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**INTERNATIONAL INSTITUTE FOR INFRASTRUCTURAL
HYDRAULIC AND ENVIRONMENTAL ENGINEERING**

**EVALUATION OF FUNCTIONING QUALITY PARAMETERS
AND POSSIBILITY OF COMMUNITY MANAGEMENT IN
GRAVITY FED RURAL WATER SUPPLY SCHEMES IN
GARHWAL (UTTAR PRADESH, INDIA)**

**MASTER OF SCIENCE THESIS BY
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ABSTRACT

The study was initiated in Dehra Dun district of Garhwal commissionerary (Uttar Pradesh, India) to assess the possibility of community management of gravity fed single village rural water supply schemes. Three w/s schemes in Rai Pur block of Dehra Dun district were selected for study. Two of the w/s schemes were community managed, and the third was managed by a government organisation. The three schemes were compared on the basis of functioning (reliability), quality parameters, O&M cost, utilisation of services at community level. A study was made of the institutions involved in O&M of these rural w/s schemes. Local village leaders, villagers, men's and women's organisations and government officials were approached to collect information and to ask their views regarding the w/s systems.

Three households in the supply area of each w/s system were visited. Personal visits were made to w/s systems. Staff and community members responsible for O&M were interrogated to assess the actual mode of operation.

Water supply schemes managed by the community were satisfying the needs of the consumers. The supply of water from the public stand posts was regular and continuous throughout the month. Water regulation in the systems was equitable amongst all public stand posts and the reliability of the schemes was good. The water supply scheme managed by the government organisation was not serving the consumers as well. The supply of water from the public stand posts was irregular and there were two to three breakdowns in the system every month. The water regulation in the system was not uniform. Therefore public stand posts situated higher up the hill were not receiving water at times of peak demand. The reliability of the scheme was fair.

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The cost of operation and maintenance of community managed w/s schemes was low, whereas the cost of O&M in the government managed w/s scheme was high. Consumers of community managed w/s schemes were satisfied whereas consumers of the government managed scheme were dissatisfied. This shows that community management in O&M of gravity fed w/s schemes is feasible and preferable.

Though village committees are operating and maintaining rural w/s schemes satisfactorily, the community members need further

technical, managerial and financial training. In two villages there is no well established and developed O&M organisation. The O&M organisations should preferably be independent of village governments, so that there is no interference from political rivalries. The U.P.government and water agencies should support village O&M organisations till they are self-sustainable.

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R.D. Saraswat.
Delft, The Netherlands
July, 1994.

LIST OF ABBREVIATIONS USED IN THIS DOCUMENT

A.E.	Assistant Engineer.
Cumec.	Cubic metres.
C.E.	Chief engineer.
E.E.	Executive Engineer.
F.D.	Finance Director
Govt.	Government.
/hr.	Per hour.
IDWSSD	International Drinking water supply and sanitation Decade.
IRC	International Reference Centre, Hague.
J.E.	Junior Engineer.
Garhwal Jal sansthan.	Garhwal regional jal sansthan.
Km.	Kilometre.
Kld.	Kilo litres daily.
LDC	Less developed countries.
M.D.	Managing Director.
m	Metre.
mg/l	Milligramme per litre.
O&M.	operation and maintenance.
Rs	Rupees.(Indian currency)
S.E.	Superintending Engineer.
Tcu.	True colour units.
UNDP	United Nation's Development Programme.
WASH	Water and Sanitation for Health.
WHO	World Health Organisation.
W/S Or WS	Water Supply.

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1 INTRODUCTION

1.1 International drinking water supply and sanitation decade:

The United Nations conference on environment held in Stockholm in 1972 first gave international expression to the problems pertaining to the provision of safe drinking water and adequate sanitation in developing countries.

The United Nations conference on human settlements (Habitat) held in Vancouver, Canada, in 1976 recommended that safe water supply should receive priority from national governments and international agencies with a view to achieve the targets for serving all the population by 1990. The recommendations of the HABITAT conference were adopted by the United Nations's water conference at Mar-Del-Plato, Argentina in march 1977 and it was decided that 1981-90 would be known as the "International Drinking water supply and sanitation Decade."

Healthy citizens are one of the nation's basic resources. The value of health to the individual can never be overestimated. Therefore every town and village must have a hygienically safe water supply scheme. It is a must in a welfare state.

The money spent on these services saves a lot of recurring expenditure incurred by state and local governments, as well as private persons in control of epidemics which are the result of insufficient, impure water supply and improper sanitation.

The "Water supply and sanitation collaborative council", was a global forum held in OSLO, Norway, in September 1991 where deep concern was expressed regarding the poor performance of drinking water supply systems. During the course of discussion it was stressed that the investment already made in the w/s sector in the past and the new investment proposed for execution of w/s systems, will be useless and harmful in absence of proper O&M facilities. Hence proper maintenance of drinking w/s systems should get priority, so that they may fulfil the need of users. It was emphasised that poorly maintained w/s systems lack in aspects of safe quality and adequate quantity.

On the basis of past experience, it was felt that government or local bodies can't successfully operate and maintain the w/s systems without cooperation of the communities. The main reason for this idea was that large numbers of w/s systems were created but these systems were not properly maintained, due to lack of maintenance funds.

Keeping in view the various factors for O&M of w/s systems, the guiding principles adopted in the New Delhi consultation in 1990 are "Community management of services, backed by measures to strengthen local institutions in implementing & sustaining water and sanitation programmes." On institutional reforms, the New Delhi statement promotes an integrated approach, including changes in procedures, attitudes, behaviour and full participation of women at all levels in sector institutions. It urges too the adoption of sound financial practices, where community management can also play a role.

In India, at the end of the decade, nearly 574,000 villages have received safe drinking water. In Uttar Pradesh at present out of 112,566 villages, nearly 107,832 villages have access to safe drinking water. In U.P. state, due to limited financial resources for operation and maintenance (O&M) in the rural w/s sector, it was decided that single village w/s systems be operated and maintained by village Panchayats (village committees). The multi village w/s systems are maintained by government organisations, i.e. regional Jal sansthan (operating & maintaining agencies at commissioner level) and U.P. Jal nigam (State level organisation for planning, execution and maintenance). In compliance of this policy 771 w/s systems are handed over to village panchayats (non governmental committees elected by villagers) in Garhwal commissionerary. Complete information regarding the functioning of the above is not available, but as per personal communication of Garhwal Jal Sansthan nearly 80 % of w/s systems with village panchayats are running satisfactory, whereas 20 % of the village panchayats are facing difficulties in operation and maintenance. People living in areas where w/s systems are not running properly, are not getting safe water and are using conventional sources for drinking water.

2 OBJECTIVES, SCOPE AND LIMITATIONS OF STUDY :

2.1 The research area:

The research was carried out in Dehra Dun district of Garhwal a northern commissioner of Uttar Pradesh (U. P. state), it is situated nearly 300 Km. from Delhi, the capital city of India. Garhwal is well connected with other parts of the Uttar Pradesh by rail, air up to Dehra dun (the district head quarter which is situated in Garhwal commissioner) and by road to important hilly towns only. Garhwal is situated in the Himalayan ranges. The hilly terrain provides springs, Gaderas and rivers as a source of water for local people. The population of the villages varies from 100-500 people. The rural w/s schemes are executed in which water sources are springs or gaderas. The total number of villages in Garhwal is 8165, out of which 7848 villages were benefitting from safe drinking water supply systems up to 1993. It means that 96 % villages have already been covered in the region up to year 1993.

Criteria for selection:

Dehra Dun district was selected on the basis of the following considerations.

(i) Accessibility.

(ii) Availability of single village w/s schemes.

Depending upon availability of meagre time of three months for the field study, it is confined to one district "Dehra dun" which is representative for the whole Garhwal region in respect of culture and environment. Gravity fed w/s schemes have a similar type of source i.e. springs or gaderas throughout the Garhwal. Regional topography, climate, house pattern, people and dress are similar in the central Himalayas.

2.2 Research Questions:

The Central government and U. P. government have aimed to provide safe drinking water to the population, but the w/s systems in Garhwal commissioner are not sustainable due to poor operation and maintenance. The w/s schemes are not able to generate sufficient funds by collecting water tax from the consumers and the state government is not able to subsidise the total amount of deficit in O&M per year. Therefore, the government of Uttar Pradesh has taken a decision that single village w/s systems should be operated and maintained by village committees. In compliance with that decision single village w/s systems were handed over to village committees by government organisations. Data for the five Garhwal districts are available in Table No.2 (page No.18).

In such a situation a study of the functioning of the water

supply schemes, the utilisation of treated water in domestic and other uses, and the economic and social status of the communities was required. The objectives of the research were as follows:

- (i) The main objective of the research was to know the possibility of community participation and management in the O&M of gravity fed rural w/s systems. Gravity fed w/s systems are simple in technology & operation, for which little knowledge of operation and maintenance may help communities in the day to day operation of the systems. It is important that communities should have the interest to learn such activities.

The central hypothesis behind the study is that rural w/s schemes may be made self supporting if community participation is adopted since their inception, and if communities manage their own water supply systems. There is ample scope to enhance community participation and management in Garhwal.

- (ii) To compare the cost effectiveness in operation and maintenance, of rural w/s schemes managed by village committees and government organisation (Garhwal Jal Sansthan).

The Garhwal Jal Sansthan (government organisation) and the communities both maintain similar rural w/s systems. Therefore comparison of O&M cost at the level of village committees and government organisations would provide a knowledge of the cost effectiveness.

- (iii) To evaluate the functioning of the facilities.

The village gravity fed water supply schemes will be evaluated on the basis of the minimum evaluation procedure (MEP) to determine their performance. This would reveal the present situation in terms of quantity, quality and reliability, as well as consumer satisfaction .

- (iv) To assess the utilisation of services.

The schemes are designed to provide safe drinking water to communities. Study would reveal the actual use of systems by communities and the service rendered by these schemes .

On the basis of availability of time and methodology adopted, three w/s systems in the Rai Pur block of Dehra Dun district were selected for study. These are :

- (i) Mal Devta w/s scheme in Mal Devta village.
- (ii) Mohmmad Pur Kemri W/s scheme in Mohmmad Pur Kemri village.
- (iii) Talli Kheri Khurd w/s scheme in Talli Kheri Khurd village.

Out of the three schemes Mal Devta is maintained by Garhwal Jal Sansthan and the other two schemes are maintained by village

What selection criteria used? Representative?

communities. The study will discuss various aspects and activities of O&M which are taken care of by each agency. Comparison will provide the different activities and per capita expenditure incurred on operation and maintenance by government department and gram panchayats (village communities).

The study is limited to the functioning, quality parameters of water, assessment of the capability of communities for management/participation in operation and maintenance, utilisation of services, institutional and financial data analysis of the single village w/s schemes.

2.3 Methodology for the exploratory field study :

Three w/s schemes in Rai Pur block were visited and the organisations responsible for their O&M and manpower were interrogated. Local village leaders, local village welfare organisations and women's organisations were also approached to know their views regarding w/s schemes.

[1] Literature study.

A literature study was made at IHE Delft, the Netherlands, and the University of Roorkee, Roorkee, India. Literature was consulted about the Himalayas and maintenance of w/s schemes in U.P.

[2] Interviews with key informants.

Interviews were made with important officials, village leaders, men and women's organisations to know their views about w/s systems and to assess the possibilities of community management of w/s systems.

[3] Questionnaire.

Three households were interviewed in each of three villages. As the total number of households in the three villages was 117, the sample size was about 8% (5, 8 and 15% respectively). Data were collected in formats of functioning, quality parameters, a household survey and personal observation. These formats are available in appendices. Discussions with officials of U. P. Jal Nigam, Garhwal Jal Sansthan and community members were made to determine the actual operation of the w/s systems. Household level information was collected through a household questionnaire, to know the views of users about the benefits derived from the scheme.

[4] Observation (personal visits).

The w/s schemes were studied by personal visits to sites and the area covered by these schemes. Officials and scheme operators were interviewed regarding the functioning of the schemes.

[5] Study of institutional and financial data.

*selectm
criteria?
(eg caste,
see status
accor?)*

Information was collected from the records of the U.P. Jal Nigam, Garhwal Jal Sansthan and village panchayats and reviewed by interviews with the officials.

[6] Examination of the legal status of the village panchayats. Village panchayats are the local authority administering the villages and promoting agricultural activities and social welfare activities in the villages. The panchayati raj department of state controls the village pachayats. Recently single village w/s systems are operated and maintained by village communities with cooperation of village panchayats. O&M of the schemes is managed by the community, which contributes labour and money. It needs close observation and study to know the actual working of the system.

3. LITERATURE STUDY :

3.1 Literature overview:

During the International drinking water supply and sanitation decade (IDWSSD) efforts were made to extend safe drinking water and adequate sanitation facilities to people. The results in respect of coverage of unserved population were encouraging, but the paucity of maintenance funds is the main hurdle to keep these w/s systems in optimal running condition. It is observed that many systems are not performing ideally and poor maintained systems are producing unsafe and inadequate quantity of water. W/s systems, which were designed for future demand at above the year 2003, are not even able to meet the present requirement of water. It is felt every year that the need for rehabilitation is growing at a faster rate.

The literature related to the subject of rural w/s system, gravity fed piped w/s, specifically with reference to operation and maintenance aspects were studied in detail. The main obstacles such as poor maintenance, organisational problems and others were studied, especially with greater stress on financial aspects.

3.2 Key aspects:

After creation of a large number of rural w/s systems in developing and under developing countries, maintenance problems are experienced. The basic causes are quite clear that sudden rise in water sector could not produce the required number of trained personnel and funds needed for operation & maintenance were beyond the limit of national planning. Beneficiaries were not eager to share the running cost of the w/s systems. These factors together created a mismanagement of water services. Studies in this respect were carried out at the level of international agencies like, WASH 1981, WHO 1983, Hofkes 1982 and the workshop for maintenance of rural w/s systems conducted at IRC. Hague in 1993 to discuss possibilities of community management of rural w/s systems. Out of all studies a rational extract was determined to use various approaches in practical field study.

A Working group on O&M of water supply and sanitation system was established by WHO, on an adhoc bases. The first meeting was held

at Geneva in feb 1989, second meeting was again held in Geneva in june 1990 and attenders were from nearly 25 countries, were all water and sanitation specialists of their countries. The objective of the Geneva meeting was to seek ways and means for improvement in O&M of w. s. and sanitation systems in developing countries. In this report they have fixed the important issues which influence the operation and maintenance to a great extent are described below.

1 Technology choice.

- (i) Selection of technology with out user's consultation.
- (ii) In adequate water in the source.
- (iii) Poor construction.
- (iv) Lack of scope for extension and upgrading.
- (vi) Selection of service level without user's consultation.

2 Institutional arrangement and legislation.

- (i) Low profile of O&M.
- (ii) Undefined tasks.
- (iii) Unclear division of responsibility.
- (iv) Improper structure with out involvement of community.

3 Financial viability of maintenance system.

- (i) Inefficient use.
- (ii) Higher operative costs.
- (iii) Improper budgeting.
- (iv) Inadequate tariff.
- (v) Improper money collection system.
- (vi) Unaccountability and book keeping.

4 Manpower development.

- (i) Lack of training.

5 Logistics.

6 Monitoring and control.

- (i) Inadequate data.
- (ii) Lack of communication.
- (iii) Improper management informative system.

7 Political interference.

- (i) Awarding a contract.
- (ii) Selection of site for source.
- (iii) Propaganda for free water.
- (iv) Fixing the service level.

Considering the above points, it is obvious that most of them are closely connected to one another and the central idea of these points indicates the importance of users. Discussion of the above points are described below.

3.3 Technology choice.

(i) The selection of technology should primarily be based on local maintenance facilities. It should be cheaper and affordable by users. The project design should include users choice of w/s system based on judgement of people to suit willingness and ability to pay. This leads to examine many alternatives at the level of users to arrive at one choice of technology. This relieves the designer from so many uncertainties which would have been there in his own choice of technology. Higher level of technology needs trained and skilful operators which is costlier. Common communities may not have educated members to understand modern technology.

(ii) selection of water source is an important aspect that it should be perennial, adequate and safe. The quantity of water should meet the summer requirement at the end of design period.

(iii) Construction of components of w/s system should be based on standard structural design and the material used be of standard quality, so that it may with stand the physical and chemical activities during functioning of the system.

(iv) Design and construction work must have the flexibility to adopt the future requirements which would be needed in due course. Such design and construction works are necessary for future development. It must have the scope for augmentation, extension and upgrading of service level. In nutshell, design and construction should fit in a master planning.

3.4 Institutional arrangements and legislation.

(i) Poor O&M is connected with many institutional problems, some times it needs complete overhaul of the setup of the institution. The system will not work properly if construction works take

priority and O&M is neglected. In other words execution and maintenance should be the responsibility of one institution so that it may not get benefit of doubt as it is the construction defect etc. The work of construction and maintenance together should be shared amongst officials and their performance be determined on the basis of collective work.

(ii)&(iii) As a whole O&M comprises many activities such as preventive maintenance, repairs, revenue collection, training and monitoring. Each activities and task be distributed at the level of each employee and printed description be handed over to each member so that he is always in full knowledge of responsibility and task which are to be taken care of by him. Necessary article which are needed for task be available with each employee.

Users should always receive priority in solving their problems related to water service, because they are the real instrument to improve capacity of institution. The image of institution depends on its officials, polite and prompt working brings good name to institutions. When w/s organisations are utilised as political tool by leaders then the working of the department is affected adversely.

(iv) No institution can succeed in rural area with out the support of community, so community is the key of success in matters of rural activities. Community managed w/s systems are successful in Yemen, Honduras, Philippines, Pakistan and India. The w/s systems which are maintained by community do not have higher over heads like government department and labour is performed by community members which reduces the maintenance cost. Proper training of community members would be a cost effective measure in O&M activities of rural w. s. systems.

3.5 Financial viability.

The provisions of maintenance need a realistic assessment of available resources. Every system is surviving on the collection of water charges. When beneficiaries have to pay for O&M it needs a transparent and simple system of accounting which is preferred by community members. Though long term viability includes the cost of expansion, replacement and reorganisation of the system. The collection, of water charges from each house hold may easily be made on the basis of flat rates than difference in income level(graded rates).

What are the ways to get contributions from the community ? C. van Wijk in 1987 has developed a systematic approach in her book " What price water ? " Finance is needed to generate for the capital cost as well as for recurrent expenditure. There are two methods for fund raising from community. (a) Community fund raising. (b) Regular collection.

(a) Community fund raising : This method is suitable for capital cost raising and for emergency repairs when regular charging falls short of need.

(b) Regular charges: This system is use full for recurring costs raising. For regular charges of O&M the following systems of water charge collection may be considered.

Flat rates: This is the basic system which is utilised to collect water charges per household, irrespective of the quantity of water consumed, it is useful in rural w/s schemes maintained by communities.

Graded rates: This system is only useful when community members are ready to pay rates on the basis of their income, per household. It helps the community to generate more funds and provides water to weaker sections of people.

Mixed system : This system is to cover the recurring cost of community water supply, combining private house connection and public stand post. Here classification is made on the basis of service level.

Water metering : This needs higher initial investment cost and supervision cost, this system is unsuitable for rural w/s systems.

Indirect taxation: This system reduces administrative cost because it need occasional collection system. In India this system is in practice for O&M of rural w/s systems. Community may select suitable method of taxation.

3.6 Manpower development and training.

People will have to be trained to carry out their tasks and responsibilities. Community must have capacity to perform their task of maintenance. Such as technical repairs, book keeping, operation, preventive maintenance. Agency must help community to

strong management organisation and also in making proper distribution of task among members. Important task of community is to make decision, it needs the help of agency in beginning but after some time, when members gain confidence it is easy for them to take decision.

3.7 Logistics.

Sometimes it is not possible to get the spare parts even in nearby towns. Some special spare parts have need to be arranged from the manufacturer situated far from the village, during rainy season when roads are blocked, for three months requirement of material should be kept in stock.

3.8 Monitoring and control.

Monitoring of a maintenance system involves the formulation of maintenance standards, the collection, processing, interpretation of data on functioning and use of the system including equipment involved. Following are the indicators for monitoring which should be used for comparing that what is there and what actually should be there.

- 1 Quality of installed facility.
- 2 Water consumption and provision per water point.
- 3 Maximum number of beneficiaries per water point.
- 4 Acceptable water quality.
- 5 Water pressure at specific points.
- 6 Acceptable no. of break downs.
- 7 Acceptable duration of break downs.
- 8 Stock and quality of spare parts and repair material.
- 9 Level of preventive maintenance.
- 10 Cost of maintenance.
- 11 Revenue collection.
- 12 Supply regulation.
- 13 Leakages.
- 14 Wages and other repair cost.
- 15 Users satisfaction.

These data are to be collected to monitor the w/s systems and to take suitable action to improve the performance of the system and organisation through staff and community.

Quality control is important and should include regular checking.

3.9 Political Interferences.

Political interference has been as a serious contributing cause to poor O&M. This is most noticeable in countries where government is directly involved in operation and maintenance of w/s systems. It is used as political tool in some cases.

In some countries for social and political reasons water is free. This decision not to charge for water makes it difficult to run a self financing viable system, even if the government provides subsidy for O&M. When government are in shortage of funds it adversely affects the w/s systems.

Political interference is evident in choice of technology. Government department are pressurised to purchase specific type of pipes and material.

The working group on O&M sponsored by WHO, concluded that a pre condition for better management of water facilities was to devolve the responsibility for managing these systems from govt. to autonomous agencies. This system of working created difficulties due to over staffing and lack of finances.

3.10 Involvement of community including women.

Engineering approach is to identify a problem, design a solution, construct the resulting project and leave O&M considerations to local authority. It is a top down approach which is not useful at present. Now we need approach which is " bottom -up approach " is a definition of users involvement. The advantages of this approach (community participation) are put forward by White in 1981 which are described below.

- 1 It reduces cost of the w/s project.
- 2 It may serve more people.
- 3 It allows for adaptation to local situation.
- 4 Participation increases the chances of proper use and continuous functioning of improved facility.
- 5 Participation is a stimulus for further socio economic development.

In the proceedings of the meeting of the working group on O&M 1990, sponsored by WHO, described that now, the users participate in decision making from beginning with project identification, through all intermediate steps of implementation up to end, how the system will be operated and by whom.

institutions must equip themselves to work with the community by adapting its structure and by engaging qualified staff. User participation permits the users to determine their involvement in O&M activities.

Extensive training of the engineering staff is required to explain the techniques of community participation to be adopted.

Within community men and women both should be involved. C.v. Wijk, 1985, describes the benefits of women participation. It can contribute to the achievement of specific project objectives of functioning and use of facilities.

As a domestic manager, women decides where to collect, how much water to collect and how to use it. As prime beneficiaries, they have promoted the interest and willingness of men to contribute to improving water supplies.

Christine van Wijk, 1989, suggested 10 steps for women involvement which are given below.

- 1 Orient male management and staff how women's involvement helps realise technical project objectives.
- 2 Work with women field workers and local intermediators.
- 3 Discuss with local leaders and authorities why and how to involve in planning and management of water supply services.
- 4 Inform women about project and project meetings along different channels and encourage their participation.
- 5 Organize meetings at times and places suitable for women.
- 6 Facilitate women to hear and speak out, and use of translation into vernacular.
- 7 stimulate dialogue by way of presentation, invitation of comments / questions / criticism, insertion of discussion break involvement of respected and representative spokesman.
- 8 Where participation of women in general, or poor women, is difficult, organise separate meeting at suitable time and places.
- 9 Explain tasks and authority in maintenance/ management/ hygiene education/ finance before choosing local candidate ; discuss which are best done by women, and who are most suitable candidates.
- 10 Give training adapted to women's condition and role and include follow up visit for monitoring and support.

Siri Melchior, 1989, explained the importance of women, as a main interest group. They are beneficiaries and partners. Following are some obstacles in participation of women in the programme.

- 1 Many still don't understand what women's participation is.
- 2 many believe that women's participation is marginal to project success.
- 3 Many believe that it costs too much and takes too much time.
- 4 For workers from outside the community, many feel that they can encourage the women's involvement, it is too sensitive issue.
- 5 Many have tried to get participation but women have not come for meeting. It requires specific skills.
- 6 Many engineers do not care for development while many social scientist are too academic and too micro level.
- 7 No evaluation data are available on large scale projects to justify cost in financial, social and political terms.
- 8 Many organisation have women involvement division (branch or wing) is incorporated in their policy but not translated programmatic terms.

There are different views about cost implication in community participation, it varies from 10 -35 % of the total project cost.

3.11 Community management of w/s systems :

More than participation, community management explains community own decision-making power over those water supplies or component for which they hold or share responsibility, and stress the importance of crucial period after construction. Village councils or village organisation were neither involved in local planning nor prepared for local management.

In addition to joint decision-making, the agency must be able to help communities set up viable water management organisation, assist them in defining the organisation's responsibilities, tasks, status and authority, train its members & employees in

maintenance, management and financing. The important ingredients for sound community managed w/s systems are given below.

- 1 Capacity to make budget.
- 2 Run a pragmatic book keeping system.
- 3 Exert financial control.
- 4 Regularly account to users for local services and financing.

4. ORGANISATION OF THE WATER SUPPLY SECTOR IN GARHWAL COMMISSIONARY

4.1 Development of rural w/s programme in U.P. state :

The development of the water supply sector in U.P. state began in 1975. In Garhwal, rural w/s systems were constructed with spring sources/gaderas. Most of the schemes were implemented under the accelerated rural programme and minimum needs programme which were financed entirely by the central government and U.P. government.

4.2 Description of Garhwal w/s schemes:

The present coverage of the villages with water supply schemes in Garhwal commissionary is shown in Table No.1. The table includes multi village w/s systems, single village w/s systems and pumping schemes of Dehra Dun district only. Table No. 2 shows the number of single village water supply schemes and O&M agencies responsible for them. These tables provide an overview of the water supply sector in Garhwal commissionary at the end of 1993.

Table No. 1
Numbers of villages and served by piped water supply (1993)

Name of district	No. of villages	No. of villages served	% villages covered
Uttar Kashi	672	654	97
Tehri	1958	1904	97
Dehra dun	767	716	93
Chamoli	1532	1499	98
Pauri Garhwal	3236	3077	95
TOTAL	8165	7848	96

Table No. 2 Numbers of single village w/s schemes in Garhwal and O&M agencies (1993).

Name of district	Total No. of single village w/s systems	Maintained by Garhwal jal Sansthan	Maintained by village committees
Uttar Kashi	356	308	48
Tehri	527	358	169
Dehra Dun	302	150	152
Chamoli	362	284	78
Pauri Garhwal	651	327	324
Total	2198	1427	771

4.3 Selection of service level and technology:

Rural w/s systems are designed at 40 lpcd. and distribution of water through public stand posts. Only the water demand for human consumption is being considered. Springs are the main source utilised for w/s schemes, which are normally gravity fed. Due to high hydraulic heads and excavation problems only galvanised iron pipes are successful in these w/s systems. The schemes are designed to provide water continuously.

(i) Single village w/s system :

When the quantity of water in a spring is only sufficient to meet the 15 years projected demand for water in the village, then a single village w/s scheme is executed.

(ii) Multi village w/s scheme:

When a large quantity of water is available in the spring or gadera multi village w/s systems are designed and implemented.

(iii) Pumping w/s schemes :

Pumping schemes are executed only when gravity sources are not available, because it needs energy which increases the operation and maintenance cost.

(iv) Rain harvesting :

In Villages where spring, river and other water sources are not available, only then rain harvesting is used as the last solution.

4.4 Implementing agencies :

Following are the main implementing and operation and maintenance agencies in Garhwal.

- 1 U.P. government.
- 2 U.P. Jal Nigam.
- 3 Garhwal Jal Sansthan.
- 4 Gram panchayats (village committees).

Information about above agencies in respect of organisational setup, constitution, functions, duties and powers are presented in appendix no 2.

4.5 Present Policy for O&M in U.P. state :

The present policy of state government is that pumping w/s schemes in Garhwal commissionerary are operated and maintained by U.P. Jal Nigam, whereas single village w/s systems are being transferred to village panchayats from Jal Sansthan, multi village w/s schemes are operated and maintained by Garhwal Jal Sansthan and new systems which are executed by U.P. Jal Nigam since april 1993 are operated and maintained by Jal Nigam. The present policy of U.P. government may be summarised as follows.

Type of w/s system	Organisation responsible for O&M	Tax pattern
Multi village w/s schemes (pumping)	U.P. Jal Nigam	No tax
Single village w/s schemes	Village panchayat	Per household
Multi village w/s schemes	Garhwal Jal Sansthan	Per household

Due to creation of large number of w/s schemes in Garhwal and Kumaon commissionerary U.P. government devised a policy that all the single village w/s schemes be handed over to village committees, and schemes which are constructed after march 1994 and onward be maintained by Jal nigam. These two steps created a competitive feelings in O&M agencies and number of w/s schemes per agency were reduced considerably. From the above it is clear that U.P. state in its jurisdiction has different types of w/s systems. Depending upon the nature of the w/s arrangement, the water tax pattern is not uniform in practice . Only multi village w/s systems which are maintained by Jal Sansthan are subjected to realization of water tax from consumers, whereas U.P. Jal Nigam does not have the authority of tax realization in Garhwal. Therefore the w/s systems maintained by Garhwal Jal Sansthan are also not generating sufficient funds from their users. The study will reveal the O&M methods adopted by each agency and the cost involved in it.

4.6 Procedure to establish rural w/s scheme:

1 In a general meeting of the village panchayat a resolution is passed for implementation of w/s system in the village in which the need of safe and adequate water is emphasised. The copy of the resolution bearing the signature of the Gram pradhan (village committee head) is forwarded to U.P. Jal Nigam to prepare a w/s scheme in which a description of water sources is made which are perennial and their approximate quantity of discharge.

On the basis of this request the local unit of U.P. Jal Nigam will investigate the conventional water sources. If conventional sources are unsafe or situated at 100 metres or more elevation difference with respect to the village in hilly areas, then Jal Nigam will conduct a survey of the water sources. The adequacy of summer and winter discharge of the source is established. Planning, implementation and trial run of scheme is supervised for a period of six months by U.P. Jal Nigam. If the w/s system is single village it will be handed over to the village panchayat. As per present norm, now Jal Nigam will also maintain multi village w/s systems along with Garhwal Jal Sansthan.

4.7 Construction and handing over of w/s system:

Single village w/s systems, are planned, executed and after successful running for six months by U.P. Jal Nigam, are handed over to the village panchayats. In the past multi village w/s

Details
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Costs
w/s/1000

- CP in (pt.)
& design
- Man. system
- choice
- cost app.
- choice?
- financing
system
choice?

systems were handed over to Garhwal Jal Sansthan, but since april 1993 schemes executed by U.P. Jal Nigam are maintained by Jal Nigam and old schemes already with Garhwal Jal Sansthan will be maintained as usual by Jal Sansthan. This decision was taken by the U.P. government to facilitate operation and maintenance of w/s schemes in Garhwal and Kumaon commissionaires.

Mal Devta w/s scheme was constructed by project division U.P. Jal Nigam Dehra Dun and haded over to Garhwal Jal Sansthan in may 1993 after a successful trial run of six months. The regulation of water was uniform and it was continuous during the week.

Mohammad Pur Kemri w/s scheme was constructed by the 2nd construction division U.P. Jal Nigam Dehra Dun and handed over to Mohammad Pur Kemri village committee in march 1992 after a trial run of six months. The scheme was running satisfactorily. The other source of water in this village is a river which is situated 500 m from the village. Because the river is far, villagers pay due attention to O&M of the scheme. Talli Kheri Khurd w/s scheme was also constructed by the 2nd construction division U.P. Jal Nigam Dehra Dun and handed over to the village committee of Talli Kheri Khurd in March 1991 after a trial run of six months. In this village an alternative spring source is situated at a distance of 500 metres. Therefore the scheme is operated and maintained with utmost care.

4.8 Responsibilities of the village Panchayat :

The village panchayat is an elected body, it has one gram pradhan (village committee head) and some elected members from the village to organise village administration. The main functions of the Panchayats are :

- (i) Maintenance of village roads, streets, street lights and construction of drinking water wells with the help of a block development office after getting a grant from the block office.
- (ii) The main occupation of livelyhood in villages is agriculture, therefore the activities of the panchayats are connected with the community of farmers. The village panchayat has a village secretary who is an employee of the panchayati raj dept. The duties of secretary are to maintain family records of birth and death. With help of the village secretary, gram pradhan maintains the accounts

of Jawahar Rojargar Yojana, national rural employment programme (NREP) and rural landless employment guarantee programme(RLEGP). These programmes are introduced through the district rural development authority (DRDA). In Garhwal the village panchayats are responsible for O&M of single village gravity fed w/s schemes. Village panchayats do not have sufficient funds, tools and spare parts for proper maintenance of w/s systems. The w/s systems are operated and maintained by volunteer organisations(Men and Women) working in the villages.

5. WATER USE IN THE THREE VILLAGES

5.1 Description (comparison) of villages:

Two villages Mal Devta and Talli Kheri Khurd are traditionally structured, with the upper and middle caste living in the core and the lower caste on the periphery. In village Mohammad Pur Kemri nomadic tribes (Gujars) are settled. The government has provided them with land for agriculture, and loans to purchase cows and buffaloes to promote dairying. The status of each village is shown in table No. 3. The villages are situated in the Himalayas, therefore there is no flat land available for agricultural activities. Terrace farming is practised to produce food grains, vegetables and fruits. Large deposits of building and road material are available in this area, which are being exploited through unplanned mining activities. This activity improves the economic condition of the local population but creates an environmental disorder in the whole area.

It may be observed from Table No.3 that Mal Devta village is well connected by an all weather road to the district head quarters Dehra Dun, whereas the other two villages are having 8 Km and 3 km of seasonal paths. These villages are not approachable during the rains.

Mohammad Pur Kemri village is situated in Rajaji National park, a forest reserve area, where a perennial river is flowing. The population of this village is homogeneous consisting of one caste, the Gujars. They are not well educated. The basic cause of this is the nomadic character of the masses and the non availability of schools in the village.

Economically Mal Devta village is richer than the other two villages, because village members are earning handsome money from trade.

5.2 Water use patterns.

The water use patterns in the Garhwal villages vary significantly with caste and affluence, wealthier households using more water than others. The use of water is determined by its availability, continuity of supply and distance from the water point. Water is also used at the water point.

Upper and middle cast women stay at homes for the domestic work, whereas lower cast women work out of the village during day time.

Therefore they get less time to collect and use water in comparison to Upper and middle cast women. It resulted in less collection and use of water.

Table No. 3 Status of three villages in Dehra Dun district.

Name of village	Mal Devta	Mohmmad Pur Kemri	Talli Kheri Khurd
Location	15 Km. from Dehra Dun	30 Km. from Dehra Dun	12 Km. from Dehra Dun
Accessibility (i) all weather road (ii)village path (seasonal)	15 Km.	22 Km. 8 Km.	9 Km. 3 Km.
Population (No)	400	190	102
Average population /household	6.5	5	5
House hold (No).	60	37	20
Social & cultural stratification	Various castes upper, middle & lower cast.	One caste only nomadic (Gujar)	Various castes upper caste, middle and lower caste
Education level	post graduate, graduate, matriculation and primary level	primary level up to 5th standard	Post graduate, graduate, matriculation and primary level
Educational Institutes.	10 th class	No school	5th class
Main economic activities	Agriculture, service & trade	Agriculture , poultry, dairy & service	agriculture & service

5.3 Use of unimproved water sources:

For washing of clothes and watering of animals, river, canal and spring sources are used.

Washing of clothes:

Conventional sources (canals, rivers and springs) are situated 40 m-500 m from the village whereas the water points of the w/s scheme are within a distance of 24 m from the houses. But due to non availability of washing platforms near the water points and according to social custom, clothes are not washed at the stand posts, which are used for collection of drinking water only.

Therefore canals, rivers and springs are the only alternatives for washing clothes.

Watering of animals:

The w/s systems are designed at the rate of 40 lpcd. which represents only the human requirements. Cattle are taken for grazing in forests and fields which are near the conventional water sources (canals, rivers and ponds). So watering and washing of cattle is done at these sources.

Water for gardening:

Design criteria of government provides 40 lpcd for human consumption, therefore there is no provision for irrigation requirements in the w/s systems. House connections are also not included in the criteria.

5.4 Comparison of water use in the three schemes and quantities collected at public stand posts :

The quantity of water collected and fetched to the houses is given in table no 4. Mal Devta, Mohammad Pur Kemri and Talli Kheri Khurd w/s schemes are serving 40, 38 and 20 people per water point. The quantity of water fetched to households in each of the three villages from the water point was 8.9, 9.6 and 12.4 litres per capita per day. The male members and children of households were bathing at water points, which reduced the amount of water to be fetched to the houses.

Mal Devta w/s system was experiencing a shortage of water. Only 8.9 lpcd of water could be collected, whereas the other two systems had excess quantity of water which was overflowing from c. w. r. and used for irrigation purposes. All three w/s systems had unauthorised house connections, which were drawing a major quantity of water. It indicated that consumers were interested

in having house connections. Influential people connected unauthorised house connections in the distribution network and used the w/s system in their own requirement of water and were not allowing other community members to use their water point.

Table No. 4 - Fetching of water to households

Name of w/s scheme	Average population/house hold No	Quantity of water fetched from water point to houses (Litres)					
		Drinking & cooking	Washing of food & utensils	Personal washing	Kitchen cleaning	Total	Per capita/day
Mal Devta	6.5	15	20	15	8	58	8.90
Mohammad Pur Kemri	5	10	16	15	7	48	9.60
Talli Kheri Khurd	5	12	20	20	10	62	12.40

6. COMPARISON OF THE THREE WATER SUPPLY SYSTEMS:

6.1 Reliability and Quantity :

Three rural w/s schemes were studied to evaluate the functioning of these schemes. A comparative position is presented in the table No. 5 below.

TABLE NO. 5 Comparison of functioning.

1	Name of the W/S scheme	Mal Devta	Mohammad pur kemri	Talli Kheri khurd
2	Name of agency maintaining	Garhwal Jal Sansthan	Community	Community
3	present population/ultimate Population for supply	400/470	190/240	102/125
4	Estimated consumption of water (based on design)	40 Lpcd	40 Lpcd	40 Lpcd
5	Present water requirement (Excluding losses) Ultimate water requirement	16 Kld 18.8 Kld	7.6 Kld 9.6 Kld	4.08 Kld 5 Kld
6	Present production of water	20 Kld	10 Kld	8 Kld
7	For how many hours per day the supply operates	18 Hours	24 Hours	24 hours
8	For how many days per week does supply operates	6 days (average)	7 days	7 days
9	What has been the trend in water production	Interruptions	Continued production	Continued production
10	What is the capacity in cumec/hour	0.84 cumec	0.41 cumec	0.33 cumec
11	What is the capacity in cumec /day	20 cumec	10 cumec	8 cumec
12	Is there a seasonal variation in capacity	No	No	No
13	Is there a seasonal variation in demand	yes	yes	yes
14	Which component of supply is limiting	Distribution system	distribution system	distribution system
15	Convenience of water points	10 metres	10 metres	24 metres

The W/S system managed by the government organisation is not performing ideally, though it has skilled supervision and regular O&M staff. It is lacking in hours and days of weekly supply. The distribution of water is not proper. Public stand posts situated in the higher zone do not receive water during peak demand of the day. This is due to improper regulation of the valves of the system. There are frequent breakdowns and interruptions in the system. As a result the consumers are not satisfied. In the community managed systems water supply is continuous throughout

underlying reasons - idem

the week, and the distribution of water is equitable for all public stand posts and consumers are satisfied. It indicates that the reliability of government w/s schemes, is low.

6.2 Quality of water in the three w/s schemes:

Samples of tap water from three w/s schemes were collected and were analyzed in departmental laboratory. The results of the analysis are available in table No 6.

TABLE No. 6 Comparison of water quality in three schemes.

Name of the w/s system	MAL DEVTA	MOHAMMAD PUR KFMRI	TALLI KHERI KHURD
PHYSICAL PARAMETERS			
(a) Turbidity	4 Ntu	2Ntu	1Ntu
(b) Suspended solids	Nil	Nil	Nil
(c) Flow (Cumec/hour)	1 00	0 41	0 33
(d) Taste	Good	Good	Good
(e) Colour	3Tcu	2Tcu	2Tcu
CHEMICAL PARAMETERS			
(a)pH	7 5	7 4	7 4
(b)F mg/lit	Nil	Nil	Nil
(c) No3 "	2 00	3 00	Nil
(d)Chlorides "	Nil	NIL	Nil
(e)Arsenic "	Nil	Nil	Nil
(f) Sulphate "	Nil	Nil	Nil
(g) Total hard "	48 00	40 00	52 00
(h) Calcium hardnessCaCo3	42 00	35 00	47 00
(i)Mg hardne "	6 00	5 00	5 00
BACTERIOLOGICAL			
E-Coli Mpn/100 ml	Nil	Nil	Nil

The quality of water in the three schemes is satisfactory but it needs a nominal chlorine (bleaching powder) dosage of 1 ppm to check the after growth in supply main and distribution net work. Community members are not familiar with the use of bleaching powder, but the employee of the government organisation is lazy in using it.

6.3 Comparison of the organisation of operation and maintenance in three villages :

Garhwal Jal Sansthan and the village panchayats (village committees) differ widely in the level of technical knowledge, staff, tools and equipment, skilled supervision and financial

control required in O&M. An attempt is made to evaluate the two organisations. The Mal Devta w/s scheme is managed by government organisation for which O&M is the responsibility of the Jal Sansthan. Mohammad Pur Kemri w/s scheme is operated and maintained by the village community, the expenditure incurred and repairs carried out are listed in a register by date along with other communal activities. The O&M expenditure is shared by the households at each occurrence. Each household in turn looks after the water points and its site cleaning work. A volunteer organisation is responsible for all communal activities. Talli Kheri Khurd W/s scheme is operated and maintained by male and female youth organisations. The village has members who are well trained in repair works and account keeping. The comparative picture in table No.7 reveals the merits and demerits which are prevalent in O&M organisations.

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Table No. 7 - Comparison of O&M organisations in the three villages.

W/s scheme	Mal Devta	Mohammad Pur Kemri	Talli Kheri Khurd
Operating & maintaining organisation	Garhwal Jal Sansthan	Community	Community
Tools & equipment	Available with employees	Inadequate tools and equipments	Inadequate tools and equipments
Maintenance staff	One full time fitter maintaining 6 No w/s systems One part time employee	Plumber is hired for repairs Physical labour is done by villagers	Tools for repairs are arranged from Garhwal Jal Sansthan Through member of village and physical labour is performed by volunteer organisation
Task description	Well defined it is available with employee	There is no task description for volunteers they perform the duties as per need	There is no task description for volunteers it is decided as per requirement
Maintenance manual	No employee has it	No manual	No community member has it
Educational qualification of staff	5th & 8Th standard No additional training	Volunteer organisation members with education level up to 5th standard	Members of volunteer organisation are educated up to post graduate level
Stock for repairs (spare parts)	Available in Rai pur departmental store 8 km	Nothing in stock It is purchased when needed from Dehra dun	Nothing in stock It is purchased when needed from Dehra dun
Supplies(bleaching powder)	"	It is available at Dehra Dun in market	It is available at Dehra Dun in market
Water tax collection method	Monthly rate Rs 2 5/house hold but billing is yearly	No tax realisation expenditure of repairs is distributed amongst house holds	No tax realisation. expenditure of repairs is shared by house holds
No of stand posts	10	5	5
No of house holds	60	37	20

Garhwal Jal Sansthan provides tools and equipment to its employees for the O&M of Mal Devta w/s system. Mohammad Pur Kemri w/s scheme and Talli Kheri Khurd w/s systems don't have tools and equipment but the volunteer organisation of Talli Kheri Khurd borrows tools and equipment for repairs from the employee of Garhwal Jal Sansthan.

Mal Devta w/s system is looked after by one fitter who is responsible for 6 w/s schemes and one part time employee to use bleaching powder in the scheme. For Mohammad Pur Kemri w/s system a plumber is hired and physical labour is done by a volunteer

organisation. In Talli Kheri Khurd repairs are carried out by a volunteer organisation.

The description of tasks for Jal Sansthan employees is there, but no tasks were defined for the volunteer organisations in Mohammad Pur Kemri and Talli Kheri Khurd W/s systems. Neither the employees of Jal Sansthan nor the volunteer organisations of the villages have a maintenance manual.

The educational qualification of the staff working for Garhwal Jal Sansthan is 5th and 8th standard. Members of the volunteer organisation of Mohammad Pur Kemri village were educated to 5th standard. Members of the volunteer organisation of Talli Kheri Khurd village were educated at post graduate, graduate and matriculation standard.

Stock of tools and repairing material for Mal Devta w/s scheme are available at Rai Pur (departmental store of Garhwal Jal Sansthan) which is situated at 8 Km from this scheme. In the other two schemes which are managed by communities, there is no stock of repairing material available, but it can be purchased from the market in Dehra dun.

Garhwal Jal Sansthan realises a water tax of Rs 2.5/month/household which is collected annually. In the other two w/s systems, there is no tax realisation ; the repair expenditure is shared by households.

In spite of the fact that Garhwal Jal Sansthan receives subsidy from the state government and regular staff for O&M is available, the organisation is unable to manage properly the Mal Devta w/s scheme.

6.4 Comparison of O&M costs

There are two types of cost involvement for w/s systems (i) Capital cost, and (ii) Recurrent cost.

(i) Capital cost. The main requirements of funds for rural w/s systems (gravity fed), are in planning and execution activities. These activities are already over in Garhwal commissioner, for which the governments of India and U.P. have spent a huge amount.

(ii) recurrent cost. Recurrent cost is the cost which is needed regularly for operation and maintenance of w/s systems. This

part includes repairs, chemical & labour expenditures. This cost may be calculated on the basis of standard values or in terms of actual expenditures.

[A] Standard O&M Standard recurrent maintenance expenditure.

The standard expenditure is the cost of O&M based on current market prices of labour and material, taking into account the aging of the scheme. It is used as a yardstick for comparison of actual O&M expenditure of the w/s schemes.

Standard O&M expenditure calculations per scheme are available on page No 70-71; the comparative position is shown in Table No. 8.

The O&M criteria for newly constructed schemes are as follows:

- 1 Civil works need yearly O&M cost @ 1%
- 2 Distribution system need yearly @ 0.25 %
- 3 Mechanical works need yearly @ 2 %
- 4 One part time fitter needed @ Rs200 / month.
- 5 Cost of bleaching powder,, @ Rs 6/ Kg
- 6 Casual labour cost. Lump sum.

Table No. 8 Comparison of standard O&M expenditure in three w/s schemes

Name of w/s scheme	estimated cost (Rs)	Present population	O&M cost / capita/year (Rs)
Mal Devta <i>dy</i>	560, 000	400	12.90
Mohammad Pur <i>dy</i> Kemri	430, 000	190	26.70
Talli Kheri <i>dy</i> Khurd	190, 000	102	35.74

[B] PER CAPITA ACTUAL OPERATION & MAINTENANCE EXPENDITURE:

This is the actual expenditure which indicates the item-wise details of work expenditure. It may be less, equal or more than the standard recurrent maintenance expenditure. It depends on quality of maintenance, age of scheme, service level and on the skill of the operators. Before making comparisons between the two types of schemes (government and community managed) it is important to know the annual actual maintenance expenditure of each scheme, for which calculations are as follows.

(i) Garhwal Jal Sansthan:

Garhwal Jal Sansthan is responsible for O&M of w/s schemes in Garhwal commissionerary. The sum of expenditures for all schemes in each district is used to calculate the per capita cost of maintenance. Consumers pay water taxes at a flat rate of Rps. 2.5 per month per household only, and a subsidy is obtained from the U.P. government to cover the rest of the O&M expenses. Therefore the calculation of per capita ^{current} cost is not causing any extra burden to the consumers. The U.P. government asks the Jal Sansthans for annual reports of total expenditure, operation and maintenance costs, as well as per capita O&M expenditure, to assess the relative efficiencies amongst all regional Jal Sansthans. On the basis of the annual deficit in O&M expenditure, the proportionate subsidy and grants from the government are determined.

Details of District-wise actual O&M expenditure figures for the financial year 1993-94 are tabulated in table No. 9 below.

TABLE NO. 9 - O&M expenditure by district

District	Cost of O & M Yr. 1993-94	Population benefitted	Per capita cost in Rs.
Uttar Kashi.	4,832,000	116,660	41.42
Tehri.	8,725,000	333,862	26.13
Dehra Dun	31,990,000	365,329	87.59
Chamoli.	6,906,000	213,862	32.28
Pauri Garhwal.	10,550,000	384,311	27.45
TOTAL	63,003,000	1,414,024	44.56

Ref. Garhwal Jal Sansthan, Action plan of U.P.hill region 1994

From Table No. 9 it is clear that Dehra Dun district has the highest O&M cost, i.e. Rs 87.59/ capita/ year. The author questioned the Garhwal Jal Sansthan authorities about the high per capita cost of Dehra dun; they replied that Dehra Dun district has some w/s systems that are operated by electrical energy, and need heavy expenditure for operation and maintenance. The over all cost of maintenance is Rs 87.59 /capita /year which is nearly three times more than in Tehri district. Tehri district has the lowest O&M cost of Rs 26.13 /capita /year, the other districts falling in between. The overall O&M cost of the commissionerary is Rs 44.56 /capita/year.

It is not very possible that a single parameter, i.e. energy, can boost maintenance expenditure to the tune of three times. The author learned from other staff members that the real reason was on account of heavy repair works in w/s systems, which crept up due to slack supervision, improper communication between operators & controlling staff.

The actual cost of operation and maintenance of the Mal Devta w/s scheme is calculated as below.

MAL DEVTA W/S SYSTEM:

Estimated cost	= Rs. 560, 000
Population	= 400
Maintenance agency	Garhwal Jal Sansthan (government organisation)
Cost of supervision (1993-94)	= Rs 6925. 00
Labour cost	,, = Rs 6000. 00
Cost of chemical	,, = Rs 144. 00
Material used	,, = Rs 4560. 00
Total	= Rs 17629. 00

O&M / capita / year = $17629.00 / 400 = 44.07$
= Say Rs 44. 00

(ii) Village panchayats (Village committees) :

The following schemes are operated and maintained by village communities. Calculation of actual O&M costs are given below.

MOHAMMAD PUR KEMRI W/S SYSTEM:

Estimated cost =Rs. 430,000

Population = 190
 Maintenance agency = village community.
 cost of material used in
 repairs during year 1993-94 =Rs. 1640
 Labour cost of plumber " =Rs 1400
 Total yearly O & M cost =Rs. 3040
 Annual per capita O&M cost = 3040/190 =Rs 16

TALLI KHERI KHURD W/s SYSTEM:

Estimated cost = Rs 190,000
 Population =102
 Maintenance agency Village community

 maintenance cost in year 1993-94
 (i) material =Rs300
 (ii) Labour =Rs600
 Total =Rs900
 O&M cost/capita/year =900/102 =Rs 8.82

6.5 Comparison of O&M cost / capita / year :

Operation and maintenance costs for government managed and community managed w/s systems can now be compared on a per capita basis, as shown in Table No.10 below. It may be observed that in the government managed scheme, actual O&M costs per capita are more than three times higher than the standard costs, whereas in village managed schemes the actual costs are much lower than the standard costs.

Table No. 10 - Comparison of O&M cost of the three w/s schemes (1993-94)

Name of w/s system	Month/year of commissioning	O&M agency	Actual O&M cost / capita Rs	Standard O&M cost/ capita Rs
Mal Devta	May 1993	Garhwal Jal Sansthan	44.00	12.90
Mohammad Pur Kemri	March 1992	Village committee	16.00	26.70
Talli Kheri Khurd	March 1991	Village committee	8.82	35.74

6.6 Observations and flaws:

The maintenance of existing rural water supply systems by the government has by and large been a sore point and has come in for severe criticism by the public as well as popularly elected ministers. The reasons are not far to seek.

One is the lack of master planning of water supply systems for 15 or 30 years so as to be flexible enough as to provide for additional works as and when demand is expected to arise in any particular part of the water supply systems.

The basic reason for the problems in O&M is the lack of proper orientation of the maintenance engineers toward the design aspects of the system. It is obvious that if a scheme is not run on the basis of the concepts on which it was designed, it can not perform ideally. Unfortunately, the poor service conditions in the old local institutions hardly ever attracted good engineers. Most of them wanted to join government organisations. Thus many engineers of lower qualifications were absorbed in the local bodies, they are now also working in Jal Sansthans. Such engineers lack in knowledge of modern design aspects of the schemes. On the other hand some electrical and mechanical engineers are also working for gravity fed w/s systems whom are not familiar with design aspects.

Only a few years back, the services of the water works engineers were centralised and made transferable when they had an opportunity to work on different undertakings than those on which they had gained experience. It shows that managerial staff lack in experience.

To keep his position secure and sound with the local people or administrator, the unexperienced engineers have to adopt a critical attitude towards the w/s schemes implemented in their jurisdiction. Being men dealing with the public and being in constant touch with the administration, they often bring down the image of the executing agency i.e. the Jal nigam. It has been the habit to project a minor defect in a system as a major catastrophe while hiding one's own inefficiency behind excuses, such as leakage of pipelines at a few places, seepage of water through glands of sluice valves, and so on and so forth.

Design criteria of w/s systems include only human water consumption, which is insufficient for other uses. Washing

platforms and cattle troughs are not constructed in the w/s systems, although they are essential to the communities. As a result of cloth washing and animal watering, canals, rivers and springs are polluted. The per capita water consumption appears to be low because house connections are not included in the design criteria. Illegal house connections exist in all three w/s schemes.

The financial condition of the villages is satisfactory they can afford house connections. During interviews community members showed their desire to have house connection and were prepared to pay water charges of Rs 10-30 /month/household.

7.1 SUMMARY AND CONCLUSIONS:

The possibilities and problems of community participation and management in operation and maintenance of rural water supply systems in Garhwal commissionerary was investigated by means of interviews with key informants and household questionnaires in three villages. In one of these O&M was the responsibility of the government organisation, whereas the other two schemes were managed by the village panchayats. A comparison was made between the two modes of management so as to establish their respective advantages and disadvantages. Attention was paid to aspects of O&M costs, reliability of supply and water quality parameters, as well as to consumer satisfaction.

- 1 Comparison of the functioning of the three w/s schemes reveals that the quantity of water in the sources is sufficient up to the end of design period and production of water in the systems is in excess of current water requirements. The Government organisation lacks in supervision of the system, therefore sufficient water was not available to the consumers in the government managed w/s system. The community managed w/s systems were operating continuously throughout the month, but the government managed system operated for fewer hours and days per week due to frequent breakdowns. The regulation of water in the government managed w/s scheme was not optimal, resulting in non availability of water in stand posts situated at higher altitude during peak demand.

Thus, the reliability of community managed systems was good, whereas that of government managed schemes was only fair. Consumers in community managed w/s schemes were satisfied, but consumers of the government managed scheme were dissatisfied.

The quality of water in the three w/s schemes was satisfactory, but a nominal dosage of 1 ppm of chlorine (bleaching powder) is essential to check the after growth in the supply mains and distribution network.

- 2 The users of the three w/s systems were utilising the water of the schemes for drinking & cooking, washing of food & utensils, personal washing and cleaning of kitchens. The use of water for washing of clothes and watering of cattle

was not possible due to non availability of washing platforms and cattle troughs in the systems. This causes pollution of canals, springs and rivers. The design criteria need to be revised in order to accommodate non-domestic forms of water use, especially watering cattle.

3 Operation and Maintenance costs :

costs? (scheme dimension capital costs + O&M)
O&M? risks that high?
city improved choice?

In the community managed w/s system there were only few breakdowns during the year and physical labour was done by community members. Therefore the O&M cost is low. The water supply system operated and maintained by Garhwal Jal Sansthan had frequent breakdowns during the year. Therefore it required more labour and material expenses. The overhead costs of skilled supervision further enhanced the O&M cost.

4 Organisational problems occur both with Garhwal Jal Sansthan (the government organisation) and the village panchayats. The former is weak in supervision and communication amongst its employees. The latter are political organisations in which political rivalries may affect the equatability of water regulation in the systems. In order to avoid such problems, the village O&M organisations should be independent of the village panchayats. Neither government organisation nor village panchayats had the funds to train their staff/community members.

compare new planned policy (Panchayat law)

5 Though community managed w/s schemes are running satisfactorily, gravity fed w/s systems are simple in technology and therefore easy to operate and maintain. Nevertheless, technical, managerial and accounts training is essential for community members.

Taking into account these observations it is evident that community management of gravity fed rural w/s schemes is feasible and preferable. However, the field study has shown that villages in general do not have well established and systematic organisations for the O&M of w/s schemes. The existing forms of organisations are voluntary and self styled. If such organisations would be well developed they would be able to solve most of the problems at village level. As the villages are in a position to afford water charges, they could cover their own O&M costs.

Although the villages do not have well established and developed O&M organisations, the actual O&M cost per capita per year is low in comparison with that in government managed schemes. This explains that community management is a cheaper, more reliable and sustainable solution for maintenance for rural w/s schemes.

7.2 RECOMMENDATIONS:

As the author holds an executive position with the state water organisation (Jal Nigam) the research project was of particular relevance to increase his perception of village level problems with rural water supply. Conversely, it was difficult to separate the research findings from his prior professional experience. It is felt that this combination of research and professional experience justify a number of recommendations.

From the study, the author learned the importance of various circumstances that may interfere with self sufficiency in operation and maintenance of water supply systems. These are related to the organisation of water agencies and village communities. Some recommendations can be made to improve the situation in this respect.

A. Govt. departments (U.P. Jal Nigam & Garhwal Jal Sansthan):

(i) Amalgamation:

A closer integration of construction engineers and maintenance engineers would be desirable; at present they tend to work separately. It is necessary for the maintenance engineers to be familiar with the modern design concepts on which their schemes are based, and at the same time the design and execution engineers should be conversant with problems of maintenance and operation. To achieve this refresher courses could be helpful. Preferably, both disciplines should be under the same organisation. This would ensure availability of higher technical control over the maintenance problems and rectification of any shortcomings.

(ii) Deputation:

Temporary assignment of personnel from U.P. Jal Nigam to Garhwal Jal Sansthan may ease the problem of staff shortage in the short run. But the experience of some people recently assigned to Jal Sansthan is that they are not trusted and therefore are hardly effective in the present setup. It would be necessary to change

the attitudes of the two sets of engineers to instill a spirit of cooperation.

(iii) Schedules:

There should be proper maintenance schedules for w/s systems to ensure regular inspection at specified intervals. There should also be a reporting system to ensure that remedial steps are taken well in time.

(iv) Completion plans:

Up to date completion plans for the various water supply systems are not available either with Jal Nigam or the Garhwal Jal Sansthan. These plans should show the location of various fittings along with the numbers, type and size of pipes for better control of the distribution of water. It has been observed that in the old w/s systems the knowledge of the location of vital fittings disappears when the operator retires or is transferred. It is therefore essential that such plans are prepared and displayed on a large scale in the office of the w/s agency.

(v) Statistics:

A serious handicap in the improvement of maintenance systems is the non availability of performance statistics of different units of w/s systems. A system of recording meaningful statistics should be enforced, as this will be quite useful in any future reorganisation or modification of the schemes.

(vi) Office cum store :

Each w/s system should have an office cum store to collect all information, records related to the w/s system and to store chemicals, materials for repairs, and tools.

B. Village organisations

(i) Gravity fed w/s systems from spring sources are the appropriate choice of technology because a sufficient quantity of water is available in the sources throughout the year and the technology is well within the knowledge of the villagers. W/s systems could be operated and maintained by community members, taking into account the following considerations at the level of the planning and implementing agency (U.P. Jal Nigam).

(ii) New schemes should only be prepared with full involvement

of the community after assessing the real demand for water. W/s schemes should be designed at 70 lpcd. instead of 40 lpcd. so that the revenue from the scheme may be improved by authorising house connections. Provision of washing platforms and cattle troughs should be included in the design criteria of the department.

(iii) Institutional set up and legislative support:

(a) Formation of village committees

Village organisations should fairly represent the different sections of the community, with special attention for the important role of women in management of the village water supply. As much as possible the water committees should be protected from political interference. Energetic members or even secretaries of the village panchayat may be committee members. Junior staff of Jal Sansthan (engineer, fitter) should be on the committee, but no employee of any Govt. organisation should be allowed to be chair person of the village organisation.

A model of O&M organisation is proposed, which is available on page 60.

(b) Duties of the village water committees

The main objective of the committee is to run the water supply scheme properly by assigning individual tasks to each committee member with the help of members of U.P. Jal Nigam and Jal Sansthan. Their tasks would include maintenance of civil works, collection and administration of water tax, preparation of budget proposals on the basis of service level, extension and reorganisation of the system. The committee is responsible for the allocation of tasks among the committee members. Tools and materials needed for repairs should be kept in stock of the village so that repairs can be carried out immediately.

(iv) Financial viability of the systems:

From the field study it has become clear that the villages which are maintaining rural w/s schemes do not have a sound system of accounting but only adhoc systems of fund raising for urgent repairs. The following steps are needed to improve financial control:

a. The community should be involved in the financial management

city
corp.
h/g.

of the scheme. Simple systems of keeping accounts should be designed and practical training arranged at village level.

b. The Village Panchayat is empowered to impose water taxes and other charges on the population. The revenue earned by the w/s scheme should not be diverted to other village development projects.

c. The government should allow the installation of house connections in rural areas so as to enhance the revenue from water supply schemes.

(v) Man power development and training:

Community members should be trained in repair works and management systems, so that they may run w/s schemes efficiently.

(vi) Monitoring & Control :

a. U.P. Jal Nigam should collect and analyze the information about the progress of establishment of w/s organisation at village level. Bottlenecks should be identified and necessary steps, to remove them be taken up on priority.

b. Jal Nigam should conduct water sampling in these schemes to evaluate the water quality in mobile laboratories. The government should provide financial assistance to U.P. Jal Nigam to strengthen its water testing laboratory to conduct field tests.

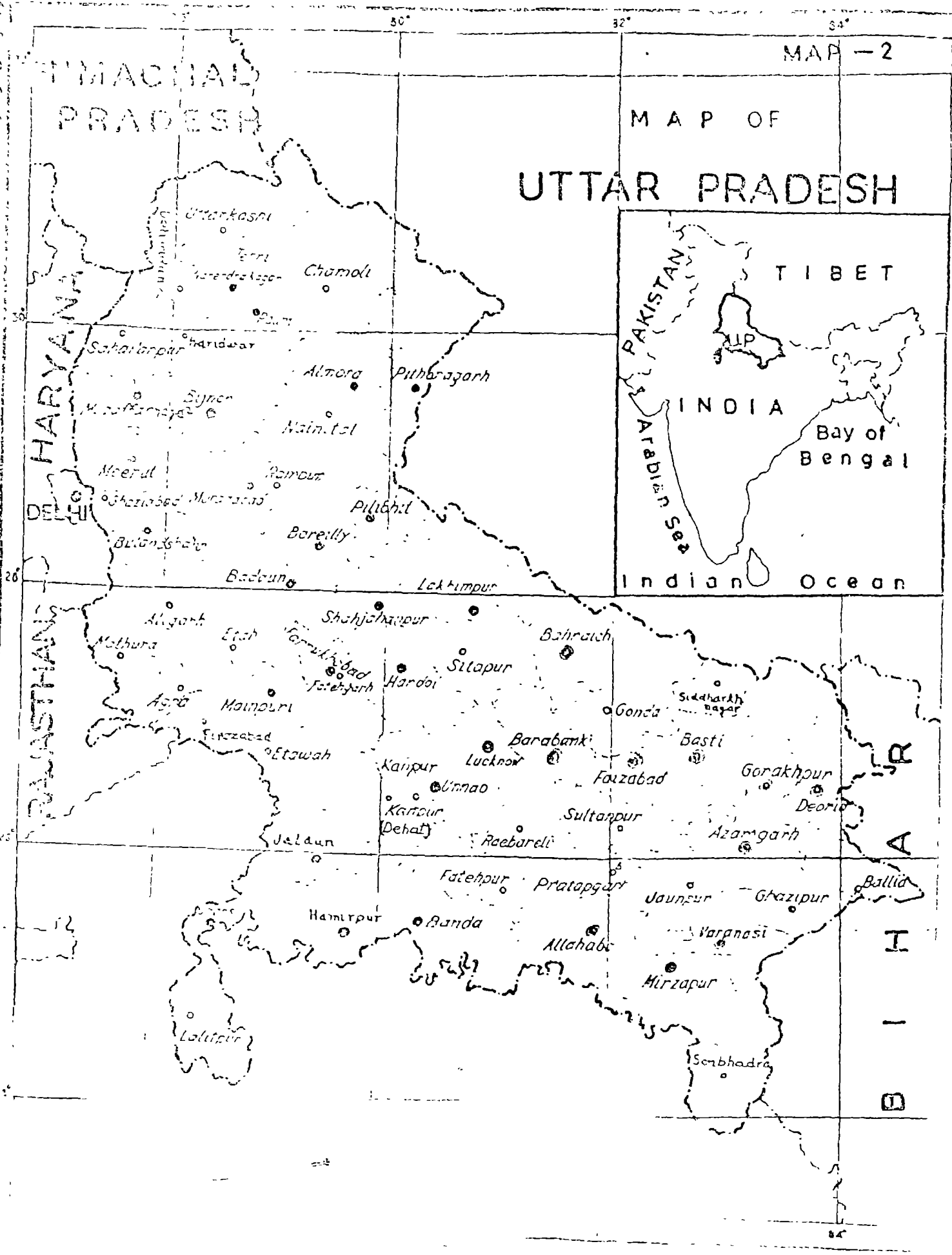
(vii) Political interference:

During the field study no political interference was apparent but the slogan of free water for all creates the wrong assumption among the people that they are not supposed to pay water charges ever. Instead, they should be made to understand that user charges are inevitable in the long run.

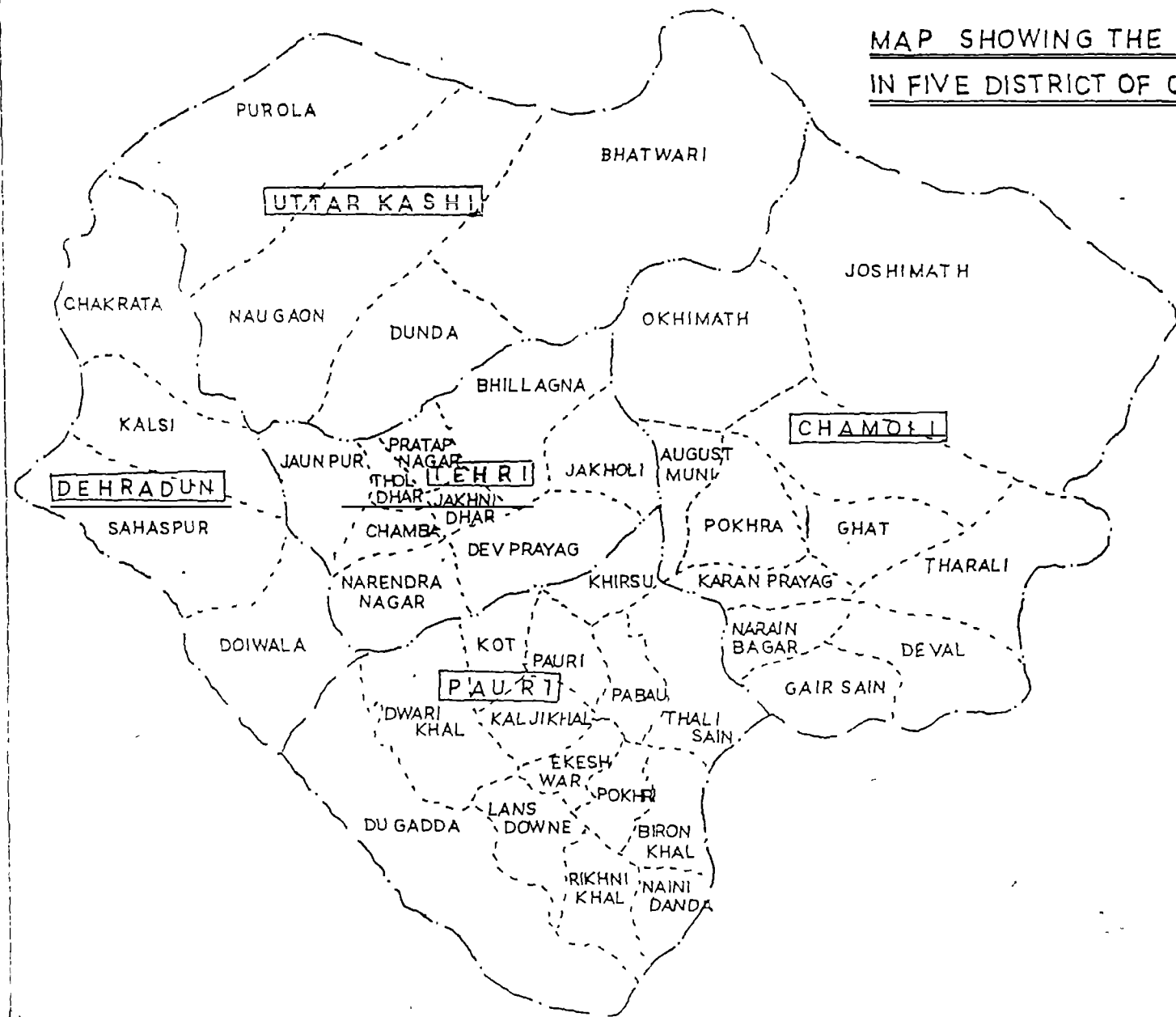
capexd units are free

APPENDIX 1
DRAWINGS AND ORGANOGRAMS

MAP OF UTTAR PRADESH

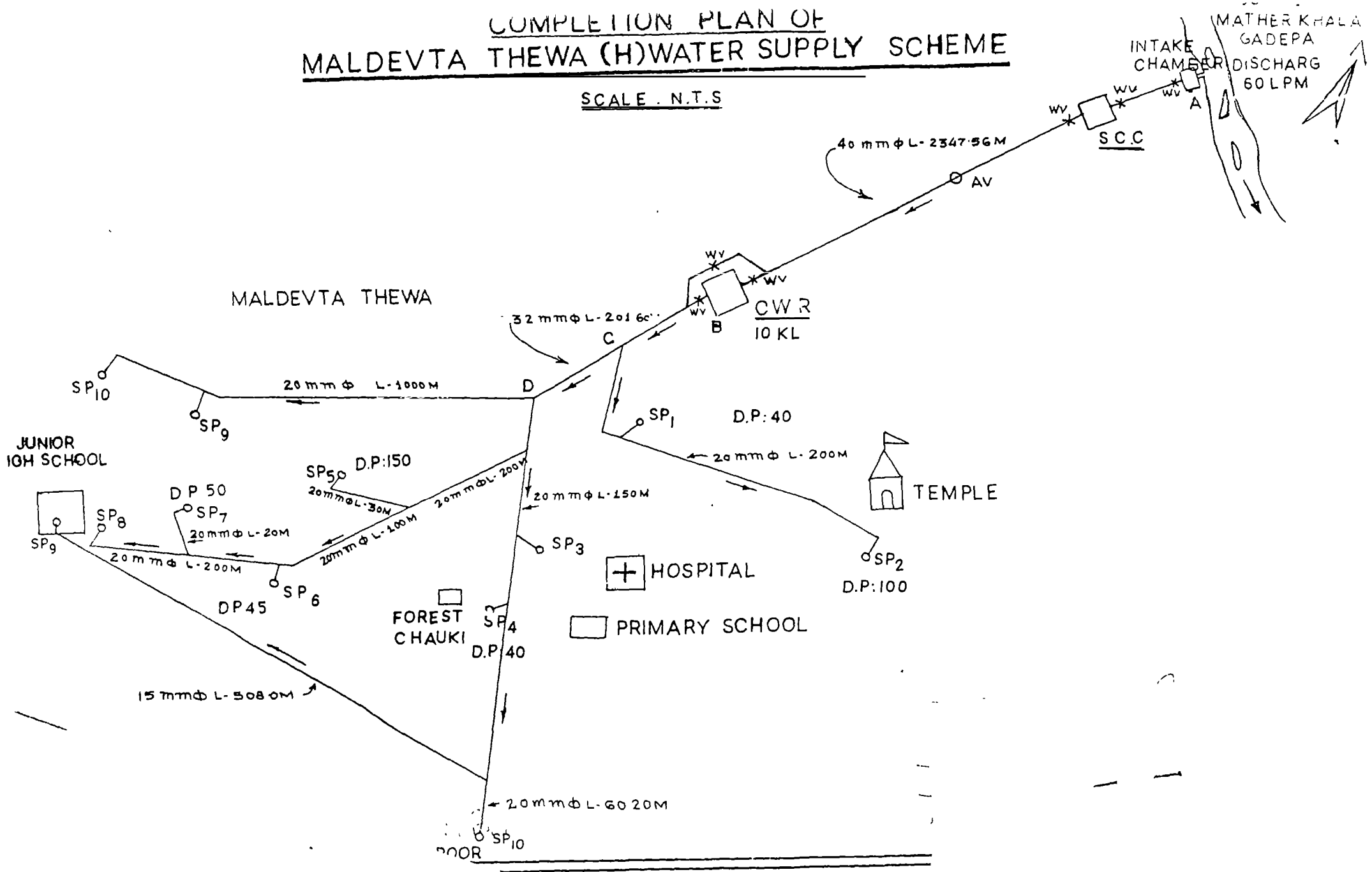


MAP SHOWING THE BLOCK
IN FIVE DISTRICT OF GARHWAL



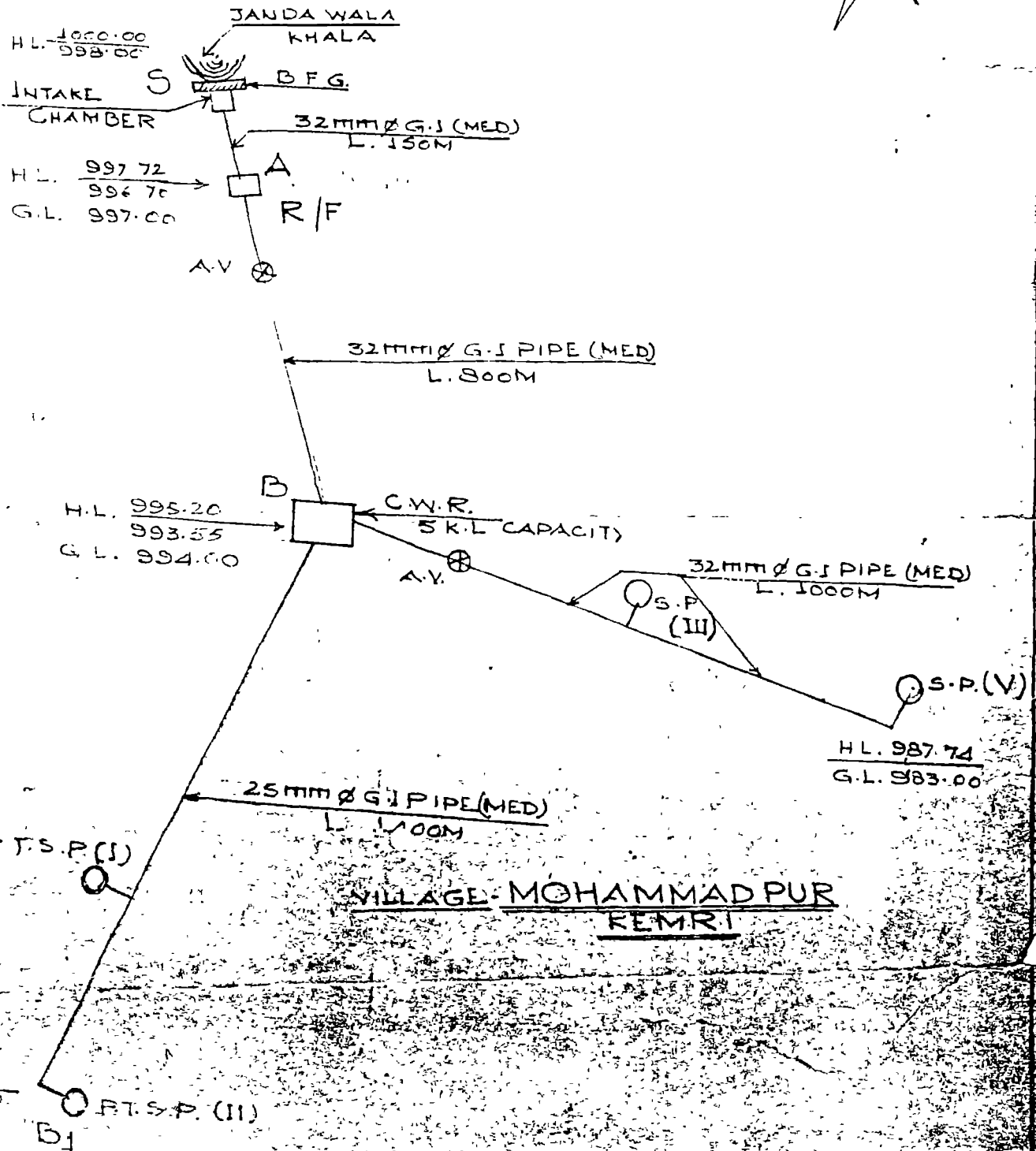
COMPLETION PLAN OF MALDEVTA THEWA (H) WATER SUPPLY SCHEME

SCALE . N.T.S



INDEX PLAN FOR
MOHAMMAD PUR KEMRI (H) W/S SCHEME

NOT TO SCALE

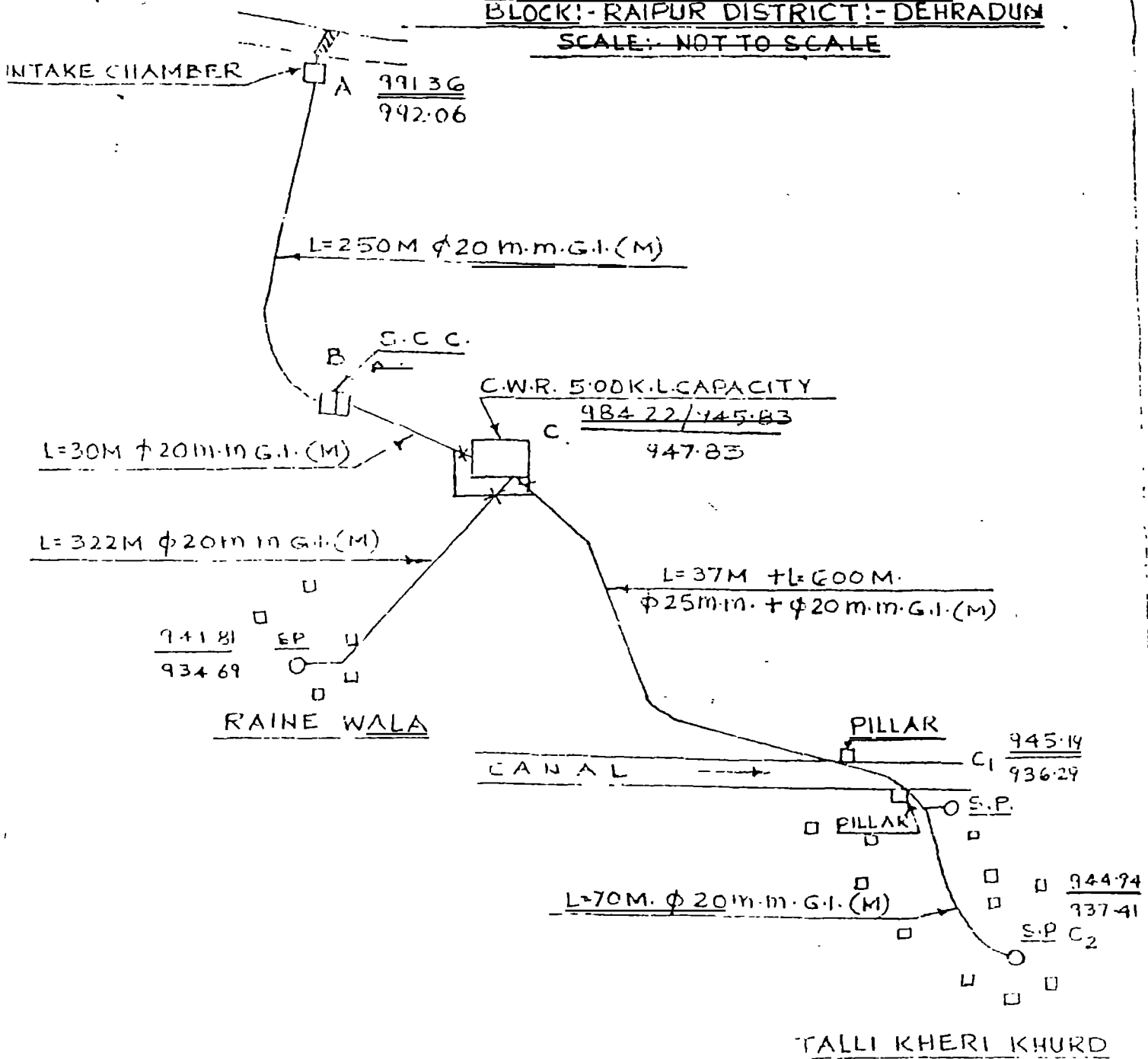


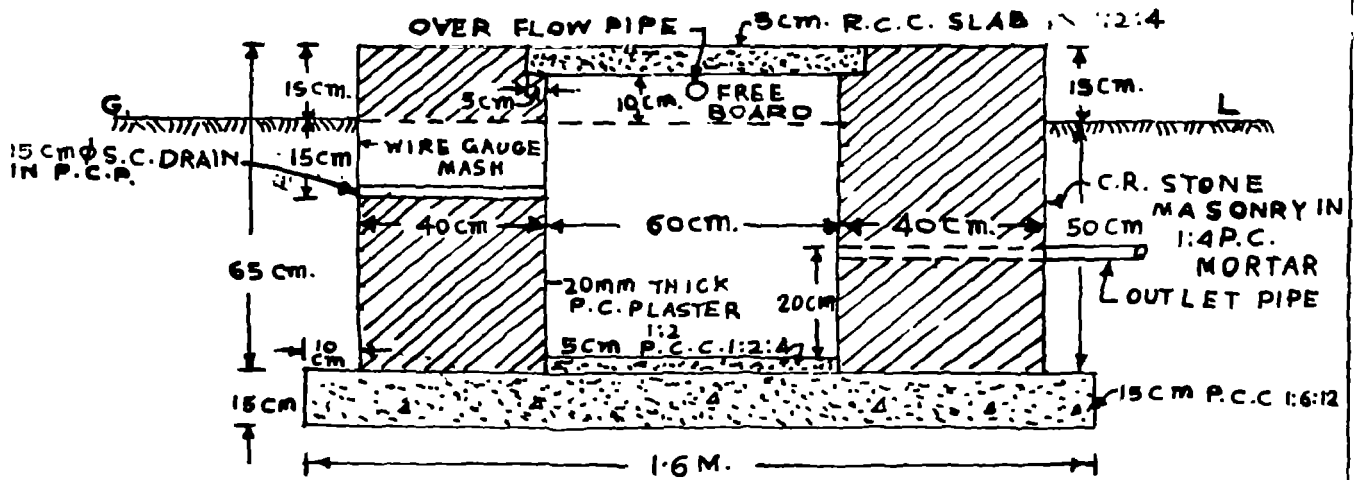
SOURCE:
TALLI KHERI KHALA
CHARGE: 7 LPM

COMPLETION PLAN OF TALLI KHERI KHURD (HAMLET) WATER SUPPLY SCHEME

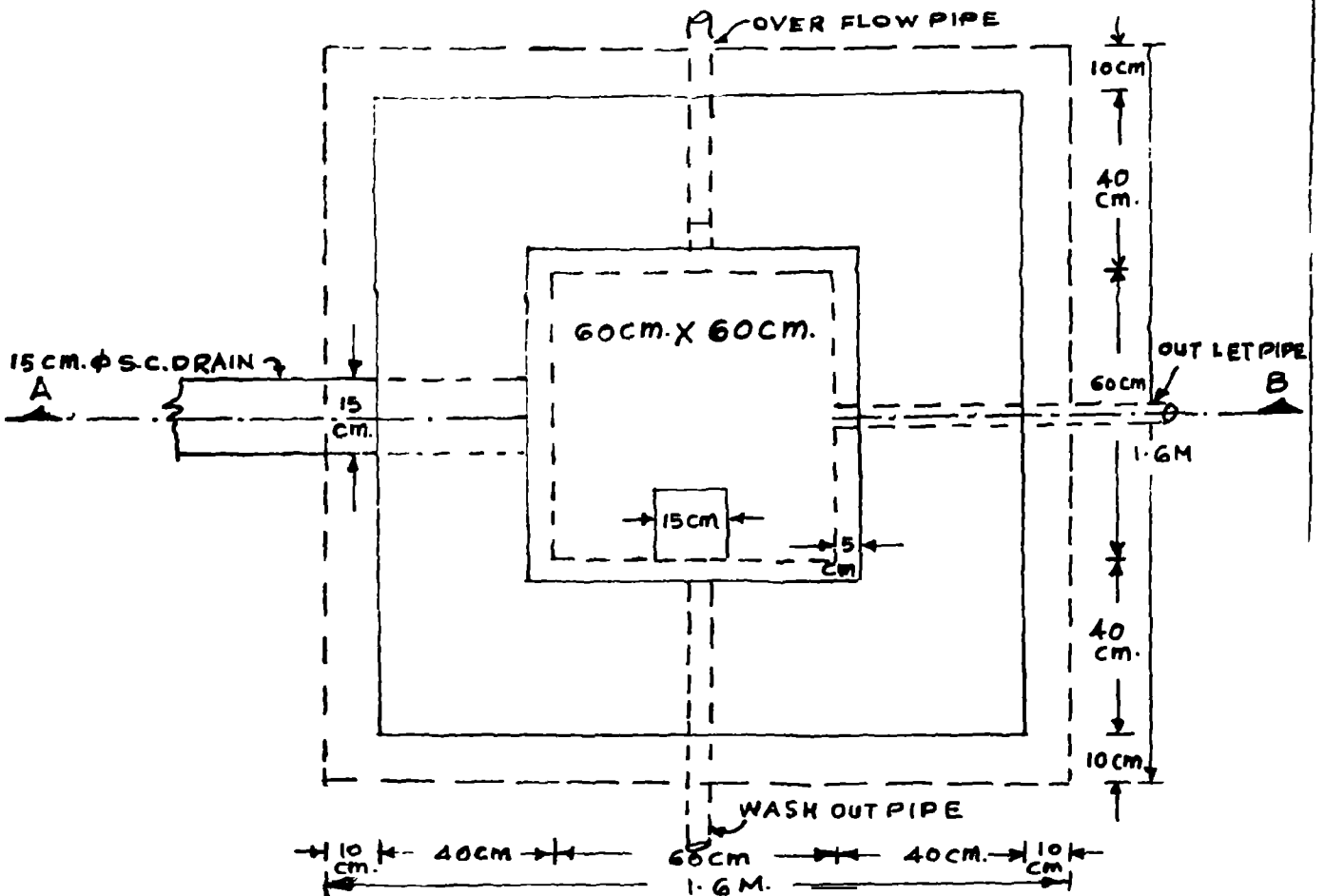
BLOCK:- RAIPUR DISTRICT:- DEHRADUN

SCALE:- NOT TO SCALE





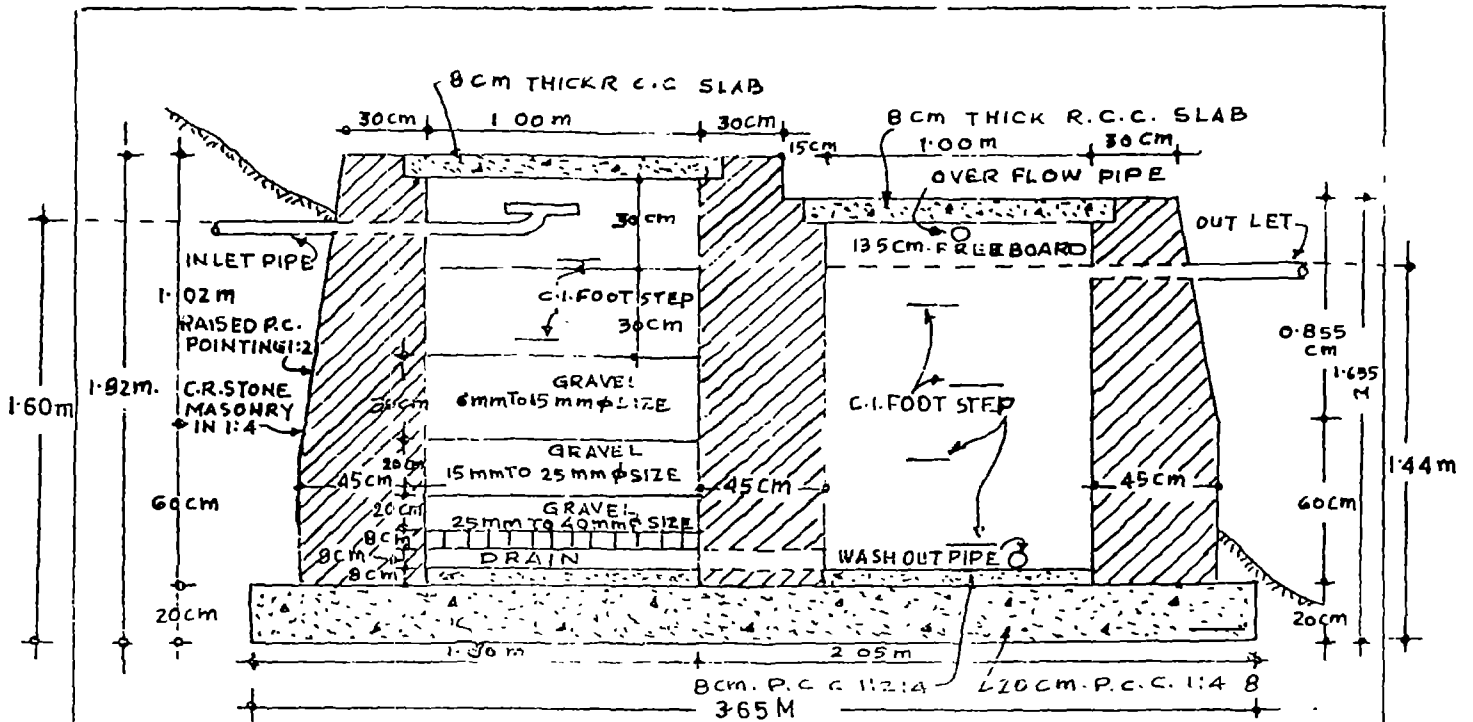
SECTION ON A-B



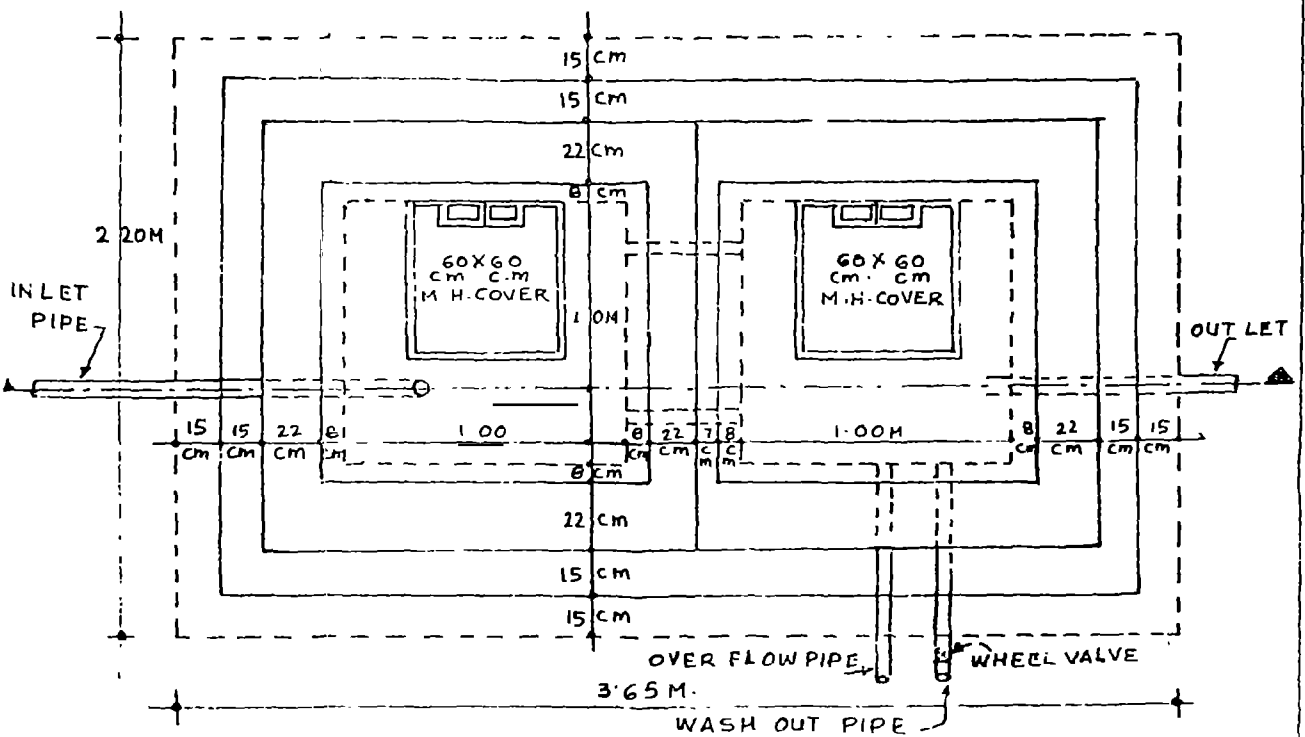
PLAN

TYPE DESIGN FOR
INTAKE CHAMBER
(60cm x 60cm)

SCALE:-
1cm = 15cm.



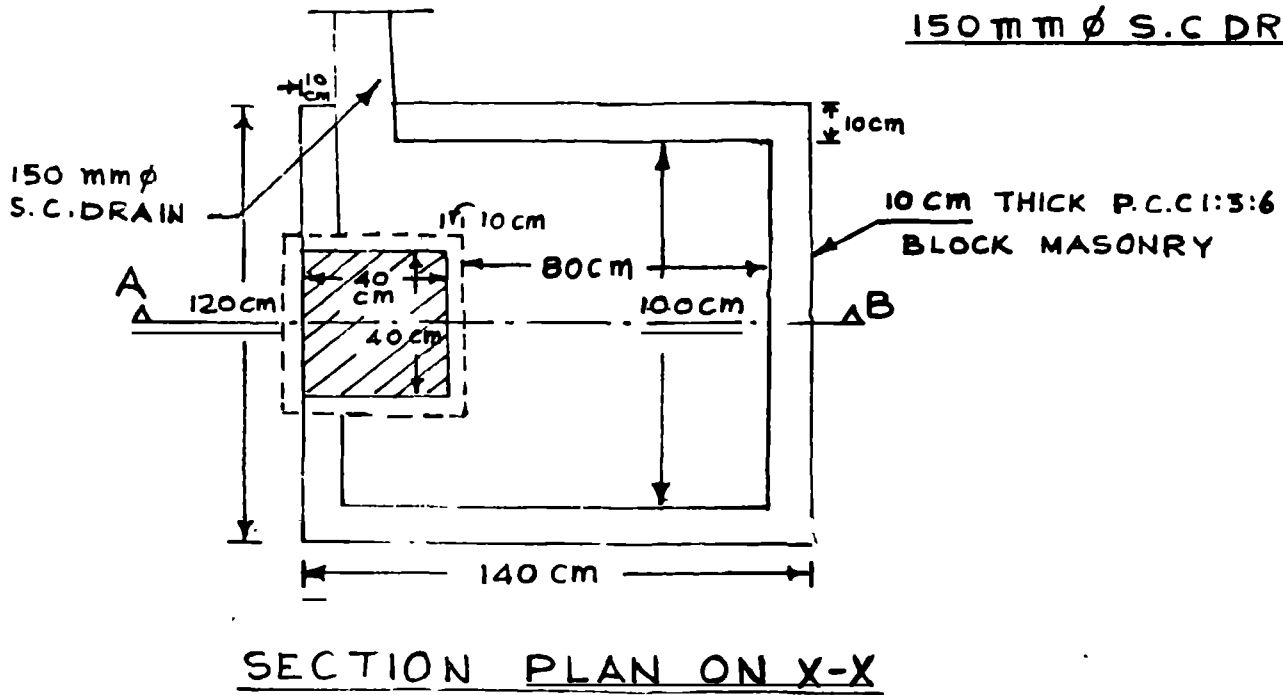
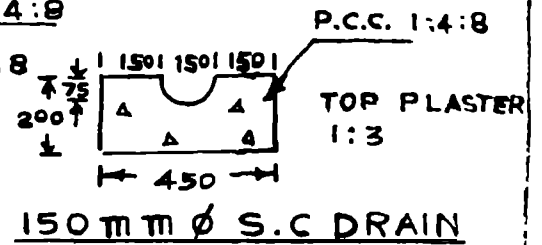
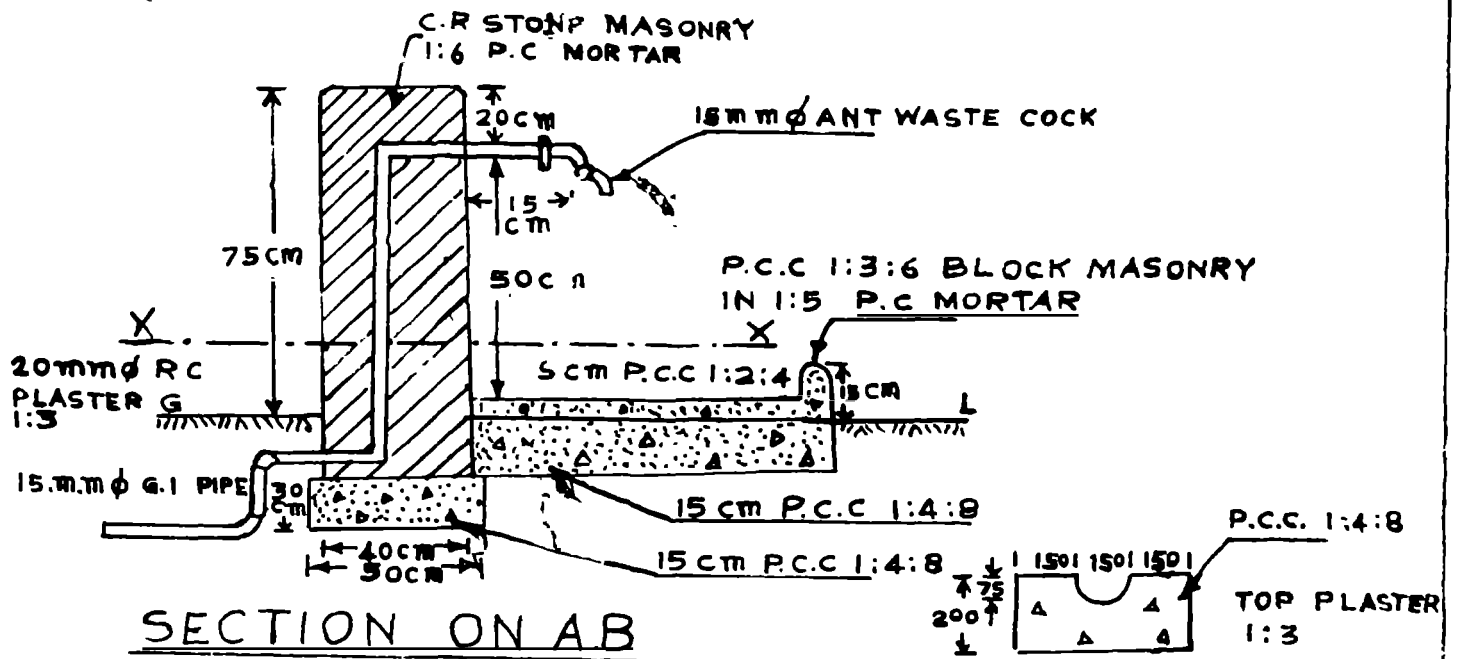
SECTION



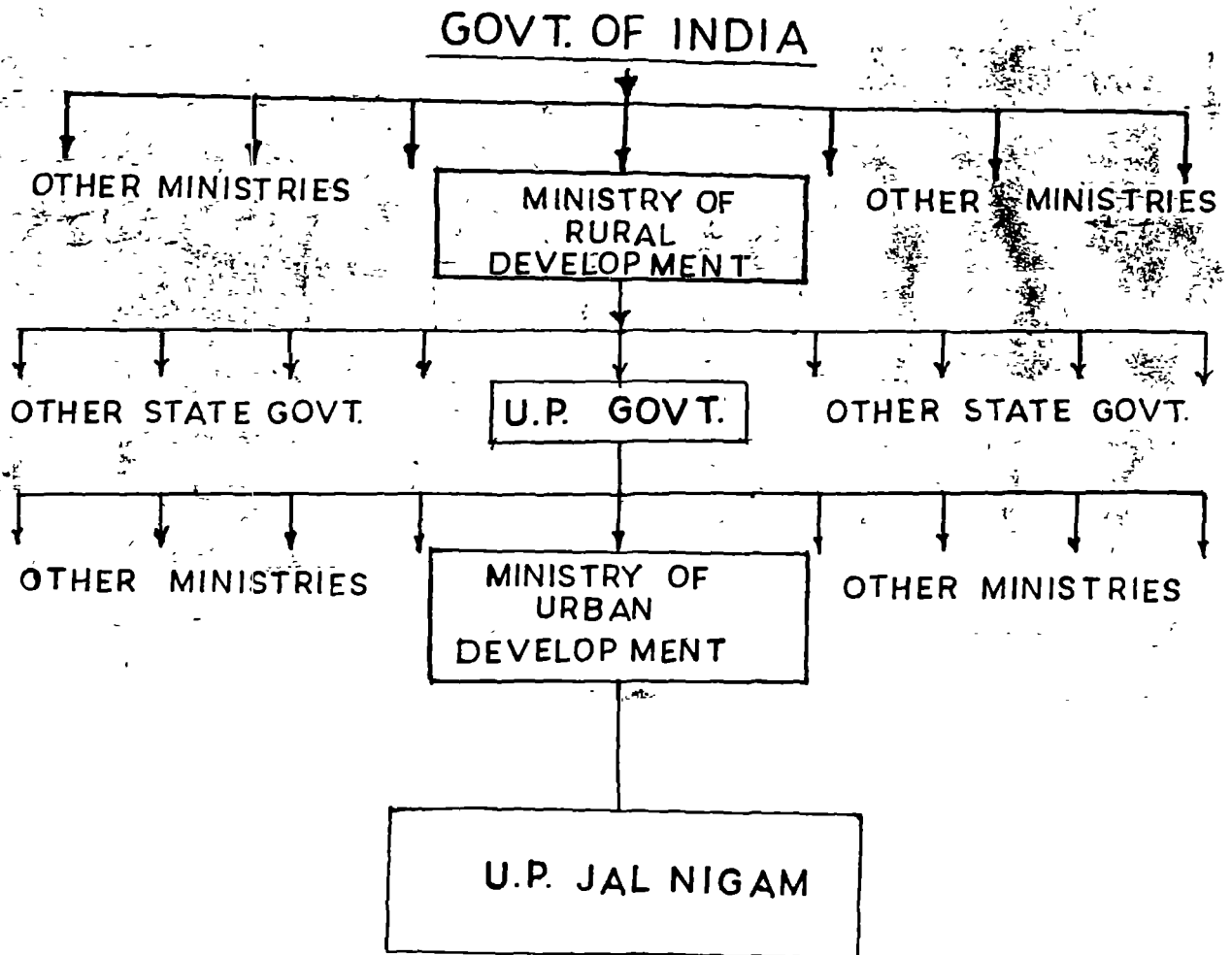
PLAN

SCALE 1 CM = 25 CM.

TYPE DESIGN OF ROUGHENING FILTER CUM COLLECTING CHAMBER

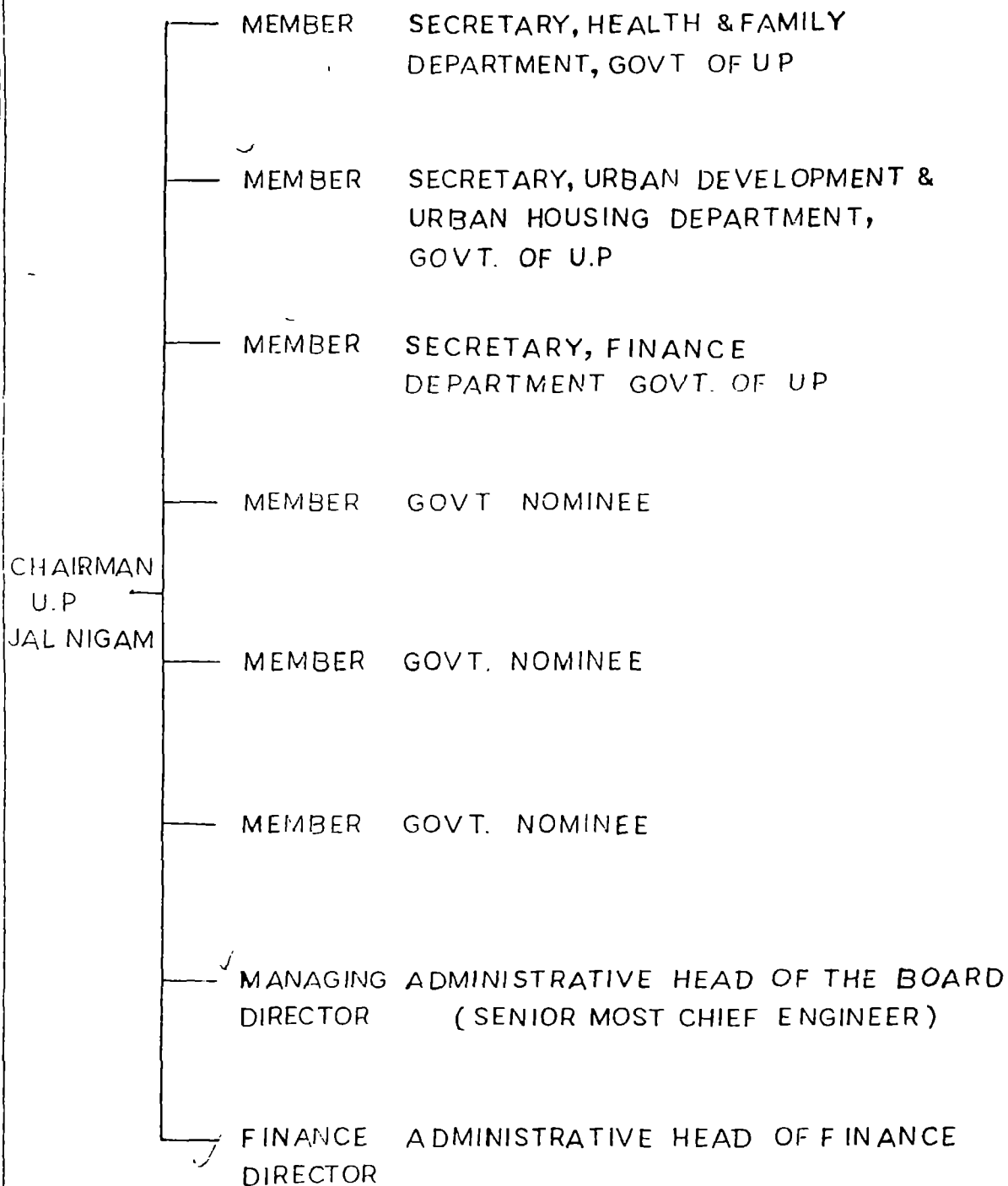


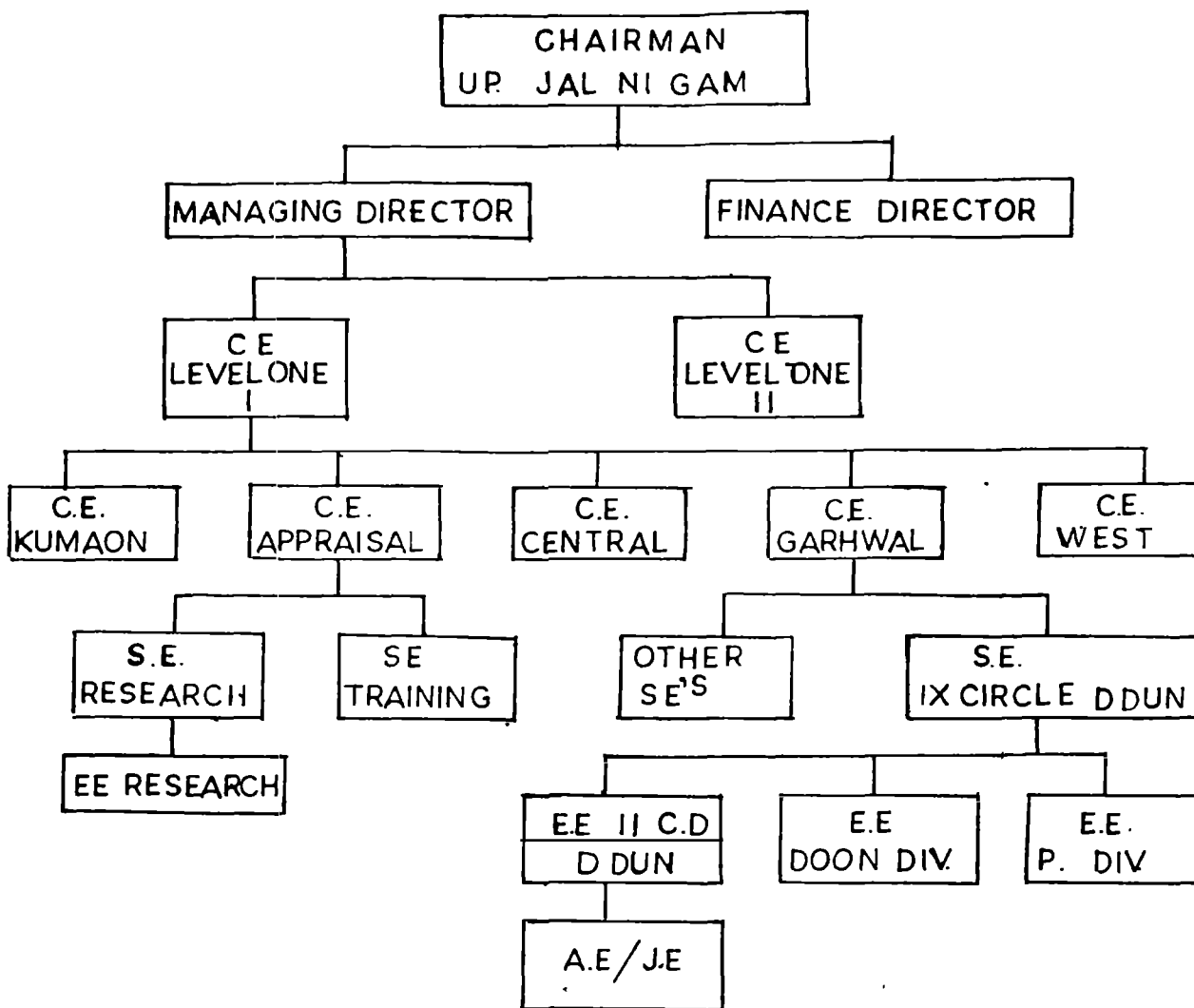
TYPE DESIGN FOR SCALE:- 1cm=20cm
MASONRY STAND POST



CONTROL OF WATER SUPPLY SECTOR
IN
UTTAR PRADESH

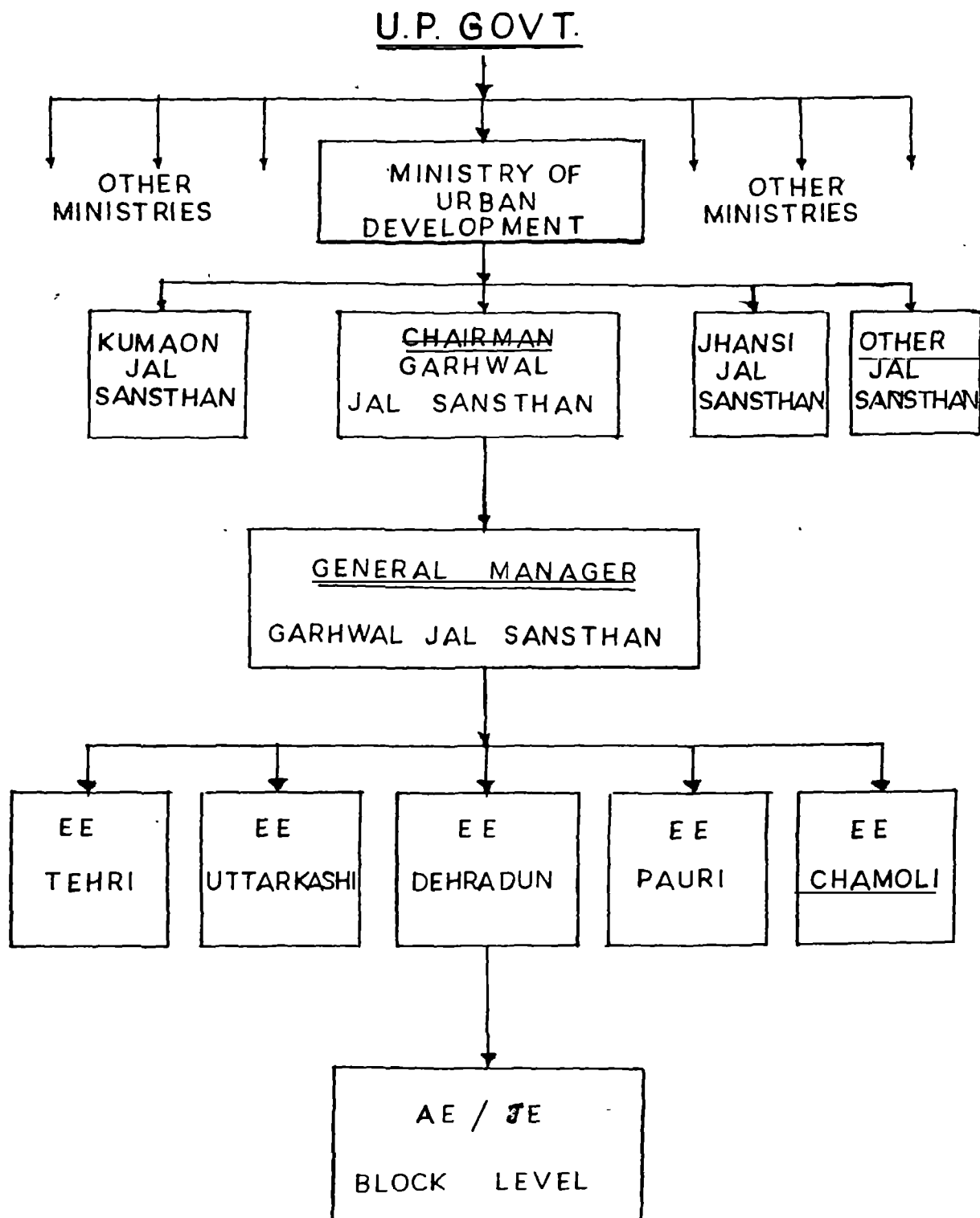
PRESENT SET UP OF U.P JAL NIGAM





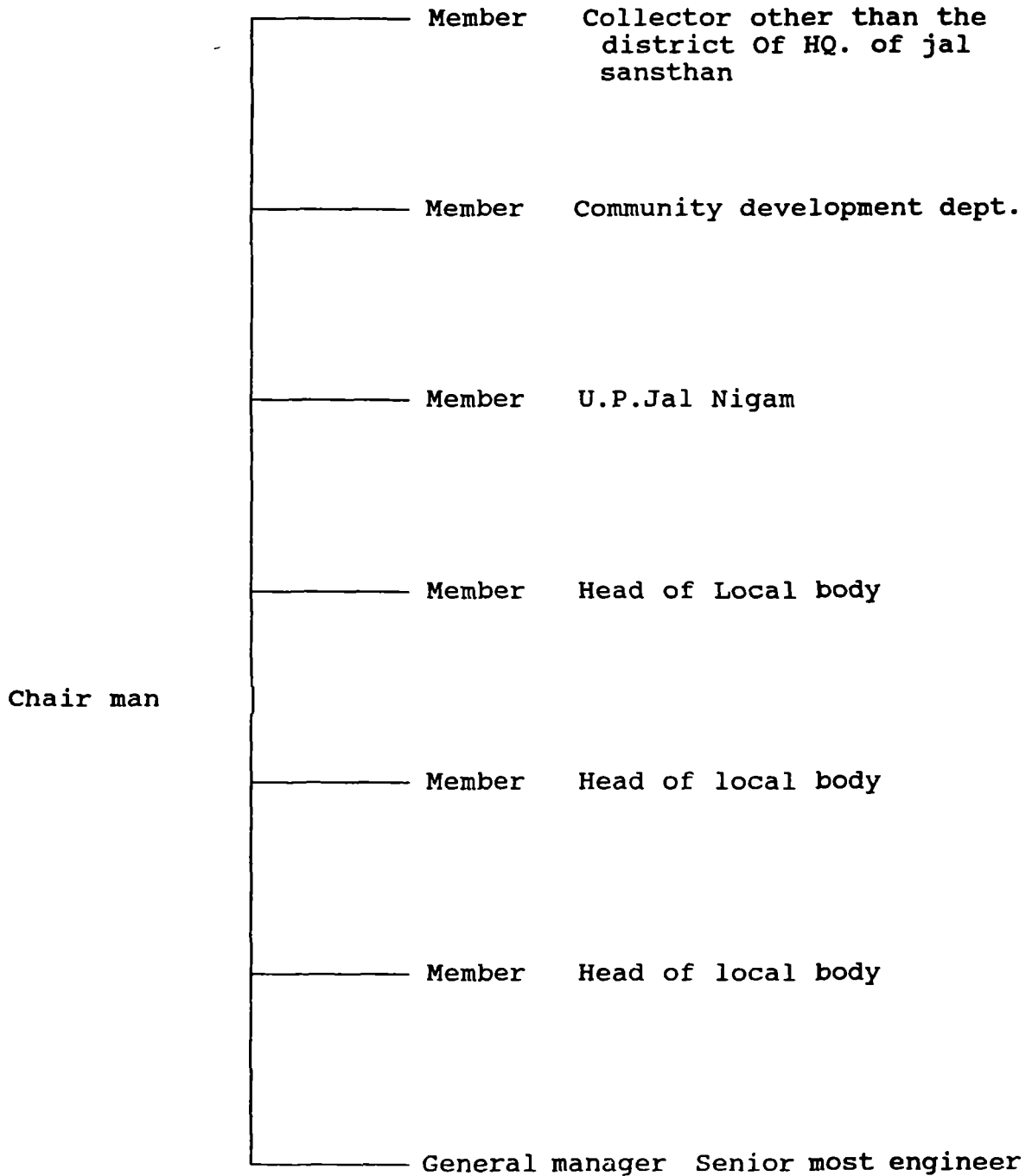
C.E. - CHIEF ENGINEER
 S.E. - SUPERINTENDING ENGINEER
 E.E. - EXECUTIVE ENGINEER
 A.E. - ASSISTANT ENGINEER
 J.E. - JUNIOR ENGINEER
 DDUN- DEHRA DUN
 P - PROJECT
 DIV - DIVISION

ORGANOGRAM OF U.P. JAL NIGAM

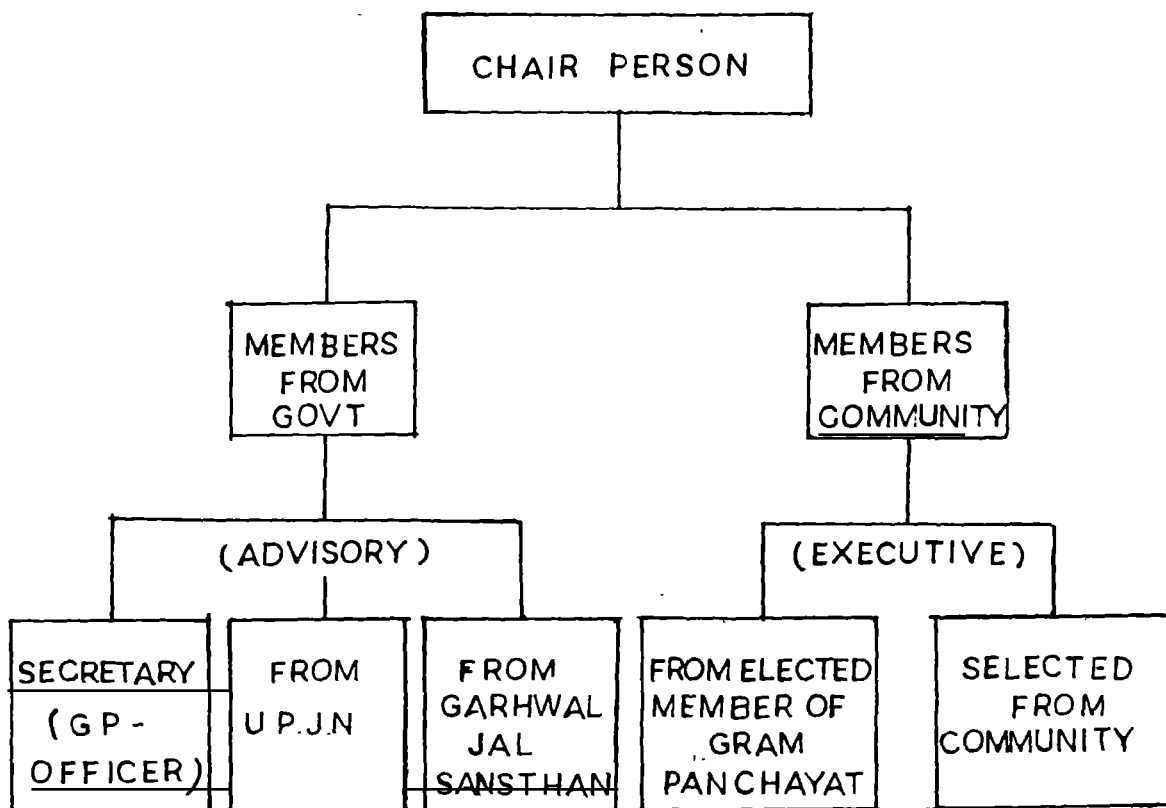


ORGANOGRAM OF GARHWAL JAL SANSTHAN

PRESENT SET UP OF GARHWAL JAL SANSTHAN



TYPICAL MODEL OF ORGANISATION FOR O&M OF RURAL WS SYSTEM



APPENDIX 2

IMPLEMENTING AGENCIES :

[1] U.P. Govt. :

State government recognises the water scarcity villages in each district, which are provided with safe drinking water under various programmes. Central government provides financial assistance for implementation of rural water supply schemes under accelerated rural programme. U.P. state government also provides funds for execution of rural w/s systems under minimum need programme.

Scarcity villages:

Following norms have been adopted for classification of scarcity villages.

- (i) Villages which do not have an assured source of water, with in a distance of 1.6 Km. or with in a depth of 15 metre below ground level in plain areas.
- (ii) Villages where water sources are available at an elevation difference of more than 100 m from the habitation in hilly areas.
- (iii) Villages where the available water has an excessive salinity, iron, fluoride and other toxic elements.
- (iv) villages where diseases like cholera, guinea worm etc. are endemic.

Selection of w/s systems i.e. Piped, hand pump and open well construction depends on geo-hydrological, geographical and financial implications for which funds are provided by government.

[2] U.P. Jal Nigam :

Uttar Pradesh legislation passed an act known as Uttar Pradesh w/s and sewerage act 1975 [Act No. 43 of 1975] under this act U.P. Jal Nigam was created by converting local self government engineering department to U.P. Jal Nigam. Jal Nigam has

technical role of conducting technical study, preparing feasibility reports, planning, designing of projects, execution of the projects and handing over of the completed w/s scheme to Village committees, Jal sansthan and now to maintain rural w/s systems which are created in march 1994 as well as on ward.

(a) Constitution of U.P. Jal Nigam :

- (i) U.P. Jal Nigam consist of chair man appointed by the state government besides the members specified below.
- (ii) Managing Director [To be appointed by state government] who shall be qualified engineer having administrative experience and also the experience of w/s and sewerage works.
- (iii) Finance director [To be appointed by state Govt.] who shall have experience of matters relating to finance and accounts.
- (iv) Secretary to the state Govt. in finance dept. ex. officio.
- (v) The secretary to the state Govt. dept. Nagar vikas ex. officio.
- (vi) Secretary health and family welfare dept.
- (vii) Three elected heads of local bodies in the state to be nominated by the state Govt.
The organograms are on page No.55,56 and 57.

(b) Functions of U.P. Jal Nigam :

Some important functions of Jal Nigam are as following.

- (i) The preparation, execution, promotion and financing schemes for the supply of water and for sewerage and sewage disposal.
- (ii) To prepare state plans for w/s, sewerage and drainage on the direction of the state Govt.
- (iii) To establish state standards for water supply and sewerage services.
- (iv) To operate, run and maintain any water works and sewerage

system if and when directed by state Govt.

(v) To carry out applied research and imparting training to personnel for efficient discharged of duties of the functions of the Jal Nigam or Jal Sansthan.

(c) Powers of U.P. Jal Nigam:

(i) To inspect all water supply and sewerage facilities in the state by whom so ever these are operated.

(ii) To adopt its own budget annually.

(iii) To approve tariffs for water supply and sewerage services applicable to respective areas comprised with in the jurisdiction of Jal Sansthans or local bodies.

[3] Garhwal Regional Jal sansthan :

In the act state Govt. created Regional Jal sansthans for O&M of w/s systems and waste water systems, as per act of 1975. Garhwal Jal sansthan is one of these institutions.

(a) Constitution of regional jal sansthan :

Garhwal jal sansthan is headed by chair man, appointed by U.P. state Govt. and members from various departments.

(i) Collector other than the district in which head office of the Sansthan is situated.

(ii) Senior most member of the community development department having his head quarter with in the area of Jal sansthan.

(iii) General Manager, who shall be qualified engineer having experience of water supply and sewerage works.

(iv) Member of the Jal Nigam.

(v) Three elected heads or members of the local bodies falling under jurisdiction of Jal sansthan.

Administrative set up of Garhwal Jal sansthan :

Organogram of Garhwal Jal Sansthan is on page No.58 & 59. Garhwal Jal Sansthan has its head quarters at Dehra dun and executive engineers, assistant engineers and other officials are having their head quarters at district, blocks and towns.

(b) Functioning of Garhwal Jal Sansthan :

Followings are the functions of Garhwal Jal Sansthan.

- (i) To operate and maintain drinking w/s schemes, including realization of charges from users in its jurisdiction.
- (ii) It manages all its affairs so as to provide the people with whole some water.
- (iii) Jal sansthan takes such other measures, as may be necessary, to ensure water supply in time of emergency.

(c) Powers of Jal Sansthan :

- (i) To exercise all powers and perform all functions relation to water supply of the area which lies with in its jurisdiction.
- (ii) To abstract water from any natural source and dispose of waste.
- (iii) To adopt its budget annually.
- (iv) To introduce or amend tariff for water supply, subject to approval of the Jal Nigam and collect all taxes and charges for this service as may be prescribed.
- (v) To incur expenditure and manage its own funds.
- (vi) Jal sansthan receives subsidies and grants from the state Govt. for O&M of w/s schemes.
- (vii) Collection of operation and maintenance charges from users.

(d)Accounts and audits :

Jal Sansthan maintains proper books of account and other books in relation to its accounts and prepare the balance-sheet in such

a manner as the regulation laid down by state Govt.

[4] village Panchayat :

The village panchayat is an elected body, it has one gram pradhan (village committee head) and some elected members from the village to organise village administration.

The main functions of the Panchayats are :

- (i) Maintenance of village roads, streets, street lights and construction of drinking water wells with the help of a block development office after getting a grant from the block office.
- (ii) The main occupation of livelihood in villages is agriculture, therefore the activities of the panchayats are connected with the community of farmers. The village panchayat has a village secretary who is an employee of the panchayati raj dept. The duties of secretary are to maintain family records of birth and death. With help of the village secretary, gram pradhan maintains the accounts of Jawahar Rojargar Yojana, national rural employment programme (NREP) and rural landless employment guarantee programme (RLEGP). These programmes are introduced through the district rural development authority (DRDA). In Garhwal the village panchayats are responsible for O&M of single village gravity fed w/s schemes. Village panchayats do not have sufficient funds, tools and spare parts for proper maintenance of w/s systems. The w/s systems are operated and maintained by volunteer organisations (Men and Women) working in the villages.

[4] Involvement of women:

In Himalayas women are responsible for collection of water. Recently U.P. government has launched a women training programme in O&M of rural w/s systems, for which allotment of funds were made vide G. O. No. 3942/28-1-93-8(47pe.)/93, Lucknow dated 25-1-1993 in which allocation of funds amounting to Rs 696, 000 was sanctioned to Garhwal jal sansthan. Sub head wise details are as below.

Sl	Head of expenditure	Quantity	Sanctioned amount Rs.
1	Gi. pipe, elbows, unions and sockets	120 sets	48,000
2	Tool kits	480 sets	336,000
3	Daily allowance for 4 days training.		288,000
4	Advertising & extension programme expenses.		9,000
5	Cartage cost for above material		15,000
		TOTAL	Rs 696,000

APPENDIX 3

DESCRIPTION OF THE UNITS OF GRAVITY FED WATER SUPPLY SYSTEMS

The present design criteria consist of the following units which are provided in gravity fed w/s systems, details about these units are described below.

Intake chambers:

Intake chambers in all the three w/s systems are constructed 60 cm. * 60 cm. in size, with wire mesh to check the entry of leaves of plants and suspended matter. The capacity of in take chambers is sufficient to handle the in take of water. This is a standard type design of in take which is available on page No.52

Roughing filters:

Roughing filter of size 1 m. * 1 m. is a standard type design available on page No.53, which is sufficient to handle the discharge of individual w/s system. Calculations of filtration rate are given below.

(i) Mal Devta w/s system.

Capacity of w/s system = 20Kld. = 20 cubic metres. per day.

Area of the roughing filter = 1 Sq. m.

Rate of filtration/hour = $Q/A = 20/24 * \text{cumec/hour} * 1/1\text{Sq. m.}$
= 0.84 m/hour.

(Limit 0.3- 1.5 m/hour)

(ii) Mohmmad Pur Kemri w/s system.

Capacity of w/s system = 10 Kld. = 10 cumec/day.

Area of roughing filter = 1 Sq. m.

Rate of filtration/hour = $10/24 * \text{cumec. /hour} * 1/1 \text{Sq. m.}$
= 0.41m/hour. O. K.

(iii) Talli Kheri Khurd w/s system.

Capacity of w/s system = 8 Kld. = 8 Cumec. /day

Rate of filtration/hour = $8/24 * \text{cumec/hour} * 1/1 \text{ Sq. m.}$

= 0.33m/hour. O. K.

Chlorinator & clear water reservoir:

Chlorinators are installed on c.w.r. in which bleaching powder solution is used, but in actual practice chlorinators were not in use. Clear water is supplied directly from c.w. r. to public stand posts in each w/s scheme. The capacity of reservoir in each scheme is approximately equal to 12 hour production capacity of the system.

APPENDIX 4

CALCULATION OF THE QUANTITY OF BLEACHING POWDER :

(i) Mal Devta w/s system

Quantity of water required per year = $400 * 40 * 365$ Litres.

Quantity of chlorine needed per year

$$\begin{aligned} @ 1 \text{ ppm.} &= 400 * 40 * 365 * 1/1000000 \\ &= 5.84 \text{ Kg.} \end{aligned}$$

Bleaching powder required per year = $100/25 * 5.84$

$$= 23.36 \text{ kg. say } 23\text{Kg.}$$

(ii) Mohammad Pur Kemri w/s system:

Quantity of water needed /year = $\text{Pop} * \text{water needed/person/day} * 365$
 $= 190 * 40 * 365 = 2774,000 \text{ Kg.}$

Quantity of bleaching powder required per year

$$\begin{aligned} @ 1 \text{ ppm.} &= 1/1000000 * 2774,000 * 100/25 \text{ Kg.} \\ &= 11.08 \text{ say } 11 \text{ Kg.} \end{aligned}$$

(iii) Talli Kheri Khurd :

Quantity of water required /year = $102 * 40 * 365 \text{ Kg.}$

Quantity of bleaching powder needed /year

$$\begin{aligned} @ 1 \text{ ppm. (strength 25\%)} &= 100/25 * 102 * 40 * 365 * 1/1000000 \text{ Kg.} \\ &= 5.95 \text{ say } 6\text{Kg.} \end{aligned}$$

Quantity of water required/year = $224 * 40 * 365 = 3270,400 \text{ Kg.}$

Quantity of bleaching powder

$$\begin{aligned} \text{needed/year} &= 1/1000000 * 3270,400 * 100/25 \\ &= 13 \text{ Kg.} \end{aligned}$$

APPENDIX 5

STANDARD ANNUAL MAINTENANCE EXPENDITURE :

Mal Devta w/s system:

Sl.	Items	Cost Rs.	Yearly maint. Rs.	Amount Rs.
1	Civil works.	95,000	@ 1 %	950
2	Distribution system.	416,950	@1/4 %	1043
3	Chlorinator.	1200	@ 2 %	24
4	One part time fitter.			2400
5	Casual labour on lump sum basis.			600
6	Cost of bleaching powder 23Kg. @ Rs. 6/ Kg.			138
	TOTAL			Rs. 5155

Annual O&M cost per capita = 5155/400
= Rs. 12. 88 say Rs.12.90

Mohammad Pur Kemri w/s system

Sl.	Items	Cost Rs.	Yearly O&M charges	Amount Rs.
1	Civil works.	1 45, 500	1 %	1455
2	Distribution system.	2 48, 500	0. 25 %	622
3	Chlorinator.	1, 200	2 %	24
4	Cost of bleaching powder. 11Kg. @ Rs. 6/ Kg.			66
5	One part time fitter. @ Rs. 200/ Month.			2400
6	Casual labour on lump sum basis.			500
	TOTAL			5067

Annual per capita O&M cost =5067/190
= Rs.26.66 say Rs.26.70

Talli Kheri Khurd w/s system

sl.	ITEMS	Cost Rs.	Yearly O&M. %	Amount Rs.
1	Civil works.	60, 000	1 %	600
2	Distribution system.	74, 000	0. 25 %	185
3	Chlorinator.	1, 200	2 %	24
4	Cost of bleaching powder. 6 Kg.	@ Rs. 6/Kg.		36
5	One part time fitter. @ Rs. 200/ month.			2400
6	Casual labour on lump sum basis.			400
			TOTAL	3645
	Per capita O & M. cost	= 3645/102		
		= Rs.35.74		

APPENDIX 6

FORMATS AND QUESTIONNAIRES

6.1 Evaluation of functioning of w/s schemes

Name of the district.

Name of the agency maintaining.

Name of the w/s scheme.

1. Present population with in supply area. = No.
2. Present consumption of water. = lpcd.
(On the basis of design criteria)
3. Present water requirement = kld.
(excluding losses)
4. Present production of water. = kld.
5. For how many hours per day does the supply operate. = hrs.
6. For how many days per week does the supply operates= day.
7. What has been the trend in water production supply was opened ?
8. What is the capacity in cumec/hr. = kld.
9. What is the capacity in cumec/day = kld.
10. Is there a seasonal variation in capacity. =
11. Is there a seasonal variation in demand =
12. Which component of supply is the limiting factor. =
(The source, treatment plant, distribution system)
13. Reliability of the w/s system =
(Reliable/fair/poor)
14. Convenience of water points =

6.2 WATER QUALITY

[1]. Physical parameters.

- (a) Turbidity. = Ntu.
- (b) Suspended solids. = mg/lit.
- (c) Flow. = cumec/hr.
- (d) Taste
- (e) Colour

[2]. Chemical parameters.

- (a) pH. =
- (b) F = mg/lit.
- (c) No3 = mg/lit.
- (d) Chloride = ppm.

[3]. Bacteriological.

- E-coli = Mpn/100ml.

6.3 HOUSEHOLD SURVEY QUESTIONNAIRE

State:
 District:
 Village:
 Interviewer:
 Respondent: (M/F)
 Date:

1. Household identification -----
 2. Number of household members

Adults		Children < 18 years		Total
M	F	M	F	

3. Are you using water from the community water supply ?
 Yes --- No---
4. What type of Service do you have ?
 House connection -----
 Plot connection -----
 Communal water point -----
 Other -----
5. How far is the water point ? ----- meters (estimated)
 6. How long does it take to go there,
 fetch water and come back? ---- hours(estimated)
 7. Who collects water ?

	Usually	Some times
Children		
Women		
Men		

8. How much water is collected each time ? ----- litres
 (estimate)
9. How many times a day is water collected? -----
10. When was the supply last not functioning ? -----
11. How frequently do breakdowns occur ?
 Never ----
 Dry season -----
 Monthly -----
 Weekly ---
 Other ----
 Specify -----

12. For how long do breakdown last? -----
 13. How much do you pay for the water service? -----
 14. For what purpose is the water collected being used?

Activity	Proportion
Drinking and cooking	
Washing of food and utensils	
Personal washing	
Washing of cloths	
Watering of animals	
Watering of garden	
Other, specify	
	100%

15. Do you use any other water source for any of the above activities or any other activities?

16. What water source do you use for the following activities?

	Activity	Water source	Distance
<u>Dryseason</u>	Drinking and cooking		
	Washing food and utensils		
	Personal washing		
	Washing of clothes		
	Other		
<u>Wet season</u>	Drinking and cooking		
	Washing food and utensils		
	Personal washing		
	Washing of clothes		
	Other		

17. What is the distance from your house to alternate water source?

Meters

18. For what reasons are you not using the gravity fed water supply?

- Traditional source more convenient
- Water supply too expensive
- Water from the supply does not taste good
- Considers water from the supply unhealthy
- Conditions at water point unsanitary
- Children can not reach or turn the tap
- The supply is un reliable

Would like to participate but can not because;
 Not a member of the water group
 Have not paid the fees
 Other reasons, specify

Excluded by others because:
 Social, cultural or religious reasons

19. What changes would be needed for you to use the supply for all purposes?

20. Main source of livelihood.
 (i) Agriculture
 (ii) Cattle
 (iii) Poultry farm
 (iv) Service
 (v) Cottage/Home industries
 (vi) Trade/Business
 (vii) Other

21. Willingness and capacity to pay

Range of tariff acceptable to this household in rupees/month.						
Tariff	10	20	30	40	50	60
House connection						
(i) Cash						
(ii) Kind						
Community stand post						
(i) Cash						
(ii) Kind						

Total-

22. In what way would you suggest the water supply service could be improved?

(More information to and involvement of consumers, improvements in the system for revenue collection, improvements in maintenance, training to operators, removal of social barriers)

23. Opinion of the respondents on:

(i) Community management of w/s schemes.
 (ii) Full payment of O. & M. charges by household or by community.

6.4 ASSESSMENT OF SOCIAL AND ECONOMIC POTENTIAL OF COMMUNITY

1. Religious or ethnic beliefs of community in relation to water.
2. What Access to media do communities have?
 - (i) Radio and T. V.
 - (ii) News papers.
 - (iii) Films.
 - (iv) slide/tape show facilities
 - (v) Posters, use of different materials
 - (vi) Local plays, dance, etc.
 - (vii) Pamphlet distribution.
3. Are there major social and cultural differences with in communities?
 - a. No. of ethnic and religious groups
 - b. Indicators of wealth
 - (i) Land holding
 - (ii) Cattle
 - (iii) Service
 - (iv) Cottage/Home industries
 - (v) Land labourers
 - (vi) Others
4. Community leaders willing in activities of water supply.
 - (i) How they think about community management of water supply systems
 - (ii) what methods of financing for O&M they like.
 - (iii) What infrastructure is available in the village for O&M (committees)
5. What traditions of self help are there?
 - (i) In which sectors is self-help a tradition?
 - (ii) Has self-help been successfully used in an "outside" project?
 - (iii) Who is involved in self-help?
 - (iv) How is it organised?
 - (v) What problems have already been experienced in self-help?
6. Available skill in community.
 - (i) Black smith.
 - (ii) Mason.
 - (iii) Carpenter.
 - (iv) Welder.
 - (v) Plumber.
 - (vi) Unskilled labour.
 - (vii) Others.
7. Present role of women and their potential over the next coming years.

- (i) Position of women in community development.
- (ii) Activities are open/barred to them.
- (iii) Various roles played by women in family and community for decision making.
- (iv) Do they play any role in self help?
- (v) can they become community level worker?
- (vi) Women leaders, their activities and specific opinion regarding community management of w/s schemes.
- (vii) Where do women get together?
- (viii) Who is training women?
- (ix) Are women members of Organization?

8. Levels of education | Primary | high school | intermediate | Other

(i) % | | | |

- (ii) Ability to compute. yes/no
- (iii) Ability to read technical drawings. yes/no

9. Economic base of communities which can be used to pay for water service.

Per capita monthly income by house holds

Range of per capita monthly income in Rupees

Status	Very poor	Poor	Surviving	Low middle	Middle
House hold	(Below 25)	(25-50)	(50-100)	(100-300)	(300-500)
No.					

10. Willingness and capacity to pay

Range of tariff acceptable to communities in Rupees.

Tariff | 10 | 20 | 30

11. Payment of water charges.

- (i) Why they are not paying at present?
- (ii) Payment of other services is regular or irregular ?

12. Community willingness to take training for operation and maintenance.

13. Need of training.

- (i) Technical training.
- (ii) Managerial training.
- (iii) Book keeping.

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