India. It is situated in the Southeast of the Indian sub-continent. It is surrounded by the states Madhya Pradesh and Orissa in the North, the state Tamil Nadu in the South, the state Maharastra in the North West, the state Karnataka in the West and Bay of Bangal in the East.

It has an area of 2,75,068 sq. kms. Hyderabad is the capital and the official language is Telugu.

The state is divided into three regions called Coastal, Rayalaseema and Telengana.

Andhra Pradesh State is divided into 23 districts depending upon the geography, population and convenience of administration and each district is sub- divided into three to four revenue divisions, each revenue division is sub- divided into 10-15 mandals and each mandal is again sub-divided into 15-20 Gram Panchayats.

Anantapur district is the largest one with an area of 19,130 sq. kms. Moreover, Hyderabad is the smallest district with an area of 217 sq kms

1.2.2 Population

The State has a population of 66.5 million as per 1991 census. The density of population is 242 persons per sq. km. About 77% of the state's population live in rural areas. The rural population as per 1991 census is 48.62 million spread over 27379 villages.

1.2.3 Administrative structure of Andhra Pradesh State

The Andhra Pradesh Government has a four tier administrative systems. One is at state level, which is called State Government, second one at district level called "Zilla Parishad", third one at mandal level called "Mandal Parishad" and last one at village level called "Gram Panchayat". Each tier will have a Governing body with the members elected from the people in its jurisdiction. The government staff allocated to the governing bodies will be under the direct administrative control of State Government but works in close co-ordination and supervision of the Governing bodies at each level.

The Gram Panchayat is the local government at village level. It is constituted by election. It has to look after general village administration like maintenance and repairs of village infrastructure like roads, drainage, streetlights, water resources, agricultural activities, etc.

1.2.4 Water Supply Agencies

In Andhra Pradesh, rural and urban water supplies are managed by two different Engineering departments namely the Panchayati Raj Engineering Department (PRED) and the Public Health Engineering Department (PHED) for rural and urban schemes respectively.

1.2.5. Panchayati Raj Engineering Department

In the State, the PRED is vested with the responsibility of rural development works like construction of rural roads, rural buildings, minor irrigation schemes, and all developmental works relating to local bodies, i.e. Zilla Parishads, Mandal Parishads and Gram Panchayats. The PRED has an RWS wing to look after the rural water supply and low cost sanitary facilities in the villages.

1.2.6. Types of Water Supply

The following are the types of drinking water supply to the rural areas constructed by the PRED:

- Piped water supply to an individual village through a individual Mini Protected Water Supply Schemes (MPWS) or Protected Water Supply scheme (PWS) with ground water or surface water as source.

- Comprehensive Piped Water Supply Scheme (CPWS) for a group of villages with mainly surface water as source i.e., either river water or water drawn from irrigation canals.

- Spot sources i.e., a bore well fitted with a hand pump

In Mini Protected Water supply Schemes the water is distributed to the users through only one or two cisterns i.e. water tubs with a number of taps around the cistern.

In the Protected Water Supply Schemes the water is distributed to the users through public stand posts if the scheme is designed for 40 litres per capita per day. House service connection will be allowed if the scheme is designed for more than 40 lpcd.

In the Comprehensive Piped Water Supply Schemes the water is distributed to the users through public stand posts and mostly no house service connections are provided.

In the schemes where the source is surface water, the water will be distributed only after conventional treatment (slow sand filtration).

1.2.6. Bilateral assistance programs

The Royal Netherlands Government has been assisting the Government of AP in providing safe drinking water facilities in fluoride affected and other priority villages since 1979.

1.2.7. Coverage

The coverage of water supply facilities in Andhra Pradesh State upto October 1997 is as follows

Priority villages identified	22960
Priority villages covered	20427
Hand pumps provided	218404
PWS and MPWS Schemes	18235
CPWS Schemes	69

1.2.8. Decentralisation Policy of AP Government.

Andhra Pradesh State has no separate policies in the rural water supply projects. Based on the Government of India policies and guidelines, the Government of Andhra Pradesh has handed over the individual piped water supply schemes i.e. PWS and MPWS schemes after construction to the Gram Panchayats for operation and maintenance.

The water supply schemes to a group of villages i.e. CPWS schemes are still maintained by the PRED

The Government of AP has ordered the District administrative officer to form a Village Maintenance Committee to look after the maintenance of the scheme but in practice such committees are no existing.

1.2.9 Maintenance of water supply schemes

1.2.9.1 By PRED

The Panchayati Raj Engineering Department with a separate Rural Water Supply Wing maintains all the CPWS Schemes and hand pumps. The state government provides fund for maintenance of all these schemes. 50% of the total operation and maintenance cost will be borne by the Gram Panchayats, either by means of recovery from the amounts due to the Panchayats (some percentage of stamp duty collected from the villagers towards registration fee of their land, entertainment fees by the state government, and developmental fund due to the GPs etc) or by obtaining the costs directly from the Gram Panchayats.

1.2.9.2 By Gram Panchayat

The policy of the Government is to hand over all individual schemes, after construction, to the concerned Gram Panchayats for operation and maintenance. The Gram Panchayats can collect water tax in addition to the house tax upto a maximum limit of 20% of the house tax amount in case of public stand posts or Rs 10-20 per house hold per month in case of house service connections. In case of major repairs they have to approach the PRED for technical and financial help.

Chapter -2

PROBLEM IDENTIFICATION

2.1 General Problem

Operation and maintenance of water supply and sanitation systems have been badly neglected in developing countries over the past years. Often, the operation and maintenance of water supply and sanitation facilities are regarded as low profile areas, with construction of new facilities being given the highest priority and importance in the overall decision-making process. Due to low importance to operation and maintenance, many water supply and sanitation facilities are collapsing and are working with a fraction of their installed capacity.

Due to the fact that operation and maintenance of water supply facilities in the developing countries is highly neglected, data on the number of people served by water supply facilities often are overly optimistic because, in reality, many of these facilities are broken or operating at reduced capacity. It is the fact that due to lack of effective operation and maintenance the actual coverage level of safe drinking water is lower than the statistic values(page 4). In most cases management systems have failed to provide the necessary guidance and structure for effective operation and maintenance of water supply facilities. The deterioration of these valuable physical assets is a major loss to national economies that should be avoided (Hueb,1997).

2.2 Main problems of rural water supply in Andhra Pradesh

Rao (1993) states that the performance of rural water supply schemes, maintained by the PRED and GP, are found to be poor and problems like poor quality of water and operating at low efficiency are common. The following are the main causes:

- defective operation and maintenance and its organisation,
- lack of knowledge of the plant operators
- defective cleaning process of filters
- delay in rectification of leakages and repairs
- inadequate communication facilities
- no proper quality monitoring and process controls
- lack of skilled operation and maintenance personnel and
- lack of funds for operation and maintenance

According to the National Environmental Engineering Research Institute (NEERI), the following are the causes of problem in water supply schemes maintained by the Gram Panchayats:

- unskilled operators/ caretakers
- lack of funds
- poor service level
- lack of cost recovery (Reddy,1995).

The Government of Andhra Pradesh has instituted a committee to conduct village level water supply management studies, with the aim of developing a systematic approach to the operation and maintenance of water supply schemes. The team has investigated the nature and reasons for recurring operation and maintenance problems in the areas of efficiency and level of functioning of rural water supply schemes in seven districts of Andhra Pradesh. In line with the previous sources, the Village Level Water Supply Management (VLWSM) study team has concluded that the following are the main causes of problem in the water supply schemes:

- inadequate quantity supply
- poor quality
- poor chlorination
- irregular supply timings
- poor maintenance of the filter beds
- no trained operators / care takers
- the delivery of water only one to one and half hours a day
- more leaks in the distribution system (Reddy, 1995)

Now the Government is in a intention of handing over of CPWS scheme in addition to the individual schemes after construction by the PRED to Gram Panchayats to look after the operation and maintenance at village level.

Hence to review and improve the performance of the present maintenance systems and to suggest proper future arrangements a study on the present maintenance system and on its performance is important and may help the planners and decision makers to identify the backlog in the present system and the alternative arrangements for the future set-up off maintenance in Andhra Pradesh.

2.3 Present study Objectives

The present study is to find out the performance of rural piped water supply schemes maintained by the two different agencies i.e. PRED and GP in Andhra Pradesh with the emphasis on the organisational set-up and procedures followed for operation and maintenance and performance.

The main study objectives are:

- To learn about the Organisational set-up of Panchayati Raj Engineering Department (PRED) and the Gram Panchayat (GP) set-up regarding the operation and maintenance of piped water supply schemes.

- To compare the performance of these two set-ups on the operation and maintenance of piped water supply schemes.

- To find out what are the problems faced by the GP after taking the piped water supply schemes from the PRED

- To suggest possibilities to improve the performance.

Chapter -3

LITERATURE REVIEW

This chapter covers the literature on the operation and maintenance approaches, organisational set-up and the performance of the maintenance in slow sand filters.

3.1 Operation and Maintenance

Operation refers to the routine activities necessary to make the system function.

The proper operation of a scheme results in its optimum use and contributes to a reduction in breakdowns and maintenance needs.

Maintenance refers to periodic inspection , replacement or repair the damaged parts, cleaning of filters etc. Maintenance can be divided into two types, one is preventive maintenance (planned maintenance) and other is corrective maintenance (breakdown maintenance).

Preventive maintenance is that which is conducted to prevent or to minimise the breakdowns

Corrective maintenance is that which is done after breakdown occurred and it tries to restore a service in malfunctioning the systems as quickly as possible

Most operation and maintenance evaluations will be much more concerned with the maintenance than with operation. Both planned and breakdown maintenance is needed for all systems but the aim is to minimise the breakdowns through planned maintenance. There is an obvious relation between proper maintenance of a system and its operation. Those which are well maintained are much more likely to operate with minimal difficulty (Cairncross, 1980). Rehabilitation entails the correction of major defects and the replacement of equipment to enable a facility to function as originally intended. Rehabilitation becomes necessary when it is no longer technically feasible or economically viable to maintain a facility in good working order. Maintenance will become uneconomic if the long term cost of rehabilitation and subsequent operation is more favourable than continued repair and maintenance.

3.2 Maintenance approaches

Three main approaches to maintenance are identified and developed in a logical sequence (IRC, T. Bastmeyer, J.T.Visscher, 1987)

1. **The Technical approach**
2. **The Organisation approach**
3. **The Systematic approach**

3.2.1 Technical approach

The technology of the scheme should be understandable to the village people and which can be maintained and repaired by local operators and with occasional support from the agency staff. Experiences in this field show that technology improvements are not sufficient to ensure the reliable functioning of rural water supply systems (Sundaresan et.al,1982). This shows that even technology which can be maintained at village level, needs to be properly introduced by involving the users from the beginning. The need to involve users and give them some control is also stressed by van Wijk (1985). Examples from Burkina Faso and Ghana indicate that village level maintenance is more successful with continuing support from the outside. The shift from a technical approach to community based maintenance can also be observed in community piped water supply projects in Sri Lanka, Indonesia, Zambia and Malawi (Darmawan, 1985).

3.2.2 Organisational approach

In this organisation approach, responsibilities are shared by local communities and relevant government agencies in a decentralised maintenance system. The success mainly depends on technical management of human and material resources(Donaldson,1984). Decentralisation of certain responsibilities reduces the maintenance costs, but requires technology which can be operated and maintained at community level. Further, back-up services for the operators and supply of spare parts need to be ensured (Hofkes,1982).

In general, the central or regional Government is responsible for the overall management, including organisational set-up, payment to staff, the users and local authorities do not have a say in or control over maintenance. Mostly maintenance is financed completely by the government . In any case no clear responsibility is set for manpower development and training, purchase and distribution of spare parts. In 75% of cases , no formal provision have been made to monitor the functioning of the system. This explains the limited data available on maintenance system performance.

Over the years the organisational approach to maintenance has developed and now includes a wide range of essential elements, but often too little emphasis has been placed on local environmental conditions, local resources maintenance and affordability to technology. The choice of technology should be related to these local conditions which determine the

maintainability of rural water supply systems. Thus often the organisational approach has not been successful because of inappropriate technology and insufficient users involvement.

3.2.3 Systematic approach

This approach to maintenance combines both the technical and organisational approaches but also includes the environmental conditions, affordability and users involvement. Pacey concluded in 1977 that experiences of donor agencies in Bangladesh, India and East Africa showed that the greatest effort was put into technology development. Other factors of the maintenance problem such as the social and human aspects were often neglected. Many water projects are implemented as crash programmes, whereas they should be part of development approach which takes into account the local situation. In an attempt to apply systems theory to rural water supply, Pacey outlines maintenance systems for three situations distinguished mainly by the degree of the community participation as follows:

- Total community self reliance in construction and maintenance
- Partial self reliance - responsible for maintenance
- No community involvement –construction and maintenance by government

For each of these situations he addresses technology choice and maintenance organisation, the level of training, local production potential and quality control.

Pacey's ideas form the basis for the systematic approach to maintenance, but do not sufficiently address the aspects such as finance, spare parts supply and management organisation. These aspects received more attention from Shawcross (1978), who stressed the relationship between the local conditions for maintenance, the organisational set-up of the maintenance system, technology selection and financial resources. He proposed set-wise decision making process which includes two main stages:

- Selection of general maintenance strategy (comparable with the three typical situations outlined by Pacey)
- Definition of the most suitable organisational set-up on the basis of available governmental capacities and local resources for maintenance.

Field experiences show that local factors are best taken into account by involving users in decision making. For example, the Yatega-Comoe village water supply project in Burkina Faso, 24% of the villages preferred open wells to bore wells with hand pumps (BURGEAP, 1986). In some districts in Benin, 60% of the communities refused improvements to their existing water supply facilities when their responsibilities were made clear to them. In other districts, where drinking water was scare, almost 100% villages accepted fully these responsibilities and contributed towards maintenance. Experiences in other African countries (Diluca,1983) indicate that early user involvement and clear agreement on responsibilities may lead to lower maintenance costs and more functioning of facilities.
Considering above situations, the systematic approach seems to be more effective approach to maintenance.

3.3 Organisation set-up

An effective rural water supply system is not simply a technological object but a combination of technology, institutions and people who are involved in planing, design, finance, construction, operation and maintenance, monitoring and use of the system. Major number of systems require a central organisational set-up for planning, financing, engineering, construction, training, supervision and monitoring and for operation and maintenance the system local organisational set-up required. The organisation is also responsible for administering the national, regional government program and policy. The following parameters are important when describing the organisational set-up.

3.3.1 Staffing

For every system some physical activities are necessary to maintain that system in a sustainable manner. To perform these activities certain staff are required. The required number of staff and their skills depend upon the work load i.e. production capacity, complexity of the operating units and coverage of the system etc. The following table shows the staff required in the Kerala water authority, India, for production of water in various capacities (Study report on O&M of RWS Schemes in Kerala, 1980).

Staff required	**Capacity of schemes**	
	Above 5 mgd	**Below 5 mgd**
AEE/AE	1	-
Shift Operators	12	12
Shift Assistant cum Cleaners	12	12
Shift Mazdoor	12	4
Fitter cum Mechanic	1	-
Electrician	1	1

mgd – million gallons per day.

3.3.2 Management system

Overall management, preventive maintenance, repairs, spare parts and chemicals supply, collection of tariff, supervision, monitoring and training are the key element in maintenance of any scheme. Prior to implementation a detailed analysis is required for the realistic division of the responsibilities, roles, powers and limitations to appoint required staff. The degree to which the user can assume certain responsibilities vary according to available resources and capacities. Devolving tasks, responsibilities and risks to local institutions need to be authorised formally and reflected in the legislation (IRC,1987).

The overall management of operation and maintenance comprises of the following main activities (RGNDWM, 1993):

- Defining the preventive maintenance schedule
- Identifying the agencies to carry out the repairs as and when needed
- Employing the operating staff, ensuring training
- Setting up the procedures for procurement of the spare parts
- Ensuring required man power and training
- Supervision on the maintenance
- Monitoring the performance and feed back to evaluate the performance
- Arranging for collection of revenue
- Preparation of annual budget estimates for operation and maintenance and arranging the funds and responses

In overall management, attention will be paid as to how these activities can be performed effectively. It includes the procedures adopted for receiving the complaints i.e. communication system between the users and the operating staff and also to look after that how efficiently these complaints are being attended. It is also comprises the procurement of the required spare parts and chemicals and man power development, training to the operating staff to perform the preventive maintenance effectively (IRC,1987)

3.3.3 Supervision

Supervision of maintenance system consists of formulation of objective standards and inspection and reporting on the functioning, use of the facilities and equipment. It is essential to set objective standards. Items on which standards are needed to be set are

- Daily routine work in his jurisdiction
- Maintenance of records on stock of spare parts and chemicals
- Maintenance of log reports on cleaning of filter units, operation schedule etc
- Maintenance of turnout registers of operators
- Maintenance of record on repairs and its rectification
- Acceptable breakdown period
- Level of preventive maintenance

The data reported during the supervision should be compared with the objective standards and the required action will be taken in case of sub standard functioning of the system. Whenever possible the collected information should be used to check the performance of the system, agency staff and the operators with respect to the objective standards. A healthy competitive spirit should be initiated by instituting prizes and awards for the best annual performance by the field staff (Ghosh.G, 1995)

3.3.4 Monitoring

Monitoring of maintenance involves the formulation of maintenance standards and the collection, processing and interpretation of data functioning and use of facilities and

equipment. It is essential to set objective standards according to which a system could function. Items on which standards need to be set are shown below.

- Quality of the installed facilities
- Water consumption
- Maximum number of users per stand post
- Acceptable water quality
- Acceptable breakdown period
- Quality of spare parts and chemical
- Level of preventive maintenance
- Cost of maintenance
- Revenue collection
- Users satisfaction

The data collected for the monitoring process need to be compared with the objective standards and action needs to be taken in case of sub-standard functioning of the system. When ever possible the collected information should be used to improve the performance of the systems, agency staff and the operators. Careful monitoring will also enable timely modifications of the water supply or the maintenance system, in order to meet the agreed standards on a continuous basis (IRC, 1987)

Monitoring and evaluation should focussing issues related to sustainability such as quality of the constructed water units, their usage, performance, maintenance, health awareness in the communities, the level of community participation in the decision making. And the results of training of local people. The whole water supply system should, at all levels, be evaluated, to identify the possible weak points and verify whether applied methods and systems were adequate. The kind of monitoring and evaluation activities depends largely on the maintenance system. It will be clear that all data have to be gathered from all levels involved (Albert Buiten Huis, 1993).

3.4 Requirements of Slow sand filters

The following are the general requirements for the effective function of a slow sand filter:

Period of operation	24 hours a day
Filtration rate	0.1 - 0.2 m/h
Filter bed area	5 – 200 m^2 per filter and minimum of 2 units
Height of filter bed	
Initial	0.8 - 1.0 m
Minimum	0.5 - 0.6 m

Specification of sand	
Effective size	0.15 – 0.30 mm
Uniformity coefficient	< 5, preferably below 3
Height of under drains including gravel layer	0.3 – 0.5 m
Height of supernatant water	1.0 m
Charging of filter	From the bottom

3.5 Operating Procedures of Slow Sand Filter Water Supply Schemes

The following are the important operation procedures in which a caretaker/ operator must become proficient.

- Cleaning of raw water intake and raw water pump
- Starting-up a new filter
- Operation procedure and daily adjustments
- Shutting down procedure
- Cleaning a filter-bed
- Re-sanding a filter
- Sand washing by hose
- Chlorination
- Sampling procedures
- Plant records

3.6 Water demand per capita

The average amount of water fetched from the water supply systems in developing countries ranges from 20 to 150 litres per person per day. This is influenced by many factors, such as quality and availability of the water, cost, cultural practices and climate. The most important of these factors are the time that the people can afford to collect the water, the convenience and accessibility of the water distribution points and whether water is also used for watering livestock.

Table- Average amount of water use for various types of rural water supplies

Type of supply	Average daily water use (l/p/d)	Range of daily water use (l/p/d)
Point sources	15	5 - 25
Piped supplies with stand post	30	10 - 50
Piped house connection (single tap)	50	20 - 150

Table- Estimate of water demand per capita for house connection in rural areas in India

Water usage	litres per day
Drinking	5
Cooking and cleaning	18
Ablution	6
Flushing	8
Bathing	20
Washing clothes	20
Water livestock	18
Total water usage	**95**

(Source: Slow Sand Filtration for Community Water Supply, Technical paper series 24, IRC)

3.7 Water Quality

Water quality examination is basically a determination of the organisms and mineral and organic compounds contained in water. The following are the basic requirements of the drinking water and it should be:

- free from pathogenic organisms
- containing no compounds that have an adverse effect acute or in the long term , on human health
- fairly clear (low turbidity, little colour)
- not saline
- containing compounds that cause an offensive taste or smell
- not causing corrosion or encrustation of the water supply system, nor staining clothes washed in it.
  (source: Lloyd and Helmer, 1994)

Chapter - 4

RESEARCH METHODOLOGY

This chapter describes the method adopted for the present study. This chapter consists of two parts. The first part describes the themes and corresponding indicators selected for the study. The second part describes the methods adopted for data collection in which it describes the selection of schemes, organising of field visits, observation procedures adopted in field interview procedures.

4.1. Introduction

Research is an inseparable part of human knowledge. Research is an important pre-requisite for a dynamic social order. Society has marched on to its present form with the help of constant research and investigation. Research should never be treated as a piece of compilation of work. By reading a number of books and compiling their material in another book is no research. Research must be based on facts. Observable data forms a sound basis for research. Inductive investigations lend greater support to research findings (Sadhu et.al, 1985).

4.2. Themes and Indicators

In the present study some parameters are selected as themes and corresponding indicators which describe the existing organisational set-up and performance of the operation and maintenance of the piped water supply schemes with conventional treatment (slow sand filtration) in Andhra Pradesh State of India.

4.2.1 Organisational set-up

The following themes are selected to describe the existing organisational set-up:
(Visscher et.al, 1996, Kalyan 1997)

4.2.1.1 Staffing

To operate and maintain the piped water supply schemes in a systematic way, some key persons are needed. The number of staff involved per scheme is an indicator for the efficiency of the organisational set-up and the indicators selected for this theme are

- Number of staff working in the organisation,
- Number of staff involved for that scheme, and their roles and responsibilities.

This information was collected from the office files of the head office and sub division offices.

4.2.1.2 Management System

Management is the key factor for any system. To understand the management system the following aspects are important.

- What is the overall management process
- Procedures adopted for receiving & attending to complaints,
- What are the training activities

- How is the procurement and supply of the spare parts, chemicals and tools

The information for this theme was collected from the office records and from interviews with officials.

4.2.1.3 Supervision

Close supervision improves the performance of any work. Supervision consists of formulation of objective standards, inspection and feed back to staff. The following aspects are important for this theme.

- Objective standards
- Procedures adopted for supervision

The information about these aspects is collected from the literature, guidelines, and interviews with officials.

4.2.1.4 Monitoring

Monitoring of a maintenance system involves the formulation of maintenance standards, collection of data, processing and interpretation of data concerning the functioning and use of facilities. Feedback is to evaluate the performance (Kalyan, 1997).
Important aspects for this theme are

- Monitoring criteria and
- Procedures adopted for monitoring and feedback.

The information was collected from the guidelines for monitoring and interviews with the officials.

4.2.2 Performance of maintenance system

The following themes are selected to know the performance of maintenance system:
(Visscher et.al,1996, Kalyan, 1997)

4.2.2.1 Organisational efficiency

Indicating the efficiency of the organisation and the staff salaries for O&M. The indicators selected are

- Number of staff working per one cubic metre production of water per day
- Cost of staff working per one cubic metre production of water per day

The information about these indicators is collected from the office records and in the field visits interviews.

4.2.2.2 Usage

Indicating the actual benefit to the users of the system. The indicator selected is:

- Number of users using this system for drinking and washing / No. Of users interviewed

This data was collected from interviewing users during the field visit

4.2.2.3 Quantity of use

Indicating the actual quantity of water drawn by the users of the system. The indicator selected is:

- Total quantity of water drawn by the user from the stand post / designed quantity

This data was collected from the users and from observation during the field visit.

4.2.2.4 Quality of water

Indicating the actual quality of water released to the public. The indicators selected are:

- Turbidity
- Risk of Contamination

The first indicator data was collected from the analysis of water samples in the Division office laboratory and the second indicator data was collected from the sanitary survey.

4.2.2.5 Reliability

Indicating how much we can rely on the scheme. The indicators selected are:

- Number of breakdowns in last 2-3 months
- Delivery time Schedule

This data information was collected from the records and also from the users interview

4.2.2.6 Continuity

Indicating the continuation of supply of water in a day. The indicator selected is:

- Number of hours supply of water / 24 hours

This data information was collected from the records and also from the users interview.

4.2.2.7 Maintenance of system components

In this two themes were selected. They are

Leakage of tap
Environment of Stand post

These themes indicate the maintenance of stand post, wastage of water and also the importance given by the staff/ users to hygiene. The corresponding indicators selected are

- Number of stand posts leaking / total number of stand posts visited
- Number of stand posts without proper drainage / total number of stand posts visited

This data was observed in the field visits with a preprepared observation sheet

4.2.2.8 Use of other sources

This theme indicates the use of other sources of water instead of the water supply system. The corresponding indicator selected is:

- Number of users using other sources of water / number of users interviewed

This data information was collected from users interview.

4.2.2.9 Users satisfaction

Indicating the users view about the operator that directly reflects the performance of the scheme. The indicator selected is

- Number of users satisfied with the performance of the scheme / number of users interviewed

This information was collected from users interview.

4.2.2.10 Cost recovery

This theme indicates the self-sustainability of the scheme. The indicator selected is:

- Revenue collected from the users / O&M cost of the scheme

This information was collected from the office records and also from the user interview .

4.2.2.11 O&M capacity

This theme describes the O&M capacity of the operator which reflects the performance of the

scheme. The indicators selected are:

- Performance of the operator
- Availability of working tools

The first information was gathered from the time-line programme of the operator and the second information was collected from the office records and field observation.

4.3. Methods of data collection

4.3.1 Preliminary investigation

To get an overall picture of the schemes, which are maintained by the PRED and GP, a preliminary investigation was done in the Head office at Hyderabad. Two districts were selected out of 11 districts from the coastal region of the Andhra Pradesh for the research study where a high number of schemes are existing. They are East Godavari and Krishna districts. These two districts will represent the overall picture of the coastal region. Only two districts were selected because time factor is the major constraint for the research study in India.

4.3.2 Selection of the Schemes

The selection of the scheme was done based on the following criteria

- It should have been in operation around 1993
- It should include a slow sand filter because in coastal region Protected Water Supply schemes are existing with two different water sources i.e. ground water and surface water and Comprehensive Protected Water Supply schemes are existing with mainly one source i.e. surface water. So to compare the two maintenance systems only the schemes with slow sand filters are considered.
- It should contain a population of around 3000 (actually in the research proposal a population of around 2000 was suggested, but in AP the number of schemes with that population is low and those schemes are old)
- Three schemes should be maintained by PRED and three schemes by GP.

4.3.3 Selection of Village

From the above selected districts, the researcher obtained information about the running schemes maintained by PRED and GPs from the Superintending Engineer office. From that information and in consultation with the officials of the PRED in the respective Divisions and Sub divisions, two 'Mandals' in each district are selected for the research study such that one scheme from each mandal as per the research proposal. As per the request of the officials, two other schemes one from GP and other from PRED are also selected in addition to the proposal i.e. six schemes from four mandals for the research study. The details of schemes selected are as follows

Table- Details of schemes for the research study

S.No	Name of the Scheme	Name of the District	Name of the Mandal	O&M by	Village
1.	CPWS Scheme to Corangi & other villages	East Godavari	Tallarevu	PRED	Chinnaboddu venkatayapalem
2.	CPWS Scheme to Tallarevu & other villages	East Godavari	Tallarevu	PRED	Setharampuram
3.	PWS Scheme to Selapaka	East Godavari	Kajuluru	GP	Selapaka
4.	CPWS Scheme to Malleswaram & other villages	Krishna	Bantumilli	PRED	Malleswaram
5.	PWS Scheme to Atapaka	Krishna	Kaikaluru	GP	Atapaka
6.	PWS Scheme to Bhujabalapatnam	Krishna	Kaikaluru	GP	Bhujabalapatnam

4.3.4 Collection of data

4.3.4.1 Documentation

The literature pertaining to the O&M of the schemes was gathered from the departmental people.

Operation and maintenance by Gram Panchayat

In the present situation, the individual schemes after construction are handed over to the concerned GPs for their maintenance. To know the organisation set-up of the Gram Panchayats, staff of the GP, policies and guidelines for the O&M of the scheme, the researcher visited the concerned GPs offices and the East Godavari District Panchayat officer's office and collected the following information.

- Structure of organisation
- Classification of Panchayats
- Staffing pattern
- Activities of Panchayats

- Income of Panchayats
- Staff for the Scheme
- O&M cost of scheme
- Collection of revenue procedure
- Problems in O&M

Operation and maintenance by PRED

To know the Organisational set-up of the RWS wing, and the policies and guidelines for the O&M of the scheme, the researcher visited the Engineer-in -chief office, Superintending Engineer office, Executive Engineer office, Deputy Executive Engineer office, and Section officer's offices.

The researcher interviewed the officials like EE, Dy.EE, AEE/AE's, and also WI & operators and he obtained the following information.

- Organisation set up
- No. of schemes in AP
- O&M policies and guidelines
- Roles & responsibilities of staff
- Procedure of Supervision
- Procedure of monitoring
- Staff for the Scheme
- O&M cost
- O&M procedure
- Procurement of spare parts/ chemicals

4.3.4.2 Field Visits

For efficient data collection the co-operation of the key personnel such as Sarpanch and other local leaders, in those villages was very necessary. The researcher gathered the information about the key persons in those villages from the departmental people and then visited the villages and contacted the key persons and also GP officials. It was made very clear that for the time being the researcher did not represent the Government and that the reason for the field visit has to study the O&M performance of the scheme for thesis submission at IHE, DELFT, THE

NETHERLANDS.

The locations of the Stand posts and other scheme details and other traditional sources are marked with the help of the key persons, villagers, and with the scheme operator in the mapping exercise.

4.3.6 Data collection method

After getting sufficient information about the location of stand posts, the researcher fixed a date for a field visit including consultation of key persons. Then the villages of the schemes were visited for the data collection. More than four days in each village was spent for observation of the scheme details, performance of the scheme, operator performance, for conducting a sanitary survey, for conducting interview with the users, etc.

4.3.6.1 Observation method

The head works site of the schemes and the villages were inspected by making use of the observation sheet (Annex-8) and all the scheme details and observations were noted in that format. The sanitary survey details were noted in the Sanitary format (Annex 7).

Six stand posts were also selected for each village for sampling in such a way that they represented the overall supply of water to that village. Observations of stand posts were also noted separately.

4.3.6.2 Interview method

4.3.6.2.1 Selection of Households

According to the research proposal 9 households were to be selected for interviews, 3 households within a radius of 50 Mts., 3 within radius of 100 Mts. and 3 within radius of 150 Mts. from the stand post. Since the distance between two stand posts was less than 200 Mts., only six households were selected for each stand post, 3 households within a radius of 50 and 3 within a radius of 100 Mts. from the stand post.

4.3.6.2.2 User interview

All households were interviewed with a questionnaire (Annex-4, 6) in the local Telugu language. The questionnaire contained all the details such as the number of persons in the household, quantity of stand post water collected, quantity of water collected from other sources, quality of water, breakdown details of the scheme, performance of the operator, number of hours getting water, whether the time of releasing is same or not, who is doing the O&M, how much they are paying for water tariff etc. Users were also asked about their usage of water for different purposes (Annex-6).

The details of the number of households interviewed in each village are given below:

S.No	Name of Village	No. of households
1	Chinnaboddu venkatayapalem	36
2	Setharampuram	36
3	Selapaka	36
4	Malleswaram	36
5	Atapaka	36
6	Bhujabalapatnam	42

The scheme operators who were present at the time of field visit were also interviewed using a questionnaire (Annex-5) and all the information about their experience, training, continuity of supply, kind of major breakdown occurred, availability of spare parts, tools, bleaching powder, who are supervising, and the registers maintained etc., were noted. During the discussion on the time-line, the operator described every step of his daily routine work with timings and also activities in the slow sand filter i.e., about how he charged the filter at the beginning or after breakdown of filter, scraped the sand, how much time was allowed for ripening period, and also the procedure adopted for chlorination.

Chapter 5

RESULTS

This chapter begins with the description of the Organisation set-up of PRED and GP and funds for O&M, then describes the maintenance systems by PRED and GP in the selected villages followed by a description of the performance of the schemes visited in the villages. In this chapter 5.1 deals in general how it is on paper and 5.3 discuss what is happening in reality.

5.1 Panchayati Raj Engineering Department (PRED)

5.1.1 Organisational set-up

The Panchayat Raj Engineering Department is one of the biggest engineering departments, within the Government of Andhra Pradesh and it is being expanded to cope with the increased developmental works in rural areas. The PRED is under the control of the ministry of Panchayat Raj and Rural Development.

Persons involved in the planning, designing , construction and maintenance of rural water supply

Engineer-in-chief

The PRED is headed by the Engineer -in-chief, who is in charge of all administration and technical matters. Under his control two separate wings are working, one is the Panchayat Raj Regular (PR), another one is the Panchayat Raj Rural Water Supply PRED. The heah office is situated in Hyderabad.

Chief Engineers

PRED has three chief Engineers one for regular RWS works, one for RWS projects, and one as Executive Director for human resources development. The Chief Engineers is responsible for planning and proper implementation of the various programmes under their control.

Superintending Engineers

The Superintending Engineer is the head of the office called circle office and working under the control of Chief Engineer with a jurisdiction of two districts. He is responsible for tendering and implementation of works under his jurisdiction. The SE is supported by about twenty technical and non technical staff in his office.

Executive Engineers

The Executive Engineer is the head of Division office and working under the control of SE with a jurisdiction of two revenue divisions. About twenty technical and non technical staff is working in his office. He has a Divisional Accounts Officer in his office who assists the EE in maintaining compliance with the Departmental and Financial codes. Only Executive Engineer is the check drawing officer with the district treasury accounts. He is responsible for proper maintenance of records and responsible for tendering and execution of all works under his jurisdiction.

Deputy Executive Engineer
The Deputy Executive Engineer is the head of the Sub-division office and he is working under the control of the Executive Engineer with a jurisdiction of about 5-8 mandals. He is responsible for the execution and maintenance of the works under his jurisdiction. He is assisted by about 10 technical and non technical staff in his office.

Assistant Executive Engineer/ Assistant Engineer
The Assistant Executive Engineer/ Assistant Engineer is the head of section office and he is working under the control of Dy.E.E. with a jurisdiction of 1-2 mandals, and responsible for every work in his area. He is the pillar of the department, as he is the sole in charge for the preparation of estimates , designs and execution of works.

Work Inspectors
Under the control of Assistant Executive Engineer/ Assistant Engineer, 1-2 Work inspectors are working and they have to watch the works continuously as per the directions of the section officer and also helping the AEE/AE in preparation of estimates and during surveys etc.

In addition to these officers, Geologists are working at three levels, one Joint Director is working at Chief Engineer office and other senior geologists at districts level and junior geologists at revenue division level.

Quality control EEs are working under the control of Deputy Chief Engineer (in the cadre of SE) for the entire RWS works. Their nature of work is pre-delivery inspection of the materials ordered by the RWS staff and inspects the disputed works and submission of the reports to the CE.

The staff of the department are bound by the regulations laid down in the Departmental and Financial codes of the Government.

As far as the functioning of Comprehensive Schemes is concerned, a separate section, a sub-division, or a division is established with necessary field staff depending upon the work load .

5.1.1.1 Operating Staff at Schemes for operation and maintenance

General monitoring on the operation and maintenance will be done by the officials higher than the rank of Deputy Executive Engineer in offices only. Below the Deputy Executive Engineer level all the staff will be more involved in the operation and maintenance of the schemes at field level. The main operating staff such as Pump operators, fitters, electricians, valve operators, watchmen etc., depending upon the volume of work is recruited on temporary basis from the local persons or experienced staff of the construction contractor. Minimum one Works Inspector is allotted for each scheme.

Roles and responsibilities of the staff working on a daily basis in the schemes:

Work Inspector : He has to attend daily to the scheme and monitors the operator performance and he observes the time schedule of the current availability and operation schedule of the motors and spare parts requirements and he will inform about the progress of the scheme, repairs to be done, chemicals and spare parts requirement to his officials as and when required. He will also observe the opinion and needs of the villagers very closely and inform those views to the officials.

Electrician : He is responsible for the maintenance of all electrical appliances of the scheme, keeps contact with the Electricity department and maintains the scheme as per the schedule of the APSEB (Andhra Pradesh State Electricity Department). He also observes all motors and attends to the repairs of the motors. He is also attending to the other works in the head works site and on the pipeline.

Valve Operator: He is responsible for the operation and maintenance of the Valves, pipe line and taps etc. in his jurisdiction and he operates the valves as per the schedule. He has to observe all taps, valves, pipe line leakage and he has to entry every activity in the registers available. He has to inform to the officials about the repairs to be done immediately and the required spare parts. He will attend to the repair immediately with the help of the other workers. He is responsible for valve pit cleaning, leakage arresting, pipe laying and maintenance of public stand posts.

Pump Operator : He is responsible for the operation and maintenance of the scheme, operate the motors as per the schedule of Electricity department and observes all motors, performance of the slow sand filters, cleaning of the filters & other head works structures, mixes the bleaching powder as per the daily requirement and he has to entry every activity in the registers available.

If no valve operator and electricians are available, the pump operator has to perform all their duties as well.

Watch man : He is responsible to look after the head works site assets and not to enter anybody or any animals into the compound.

5.1.1.2 Management System

Annual estimate of the operation and maintenance cost and required staff will be prepared and submitted to the Government before completion of the construction. After completion of the construction of the scheme, the contractor of the scheme has to run the scheme for a period of three to six months depending upon the contract rules. During this period the required staff will be taken as already described depending upon the funds availability from the Government.

This department has provided a preventive maintenance checklist and some registers to the field staff of the schemes. The field staff has to follow the norms of the preventive maintenance check list and also note down every activity such as kind of repair occurred and rectification of that repair with dates & timing, operation schedule of motors, release of water to the distribution and cleaning dates of units of the scheme in the respective registers.

Every complaint of the failure will be noted down in the registers and the operating staff is expected to attend to the complaint. In the meanwhile this will be informed to the AEE and to the Dy.EE through works inspector. If the complaint is bigger then they will come and rectify that complaint immediately. In no case the breakdown should be more than 7 days.

Training on the water treatment and quality monitoring, operation and maintenance of the schemes is given to the staff by the Human Resources Department section of PRED at Hyderabad. In some cases training will be given in the trail run period of the scheme by the contractor.

Generally, the routine required spare parts are assessed once in a year at the beginning of the financial year. The assessment of the spare parts is based on the previous experience and suggestions of the section officers (AEEs) concerned. The spare parts are procured on an annual basis by open tendering, or either from the authorized dealers of the government or from the rate contact holder of the PRED, depending upon the nature of material. All the spare parts are kept under the control of the stores section officer at the Division level. For the purchase of miscellaneous spare parts the Executive Engineer will called for quotations from different material supplying agencies and then approves the lowest quotation and then purchases from that agency. No purchasing powers are delegated to the Dy.EE to the immediate purchase of the required spare parts

The required chemicals are purchased from the authorized agencies only after the approval of the Executive Engineer concerned.

The required working tools are supplied to the operating staff by the department.

5.1.1.3 Supervision

There is no specific objective standards and procedures adopted for supervision in the department. The Dy.EE and AEE are responsible for the proper functioning of the scheme. They have to inspect the schemes regularly and supervise the operating staff. They have to check the preventive maintenance level and all the registers in the plant and sign it.

5.1.1.4 Monitoring

Every month the operating staff has to take water samples and analyse them in the Division Office Laboratory. Every month a review meeting is called for by the Deputy Executive Engineer and in turn by the Executive Engineer. In those meeting they review overall maintenance i.e. maintenance costs, repairs occurred in the last month, repairs attended so far,

what are the requirements in future, performance of the operators and users satisfaction. The monitoring report will be submitted to the higher official for information.

5.1.1.5 Funds for operation and maintenance

The state government provides the operation and maintenance cost of the CPWS schemes, there is no contribution from the users.

The annual maintenance estimate consists only of operators, electricians, fitters and watchmen salaries, spare parts and chemicals charges, electricity charges and any other repairing charges etc.

The annual maintenance cost of the schemes are being prepared and submitted to the Chief Engineer RWS by taking into consideration the previous year's expenditure and also forecasting expenditures at Sub-division level by the AEE/AE. The annual budget is prepared by the Engineer-in -Chief / Chief Engineers and presented to the Government, which presents it to the Assembly. The Assembly passes the budget. Based on the approved budget, the Engineer-in -Chief / Chief Engineers allocates funds to all the divisions as per the requirements. Funds are released quarterly and the financial year starts from 1 April to 31 March of next year.

5.2 Gram Panchayat

5.2.1 Organisation set-up

Gram Panchayats are divided into two categories based on their annual income. If the annual income is less than 0.2 million rupees it is called a Non-Notified Panchayat and if it is more than that it is called Notified Panchayat. Each Panchayat has democratically elected members from the different wards of the village and is headed by a Sarpanch.

The government staff of Gram Panchayat is also under the control of the ministry of Panchayat Raj and Rural Development. It is headed by Commissioner of Panchayats at state level and District Panchayat officer at district level as PA to District administrative officer (collector). Under the District Panchayat officer, Divisional Panchayat officers are working at revenue division level. Under the Divisional Panchayat officers, Extension officer Panchayats are working with a jurisdiction of 3-4 mandals. Executive officers are working in notified GPs and they are supported by Junior Assistant, Bill Collector, Attainder and Sweepers. Group Executive officers are working for a group of 3-4 non-notified GPs and under him only JA/ Bill collector and Sweepers are working for each non-notified GP.

In the Gram Panchayats, the executive staff i.e. government staff is non-technical persons.

The executive officer is the responsible person to look after the every developmental activity in the GP. He is the most important person to the operation and maintenance of the water

supply scheme and he has to supervise over all performance of the scheme and the required spare parts, chemicals and working tools should be supplied to the operating staff.

5.2.1.1 Operating staff for operation and maintenance

The main operating staff such as Pump operators, watchmen etc is recruited on temporary basis from the local persons or experienced staff of the construction contractor.

Roles and responsibilities of the operating staff:

Pump Operator : He is overall responsible for the operation and maintenance of the scheme, operate the motors as per the schedule of Electricity department and observes all motors, performance of the slow sand filters, cleaning of the filters & other head works structures, mixes the bleaching powder as per the daily requirement and he has to entry every activity in the registers available.

Watch man : He is responsible to look after the head works site assets and not to enter anybody or any animals into the compound.

5.2.1.2 Management System

Generally, the Gram Panchayat will appoint the required staff for O&M from the local village after getting the approval in General body meeting of GP on contract basis. For permanent recruitment of operating staff, the GP has to take permission from the District Collector.

Before taking over the scheme the temporarily appointed operator will be sent to the plant for some training from the contractor in the trail run of the scheme.

The scheme will be taken over by the GP from the PRED with all relevant files, drawing of the scheme details and with design particulars. Then the Executive officer will call for a meeting and in that meeting the details of the scheme, the required operation and maintenance cost, the proposed house service connections in addition to the public stand posts and the tariff fixation and collection procedure will be discussed. Then the resolution will be passed in the meeting with the above proposals and one resolution copy will be submitted to the District collector for the approval of the tariff fixation and one copy to the Superintending Engineer PRED to sanction the number of house service connections. After obtaining the approvals from the competent authorities, the GP will give house service connections and collect the tariff from the users.

In the beginning, the PRED staff will assist the operator for the overall operation and maintenance procedure of the scheme.

For the preparation of any estimate regarding major repairs, the GP has to approach the PRED. Then the AEE will come and inspects the site and prepare the estimate. After getting

the estimate from the PRED, the GP will approve the estimate in the General body meeting. After that, only the Executive officer can meet the expenditure on the operation and maintenance cost from the funds.

Every complaint of the failure will be noted down in the registers at the GP office and the operator will attend to the complaint. The Executive officer and Sarpanch will takes care of the complaints. If the repair is a major one, the GP approaches the PRED for technical and financial help. The PRED will take care of that repair. In no case, the breakdown should be more than 7 days.

In the GP there are no training activities and only PRED providing the training to the operators whenever possible. In some cases, training will be given in the trail run period of the scheme by the contractor.

Generally, the routine required spare parts should be kept as reserve stock for the immediate usage. The spare parts are procured from the authorized dealers of the government or from the rate contact holder of the PRED. All the spare parts are kept under the control of the Executive officer.

The required chemicals are purchased from the authorized agencies every month.

The required working tools will be supplied to the operating staff by the GP.

5.2.1.3 Supervision

There are no specific objective standards and procedures adopted for supervision in the GP. The Executive officer and the Sarpanch are mainly responsible for the proper functioning of the scheme. They inspect the schemes regularly and supervise the operating staff. They have to check the complaint register.

5.2.1.4 Monitoring

Every month the operator has to take water samples and analyse them in the PRED division office laboratory. Every month a review meeting is to call for by the Executive officer to review the performance of the scheme. In every three months the performance of the scheme and the incurred expenditure and revenue collection will be reviewed in the General body meeting. The monitoring report will be submitted to the District Panchayat officer.

5.2.1.5 Funds for operation and maintenance

The annual maintenance estimate consists salaries of operators and watchman, spare parts and chemicals charges, electricity charges and any other repairing charges etc.

The annual operation and maintenance cost including staff salaries and cost of chemicals is being proposed in the General body meeting of the GP. After getting approval the Executive officer can meet the expenditure of the O&M cost from the General funds of the GP. The

General funds consist of all income of the GP i.e., from the State Government, village general taxes, and water tax and water tariff. At the time when the house service connection is given, the GP collect a capital amount ranging from Rs 500 to 2000 /-.

The GP can collect water tax at maximum of 20% over the house tax annually in case of users using stand post water and Rs 10-20 from the users having the house service connections.
The normal operation and maintenance cost of the schemes is purely provided by the GP and no contribution from the government.

Government has also instructed the District Administration to utilise 10% of MNP/ARWS funds for maintenance and operation of the PWS Schemes wherever the non-plan provisions are not sufficient or when major investments are required, when the GPs are not able to maintain the scheme satisfactorily due to major break downs such as bursting of the pipe lines, source failure or pump sets burning and going out of order.

The State Government supported the non-notified Panchayats with an annual income less than 0.2 million rupees by paying the complete electricity charges of the schemes to the Andhra Pradesh State Electricity Board.

5.3 General description of schemes for study

It describes what is happening in reality in the schemes.

5.3.1 PRED

The following are the schemes selected for the study:

1. CPWS scheme to Corangi and other villages

2. CPWS scheme to Tallarevu and other villages

3. CPWS scheme to Malleswaram and other villages

Table 1 – Details of the schemes selected for the study in PRED maintenance

Scheme name	**Corangi**	**Tallarevu**	**Malleswaram**
Scheme number	**1**	**2**	**3**
Mandal name	Tallarevu	Tallarevu	Bantumilli
Plant at village	C.B.V.Palem	Tallarevu	Malleswaram
No. of villages covered	5	12	8
Population covered	5597	15589	14346
Source of raw water	Canal water	Canal water	Canal water
Daily demand per capita	40 lts per day	55 lts per day	50 lts per day
Distribution period	8 hrs	8 hrs	8 hrs
No. of house connections	nil	nil	nil
Production quantity	130000 lts/day	300000 lts/day	550000 lts/day
Type of Panchayat	notified	notified	non-notified
Village committee*	strong	no	no
Villagers**	co-operative	not co-operative	not co-operative

*There are no village water committees in any schemes but in scheme 1, there is a strong committee called Village Peddala committee in which the leaders will take any decision making regarding any activity in the village and the villagers will follow their decision.

** Villagers co-operation is observed in the field visits, from the users interview and also from the maintenance of the drainage at stand post etc.

5.3.2 Gram Panchayats

The following are the schemes selected for the study:

1 PWS scheme to Selapaka

2. PWS scheme to Atapaka

3. PWS scheme to Bhujabalapatnam

Table 2 – Details of the schemes selected for the study in GP maintenance

Scheme name	Selapaka	Atapaka	Bhujabalapatnam
Scheme number	**4**	**5**	**6**
Mandal name	Kajuluru	Kaikaluru	Kaikaluru
Plant at village	Selapaka	Atapaka	Bhujabalapatnam
No. of villages covered	1	1	1
Population covered	3852	4045	3928
Source of raw water	Canal water	Canal water	Canal water
Daily demand per capita	40 lts per day	40 lts per day	40 lts per day
Distribution period	8 hrs	8 hrs	8 hrs
No. of house connections	nil	195	425
Production quantity	120000 lts/day	120000 lts/day	120000 lts/day
Type of Panchayat	non-notified	notified	non-notified
Sarpanch	retired teacher	lady	good leader
Village committee*	no	no	no
Villagers**	not co-operative	not co-operative	very co-operative

*There are no village water committees in any schemes.

** Villagers co-operation is observed in the field visits, from the users interview, from the maintenance of the drainage at stand post etc.

During the filed visit, it is observed that the Sarpanch of the scheme 6 is very active and he has taken more interest in the O&M of the scheme. According to the users view, the Sarpanch has good leader ship qualities in the development of the village.

5.4 PRED organisation set-up and performance of maintenance System in the study area

5.4.1 Organisation set-up

5.4.1.1 Staffing in the study Schemes

The operating staff i.e. pump operators, electricians, valve operators and watchmen etc for operation and maintenance were taken from the local people in schemes 1&2 and from the construction contractor's staff in scheme 3 on contract basis duly observing the departmental procedure by the PRED. No permanent operating staff was working in the Schemes of the research study. All the operating staff are not satisfied with their low salaries, more working hours and with temporary job.

Number of staff per scheme :

The number of staff working at present in the PRED maintained schemes is tabulated in the following table.

Table 3- Number of staff working in the schemes maintained by the PRED

Name of the Scheme	**CPWS to Corangi**	**CPWS to Tallarevu**	**CPWS to Malleswaram**
Number of the scheme	**1**	**2**	**3**
W.I	1	2	1
Pump Operators	2	2	2
Valve Operators	-	-	3
Electricians	-	-	1
Watch man	-	-	2

Table shows that the number of staff working in the scheme 3 is higher than the other schemes. The duties performed by the staff are described in the following paragraphs.

Work Inspector: In all the schemes the works inspectors attending to the scheme daily, supervising the operating staff and informing to the AEE daily about the performance of the scheme and the operator and all are moving closely with the users and observing their views about the performance of the scheme.

Electrician: Only in scheme 3 the electrician is working and he is maintaining all electrical appliances of the scheme in good condition and observing the schedule of the current availability from the APSEB. He is observing all motors and attending to the repairs of the motors. In the leisure time, he is also attending to the other works in the head works site and on the pipeline. He is also recording his daily work in the register.

Valve Operators: Only in scheme 3, the separate valve operators are working and maintaining all valves, pipe line and taps etc. and noting down every activity in the register. They are always in a contact with the WI and with the AEE. They are informing the repairs and the required spare parts to the AEE. They are working in shifts.

Pump Operators: In all the schemes two pump operators are working. The operators in schemes 1&2 are also doing the work of the electrician and the valve operator. They are operating the motors as per the schedule of Electricity department and observing all motors, performance of the slow sand filters, cleaning of the filters & other head works structures, mixes the bleaching powder as per the daily requirements and they are entering every activity in the registers available. In the schemes (1) & (2) the operators are working 4 hours more than the scheme (3) and they are over loaded with the additional work of the valve operators and electrician.

Watch man: Only in scheme 3, two watchmen are working in shifts and they are watching all the head works assets and also controlling the animals and the people other than the department not to enter into the compound.

5.4.1.2 Management System

The operating staff are provided with preventive maintenance check list and some registers to record the activities in the scheme. The operating staff of schemes 1 & 3 are doing the preventive maintenance well and in the scheme 2 the operating staff are partly doing the preventive maintenance. In all the schemes, the operating staff is maintaining the activities of the scheme in the records. In all the schemes, every complaint is recorded in the registers and the operating staff rectifying the minor repairs and for the major repairs they conveys the message to the PRED officials and then the AEE arranges the external skilled persons to rectify that repair. The operating staff maintained records are tabulated in the following table.

Table 4 : Maintenance of records

Scheme No	**1**	**2**	**3**
Maintaining records	yes	Yes	yes
Kind of records	log books, chemicals, filter cleaning, other units cleaning, repairs	log books, chemicals, filter cleaning, other units cleaning, repairs	log books, chemicals, filter cleaning, other units cleaning, repairs, turnout register of staff

They are not maintaining the records of the filtration rate, raw water and filtered water quality analysis reports.

***Training activities*:** The staff at the studied schemes did not get any external training and only in scheme 3 some operating staff are trained during the trail period of the scheme by the contractor.

***Spare parts*:** In all the schemes, the staff is maintaining a reserve stock of spare parts such as CID joints and pipes etc at head works site for immediate usage. They are purchasing the other spare parts whenever required from the local market after obtaining the approval from the Executive Engineer. In this process, some delay was observed many times according to the operating staff. No permission was delegated to the DyEE to purchase the required spare parts, chemical and tools from the local market immediately. They are purchasing the required chemicals every month from the authorised dealer of the PRED. Only scheme 3, the operating staff was provided with proper working tools and in the other two schemes the

operating staff is not provided with the working tools so some times delay was observed in the repairs of these schemes.

5.4.1.3 Supervision:

In PRED. there are no specific objective standards and procedures adopted for supervision by the staff but the supervising details of the staff in the study schemes is gathered and tabulated in the following table.

Table 5: Supervision in the PRED maintained schemes

Scheme No.	1	2	3
Work Inspectors	daily	Daily	Daily
AEE/AE	twice a week	twice a week	Daily
Dy.EE	twice a month	twice a month	twice a month
EE	3 months	3 months	3 months

Table shows that one Work Inspector is exclusively allotted to one scheme, he visits the Scheme daily and informs his officials if there is any repair or any trouble within the scheme or with the villagers. In schemes 1&2, AEE visiting the Scheme two times in a week and in scheme 3 the AEE visits regularly and observes the ongoing process and he suggests improvement if necessary. The Deputy Executive Engineer visits the site twice a month and he supervising the overall scheme performance. Executive Engineer also visiting the scheme once in every three months.

5.4.1.1.4 Monitoring:

In all the schemes the PRED is monitoring the quality of the water and reviews the performance of the scheme.

Table 6 : Monitoring in PRED maintained schemes

Scheme No.	1	2	3
Review in meetings	Monthly	Monthly	monthly
Collection of Water samples	Yes	Yes	yes

Table shows that in all the schemes, the staff is taking the water samples not in every month and analysing them in the Division Office Laboratory. Every month a review meeting was called for by the Deputy Executive Engineer and in turn by the Executive Engineer. In those meeting they are mainly reviewed the overall maintenance cost, spare parts requirements, repairs occurred in the last month and repairs attended so far.

5.4.1.5 O&M cost: For the year 1996-97

The operation and maintenance cost of the schemes is tabulated in the following table with details

Table 7 : Operation and maintenance cost of the schemes maintained by the PRED

Scheme No	1	2	3
Salaries[1]	61440	99840	161451
Electricity	13644	44304	0*
Chemicals	26420	36800	36620
Spare parts &Repairs	28520	35650	44211
	130024	**216594**	**242282**

* For the schemes in the non-notified Panchayats, the Government pays the entire electricity charges of the water supply schemes.1

Table shows that the scheme 3, the cost towards salaries and repairs is high than the other schemes.

5.4.2 Performance of maintenance system

For assessing the performance of the schemes, 11 themes are identified. Against each theme, some indicators are also formulated. The results of the themes and indicators are described in the following paragraphs.

5.4.2.1 Organisation efficiency

The results of the organisation efficiency in the schemes are tabulated in the following table

Table 8 - Organisation efficiency

Scheme No.	1	2	3
No of staff/cum/day	0.023	0.013	0.016
Cost of staff/cum/day	1.29	0.91	0.80

From the table, it can be seen that number of staff working in scheme 1 is more and cost of staff per cubic meter production per day is more in scheme 1.

1 The regular operating staff salaries are only included.

5.4.2.2 Usage

This theme indicates the use of water from the stand post to the different purposes. The results of usage are tabulated in the following table.

Table 9 -Usage of water by the users for different purposes

Scheme No.	1	2	3
No of Users Interviewed	36	36	36
Users using Water for			
Drinking	36	36	36
Cooking	36	36	36
Washing	11	3	11
Bathing	17	3	17
Personal hygiene	35	24	33
Gardening	0	1	5
Cattle feeding	0	0	0

From the table can be seen that almost all the interviewed beneficiaries utilise the stand post water for drinking and cooking. The users using the stand post water for personal hygiene purposes after drinking and cooking purposes. In case of scheme 2 only 67%, users are using the SP water for personal hygiene because water from the stand post was not sufficient. After personal hygiene, the users given importance to bathing, then to washing and gardening. In schemes 1&3 maximum 47% users use the stand post water for bathing and in scheme 2 only 8% of users use this water for bathing. In scheme 3, maximum 31% of users use the stand post water to the washing. In all the schemes much importance was not given to the gardening and cattle feeding.

5.4.2.3 Quantity of use

This theme indicates how much water the user is getting from the stand post. The users are collecting the water from the SP into a container with a capacity from 15 to 20 litres. In case of scheme (1), big containers are used for water collection (25 litres). The Quantity of water drawn from the stand post was tabulated in the following table.

Table 10 - Quantity of use

Scheme No	1	2	3
Range of the water drawn from the SP in lpcd	11-33	7-40	15-45
Average volume of water drawn from the SP in lpcd	22	14	24
Designed quantity of supply of scheme in lpcd	40	55	50
% of supply	55	25	48

* Lpcd - litres per capita per day

It can be observed from the table that the amount of water used per beneficiary in relation to the designed quantity is only 26% in scheme 2.

5.4.2.4 Quality of water

To know the quality of water supplied through a stand post the following parameters were selected.

1 Turbidity
2 Risk of contamination

The data of the second parameter collected in sanitary survey during the field visits is tabulated in annex-7. The turbidity of the water sample from the analysis report and the percentage risk of contamination are tabulated in the following table.

Table 11- Survey on water quality

Scheme No.	1	2	3
Turbidity	5	5	5
Risk of contamination %	31	46	15

From the table, it found that turbidity values are higher than the WHO guide line values and the water from the scheme 1 is more turbid than the other schemes. It can also observed that the risk of contamination is highest in scheme 2 followed by scheme 1 and 3.

5.4.2.5 Reliability

The data for the indicators of the reliability was tabulated in the following table.

Table 12 - Reliability

Scheme No	1	2	3
No. of breakdowns in last 3 months	1 (1day)	1 (7days)	No
Delivery time schedule	90 min (M)	120 min (M)	180 min (M) 180 min (E)

*M-Morning; E-Evening

In scheme 3, the water is released in morning to 4 villages and in evening to the other 4 villages.

It can be seen from the table that only one breakdown occurred in the schemes 1 & 2 but the time taken for that repair is higher in case of scheme 2. No breakdowns were noticed in schemes 3.

In all the schemes, the schedule of time of delivery of water is fixed and if there was any change, users were informed about that change of timing in advance.

5.4.2.6 Continuity

The number of hours of supply of water per day was collected and tabulated in the table below.

Table 13 - Continuity

Scheme No.	1	2	3
No. of hours supply/24 hrs	(1.5/24)	(2/24)	(3/24)

The scheme 3 has a higher continuity than other schemes.

5.4.2.7 Maintenance of system components

The data on the maintenance system i.e. leakages of taps and the environment of the stand post is tabulated in the following table.

Table 14 - Maintenance systems

Scheme No.	1	2	3
Leakage of tap			
No. of SP's leaking /No of SP's visited	(2/20)	(6/16)	(3/18)
% leakage	10	38	17
Environment of SP			
No. of SP's with out proper drainage/ No of SPs visited	(3/20)	(5/16)	(4/18)
% with out proper drainage	15	31	22

From the table, it can be seen that about 10% of the taps are leaking in case of scheme 1 and the percentage of leaking of taps is very high 38% in scheme 2.

It is also found from the table that the bad environment of SP is highest in scheme 2 followed by scheme 3 and 1.

5.4.2.8 Use of other sources

The data of the use of the other sources of water by the users is tabulated in the following table.

Table 15 – Use of other sources

Scheme No	1	2	3
Number of users interviewed	36	36	36
No of users using OS/ No of users interviewed (%)	69	97	100

In all schemes most users are using other sources of water for different purposes such as for bathing, washing of cloths, cattle feeding etc(Annex-6). In scheme 1, less percentage users are using other sources of water when compared to other schemes.

5.4.2.9 Users satisfaction

The data of the users satisfaction on the performance of the scheme is tabulated in the following table.

Table 16 – Users satisfaction

Scheme No.	1	2	3
No. of users satisfied with the performance of the scheme/ No. of user's interviewed	30/36	20/36	27/36
% of users Satisfaction	83	56	75

From the table, it can be seen that 83% users were satisfied in scheme 1 and less satisfaction was seen in the scheme 2.

5.4.2.10 Cost Recovery

Table 17 - Cost recovery

Scheme No.	1	2	3
No. of SP	31	20	31
No. of HC	-	-	-
Collection of water tax	No	no	no
Collection of tariff	No	no	no
Collection on water	Nil	nil	nil
Expenditure	130024	216594	242282
Revenue /Expenditure	0	0	0

In PRED maintained schemes, only stand posts are provided and no water tax is collected from the users. The entire cost of the O&M is provided by the State Government. One proposal was submitted to the State Government by the PRED to collect the water tariff but that approval was not sanctioned so far.

Almost all users in the schemes 1 to 3 are willing to pay the operation and maintenance cost and 40 to 50% households preferred the house service connections.

5.4.2.11 O&M capacity

The data for the performance of the operator and availability of working tools collected during field visits, users interviews, and operators interviews is tabulated in the following table.

Scheme No.	1	2	3
Performance of operator	Good	good	good
Availability of work tools	Poor	Poor	good

It can be seen from the table that all operators performance was good and availability of working tools was good in scheme 3.

5.5 Gram Panchayat organisation set-up and performance of maintenance

5.5.1 Organisation set-up

5.5.1.1 Staffing in the study Schemes

The operating staff i.e. operator and watch man etc for operation and maintenance were taken from the local people in schemes 5&6 and from the construction contractor's staff in scheme 4 on contract basis. No permanent operating staff was working in the schemes of the research study. All the operating staff are not satisfied with their temporary job, low salaries and with more working hours.

Table 19 : Number of staff working in the schemes maintained by the GP

Name of the Scheme	PWS to Selapaka	PWS to Atapaka	PWS to Bhujabala patnam
W.I	Nil	Nil	nil
Pump Operators	1	1	1
Watch man	-	1	1

Table shows that the number of staff working in the scheme 4 is less than the other schemes. The duties performed by the staff are described in the following paragraphs.

Pump Operators: In all the schemes one pump operator is working. All the operators are operating the motors as per the schedule of the Electricity department and doing the work of electricians and the valve operators. The operators in the schemes 5&6 are not familiar with the slow sand filter operation, procedure of the cleaning of filters and chlorination process. It is observed that the operator in the scheme 6 stopped the filtration for 3 to 4 hours daily. The operator in scheme 4 is familiar with the activities of the filters.

In all the schemes the operators are working through out the day and they are over loaded with the additional work of the valve operators, electrician and the other works entrusted by the Sarpanch / Executive officer not pertaining to the scheme.

Watch man: Only in schemes 5&6 one watch man is working and they are watching all the head works assets and also controlling the animals and the people other than the department to enter into the compound. They are also doing the works entrusted by the Sarpanch / Executive officer not pertaining to the scheme.

5.5.1.2 Management System

In all the schemes, handing over procedure of the scheme by the PRED to the GP was not systematic and the GP faced many problems to familiar with the concept of the scheme, procedure of the operation and maintenance, in tariff fixation and in issuing of the house service connections.

In schemes 5&6, the required operation and maintenance cost, the proposed house service connections in addition to the public stand posts and the tariff fixation and collection procedures are discussed in the GP meeting. The resolution copy of the GP is submitted to the District collector for the approval of the tariff fixation.

The GPs of the schemes 5&6 are not taken any permission from the Superintending Engineer PRED for the sanction of the house service connections. They provided the house service connections at their will without considering the design parameters.

In all the schemes, the GP is approaching the PRED for the preparation of estimate for the major repairs. More delay was observed in the preparation of the estimates by the PRED. After obtaining the estimate, the GP again called for the General body meeting to approve the administrative sanction. All the expenditure of the O&M is drawn from the general funds of the GP by the Executive officer.

In all the schemes, no complaint book is maintained at GP office. The users are complaining the failure to the Sarpanch / Executive officer in all the schemes. Then the Executive officer/ Sarpanch is taken care of the repair by employing the operator or by the external staff. In schemes 5&6, the GP approached the PRED for technical and financial help in the major breakdowns .

The operating staff is not provided with any preventive maintenance check list and any registers to the operating staff to record the activities in the scheme.

Table 20 - Maintenance of records

Scheme No	4	5	6
Maintaining records	No	no	no
Kind of records	-	-	-

The operators of the schemes of the research study maintain no kind of records.

***Training activities*:** The staff at the studied schemes did not get any external training and only in scheme 4 the operator got trained during the trail period of the scheme by the contractor.

***Spare Parts*:** No reserve stock is maintained at any scheme for immediate use. All spare parts are procured whenever required from the local market. The required chemicals are also purchased every month from the local market. In scheme 4, the spare parts and chemicals procurement is much delayed. Only in scheme 6, the operator is provided with the proper working tools and in other schemes no working tools available.

5.5.1.3 Supervision:

In all the schemes, there is no objective standards or procedures for the supervision of the Executive officer or by the Sarpanch. The supervision in the schemes 4&5 by the Sarpanch/ Executive officer is not regular and in scheme 6, the Sarpanch regularly supervise the scheme and the operator performance.

Only as and when required the PRED officials visits the schemes and gives suggestions to improve the performance of the scheme.

5.5.1.4 Monitoring:

Table 21 - Monitoring of the GP maintained schemes

Scheme No.	4	5	6
Review in meetings	3 months	3 months	3 months
Collection of Water samples	No	no	no

In all the schemes in every three months, a General body meeting is held. In that meeting the performance of the scheme and expenditure etc is discussed. In all the schemes, the GP is not monitoring the quality of the water from the scheme. The PRED officials are only taking the water samples in three to six months.

5.5.1.5 O&M cost: For the year 1996-97

Table 22 - Operation and maintenance cost for the year 1996-97 by the GP.

Scheme No	4	5	6
Salaries 2[2]	4800	21600	19800
Electricity	0*	0**	0*
Chemicals	6695	15000	15120
Spare parts & repairs	9686	9500	18000
	21181	**46100**	**52920**

* The schemes 4 & 6 are non-notified Panchayats and so the State Government pays the entire electricity charges of the water supply schemes.

* * No electricity charges are paying in scheme 5 because one suit was filed in the court of law against the electricity department.

Table shows that the cost of the salaries in the scheme 4 is very less compared to the other schemes and the over all O&M cost is also less. The O&M cost in scheme 6 is higher especially in spare parts and repairs.

5.5.2 Performance of maintenance system

The results of the themes and indicators are described in the following paragraphs

5.5.2.1 Organisation efficiency

The results of the organisation efficiency in the schemes are tabulated in the following table.

Table 23 – Organisation efficiency

Scheme No.	4	5	6
No. of staff/cum/day	0.01	0.02	0.02
Cost of staff/cum/day	0.11	0.49	0.45

From the table, it can be seen that number of staff for cubic meter water production per day in scheme 4 is very low than the other schemes and the staff in other schemes is the same.
The cost of staff for the production of one cubic meter of water in scheme 4 is very low and high in schemes 5 & 6.

2 – This salaries does not include the salary of the Executive officer and this is only salaries of the regular operating staff.

5.5.2.2 Usage

This theme indicates the use of water from the stand post to the different purposes. The results of usage are tabulated in the following table.

Table 24 - Usage of water by the users for different purposes

Scheme No.	4	5	6
No of Users Interviewed	36	36	42
Users using Water for			
Drinking	34	36	42
Cooking	34	36	42
Washing	4	2	8
Bathing	8	3	11
Personal hygiene	32	31	41
Gardening	0	1	7
Cattle feeding	0	0	6

From the table can be seen that almost all the beneficiaries utilise the stand post water for drinking and cooking. In case of scheme 4, only two households are not using this water due to bad taste. They are using water from the existing dug well. The users using the stand post water for personal hygiene purposes after drinking and cooking purposes. After personal hygiene, the users given importance to bathing, then to washing and gardening. In scheme 5 only 8% of users use this water for bathing. In scheme 5, only 6% users use this water for washing. More number of users in scheme 6 use this stand post water for gardening and cattle feeding.

5.5.2.3 Quantity of use

This theme indicates how much water the user gets from the stand post. The users are collecting the water from the SP into a container with a capacity from 15 to 20 liters. The Quantity of water drawn from the stand post was tabulated in the following table.

Table 25 - Quantity of use

Scheme No	4	5	6
Range of the water drawn from the SP in lpcd	7-50	6-40	10-80
Average volume of water drawn from the SP in lpcd	19	15	25
Designed quantity of supply of scheme in lpcd	40	40	40
% of supply	47	37	64

* lpcd - litres per capita per day

It can be observed from the table that the amount of water used per beneficiary in relation to the designed quantity is more (64%) in scheme 6.

In scheme 5, there are seven illegal motor service connections to the commercial purpose.

5.5.2.4 Quality of water

The data of the second parameter collected in sanitary survey during the field visits is tabulated in annex-7. The turbidity of the water sample from the analysis report and the percentage risk of contamination is tabulated in the following table.

Table 24 - Survey of water quality

Scheme No.	4	5	6
Turbidity	10	-	10
Risk of contamination %	54	67	50

The water sample from the scheme 5 is not taken due to the changing of the filter media.

It can also observed that the risk of contamination is more than 50% in all the schemes and very much in scheme 5.

5.5.2.5 Reliability

The data for the indicators of the reliability was tabulated in the following table.

Table 27 - Reliability

Scheme No	4	5	6
No of breakdowns in last 3 months	no	2 (1 to 4days)	no
Delivery time schedule	60 min(M)	110 min (M) 95 min (E)	50 min (M) 50 min (E)

*M-Morning ; E-Evening

It can be seen from the table that two breakdowns occurred in the scheme (5) and the time taken for those repair from 1 to 4 days. No breakdowns were noticed in schemes (4) & (6) during the last three months before the research study but in last summer (May, 1997) major

breakdown of the scheme (4) was observed in quantity of raw water collection and the scheme was closed for 45 days.

In schemes 5 & 6, the water is released in morning to the left side and in the evening to the right side of the scheme. In all the schemes, the change of time in delivery is informed to the users well in advance.

5.5.2.6 Continuity

The number of hours of supply of water per day was collected and tabulated in the table below.

Table - Continuity

Scheme No.	4	5	6
No. of hours supply/24 hrs	1/24	1.71/24	0.83/24

The scheme 5 has a higher continuity than other schemes.

5.5.2.7 Maintenance of Systems components

The data on the maintenance system i.e. leakages of taps and the environment of the stand post is tabulated in the following table.

Table 29 - Maintenance systems components

Scheme No.	4	5	6
Leakage of tap			
No. of SP's leaking /No of SP's visited	(2/21)	(5/20)	(2/18)
% leakage	10	25	11
Environment of SP			
No. of SP's with out proper drainage/ No of SPs visited	(5/21)	(15/20)	(6/18)
% with out proper drainage	24	75	37

From the table, it can be seen that about 10% of the taps are leaking in case of schemes 1&6 and that the percentage of leaking taps is as high as 25% in scheme 5.

It is also found from the table that the bad environment of SP is highest in scheme 5 followed by scheme 6 and 4

5.5.2.8 Use of other sources

The data of the use of the other sources of water by the users is tabulated in the following table.

Table 30 – Use of other sources

Scheme No.	4	5	6
No. of user's using OS/ No. of user's interviewed	94%	97%	49%

In all schemes most the users are using other sources of water for different purposes such as for bathing, washing of cloths, cattle feeding etc In scheme 6 the number of users using other sources was low.

5.5.2.9 Users satisfaction

The data of the users satisfaction on the performance of the scheme is tabulated in the following table.

Table 31 – Users satisfaction

Scheme No.	4	5	6
No. of users satisfied with the performance of the scheme/ No. of user's interviewed	30/36	22/36	33/42
% of users Satisfaction	83	61	79

From the table, it can be seen that more users are satisfied in scheme(4) & (6) and less satisfaction was seen in the scheme(5).

5.5.2.10 Cost Recovery

Table 32 - Cost recovery

Scheme No.	4	5	6
No. of SP	34	36	35
No. of HC	-	195	425
Collection of water tax (for stand post)	no	20% levy on house tax yearly	20% levy on house tax yearly
Collection of tariff (for house connection)	no	Rs 10/- per HC/ month	Rs 20/- per HC/ month
Collection on water	nil	48606	103929
Expenditure	21181	46100	52920
Revenue /Expenditure	0	1.05	1.96

The GP maintained schemes 5&6 are provided with house connections in addition to the public stand posts. In these schemes water tax of 20% over the annual house tax was collected from the users of the public stand posts and water tariff of Rs 10/- & Rs 20/- per month per house hold was collected from the users of the house service connection in the schemes 5 & 6 respectively.

From the table, it can be seen that about 100% cost recovery was observed in case of scheme5 and nearly 200% cost recovery was observed in scheme 6. The excess recovery funds are kept under a reserve fund and the Sarpanch has been using that fund as contribution to the Government for laying of extension lines and for construction of new stand posts etc,.

In scheme 4, no house service connections are provided and no cost recovery was implemented by the GP. The recovery of the house taxation is also poor. It is also observed that more illegal house service connections are existed in the scheme. The Sarpanch also had the illegal house service connection.

In the scheme 4, 50% of users are willing to pay the O&M cost and 20% of the households preferred house service connections.

5.5.2.11 O&M capacity

The data on the performance of the operator and availability of working tools collected during field visits, users interviews, and operators interviews is tabulated in the following table.

Table 33 – O&M capacity

Scheme No.	4	5	6
Performance of operator	good	good	good
Availability of work tools	poor	poor	moderate

It can be seen from the table that all operators performance was good according to the users but the performance of the operators in scheme 5 & 6 was not good especially in maintenance of the filters.

The availability of working tools was moderate in scheme 6 and poor in case of the remaining schemes.

Chapter 6

DISCUSSIONS

This chapter provides an over view of the relationship with the indicators selected in the present study for the description of the organisation set-up of the two system for the maintenance of the piped water supply schemes and to review the performance of the maintenance systems. The chapter starts with the discussion on the organisation set-up of PRED and GPs for the maintenance of the schemes and relationship of various parameters involved in the present study. Further, it describes the relationship of various components with the performance of the piped water supply maintenance systems in the study area.

6.1 Organisation set-up

In the literature reviewed earlier in chapter 3, the information about the organisation set-up and its management system was described. In the literature review section, the main activities in the over all management are listed and the possible relationship of the selected indicators with the organisation set-up are explained. The following paragraphs explain the relationship of the indicators selected with the PRED set-up and the GP set-ups for the maintenance of the piped water supply schemes.

6.1.1 Staffing

Table 34 - Staff working in the schemes

Schemes maintained by	**PRED**			**GP**		
Scheme number	**1**	**2**	**3**	**4**	**5**	**6**
Works Inspector	1	2	1	-	-	-
Pump Operators	2	2	2	1	1	1
Valve operator	-	-	3	-	-	-
Electricians	-	-	1	-	-	-
Watch man	-	-	2	-	1	1

There is no definite policy and guideline for the staffing required for the operation and maintenance of the piped water supply schemes. In all the schemes, the operating staff is not permanent and the staff is taken only on contract basis. The operating staff in all schemes was unsatisfied with their salaries.

The above table shows that the staff at the schemes is inadequate when compared with the staff in literature (KWA study report). Only in scheme 3, the operating staff is more when compared with the other schemes of the research study. Very less number of staff is working in scheme 4. The main constraint for the under staffing is lack of funds, lack of guidelines and policy. In PRED set up the operating staff is working in shift duties and in GP set up the operating staff are working without any shifts and they also attending to the plant site in the nights. The operating staff in GP set up is over loaded with the work. More staff is working in PRED schemes (ranging

from 3-9) than the GP schemes (ranging from 1-2).

The responsibility of the operating staff in the PRED is pertaining to the O&M of the scheme but the responsibility of the operating staff in the GP is pertaining not only to O&M of the scheme but also to the other GP works. So some times, they are diverted from the duty of the O&M.

6.1.2 Management system

In the PRED maintained schemes, all the schemes are facing the funds problem for the operation and maintenance may be due to less O&M budget allocated by the government. The schemes under GP are not facing funds problem except in scheme 4 may be due to water taxation on public stand posts and water tariff on house service connections. In scheme 4, water taxation is not implemented by the GP for the stand posts may be due to the poor community and the collection of house tax is less. The GPs are facing the delay problem in the technical sanctions for the major repairs by the PRED.

In the PRED maintained schemes, for some extent the operating staff is implementing the preventive maintenance checklist and maintaining the record on the overall activities of the scheme but in case of GP, they are not maintaining any kind of plant records. The record maintenance is very important activity for the evaluation of the performance of the scheme but the information about the scheme performance was not found in any schemes of the GP. It reveals the actual performance of the implementing agency. This may be due to lack of knowledge in the agency.

In the PRED schemes, the complaints are all noted in the registers where as in GP there are no complaint registers and so there is no monitoring on the complaints in GP system. In some cases the GPs are more effective than the PRED in rectifying the repairs may be due to the powers of the Executive officer and high centralisation in PRED.

In all the schemes, the knowledge base of the plant operators and supervisory staff on the slow sand filtration is very poor may be due to lack of training.

In PRED schemes, the maintenance of reserve stock of the spare parts and chemicals is also not adequate and also proper working tools are not available for the field staff except in scheme 3 may be due to the lack of funds and lack of purchasing powers to the Dy.EE and AEE/AE. In addition, the high centralisation in the department leads to the delay in procurement of materials. In the GP schemes, the agency is empowered to purchase any materials such as spare parts and chemicals etc. but the agencies are not maintaining any reserve spare parts and chemicals this may be because they are not aware of the down time of the breakdown and lack of knowledge about the O&M.

6.1.3 Supervision

Closer supervision was observed in PRED maintained schemes than the GP maintained schemes except in scheme 6. In scheme 6, the Sarpanch is always in close contact with the operator and supervises the performance of the scheme. In some times supervision of the PRED staff is also lacking due to over burden of the construction activities and low importance to the O&M.

Technical supervision is lacking in GP maintained schemes and so the maintenance of the filters, such as minimum filter media depth, is lacking in these schemes except in scheme 4 due to trained operator.

6.1.4 Monitoring

In PRED maintained schemes the staff are taking the water samples for quality monitoring and in GP schemes, there is no quality monitoring by the agency. This situation may be due to lack of proper knowledge on the operation and maintenance by the maintenance agency and lack of proper training. Monitoring on the scheme and operator performance is very effective in PRED and less effective in GP because of the proper maintenance of the records.

6.1.5 O&M cost: For the year 1996-97

Table – 35 operation and maintenance cost

Scheme No	**1**	**2**	**3**	**4**	**5**	**6**
Salaries	61440	99840	161451	4800	21600	19800
Electricity	13644	44304	0*	0*	0**	0*
Chemicals	26420	36800	36620	6695	15000	15120
Repairs	28520	35650	44211	9686	9500	18000
	130024	**216594**	**242282**	**21181**	**46100**	**52920**

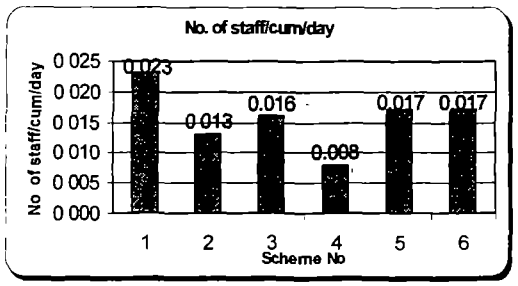
* For the schemes in the non-notified Panchayats, the Government pays the entire electricity charges of the water supply schemes.

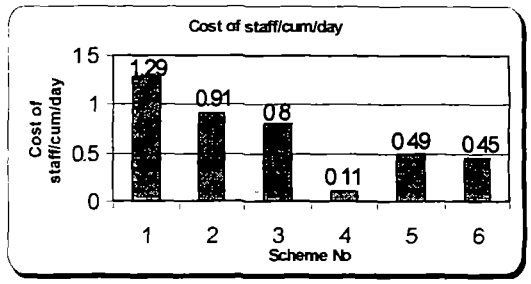
* * No electricity charges are paying because one suit was filed in the court of law against the electricity department.

It may not be possible to compare the operation and maintenance cost of the PRED schemes and the GP schemes because the schemes under the PRED are bigger than the GP schemes in production capacity, size of the plant and distribution area.

6.2 Performance of maintenance systems

6.2.1 Organisation efficiency





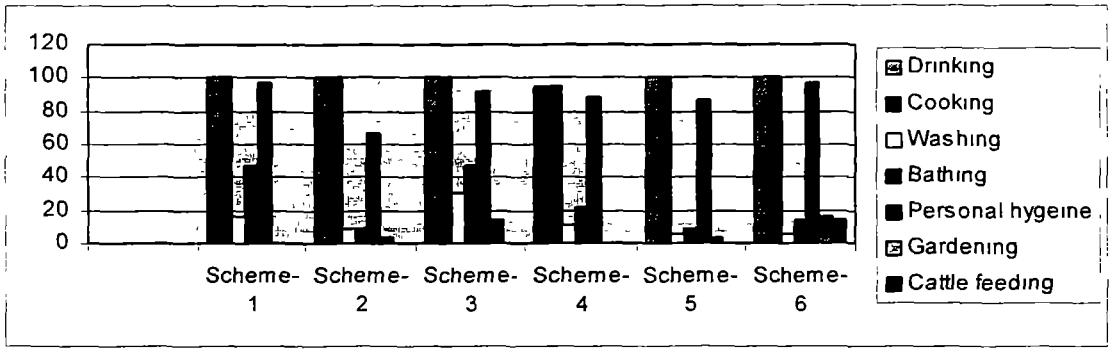
From the graphs , it can be seen that number of staff working for production of one cubic meter water per day in scheme 1 is more and staff in scheme 4 is very low and in other schemes, the staff working is almost same. Comparison mayn't be done because although the scheme 1 is

running with the minimum staff , the staff per cubic meter per day is very high.

From the graph of number of staff per cubic meter production of water per day, the staff in PRED maintenance schemes is higher than the GP schemes because in PRED maintaining schemes the staff is working in shifts and in GP schemes the staff is working without shifts. The staff of the GP is therefore overloaded than the PRED staff.

From graph 2, it is found that the cost of staff in the schemes of PRED is higher than the GP schemes because staff that are more technical are working in these schemes. The cost of staff in scheme 4 is very low because of the low salary of the operator (Rs 400 per month).

6.2.2 Usage

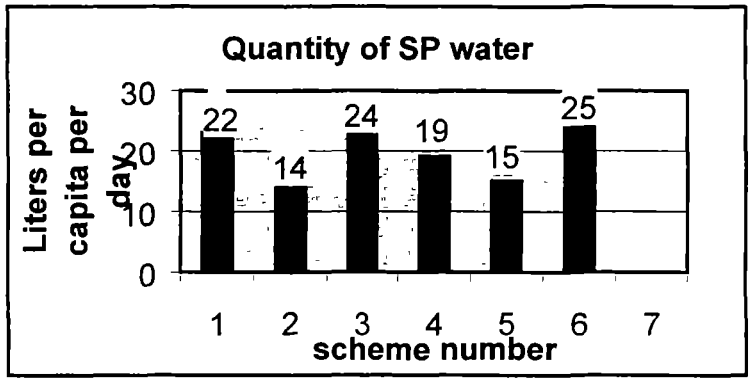


From the Graph, it is found that in all the schemes the users using the stand post water in the following priority: drinking, cooking, personal hygiene, bathing, washing, gardening and cattle feeding.

It can be seen that almost all users of all schemes utilise the stand post water for drinking and cooking in PRED schemes. In case of scheme 2, only 67%, users are using the SP water for personal hygiene because water from the stand post was not sufficient.

In GP schemes, also almost all users of all schemes utilise the stand post water for drinking and cooking except in scheme 4 of GP. In case of scheme 4, only two households are not using this water may be due to bad taste and they are using the existing dug well water More number of users in scheme 6 use this stand post water for gardening and cattle feeding may be due to the higher number of house service connections.

6.2.3 Quantity of use

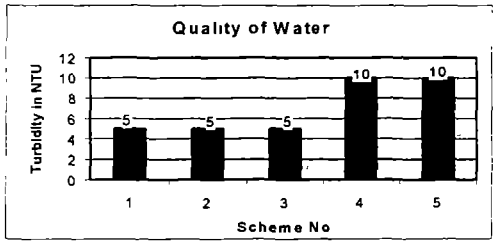


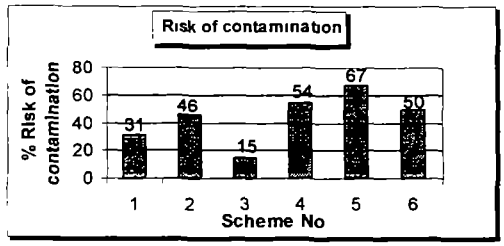
In all schemes under the study, the users getting water below the government norms i.e. 40 litres per capita per day.

In PRED maintenance schemes, users are getting water more than 22 litres per capita per day in two schemes 1&3 and below 15 litres per capita in scheme 2. The less quantity of water may be due to low filtration rates, leakage's, wastage of water at stand posts, lack of power supply, lack of proper monitoring of the performance of the scheme. In scheme 2 very low quantity of supply may be due to the non-utilisation of the third filter, inadequate staff in addition to the causes mentioned earlier.

In GP maintained schemes the users are getting more than 25 liters per capita in scheme 6 may be due to the close supervision of the Sarpanch, no illegal house service connection, less leakage's. Less quantity of water in scheme 5 i.e. below 15 liters per capita may be due to less supervision, more leakage's, wastage at stand posts and mainly due to 7 illegal motor connections to the commercial purposes.

6.2.4 Quality of water





From the Graphs, it is found that turbidity is higher in case of schemes maintained by the GP than the PRED schemes may be due to mainly lack quality monitoring in the system. It can also observed that the risk of contamination (Annex -7) is less in schemes maintained by the PRED except the scheme 2 may be due to the inadequate staff and also lack some training. Maximum risk of contamination (67%) observed in scheme 5 may be due to the lack of monitoring, more leakage's and lack of training.

6.2.5 Reliability

1. Number of breakdowns in last three months and time taken for repair
2. Delivery time schedule

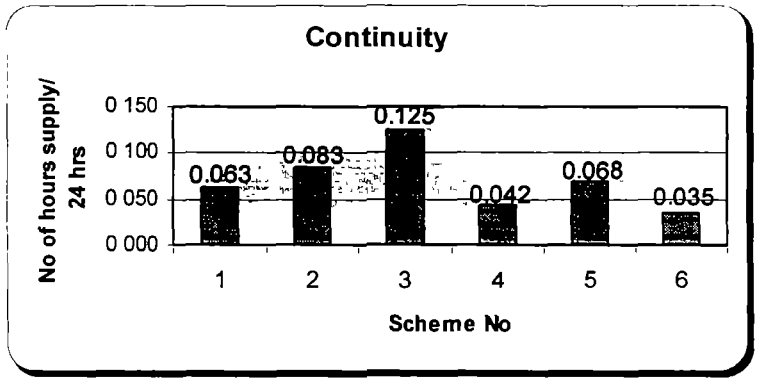
Scheme No	1	2	3	4	5	6
No. of breakdowns in last 3 months	1 (1day)	1 (7days)	no	no	2 (1 to 4days)	No
Delivery time schedule	90 min (M)	120 min M)	180 min (M)	60 min (M)	110 min (M)	50 min (M)
			180 min (E)		95 min (E)	50 min (E)

M-Morning ; E-Evening ; (*) down time

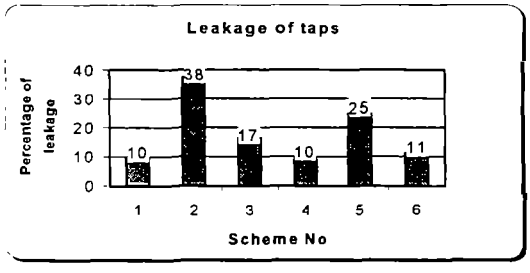
It can be seen from the table that only one breakdown occurred in first two schemes but the time taken for that repair is higher in case of scheme 2 may be due to inadequate staff. No breakdowns were noticed in schemes 3,4 and 6 during the three months before the interview time but in scheme 4 major breakdown occurred in the last summer for nearly 45 days may be due to non-availability of raw water. This is may be due to non-awareness of the operating agency, power supply problem and lack of funds. In case of scheme 5 two breakdowns occurred and the time taken to repair that breakdown was 1 to 4 days may be due to inadequate staff and lack of proper working tools.

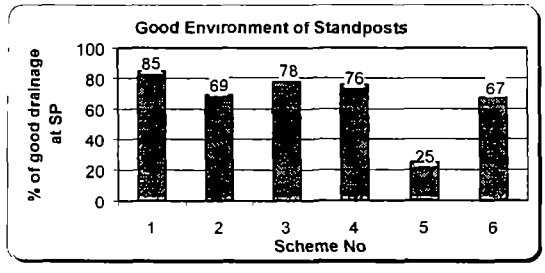
6.2.6 Continuity

It is evident that the schemes maintained by the PRED have the more continuity than the GP schemes. The scheme 3 has a higher continuity than other schemes may be due to the supervision, higher staff and training.



6.2.7 Maintenance of Systems





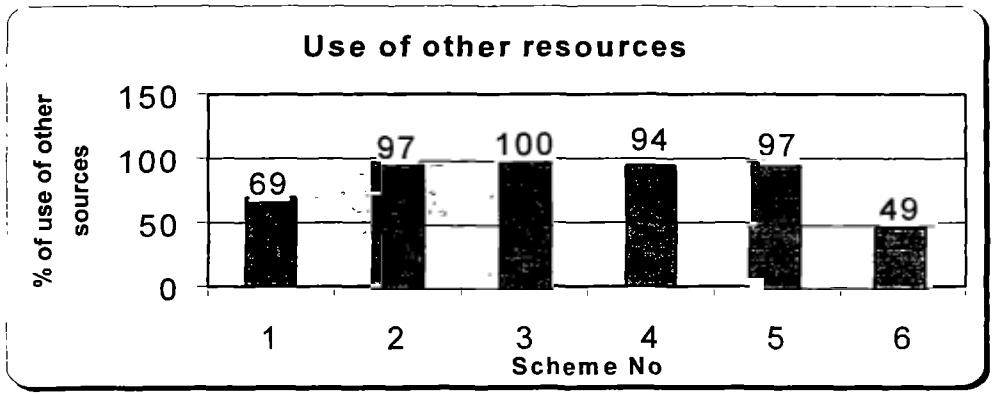
From the graphs, it can be seen that in PRED schemes, less percentage of taps are leaking in scheme 1 than the other schemes may be due to co-operation of the users and the strong village committee. Very high percentage of taps is leaking in scheme 2 may be due to under staff and lack of co-operation in the users.

In GP schemes, only 10% of the taps are leaking in schemes 4 & 6 may be due to the some training to the operator from the contractor in scheme 4 and good leadership of the Sarpanch and his supervision and the villagers co-operation in scheme 6. The percentage of leaking taps is found in scheme 5 is high may be due to the inadequate staff, inadequate supervision, and monitoring and non co-operation in the users.

It is also found from the graph that the environment of stand post in PRED schemes is (85%) good in scheme 1 and (75%) in scheme 3 may be due to the users co-operation in scheme1, supervision and quality monitoring in the schemes

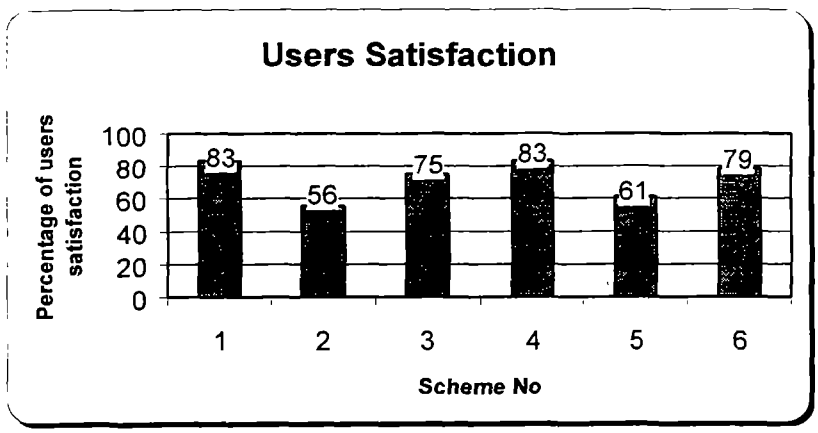
The environment of the stand post in scheme 5 of GP is very poor and this may be due to inadequate supervision, quality monitoring and non co-operation by the users.

6.2.8 Use of other sources



In all the schemes of the PRED and GP the users are using the other sources of water may be due to less quantity of water supply from the schemes than the designed quantity. In four schemes i.e. schemes 2 & 3 in PRED and two schemes 4 & 5 in GP, most of the users are using other sources of water for different purposes such as for bathing, washing of cloths, cattle feeding etc. In scheme 6, the number of users using other source is low, may be due to a high number of house service connections. In case of scheme 1, a lower number of users using the other sources may be due to the less number of cattle and less gardening.

6.2.9 Users satisfaction



From the graph, it can be seen that 83% users were satisfied in scheme 1 of the PRED and in scheme 4 of GP due good overall performance of the scheme in respect of quantity and quality of supply of water and less satisfaction was seen in the scheme 2 may be due to insufficient water and reliability of the scheme. In detail·

Users satisfaction in

Scheme No	Quantity %	Quality %
1	83	100
2	58	94
3	75	100
4	89	94
5	61	83
6	83	95

The least 58% satisfaction on quantity was observed in scheme 2 may be due to the leakage's in the distribution system and non-production of the designed quantity .

In scheme 5 only 61% users satisfaction was observed may be due to 7 illegal motor connections on the main distribution line and the EO / lady Sarpanch could not able to disconnect those illegal connections.

In PRED schemes 1 & 3, 100% users were satisfied with the quality of water supply and only 94% satisfaction was observed in scheme 2 may be due to bad taste of bleaching powder In schemes 4 & 6 almost 95% satisfaction was observed because their traditional source of water (canal) was very contaminated and their shallow dug wells contain saline water. Out of the all schemes ,scheme 5 was least satisfied (83%) may be due to the coloured water from the stand post. This might be due to some soil was entered into the distribution system when the pipeline was repaired and also in this scheme no scour valves only dummies are existing and this implies the performance of the operating agency.

6.2.10 Cost Recovery

In RWS maintained schemes, only stand posts are provided and no water tax is collected from the users.

In GP maintained schemes, the scheme 4 is provided with only stand posts and the schemes 5 & 6 are provided with stand posts and house service connections and in the last two schemes water tax is collected from the users.

The 100% cost recovery of the O&M cost in scheme 5 may be due to high number of house connections and proper water tax collection by the GP. The high 200% of recovery in scheme 6 was mainly due to the high number of house connections, capable Sarpanch and co-operation

among the villagers.

6.2.11 O&M capacity

Operators performance was good in all schemes of the PRED and availability of working tools was good in scheme 3. The O&M capacity in scheme 3 of PRED is good may be due to the technical staff, close supervision, monitoring and high number of operating staff.

In GP schemes, all operators performance was good according to the users view but the performance of the operators in scheme 5 & 6 was not good especially in maintenance of the filters (in field observation by the researcher). The availability of working tools was moderate in scheme 6 and poor in case of the remaining schemes.

In general the O&M capacity of the scheme 6 is good may be due to the co-operation among the villagers, good revenue collection and good leadership of Sarpanch and his supervision in addition to the above said things.

Chapter -7

CONCLUSIONS AND RECOMMENDATIONS

This chapter provides the general findings obtained in the present study in two sections, one under the organisation set-up of (PR) RWS and GPs and second under the performance of the maintenance systems. It gives a few recommendations of the study to improve the performance of the present maintenance systems.

7.1 Conclusions

The conclusions drawn from the study on the organisation set-up and performance of maintenance system of the PRED and GP regarding the operation and maintenance of the piped water supply schemes.

7.1.1 Organisation set-up

7.1.1.1 PRED

- There is no definite policy and guidelines for the staffing required for the operation and maintenance of the piped water supply schemes. At present the maintenance system is under staffed when compared with the staffing in KWA and there is a requirement of additional staff to run the system properly.

- Also there is no job satisfaction among the operating staff as their appointment was on contact basis, more working hours and less salaries.

- Though there are guidelines for preventive maintenance, the level of preventive maintenance is found poor.

- The most important plant records with respect to raw and filtered water qualities, filtration rates are not maintained.

- There is a high degree of centralisation and inadequate delegation of power to the Sub-divisional and Section officers. Power may be delegated to the lower level staff to purchase the immediate required spare parts and chemical with out any delaying departmental procedures.

- There are no trained operating staff and the knowledge base of the plant operators and supervisory staff on slow sand filtration is poor, thereby adversely affecting the performance of the filters.

- There is no objective standards set for supervision and monitoring processes and there is no effective monitoring system in the present organisation. There is no proper feedback of the system to the management levels for evaluation of performance of the maintenance system and to improve the performance of the operating staff.

7.1.1.2 Gram Panchayat

- The present maintenance system is under staffed and the operating staff was engaged in other works not pertaining to the water supply scheme and there is a requirement of additional staff to run the system properly.

- There is no job satisfaction among the operating staff as their appointment was on contact basis, more working hours and very less salaries.

- There are no guidelines for preventive maintenance and the level of preventive maintenance is very poor.

- The most important plant records with respect to pumping and filtration schedule, filter cleaning, record on breakdown of the plant, the raw and filter water quality, filtration rate are not maintained.

- Powers are delegated to the Executive officer/ Sarpanch to purchase the immediate required spare parts and chemical with out any delay once the budget was approved in the General body meeting.

- There are no trained operating staff and the knowledge base of the plant operators and supervisory staff on slow sand filtration is poor, thereby adversely affecting the performance of the filters.

- There is no objective standards set for supervision and monitoring processes and there is no effective monitoring system in the present organisation. There are no technical persons to supervise and monitoring the system performance and they are always depends upon the PRED for technical help.

- The collection procedure of the water tax is found good.

7.1.2 Comparison of Performance of the maintenance systems of PRED and GP

The following conclusions have drawn from the study regarding the performance of the maintenance system.

- The organisation efficiency of the Gram Panchayat is found high when compared with the PRED but the technical knowledge is very less in GP.

- In both the systems the quantity of water getting by the users is below the government norms i.e. 40 litres per capita per day. In both the systems the quantity of water drawn by the users from the stand posts is less than the designed quantity. On average the users from GP are getting 49% of the designed quantity where as the users in PRED are getting 42%.

- The quality of the water from the PRED system is good when compared with the GP system. The turbidity values of the filtered water in the GP system are very high and this may be due non-technical persons and lack of quality monitoring.

- The risk of contamination in the PRED systems is less than the GP systems. The high risk of contamination may be due to lack of monitoring, training, technical knowledge, villager's co-operation and inadequate staff.

- The reliability of the schemes under PRED is higher than the GP schemes and the downtime is also less but in some cases higher may be due to under staffing. Major downtimes occurred in GP schemes may be due to non-awareness of the agency (Scheme 4), less monitoring, power supply problems and lack of funds.

- The continuity of the schemes under PRED is more than the schemes under GP.

- Leakage's of the stand posts in the PRED system are 5% more than the GP systems but the bad environment of the stand post i.e. without proper drainage is observed 100% less than the GP systems.

- More number of users using the other sources of water in both the systems to the purposes of bathing, washing of clothes and for cattle feeding.

- User satisfaction on the performance of the maintenance is found more in GP systems (75%) than the PRED systems (61%). This may be due to insufficient quantity of water from the stand post and quality of the water from the stand post.

- More number of house service connections are provide in the GP schemes which is against the design criteria but the cost recovery of the O&M cost is very good. In the schemes under PRED have no house service connections and hence no cost recovery is implemented. In most of the times, the PRED is facing funds problem for the effective operation and maintenance. The schemes under GP are more financially sustainable than the PRED schemes.

- Operation and maintenance capacity in high in case of PRED due to technical supervision, quality monitoring and more staff than the GP.

7.2 Recommendations

The following recommendations are suggested for the improvement of the existing systems of the both agencies.

7.2.1 PRED

- At present there is no systematic guide lines and policies on the operating staff pattern and also on the supervision and monitoring processes and so setting up of the guidelines for the staffing pattern and also to the supervision and monitoring processes.

- At present the operating staff in the system is not sufficient and hence additional staff recruitment is required.

- Specific guidelines on the qualification and experience should be given to recruit the operating staff.

- Level of preventive maintenance is low and so stress should be given on the implementation of the preventive maintenance and also rewards should be introduced to encourage the performance of the operators.

- Proper maintenance of the records should be insisted regarding the quality of waters and also filtration rates.

- Powers should be given to the sub division level for immediate procurement of spare parts and chemicals.

- Proper working tools should be supplied to the operating staff.

- The knowledge base of the operating staff and supervisory staff on slow sand filtration is poor and hence proper training should be given to them.

- In order to make the schemes financially sustainable, at least 40-50% house holds should be given house service connections and the per capita design quantity also should be enhanced from 40 litres per day to 70 litres.

- Strict cost recovery should be implemented and the Government should give the powers to the agency.

- All the staff in the rural water supply schemes are more engaged in the work when compared with the regular Panchayati Raj staff as it is an important and emergency work. So some incentives may be given to the rural water supply staff.

7.2.2 Gram Panchayat

- This system is also functioning with under staff so immediate recruitment of the staff is required to work on shift wise.
- Powers should be given to the Sarpanch/ Executive officer to recruit the permanent operating staff or with some attractive salaries to the operating staff. The operating staff should not be engaged on extra work other than the water supply scheme.
- Preventive maintenance list should be given to the operating staff and agency should monitor the implementation of the preventive maintenance.
- Record on the operation and maintenance of the scheme should be should be maintained properly by the operating staff.
- The reserve stock of the required spare parts and chemicals should be maintained.
- Proper working tools should be given to the operating staff.
- In this system there is no technical knowledge persons to implement or supervise and monitoring the performance of the scheme. So training should be given to the operating staff and also to the Sarpanch/ Executive officer for the proper performance of the scheme.
- Regular quality monitoring should be done by the operating agency. Water sampling and analysis of the samples at the divisional laboratory of PRED should be implemented.
- Excessive house service connections should be avoided and permission should be taken from the Superintending Engineer Panchayati Raj before giving any such connection.
- All illegal house service connections should be made as legal house service connections by imposing some extra amount.
- Transparency of accounts should be made.
- The technical support of the PRED should also be extended in future.

Annex-2

Concept page for community description

Name of the District :

Name of the Mandal :

Name of the village :

Area of the village :

Distance from the nearest town :

Population :

No.of houses :

Access to media :Telephone/ Radio/TV/ News papers/ Cinema hall

What are types of committee existing in this village :

What are the activities of that committee :

Coverage of water supply by : MPWS / CPWS

Maintained under : PRED/ GP

Other water sources : Hand pumps/open wells

Village map showing the locations of the stand posts, other scheme details and other traditional water sources will be drawn for each village visited.

Annex-3

Checklist for collection of data from PRED/GP for individual schemes

Organization

1. Number of staff per scheme
2. What are there roles and responsibilities
3. How they are managing the O&M
4. What kind of registers are being maintained
5 How they are attending to the failures of the scheme
6. What are the training activities
7. How they are managing the spare parts
8. What are the procedures adopting for supervision
9. How they are monitoring
10. What is the O&M cost
11 What is the cost recovery
12. What are the norms for fixation of tariff
13. How they are collecting the tariff

Annex -4

Users questionnaire

1. How many persons are there in your house .
2. How much water do you get daily from the SP :
3. How much water do you get daily from other sources :
4. Is the water from SP sufficient :
5. What do you think of the quality of the water :
6. How many hours you are getting water per day :
7. Are you getting water regularly at the same time :
8. What kind of breakdowns occurred during last 3 month :
9. How much time they taken to repair that breakdown :
10. Do you know who is doing the O&M work :
11. How do you feel about operator performance:
12. Who takes care of the cleanliness of the standpost site :
13. Who bears the O&M cost :
14. How much your are paying for the O&M cost :

Observation sheet

How is the water stored in the house for drinking ?

Are they keeping lid over the pot - Y/N

What is the environment of the pot - G/P

How they are taking water from the pot

- Using one cup and pouring water into the other glasses and keeping that cup in hygiene place
- Using long handle utensile and hanging to the wall
- Directly dipping the glass and taking water
- Others - - -

Annex-5

Scheme operator questionnaire

1. Name of the operator :
2. Qualification :
3. Experience :
4. Have you got training : Y/N
5. What kind of training undergone :
6. Do you have the preventive maintenance check list: Y/N
7. Are you releasing water at the same time as per the schdule: Y/N
8. How many hours do you release the water :
9. Are you maintaining any records : Y/N
10. What are they :
11. Are you chlorinate the water : Y/N
12. How do you chlorinate the water :
13. What are the major breakdowns of the scheme :
14. If the breakdown exceeds your repair skill, what will you do:
15. Are you faced any problem with spare parts, tools, etc., :
16. Who pays your salary :
17. Who pays the O&M charges :
18. Who will Supervise this scheme :

Operator performance -by TIME LINE

To know the knowledge of the operator about the slow sand filter , I will ask what is the main important activity in the SSF. From that I can assess his daily operating procedure.

Annex-6

Source -use Matrix

Purpose	Source of water								Reasons if any
	SP water		Hand pump		Dug well		River/ canal		
Season	wet	dry	wet	dry	wet	dry	wet	dry	
Drinking									
Cooking									
Washing									
Bathing									
Personal hygiene									
Gardening									
Cattle feeding									

Annex-7

Sanitary survey for the assesment of risks of contamination of drinking water source (Lloyd ,B. et al ,1991)

S.No	Description of source of contamination	Risk	
		Yes	No
1	Is there any open defication at intake point of the source?		
2	Is there any transmission pipe crossing the drainage?		
3	Is the reservoir protected from animals etc?		
4	Is the filtration not continuied?		
5	Are they distributing the water to the public without allowing repening time after breakdown?		
6	Are the Valve pits insanitary?		
7	Is the inspection cover on the reservoir insanitary?		
8	Are any air vents insanitary?		
9	Do the roof and walls of the reservoior allow any water to enter?		
10	Is the reservoir water unchlorinated?		
11	Are the distribution pipes crossing the drainage?		
12	Is pressure low in any part of the distribution system?		
13	Are the labours not wearing Hygeine shoes while cleaning filters?		
	TOTAL		

Annex-8
Observation sheet of scheme

Intake condition

Inlet position - one level
- multi level
Inlet sccren - Good/ poor

Transmission main

Leakage - Y/N
Air valve condition - Good/poor

Summer stogage tank

Condition of the bund- G/P
Seepage - Y/N
Algae present - Y/N

Slow sand filters

Provision of inlet weir- Y/N
Provision of outlet weir- Y/N
Depth of supernatant water -?
Depth of filter bed -?
Provision for charging arrangement from the bottom?
Condition of the supernatant box? - G/P
Provision of scum layer removing outlet -Y/N
Sand washing facility - Y/N
Where they kept the scraped sand?
Filteration continuity
Allowing for ripening period - Y/N
Filtration rate
No. of cleanings / year

Clear water reservoir

Environment of CWR - G/P

Good ventilation - Y/N

Leakage of side walls/dome - Y/N

Chlorination arrangement - Y/N

Over head reservoir

Leakage of side walls/dome - Y/N

Distribution system

Leakage - Y/N

Pressure - G/P

Sluice valve condition - Good/poor

Scour valve condition - Good/poor

Flow measuring devices - Y/N

Pumps

No. of pumps working- ?

Present discharge - ?

Leakage - Y/N

Sound - Y/N

Condition of pump - G/P

Log report - Y/N

Electical connections

Earthening condition - G/P

Proper insulation - Y/N

Proper maintenance of fuse carriers - Y/N

Loose wire connections - Y/N

USER QUESTIONAIRE

Name of the Scheme	No of persons in the house	Qty from SP in ltrs	Avg SP liters per capita/day	Qty from OS in ltrs	Avg OS liters per capita/day	Sufficent / Not sufficient	Quality of water	No of hours getting water	Getting water at same	Kind of break down	Time for repair	Who is doing O&M	Operator per-formance	Who cleans the SP	Who bears the O&M cost	How much paying for O&M
1,CPWS Scheme to corangi & other villages																
Tap No 1	7	200	29	-		S	G	90 min	ST	PR	SD	GT	G	US	ZP	Nil
	6	200	33	-		S	G	90	ST	No	No	ZP	G	US	ZP	Nil
	6	200	33		0	S	G	90	ST	PR	SD	ZP	G	US	ZP	Nil
	2	50	25	-		NS	G	90	ST	PR	SD	ZP	G	US	ZP	Nil
	7	150	21	-		S	G	90	ST	No	No	ZP	G	US	ZP	Nil
	4	150	38	-		S	G	90	ST	PR	SD	GT	G	US	ZP	Nil
	32	**950**	**30**	**0**	0											
Tap No 2	5	100	20	120	24	S	G	90	ST	PR	SD	GT	G	US	GT	Nil
	7	100	14	120	17	S	G	90	ST	PR	SD	ZP	G	NB	ZP	Nil
	10	150	15	120	12	S	G	90	ST	PR	SD	GT	G	NB	GT	Nil
	4	100	25	60	15	S	G	60	ST	PR	2days	ZP	G	US	ZP	Nil
	6	100	17	120	20	S	G	60	ST	PR	SD	GT	G	US	GT	Nil
	3	75	25	120	40	S	G	90	ST	PR	SD	GT	G	US	GT	Nil
	35	**625**	**18**	**660**	**19**											
Tap No 3	6	160	27	80	13	S	G	90	ST	PR	SD	ZP	G	US	ZP	Nil
	6	160	27	80	13	S	G	90	ST	NK	SD	ZP	G	US	ZP	Nil
	5	160	32	120	24	S	G	90	ST	NK	SD	GT	G	NB	GT	Nil
	3	80	27	80	27	S	G	90	ST	PR	SD	ZP	G	US	ZP	Nil
	6	180	30	60	10	S	G	90	ST	PR	SD	ZP	G	US	ZP	Nil
	3	100	33	60	20	S	G	90	ST	PR	SD	ZP	G	US	ZP	Nil
	29	**840**	**29**	**480**	**17**											
Tap No 4	5	100	20	80	16	S	G	90	ST	PR	SD	GT	G	US	GT	Nil
	7	100	14	100	14	NS	G	90	ST	PR	SD	ZP	G	US	ZP	Nil
	4	100	25	60	15	S	G	90	ST	PR	SD	ZP	G	US	ZP	Nil
	5	75	15	60	12	NS	G	90	ST	PR	SD	ZP	G	US	ZP	Nil
	7	100	14	80	11	S	G	90	ST	PR	SD	ZP	G	US	ZP	Nil
	5	100	20	40	8	S	G	90	ST	PR	SD	ZP	G	US	ZP	Nil
	33	**575**	**17**	**420**	**13**											
Tap No 5	6	160	27	-		S	G	90	ST	PR	SD	GT	G	US	GT	Nil
	6	160	27	-		S	G	90	ST	PR	SD	ZP	G	US	ZP	Nil
	6	120	20	60	10	S	G	90	ST	PR	SD	ZP	G	US	ZP	Nil
	3	80	27	-		NS	G	90	ST	PR	SD	ZP	G	US	ZP	Nil
	6	120	20	60	10	S	G	90	ST	PR	SD	ZP	G	US	ZP	Nil
	2	60	30	40	20	S	G	90	ST	PR	SD	ZP	G	US	ZP	Nil
	29	**700**	**24**	**160**	**6**											
Tap No 6	6	100	17	60	10	S	G	90	ST	NK	SD	GT	G	US	GT	Nil
	5	100	20	40	8	S	G	90	ST	NK	SD	ZP	G	US	ZP	Nil
	11	200	18	80	7	S	G	90	ST	PR	SD	ZP	G	US	ZP	Nil
	3	75	25	-		NS	G	90	ST	NK	SD	ZP	G	US	ZP	Nil
	4	100	25	-		S	G	90	ST	PR	SD	ZP	G	US	ZP	Nil
	9	100	11	80	9	NS	G	90	ST	PR	SD	ZP	G	US	ZP	Nil
	38	**675**	**18**	**260**	**7**											
Total	**196**	**4365**	**22**	**1980**	**10**											

2,CPWS Scheme to Tallarevu & other villages

Tap No 1	6	60	10	200	33	NS	G	120	ST	NK	-	ZP	G	NB	ZP	Nil
	5	60	12	200	40	NS	G	120	ST	PR	4days	ZP	G	NB	ZP	Nil
	5	200	40	-		S	G	120	ST	PR	5	ZP	G	NB	ZP	Nil
	4	120	30	200	50	S	G	120	ST	PR	7	No	G	NB	NK	Nil
	2	40	20	40	20	S	G	120	ST	PR	7	ZP	G	NB	ZP	Nil
	5	60	12	160	32	NS	G	120	ST	PR	4	ZP	G	NB	ZP	Nil
	27	**540**	**20**	**800**	**30**											
Tap No 2	6	60	10	160	27	S	G	120	ST	PR	6days	GT	G	US	GT	Nil
	5	40	8	160	32	NS	G	120	ST	NK	7	ZP	G	NB	ZP	Nil
	3	60	20	120	40	S	G	120	ST	PR	7	ZP	G	NB	ZP	Nil
	9	80	9	240	27	NS	G	120	ST	PR	4	ZP	G	US	ZP	Nil
	4	40	10	80	20	NS	G	120	ST	PR	7	ZP	G	US	ZP	Nil
	4	40	10	200	50	NS	G	90	ST	PR	7	ZP	G	US	ZP	Nil
	31	**320**	**10**	**960**	**31**											
Tap No 3	5	60	12	80	16	NS	G	120	ST	PR	7	ZP	G	US	ZP	Nil
	4	100	25	120	30	S	G	120	ST	PR	7	ZP	G	US	ZP	Nil
	4	80	20	100	25	NS	G	120	ST	PR	6	GT	G	NB	GT	Nil
	4	60	15	120	30	NS	G	120	ST	NK	7	ZP	G	US	ZP	Nil
	8	80	10	200	25	NS	G	90	ST	NK	6	ZP	G	US	ZP	Nil
	11	240	22	100	9	S	G	120	ST	NK	-	ZP	G	US	ZP	Nil
	36	**620**	**17**	**720**	**20**											
Tap No 4	10	80	8	200	20	NS	G	120	ST	NK	-	GT	G	NB	GT	Nil
	4	60	15	120	30	S	G	120	ST	PR	7	ZP	G	NB	ZP	Nil
	7	140	20	200	29	S	G	120	ST	PR	6	ZP	G	NB	ZP	Nil
	4	40	10	80	20	S	G	120	ST	PR	7	ZP	G	NB	ZP	Nil
	3	60	20	120	40	S	G	120	ST	NK	-	ZP	G	NB	ZP	Nil
	5	80	16	120	24	S	G	120	ST	PR	4	ZP	G	NB	ZP	Nil
	33	**460**	**14**	**840**	**25**											
Tap No 5	4	100	25	200	50	S	NT	120	ST	PR	4	GP	G	NB	GP	Nil
	6	80	13	200	33	S	G	120	ST	PR	7	ZP	G	NB	ZP	Nil
	4	80	20	160	40	S	G	120	ST	PR	7	ZP	G	NB	ZP	Nil
	5	80	16	200	40	S	G	120	ST	PR	7	GT	G	NB	GT	Nil
	9	100	11	400	44	S	G	120	ST	PR	7	ZP	G	NB	ZP	Nil
	11	80	7	300	27	NS	NT	120	ST	PR	6	ZP	G	NB	ZP	Nil
	39	**520**	**13**	**1460**	**37**											
Tap No 6	8	60	8	200	25	NS	G	120	ST	PR	7	GT	G	NB	GT	Nil
	8	60	8	100	13	NS	G	120	ST	PR	7	ZP	G	NB	ZP	Nil
	5	60	12	100	20	S	G	120	ST	PR	6	ZP	G	NB	ZP	Nil
	5	60	12	80	16	S	G	120	ST	PR	7	GT	G	NB	GT	Nil
	2	40	20	120	60	S	G	120	ST	PR	7	GT	G	NB	GT	Nil
	4	40	10	120	30	S	G	120	ST	PR	6	ZP	G	NB	ZP	Nil
	32	**320**	**10**	**720**	**23**											
Total	**198**	**2780**	**14**	**5500**	**28**											

3,CPWS Scheme to Malleswaram & other villages

Tap No 1	5	150	30	160	32	S	G	240	ST	No	-	GT	G	US	GT	Nil
	5	150	30	200	40	S	G	240	ST	No	-	GT	G	US	GT	Nil
	4	120	30	200	50	S	G	180	ST	No	-	GT	G	US	GT	Nil
	4	150	38	160	40	S	G	240	ST	No	-	GT	G	US	GT	Nil
	3	120	40	100	33	S	G	240	ST	No	-	GT	G	US	GT	Nil
	4	180	45	160	40	S	G	180	ST	No	-	GT	G	US	GT	Nil
	25	**870**	**35**	**980**	**39**											
Tap No 2	5	150	30	100	20	S	G	180	ST	No	-	ZP	G	US	GT	Nil
	4	120	30	100	25	S	G	180	ST	No	-	GT	G	NB	GT	Nil
	6	120	20	160	27	S	G	180	ST	No	-	ZP	G	US	ZP	Nil
	5	120	24	160	32	S	G	180	ST	No	-	ZP	G	US	GT	Nil
	5	180	36	100	20	S	G	240	ST	No	-	ZP	G	US	ZP	Nil
	4	60	15	120	30	NS	G	180	ST	No	-	ZP	G	US	ZP	Nil
	29	**750**	**26**	**740**	**26**											
Tap No 3	4	120	30	160	40	S	G	180	ST	No	-	ZP	G	US	ZP	Nil
	7	150	21	200	29	NS	G	180	ST	No	-	ZP	G	US	ZP	Nil
	4	120	30	100	25	S	G	180	ST	No	-	ZP	G	US	ZP	Nil
	6	120	20	160	27	NS	G	180	ST	No	-	ZP	G	US	ZP	Nil
	2	90	45	100	50	S	G	180	ST	No	-	ZP	G	US	ZP	Nil
	10	180	18	200	20	S	G	240	ST	No	-	ZP	G	US	ZP	Nil
	33	**780**	**24**	**920**	**28**											
Tap No 4	4	120	30	100	25	S	G	180	ST	PR	1	GT	G	NB	GT	Nil
	4	120	30	160	40	S	G	180	ST	PR	1	GT	G	US	GT	Nil
	7	150	21	200	29	NS	G	180	ST	NK	1	GT	G	US	GT	Nil
	10	180	18	100	10	NS	G	180	ST	PR	1	GT	G	US	GT	Nil
	2	60	30	60	30	S	G	180	ST	PR	1	GT	G	US	GT	Nil
	4	90	23	120	30	S	G	180	ST	PR	1	GT	G	US	GT	Nil
	31	**720**	**23**	**740**	**24**											
Tap No 5	6	120	20	160	27	S	G	180	ST	No	-	GT	G	US	GT	Nil
	4	120	30	100	25	S	G	180	ST	No	-	GT	G	US	GT	Nil
	4	120	30	60	15	S	G	240	ST	No	-	GT	G	US	GT	Nil
	5	120	24	100	20	S	G	180	ST	No	-	GT	G	US	GT	Nil
	12	180	15	200	17	NS	G	180	ST	No	-	GT	G	US	GT	Nil
	6	120	20	80	13	S	G	240	ST	No	-	GT	G	US	GT	Nil
	37	**780**	**21**	**700**	**19**											
Tap No 6	6	120	20	120	20	S	G	180	ST	No	-	GT	G	US	GT	Nil
	7	120	17	160	23	NS	G	180	No	No	-	GT	G	US	GT	Nil
	7	120	17	140	20	Ns	G	180	ST	No	-	GT	G	US	GT	Nil
	4	120	30	60	15	S	G	180	ST	No	-	GT	G	US	GT	Nil
	4	120	30	120	30	S	G	180	ST	No	-	GT	G	US	GT	Nil
	6	120	20	160	27	NS	G	180	ST	No	-	GT	G	US	GT	Nil
	34	**720**	**21**	**760**	**22**											
Total	**189**	**4620**	**24**	**4840**	**26**											

4 PWS Scheme to Selapaka village

Tap No 1	9	60	7	300	33	NS	G	60	ST	No	-	GP	G	US	GP	Nil
	5	-		200	40	-	NG	60	ST	No	-	GP	G	NB	GP	Nil
	2	100	50	-		S	G	60	ST	No	-	GP	G	NB	GP	Nil
	8	80	10	240	30	S	G	60	ST	No	-	GP	G	NB	No	Nil
	6	60	10	160	27	S	G	60	ST	No	-	GT	G	NB	No	Nil
	5	60	12	140	28	S	G	60	ST	No	-	GP	G	NB	GP	Nil
	35	**360**	**10**	**1040**	**30**											
Tap No 2	5	80	16	120	24	S	G	60	ST	PR	1	GP	G	US	GP	Nil
	4	-		200	50	-	NG	60	ST	No	-	GP	G	NB	GP	Nil
	4	200	50	-		S	G	60	ST	No	-	GP	G	NB	GP	Nil
	4	120	30	120	30	S	G	60	ST	No	-	GP	G	US	GP	Nil
	10	200	20	200	20	S	G	60	ST	No	-	GP	G	US	ZP	Nil
	4	80	20	100	25	S	G	90	ST	PR	1	GP	G	US	GP	Nil
	31	**680**	**22**	**740**	**24**											
Tap No 3	10	200	20	200	20	S	G	60	ST	No	-	GP	G	NB	GP	Nil
	4	100	25	160	40	S	G	60	ST	No	-	GP	G	NB	GP	Nil
	4	80	20	160	40	S	G	60	ST	No	-	GP	G	NB	GP	Nil
	8	120	15	200	25	S	G	60	ST	No	-	GP	G	NB	GP	Nil
	6	100	17	120	20	S	G	60	ST	No	-	GP	G	US	GP	Nil
	5	80	16	200	40	S	G	60	ST	No	-	GP	G	NB	GP	Nil
	37	**680**	**18**	**1040**	**28**											
Tap No 4	5	140	28	60	12	S	G	60	ST	No	-	GP	G	NB	GT	Nil
	5	140	28	60	12	S	G	60	ST	No	-	GP	G	NB	GP	Nil
	3	100	33	120	40	S	G	60	ST	No	-	GP	G	NB	GP	Nil
	2	80	40	60	30	S	G	60	ST	No	-	GP	G	NB	GP	Nil
	5	120	24	120	24	S	G	60	ST	No	-	GP	G	NB	GP	Nil
	5	140	28	60	12	S	G	60	ST	No	-	GP	G	NB	GP	Nil
	25	**720**	**29**	**480**	**19**											
Tap No 5	7	100	14	200	29	Ns	G	60	ST	PR	1	GP	G	NB	GP	Nil
	6	80	13	120	20	S	G	60	ST	No	-	GP	G	NB	GP	Nil
	6	120	20	120	20	S	G	60	ST	No	-	GP	G	NB	GP	Nil
	6	120	20	160	27	S	G	60	ST	No	-	GP	G	NB	GP	Nil
	2	60	30	60	30	S	G	60	ST	PR	1	GP	G	NB	GP	Nil
	3	80	27	120	40	S	G	60	ST	No	-	GP	G	NB	GT	Nil
	30	**560**	**19**	**780**	**26**											
Tap No 6	5	60	12	100	20	Ns	G	60	ST	No	-	GP	G	NB	GT	Nil
	5	80	16	140	28	S	G	60	ST	No	-	GP	G	NB	GP	Nil
	5	60	12	120	24	Ns	G	60	ST	No	-	GP	G	NB	GP	Nil
	5	100	20	100	20	S	G	60	ST	No	-	GP	G	US	GP	Nil
	6	100	17	100	17	S	G	60	ST	No	-	GP	G	NB	GP	Nil
	2	60	30	40	20	S	G	60	ST	No	-	GP	G	NB	GP	Nil
	28	***460***	***16***	***600***	***21***											
TOTAL	**186**	**3460**	**19**	**4680**	**25**											

Tap No 7	6	40	7	120	20	NS	G	60	ST	No	-	GP	G	GP	GP With HT Rs25
	3	40	13	80	27	NS	G	60	ST	No	-	GP	G	GP	GP With HT Rs25
	4	40	10	120	30	NS	G	60	ST	No	-	GP	G	GP	GP With HT Rs25
	4	40	10	80	20	NS	G	60	ST	No	-	GP	G	GP	GP With HT Rs25
	4	40	10	60	15	NS	G	60	ST	No	-	GP	G	GP	GP With HT Rs25
	6	60	10	160	27	NS	G	60	ST	No	-	GP	G	GP	GP With HT Rs25
	27	**260**	**10**	**620**	**23**										
TOTAL	**195**	**4960**	**25**	**3820**	**20**										

Codes used to fill the tabulation

S - Sufficient
NS - Not Sufficient
G - Good
ST - Same Timming
PR - Pipe repair/pipe leakage
MR - Motor repair
SD - Same day
2d - 2 days
GT - Government
ZP - Zilla Parishad (District Government)
GP- Gram Panchayat (Local Government)
US- Users/ near by people
NK- Not known
NB- No body
m - Minutes
NT- No taste
HT- House tax

Operator Questionnaire

Name	K.venkateswara Rao	M.Sharat babu	operator-1. N.V T.V. Prasad operator-2 S.Naga raju
Qualification	ITI Fitter	10 th class	operator-1. LCE operator-2. ITI fitter
Experience	1year in local industry	As electrician and fitter in local firms	working on this scheme from the beginning of construction
Have you got training	No	No	Yes
What kind of training undergone	-	-	O&M from the contractor
Due you have the preventive maintenance check list	Yes	Yes	Yes
Are you releasing water at the same time as per the schedule	Yes	Yes	Yes
How many hours do you release the water	90 min	120 min	8 hours
Are you maintaining any records	Yes	Yes	Yes
What are they	Log books	Log books	Log books
Are you chlorinate the water	Yes	Yes	Yes
How do you chlorinate the water	Mixing 1 5 kg bleaching powder with water in a bucket and poured that liquid into 'V'notch chamber	Mixing 4.0 kg bleaching powder with water in a bucket and poured that liquid into 'V'notch chamber	Mixing 3 0 kg bleaching powder with water in a bucket and poured the top liquid into CWR
What are the major breakdowns of the scheme	MR & PL	PR*	No
If the breakdown exceeds your repair skill,what will you do	Inform to departmental people	Inform to departmental people	Inform to departmental people
Are you faced any problem with spare parts, tools etc ,	No problem with spareparts Required tools are not sufficient	No spareparts and required tools are not sufficient	No sufficient spareparts and required tools are sufficient
Who pays your salary	RWS Executive Engineer	RWS Executive Engineer	RWS Executive Engineer
Who pays the O&M cost	Department	Department	Department
Who will supervise this scheme	WI daily & AE twice a week	WI daily & AE in a week	WI, AEEdaily

Sanitary Survey

Sanitary survey for the assessment of risks of contamination of drinking water source
(Lloyd ,B. et al ,1991)

	Scheme No.	1	2	3	4	5	6
S.No	**Description of source of contamination**						
1	Is there any open defication at intake point of the source?	Yes	Yes	Yes	Yes	Yes	Yes
2	Is there any transmission pipe crossing the drainage?	Yes	No	No	Yes	No	No
3	Is the reservoir not protected from animals etc?	No	No	No	No	Yes	No
4	Is the filtration not continued?	No	No	No	No	Yes	Yes
5	Are they distributing the water to the public without allowing ripening time after breakdown?	Yes	Yes	No	Yes	Yes	Yes
6	Are the Valve pits insanitary?	Yes	Yes	No	Yes	Yes	Yes
7	Is the inspection cover on the reservoir insanitary?	No	Yes	No	No	No	No
8	Are any air vents insanitary?	No	Yes	No	Yes	No air valve	No air valve
9	Do the roof and walls of the reservoir allow any water to enter?	No	No	No	No	No	No
10	Is the reservoir water unchlorinated?	No	No	No	No	No	No
11	Are the distribution pipes crossing the drainage?	No	No	No	Yes	Yes	No
12	Is pressure low in any part of the distribution system?	No	Yes	Yes	Yes	Yes	Yes
13	Are the labours not wearing Hygiene shoes while cleaning filters?	No	No	No	No	Yes	Yes
	Total risk	4 out of 13	6 out of 13	2 out of 13	7 out of 13	8 out of 12	6 out of 12

Observation sheet of Schemes

Intake Condition							
Inlet position	@ canal	one level	one level	one level	one level	one level	one level
	@ SS tank	Two level	Two level	Three level	one level	one level	one level
Inlet Screen		No	No	No	No	Poor	Poor
Transmission Main							
Leakage		No	No	No	Yes	No	No
Air valve condition		Good	No valve	No valve	No valve	No valve	No valve
Summer Storage Tank							
Condition of bund		Good	Good	Good	Moderate	Poor	Good
Seepage		Yes	Yes	Yes	Yes	No	No
Algae present		yes	yes	yes	No	Yes	No
Slow Sand Filters							
Size		12 00m dia	19 00m dia	25 x11 m	10 00m dia	7 00m dia	8.00m dia
Number of filters		2	3	3	2	2	2
Provision of inlet weir		No	No	Yes	No	No	No
Provision of outlet weir		Yes	Yes	Yes	Yes	Yes	Yes
Depth of supernatant water		90,95cm	130,145cm,NS	86cm	60 cm ,0	-	120 cm, 0
Depth of filter bed		90,89cm	70,55,100cm	95,90,86cm	70, 74cm	CM	45 cm, CM
Provision for charging arrangement from bottom		Yes	Yes	Yes	No	Yes	No
Condition of supernatant box		Good	Good	Good	Good	Poor	Good
Provision of scum layer removing outlet		No	No	No	No	No	No
Sand washing facility		Yes	No	Yes	Yes	Yes	Yes
Where they kept the scraped sand		washing tub	On ground	washing tub	On ground	On ground	On ground
Filtration continuity		Yes	Yes	Yes	Yes	Yes	No
Allowing for ripening period		No	No	36 hrs	No	Yes	No
Filtration rate		0.085 m/h	0 069 m/h	0.08 m/h	0 11 m/h	-	0 15 m/h
Number of cleanings / year		6	10	8	6 to 8	10/month	4/month

Name	P Srinivasa Rao	K. Babu Rao	J Srinivasa Raju
Qualification	10 th class	ITI Fitter	ITI Fitter
Experience	working on this scheme from the beginning of construction	2 years as fitter in a local fir	14 years as fitter in a local firm the beginning of construction
Have you got training	Yes	No	No
What kind of training undergone	6 months training on O&M from contractor	Only gathering information from the nearby scheme operator	Only gathering information from the nearby scheme operator
Due you have the preventive maintenance check list	No	No	No
Are you releasing water at the same time as per the schedule	Yes	Yes	Yes
How many hours do you release the water	60 min	120 min	120 min (60 min on each side)
Are you maintaining any records	No	No	No
What are they	No	-	-
Are you chlorinate the water	Yes	Yes	Yes
How do you chlorinate the water	Mixing very small bleaching powder with water in a bucket and poured that liquid into CWR	Mixing 2.0 kg bleaching powder with water in a bucket and poured the top liquid into 'V'notch chamber	Mixing 1 2 kg bleaching powder with water in a bucket and poured that liquid into CWR
What are the major breakdowns of the scheme	ML & No water in SS tank in summer	MR	Change of filter media
If the breakdown exceeds your repair skill,what will you do	Inform to Sarpanch	Inform to EO/Sarpanch	Inform to Sarpanch
Are you faced any problem with spare parts, tools etc ,	Spareparts and required tools are not sufficient	Spareparts and required tools are not sufficient	No sufficient spareparts and required tools
Who pays your salary	GP	Executive officer, GP	GP clerk
Who pays the O&M cost	GP	GP	GP from the users
Who will supervise this scheme	Sarpanch,members, WI, AEE	EO,Sarpanch, WI, AEE	Sarpanch, WI, AEE

USAGE OF WATER FOR

S.No.	Name of the scheme	Number of users interviewed
1	CPWS Scheme to Corangi	36
2	CPWS Scheme to Tallrevu	36
3	CPWS Scheme to Malleswaram	36
4	PWS Scheme to Selapaka	36
5	PWS Scheme to Atapaka	36
6	PWS Scheme to Bhujabalapatnam	42

S.	Drinking								Cooking								Washing								Bathing								Personal hygeine								Gardening								Cattle feeding							
No.	SP		HP		DW		SS		SP		HP		DW		SS		SP		HP		DW		SS		SP		HP		DW		SS		SP		HP		DW		SS		SP		HP		DW		SS		SP		HP		DW		SS	
	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D
1	36	36	-	-	-	-	-	-	36	36	-	-	-	-	-	-	11	-	-	-	-	-	25	36	17	-	-	-	-	-	19	36	35	35	-	-	-	-	1	1	-	-	-	-	-	-	3	3	-	-	-	-	-	-	2	2
2	36	36	-	-	-	-	-	-	36	36	-	-	-	-	-	-	3	-	-	-	-	-	33	36	3	-	-	-	-		33	36	24	23	-	-	-	-	12	13	1		-	-	-	-	6	7	-	-	-	-	-	-	14	14
3	36	36	-	-	-	-	-	-	36	36	-	-	-	-	-	-	11	8	-	-	22	28	3	-	17	13	-	-	19	23	-	-	33	21	-	-	3	15	-	-	5	-	-	-	15	20	6	-	-	-	-	-	19	23	4	-
4	34	34	-	-	1	2	1	-	34	34	-	-	1	2	1	-	4	3	1	1	26	32	5	-	8	6	1	1	26	29	1	-	32	32	1	1	2	3	1	-	-		-	-	24	24	-	-	-	-	-	-	3	3	-	-
5	36	36	-	-	-	-	-	-	36	36	-	-	-	-	-	-	2	2	-	-	12	12	22	22	3	2	-	-	12	12	21	22	31	27	-	-	-	-	5	9	1	1	-	-	9	9	22	22	-	-	-	-	11	11	12	12
6	42	42	-	-	-	-	-	-	42	42	-	-	-	-	-	-	8	6	-	-	-	6	34	30	11	6	-	-	-	6	31	30	41	41	-	-	-	1	1	-	7	6	-	-	-	1	20	20	6	6	-	-	-	1	15	14

SP - Stand post HP - Hand pump DW - Dug well SS - Canal/Bodhu/Summer storage tank

Clear Water Reservoir						
Environment of CWR	Good	Good	Good	Good	Poor	Good
Good ventilation	Yes	Yes	No	Yes	No	No
Leakage of side walls/dome	No	No	No	No	No	No
Chlorination arrangement	No	No	No	No	No	No
Over Head Reservoir						
Leakage of side walls / dome	No	No	No	No	No	No
Distribution System						
Leakage	Yes	Yes	Yes	Yes	Yes	Yes
Pressure	Good	moderate	Good	Good	Moderatre	Moderate
Sluice valve condition	One not good	poor	Good	One not good	One not good	Good
Scour valve condition	Good	Good	Good	Good	No valves	No valves
Flow measuring devices	No	No	No	No	No	No
Pumps						
No of pumps installed	3+3	3+3	3+3	3+3	2+1	2+2
No of pumps working	3+2	3+2	3+3	3+2	2+1	2+2
Leakage	Yes	Yes	No	No	Yes	No
Sound	No	1	No	No	No	No
Condition of pump	Good	Good	Good	Good	Good	Good
Log report	Yes	Yes	Yes	Yes	No	No
Electrical connections						
Earthening condition	Good	Good	Good	Good	Good	Good
Proper insulation	Yes	Yes	Yes	Yes	Yes	Yes
Proper maintenance of fuse carriers	Yes	Yes	Yes	Yes	Yes	Yes
Loose wire connections	No	No	No	Yes	No	No

NS - Not started
CM - Changing of filter media

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