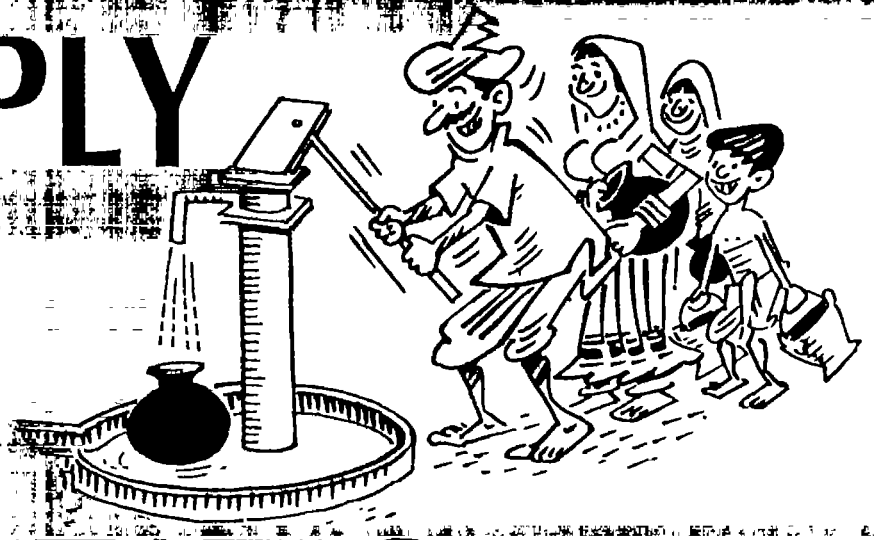
AN INTRODUCTION

RURAL WATER SUPPLY & SANITATION PROGRAMMES IN INDIA



RAJIV GANDHI NATIONAL DRINKING WATER MISSION
NEW DELHI

AN INTRODUCTION TO

RURAL WATER SUPPLY AND SANITATION PROGRAMMES IN INDIA

RAJIV GANDHI NATIONAL DRINKING WATER MISSION

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FOREWORD

The quantity of safe water consumed by an individual directly or indirectly, can well be considered a measure of the advancement of the society in which he/she lives. Even the per capita availability of safe water for domestic use can be an indicator of the stage of the society's development.

In India, we have adopted a norm of 40 litre per capita and we have been able to reach this norm in most of the villages. The quality of life in the Indian countryside has improved considerably during the past four decades. Water has been an essential input in this improvement.

However, there are a few pockets and areas where the water supplied is either insufficient or beset with various quality problems arising from chemical contamination. It is also pointed out sometimes that the water used by the rural population contains biological contaminants which enter the drinking water before or after the water has been taken from the source

While the state governments in charge of the rural water supply have a definite role in ensuring the availability of safe water, awareness of the people of these problems, their education to tackle these problems in every home through simple methods and also their ability to tackle various problems arising out of the use of unsafe water holds the key to the full success of any governmental effort. It is now well known that the success of Guineaworm Eradication Programme is more as a result of educating people.

In the fight against fluorosis we are yet to make a sufficient impact among the people. In the areas affected, awareness of people and their education to tackle such problems through home defluoridation should help a great deal.

It is hoped that the present volume will act as a source book for the resource persons in these campaigns in planning the mass awareness campaign in the local areas. Ideas form here will have to be adopted and used for dissemination in local language.

NIRMALA BUCH

PREFACE

The launching of a societal mission for rural water supply in 1986 meant a departure from the routine way of implementing the water supply schemes in rural areas. It was intended to help in bringing in the best available appropriate technology easily acceptable and usable by people , The Rajiv Gandhi National drinking Water Mission has been striving to achieve this objective with active cooperation of State Governments, Research Institutions and Voluntary organisations

In creating awareness and for dissemination of information the Mission has brought out a large number of publications; some of these with the help of specialised institutions and well known experts. However, no introductory book on the activities of the Mission was brought out till now which can be utilised by professionals and field workers alike. The present effort in this direction is made in the context of launching a nation-wide campaign against fluorosis.

Chapter 1 covers the brief introduction to various types of activities. In Chapter 2 the relation between water and health and the various methods by which the diseases can be caused through use of impure water are outlined. It also describes the strategy for a health education programme for the community. In Chapter 3 some basic technical aspects concerning the design for various water supply systems are given. This can be used as general reference both by the professionals and field level workers. In Chapter 4 the practical problems of putting technology to work and reach the real beneficiary are discussed. Chapter 5 deals with the involvement of various organisations in implementation, operation, maintenance of water supply and sanitation systems. Emphasis obviously is on involving the community in a larger way. Chapter 6 deals with development of human resources not only of professionals but also other field workers and even the beneficiaries. Chapter 7 deals with the need for involving community in evaluating the project.

The initial draft for this volume was prepared by Shri A. K. Dubey, Deputy Secretary and by Shri K. Mazumdar, Assistant Adviser. It was edited and shortened by Prof. S. Ramachandran who joined as a Consultant later. He also located suitable illustrations form various books to be included in this volume. They were ably supported by the other members of the technical wing led by Dr. S. K. Biswas, Additional Adviser. Prof. A. K. Susheela, National Coordinator, Fluorosis Control cell (RGNDWM) All India Institute of Medical Sciences, New Delhi took the responsibility of printing this book and also have taken a lot of pains in going through the proofs. It was the hard work of all these officers and experts which made this book possible.

The work has been completed within a short time frame. Users of the volume may kindly bring to our notice any mistake in any form in this book.

(S. SOM)
Additional Secretary Ministry of Rural Development
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C: P-face

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CHAPTER - I

RAJIV GANDHI NATIONAL DRINKING WATER MISSION: GOALS, ACHIEVEMENTS.

INTRODUCTION

Supply of safe water and provision of sanitation comprise much more than installation of water supply systems and construction of latrines. They encompass all activities which improve hygiene in order to raise the quality of life and the health of the people. It is estimated that every year, 1.5 million children under five years die in India of water-related diseases, the country loses 1800 million person hours (Over 200 million mandays) each year due to these diseases. Supply of drinking water has therefore, been given very high priority in Indian Planning.

The provision of drinking water supply in rural areas is the responsibility of the states and funds were provided in the state budgets, right from the commencement of the First Five Year Plan. National water supply and sanitation programme was introduced in social welfare sector in 1954. The States gradually built up the PHEDs to attend to the problems of water supply and sanitation. Inspite of these efforts, it was observed during the mid 1960s that rural water supply schemes were implemented only in those villages which were easily accessible and in the process, hard-core rural areas were not attended to. Government of India therefore, requested the states to identify such hard-core problem villages and provided assistance to the states to establish special investigation divisions in the Fourth Five Year Plan.

Taking into account the magnitude of the problem and in order to accelerate the pace of coverage of problem villages, the Government of India introduced the Accelerated Rural Water Supply Programme in 1972-73 to assist the States and Union Territories with 100% grants in aid to implement the schemes in such villages. This programme continued to 1973-74 but with the introduction of Minimum Needs Programme (MNP) during the Fifth Five Year Plan from 1974-75, it was withdrawn. However, the programme was reintroduced in 1977-78 when the progress of supply of safe drinking water to identified problem villages was not found to be as per expectation.

In the year 1977 the United Nations Water Conference separated the issue of drinking water and sanitation from other water issues to stress the seriousness and magnitude of the problem of drinking water It suggested the decade approach to provide a realistic standard of quality and quantity to urban and rural areas by 1990 The Conference recommended that each country should develop national plans and programmes for water supply and sanitation giving priority to the schemes of the population which require greatest attention. India was a signatory to the resolution seeking to achieve the target by 1991. The water decade programme in india was accordingly launched on 1st April, 1981 to achieve definite targets of coverage of entire population by 31st March, 1991.

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

The National Drinking Water Mission was launched as one of the 5 societal Missions in the year 1986 The Mission has since been renamed as Rajiv Gandhi National Drinking Water Mission (RGNDWM). Government of India continues to give highest priority to rural water sector through the activities of the Mission and ARWSP. It also forms a part of state funded MNP and Point No. 7 of the Twenty Point Programme 1986.

GLOBAL CONSULTATION ON SAFE WATER AND SANITATION FOR THE 1990s

The International Drinking Water Supply and Sanitation Decade 1981-1990 (IDWSSD) had its origin in the resolutions from the United Nations Habitat conference in 1977, in Vancouver, followed by the resolution taken in its General Assembly in 1980 to this effect. The activities under the aegis of this concerted international effort have led to the provision of safe water supply to an estimated 700 million new users during the Decade. Sanitation facilities during the same period were provided to over 250 million people.

The Global consultations were held in New Delhi from September 9-14 in 1990 under the auspices of Government of India and United Nations Development Programme and was co-sponsored by UN Sub-Committee for Action for International Drinking Water and Sanitation Decade together with external support agencies and collaborative councils.

The New Delhi Declaration was later adopted by the UN General Assembly in October, 1990, as strategy for the decade of 1990s·

a) Protection of environment and safeguarding of health through integrated management of water resources and liquid and solid wastes.

b) Institutional reforms promoting an integrated approach, including changes in procedures, attitudes and behaviour and full participation of women at all levels.

c) Involving local institutions in implementing and sustaining water and sanitation programmes.

d) Sound financial progress achieved through better management practices of existing assets and widespread use of appropriate technologies.

RAJIV GANDHI NATIONAL DRINKING WATER MISSION

Rajiv Gandhi National Drinking Water Mission was launched with the following objectives:

- COVER ALL NO SOURCE PROBLEM HABITATIONS
- SUPPLY OF 40 LPCD IN ALL AREAS FOR HUMAN BEINGS AND ADDITIONAL 30 LPCD IN DESERT AREAS FOR CATTLE WITHIN ACCESSIBLE REACH
- EVOLVE COST EFFECTIVE APPROPRIATE TECHNOLOGY TO SOLVE SPECIFIC PROBLEMS
- TAKE CONSERVATION MEASURES FOR SUSTAINED SUPPLY OF WATER
- IMPROVE PERFORMANCE AND COST EFFECTIVENESS OF ONGOING PROGRAMMES
- CREATE AWARENESS ON USE OF SAFE DRINKING WATER
- PROMOTE COMMUNITY PARTICIPATION

Accelerated Rural Water Supply Programme is a centrally sponsored plan scheme supplementing the efforts of the state governments in providing drinking water in the rural areas.

During the Sixth Plan the aim was to provide at least one source in all the 231,000 identified problem villages that remained uncovered at the commencement of the Sixth Plan. With intensive efforts and investment of the order of Rs. 2457 crores (1538 crores under State Sector MNP and 919 crores under Central Sector ARWSP), it was possible to cover 192,000 problem villages. However, 39,000 to hardcore problem villages spilled over to Seventh Plan.

During the Seventh Plan, it was also decided to give priority for coverage of SC/ST habitations and for this purpose funds are earmarked under ARWSP in the same proportion as is being done under the State Sector Minimum Needs Programme (MNP) for SCs under Special Component Plan and for STs under the Tribal Sub Plan. From 1989-90 this earmarking was changed to provide for a minimum of 25% of ARWSP funds for SCs and another 10% for STs. Efforts were made to develop location specific low cost alternatives to costly and sophisticated systems. Special attention was given to maintenance of the systems. Initially the State governments were utilising upto 10% of the plan funds under MNP for maintenance. From 1987-88, the State govts. were given permission to utilise upto 10% of ARWSP funds for Operation and Maintenance of water supply schemes Greater efforts were made to involve the voluntary organisations in execution of scheme through Council for People's Action and Rural Technology (CAPART).

Norms

RGNDWM has adopted following norms for providing safe drinking water to rural population in the villages.

a) 40 litres of drinking water per capita per day for human beings.

b) 30 lpcd additional for cattle in desert districts (under Desert Development Programmes).

c) One handpump or standpost for every 250 persons.

d) Water sources should exist within 1.6 km in the plains and within 100 m elevation difference in hilly areas.

e) The water is defined as safe if it is free from biological contamination (guineaworm, & bacilli causing diseases like cholera, typhoid etc.) and chemical contamination (excess fluoride, brackishness, excess iron, arsenic, nitrates etc.)

Priority

Under ARWSP, the Government of India usually releases funds and the States implement the programme. Certain broad parameters are monitored by the Central government. Decentralized approach is being followed both at the State and the Central level. It was seen that certain areas being backward were not attended to by the State PHEDs. Therefore it was felt necessary to identify such villages and to bring them to the forefront so that they could be covered under the Mission programme. The following priorities have been adopted to cover those difficult areas which were not touched earlier.

a) To cover 6th plan spillover problem villages (as per 1980 list)

b) To cover all villages with no water source (1985 list)

c) To cover no source problem villages surveyed or identified subsequently.

d) To cover all villages with contaminated drinking water (both chemical and biological)

e) To cover all villages with per capita supply less than 40 lpcd to bring the service level to the norm level.

f) To cover hamlets and habitations.

Under the Accelerated Rural Water Supply Programme (ARWSP) funds are allocated to the States/UTs in accordance with the following criteria (in the Seventh Plan):

1 Weightage is given for·

Rural population	35%
Rural Area	20%
Incidence of poverty	20%
State under DPAP, HADP and special category in terms of:	
i) Rural population	12.5%
ii) Rural area	12 5%

2. Protected allocation is given to the States of Assam, Himachal Pradesh, Jammu & Kashmir, Manipur, Meghalaya, Nagaland, Sikkim and Tripura and UTs of A&N Islands, Lakshadweep, Dadra and Nagar Haveli and Pondicherry of 1986- 87 level of allocation.

3 Five per cent of the annual plan allocation is earmarked for DDP districts in Gujarat, Haryana, Himachal Pradesh, J&K & Rajasthan without matching provision under MNP.

4. Five per cent of the annual plan allocation is earmarked for Sub Missions, S&T inputs and R&D activities

5. The states provide allocation for RWS under MNP in their plans

MINIMUM NEEDS PROGRAMME(MNP)

The Minimum needs Programme, was introduced in the Fifth Plan with the objective of providing the rural population, particularly the rural poor, access to certain items of social consumption which form an integral part of the basic needs. Rural Water supply and Rural Santation (Since Seventh Plan) form part of the programme. The Seventh Plan (1985-90) outlay for Rural Water supply undedr MNP was Rs. 4235.23 crores (expenditure. Rs. 4467.37 crores). For Rural Sanitation, the Seventh Plan MNP allocation was Rs.93.02 crores of which Rs 43.58 crores were utilised.

MINI MISSION PROJECTS

The concept of Mini-Mission is a district-based integrated project covering major aspects of rural water supply to attain sustainable water supply on long term basis with close involvement of community and NGOs in the implementation, O&M and health education and solution of specific problem of excess fluoride, iron, brackishness etc. It aims at adopting appropriate technology and such other techno-scientific inputs as scientific source finding by satellite imagery etc. for sustainable and safe water supply. The objective is to develop a model in the fifty five Mini Mission districts selected in different parts of the country which have unique problems the tackling of which gives an experience which is replicable elsewhere.

Mini-Mission projects were taken up in the entire State of Goa and UTs of Andaman & Nicobar Islands, lakshadweep and Pondicherry, besides 51 districts in the remaining 24 States Projects worth Rs 212 19 core were approved. The entire progremme was funded by Government of India. Funds to the extent of Rs. 186 60 crores have been released so far and the expenditure reported till March, 1992 is about Rs. 159 25 crores.

SUB-MISSION PROJECTS

RGNDWM recognised the need to concentrate on certain specific problems which were area-specific and the the same time needed to be tackled on a national scale because each of these problems existed in several States. The following sub-mission areas were identified and nodal and collaborating agencies selected to look at these problems and work, towards eradication, and other solutions on a scientific basis. The following sub-Missions have been active under RGNDWM.

- Sub-mission on Eradication of Guineaworm
- Sub-mission on Desalination of water
- Sub-mission on Control of Fluorosis.
- Sub-mission on Removal of Excess Iron.
- Sub-mission on Conservation of Water and Recharging of groundwater aquifers

GUINEAWORM ERADICATION

Dracunculiasis or Dracontiasis (Guineaworm infection) is caused by a female Nematode Dracunculus Medinensis which lies in the subcutaneous tissues and invariably comes out of the body through the lower extremities. When a guineaworm infected patient enters into a water source like stepwell, pond and tank, the female guineaworm liberates thousands of larvae into water which are infested by the cyclops which are present in the water. When the people consume the water from such sources containing guineaworm infected cyclops they get a disease after an incubation period of about 9-12 months Transmission of guineaworm disease is predominant during the summer months (March - June) at the time when water is scarce

The guineaworm eradication has been an important activity of RGNDWM The Mission plays a vital role providing safe water supply including conversion of unsafe water sources into safe ones in guineaworm affected villages, besides chemical treatment of the source by Temephos or Chlorine.

Table 1.1 indicates the number of infected villages and cases in each of 7 states in 1984 and 1992 which shows the percentage reduction in infection·

Table 1.1

Comparison of Guineaworm cases (1984-1992)

State	Affected In 1984					Affected as on 1-7-92					
	Distt	Vill	Popul-ation	GW case	% of total no.of cases	Distt	Vill	Popul-ation	GW case	% of total no,of cases	% of reduc tor w.r.t 1984
Andhra Pradesh	6	1160	1566218	4461	11	5	27	261865	21	4	99
Gujarat	13	444	1058012	426	1	4	5	9739	Nil	—	100
Karnataka	8	991	1666123	5239	13	4	165	387661	160	29	97
Madhya Pradesh	21	3647	2723934	11341	29	13	295	509446	71	12	99
Maharash tra	15	1213	1058452	3115	8	6	Nil	—	1	—	100
Rajasthan	23	5376	4849340	15210	38	13	1339	1033365	313	55	99
Tamilnadu	3	9	10048	Nil	--	Nil	Nil	Nil	Nil	--	Nil
	89	12840	12932127	39792	100	45	1831	2202076	566	100	99%

Table I 2 indicates the statewise breakup of the number of stepwells converted into sanitary wells

Table 1.2

Conversion of Stepwells into Sanitary Wells

State	No. of approved (1986)	Converted upto Dec. 91	Convern sion progress.	Balance	Remarks
Andhra Pradesh	397	225	16	34	122 dropped
Gujarat	392	276	Nil	Nil	116 dropped
Karnataka	190	72	15	49	2 closed
Madhya Pradesh	1248	952	12	384	——
Maharashtra	346	292	54	Nil	——
Rajasthan	2569	1651	23	895	——

The eradication of guineaworm is programmed by March, 1993. As on date, the problem is largely endemic in Rajasthan and Madhya Pradesh.

DEFLUORIDATION ACTIVITIES

Certain areas have reported presence of fluoride in drinking water and consequent contamination of the same which has resulted into endemic fluorosis in those areas, manifesting into dental and skeletal fluorosis in human beings. The skeletal fluorosis in due course cripples the person making him/her virtually invalid. Although detected in India way back in 1930s, the disease is still not part of the regular curriculum of medical education. Consequently, it never got any attention and priority in community health practices and programmes. Moreover, the disease being symptomatically similar to diseases like Spondylitis, Arthiritis, etc., is difficult to diagnose. RGNDWM has taken a comprehensive programme of not only creating awareness about fluorosis but also to treat the water and make it potable and bring within the permissible limit of fluoride of 1 5 ppm . Of course, emphasis is more on alternate source but wherever that is not possible the water is treated through a chemical treatment plant based on Nalgonda technique which could be either fill and draw type (for larger designs) or handpump attached type. The Mission has sanctioned 106 fill and draw type and 375 handpump attached types of defluoridation plants out of which 40 F&D and 161 HPA type have already been commissioned as on 31 3.1992. Steps are being activated for completion of the balance.

Table III indicates the status of the defluoridation plants.

Table 1.3 : Current status of defluoridation plant installation in various states (1992) :

S No	State	No of plants F&D	Approved HPA	No of F&D	Plants comm. HPA
1	Andhra Pradesh	30	269	20	111
2.	Haryana	5	-	4	-
3	Gujarat	11	-	4	-
4	Karnataka	10	9	-	9
5	Madhya Pradesh	2	8	-	8
6	Maharashtra	2	2	-	-
7	Punjab	2	-	-	-
8	Rajasthan	0	64	12	10
9	Tamil Nadu	4	11	0	11
10	Uttar Pradesh	-	12	-	12
	Total	106	375	40	161

REMOVAL OF EXCESS IRON

Excess iron in water causes corrosion of tubewells, water supply installations and encourages growth of bacteria. It creates an aesthetic problem because of its taste and odour. The control measures are:

1 Supply water within permissible limit (1.0ppm) by providing alternative sources.

2. Supply water after treatment.

The problem is prevalent in 15 states and the UT of Pondicherry. The Mission had approved of setting up of 11,908 IRPs. More than 4000 plants have been commissioned in the 15 states and UT of Pondicherry.

CONTROL OF BRACKISHNESS

Excess brackishness causes the problem of taste and laxative effects Control measures include supply of water with total dissolved solids within permissible limits (1500 parts per million) either by providing alternative sources or by supplying water after desalination. The excess salinity

in drinking water is prevalent in 12 states (Andhra Pradesh, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamilnadu and West Bengal) and 3 UTs (Pondicherry, A&N Islands and Lakshadweep). 152 deslaination plants were approved by the Mission. Out of this 134 plants have been commissioned till March 1992.

CONSERVATION OF WATER

A sizeable portion of the Country's precipitation passes on to the sea Even otherwise only a very small percentage of the hydromass is available as water fit for different uses. The groundwater is the most popular source both for drinking and also for different industrial and agricultural purposes In the recent past, there has been heavy withdrawal of groundwater. This situation coupled with massive deforestation and consequent washing away of top soil which has led to diminishing water retention capacity of the soil and a gap between availability of groundwater and its demand and depletion of groundwater resources. Under these circumstances it becomes absolutely necessary to think of recharging the groundwater by all possible means including traditional and non conventional methods. As a step towards this, the conservation of water is given tremendous importance For example, cascade terracing on hilly areas supplemented by moisture retaining plants on the borders of the terraces or various rain water harvesting structures are some of the areas of initiative in this regard. Rain water harvesting has been tried in different parts of the country. Rain water harvesting connotes 'collection and storage of rain water and also other activities aimed at harvesting surface water and groundwater and prevention of losses through evaporation and storage, Hydrological studies and engineering innovations aim at conservation and efficient utilisation of precipitation in diverse geomorphic units. Water can be harvested in situ like in tanks, ponds, roof tops, hill tops, platforms and other traditional forms of collection. Storage in water acquifers like percolation tanks, check dams, sub surface dams, barriers, injection wells etc is also done Certain other activities related to soil conservation methods like gully plucking, contour bunding, afforestation, contour trenching, land lifting and bunding of fields have also proved effective in water harvesting activities. In a specialised effort catchment treatment is also given in order to utilize surface run off in catchment area. Apart from this, measures of evaporation control are also taken up. The Mission has been active in promoting both orthodox and innovative methods of conservation of water including the construction of water harvesting structures. Projects worth Rs. 26 crores have been approved and steps taken to complete the ongoing projects at the earliest.

WATER QUALITY TESTING LABORATORIES

The Mission has been concerned about the various types of contamination of drinking water particularly chemical contamination In order to ensure that the source is safe or to test whether the quality of water from the source is fit for consumption by human beings the water has to be chemically tested for which a specialised training as well as equipments are required for surveillance of water quality and analysis. The Mission has approved 110 stationary laboratories and aims to cover in due course each district with one such laboratory. The Mission has also sanctioned 26 mobile testing laboratories out of which 17 have already been fabricated and put to use and the remaining ones are being fabricated. Such a network of water quality testing laboratories will help in effective surveillance and monitoring the quality of drinking water to avoid use of comtaminated water and prevent the diseases caused by polluted water and insanitary conditions.

SOLAR PHOTO VOLTAIC PUMPING SYSTEM

In many rural areas, the availability of drinking water is a problem because the water table in such areas is too deep to be effectively tapped by conventional handpumps. Some of these areas do not have electricity facilities for motor pumpsets. Even if electricity is present it is not reliable. In addition, remote or inaccessible areas also get left out because of prohibitive cost of transportation of conventional system & equipments to these areas. The solution to this problem comes from the Solar Photo Voltaic Pumping System by tapping solar energy by cells exposed to the sunlight which is converted into electricity for lifting water from great depths These systems are easier, flexible and field upgradeable. The Mission has attempted to cater to the need of remotest places and most inaccessible areas where conventional schemes are difficult to implement, and sanctioned a total of 142 SPV systems out of which 97 have already been installed till 1991-92.

COMMUNITY PARTICIPATION AND WOMEN'S INVOLVEMENT

It has been the general feeling that the massive investment in infrastructure and efforts to install handpumps, lay water pipes and build latrines should necessarily be accompanied by increased community participation and awareness and decentralized management.

Women need to be associated with the community participation efforts since mostly they carry and use water. They spend 1 to 4 hours a day in water collection and transportation Whenever there is a breakdown in the water supply, it is the woman who suffers the most The need for involving women is further reinforced when it is realised that the ultimate goal of the Water Supply and Sanitation Programme is to improve health and quality of life.

Information, Education, Communication (IEC) activities of the Mission aim at training and providing information material widely to create awareness about maintenance of community assets.

A colloquium on the role of women in rural water supply and sanitation was organised in India and follow up action is on. Emphasis is being laid not only in the involvement of women in maintenance of handpumps but also in various other activities right from the commencement of project identification, planning, selection of sites and implementation

To decide on the coverage of a village or to treat a village as a problem village, the Mahila Mandals and women's groups are being involved. It is desirable that a reasonable number of women are represented in the village level water monitoring committee.

RESEARCH AND DEVELOPMENT

With the launching of National Drinking Water Mission, a Memorandum of Understanding was signed between MRD and CSIR for undertaking various Research & Development and

Science & Technology activities with a view to developing cost effective appropriate technologies for the Rural Water Supply Programme. A total of 16 R&D projects have been approved by the Ministry. Out of these, 13 projects have been completed.

HUMAN RESOURCE DEVELOPMENT

Ministry of Rural Development in collaboration with State PHED/Water Boards and identified Training Institutions is running a number of training programmes for development of human resources in Rural Water Supply and Sanitation Programmes. Though sporadic efforts have been made in this field in last Plan Period, a concerted effort is aimed with the following objectives·

- to develop in the existing personnel adequate technical skills and capacity to motivate people;
- to ensure that technical personnel keep abreast of the latest technical developments;
- to familarise with appropriate low cost technologies;
- to train grassroot level people to operate and maintain water supply and sanitation systems at their level to the extent possible;
- to bring about participation of the beneficiaries in the planning, implementation, operation and maintenance of the systems.

The training programme has been divided into two parts:

a) District level training of the trainers linked with grassroot level training for the block level workers;

b) Professional level training for staff and instructors of the institutions;

The Ministry of Rural Development has so far identified seven institutions to start with the training programme. This is apart from the State PHED training facilities and it is expected that a few more will be added soon. These aspects are covered in detail in chapter 6

CHAPTER - 2

COMMUNITY HEALTH AND EFFECTIVE HEALTH EDUCATION

Introduction

Water related diseases may be divided into two categories, firstly those which are caused by a biological agent of disease (a pathogen) and secondly those which are caused by some chemical substance in water.

The first group may be called the **water related infections** and include some of the greatest causes of disease and death in developing countries including India (for instance diarrhoeal diseases and malaria).

Excreta related disease is one related to human excreta meaning urine and faeces which are the source of nearly 50 infections. The spread of major infections and parasitic diseases such as cholera, typhoid, dysentry, hepatitis, giardiasis, guineaworm infection are due to poor drinking water quality, which manifest as acute diarrhoea.

The second category includes diseases such as fluorosis (linked to high fluoride levels in drinking water), infantile methaemoglobinaemia i.e blue born baby (related to high nitrate levels in drinking water), aresenical keratosis (due to high concentration of arsenic in water) and development of bacteria causing odour, bad taste, frothing and undesirable colour in water due to presence of excess iron in water. The toxic effects of pesticides, lead and other metals have at times led to various physiological disorders. Industrial wastes from paper and textile mills, tanneries, petroleum industery also contaminate important sources. (Fig 2.1)

CLASSIFICATION OF WATER BORNE DISEASES ON THE BASIS OF TRANSMISSION ROUTE

Water Borne Diseases can be broadly classified into following categories, based mainly on the routes taken to transmit them.

WATER - BORNE ROUTE

Truly water-borne transmission occurs when the pathogen is in water which is consumed by a person or animal getting infected on account of completion of the pathogen's incubation period or infectious stage of its life cycle.

WATER - WASHED ROUTE

A water-washed disease may be formally defined as one whose transmission will be reduced following an increase in the volume of water used for hygienic purposes, irrespective of the quality of that water

Water washed diseases are of three main types. First there are infections of the intestinal tract such as diarrhoeal diseases. Any disease which is transmitted by the pathogen passing out in the faeces of an infected person and subsequently being ingested (a faecal-oral disease) can either be transmitted by a truly water-borne route or by an almost infinite number of other faecal-oral routes, in which case it is probably susceptible to hygiene improvements

The second type of water-washed infection is that of the skin or eyes. Bacterial skin sepsis, scabies and fungal infections of the skin are prevalent in our country, while eye infections such as trachoma, are also common .

DISEASES RELATED TO THE IMPROPER USE OF LOW-COST TECHNOLOGIES

	TECHNOLOGY	WATER-BORNE DISEASES 1	WATER-RELATED DISEASES 2	SOIL POLLUTION 3	FLY-AND INSECT-BORNE CONTAMINATION OF FOOD
WATER SUPPLY	RAINWATER HARVESTING AND SUPPLY				
	GROUNDWATER FROM WELLS AND SPRINGS				
	SURFACE WATER SUPPLIES				
	STAND PIPES				
	STORAGE OF WATER				
SANITATION	PIT LATRINE				
	POUR/FLUSH				
	VENTILATED IMPROVED PIT				
	VAULT AND CARTAGE				
	TRENCHING				
	AQUA PRIVY AND SEPTIC TANK				
	WASTE STABILIZATION POND				
	REFUSE DISPOSAL				

1. Includes diarrhoea, dysentry and typhoid
2. Includes malaria, filariasis dengue and schistosomiasis
3. Includes hookworm, round worm and other helminths.

Fig: 2.1

The third type of water-washed infections is caused by lice or mites which may be reduced by improving personal hygiene and therefore reducing the probability of infestation of the body and clothes with these arthropods Louse-borne epidemic typhus and louse borne relapsing fever transmitted by body lice cannot persist is those who regularly bathe and launder their under garments.

WATER - BASED ROUTE

A water - based disease is one in which the pathogen spends a part of its life cycle in molluscan (water shails) or other aquatic species. All these diseases are due to infection by parasitic worms (helminths) which depend on aquatic intermediate hosts to complete their life cycles. Important examples are schistosomiasis, and guineaworm.

INSECT VECTOR ROUTE

The fourth route is spread by insects which either breed in water or bite near water Malaria, Yellow fever and Dengue, for example, are transmitted by insects which breed in water. Sleeping sickness is transmitted by the riverine fly which bites near water.

Table 2.1.

CLASSIFICATION OF WATER RELATED INFECTIONS

Category	Infection	Preventive strategy
1 Faecal-oral (water - borne or water - washed)	Diarrhoea, dysentry Giardiasis, Cholera, typhoid	Improve quality of drinking water Prevent casual use of the un-hygienic sources.
2 Water - washed	Infectious skin diseases	Increase water quantity use
(a) skin and eye	Infectious eye diseases	Improve accessibility and reliability of domestic water supply
(b) others	Louse-borne typhus Louse-borne relapsing fever	Improve hygiene
3 Water - based		
(a) penetrating skin	Schistosomiasis water	Decrease need for contact with infected
(b) ingested	Guineaworm	Control snail populations Reduce contamination of surface water
4 Water related insect vector		
(a) biting near water	Sleeping sickness	Improve surface water management
(b) breeding in water	Malaria Filariasis (Elephantiasis) Mosquito-borne diseases like yellow fever, Dengue	Destroy breeding sites of insects Decrease need to visit breeding sites Use mosquito nets

TRANSMISSION ROUTE FOR EXCRETA RELATED INFECTIONS

Transmission mechanisms in excreta related infections may be broadly classified into two categories.

Transmission is via infected excreta.

In this case pathogen is released into the environment through the faeces or urine of an infected individual.

In the second case, transmission is by an excreta related insect vector.

In this case, the insect which visits excreta to breed or feed may mechanically carry excreted pathogens to food or an insect vector of a non - excreted pathogen may preferentially breed in faecally polluted sites.

CLASSIFICATION OF EXCRETA RELATED INFECTION

Many excreta related infections are difficult to classify precisely as the water related infections The classification by World Bank is indicated in Table 2.2.

(I) Faecal-Oral Infections (non-bacterial):

Improvements in excreta disposal will have differing degrees of influence on various faecal - oral diseases. Some of these infections, caused by viruses, protozoa and helminths, can spread very easily from person to person whenever personal and domestic hygiene is not ideal. Changes in excreta disposal methods are unlikely to have much effect on their incidence unless accompanied by sweeping changes in personal cleanliness, requiring substantial improvements in water supply and housing, coupled with major efforts in health education.

Feces-to-mouth Infection

The way these infections are transmitted can be very direct.

For example: A child who has worms and who forgot to wash his hands after his last bowel movement, offers his friend a biscuit, His fingers, still dirty with his own stool, are covered with hundreds of tiny worm eggs (so small they cannot be seen). Some of these worm eggs stick to the biscuit. When his friend eats the biscuits, he swallows the worm eggs, too.

Soon the friend will also have worms.

His mother may say this is because he ate too many sweets. But no, this is because he ate shit!

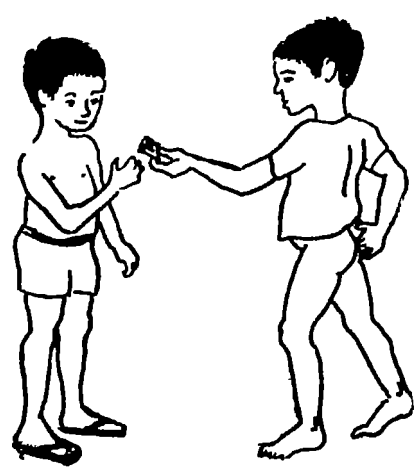


Fig. 2.2. Faeces-to-mouth Infection

Amoeba:

These are not worms, but tiny animals-or parasites-that can be seen only with a microscope.

How they are transmitted:

Fig. 2.2. Faeces-to-mouth Infection

The stools of infected people have millions of these tiny parasites. Because of poor sanitation, they get into the source of drinking water or into food, and other people become infected.

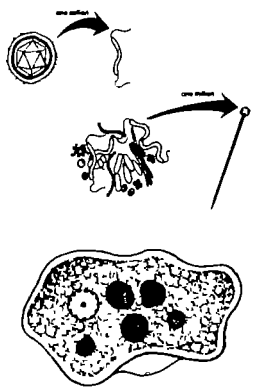


Fig. 2.3.Bacterial Infection

Signs of infection with amoebas:

Many healthy people have amoebas without becoming sick. However, amoebas are a common cause of severe diarrhoea or dysentery (diarrhoea with blood)– especially in persons already weakened by other sickness or poor nutrition. Less commonly, amoebas cause painful, dangerous abscesses in the liver.

(ii) Faecal - Oral Infection (bacterial):

For the faecal oral diseases caused by bacteria, person to person transmission routes are important but so are other routes too, with longer transmission cycles, such as the contamination of food, crops, or water sources with faecal material. Some of the pathogens in this category, notably campylobacter, Salmonella and Yersinia, are also passed in the faeces of animals and birds and are transmitted also in affluent communites.

What else do faeces contain

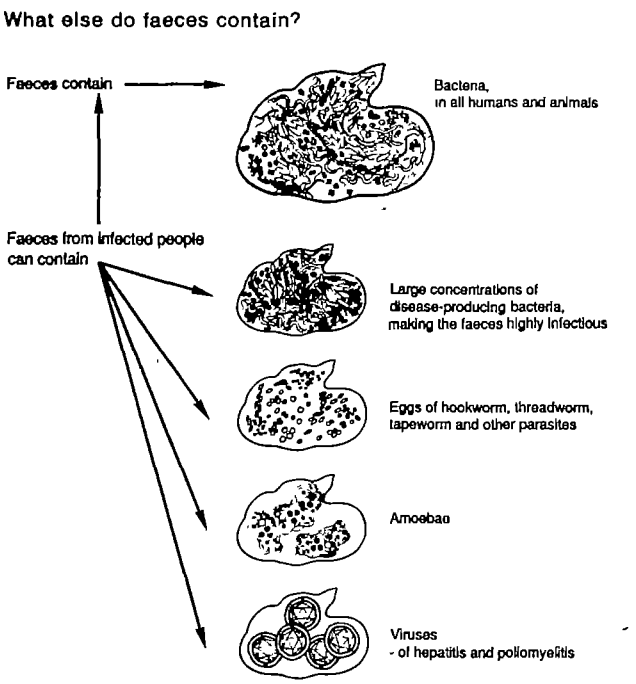


Fig. 2.4. What else do faeces contain ?

(iii) Soil - Transmitted Helminths:

This category contains several species of parasitic worms the eggs of which are passed in faeces. They are not immediately infective, but first require a period of incubation or development in favourable conditions, usually in moist soil. They reach their next human host by being ingested, for instance in vegetables, or by penetrating the soles of the feet Since the eggs are not immediately infective, personal cleanliness has little effect on their transmission, but any kind of latrine which helps to avoid faecal contamination of the floor, yard, or fields will limit transmission.

The eggs of these worms can survive for months between hosts so that adequate treatment of excreta is essential if they are to be reused in the land as fertilizer.

(iv) Water-based helminths:

All the water based diseases already mentioned except for guineaworm are caused by helminths which are passed in excreta and must then pass a stage in the body of an aquatic host, usually a snail They then reinfect a person through the skin or when insufficiently cooked fish, crabs, crayfish or aquatic vegetation are eaten.

Appropriate excreta disposal method can be adopted to control them by preventing untreated excreta from reaching water in which the aquatic hosts live.

(v) Excreta - related insect vectors:

These are of two main kinds. First, the Culex-pipiens group of mosquitoes, found in most of the world, breeds in highly polluted water, for instance in septic tanks and flooded pit latrines, and transmit Bancroftian filariasis in some region.

Second, the flies and cockroaches which breed where faeces are exposed. They carry pathogenic organisms on their bodies and in their intestinal tracts.

Table 2.2

CLASSIFICATION OF EXCRETA RELATED INFECTIONS

Category	Infection	Dominant transmission routes	Major control measures
1 Faecal-oral (non-bacterial)	Poliomyelitis Hepatitis A, Rota virus diarrhoea, Amoebic dysentery, Giardiasis Entrobiasis	Person to person contact Domestic contamination	Domestic water supply Improved housing Provision of toilets Health education
2 Faecal-oral (bacterial)	Diarrhoeas and dysenteries, cholera, E Coli diarrhoea, typhoid Paratyphoid	Persons to person contact Domestic contamination Water contamination Crop contamination	Domestic water supply Improved housing Health education Excreta treatment prior to land use or disposal Provision of toilets
3. Soil trans-mitted helminths	Ascariasis, Hookworm Strongyloidiasis	Yard contamination Field contamintion Fodder contamination	Provision of toilets with clean floor Excreta treatment prior to land application
4 Water based helminths	Schistosomiasis, Clonorchiasis Fascialopsiasis Paragonimiasis	Water contamination	Provision of toilets Excreta treatment prior to discharge Control of animal harbouring infection Cooking of food
5 Excreta related insect vectors	Filariasis	Insects breed in various faecally contaminated Sites	Identification and elimination of potential breeding sites Use of mosquito nets

DISEASES

The major water and sanitation related diseases may be broadly classified as follows:

(i) Diarrhoea

(ii) worm infections

(iii) skin and eye infections and louse borne infections

(iv) mosquito and fly borne infections.

Table 2.3 Water and sanitation Related diseases.

Group of Diseases		Infections
(i)	Diarrhoea	Cholera
		Dysentery
		Unspecified diarrhoeas
(ii)	Worm infections	Round worm (ascariasis)
		Whipworm ((trichuriasis)
		Pinworm (enterobiasis)
		Hookworm
		Guineaworm (dracunculiasis)
		Schistosomiasis (bilharzia)
(iii)	Skin and eye infections,	Scabies
	louse borne infections	Ring worm (fungus infection)
		Yaws
		Trachoma
		Louse-borne typhus and
		Louse borne relapsing fever.
(iv)	Mosquito and fly-borne	Malaria
	infections	Yellow fever and dengue
		Filariasis (elephantiasis)
		Sleeping sickness (trypanosomiasis)

DIARRHOEA:

Diarrhoea is the frequent passing of watery stools. There are many different diarrhoeal disease like cholera, dysentery and acute or unspecified diarrhoeas

CHOLERA:

A person with cholera passes very frequent stools. These stools look almost like clear water. The diarrhoea is usually followed by vomiting. Cholera often comes in epidemics.

If the people would take the following precautions, the spread of cholera can be prevented:

- If one uses latrine or outhouse
- If there is no latrine, stool is covered with mud
- If the food in the kitchen is kept covered
- If the sweets in the shop are kept covered
- If the child does not consume uncovered sweets

DYSENTERY

A person with dysentery passes watery stools with blood in them. Other symptoms are fever, vomiting and stomach pain.

Unspecified diarrhoeas:

A person with unspecified or acute diarrhoea passes more than five watery stools in 24 hours. Often there are also other symptoms like fever and vomiting.

Diarrhoeal diseases are common all over the world. People of all ages can get diarrhoea. Babies and children are often more heavily infected than adults.

Death from diarrhoea is often caused by the loss of too much body water along with stools resulting in dehydration. Therefore it is very important to replace this water as soon as possible by oral dehydration.

Helping to prevent diarrhoeas

To help prevent diarrhoeal diseases it is important to try to stop the germs in the faeces from reaching the mouth Most diarrhoeas could be prevented with good hygiene and good food. Therefore it is necessary to:

- use safe water for drinking, handwashing, washing of raw vegetables and fruit and for cleaning of cups and eating utensils;
- dispose of faeces in a safe way ;
- wash hands after defecating and before preparing and/or eating food;
- wash raw vegetables and fruit carefully before eating, or peel fruits;
- cook meals properly ;
- protect food from flies.

But even with all possible measures it will be impossible to prevent diarrhoea altogether. Partly this is due to the fact that there are so many transmission routes from faeces to mouth. Another reason is that diarrhoea can be a symptom of a non- diarrhoeal disease, e.g. malaria, measles and ear diseases. As these diseases do not follow the faecal-oral transmission route, the preventive measures above will not help in these cases But every reduction in the frequency of

diarrhoea, particularly in children, is worthwhile and the above measures can do a great deal to help.

WORM INFECTIONS

Very many people suffer from one or more worm infections All worms infections - except guineaworm and urinary schistosomiasis and caused by the eggs of the worms passed in the faeces of the infected persons

Worms and Other Intestinal Parasites

There are many types of worms and other tiny animals (parasites) that live in people's intestines and cause diseases Those which are larger are sometimes seen in the stools (faeces)

The only worms commonly seen in the stools are roundworms, threadworms, and tapeworms. Hookworms and whipworms amay be present in the gut in large numbers without ever being seen in the stools.

Mild worm infections are usually without serious symptoms(except guineaworm). Sometimes, there are no symptoms at all. But the faeces of people with a mild infection might be as dangerous as the faeces of people with a serious infection. That is why safe disposal of all faeces and personal hygiene are very important in the prevention of this group of infections.

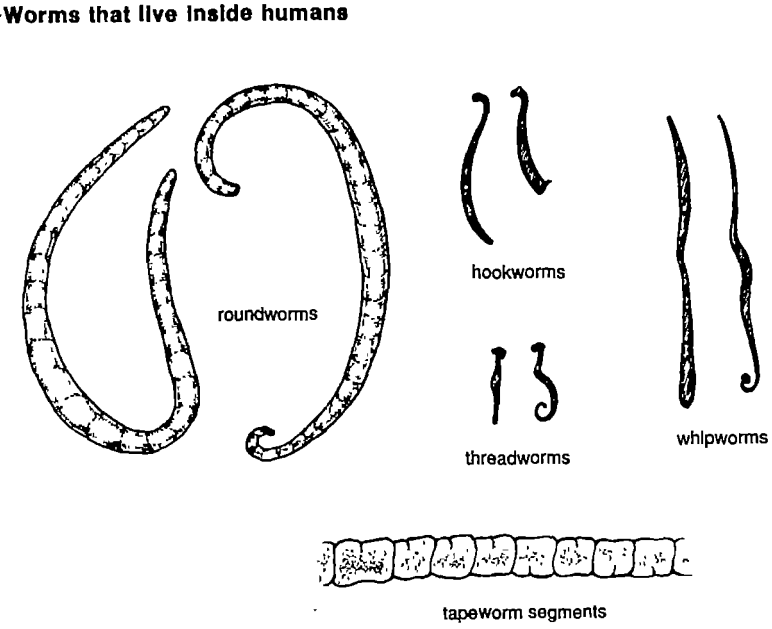


Fig. 2.5 All parasitic worms are spread by poor sanitation and hygiene

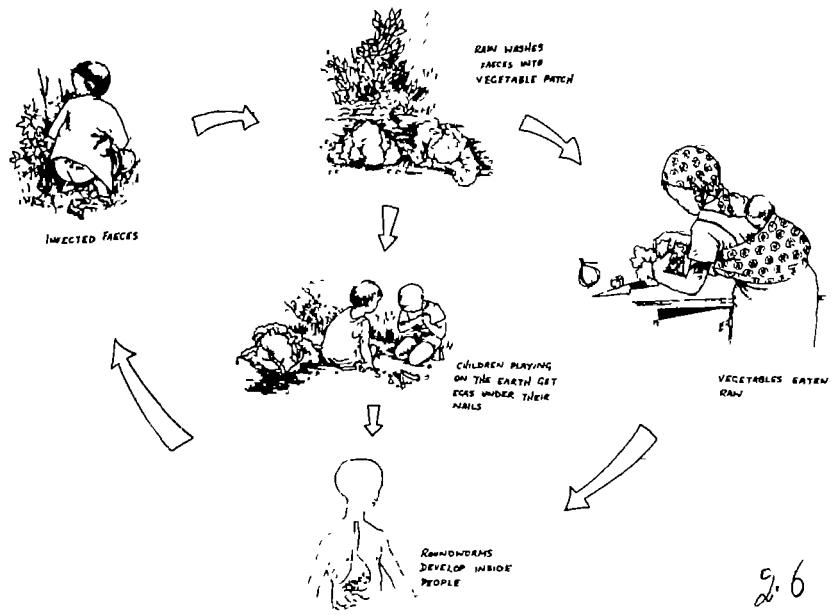


Fig. 2.6. Life cycle of the roundworm

ROUNDWORM (ASCARIASIS)

Roundworms have a round shape pink or white colour and are about as long as a man's foot. The worms live in a person's intestine and feed on the food eaten by the person So when a person has a lot of worms they will feel weak, because the worms use a part of their food. Another danger is that the worms may by their presence block the intestine and cause difficulties in defecating.

The eggs of the worms are excreted through the stools. To become infected the eggs have to enter the body through the mouth. In two routes.

The first route is unclean fingers. This is why children are more frequently infected than adults. They often put their fingers in their mouth. The second route is raw vegetables and fruits, which get contaminated with eggs when people with roundworm defecate in a field where vegetables or fruits are growing or when a vegetable field has been manured with fresh human faeces.

WHIPWORM (TRICHURIASIS)

Whipworms are thin like thread. These worms show the same characteristics as roundworms and infection also occurs in a similar way ,but are not as harmful, because drying and sunlight kill the eggs.

3 to 5 cm, long. Color : pink or gray.

This worm, like the round worm, is passed form the feces of one person to the mouth of another person. Usually this worm does little harm, but it may cause diarrhoea, In children it occasionally causes part of the intestines to come out of the anus (prolapse of the rectum).

Prevention: The same as for roundworm.

PINWORM (ENTEROBIASIS)

Pinworms are very small and thin. The worms live in a person's intestine. They come out of the anus at night and lay eggs at the anal region. The eggs are excreted in the stools. Pinworms cause severe itching of the anus. The person will scratch and so the eggs get on the fingers. Pinworms spread often on unclean fingers. Due to itching, some people confuse it with piles.

Threadworm (Pinworm, Enterobius).

1 cm long Color white, Very thin and threadlike

How they are transmitted :

These worms lay thousands of eggs just outside the anus (ass hole), This causes itching, especially at night When a child scratches, the eggs stick under his nails, and are carried to food and other objects. In this way they reach his own mouth or the mouths of others, causing new infections of threadworms.

Effect on health

These worms are not dangerous Itching may disturb the child's sleep.

HOOKWORM

Hookworms are small and red in colour. The worms live in a person's intestine and feed on his blood by making small wounds in the wall of the intestine. When there are many worms sucking blood, the person will feel weak and tired Hookworm eggs are excreted in the stools and develop into worms Which get into the skin of the feet when people walk with bare feet So, hookworm infection can be prevented when people wear shoes, or do not walk with bare feet

1 cm, long. Color: red.
Hookworms cannot usually be seen in the feces. A stool analysis is needed to prove that they are there.
How hookworms are spread:

1. The baby hookworms enter a person's bare feet. This can cause itching.

2. In a few days they reach the lungs through the blood-stream. They may cause a dry cough (rarely with blood).

3. The person coughs up the young worms and swallows them

4. A few days later the person may have diarrhoea or a stomach-ache

5. The hookworms attach themselves to the walls of the gut. Many worms can cause weakness and severe anemia.

6. The hookworm eggs leave the body in the person's stools. The eggs hatch on moist soil.

Hookworm infection can be one of the most damaging diseases of childhood. Any child who is anemic, very pale, or eats dirt may have hookworms. If possible, his stools should be analyzed.

Prevention of roundworm, whipworm, pinworm and hookworm.

All these worm infections of the intestines can be greatly reduced by safe excreta disposal in a latrine. which is kept clean as a dirty latrine can easily increase the risk of worm infections instead of reducing it. This is especially true for the transmission of hookworm. Other important preventive measures are the washing of hands after defecating and before handling food, and the washing of raw vegetables and fruits. Faeces that will be used as manure on the field should first be allowed to become harmless. Composting for 6 to 12 months will kill the eggs so that the composted faeces can safely be used

GUINEAWORM

Guinea worm (dracunculiasis)

The guinea worm incubates in a person's limbs. There it causes a wound which often makes walking difficult. When this person gets into the water, the larvae of the worm pass into the water. There the larvae infect cyclops (tiny little shellfish that barely can be seen with the naked eye). When another person drinks this water contaminated with the infected cyclops, the larvae will be swallowed. In side the body the larvae will develop into new worms in the legs of the infected person., Because of this transmission route, guinea worm infections are very common in areas where people get their drinking water from unprotected shallow ponds or step wells

Prevention of Guineaworm:

The disease can be prevented either by protecting the drinking water from physical contact with the patients or by preventing people from drinking water containing infected cyclops or freeing the water from cyclops. In the absence of protected water supply, it is not possible to prevent people using the infected water for drinking purposes. In these circumstances, the water can be freed from cyclops, by sieving through a double layered muslin cloth. Mono filament nylon gauze has been developed with 60 to 100 pores/cm that will filter cyclops. Chemicals such as temephos are very effective and safe as cyclopicidal agents.

SCHISTOSOMIASIS (BILHARZIA)

Schistosome may even enter into a person's blood system. The eggs are excreted in faeces or urine depending on the type of schistosomiasis. A person with schistosomiasis complains of pain in the belly and of passing blood with urine or faeces.

The route of transmission of schistosomiasis is rather complicated. When people who have schistosomiasis urinate or pass stool in or near water, the eggs of the worms get into the water In the water the eggs have to enter a snail to become young worms. The young worms leave the snails and enter people through the skin. So people get infected when they bathe, wash clothes, work, walk, fish or play in contaminated water. To a lesser extent people can get infected when they drink this water

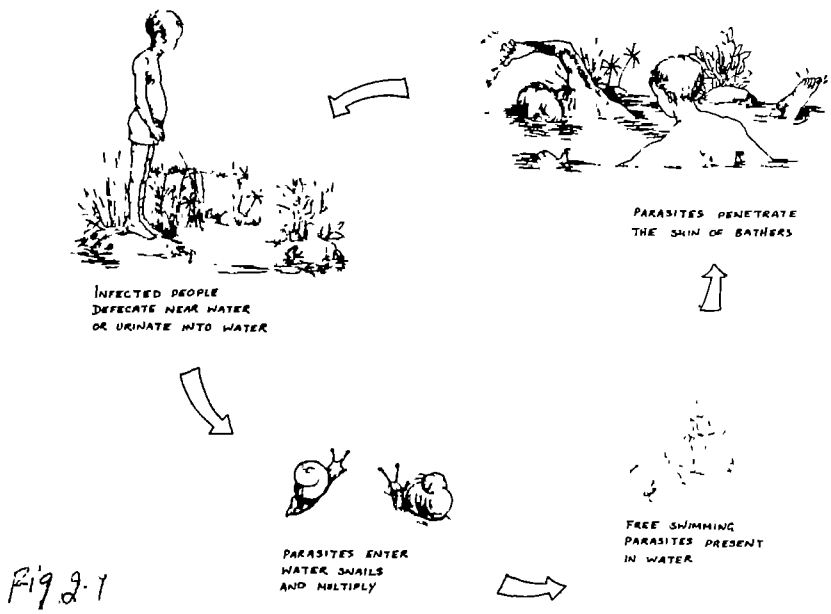


Fig 2.7. Schistosomiasis (bilharazia)

Prevention of Schistosomiasis

Control and prevention of schistosomiasis is difficult Measures for control can concentrate on.

a **Prevention of water contamination:** Safe disposal of all faeces and/or urine by all people in the community will prevent contamination of water and control infection.

Yet just one failure in safe disposal is enough for snails to produce young worms causing health problems for a long period of time.

b. **Avoidance of skin contact with contaminated water:** Piped water supply may greatly help reduce contact between a person and contaminated water and consequently break the transmission of schistosomiasis.

Other methods to reduce contact with contaminated water are to:

- keep water (without snails) in a container for 48 hours Within this period the worms will have died;
- drain small ponds or fill them with earth and stones; use logs to make bridges to cross small streams;
- avoid water contact at crowded places as contamination is more likely there;
- avoid still water with vegetation as the snails prefer this

SKIN INFECTIONS

SCABIES

Scabies is a skin disease. It is caused by small mites just under the skin Little marks will appear on the skin and the skin will itch, especially at night leading to, to scratching and to other infections. Scabies spreads by touching the infected skin or by touching the clothes or bed clothes used by the person with scabies. Children often get this disease

Scabies can be prevented by regular bathing and washing of clothes and bed clothes. Mild cases of scabies can even be cured by hard washing (scrubbing) of the body twice a day.

RINGWORM

Ringworm is a skin disease, not caused by a worm but appears as small rings on the skin. Signs of this disease are most often found on the head (in the hair), on the feet (between the toes) and under the nails. The disease is spread in the same way as scabies It also can be prevented or stopped in the same way as scabies.

YAWS

The first signs of yaws are small infections of the skin. Later it affects the bones People of all ages can get it, but children get it more frequently. Yaws is spread when a healthy person touches an infected person. It also can be spread by flies from one person to another. Yaws can be prevented by regular bathing and by keeping flies away.

EYE INFECTIONS

TRACHOMA

Trachoma is a very common eye disease in dry, dusty areas The disease starts with irritation of the eyes After some time the disease will appear under the upper eyelids which become thick Trachoma can lead to blindness. It spreads when the discharge (fluid) from the eyes of an infected person comes into contact with another person. This can happen when a fly carries the disease to the eye of another person. It also can happen if people clean their face with a cloth (e.g. towel or handkerchief) which has been recently used by an infected person.

Trachoma can be prevented by washing the face every day with water and, if possible, soap. Another preventive measure is to keep flies away from the eyes.

CONJUNCTIVITIS

Conjuctivitis is another common eye disease. It causes redness of eyes and results in watery discharge and thick eyelids. Transmission occurs in the same manner as trachoma and can be prevented in the same way.

LOUSE-BORNE INFECTIONS

Lice cause irritating bites, itching and scratching This may lead to other infections

The head louse is common among school children and people with long hair. Normally head lice are more a nuisance than a health problem. The body lice live in clothing, especially underwear.

Body lice are more common in cold areas where people are unable to wash or change clothes very often. Body lice can cause dangerous diseases like louse-borne typhus and relapsing fever. Water and soap will help to destroy the lice and their eggs (called nits). So regular bathing and washing of clothes and bed clothes is very important in the prevention and control of lice. The heat of the sun can also kill lice and nits.

Prevention of skin and eye infection and louse-borne infections:

Many of the skin and eye infections and louse-borne infections are often caused by a lack of water for personal hygiene. That is why these infections are found more often in dry areas and in dry seasons or where people have to go far to fetch water. For all these infections the quantity of water available is more important than the quality of the water.

The best way to prevent or reduce these infections is to have plenty of water near people's homes Thus the new standposts may greatly help reduce these diseases But then the water has to be used not only for drinking and cooking, but also for bathing and washing. As these infections are transmitted by close contact, it is important that all family members regularly bathe and wear clean clothes.

Another preventive measure is the proper disposal of faeces and other waste in order to prevent fly breeding. This will reduce the risk that flies will carry infections from one person to another.

MOSQUITO AND FLY-BORNE INFECTIONS

The diseases in this group are caused by the bites of mosquitoes or flies that breed in or near water. That is why these diseases also belong to the water related category.

The prevention of these diseases is beyond the scope of a new local water supply and. sanitation programme. But in some cases the risk of infection might be reduced by reducing the breeding places of mosquitoes and flies near the houses or by not allowing the water to stagnate near the habitations and leading waste water into soakpits.

MALARIA

Malaria is an infection of the blood caused by female Anopheles mosquito bite. The disease causes fever and other symptoms, like headache, shivering and diarrhoea. Some times, it proves fatal if proper preventive measures are not taken. Malaria is transmitted from one person to another by mosquitoes. When a mosquito bites a person who has Malaria,it sucks the diseased blood. When it bites another person, it puts the malaria germs into that other person's blood. That person then has Malaria.

Control of malaria is very difficult. In dry areas it may help reduce the disease by removing breeding places around houses as mosquitoes like to bite near breeding places. To prevent mosquitoes from breeding around the houses people could take care to:

- Put away tin cans, broken bottles, coconut shells and other things that can collect rain water;
- cut grass and plants around the house which can hold water;
- cover water storage tanks, rainwater tanks, tree holes, etc.;

- drain or fill in little ponds;
- empty all open vessels at least every four days (this is before eggs have developed into new mosquitoes).

It is also important to take care that new handpumps/ standposts and latrines do not become new breeding places because of stagnation of water in the vicinity

Other measures to reduce transmission of the disease is to use mosquito nets (if affordable), especially to protect babies and little children at night and use fine wire mesh or nets over the exit of gas pipes of septic tanks.

FILARIASIS (ELEPHANTIASIS)

Filariasis is also transmitted from one person to another by mosquitoes. When a mosquito bites, it puts many little larvae into the blood. These larvae develop into worms inside the body. Many bites over many years cause swellings of the legs (elephantiasis), of the genitals, or of other parts of the body. Some types of mosquitoes that may cause filariasis breed in dirty water. That is why this disease is often found in areas with poor drainage and poor excreta disposal systems. Breeding in open or cracked septic tanks, flooded pit latrines and water drains is common. That is why safe excreta disposal and water drainage is extremely important in the control of this disease. The same preventive measures as described for malaria might also help reduce transmission of filariasis

YELLOW FEVER AND DENGUE

Yellow fever and dengue are also transmitted by mosquitoes. These diseases, found in parts of Africa, especially in urban areas, are dangerous and cause fever and other symptoms. To help reduce transmission the same preventive measures could be taken as described for malaria and filariasis.

Strategy to bring about changes in the perception with regard to health and hygiene.

Characteristics of Effective Health Education

Effective hygiene education

- Promotes actions which are realistic and feasible within the constraints faced by the community;
- Builds on ideas, concepts and practices which people already have;
- Repeats and reinforces information, using different methods, over a period of time,
- Uses existing channels of communication such as songs, drama and story tellings, and is adaptable;
- Entertains the community, and attracts its attention;
- uses clear, simple language with local expressions and emphasises short term benefits of action;
- Provide opportunities for dialogue and discussions to allow learner participation and feed back on understanding and implementation;
- Uses demonstrations to show the benefits of adopting changed practices.

Drinking unclean water can also spread many diseases of the gut and the digestive tract For example:

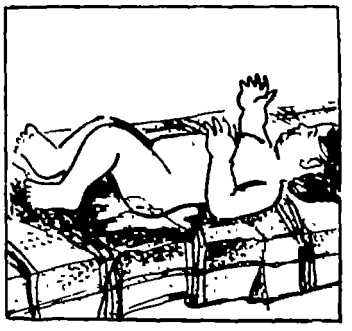
This man has hepatitis (jaundice)

He has a bowel movement near a pond The germs of the disease get into the water

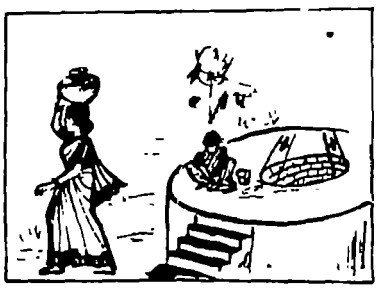
This woman takes water from the pond to her house.

Her family drinks the water

They all get hepatitis



The baby passes stools and dirties his clothes



Another woman takes water from this well

Her family drinks this water

Her family also gets hepatitis.

Fig. 2.8. How Infection spreads

The Adoption of New Practices

In a community, where handwashing is not a general practice, the people have to see the benefits of adopting a change. A direct communication like a lecture with pictures of transmission routes of diarrhoea and a picture of a healthy and happy family who wash their hands is generally not a workable approach, Germs are no part of their daily life and so people who do not see germs with naked eyes may believe the story but will soon forget it. If the communication is related to the life of someone in the community who has suffered form diarrhoea, it whould carry more conviction.

But even when people are fully convinced of the importance of handwashing, they need not immediately adopt it. There is a difference between knowing what is good for health and doing what is good for health. The hygiene promoter has always to see that he/she does not forget this difference between knowledge and behaviours. Hygiene education programmes would have been very successful if only right behaviour had followed right information.

People are aware of the health risks in bathing or washing clothes in water contaminated with schistosmiasis. Yet they ignore the risk and find it convenient to bathe and wash clothes in this water. Old practices are difficult to be changed and it is precisely this difficulty in change that is a challenge to the hygiene promoter.

Since convenience, ease and accessibility seem to be key facors in this process of change(or non-change if it is convenient not to change), standposts /handpumps are more likely to be used when they are easy to operate and give a continous flow of water. Handwashing, bathing and washing clothes in clean water can be more readily induced if plenty of clean water is available at easily accessible sites.

Rather than talk about diseases, finding out how new practices can be facilitated will be a better instrument of change. Such a facilitating approach, built on existing experiences and practices is likely to succeed faster and bring about the desired changes.

However, the best ways to promote behavioural change can only be learnt form the people in the community itself.

Status achievement is another factor that may influence the adoption of new practices Often the motivating factor for people to build a new latrine is not so much to improve their health as to improve their status. But the new facility should be properly used.

Also a key or reference person Who is generally respected can often influence the adoption of new practices. When these persons promote a change, people are more inclined to give it a try.

STRATEGY WITH REGARD TO HEALTH AND HYGIENE EDUCATIONAL PROGRAMMES FOR THE COMMUNITY

THE START OF A HYGIENE EDUCATION PROGRAMME

Integrating hygiene education activities with other project activities

There are many advantages in integrating hygiene education with other activities in the water supply and sanitation programme especially at the start of the project.

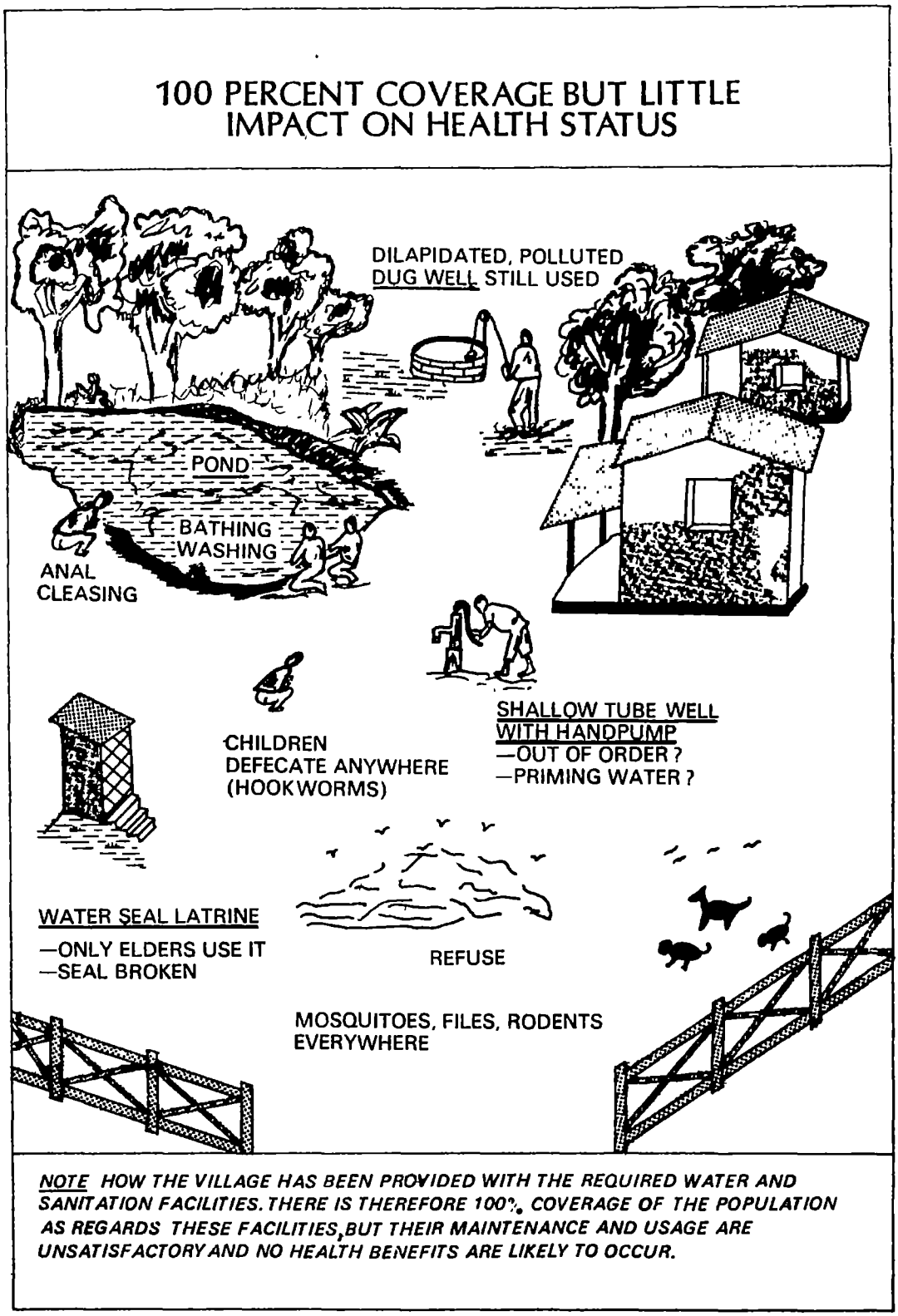


Fig. 2.9 100 percent coverage but little impact on health status

First of all the introduction of the programme into the community can be combined with a survey of the present water and sanitation situation.

Second, integration of activities will help stimulate the community to participate in the planning, design and construction of the facilities as only the people themselves can decide on convenient solutions and easily accessible sites for the new water and sanitation facilities Convenience and accessibility are key factors in the adoption of new practices. It will increase community involvement and facilitate a proper use of the new facilities.

Third, it will facilitate communication and cooperation between all parties involved in the water supply and sanitation programme (e.g. project staff, members of the community,, hygiene promoter, local authorities). helping to find the most appropriate solutions.

Fourth, the introduction of new water supply and sanitation facilities provides a good opportunity to discuss hygiene behaviour. People will be interested in what is going on in their community They will ask themselves: "What is happening, and what will it do to our lives?" So this is the best time to capture the interest and attention of the people for discussing the health risks of the present situation and to promote practices that will improve their health.,

Fifth, as it takes time before people are willing and able to change their behaviour, the sooner you start with hygiene education activities the better it is.

In practice it will not always be possible to synchronise hygiene education activities with other project activities. Ideally, hygiene education should precede, continue with the project and also afterwards.

STEPS TO START A HYGIENE EDUCATION PROGRAMME

Contact with local leaders

Within all rural communities, there are well-established patterns of informal communication and influence Hygiene educators work on the theory that if the leaders of opinion and trend setters within a community can be persuaded to change their perceptions and practices, then the rest of the community will follow their example. Large target groups are reached through traditional channels and so, educators seek out the opinion leaders who can tell about the problems and needs, health situation constratints, and the ways in which they can contribute to the new water supply/sanitation project. They can also help to find out key persons from the community to work as hygiene promoters.

Formal meeting

For achieving best results, it is essential that the potential benefits of hygiene education are understood by every body in a formal meeting.

In general meetings most people will only be listerners as there will neither be the time nor chance for everybody to give her/his view. In some societies some social groups do not attend formal meetings or cannot give their views during the meeting Examples are, women, lower socio-economic groups, low caste people, and religious minority groups. In that case special attention has to be paid to other possibilities to inform and involve these people (e.g. through special or informal meetings, home visits, gatherings in religious centres, etc.)

The formal meeting is used to discuss the water supply project and the hygiene education programme; to ask for people's opinions and their cooperation, explain the importance of hygiene

behaviour, to discuss possible ways to organise hygiene education activities and whether it might be good to elect or appoint a special health committee.

The formation of a health committee

In most cases it will be a good idea to form a small health group to discuss, develop and promote specific local hygiene education activities, as it will be impossible except in small communities to involve the entire community committee to do this task.

It is up to the community to decide who will be selected or appointed to this committee. Most likely these are leading people in the community, whose interest and support can greatly help to make the programme successful. But they are probably not very much interested in a detailed discussion on for example how to promote handwashing, and probably even less interested to discuss possible ways to improve defecating practices. It may be better to discuss with the committee only the general outline of the programme and to provide them with relevant information on disease transmission. For a detailed discussion and planning a sub committee or an informal group is desirable Again, it is up to the community to select interested, capable and accepted persons,

Getting to know the situation

Another initial step is to organise a demonstration walk through the village or neighbourhood with interested people A walk around is a very good aid to raise the awarenes of the community and get them involved.

Points of discussion during the walk for hygiene education could be

- Where the people fetch their drinking water now ?
- What are the main problems and health risks ?
- What do they expect from the new water supply ?
- What do they think of improved sanitation facilities ?

It is easier for a female health promoter to walk around and address herself to the women of the community, to enter kitchens, or to visit bathing sites for women and little children. For a male health promoter it may be necessary to find other ways to involve the women of the community e.g by organising small meetings in the open air, or by asking assistance from female community workers/members.

A walk normally starts where well-to-do people are living. Their water and sanitation situation and practices often involve less health risks than those of the poorer sections of the community,which are probably the more important parts, to discuss the different conditions and their implications and to compare the different health risks involved. such discussions with people involved (to find out why do things the way they do) are very important aids in every hygiene education programme.

Involvement of other professional workers

At the start of a hygiene education programme, other professionals in the area like doctors, primary health care workers, midwives, teachers, development agents, can give information on

the living conditions of the community members, their health situation, school attendance, literacy rate etc.

The best way to start a hygiene education programme and how to approach the community. has to be decided depending on the circumstances but it helps to plan and organise real community based activities for all the different groups of people in the community and planning and organisation of health and hygiene related activities particularly at the grass root level– information, extension.

Hygiene education for all

A real impact on the health situation can only be expected if all people in the community use the new water supply and sanitation facilities in a proper way. Otherwise the risks of disease transmission will not be substantially reduced. This means that all people in the community need to have easy access to the new facilities and that people in the community have to be involved in the activities to improve hygiene behaviour.

In some situations it may be difficult to involve underprivileged groups in general hygiene education activities. These people are often living in worse conditions and therefore form higher risk groups in disease transmission. That is why it will be necessary to take special care that these people can also participate by targetting them specifically and each

- Simple hygiene practics such as washing hands with soap, after defacation, before eating or preparing food;
- Safe disposal of garbage;
- Defacating away from the family compound till sanitation is improved;
- Planning, beginning with what they have, and building on what they know;
- Regular bathing and regular washing of clothes;
- Using clean vessels, covers, cups;
- Proper disposal of infant, adult and animal faeces;
- Recognition of diarrhoea and rehydration therapy;
- Vaccination, immunization.

The formation of a health group

There are many advantages to plan and organise hygiene education activities in close cooperation with community representatives and community level workers

In an ideal situation, representatives of all social groups would be included in such a health group: women as well as men, young as well as old, poor as well as rich, lower castes as well as higher caste people. We also may think of a school teacher, primary health workers, medical practitioners, midwives, traditional well-diggers, water vendors, etc. In reality however, it will be nearly impossible to compose a health group with such a perfect mix. What can be done instead?

Members of the health group should preferably be interested persons who are easily accepted by most people in the community Usually these persons belong neither to the privileged

section of the community nor to the underprivileged section. It is important to include some women Here we do not think only of the wives of the priviledged but also of average women who are performing all or most of the household tasks themselves.

Why do we stress so much the involvement of women? In most societies women are the main water managers and users. They carry water home, use water for cooking and other domestic purposes, wash clothes, bathe little children, clean latrines, teach children on proper hygiene and sanitation practices. That is why their involvement is very important. New water supply and sanitation facilities and new practices will affect them most. And what is more, they have lot of daily life experience on which local hygiene education activities can be built. An input from women in the health group can greatly contribute to the planning and organising of successful activities.

THE HYGIENE EDUCATION ACTIVITIES

Together with the health group all kinds of activities for community based hygiene education can be planned and organised. Questions that should be considered by the health group are:

What kind of hygiene education activities ?

The first thing to do is to decide which behavioural changes are to be promoted. Dependent on the most pressing health risks and health problems, the phase of the water supply and sanitation project, and local preferences and circumstances, a choice has to be made of what are the most feasible and profitable changes to introduce. In most cases it will be more effective to start with only two or three most desirable changes and to campaign for diffusion of these changes among the whole community.

Hygiene education activities for whom ?

Apart from general hygiene education activities for all people in the community, special activities may be organised for various groups of people like: young mothers with weaning children; farmers working in the field; children not attending school; key or reference persons; persons in charge of the operation and maintenance of the facilities; older people; people who are suffering from the same disease; for example scabies; people who are going to households of high risk groups; and so on. The main advantage of organising activities for special groups of people is that the activities can really be adapted to their needs and circumstances. We will have to take care however, that this will not be seen as stigmatizing certain groups of people (e.g. families with scabies).

When to organise hygiene education activities ?

Hygiene education activities can be organised at any time suitable for the community.

At the time of the siting of standposts; at the start of the construction works; or at the time that the water project is completed and put into use, it will be easier to capture the interest of the people in the community.

Special activities may be organised at the time of an outbreak of diarrhoea or when other water and sanitation related problems become acute. It is always easier to involve people in hygiene education activities when it relates to their present problems.

It is important to choose suitable times of the day and the year. It does not make sense to organise a school programme around the construction of new facilities when the work starts during school holidays. Or it will be difficult for the people to participate in the activities in the planting season when everybody is working in the fields. Or it may create problems when hygiene education activities are organised for women after sunset.

Where to organise hygiene education activities ?

Apart from informal talks at any place we can visit the people at home, organise special gatherings or include hygiene education activities in other programmes or gatherings.

Home visits may offer the best opportunities for effective hygiene education activities. At home families are in their daily circumstances. This makes it more easy to discuss present practices, problems and health risks. We can discuss what may be proper improvements and practical examples. The main disadvantage of home visits is that they take a lot of time. It may be a good alternative to organise small neighbourhood meetings at the house of a generally accepted member.

To concentrate on special groups of people special gatherings are organized. For example for mothers with weaning children; families which share the same health problem; families living around a new standpost; families of underprivileged people.

Another possibility is to include hygiene education in other programmes or activities, hygiene education activities for school children, literacy groups, credit associations, religious groups, youth associations, and so on.

Also informal talks with people in the community may offer good opportunities to discuss and promote hygiene behaviour Discussions can take place anywhere: in tea-houses, at water collection points, in kitchens, in shops, in the market, during work breaks or after work, social gatherings, and so on. Informal talks and demonstration walks are often important aids to raise interest and to motivate people to change behaviour.

Who will take care of the hygiene education activities ?

Of course, the hygiene promoter is well-suited. But often it has much more impact when local people themselves - women and men - take care of the activities Here we could think of: members of the health group key or reference persons, persons in charge of the operation and maintenance of the facilities, school teachers or other professional workers. Reference persons for example can take a leading role in the promotion of new practices as people are more inclined to trust and follow these persons.

School teachers are usually quite willing to organise hygiene education programmes for school children. Persons in charge of operation and maintenance can greatly help to promote a proper use of the facilities by explanations and discussions at the standpost sites, and so on. These persons may be men but at least some of them should be women as it is often easier for women to discuss with other women about water and sanitation related practices and to visit women at home .

Of course, it may be necessary first to organise a hygiene education programme for these persons before they can become hygiene promotors themselves.

How to arrange for follow up activities ?

Even a most successful hygiene education programme will require follow up activities as people tend to fall back into former behaviour and old practices; as kids are born and other children will go to school as the level of service may change; and so on. That is why, it should be discussed what kind of follow up activities could be organised, who, whom, and when or for which occasion

CHAPTER - 3

THE DESIGN AND COST ASPECTS OF WATER SUPPLY AND SANITATION INSTALLATIONS

THE DEMOGRAPHIC BASIS FOR EVALUATION OF DEMAND FOR WATER SUPPLY BOTH AT PRESENT LEVEL AND FOR FUTURE.

Demographic Method of Population Projection

The population to be served during such period will have to be estimated with due regard to all the factors governing the future growth and development of the area in term of industrial, commercial, educational social and administrative spheres.

Special factors causing sudden emigration or influx of population should also be foreseen to the extent possible.

Population change can occur only in three ways (i) by birth (population gain) (ii) by death (population loss) or (iii) by migration (population loss or gain) depending on whether movement out or movement in occurs in excess.

Migration also affects the number of births and deaths in an area and so projections of net migration are prepared before projections for natural increase.

This method thus takes into account the prevailing and anticipated birth rates and death rates of the region for the period under consideration.

Arithmetical Progression Method

In this a constant increment of growth is added periodically. It is of limited value and applicable mostly to large and established towns with their future growths practically controlled.

Geometrical Progression Method

This would apply to cities with unlimited scope for expansion and where a constant rate of growth is anticipated

Method of Varying Increment or Incremental Increase

A progressively increasing or decreasing rate rather than a constant is adopted in this method. This could be applied in general to areas likely to grow in such a manner.

Logistic Method

This is suitable in cases where the rate of increase or decrease of population with time and the population growth is likely to reach a saturation limit ultimately because of special local factors. A region or area the growth of which follows a logistic curve, will plot as a straight line on the arithmetic paper, with time intervals plotted against population in percentage of saturation.

Graphical Projection Method

This involves the extension of the population time curve into the future based on a comparison of a similar curve for comparable areas and modified to the extent dictated by the factors governing such prediction.

Final Prediction

While the prediction of the prospective population of an area at any given time during the period of design can be derived by any of the foregoing methods appropriate to each case, the density and distribution of such population within the several areas, zones or districts of the region will again have to be made with a proper judgement on the relative probabilities of expansion within each zone or district, according to its nature of development and based on existing and contemplated town/regional planning regulations.

Per Capita Supply

Water supplies for community should provide adequately for the following purposes.

(i) domestic need such as drinking, cooking, bathing, washing, flushing of toilets etc.

(ii) institutional needs like school, post office, primary health centres .

Recommendations

The Environmental Hygiene Committee suggested certain optimum rates for communities based on population groups as follows:

(a) For communities with population upto 10,000 rate of supply is 70 to 100 litres per capita per day.

(b) For communities with population between 10,000 to 50,000 rate of supply is 100 to 125 litres per capita per day.

(c) The communities with population above 50,000 rate of supply is 125 to 200 litres per capita per day (lpcd).

In case of rural communities where house service connection are not contemplated and the supply is through hand pumps or central street stand post the rate shall be not less than 40 lpcd. Where house service connections are contemplated to make the schemes self-paying the rate of supply may be 70 lpcd.

SOURCES OF SAFE WATER - LOCATION, SELECTION AND EXPLORATION.

General : The origin of all sources of water is the rainfall. Water can be collected as it falls as rain before it reaches the ground or as surface water when it flows over the grounds or is pooled in lakes or ponds, or as ground water which it percolates as ground water, or from the sea into which it finally flows The quality of the water varies according to the source as well as the media through which it flows

Precipitation

Rain water collected from the roof or prepared catchment for storage in small or big reservoirs is soft, saturated with oxygen and corrosive.

Micro-organisms and other suspended matters in the air are entrapped but ordinarily the impurities are not significant. But the collecting cisterns or reservoirs are liable to contaminations.

SURFACE WATERS

NATURAL QUIESCENT WATERS AS IN LAKES AND PONDS

These waters would be more uniform in quality than water from flowing streams Long storage permits sedimentation of suspended matter, bleaching of colour and the removal of bacteria. The microscopic organisms may be heavy in such waters on occasions. If the catchment is protected and unerodable, the stores water may not require any treatment other than disinfection.

ARTIFICIAL QUIESCENT WATER AS IN IMPOUNDING RESERVOIR

Impounding reservoirs formed by hydraulic structures thrown across river valleys, are subject more or less to the same conditions as natural lakes and ponds. While top layers of water are prone to develop algae, bottom layers of water may be high in turbidity, carbon dioxide, iron, manganese and on occasion hydrogen sulphide. Soil stripping before impounding the water would reduce the organic load in the water.

FLOWING WATERS AS IN RIVER, OTHER NATURAL COURSES AND IRRIGATION CANALS

Waters from rivers, streams and canals are generally more variable in quality and less satisfactory than those from lakes and impounded reservoirs. The quality of the water depends upon the character and area of the water shed, its geology and topogrphy the extent and nature of development by man, seasonal variations and weather conditions.

SEA WATER

Though this source is plentiful, it is difficult to extract economically water of potable quality because it contains 3.5% of salts in solution and it involves costly treatment. Off shore waters of the oceans and seas have a salt concentration of 30,000 to 36,000 mg/l of dissolved solids including 19,000 mg/l of chloride, 10,600 mg/l of sodium, 1270 mg/l of magnesium, 880 mg/l of sulphur, 400 mg/l of calcium, 380 mg/l of potassium, 65 mg/l of bromine, 28 mg/l of carbon, 13 mg/l of strontium, 4.6 mg/l of boron.

GROUND WATER

GENERAL

Rain water percolating into the ground and escaping beyond the reach of vegetation and either collecting in underground basins or flowing underground in sub-surface streams, constitute ground water source.

In an unconfined aquifer, the static water level in the well (without pumping) is the level of the groundwater table. After the pump has been used for some time, the water level in the well will sink to the pumping (or dynamic) water level. The difference between the two levels depends mainly on the rate of pumping, the length of time the pump has been used, and the permenability of the aquifer (the rate at which the porous medium transmits water). The pumping lift is the distance between the dynamic water level and the discharge point, though for convenience it is normally regarded as the depth of the dynamic water level below the ground surface.

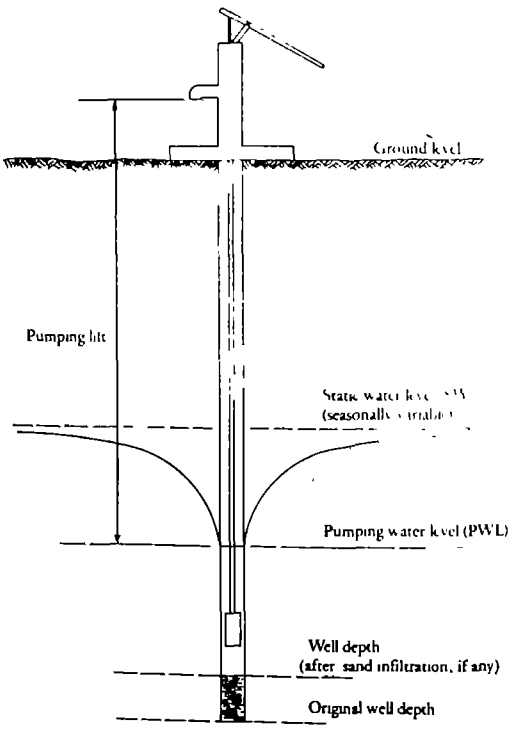


Fig. 3.1 Drawdown and pumping lift

SPRINGS

Springs are due to the emergence of ground water to the surface. Till it issues out on the surface as springs, the ground water carries minerals acquired from the subsoil layers, which may supply the nutrients to micro-organisms collected by the spring if it flows as a surface stream. Spring waters from shallow strata are more likely to be affected by surface pollution than are deep seated waters.

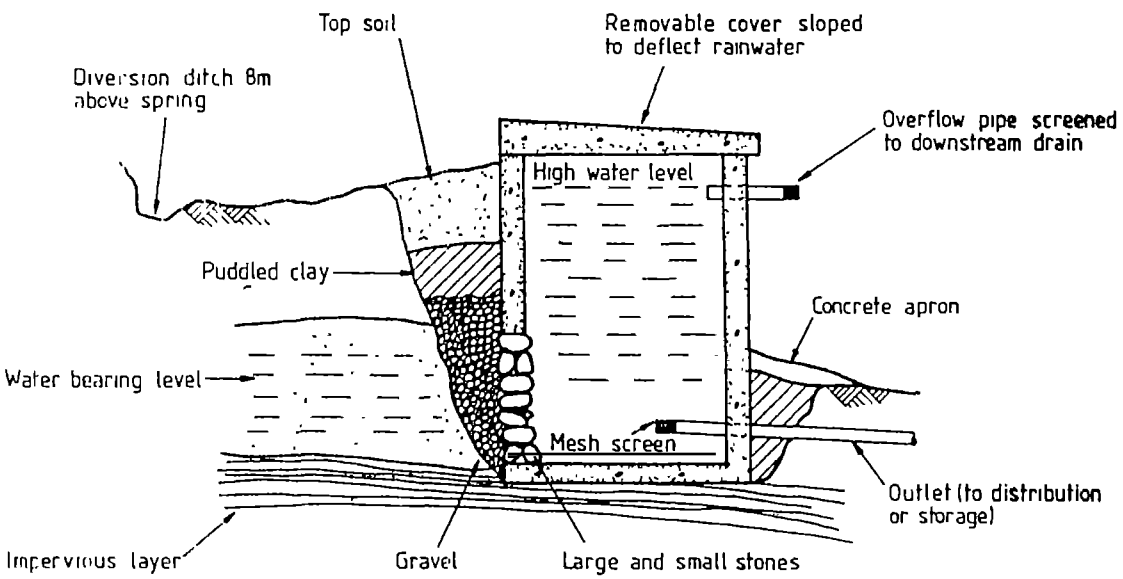


Fig. 3 2. Spring Box with Open Side

COLLECTION OF WATER, METHODS AND GENERAL ANTHROPOGENOUS FACTORS ASSOCIATED WITH IT.

COLLECTION OF SURFACE SOURCES

INTAKES

A water works intake is a device or structure placed in a surface water source to permit the withdrawal of water from the source. They are used to draw water from lakes, reservoirs or rivers in which there is either a wide fluctuation in water level or when it is proposed to draw water at the most desirable depth.

TYPES OF INTAKES

There are different kinds of intakes.

(i) Wet intakes

(ii) Dry intakes

(iii) Submerged intakes and

(iv) Moveable and floating intakes.

LOCATION

The following factors should be considered for locating the intake:

(i) The location where the best quality of water is available;

(ii) Absence of currents that will threaten the safety of the intake;

(iii) Absence of ice floes etc,

(iv) Formation of shoals and bars should be avoided as far as possible;

(v) Flash of wind and other conditions affecting the waves ;

(vi) Floods;

(vii) Availability of power and its reliability;

(viii) Accessibility;

(ix) Distance from pumping station;

(x) Possibilities of damage by moving objects and other hazards;

IMPOUNDING RESEVOIRS

Impounding reservoir is a basin constructed in the valley of a stream to store water during excess stream flow and to supply water when the flow of the stream is insufficient to meet the demand for water.

CHOICE OF RESERVOIR SITE

The suitability of a site must be judged from the following stand points:

(i) Quantity of water available;

(ii) Quality of source;

(iii) Possibility of the construction of a reasonably water tight reservoir,

(iv) Distance of the source from the consumer;

(v) Elevation of the supply;

(vi) Possibility of biological troubles in the case of a shallow reservoir;

COLLECTION OF SUBSURFACE SOURCES

The subsurface sources include springs, wells and galleries. The well may be shallow or deep shallow wells may be of the dug well type, sunk or built, of the bored type or of the driven type. They are of utility in abstracting limited rates of yield from shallow pervious layers, overlying the first impermeable layer.

Dugwells are wells taken into pervious layer below the impermeable stratum. They can be of the sunk well type or of the bored or drilled type. They are of utility in abstracting comparatively larger supplies from different pervious layers below the first impervious layers. Because of the longer travel of ground water to reach pervious layer below the top impermeable layers, deep wells yield a safer supply then shallow wells For the same reason, the supply from a deep well generally contains more minerals.

CLASSIFICATION OF WELLS

The wells are classified according to construction as follows:

(i) dug wells;

(ii) sunk wells ;

(iii) driven wells;;

(iv) bored wells.

DUG WELLS

Dug well of the built type has a restricted application in semi permeable hard formations. The depth and diameter are decided with reference to the area of seepage to be exposed for intercepting the required yield from the sub - soil layers. Unsafe quality of water may result if care is not taken in the well construction. It is necessary to provide a water tight steining upto a few meters below the vertical zone of pollution which usually extends 3 to 5 m or more below natural ground surface.

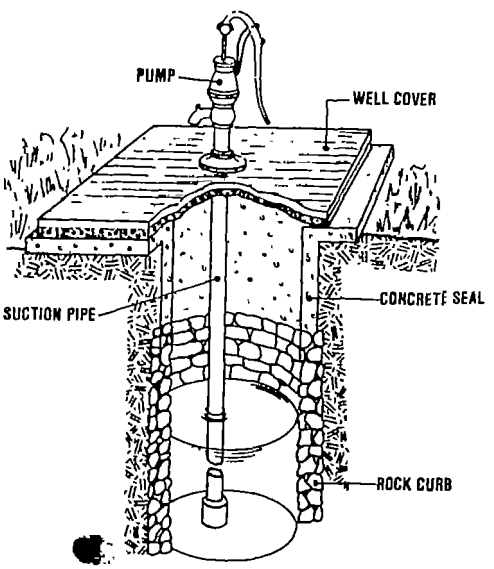


Fig 3 3 Sanitary Dugwell

The steining should extend well above the ground surface and a water tight cover provided with watertight manholes.

The bottom of the well should be at a level sufficiently below the lowest probable summer water table allowing also for an optimum drawdown when water is drawn from the well. To facilitate infiltration into well, either the steining is constructed in dry masonry or weepholes are left in the steining at suitable intervals. It is usual to insert cut lengths of pipe in the outer end covered with a wire gauze and shrouded with gravel to arrest ingress of fine material.

SUNK WELL

Sunk wells depend for their success on the water bearing formations which should be of adequate extent and porosity. The sunk well is only the interposition of a masonry barrel into such a deposit so as to intercept, as large a quantity of water as is possible.

DRIVEN WELLS

The shallow tube well also called driven well is sunk in various ways depending upon its size, depth of well and nature of material encountered. The closed end of a driven well comprises a tube of 40 to 100 mm in diameter closed and pointed at one end and perforated for some distance there from. The tube thus prepared is driven into the ground by a wooden block until it penetrates the water bearing stratum The upper end is then connected to a pump and the well is complete. Where the material penetrated is sand, the perforated portion is covered with wire gaze of suitable size depending upon the fineness of the sand. To prevent injury to the gauze and closing of the perforations, the head of the shoe is usually made large than the tube or the gauze may be covered by a perforated jacket.

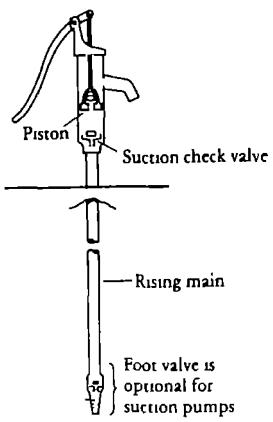


Fig 3 4 Suction Pumps

Such a driven well is adopted for use in soft ground or sand upto a depth of about 25 m and in places where the water is thinly distributed. On account of the ease with which it can be driven, pulled up and retrieving, it is especially useful in protecting at shallow depths and for temporary supplies. It is useful as a community water standpost in rural area.

BORED WELLS

Bored wells are tubular wells drilled into permeable layers to facilitate abstraction of ground water through suitable strainers inserted into the well extending over the required range or ranges of the water bearing strata. There are a variety of methods for drilling such wells through different soils and for providing suitable stainers with a gravel shrouding where necessary.

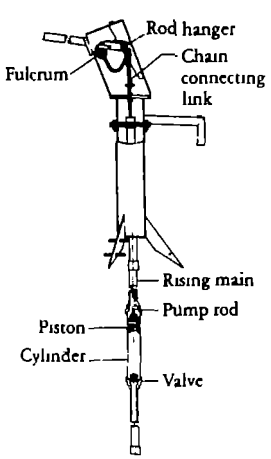


Fig. 3 5 Direct Action Pumps

Bored wells useful for obtaining water from shallow as well as deep aquifers are constructed employing open end tubes, which are sunk by removing the material from the interior, by different methods. The deeper strata are usually more uniform and extensive than strata near the surface,

so that in regions already explored, deep wells can be sunk with far more certainty of success than is usually the case with shallow wells. Methods of sinking deep wells are in many respects different from those already described and matters of spacing. Pipe friction, arrangement of connections, etc. are much more important than in the shallow wells.

For bored wells, the hydraulic rotary method and the percussion method of drilling such wells through hard soils are popular. For soft soils, the hydraulic jet method, the reverse rotary recirculation method and the sludger method are commonly used.

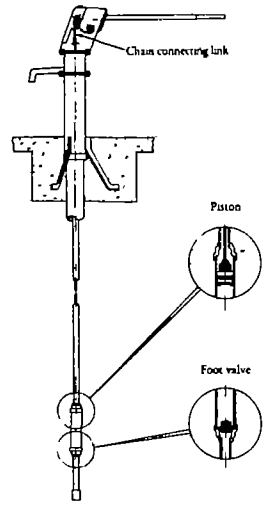


Fig. 3.6 India Mark II handpump

INFILTRATION GALLERIES

Infiltration galleries offer an improvement over a system of wells, in that a gallery laid at an optimum depth in a shallow aquifer serves to abstract the sub - soil flow along its entire length, with a comparatively lower head of depression Moreover, in the case of a multiple system of infiltration wells, the frictional losses contributed by the several connecting pipes diminish the draw down in the farther wells to that extent and the utility of a well becomes less and less in the total grid All the same, wells have to be located with a minimum distance in between each pair, so as to avoid mutual interference under normal pumping It also becomes uneconomical to lay long lengths of connecting pipes in river beds at depths where constructional difficulties add to the cost of their laying and jointing against high sub-soil water level conditions. These pipes are themselves vulnerable to damages from undue scour during high floods if adequate safeguards are not provided. The pipes are liable to break at their junction with the well steining, should there be a subsidence of the well structure under floods.

RADIAL COLLECTOR WELLS

A collector well consists of a cylindrical well of reinforced concrete say 4 to 5 m in diameter, going into the aquifer to as great a depth of the sub-strata as possible, i e upto an impermeable stratum. Normally the saturated aquifer should not be less than 7 m above the top of the radial pipes. From the bottom of the well, slotted steel pipes, normally of 200 mm to 300 mm diameter on the inside and going upto 30-35 meters in length are driven horizontally. The length is determined by the composition and yield from the aquifer. The drain tubes are made up of short length of pipes each 2.4 meters in length which are welded to each other electrically one after the other.

These steel pipes are driven horizontally into the aquifer by means of suitable twin jacks placed in the well and crossing the steining of the well, through the special openings or pott holes. At the same time, desanding operation is carried out through the head of the drain pipes. This operation is very important and results in the removal of all the fine particles in the alluvioum thus increasing the draw-off.

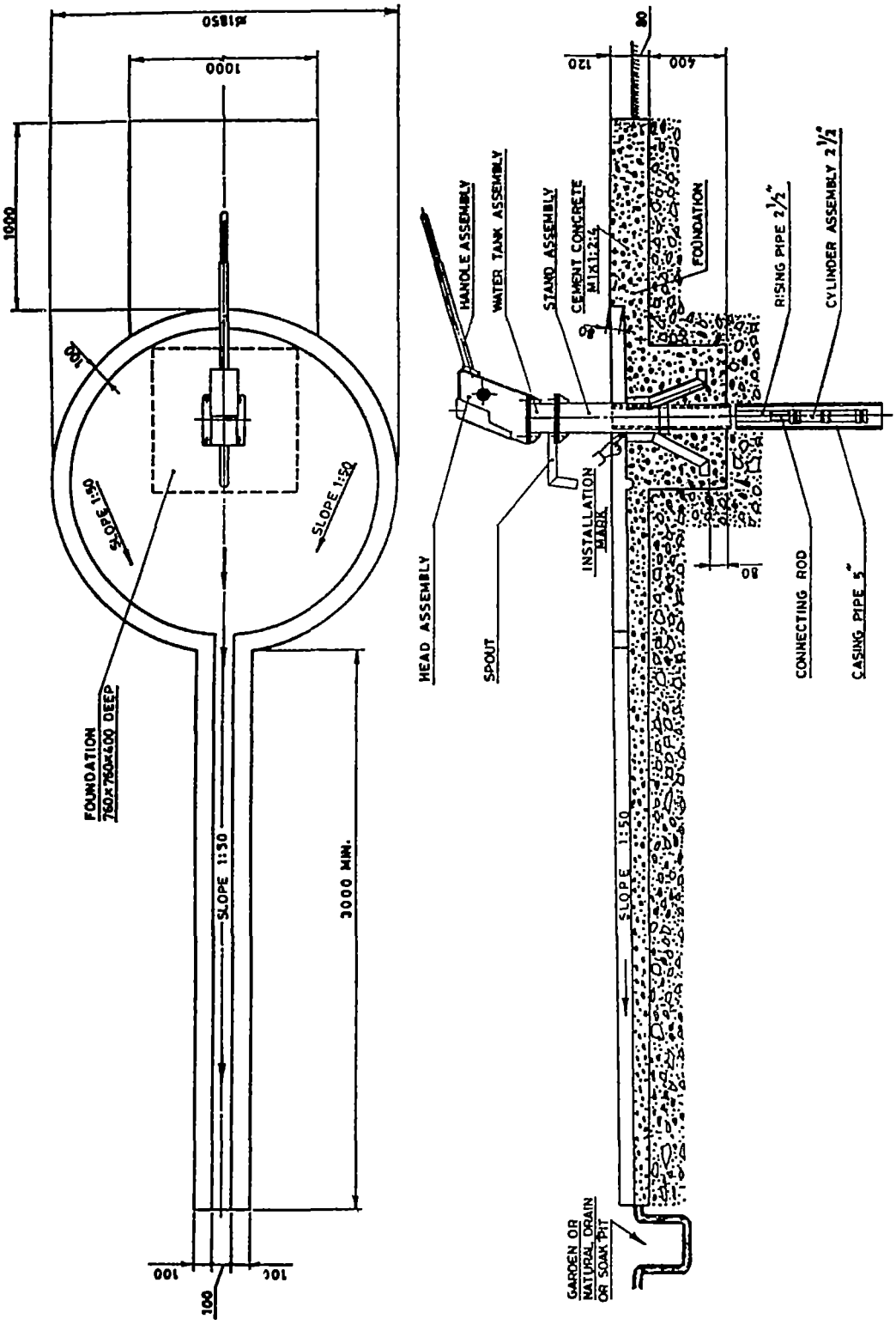


Fig. 3 7 Plat form of India Mark II handpump

WATER QUALITY INCLUDING PHYSICAL, CHEMICAL AND BIOLOGICAL CONTAMINATION FROM NATURAL AND ANTHROPAGENOUS SOURCES

The idea of water works management is to ensure that the water supplied is safe and free from pathogenic micro-organisms, clear, palatable and free from undesirable taste and odour, of reasonable temperature, neither corrosive nor scale forming and free from poisonous substances excessive amount of minerals and organic matters which could produce undesirable physiological effects. It should be free from colour and turbidity. The establishment of minimum standards of quality for public water supply is of fundamental importance in achieving this ideal. Standards of quality form the yardstick with which the quality control of any public water supply has to be assessed.

Fig 3 8 Water from a contaminated river should be boiled or at least filtered

The evolution of standards for the quality control of public water supplies has to take into account the limitations imposed by local factors in the several regions of the country. The Environmental Hygiene Committee (1949) recommended that the objective of a public water supply should be to supply water 'that is absolutely free from risks of transmitting diseases is pleasing to the senses and is suitable for culinary and laundering purposes' and added that freedom from risks is comparatively more important than physical appearance or hardness and that safety is an obligatory standard and physical and chemical qualities are optional within a range. These observations are relevant in the development of a countryside programme of protected water supply systems for communities big and small making use of the available water resources in the different regions, with a wide variation in their physical and chemical qualities. Further refinements in the chemical and aesthetic qualities can be achieved by communities in due course to suit their financial resources. The immediate need is for minimum standards consistent with the safety of public water supplies. Considering the standards prescribed earlier and further developments in the international standardisation and the conditions in the country, the committee recommended the following standards.

Bacteriological Standards

(i) Water entering the distribution system

Coliform count in any sample of 100 ml should be zero. A sample of the water entering the distribution system that does not conform to this standard calls for an immediate investigation into both the efficacy of the purification process and the method of sampling.

(ii) Water in the distribution system should satisfy all the three criteria indicated below:

- E.coli count in 100 ml of any sample should be zero

- Coliform organisms not more than 10 per 100 ml shall be present in any sample - Coliform organisms should not be detectable in 100 ml of any two consecutive samples or more than 5% of any samples collected during the year.
- If coliform organisms are found, resampling should be done. The repeated finding of 1 to 10 coliform organisms in 100 ml or the appearance of higher numbers in any sample should necessiate the investigation and removal of the source of pollution.

(ii) Individual or small community supplies

E.Coli count should be zero in any sample of 100 ml and coliform organisms should not be more than 3 per 100 ml. (if repeated samples show the presence of coliform organisms, steps should be taken to discover and remove the source of the pollution. If coliforms exceed 3 per 100 ml. the supply should be disinfected).

Virological Aspects

0.5 mg/l of free chlorine residual for one hour is sufficient to inactivate virus even in water that was originally polluted. This free chlorine residual is to be insisted in all disinfected supplies in areas suspected of endemicity of infectious hepatitis to take care of the safety of the supply from virus point of view which incidentally takes care of the safety from the bacteriological point of view as well. For other areas 0.2 mg/l of free chlorine residual for half an hour should be insisted on.

WATER TREATMENT TO ENSURE WATER QUALITY AND REMOVAL OF CONTAMINATION IN ORDER TO MAKE AVAILABLE SAFE AND QUALITY WATER.

General

In this section treatment technology techniques generally adopted in Rural Water Supply schemes in India are only discussed. These are;

(i) Sedimentation;
(ii) Filtration;
(iii) Disinfection ;
(iv) Removal of excess Iron ;
(v) Removal of excess Brackishness;
(vi) Removal of fluoride ,

Sedimentation

Sedimentation tanks (settling tanks settling basins or clarifiers) are used to separate the settleable suspended solids from water. Sedimentation of water can be plain or aided by coagulants. When the impurities are separated from the water by the action of of natural forces alone, i.e by gravitation with or without aggregation of settling particles, the operation is called plain sedimentation Plain sedimentation is usually used as a preliminary process to reduce heavy sedmiment loads prior to subsequent treatment processes such as coagulation or filtration. Sedentation following chemical goagulation and flocculation is used to remove settleable solids that have been rendered more settleable by chemical treatment, such as the addition of coagulants to remove organic colour and turbidity.

Table 3.1

The physical and chemical quality of water should not exceed the limits shown in the table below:

Physical and And Chemical Standard, of Drinking Water

S No	Characteristics	•Acceptable	••limit for Rejection
1	2	3.	4
1	Turbidity (units on J T.U Scale)	2.5	10
2	Colour (units on platinum cobalt scale)	5 0	25
3.	Taste and odour	Unobjectionable	Unobjectionable
4	pH	7 0 to 8.5	6 5 to 9.2
5	Total dissolved solids(mg/1)	500	1500
6	Total hardness (mg/1) (as $CaCO_3$)	200	600
7	Chlorides (as Cl) (mg/1)	200	1000
8	Sulphates (as SO_4) (mg/1)	200	400
9	Fluorides (as F) (mg/1)	1 0 (lesser the better)	1 5
10	Nitrates (as NO_3)(mg/1)	45	45
11	Calcium (as Ca) (mg/1)	75	200
12	Magnesium (as Mg) (mg/1)	<30 if 'X'	150
13	Iron (as Fe) (mg/1)	0 1	1 0
14	Manganesium (as Mn) (mg/1)	0 05	0 5
15	Copper (as Cu)(mg/1)	0 05	1.5
16	Zinc (as Zn) (mg/1)	5.0	15.0
17	Phenolic compounds (as Phenol) (mg/1)	0.001	0 002
18	Anionic detergents (mg/1) (asMBAS	0 2	1 0
19	Mineral Oil (mg/1)	0 01	0.3
TOXIC MATERIALS			
20	Arsenic (as As) (mg/1)	0 05	0 05
21	Cadmium (as Cd) (mg/1)	0 01	0 01
22	Chromium (as hexavalent Cr) (mg/1)	0 05	0 05
23	Cyanides (as CN) (mg/1)	0 05	0 05
24.	Lead (as Pb) (mg/1)	0 1	0 1
25	Selenium (as Se) (mg/1)	0.01	0.01
26	Mercury (total as Hg) (mg/1)	0 001	0 001
27	Polynuclear aromatic hydrocarbons (PAH)	0.2u g/1	0 2 u g/1
RADIO ACTIVITY			
28	Gross Alpha activity	3 pCi/1	3 pCi/1
29	Gross Beta activity pCi=pico curie.	30 pCi/1	30 pCi/1

'X' there are 250 mg/1 of Sulphates. Mg content can be increased to a maximum of 125 mg/1 with the reduction of sulphates at the rate of 1 unit per every 2.5 units of sulphates

NOTES

•1. The figures indicated under the column 'acceptable' are the limits upto which the water is generally acceptable to the consumers

••2. Figures in excess of those mentioned under 'acceptable' render the water not acceptable, but still may be tolerated in the absence of alternative and better source but upto the limits indicated under column "limits for rejection" above which the supply will have to be rejected.

3. It is possible that some mine and spring waters may exceed these radio activity limits and in such cases it is necessary to analyse the individual radionuclides in order to assess the acceptability or rejection.

The factors that influence sedimentation are;

(a) size, shape and weight of the particle;
(b) viscosity and temperature of water ;
(c) surface overflow ;
(d) surface area;
(e) velocity of flow;
(f) inlet and outlet arrangements ;
(g) detention periods and;
(h) effective depth of basins;

Types of sedimentation

A variety of horizontal flow tanks as well as vertical flow tanks are in use. Circular, square or rectangular, they vary in depth from 2.5 to 4.0m.

Horizontal Flow Tanks

In the design of a horizontal flow tank, the aim is to achieve as nearly as possible the ideal conditions of equal velocity at all points lying on each vertical line in the settling zone.

The most common circular horizontal flow tank in water supply practice is the radial flow tank. The flow in a central feed circular tank is essentially a "Point source flow", the flow emanating from a single point and flowing radially outward in all directions. The aim is to achieve uniform radial flow with decreasing horizontal velocity as the water flows towards the periphery. In a rectangular tank, the flow lines are parallel and in a single direction.

In the horizontal flow tanks, the direction of the flow of water in the tank is substantially horizontal Among the representative designs of the horizontal flow settling tanks, the following may be mentioned:

a) Rectangular tanks with longitudinal flow where the tanks are cut out of operation for cleaning or with ridge and furrow bottom with perforated pipes embedded in the furrows through which sludge is removed under hydrostatic pressure. Rectangular tanks with reverse bottom slope and with or without multitube settlers have been also successfully tried.

b) Rectangular tanks with horizontal flow where the sludge is mechanically scraped to the influent end and then to a sump without disrupting the operation of the tanks

c) Circular tank with radial flow, where sludge is mechanically scraped continuously to a central sump and withdrawn periodically.

d) Circular spiral flow tanks with inlet at the circumference with mechanical sludge removal.

Vertical Flow Tanks

Solid particles can be removed in a single vertical flow tank when the settling velocity is higher than the upflow velocity and decanted water is removed from the top.

Solids contact units combine in a single basin (circular or square) the various prefiltration operations of water treatment with a flow in an upward vertical direction through a layer (blanket) of flocculated suspended matter.

Filtration

Filtration is a physical and chemical process for separating suspended and colloidal impurities from water by passage through a porous bed, usually made of gravel and sand or other granular material.

Three types of filters, are commonly used and are as follows:

a) slow sand filters

b) rapid gravity filters; and

c) pressure filters

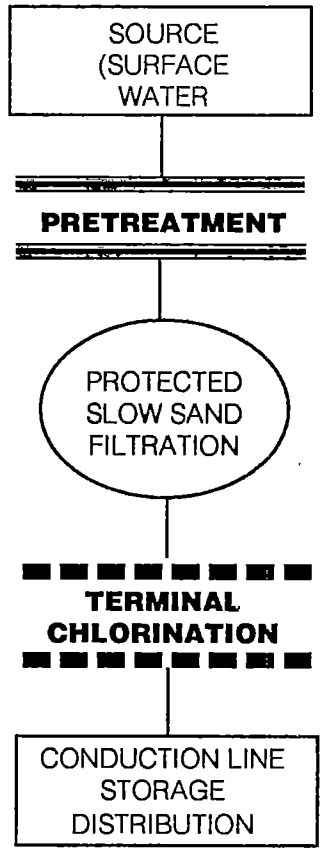


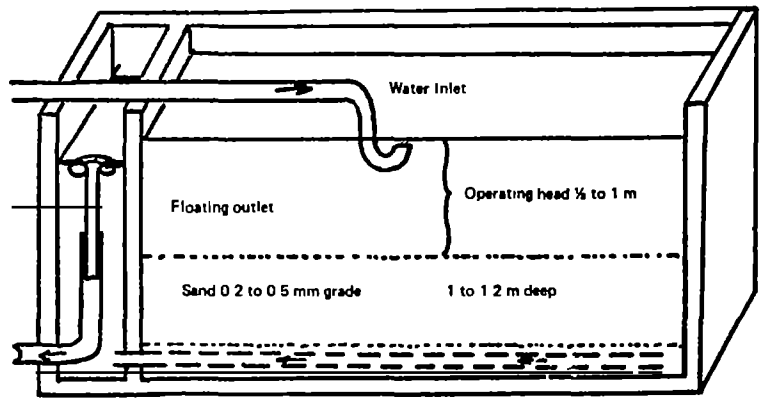
Fig. 3.9 Simple Water Treatment

Slow Sand Filters : Operation

In operation, the filter is filled with water to a depth of 1 to 1.5 m above the surface of the sand. For the initial filling after every cleaning, filtered water is admitted from the bottom till it rises some 80 mm above the sand and raw water thereafter allowed to enter from the top. The water is passed through the layer at a rate of about 100 to 150 l ph/$_{m}$2 until the difference between the water levels in the filter and the outlet chamber, or the loss of head reaches 60 cm. Although the filter can be worked until the loss of head is slightly less than the depth of water above the sand, it is uneconomical to run filters with the loss of head exceeding 1.3 metres or the depth of water over the sand. The filter is then put out of service and about 20 to 30 mm of sand at the top of the bed is scraped off which may or may not be replaced with clean sand before the filter is put back into service. A minimum depth of 45 cm of sand media should be maintained at all times. A normal period of operation between cleanings may be about 6 weeks, with the turbidity of the raw water not exceeding about 30 JTU. After 3 or 4 times of scraping, a fresh layer of clean sand is put in position to maintain bed thickness.

It is to be emphasised that no coagulant is used immediately preceding slow sand filtration. The artificial mat

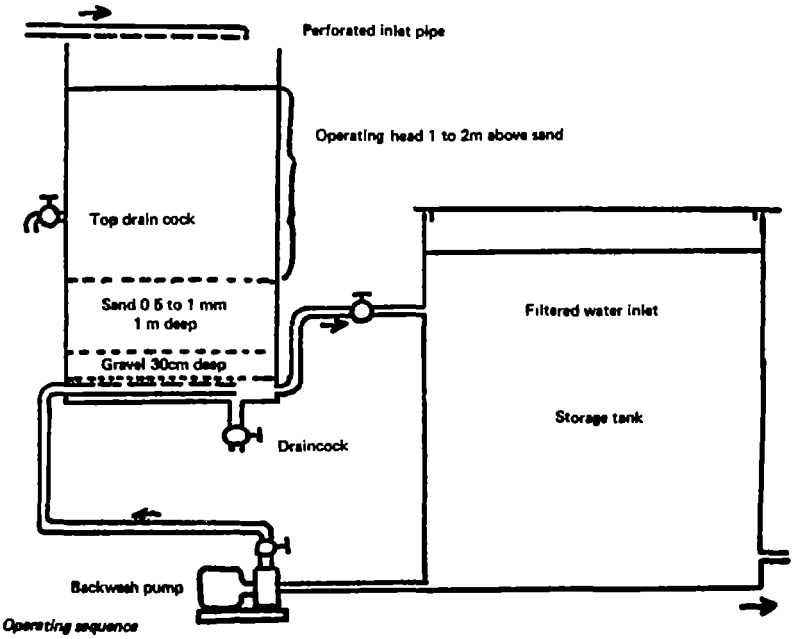
Fig. 3.10 Slow sand filter



Operating sequence

When the filter becomes blocked, it may be cleaned by stopping the flow of incoming water. Drain the bed to expose the sand The surface layer of 3 to 5 cm of soiled sand may then be removed with shovels. When this operation has been carried out 3 or 4 times a fresh layer of clean sand should be put in position to maintain the thickness of the bed.

Fig. 3.11 Rapid gravity sand filters



Operating sequence

While the filter is operating keep the draincocks and the stopcock in the backwash line closed.

To backwash, shut off flow of incoming water, close filtered water stopcock. Open top draincock until the water above the sand has drained. Open the valve in the backwash pipe and start the pump. Allow surplus water to overflow through the top draincock until the sand is clean.

In some filters this operation may be assisted by raking the sand from above or by blowing air from a compressor through the sand bed from below. After backwashing is completed, reset the valves and restart filtering.

formed by the flow will inhibit the growth of the zoogleal mass on the sand surface which is essential for proper filtration. It also clogs the pores unduly.

Rapid Sand Filters

In the case of rapid gravity filters, the water receives preparatory treatment prior to its application to the filter The water that enters the filter contains flocs in which are entrapped suspended organic and mineral matter.

Two distinct phases of the purification process should be recognized, viz., the preparatory treatment and the filtration. By far the most important of these is the former, viz., the pretreatment. As raw waters vary greatly in quality, the pre- treatment should be suited to the water. No rapid sand filter which receives untreated water or water which contains too much uncoagulated colloidal matter should be expected to funciton properly.

Rate of Filtration

The standard rate of filtration through a rapid sand filter is usually 80 to 100 1pm/m^2 Practice is tending towards higher rates in conjunction with greater care in conditioning the water before filtration and with the use of coarser sand The highest rate achieved in India is 240 1pm/m^2 by improving the pre-treatment and by grading the filter sand suitably. A prudent arrangement would be to design the filters on the basis of average consumption at a normal rate of 80 1pm/m^2 but with the inlet and the outlet control arrangements designed to permit a 100% overload for emergent occasions.

Pressure Filters

Based on the same principle as gravity type rapid sand filters, water is passed through the filter under pressure through a cylindrical tank usually made of steel or cast iron where the underground, gravel and sand are placed. They are compact and can be prefabricated and moved to site. Economy is possible in certain cases by avoiding double pumping. Pretreatment is essential. The tank axis may be either vertical or horizontal.

Pressure filters suffer from the following disadvantages:

a) The treatment of water under pressure seriously complicates effective feeding, mixing, and flocculation of water to be filtered.

b) In case of direct supply from pressure filters, it is not possible to provide adequate contact time for chlorine.

c) The water under filtration and the sand bed are out of sight and it is not possible to observe the effectiveness of the back wash or the degree of agitation during washing process.

d) Because of the inherent shape of the pressure filters it is difficult to provide waste water gutters effectively designed so that the material washed from the sand is discharged as waste and not flushed back to other portions of the sand bed.

e) It is difficult to inspect, clean and replace the sand, gravel and underdrains of pressure filters.

f) Because the water is under pressure at the delivery end, on occasions when the pressure on the discharge main is released suddenly, the entire sand bed might be disturbed violently with disastrous results to the filter effluent.

In view of these disadvantages, pressure filters are not recommended for community water supplies, particularly for large ones. They may be used for industrial needs and swimming pools.

DISINFECTION

Measures to treat water by methods such as storage, coagulation, sedimentation and filtration would render the water chemically aesthetical also. However, these cannot be relied on to provide a safe water and it is necessary to 'disinfect' the water to destroy all the disease producing organisms. As the raw water sources are becoming increasingly prone to pollution by municipal and industrial wastes, the need for disinfection cannot be over-emphasized, to ensure the safety of the water supply.

Boiling of water or use of copper and silver vessels for storing water which effect some measure of disinfection have been in vogue for a long time in this country. Chemicals like chlorine and its compounds, bromine, iodine, potassium permanganate, ozone, etc., have been used as effective disinfectants. Physical methods like ultraviolet rays, thermal treatment and ultrasonic waves have also been used on a limited scale.

Water disinfection processes, as now ordinarily considered, involves specified treatment for the destruction of disease-producing or pathogenic bacteria. Disinfection does not necessarily imply complete destruction of all living organisms, which can be accomplished only by sterilization.

REMOVAL OF BRACKISHNESS

Different technology/techniques adopted in removal of brackishness are:

(i) Distillation;

(ii) Solar stills;

(iii) Osmosis;

(a) Reverse osmosis;

(b) Electrodialysis;

Distillation

One of the processes of removing water from saline solutions, distillation is the oldest and in terms of established plants, the most productive. It differs from the other processes by its passage of water through the vapour phase. The plant design is directed to tapping the most economic sources of heat energy and exploiting the most efficient processes of heat transfer.

While relatively small quantities of water are to be distilled, straight or single effect distillation is preferred because of the simplicity of operation and the lower capital cost of the installation. With larger outputs improvement in efficiency acquires much greater importance because of the much higher rates of evaporation involved and the need for the highly efficient heat transfer systems. Problems of scale formation also play a significant role.

Solar Cells

Solar energy can be harnessed by the use of a system of mirrors following the path of the sun to focus the sunlight on sheets of water. In one of the popular methods, the salt water trickles down to trays mounted on an inclined compartment provided with glass sides and a heat insulated back which screens the condensing chamber from the sun. Since the focusing mirrors form an important element in the cost of the stills, the development of cheaper non-focusing types of mirrors and use of inexpensive materials of construction have been resorted to. In basin solar stills, a commonly used design, salt water tanks, filled either by gravity or by stainless steel impeller pumps, feed the solar still whose cover is at a shallow angle of 10^{o} to 18^{o} with the glass panes tightly sealed to the holding frame and the joints between the still cover and the vertical walls perfectly tight. The rate of feed to the still should be such that for each 7.6 litres of salt water, 3.7 litres of fresh water is obtained and 3.7 litres of brine is discarded. the collecting troughs at the foot of the still cover must be constructed so that water will drain freely to the pipe which carries the distillate to the fresh water tank but preventing the entry of any contaminated water either from the roof or the ground in which it is constructed. In addition to the fresh water tank, it is good practice to construct additional distilled water storage as to balance out the fluctuation between production and demand.

Osmosis

Certain natural and synthetic membranes have the property of permitting the solvent (water) to get through them but not the solute. Such semipermeable membranes permit the separation of solute from solvent. This phenomenon is known "Osmosis"

Reverse Osmosis

Osmotic pressure drives water molecules through a permeable membranes from a dilute to a concentrated solution in search of equilibrium. This natural response can be reversed by placing the salt water under hydrostatic pressures higher than the osmotic pressure. Hence, the term reverse osmosis. Because of its simplicity in concept and execution, reverse osmosis appear to have considerable potential for wide application in water and waste water treatment.

Electrodialysis

Reverse osmosis is a relatively slow process and hence attempts have been made to combine this with electrolysis. Application of an external electromotive force can draw the ions away from the salt solution towards the electrodes so that the solution is impoverished of its salt content. The reunion of the ions by diffusion can be prevented by using suitable membranes to separate the cathode and anode chambers and also by continuously removing the relatively concentrated solution of the electrolytes from the electrode chambers. To obtain purification of sufficient magnitude a number of electrolytic cells have to be used in series. In essence the apparatus would consist of a number of electrolytic cells each of which is composed of 3 compartments separated from each other by suitable membranes. The saline water circulates in series through the middle compartments of the cells and undergoes progressive purification. The number of cells and the rate of flow may be adjusted to give the degree of purification required. A direct current of 110 to 220 volts is employed. The electrodes are continuously washed with the treated water. One of the main diadvantages of the electrodialysis process is that the membranes get badly damaged as a result of corrosion and scale formation. Another disadvantage is that the cost rises steeply as total solids content of the finished water decreases. Power loss is minimised

if the water is demineralised only partially to final concentrations of less than 500 mg/1 in a multi compartment cell. Average power requirements are 1 kwh/1000 litres of water/1000 mg/1 of TDS removed for water with initial TDS values of 10,000 and less. Since power requirements rise sharply with higher initial values in this method compared to distillation and freezing, this process is adopted only for water containing less than 10,000 mg/1 of dissolved solids.

REMOVAL OF EXCESS FLUORIDE

Introduction

Occurrrence & Prevalence of the disease in India and other parts of the world.

Ooccurrence Of Fluoride in Nature

1. Granites, basalts, shales, clays and calcium phosphate rocks are the main source of fluoride but the concentration of fluoride leaching from them along with infiltrating rain waters, is affected by structural (geological, structures) control. The leachable fluoride from soils and alluvial deposit is the main contributor. Fluoride content of 0.4 to 0.6 parts per million is also found in rain water in the vicinity of all industrial areas, due to pollution of atmosphere.

2. Occurrence in India

Presence of fluoride in ground water and its adverse affects on the health of human beings as well as cattle was known from some parts of Andhra Pradesh, Gujarat, Punjab, Tamil Nadu, Uttar Pradesh, and Rajasthan states, but in recent days, presence of fluoride in ground water from 9 more states from deeper aquifers in basaltic rocks has been reported. These States are, Haryana, Karnataka, Maharashtra, Madhya Pradesh, Orissa, Jammu & Kashmir, Kerala, Bihar and Union Territory of Delhi.

In some areas, although there was no fluoride in shallow aquifers, the recent boom of hand pump fitted deep boreholes tapping deeper aquifers revealed the presence of fluoride ,

Occurrence in other parts of the World

The disease is prevalent in many parts of the world viz. Turkey, Syria., Jordan, Egypt, Libya, Algeria, Morocco, Sudan, Kenya, Tanzania, Iran, Iraq, Afganistan, Indonesia and South Sea Islands.

Alternate Approaches for Safe Water

(i) Tube well when dug deeper may provide water with permissible limits of fluoride;

(ii) Bringing potable water from a distance through pipelines;

(iii) Defluoridation of excess fluoride water by

Defluoridation technology

Two kinds are being practised:

(i) Based on addition of lime and alum (Nalgonda Technique);

(ii) Based on absorption using activated alumina (Prasanti Technique);

Based on Nalgonda and Prasanti Techniques the following types of defluoridation plants are adopted.

(i) community defluoridation plants (Fill and Draw type);

(ii) hand pump attached defluoridation plants;

(iii) domestic defluioridation technique ;

(I) Community (Fill & Draw Type) Defluoridation Plants:

After extensive research since 1961 NEERI has evolved a simple process for removal of fluoride which is popularly known as "Nalgonda Technique".

Nalgonda technique involves addition of aluminium salt, lime and bleaching powder followed by rapid mixing, flocculation, sedimentation, filtration and disinfection. Aluminium salt (aluminium sulphate or aluminium chloride or combination of both) is added for removal of fluoride. Lime (CaCo3) is added to raise the alkalinity of raw water, if required.

The aluminium salt is hydrolysed forming in the process transient alumenic species. These species complex with fluoride and are observed on alumino hydroxide. The dose of lime is empirically 1/20th that of the aluminium salt Lime facilitates denser floc and rapid settling. Bleaching powder is added to the raw water at the rate of 3 mg/l for disinfection. Nalgonda Technique is to be adopted in the event of

- Absence of acceptable alternate low fluoride source;
- Dissolved solids below 1500 mg/l ;
- Total hardness below 250 mg/l ;
- Alkalinity of the water sufficient;
- Raw water fluorides ranging from 2 to 20 mg/l;

Components of the Fill and Draw Defluoridation Plants

- Reactor (s): it is a reaction-cum-sedimentation tank equipped with power driven agitator assembly
- Sump well
- elevated service reservoir
- electric panel room
- chemical store house

Design Consideration

- The plant capacities are based on one to four operations in each reactor per day, subject to availability of electricity

- Each reactor will be of 10, 20 and 30 m^3 capacity
- The capacity of raw water pump will be sufficient to fill up the reactors within an hour
- The defluoridated water from the sump well will be pumped to the elevated service reservoir and distributed by gravity through stand posts and house connections
- The capacity of the sump well will be equal to the total capacity of the reactors
- The capacity of the elevated service reservoir will be half of the capacity of the sump well.

TABLE 3.2

APPROXIMATE ALUM DOSE (MG/L) REQUIRED TO OBTAIN PERMISSIBLE LIMIT (1 MG/L) OF FLUORIDE IN WATER AT VARIOUS ALKALINITY AND FLUORIDE LEVELS

Test water fluoride	Alkalinity of raw water as CaCo3 in Mg/l							
mg/l	125	200	300	400	500	600	800	1000
2	143	221	273	312	351	403	468	520
3	221	299	351	403	507	520	585	767
4	•	403	416	468	559	598	689	936
5	•	•	507	598	689	715	884	1010
6	•	•	611	715	780	936	1066	1209
8	•	•	•	•	988	1118	1300	1430
10	•	•	•	•	•	•	1508	1690

Limitations of Nalgonda Technique

- The water quality assessment is a pre requisite
- If the TDS of water is more than 1500 mg/l the water cannot be defluoridated
- Defluoridated water should be checked to ensure that there is no aluminium content arising from the alum.

HAND PUMP ATTACHABLE FLUORIDE REMOVAL PLANTS

Removal of fluoride by hand pump attachable fluoride plant is a combination of several unit operations and processes incorporating chemical dosing, mixing and feeding system, chemical interaction, pebble bed flocculation, sedimentation, filtration and periodical desludging associated with filter back washing.

The plant has following components·

(i) Syphon tanks;

(ii) Ventury;

(iii) Alum Dosing tank ;

(iv) Pebble bed chamber;

(v) Sedimentation chamber,

(vi) Filter compartment .

Operation of the Plant

The alum tank is filled with the required strength of alum solution as and when the tank is empty. The feed rate of the solution by venturi is about 40 ml/l of the raw water flow. Strength of alum solution depends upon the raw water fluoride and alkalinity. The volume of the alum tank is 100 litres, sufficient for dosing 3000 litres water.

At the start and after each cleansing of the plant, the hand pump is operated continuously for around two hours to obtain treated water from delivery tap. Once the plant is full, the treated water is obtained in two minutes operation of hand pump. After attaining the required head, the syphon starts and venturi sucks solution from the alum tank. Alum mixed raw water sprays over the pebble bed through distributors. The floc absorbs fluoride and enters sedimentation chamber through a side slit at the bottom of the pebble bed chamber. The settled water spills over weir plate to filter. the filtered water flows through tap.

Maintenance and Cleaning

The plant requires maintenance. The required concentration of alum solution is prepared daily in alum tank Once a week, filter requires cleaning. Sedimentation chamber is scoured for sludge and the pebble bed is flushed with two buckets of water.

Domestic Defluoridation

High concentration fluoride water can be treated domestically in a container (bucket) of 60 litres capacity with a tap at 3 - 5 cm above the bottom of the container for the withdrawal of treated

water after precipitation and settling. The raw water taken in the container is mixed with adequate amount of lime or sodium carbonate, bleaching powder and mixed well with water. Alum solution is then added and is stirred very gently. The supernatant which contains negligible amount of fluoride, is withdrawn through the tap for consumption. The settled sludge is discarded.

The success of the method depends on using good quality alum, besides the velocity of stirring i.e. it should be stirred very slowly and gently. The defluoridated water quality should be checked at intervals.

PREPARATION OF ALUM SOLUTION 1 kg. of Alumina Ferric commercial alum (ISI 299 - 1962) dissolved in water to make it ten litres solution in a plastic carboy. One ml (millilitre) of this solution contains approximately 100 mg. (milligram) alum. The solution should be covered to prevent evaporation of water.

TABLE 3.3

Alum required in 40 litres of raw water to reduce fluoride to 1 mg/l of water at various alkalinity and fluoride level (millilitres)

Raw water] with fluoride concentration mg/l	Alkalinity of raw water as $CaCO_3$ in mg/l							
	125	200	300	400	500	600	800	1000
2	60	90	110	125	140	160	190	210
3	90	120	1401	160	205	210	235	310
4	•	160	165	190	225	240	275	375
5	•	•	205	240	275	290	335	405
6	•	•	245	285	315	375	425	485
8	•	•	•	•	395	450	520	570
10	•	•	•	•	•	•	605	675

BLEACHING POWDER ADDED APPROXIMATELY 120 MG. PER 40 LITRES OF RAW WATER I.E. 3 MG/L

Activated Alumina Technology

The basic principle of fluoride removal technology with activated alumina are (i) absorption of fluoride ions to activated alumina surfaces (ii) regeneration of an expanded medium to remove all fluoride ions from the bed before returning it to the treatment.

Activated alumina removes certain species from water due to hydrolytic absorption. It is approximately pH 9.5 . It will remove anions below this pH and cations above. The affinity of alumina for an anion seems to be inversely related to the solubility of its aluminium salt. Therefore, when treated with an acid solution, alumina behaves like an anion exchanger and fluoride is very high on the selective list. Activated alumina can be repeatedly used after regeneration with an alkali.

Mode of Operation

There are four modes of operation:

- treatment ;
- backwash;
- regeneration and;
- neutralisation:

Treatment

The raw water containing high concentration of fluoride is allowed to flow through the column containing activated alumina medium. Fluoride ions gets absorbed on the surface/pores of the activated alumina and gets removed from the raw water. As the run progresses, the effluent fluorides also increase gradually and the breakthrough is considered to have taken place when 1.5 mg/l of fluoride is observed in the treated water.

Backwash

It is important that the bed of activated alumina be backwashed with raw water before each regeneration. First, any suspended solids that have been filtered from the raw water must be removed. Second, even though filtration may not have taken place, the downward flow tends to pack the bed, breaking up any tendency towards wall effects or channeling. A backwash for ten minutes expands the bed by about by 50%.

Regeneration

The object of regeneration is to remove accumulated fluoride as far as possible from the activated alumina medium before the bed is returned to the treatment mode for next cycle of operation. The most successful regeneration is accomplished by HCl solution.

Ringing Mode

The object of this step is to return the bed to the treatment mode as rapidly as possible. As soon as the acid regeneration is completed, almost all the fluoride must have been removed from the bed. At this point, the bed is drained again to the top of the treatment media. Raw water with high pH (approximately 8.0) is then flow fed at until the waste effluent showed a pH between 4.5 to 5.0 Usually 40 minutes were adequate for this rinse operation. The columns are ready for the next run after these operational steps.

Salient Features

- Activated alumina is specific for fluoride
- Alumina is not very friable
- Activated aluimina has a relatively high fluoride exchange capacity
- Regeneration, which can be performed with either caustic soda or alum ,is fairly straight forward
- The process is reliable, safe and relatively simple to use
- The method can economically reduce fluoride levels to recommended level
- Sludge disposal problem does not arise
- Indigenous chemicals are only required and no scarcity of chemicals

- Efficient removal of fluoride even from 10 mgF/l to desirable levels
- Plantswhich need no electricity are also available
- Defluoridation plants can be accommodated in lesser area and can be designed to any size
- Optimum removal of fluoride occurs in the range pH 5 to pH 8 which is a broad range and most of our drinking waters are in this range
- The high selectivity of activated alumina for fluoride compared with normal synthetic anion exchangers makes it extremely suitable for fluoride removal from water containing ions such as sulphates, chlorides and bicarbonates, which may compete for the limited absorbing sites.

TABLE 3.4

SUMMARY OF STATUS OF IMPLEMENTATION OF DEFLUORIDATION PLANTS: POSITION AS ON 30.06.1991

	Fill & Draw type	Handpump attached type
No. of plants sanctioned	104	375
No. of plants installed	58	158
No. of plants commissioned	36	130

Statewise break-up of Plants

	Total no. of plants		Plants Commissioned	
	F & D	H.P. attached	F & D	H.P attached
Andhra Pradesh	10	263	18	97
Uttar Pradesh	—	12	—	12
Haryana	5	—	3	—
Madhya Pradesh	2	8	—	—
Rajasthan	40	64	12	10
Gujarat	11	—	3	—
Karnataka	10	9	—	—
Tamil Nadu	4	11	—	11
Maharashtra	2	2	—	—
	104	375	36	130

OPERATION AND MAINTENANCE BOTH AT LOCAL AND HIGHER LEVEL

Operation and maintenance by the community of its water and sanitation facilities represents a very important part of the project cycle This is not only in terms of the actual functioning of the facilities, but because it is a big step by the community towards self-reliance.

The community can formally accept, through a resolution passed by the Village Panchayat and later approved by the higher Panchayati Raj bodies, the responsibilities for the operation and maintenance of these facilities.

What is the significance of the acceptance?

1. Through this formal gesture, the community emphasizes that it is capable of being an equal partner with the government in the area of water and sanitation.
2. It recognizes that the government's resources cannot indefinitely support the water and sanitation activities of the community.
3. The community indicates that it is willing to look for revenue from within the community to sustain water and sanitation facilities, over the agreed period.
4. There is an understanding by the community that it must now evolve, in consultation with the government and NGOS, ways in which such revenue can be collected and establish a firm basis of cooperation within the community, keeping in mind the special need of women, the SC/STpopulation and the economically weaker sections.
5. The acceptance of the responsibility also suggests that the community realized the link between suitable water and sanitation facilities and the continuing good health and productivity of the household and village.
6. Above all, by undertaking this responsibility, the community indicates its confidence in itself and its capacity to be self-reliant, as much as is practically possible. A sense of ownership becomes a practical basis for assuming responsibility.

What are the tasks involved?

Operation and maintenace of water and sanitation facilities can be divided into day-to-day activities which can be carried out by the community and more complex technical activities to be supported by the government's technical agencies or private sector agencies as and when needed.

Day-to-day activities refer to, for example, the following:

(i) Keeping handpumps in good working order by ensuring that:
   (a) They are operated properly by the users.
   (b) There is no trash in the drain hole.
   (c) The flow of water is regular and that water is pumped up in 8 strokes.
   (d) The pump's handle is not loose or shaky.

(ii) Keeping latrines clean and hygienic by:
   (a) Good communication with the community on hygiene.
   (b) Spot-checks of households.

(iii) Carrying out minor repair of latrines.

(iv) Seeing that waste-water from standpost and households points are properly utilized.

(v) Maintaining records regarding the operation and maintenance of facilities.

However, the community will, in co-ordination with the implementor, agree formally on clearly defined tasks that will comprise the operation and maintenance exercise. These could be as follows.

- Defining the normal operating schedule
- Defining the preventive maintenance schedule
- Setting up the procedures for procurement of spare parts, chemicals
- Identifying agencies to carry out repairs as and when needed
- Employing operating staff, ensuring training
- Establishing back up support systems
- Monitoring of performance
- Setting procedures for data recording in respect of daily operations, water levels, pumping schedules, power-failures, water-quality testing results and corrective action taken, etc.
- Arranging for collection of revenue
- Preparing annual budget estimates for operation and maintenance and arranging funds and responses
- Identifying the rehabilitation needs of the facilities installed and arranging for resources to ensure timely rehabilitation.

Attention will be particularly paid as to how best these details can be communicated effectively in low-literacy areas.

Who will do these daily tasks?

Daily operation and maintenance will be the responsibility of a village caretaker, a handpump mechanic, the village mason and of the household itself. So, as far as water at public standposts is concerned, the handpump caretaker will do the routine maintenance tasks which will include ensuring proper drainage of water from the standpost and minor repairs will be carried out by the handpump mistry or mechanic. Household members will be expected to look after their latrines as well as the arrangements for proper drainage of dirty water into kitchen gardens etc Minor repairs of latrines can be carried out by the village mason.

How will village level staff acquire the knowledge to carry out these various tasks?

A detailed training programme will have to be worked out by the implementing agency after discussions with the community and NGOs. It seems likely that technical training will be given by the government's agencies and training in communication skills by a competent NGO. This split is needed as the users need to understand the need for using the facilities properly. In that sense, good communications becomes a preventive maintenance activity.

The training programme must also focus on training women in the various operation and maintenance activities. However, there is need to ensure that women who are engaged in such activities do not suffer, because their father, husband, brother, etc. think that they are not contributing sufficiently to household work or income. Close consultation with the community is therefore needed before decisions to train and employ women are taken

Also, the Community should select persons from within the community to be trained in administrative duties such as task planning, preparation of task schedules, budget planning, etc.

How will these people be appointed?

At the village level, staff such as the handpump caretaker and mistry will be appointed by the Community. In appointing these persons, the panchayat will keep in mind the practical need for training and appointing women as mechanics and perhaps as caretakers. Also, the panchayat could look into the possibility of training women as masons, as has been done in Kerala.

Who will pay for the operation and maintenance activities and for the staff?

It is expected that the community itself will have to generate the money required to pay for the various activities and the village level staff. The Community will decide as to how much is needed, how this money can be collected, who will administer it, the ways of controlling its expenditure, and how the community can keep a check on the accounts.

Panel 1

The development of the community's skills is a major factor in the sustainability of the project.

Panel 2

Training materials relating to operation and maintenance must be prepared in consultation with the community, especially in low literacy areas.

Panel 3

Communication materials must stress the vital connection between the proper operation and maintenance of hardware and the health of the community.

Panel 4

The users must review the question of availability of spare parts and how perhaps local traders could supply these parts.

COST RECOVERY

Though cost recovery is a part of the operation and maintenance step, its importance to a successful water supply and sanitation system makes it necessary to give it special attention.

Cost recovery or revenue collection by the government from the community or by the community from itself is crucial for the development of a sustainable water and sanitation system While this concept is not new to India, effective implementation represents a major problem.

However, if a community has been involved from the very beginning of the project, especially in the planning stages it is in a better position to select the service levels it wants, keeping in mind the financial contributions it can make.

So, cost recovery from the community has three important implications.

(i) By having a financial stake in the water and sanitation facilities a sense of ownership is created which contributes to better operation and maintenance.

(ii) The original sense of dependence, both financial and psychological, on the government ends to be replaced by a **feeling of partnership**

(iii) **A sense of confidence** is created in the community about the ability to make important financial decisions based on a more complete understanding of the outcome of these decisions.

The community can elect a representative Pani Panchanyat, who will play a leading role in the process of cost-recovery It will sensitize the community as to the need for this form of participation, clear doubts as they are raised, consult with the community as to how the various steps such as assessing rates, collection, etc should be finalised The Pani Panchayat can also appoint the hand pump caretaker and mistry. A competent NGO would be of use here in devising effective training programmes and workshops, as well as effective communication material to

explain the situation to the community. More than at any other stage of the project, the poorer sections of the community who may also be the least literate have to be informed and educated about their role in this process.

As mentioned earlier, the situation has been one of dependence on the government and so the various tasks involved in cost recovery are still in an experimental stage.

However, some of the questions that the Pani Panchayat will have to consider are as follows.

(i) (a) What costs should be considered?

(b) Payment of bills for chemicals and electricity.

(c) Provision for minor repairs of handpumps, latrines, etc. as and when needed.

(ii) How will be the rates be arrived at?

(iii) How should funds be collected? On a voluntary basis as and when the need arises or should a certain fixed amount be set aside for every financial year?

(iv) What provision are being made for the economically weaker sections of their community who may not be able to pay the amount required? Will they suffer as a result?

(v) Even if the weaker sections pay (through loans, etc.) what way is there of guaranteeing them equal access to services?

(vi) What will happen if a household defaults on payment?

(vii) When should the money be collected - monthly, quarterly, half-yearly, yearly?

(viii) How does the collection time relate to the agricultural calendar?

(ix) Who should collect the money?

(x) Where will the money be kept and whose responsibility is it?

(xi) Will the community be able to examine accounts on a regular basis?

Answers to these questions may differ from State to State, or perhaps even within States and perhaps even from community to com munity. Therefore, one may come across different variations of a cost recovery system

In terms of procedure, however, it seems practical that a Pani Panchayat should make a realistic estimate of likely annual expenditure and obtain the approval and sanction of funds from the District Panchayat.

A user who is also an owner will be more motivated towards making a system work effectively.

Owners of systems will be more involved in effective monitoring and timely revenue collections.

The community must have a clear idea not only of the size of its individual contributions, but its total share of the project's finances. This will give it a more realistic idea of the control it can have over the project's activities

The system of levying charges related to water and sanitation facilities must be easy to understand and easy to operate by the community at large.

CHAPTER - 4

SOCIAL MOBILIZATION: PUTTING TECHNOLOGY TO WORK

CRITICAL APPRECIATION OF THE EXISTING PRACTICES INCLUDING LOCATION OF WEAK AREAS.

Improvement in rural water supply or sanitation alone will certainly be of little benefit if they are not complemented by a programme to ensure that the facilities provided are used well to minimise the danger of transmission of disease. Indeed, health and hygiene education should be accorded a higher priority than the provision of improved latrines, since without such education, investment in rural sanitation is very unlikely to be beneficial.

In order to identify the need for health education, it may help to study current beliefs and practices, as well as what is actually taught and practised in schools and at home. It may also be useful to learn about the activites of the existing agencies.

GOOD AND BAD WATER

Popularly, 'Good drinking water' is defined as that which is visually clear, tastes sweet (free of unpleasant flavours and odours) and cooks food well/quickly.

Conversely, bad water or water unfit for drinking is that which is visually unclear, has a tinge of colour, salty/metallic taste or smell and water in which grains/pulses take a long time to cook.

Thus, people may mistake "sweet" water which may not be safe, as safe water. Again, safe deepwell handpump water with a metalic, mineralised taste and rusty appearance may be rejected as "unfit" for drinking. People often opt for the well water rather than handpump water for drinking and cooking.

Look and taste and 'cooking quality' are the usual evaluation parameters for drinking water. Women attach much significance to the 'cooking quality' of water.

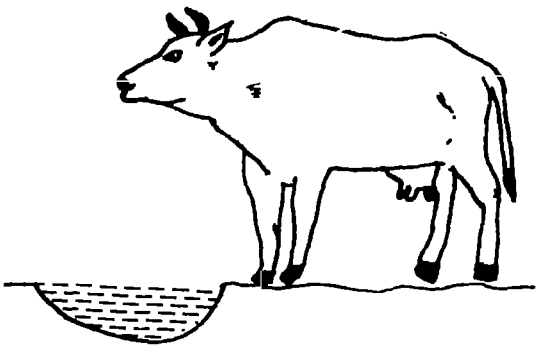
There is a large area of public ignorance about how health is affected by bad drinking water.

88-95% people believe that bad drinking water causes health problems. like fever, cough and cold, throat ache etc. which are not directly related to drinking unsafe water. Only 10-18 per cent people are aware that bad drinking water causes diarrhoea, stomach disorders, cholera. This awareness is higher in the eastern states in India. In West Bengal and Manipur more than 55 % know about bad drinking water - diarrhoea linkage. 13% of the total sample erroneously link malaria with bad drinking water.

Focused communication efforts in guineaworm/fluorosis affected areas have managed to raise public awareness about the relationship to 5 to 20 times the state average. In the guineaworm affected district of Udaipur 22% people are aware of bad drinking water causing the disease, as opposed to only 1.6% in the rest of the Rajasthan state. Similarly, 11% people of the fluorosis affected Amreli district are aware of the fluorosis - drinking water link although only 2% know about it in the rest of Gujarat.

SURVEILLANCE

All systems need some surveillance

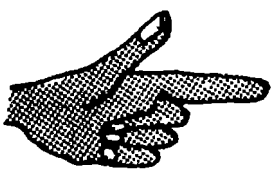


LOW-COST SYSTEMS PRESENT SPECIAL PROBLEMS DUE TO

—DISPERSED SITES
—LACK OF SKILLED MANPOWER
—LOGISTIC DIFFICULTIES
—POOR CONSTRUCTION
—LACK OF OPERATION AND MAINTENANCE

ALL TOO OFTEN, LOW-COST TECHNOLOGY APPLICATIONS ARE NOT BACKED UP BY PROPER SURVEILLANCE MEASURES REQUIRED BY THE VERY NATURE OF THE TECHNOLOGY USED:

—COMMUNITY EDUCATION
—TRAINING OF COMMUNITY LEVEL WORKERS
—CAREFUL SELECTION OF WATER SOURCE AND WASTE DISPOSAL SITES
—PROTECTION OF WATER SOURCE FOLLOWED BY PERIODIC SITE INSPECTION (SANITARY SURVEYS)
—OCCASIONAL SAMPLING AND ANALYSIS
—INSTITUTIONAL SUPPORT, ESPECIALLY IN TAKING REMEDIAL MEASURES



The challenge lies in involving the community in its own surveillance work.

Fig 4 1

PUBLIC HANDPUMPS

Two out of three users of public handpumps believe them to be the property of the government. This belief is particularly strong in Northern and Central Parts of the country. In Andhra Pradesh and Gujarat 30-40% think it belongs to the Panchayat (village council). People's ownership is an unfamiliar concept in Rajasthan, Madhya Pradesh and Andhra Pradesh, but is widely accepted in the eastern states.Although one quarter of all the users feel they should look after day to day maintenance, they expect the actual cost to be borne primarily by the government and secondarily by the Panchayat (village council).

CLEANLINESS

"We should have enough money for fresh food and clean clothes first" (poor villager, Andhra Pradesh).

"One has to go to work, ,no time, so house is unclean" (poor villager, Rajasthan).

"If people are healthy, they have the stamina to keep the house clean" (poor villager, Tamilnadu).

"If all basic amenities are present, people will have interest in being clean" (rich villager, West Bengal).

Among the village folk in India, "Cleanliness" is understood as a holistic concept, emanating from within the persons - from one's thoughts and behaviour and extending to one's physical self, home and environment, in that order.

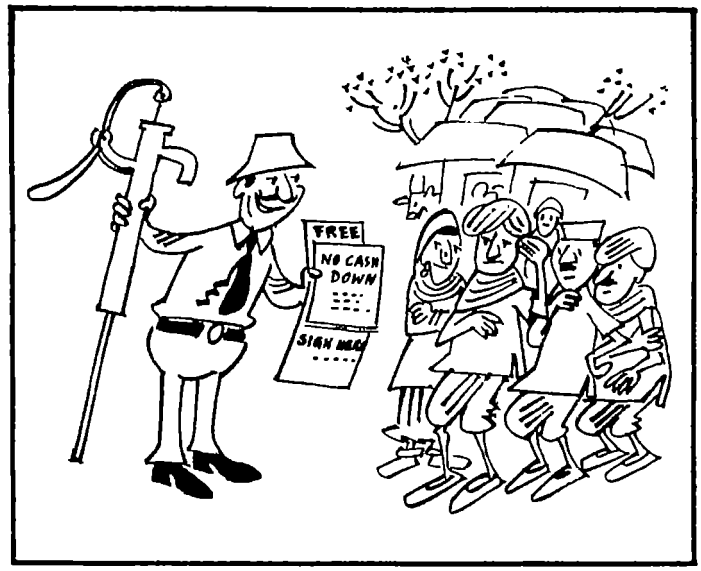


Fig. 4 2 Incentives are sometimes used to gain acceptance of the project by a reluctant public.

However, time and money are seen as major constraints to achieving the desired level of cleanliness. "Cleanliness" is low on the average family list of priorities. Poor families see it as a desirable but improbable ideal, to be pursued by those who can spare the effort and resources. There seems to be, in their minds a high positive correlation between time/money availability and different levels of hygiene, i.e.

Level 1 - personal hygiene

Level 2 - household hygiene

Level 3 - environmental hygiene

This graded relationship results in most people attempting to practice a rudimentary amount of personal hygiene and a lesser amount of household hygiene. But almost no effort is directed towards maintaining environmental hygiene which seems to be beyond everyone's area of involvement and the Panchayat's responsibility.

Most people are aware of a link between hygiene and health but it is a belief lacking conviction, diluted by years of resigned tolerance of unhygienic surroundings. While personal hygiene and to some extent household hygiene are believed to influence health, people fail to see the possibility of environmental hygiene influencing their health. Nor do they see themselves as factors influencing the quality of their own environment.

PERSONAL HYGIENE

Awareness of personal hygiene is high but often exists only at a theoretical level. Shortage of money, time and lack of conviction about its necessity cause people to neglect personal hygiene. This is an area where inadequacy of public amenities and economic status of families continue to inhibit desirable efforts for education and motivation .

Handwahing after defecation, before and after eating and cleaning of mouth everyday are reportedly universal. Six people out of every ten wash their hands with water and a little ash or mud. About one quarter use soap with water the rest wash with water only. Mouths are most often brushed with a chewed up twig.

A daily bath is infrequent. A little over half bathe every 2-4 days. In water scarce areas like Barmer in Rajasthan, people may bathe only fortnightly. Use of soap is irregular, linked to special occasions and considered somewhat a of luxury. Soap is used more frequently by upper income groups, younger and literate villagers and by women.

Although people recognise that changing clothes ought to go together with bathing, regular changing and washing of clothes is not considered feasible by most.

As one poor peasant from West Bengal commented:

"If one has money, one will have clean clothes since he can have more than one set of clothes".

The use of footwear is infrequent and limited to special occasions of when going out of the village. Men more than women think it is necessary. The major constraint is lack of habit and its cost.

Traditional beliefs and social pressures enforce maintenance of 'visible cleanliness' within the household by the rural housewife. A clean house is associated with less sickness and well being of family members. Household cleanliness is the housewife's responsibility and she meets with strong social disapproval if her household remains dirty. The only resources needed are time and effort of the housewife and villagers feel that even the poorest woman can manage to keep a clean house. However, what happens immediately outside the walls of the house is not considered her responsibility, not that of any other family member. Burdened with her usual chores, she ends up keeping a clean looking home amidst surroundings made dirty by waste water and garbage generated by her own household.

Traditionally, the highest priority is the cooking and eating area, followed by the sleeping area. The cooking area is kept clean of food particles, ash and garbage after every meal. Regular mud plastering of kitchen floor and cooking stove (chullah) is prevalent in all the states Washing

and cleaning of utensils is done after every meal in the courtyard or kitchen from where a drain leads to outside the house. In case of lack of space within the house, utensils are washed beside the roadside drain or at the village pond (West Bengal) using ash, mud and natural fibre scrubbers.

Villages are aware of the need to cover food and drinking water to keep away flies and insects It is understood that cleaning the kitchen regularly prevents flies and insects. The need to wash and eat food and give children clean food was mentioned in Gujarat. However, those who report all these practices also state that most villagers (including themselves) are negligent and do not follow them as rigorously as they should.

WHAT HAPPENS TO HOUSEHOLD WASTE ?

More than 80% households throw garbage into a private or comon garbage pit. The rest throw it anywhere within or outside the courtyard. Only 8% mention the use of manure pits.

Waste water generated in the household is simply let out into the village street/outside the house boundary by 63% families. Only 5% mention using a private soak pit and 12% lead it into a kitchen garden.

81% households have domestic animals, mainly cows and buffaloes. A third of them store and use the dung as fuel, for plastering walls or manure. 15 to 20% of the families, however, throw it away as garbage. This practice is common in Gujarat and Tamilnadu. Almost half the respondents do not believe that cow dung or buffalo dung can be harmful to human health. Dung of other animals could be harmful, buffalo dung less so and cow dung least of all.

CURRENT PRACTICES

In rural India excreta disposal is still by and large a matter of letting nature take its own course. 92% of the people surveyed defecate out of doors, at sites common for all categories of villagers. About one tenth express a distinct preference for sites close to a water source. Privacy is the overriding concern while selecting a site.

Those who do use private latrines range from 3% of the State sample in Rajasthan, 25% in Kerala and 12% in Madhya Pradesh, the overall average being 8% for all the States Manipur stands out where 85% reportedly use private latrines. Majority of the latrine owners and users belong to upper income households. Only 2% of the illiterate persons use latrines as comapred to 13% of the literate ones. While those having household latrines regularly use them, community latrines are used by less than 10% of these who have access to them.

Almost all who defecate outdoors do not cover or dispose of their excreta in any manner. Washing of hands after defecation is a universal practice. However 23% wash only with water, being most prevalent in Tamilnadu, Andhra Pradesh and Manipur. 14% use soap and water. More than 6% wash using water and mud or ash, being popular in Uttar Pradesh, Rajasthan, West Bengal and Madhya Pradesh.

Soap usage is a recent phenomenon, found among the young, the literate and the upper income group. Use of water only is markedly higher among older persons and poorer families. Use of mud or ash as a cleaning material with water seems to prevail across all socio-economic categories

BELIEFS BEHIND PRACTICES

The majority think they really have no choice and outdoor defecation is a necessary evil. Women feel this more often than men. But 31% people also feel the practice has advantages like fresh air and absence of unpleasant smell. 8% mostly poor elderly men even think outdoor defecation is a cleaner way of life since excreta is deposited far from the home.

Those who do mention specific disadvantages of outdoor defecation, speak mainly about occasion or situation-related problems rather than a sustained difficulty. Almost two thirds of the people think it is problematic during the night, the rainy season, for sick and old people Nearly 30% also mention lack of privacy and having to walk long distances to find suitable spots. These problems are voiced very frequently in densely populated States like West Bengal and Uttar Pradesh and most often, by women in almost all States. Health hazards of the practice are not mentioned by more than 7% of the people.

KNOWLEDGE BEHIND BELIEFS

Although 63% people think that exposed excreta can be harmful to health, less than 20% have correct awareness of how the harm is caused. Bad smell, revulsion on coming to contact with exposed exereta, rather than fear of disease, cause the negative feelings More than one third realise that exposed excreta breeds flies and mosquitoes, but understanding regarding how these vectors contaminate food is limited to upper income and literate groups only,

As many as 37% of the people either do not believe that exposed excreta can endanger health, or do not know whether this is possible. They feel that excreta deposited so far away from their homes cannot affect them. In any case, dogs and pigs eat it and clean up the area ! However, in crowded villages where secluded spots and vegetation cover for privacy are becoming scarce, outdoor defecation is becoming problematic and a desire for change seems to be building up, specially among women.

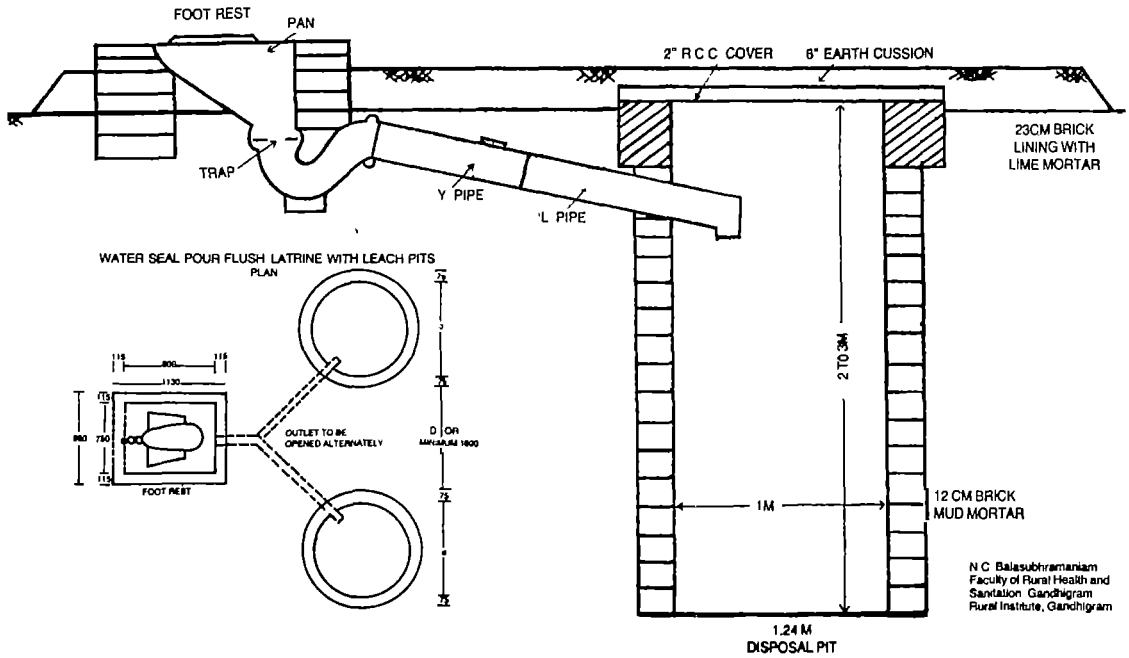
There is an unspoken tolerance of a young child's excreta which is considered less harmful than that of adults. An unweaned infant's excreta is considered 'absolutely harmless' as it is made up of mother's milk and nothing else Since these are disposed of within or close to the household they represent a major health hazard for the family.

SANITARY LATRINES

Public awareness of an alternative to outdoor defecation is limited. Only 37 and 52% people have reportedly ever seen a dry or pour flush type of latrine respectively. Those who have ever used one are even fewer in number. Apart from the minority who own a household toilet, the rest have encountered latrines only at public places like railway stations, bus terminals, health centres etc. where maintenance levels are often far from desirable. Predictably, the first impressions are unlikely to have been positive.

Families having private household latrines usually the dry type of latrine. The rest have report a mix of dry and pour flush types, the latter being more popular in West Bengal, Tamilnadu and Gujarat. Predictably latrine ownership positively correlates with income and literacy.

Fig. 4 3 **Cross-Sectional View of Water Seal pour Flush Family Latrine.**



About 5% people also have a access to community latrines. Whereas almost all who own private latrines use and clean them regularly, community latrines are rarely used by anyone due to lack of maintenance. In majority of latrine-owning families all members use the facility although in several horseholds, wherever selected members use if, they are invariably the female members of the household.

KNOWLEDGE

65% do not know what happens to the excreta flushed away from pans into a pit the ground.

30% do not know how often the pit will have to be cleaned out/emptied. Another 43% think that it will have to be cleaned out a lot more frequently than is actually needed. While the correct frequency ranges from once every 3-5 years depending on family size, as many as one-fifth think this has to be done every 6 weeks or more often.

Although, in reality, pit contents at the time of cleaning would be dry, odourless, the majority think that they would be liquid (53%) and foul smelling (81%) or are simply not sure what they would be like (19%).

More than half do not know that the pit contents can be used as manure. They envisage having to dig another pit and transfer the contents, or transporting the stinking mass to a point outside the village of the house

71% across the country are unaware that government subsidy is available for private latrine construction. While the household's actual contribution under the subsidised programme is not more than Rs. 200-400 (US $7-14 approx.), popular perceptions of the cost to the family range from Rs. 2000 to Rs. 10,000 per latrine (US $ 70-350 approx.)

The level of ignorance and misconceptions about all these questions is significantly higher among women, the elderly, the lower income groups, and the illiterates.

ATTITUDES AND INTEREST

As many as 86% people feel there are distinct advantages to having private latrines. 'Convenience', privacy, saving of time and energy spent in walking long distances and be useful during rains, winter, nights and sickness are perceived. Convenience at particular times is the most important motivating factor in Andhra Pradesh, Gujarat and West Bengal. Privacy is the prime advantage perceived by women and also by the inhabitatnts of West Bengal, Rajasthan, Uttar Pradesh. Health benefits as an advantage of having a private latrine are rarely mentioned in any State.

Villages in West Bengal are mostly in favour of household latrines followed by Andhra Pradesh and Gujarat. Upper income groups, literate persons and women are significantly more in favour of latrines than poor families, illiterate persons and men respectively.,

The minority who mention disadvantages of having household latrines are afraid of accumulation of filth near the house and foul smell resulting from it.

82-95% of the non-owners of household latrines in all the States express strong interest in getting private latrines constructed. The highest population of uninterested persons is in Tamilnadu, followed by Madhya Pradesh and Andhra Pradesh. Notably, the reasons given for lack of interest include, lack of space (36%), fear of dirt and smell near the house (38%) and lack of water (20%) but not lack of money.

If the government provides a subsidy, a rural family seems to be willing to contribute about Rs. 750 for getting a private latrine. On the whole, about 15% are unwilling to pay for a latrine. They belong to lower income groups, older age groups and are usually illiterate. Among the States, Madhya Pradesh seems to have the maximum number of 'unwilling' households (23%) and Manipur the least (5%).

To summarise, it appears that people in rural India are still not fully adequately aware that there are feasible, affordable and more hygienic alternatives to defecating outdoors. The younger, literate and better off people, who are exposed to urban influences and media are markedly more favourably disposed towards adopting sanitary latrines. Women, although less literate and less exposed are also more motivated to adopt latrines. There also exists a generally favourable climate for behavioural change because of the perceived advantages of conveniences and saving of time and effort through having private latrines.

Yet, coverage of population with sanitation facilities is painfully low and slow Half the population do not clearly know what these are like, how they work, what they cost, what effort/ resources will be needed to maintain them, how they will influence or alter their overall quality of life. Ignorance is further aggravated by serious misconceptions. The vision of having to dig an infinite number of excreta pits hereafter or to cleanout pits of slushy stinking masses of excreta every six weeks deter even the most interested individual. Coupled with these, the widespread ignorance of available subsidies and of perceived costs which are 10 to 15 times the real cost make latrines appear as a 'questionable' facility impossible to afford for the majority.

PREVENTION OF DISEASES RELATED TO WATER AND SANITATION HABITS

This Section provides a discussion of the ways in which water and sanitation related diseases can be prevented or reduced by the people in the community.

The following subdivision is used:

SAFE WATER;

SAFE EXCRETA DISPOSAL;

PERSONAL AND DOMESTIC HYGIENE;

SAFE HANDLING OF FOOD;

SAFE WASTE WATER DISPOSAL/DRAINAGE.

Table 4.1 summarises the prevention of water and sanitation related diseases.

Table 4.1: Prevention of water and sanitation related diseases

Disease	Safe water	Safe excreta disposal	Personal and domestic hygiene	Safe handling of food	Safe waster water disposal/ drainage
Diarrhoeas	•••	•••	•••	•••	•
Worm-infections					
a roundworm	••	•••	••	•••	••
b whipworm	••	•••	••	•••	••
C pinworm	••	•••	•••	••	•
d hookworm	••	•••	••	•	•
e guinea worm	•••	•	•••	•	•
f. schistosomiasis	••	•••	•	•	••
Skin-and Eye-infections, and Louse-borne infections	•	•	•••	•	•
Mosquito-and Fly borne infections					
a malaria	•	•	•	•	••
b yellow fever/ dengue	•	•	•	•	••
c filariasis	•	••	•	•	••
d sleeping sickness	•	•	•	•	•
e river blindness	•	•	•	•	•

Adapted from: Maximising Benefits to Health, WHO, 1983

••• very important to help prevent disease transmission

•• important to help prevent disease transmission

• not important

SAFE WATER

The risk of disease transmission of diarrhoeas and worm infections can be greatly reduced when safe water is used for:

- drinking;
- cleaning of teeth and washing of mouth;
- handwashing;
- washing of vegetables and fruits;
- cleaning of kitchen utensils.

Water is safe when there is nothing in it that can cause a disease. The problem is that we cannot see with our naked eyes whether water is safe or not. Even water that looks very clean can carry organisms that cause diarrhoeas and worm infections.

To be sure that the water we use is safe, contamination of water has to be prevented:

a. at the water source and in the water delivery system (pipework and taps)

b. between collection and use .

Hand Pump

The deep borewell is one of the safest sources of drinking water. Streams, open wells and reservoirs can be easily contaminated. But the water in a bore well comes through a pipe below the ground. A bore well once properly sealed is safe; germs cannot enter it. The water that is pumped up through the handpump is thus protected. Safe drinking water from handpump keeps disease away.

Public Stand Posts

Water from stand posts, can be spring water, ground water or surface water. This water will be safe when either it is taken and comes from an area where the intake area is properly protected from contamination or the water is adequately treated before it enters the piped system.

Sanitary Well

Dug well when covered properly and when a hand pump or power pump is attached becomes a sanitary well. The water may be chlorinated regularly to keep it safe.

General Discussions

Though close to 2 million handpumps have been installed in the country, reports indicate that many of these are not performing to an acceptable level. The often inadequate number of handpumps in a village, their non-working, the long distances that people (mainly women) have to walk to fetch water, the depletion of the ground water level in the summer months resulting in a no-flow situation are some of the problems.

Traditional open dug wells continue to be primary sources of water for all purposes. The handpump come as a close second. Dug well, handpump, tap is generally the order of preference for drinking water sources. (Study carried out by IMRD, a premier market research organisation of the country).

Nearly 10 per cent house holds collect drinking water from exposed surfaces like lakes, ponds, canals or rivers. In the North Eastern States rain water is collected for the purposes of drinking and other uses.

Since dug wells continue to be the most frequently used source of drinking water across the country, there may be need to devote attention to improving water quality in these wells through technical and information interventions.

Popular resistance to deep well handpump water related to its salinity or mineralised taste in certain regions may not be overcome simply through promotion of India Mark II pump as the safest water source. Particularly if the alternative source in the same area like shallow dugwells offer better tasting water. In such areas, it may be more relevant to concentrate on community education for well protection.

Prevention of Contamination of Water between Collection and Use

Safe water can easily become unsafe when it is touched by unclean fingers; when it is poured in an unclean water container; when dirt or dust gets into the water; when unclean containers or utentials are used, etc. To prevent these possible risks,the present practices of water collection, storage and use could be discussed. If necessary, improvements could be decided upon and promoted.

In order to prevent contamination of water between collection and use :

- clean hands before collecting and carrying water, especially when fingers touch the water or the inside of the container while collecting ;
- clean container to carry water home from tap;
- carry water in a covered container when it has a big opening like a bucket or basin. This will also help to prevent spillage during the trip home. (Leaves or twigs used against spilling may cause contamination as they may be dirty;
- regularly clean container in which the water is stored in the house. e.g. whenever it gets empty;
- pour water out of the container without touching it or use a clean long handed dipper to take the water out of the container;
- clean cups etc. in which water is taken and drunk.

SAFE EXCRETA DISPOSAL

Safe excreta disposal is at least as important as a safe water supply to prevent disease transmission. That is why more and more water supply projects include new facilities for excreta disposal in their programmes. Whether included or not, in both cases it is important to discuss with the people in the community present defecation practices and possible improvements, if necessary.

To discuss possible improvements in defecation practices is often far from easy. In many societies defecation is a very sensitive topic. People do not like to talk about it. And even minor changes in defecation practices may be difficult to achieve. Also the low priority people sometimes give to new sanitation facilities compared to other needs may be a handicap:

The new water supply project may offer a good opportunity to stimulate discussion on existing practices in excreta disposal, the role of faeces in disease transmission and feasible solutions to reduce health risks.

SAFE PLACES FOR EXCRETA DISPOSAL

A safe place to pass stools is a place where the faeces cannot cause infection. A clean latrine is such a place. But as we do not find latrines everywhere it is not so important to discuss in the community that everybody should have latrine, as that faeces should not be left at places where it can give rise to infection.

Excreta disposal is most likely safe when the following conditions are fulfilled:

a. where faeces are not exposed to other people or domestic animals

b. where faeces are not exposed to flies

c. where faeces are not moved or used as manure on the field before they have become harmless

d. where faeces cannot be washed into water supply sources

e. where faeces cannot drain through the soil into water supply sources

f. where urine does not get into water in areas of schisto somiasis.

Where faeces are not exposed to other people or domestic animals:

When there is no latrine, health risks can be reduced by passing stools at places where people or animals do not walk frequently. Otherwise faeces will easily get on feet and be spread all over the place. And this will increase the risk of disease transmission, especially for playing children.

For the same reason it is also important to cover or bury faeces by digging a small hole before passing stools. However, this will not prevent the risk of hookworm infection. Hookworm will come out of the earth even from 60 cm depth. Hookworm transmission may be reduced by furrowing defecation sites. These are sites where people walk on mounds and defaecate in the furrows. Only in dry, hot areas it might be better to expose the faeces to full sunlight as the drying heat of the sun will kill the disease organisms.

In some areas people defecate into water, e.g. fish ponds or rivers. Where schistosomiasis is not a health problem this does not create health risks provided the water is not used for domestic uses and when there is no contact between this water and water supply sources. There is perhaps less danger too when water is taken very far downstream from a settlement where people defecate into a river as fast-flowing rivers eventually clean up the germs of the faeces However, in populated areas this should not be relied upon. Just downstream from the settlement the water will be very unsafe so in that case water should only be taken up-stream.

Where faeces are not exposed to flies:

Excreta disposal is safer when flies cannot come into contact with faeces. Flies use faeces as a breeding place. To prevent contact between faeces and flies, the faeces on the ground could be covered If a latrine is used, a hole cover could be used to prevent flies getting in and out of the hole.

Also anal cleansing material (like paper, maize cobs, leaves, sticks, or stones) should be properly disposed of in order not to attract flies. Such material may be buried, covered or burned, or thrown away in the latrine if of a suitable type. If a latrine is used and the cleansing material cannot be thrown away in the latrine itself, it may be put temporarily in a bucket with a cover and then regularly burned or buried. When not done safely, this may include health risks.

Where faeces are not moved before they have become harmless

Excreta disposal is safer when faeces are not moved or used as manure on the field before they have become harmless. To become harmless faeces have to decompose in compost latrines. Dependent on the type of compost latrine it takes from a few months to over one year before the faeces have become harmless.

In some areas people use bucket latrines. These buckets are emptied by hand and the faeces taken to another site for disposal (e.g. agricultural field, fish pond, refuse heaps, treatment site). As this system is a source for infection, other solutions should be discussed (including other jobs for the persons who earn their living by emptying bucket latrines) .

Where faeces cannot be washed into water supply sources

Excreta disposal is safer when the faeces cannot be washed away by rains or floods to water supply sources . The risk that water will become contaminated is very likely when faeces are left on the ground or only lightly covered, especially near water sources.

Where faeces cannot drain into water supply sources

Excreta disposal is safer when faeces cannot drain through the soil into water sources. This means that latrines should not be built within 20 metres (or 50 paces) of a well or other water supply source . Also the latrines should not be located uphill from the water source. In areas which are flood prone, raised latrines may provide the most suitable solution.

Where urine does not get into the water

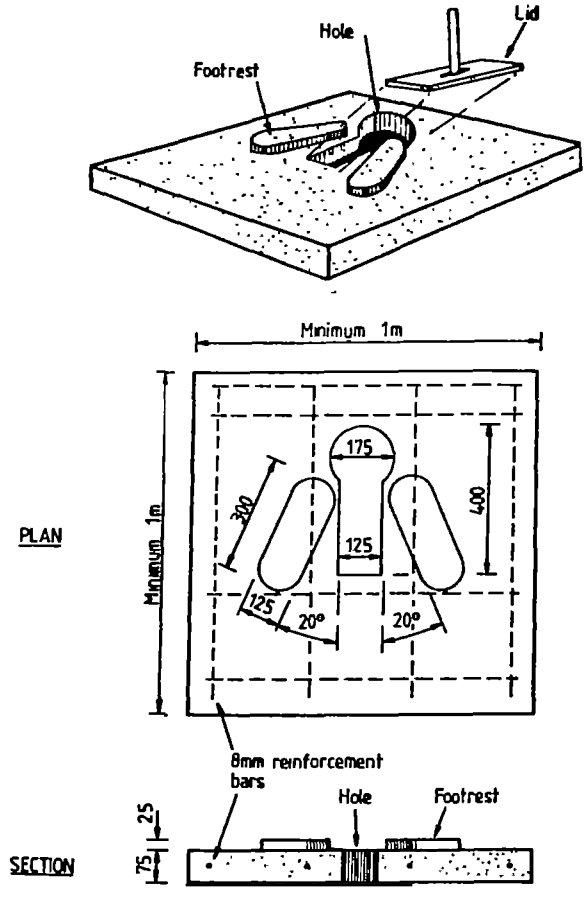
In areas where urinary schistosomiasis is found, it is very important not to urinate in or near water.

Latrines

A latrine is a safe place to pass stools and urine but only when the latrine is properly constructed, well maintained, cleaned every day , and without flies. Otherwise, the latrtine will increase the risk of disease transmission instead of reducing it.

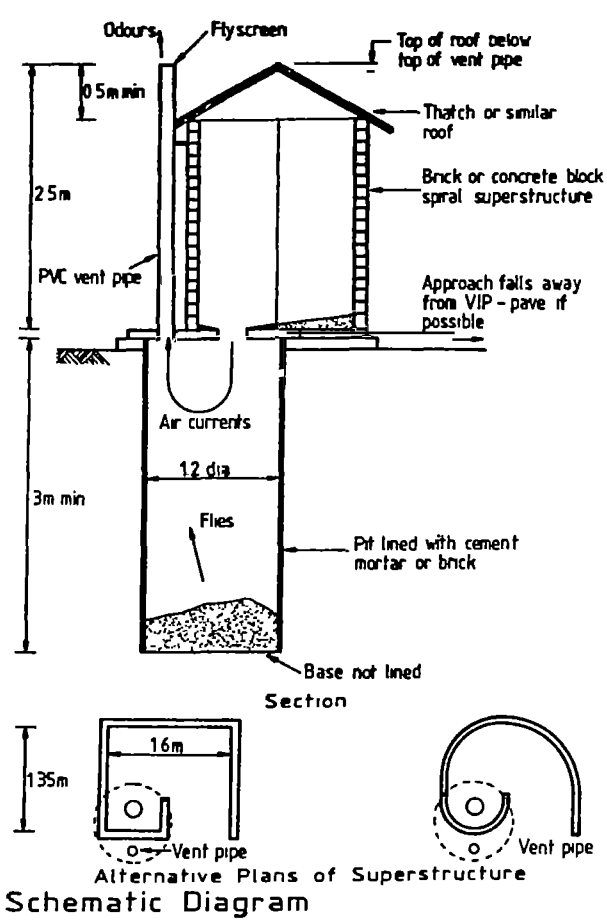
Some latrines are more safe than others. A pit latrine with a concrete slab and a long handled cover is a safe example. a concrete slab is easy to clean, cleansing materials can be thrown into the pit, and the cover will prevent flies getting in and out the pit. A ventilated improved pit latrine (VIP latrine) has the advantage that a bad smell is prevented and fly breeding is effectively controlled. The VIP latrine is more expensive than a pit latrine, but not necessarily more safe.

Cleaning and maintenance of household latrines generally cause less problems than the cleaning and maintenance of community or public latrines Community and public latrines may more likely be cleaned regularly when a person is appointed (and paid) to do the work Self-help cleaning of community and public latrines does not seem to be a suitable solution. It mostly results in poor hygiene.



Squatting Slab

Fig. 4.4



Schematic Diagram of a Ventilated Improved Pit Latrine

Fig 4.5

A dirty latrine is not only a health risk, but people also will not like to use such an unclean facility and may prefer to pass stools somewhere else and so create new risks of disease transmission.

Special attention may be given to the use and cleaning of school latrines. For many children the school latrine is their first experience with latrine use. In consultation with the school teacher the children may be instructed and encouraged to use the latrine properly and to keep the place clean,

Construction of new latrines

When the community wants to build new sanitation facilities it is very important to discuss in detail the various possibilities in relation to existing practices in the community. New facilities will more likely be used when they fit local circumstances and meet local preferences. Important considerations are

- Who may share a latrine with whom?
- What type of latrine is preferred and is it affordable?

- What is a suitable site?
  Is it easy to go there, also for children and at night?
- What is the preferred defecation posture, sitting or squatting?
- Can the preferred cleansing material be used?
- Is privacy preferred?
- Will the latrine and its site be in line with local values, beliefs, rites and taboos?

When the construction of latrines is promoted in a sanitation programme it is very important to raise the interest of the people by discussing the present situation together with the health risks involved and by stimulating the people to think of what difference the use of a new latrine may make for the health situation in the community. Without strong community support a new sanitation programme is likely o fail.

Apart from community involvement sound technical advice is also needed for proper design and construction of the new facilities and for maintenance and repair work.

Handwashing after defecation:

Handwashing after defecation will greatly help to reduce the risk of disease transmission Hands should be washed preferably with soap. But when soap is in short supply or too expensive other solutions could be discussed and promoted. (e.g. the use of clean sand, ash, etc.)

In areas where anal cleansing with water is practised the promotion of handwashing may create less problems than in areas where other cleaning materials are used. When anal cleansing is done with water it means that at least some water is available and that handwashing may be integrated more easily as a part of the defecation practice.

Safe excreta disposal for babies and young children

A common belief that the faeces of babies and little children are less harmful than those of adults is infact not true. Present practices and possible improvements are:

- dispose off faeces in a safe place (latrine or burying)
- wash babies and young children after defecation
- wash hands after handling babies's faeces
- wash soiled clothes at places where it cannot cause contamination.

For young children (too small or too scared of the squat- hole to use the latrine) a hole in the ground near the house may be made to use for defecation. Each time the faeces will have to be covered with soil. Another hole can be made when the first one is full.

This practice will reduce the risk of disease transmission except for hookworm infection. That is why the construction of a separate child's latrine may be a better solution

Of course these young children should also be taught to wash their hands after defecation

PERSONAL AND DOMESTIC HYGIENE

Personal hygiene

Personal hygiene is especially important to reduce and prevent diarrhoeas, skin and eye infections and louse-borne infections. The best way to facilitate personal hygiene is to have plenty of water near people's homes, and to use the water for

- handwashing after defecation
- handwashing before preparing food and eating
- frequent washing of the face and hands of little children, the hands preferably several times a day;
- frequent bathing or body-washing. Babies and young children, whenever possible, should be bathed every day since they are constantly soiling themselves or getting dirty at play;
- regular washing of hair;
- cleaning of fingernails whenever they are dirty. This will be easier when the finger nails are cut short;
- washing of clothes and bedclothes (laundry). Although it is useful to hang clothes out in the air and sun, they can only be kept clean by regular washing. If possible let clothes dry in the sun as this is a healthy practice to remove disease organisms.
- Cleaning of teeth.

  Whenever possible bathing and washing should be done with soap. But just using lots of water to clean the body or clothes is also effective. Or, in case of bathing, substitutes for soap could be used such as clean sand, a flat stone or a clean cloth to rub the body.

The new standposts can greatly help to improve personal hygiene as the piped system brings the water near people's homes. But then the water has to be used not only for drinking and cooking but also for bathing and laundry. The community could be stimulated to decide to construct and use special facilities for bathing and laundry at some distance from the drinking water tap with soak pit to prevent contamination of drinking water. The facilities could be put to proper use and maintenance.

Where schistosomiasis is a health problem ,it is especially important that the new standposts provide plenty of water to discourage the use of contaminated traditional bathing and laundry places . For the prevention of other diseases, the frequent use of water is more important than the quality of the water. In this context the use of traditional sources does not give rise to serious health risks provided the water does not get into the mouth (for example in cleaning of the mouth, swimming, etc.).

As skin and eye infections and louse-borne infections are transmitted by close contact it will also help to reduce these infections when

- clean clothes are put on after bathing as one cannot have a clean body with unclean clothes;

- all family members regularly bathe and wear clean clothes
- face towels are not used by more than one person to prevent trachoma.

For some groups of people the above mentioned preventive measures maynot be possible They are not allowed to bathe on certain occasions or at certain times; They may not be able to wash clothes regularly as they do not have time to do so. or they are afraid their clothes will wear out too soon, or they do not have clothes to change; Attitudinal and economic changes can lead to change in this condition.

Domestic hygiene

Some measures to improve domestic hygiene have already been discussed in other sections One of these measures is the cleaning of water containers, dippers and cups to prevent contamination of drinking water and covering water containers.

Other measures that could be discussed with the community in order to reduce the risk of disease transmission are to.

- keep kitchens clean
- keep floors of houses and areas around the houses especially where children play clean by frequent sweeping. Also animal droppings should be swept away regularly (to prevent flies)
- wash cooking pots, dishes, eating utensils, artificial teeth, etc carefully after each use A rack in the sun and above a soakway may be the best place to drain and dry washed articles
- the water from washing into the soakaway (or it can be used to water plants;
- control flies not only by covering faeces and pit latrines but also by food protection and safe disposal of domestic waste.
- dispose domestic waste in a safe way. Waste should be covered, buried or burnt to prevent flies and rats One way to store domestic waste is to put it temporally in a waste bin Always cover the bin after use. It will not only prevent flies and rats, but also bad smell When the bins are not emptied the waste may be buried or burnt every now and then (e g. twice week).

Another way to dispose of domestic waste is to dig a big hole to put the waste in and to cover it immediately with some earth. A separate hole may be dug to compost waste like tea leaves, banana skins, and so on for future agricultural use. This waste also should always be covered immediately, to prevent mosquito breeding.

SAFE HANDLING OF FOOD

Safe handling of food can further help to reduce the risk of disease transmission of diarrhoeas and worm infections. Food is handled in a safe way when

- hands are properly washed with safe water before eating or preparing food and not allowed to get dirty again during these activities. So hand washing is not only important after defecation, but also before handling food. Eating with unclean hands can easily cause infection. Also food prepared or served by somebody with unclean hands may infect everyone who eats this food.
- raw food and fruits are washed with safe water before eating. This is important as raw food and fruits may have been in contact with soil contaminated with human waste or manure. (fruit fallen on the ground or vegetables grown low); or they may have been handled with unclean hands; or they may have been sprinkled with unsafe water to keep them fresh before selling. (Washing of raw food and fruits will also help to get rid of the harmful remains of agricultural chemicals As an alternative to washing, fruit may be peeled.
- food is properly cooked before eating. Cooking will kill disease organisms and worm eggs. This is not only true for vegetables but also for pork, beef and fish. Leftovers kept for a following meal should be thoroughly heated before eating to be sure that no new disease organisms are present in the food. This is the more important for weaning babies and very small children. If possible, they should get freshly prepared food for every meal.
- cooking and eating utensils are washed carefully. This is important as clean food served in an unclean dish can become contaminated food the moment it touches the dish.
- all food is stored in washed, covered containers to protect it from flies and dust.

Safe handling of food will be made easier when there is plenty of water available at the house for washing of hands, food, dishes, etc. as well as for cleaning of the kitchen. When the standposts provide water closer to the homes it is a good opportunity to promote the use of more and safe water for these purposes.

Feeding of babies and young children

Breast feeding is not only healthy, it will also greatly; reduce the risk of diarrhoea as the baby does not get unclean things in its mouth. For safety sake a mother who is breast-feeding can wash her nipples and the mouth of her child before feeding. If a mother does not breast feed, than it is safer to use a clean cup (and spoon) and not a bottle to feed the baby. Bottle-fed babies are more likely to get diarrhoea as bottles often fall on the floor or are left around unprotected from flies and unclean hands. So the clean cup/spoon feeding method should be discussed and encouraged when breast feeding is not practised.

Young children between the ages of about six months to two years are especially at risk to fall ill with diarrhoea. This is because they have not yet built up a resistance to diarrhoea at the time they get new foods and because they like to put all kind of things in their mouths That is why it is especially important to discuss with the people in the community possible ways to protect little children from diarrhoea. Of course diarrhoea cannot be prevented altogether, but we can try to keep it to a minimum. A child with diarrhoea will need special care to prevent it from losing too much body water in the stools (dehydration).

SANITATION AND DRAINAGE SYSTEM

Sanitation denotes a comprehensive concept of not only the methods of disposal of human waste but also of liquid and solid wastes including matter originating from food and hygiene. It includes personal, domestic and environmental hygiene practices also However, as believed earlier, the disposal of human waste through various methods like cess pools, open drainage, pit latrines, etc still constitute a major portion of the works related to sanitation.

There is a direct relationship between water, sanitation and health Inadequate provision of safe drinking water, improper disposal of the human excreta and unscientific disposal of sewer and solid waste leads to unfavourable environmental conditions. This, coupled with the lack of personal hygiene which emanates from food habits serves as a basic reason of many water-borne diseases particularly diarrhoea and tetanus. Malaria is caused by negligent environmental sanitation habits. Similar is the case with filaria even though it is not an epidemic in most parts of the country. Estimatedly over 1.7 lakh children are affected by Polio myelitis. About 2 5 lakh die due to tetanus apart from 15 lakh infants' death due to dehydration caused by diarrhoea. This alarmingly high rate of infant mortality is attributed mainly to improper sanitation facilities

Mainly because of lack of awareness, the sanitation has not been a perceived priority of people; the progress on this front has also not been at greater pace. In 1954 the sanitation programme was introduced in the health sector of the Government of India. In 1981 the Decade Programme was launched with the objective of covering 25% of the population during the decade. In the year 1985 the rural sanitation programme was transferred from Ministry of Urban Development to the Ministry of Rural Development. In 1986, Ministry of Rural Development was made the nodal department for carrying out the programmes for sanitary latrines. Accordingly, a scheme was launched to construct one million sanitary latrines to be provided for the houses of SC/ST under Indira Vikas Yojana and also to provide 2,50,000 additional latrines to community units such as health sub-centres, schools, panchayat ghars, Anganwadi etc. under National Rural Employment Programme/Rural Landless Employment Guarantee Programme. In 1987 the Rural Sanitation Programme was included in State sector under Minimum Needs Programme.

The Central Sanitation Programme launched in 1986 was designed to provide sanitary latrines to SC/ST families and people below poverty line and the resources were shared by the state government and the central government on half half basis. As far as allocation of funds from the central government was concerned, there was a composite criterion for the purpose which included several bases like population (50%), area (20%), incidence of poverty (20%) and spillover problem villages (10%).

During the year 1990-91 the criteria and the norms under Central Rural Sanitation Programme were modified taking into account the lessons from past experience. Accordingly the share of the central government was increased to 75% of the total cost of schemes and the composite criterion, too, was modified to take into account the hilly states on the basis of population.

The progress under sanitation programme has been slow. It was mainly due to (i) lack of initiative at all levels particularly at the implementation level, (ii) inadequate financial resources available for this sub-sector, (iii) lack of perception of sanitation as a matter of importance on the part of the people and (iv) lack of peoples' participation in the whole programme.

Sanitation is a composite concept and not merely a method of disposal of human excreta It evolves through three clear levels of initiative and action. Firstly, it is at the individual level or at the micro level, which would include hardwares with regard to human sanitary facilities and attitudinal habits related to individual sanitation. Secondly, it is at the level of immediate environment where a local drainage system to facilitate washing of the sewer and finally it is at the macro level which includes a complete drainage system that also takes care of mini or micro systems Whereas it is a fact that sanitation at individual level requires some financial investment on part of the individual, the community drainage system is certainly not the responsibility of the individual alone. Open drainage system of sewer has been the most commonly used method even though it is not scientific and certainly not appropriate either. Of course in urban agglomerations where large concentration of population over a limited area is there, the drainage and a few treatment systems are better organised and maintained Here we are more concerned with rural sanitation.

SANITATION AT MICRO LEVEL

Dependng upon the purchasing power of the people, the facilities that they create for sanitation essentially reflect their acceptance to invest in this sub sector. Although there is no perceived priority attached to this programme as far as individual is concerned, it has certainly become a part of urban, semi-urban and peri-urban habits of living. The same is imitated to a considerable extent by the affluent rural folk The problem arises with the people who cannot afford to invest on this account Mainly because of their limited purchasing power the government has formulated the Central Rural Sanitation Programme perceiving them as target As it is designed primarily for SC/ST families and people below the poverty line in rural areas, it is subsidised also to a varying degree.

Since cost is a major factor here, it becomes a case for clear role of low cost sanitation hardware and therefore any model which can offer service at comparatively lower investment is replicale depending upon a host of factors like acceptability in local circumstance, availability of the materials including hardwares, awareness and the like. Here also awareness plays a very important role. There have been a few models which have been successful and the range is really thrilling as it varies from absolutely private individual initiative to schemes completely sponsored by government. It would not be out of place to indicate a few of such models here

Midnapore Model - Midnapore Sanitation Project in West Bengal is implemented by Rama Krishna Mission which is a well known Non- Governmental Organisation. Unlike any other model, this particular scheme envisages that the cost of sanitary facilities is completely borne by the beneficiaries themselves. For this, a proper delivery system has been adopted and a variety of options have been offered so that it suits various persons from different socio-economic segments of the population And these efforts were suitably supported by information, education and communication efforts One of the major reasons of the take off of this programme was that it was launched to control the diarrhoea and such other diseases, to achieve goals of immunization, education, nutrition and income generation among women. In the intial stage, the UNICEF had supported this programme with a view to create a revolving fund and also to support the adequate training and establishment expenses. The Rama Krishna Mission has a good network of village youth clubs and women voluntary groups which act as several nuclei of dissemination of information and act as sources of communication and education. The Lok Shiksha Parishad which is the nodal agency of the Mission enjoys the confidence of the local people and this is how the programme was accepted by people in the right spirit. This scheme is based on proper education

and dissemination of information with regard to sanitation and facilities required to be created for the same. Government has virtually no role to play. To facilitate acceptance of the programme by different sections of the society, there is a variety of alternatives or options avilable to the individuals.

Periyar Model - In sharp contrast to Midnapore Model, the Periyar model is an ideal example of a positive action on part of the government agencies which is fully acceptable to the local people. Rural welfare staff play an important role in motivation and social mobilisation in order to disseminate adequate information with regard to sanitation and education. Every household is provided with a latrine and a bathing cubicle. A few of them have even installed bio-gas plants. The cost of construction of latrine and other sanitary facilities is partly borne by the beneficiary as his contribution which is supplemented by varying degree of subsidy from the government under various schemes. The usage of sanitary latrines has become popular here. Since its inception in 1989-90, more than 30,000 household latrines have been constructed and most of the households have adopted sanitation as a comprehensive package of facilities which has also resulted in positive behavioural change in the people This development in Periyar district has now come to be known as Periyar Model and the Government of Tamilnadu is to replicate it in at least one block in each of the districts

Alwar Model - Initiated in 1987 as a part of Intensive Sanitation Programme in eight States of India, this project in the Alwar district of Rajasthan aimed at motivating the community to adopt a package of sanitary facilities and practices through a cadre of grass root change agents (at village level) with Rural Development Department, the Government of Rajasthan playing a catalytic role Called 'Motivators', the change agents formed the backbone of this initiative towards community involvement and participation. Selected through a participatory approach by block and village representatives from ongoing development projects like ICDS, DWCRA, WDP and Education, the motivators (two from each village and preferably females) were exposed to an intensive training and were equipped with appropriate IEC kits, guidelines and formats to undertake awareness creation and motivational activities through door-to-door visits, group meetings and village campaigns The impact is visible in many villages of Alwar district which can boast of significantly improved environmental sanitation conditions and villagers who are now aware of and motivated about sanitation-related issues. Many homes have a set of sanitary facilities such as latrines, soakpits, garbage pits, bathing/washing platforms and smokeless chulhas installed and maintained with the active participation and contribution of the family members. This approach now forms the basis for promoting rural sanitation in many other districts of Rajasthan.

Allahabad Model - The Intensive Sanitation Project in Allahabad (UP) with UNICEF support started in 1989-90. The project has a three pronged approach for promoting rural sanitation, particularly coverage through household latrines It is linked to the pattern of subsidy offered to the beneficiaries The first type is with a subsidy of Rs. 1200 (with Rs. 300 from the beneficiary), the second one with a subsidy of Rs. 450 (rest comes from the beneficiary) and the third type has no subsidy but the beneficiary is given technical guidance and facilities for creating the necessary infrastructure. The Department of Panchayati Raj, the NGOs the Institute of Engineering and Rural

Technology (IERT) and selected Panchayat Udyogs act as catalysts for adopting these approaches under the overall control of the Panchayati Raj Department The project has a strong software back-up for which besides the governmental agencies, NGOs are also actively involved. A core group of trainers drawn from different agencies has been formed to train various grass-root level functionaries. The Nehru Yuvak Kendra has been actively associated with promoting sanitation education. Several village contact drives have been organised for this purpose. These are backed by entertainment-cum- education shows through video-on-wheels. The extension wing of IERT has involved more than 100 female community health workers in promoting sanitation education in a particular area.

EMPIRICAL OBSERVATIONS

There are a few observations which could be made on the basis of empirical studies of the patterns described above No doubt, most of the approaches are unorthodox and quite innovative and are replicable elsewhere. The country being a diverse unit with a vast geographical area, perhaps a host of models could be suggested to be replicated in its different parts. However, these models give important messages, a few of which are summarised below:

a) Sanitation has to be a comprehensive concept and is certainly not confined to the construction of latrines alone. The low cost sanitary facilities at the domestic and the community level such as latrines, soakpits, garbage pits, smokeless chulhas and micro drainage facilities may, particularly around the the water sources, constitute an essential part of the comprehensive concept of sanitation. A distinction will have to be made among various components of the concept of sanitation which includes drinking water, disposal of waste water, disposal of human excreta, garbage disposal, human sanitation, food hygiene, personal hygiene and sanitation at the community level. This has to be supported by a strong information, education and communication package to create awareness with regard to various sanitary practices including personal hygiene and the hazards of their negligence.

b) In order to make the sanitation as a concept acceptable to people, it is a must to ensure their active involvement and participation which would demand alternatives available for people of different financial status. Obviously the subsidy will have only a limited role to play. Once the people make investments out of their own efforts, the acceptability of the scheme becomes easier and greater.

c) Not only from the financial affordability point of view but also from the technical point of view, there should be quite a few options which could be made available to the beneficiaries and depending upon their preferences any one of them could be opted for. Such technologically different options are also required because of different geographical conditions and different socio-economic and cultural practices in different parts of the country. These technologies have to be affordable, acceptable and replicable. It should also have alternatives for the production of sanitary hardwares which could further take care of cost escalations. Thus evolves the concept of low cost santiation. It has been a matter of experience that even though the personal hygiene is of some concern for an individual, the general domestic hygiene is certainly a far cry and the environmental hygiene invokes insignificant response as far as common man is concerned. This is obviously due to the lack of information and proper communication.

One method to deal with this system is a comprehensive and systematic communication strategy which has to be developed through all possible channels to motivate people This would largely depend upon the pattern of their personal communication at the village level for the willing village level functionaries like anganwadi workers, DWCRA group organisers, primary school teachers, health group and mini-mission district workers who could be taken into confidence.

d) Once an awareness is created and the demand for such facilities is precipitated, it has to be backed up by an efficient delivery system which may not be a part of the subsidy oriented programme. It is because of inadequate delivery system that one finds it difficult to construct a latrine in rural areas as one will have to carry everything from urban or semi urban places An alternative delivery mechanism to provide components for creation of sanitary hardwares has to be developed.

e) This perhaps is the time to think of private participation in this field also and the government may have a policy to encourage private initiative in this field. This would be comparatively easier for industrial ventures and social workers to associate themselves with hardware delivery systems. Perhaps public sector undertakings too can come in, for providing sanitation facilities in and around their own townships.

f) Since inter personal communication and social strategy of the santiation programme is of immense importance, the role of non-governmental organisations becomes very crucial because it is they who have tremendous rapport with the local people which can be fruitfully utilised for creation of awareness among the people, dissemination of information and extension of education with regard to personal, domestic and environmental hygiene.

MICRO AND MINI DRAINAGE SYSTEM

Drainage system for water and waste water is a must for any habitation Natural drainage (by gravity flow) has very very limited role to play and for bigger settlements, it is grossly insufficient. In the hilly areas, the terrain features result in consequent drainage system which is once again because of the natural process. But it is not the case with human agglomeration in plains. One has to go in for superimposed drainage system in such places.

As far as individual drainage system is concerned the proper awareness will result in necessary micro drains for carrying away the effluents. Soak pits and kitchen gardens or tree plantations are more useful for disposal of waste water from individual households and also from a handpump These micro drains will have to be connected to a community drain and finally the entire waste water has to be drained to the community drainage disposal centres or sites Hence the need to have a mini drainage system at the local level. In urban areas where the size of agglomeration is bigger, there are macro and even mega drainage systems. Although the construction of such elaborate systems is a cost-intensive affair, it is desirable and could be taken inphases. For this purpose, the local people and the local authorities like panchayats have to be taken into full confidence as it may require some financial initiative on part of the panchayats too

Depending upon the size of agglomeration there has to be a community drainage system, supported with arrangements for waste water treatment. It would include both treatment of solid wastes and liquid wastes. The problem becomes particularly sensitive in the areas, which are

bigger or which are nearer to industrial agglomerations. At this level the conventional rural urban dichotomy is no longer desirable while analysing this problem.

Installation of waste water treatment system and their maintenance is no easy task because it requires specialised skills. Usually the state PHEDs attend to this function and over the years they have acquired experience in these matters. The panchayats may perhaps require some orientation and training and periodical strengthening so that they are kept abrest of recent developments.

SOCIAL ASPECTS: INFORMATION, EDUCATION AND COMMUNICATION

Since sanitation as a concept endeavours to interfere with the stereo typed or present perception of people not only towards personal hygiene but also towards domestic hygiene, the role of social action becomes very important. It is usually due to the lack of awareness on part of the people that things get aggravated. For example, in case of diarrhoea and dehydration, it is more often the lack of information or awareness with regard to early rehydration which leads to alarmingly higher rate of the infant mortality. By initiatives in the field of education, the situation could be improved considerably. Dissemination of information helps in removing the misconceptions and in prompting correct perceptions about improved health and sanitary habits.

Resistance is a natural part of the behaviour and it is because of this reason that the inter-personal communication becomes very important Therefore the person who takes the message to the common people has to be acceptable to them and he also must enjoy their full confidence. Frequent visits of health workers and grass-root level workers, and adequate explanation to the people play a very important role in community education. Once again, it is because of the inter-personal communication that one comes to feel that the non-governmental organisations who have developed rapport with the local people would be of considerable help in taking the message to the people as far as health, sanitation and related matters are concerned

CHAPTER - 5

ROLE OF RELATED AGENCIES IN IMPLEMENTATION, OPERATION AND MAINTENANCE OF RURAL WATER SUPPLY SUPPLY AND SANITATION

Introduction

While the emphasis is on community participation to develop and implement water and sanitation programmes in a sustainable way, attention has to be paid to the important role played in this process by the government and non-governmental organisations (NGOs).

If these three - community, government and NGOs - are to be effective in helping each other, then a clear definition of their roles is important. The chapter outlines these roles and responsibilities.

A FUNCTIONING SYSTEM IS not necessarily a system that is being utilised. Studies indicate that handpumps located at inconvenient distances from the user's home stand a very good chance of not being used. Similarly, latrines have been known to be used as storage sheds. It is only through active community participation at all stages i.e. formulation, planning, preparation, implementation the operation and maintenance of the installed facilities, and monitoring and evaluation that these systems can become and remain part of a community's established living pattern This kind of active community participation must be based on the recognition of women as being vital to this process of creating and preserving a demand for safe water and adequate sanitation

The role of the community in establishing a sustainable safe water supply and good hygienic practices could perhaps be itemized as follows;

i) Assisting the government in the situation analysis and needs assessment exercise and in the formulation of an Identification Report.

ii) Concurring with/modifying the Identification Report

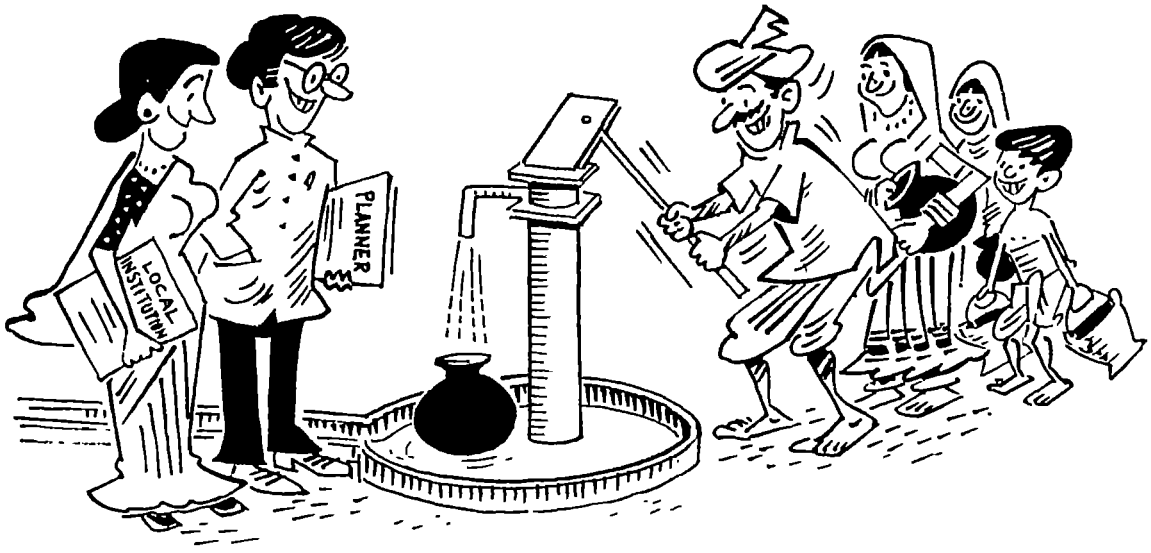


Fig 5.1 **THE SELECTION OF THE PROPER HARDWARE/SOFTWARE MIX CAN ENSURE THAT PROJECTS AND PROGRAMMES GO BEYOND THE MERE COVERAGE OF THE POPULATION WITH FACILITIES, AND THAT FACILITIES WILL CONTINUE TO FUNCTION AND BE UTILIZED FOR LONG PERIODS OF TIME UNDER OFTEN DIFFICULT CONDITIONS.**

iii) Assisting the government in formulating the Final Project Report and in the implementation of the project.

iv) Managing the operation and maintenance of the installed facilities with minimal assistance from the government.

v) Monitoring and evaluating the performance of the installed facilities, leading to timely corrective actions and formulation of further improvements.

Obviously, these skills are not, by and large, readily available at the village level. So any scheme that bases itself on community participation must plan in time for training to be given to community representatives so that they can arrive at decisions on the basis of awareness and reflection rather than being forced on them, as is often the case

The full participation of the community and especially women in planning, preparation, implementation and operation and maintenance is crucial to safe water and good sanitation practices becoming a routine part of their lives.

ROLE OF WOMEN WITHIN THE COMMUNITY

The most practical reasons for involving women in the area of water and sanitation is that they are the persons who have the most to do with water - be it collection, transportation, storage or use

Similarly, with regard to sanitation, it is the women of the community who can be the most significant influencers in terms of developing good habits of personal and public hygiene (washing of hands after defecation, disposal of waste water, etc).

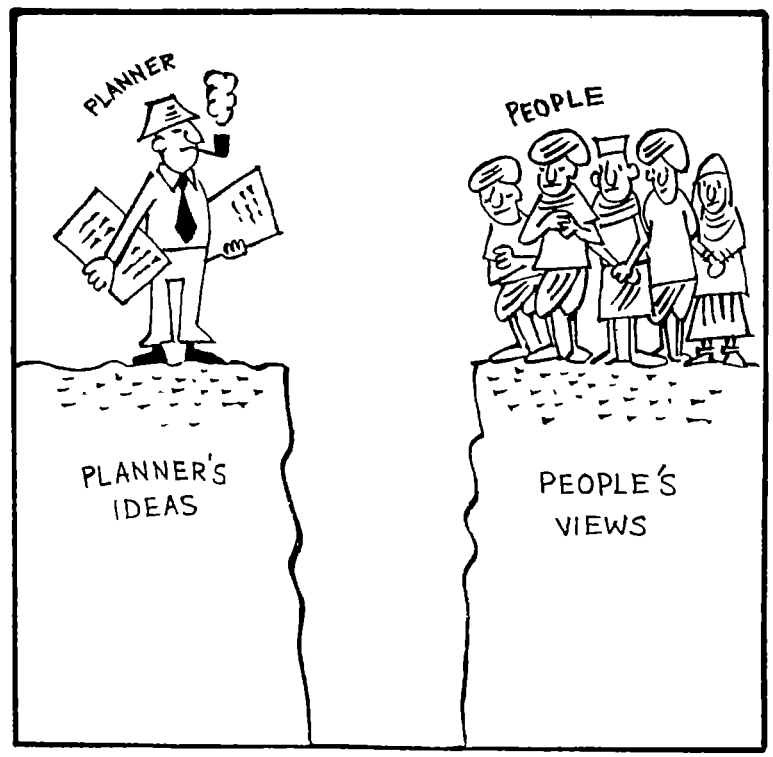


Fig. 5.2 AT THE START OF PROJECT PLANNING, THERE MAY BE A CONCEPTUAL GAP BETWEEN PEOPLE AND PLANNERS AS A RESULT OF THEIR DIFFERENT PERCEPTIONS OF COMMUNITY NEEDS.

The woman of the household can be an active agent in transmitting disease - a mother, and not necessarily from a very poor or illiterate family could, for instance, use the corner of her sari to wipe her hands, to clean kitchen utensils and wipe her child's face and bottom - all in the space of perhaps 10 minutes. Research over the past few years indicates that the need for sanitary facilities is a much higher priority for rural women than for men Also, when sanitary facilities have been constructed in consultation with the community, it is the women who generally keep them clean and also impart hygiene education to their children.

If, therefore, rural water supply and sanitation projects are to become sustainable in practice, then women must be acknowledged as the actual managers of domestic water and as the catalysts for good water and sanitation practices. This means that women must be consulted directly and not through intermediaries at every stage of a water and sanitation project.

The ways in which this could be facilitated include the following.

- By arriving at a better understanding (through participatory Knowledge, Attitude and Practice (KAP) studies, for example) of women's perceptions and needs Here, there is also a need to differentiate between the needs and aspirations of categories of rural women (such differences could be for example, between upper-caste and lower-caste women).
- Through specific efforts at developing technology oriented towards women (the village-level operation and maintenance (VLOM) handpump is an example)
- Through emphasizing that technology is not necessarily male- oriented (the training of women as handpump mechanics and as masons)
- Through the process of certification by women regarding site for handpump installation and maintenance
- Through setting-up perhaps exclusively women's Pani Panchayats or ensuring at least 50% representation by women in the Pani Panchayat or Village Water and Sanitation Committee.
- By recognizing the fact that if sanitation is to become a recognized "felt need", leading to demand, it is the women who are best placed to articulate this need and influence the community towards their use and proper maintenance.
- By appreciating the reality that most rural committees are still male oriented. So, if the woman's role is to be enhanced and she is to be given the opportunity to play her crucial part, then projects and programmes in the water and sanitation sector must recognize this reality. Therefore, one must be very careful to avoid any strategies that could lead to confrontation and must instead stress rational acceptance through emphasis on the practical reasons why a woman's role is so important. If men are neglected, they are in a position to undermine the education directed at women The role of the NGOs could be determining factor here.

Women and girls spend long hours, labour and energy to fetch water over long distances, every day of their lives.

Safe water and good hygienic practices make more sense to women than men. After all, illnesses in the family are attended to by women.

A recent UNICEF Survey indicated that in almost 70% of the households interviewed, water containers with long handles were not used - unwashed hands were in frequent contact with the stored drinking water A change of practice by the women of the household here could have many positive health benefits

Since women are the ones who collect, transport, store and determine the use of water, their awareness regarding good hygienic practices in crucial to disease prevention

Fig 5 3 STUDY THE CUSTOMS AND BELIEFS THAT COULD PREVENT COMMUNITY MEMBERS FROM READILY ACCEPTING CHANGES IN WATER SOURCE.

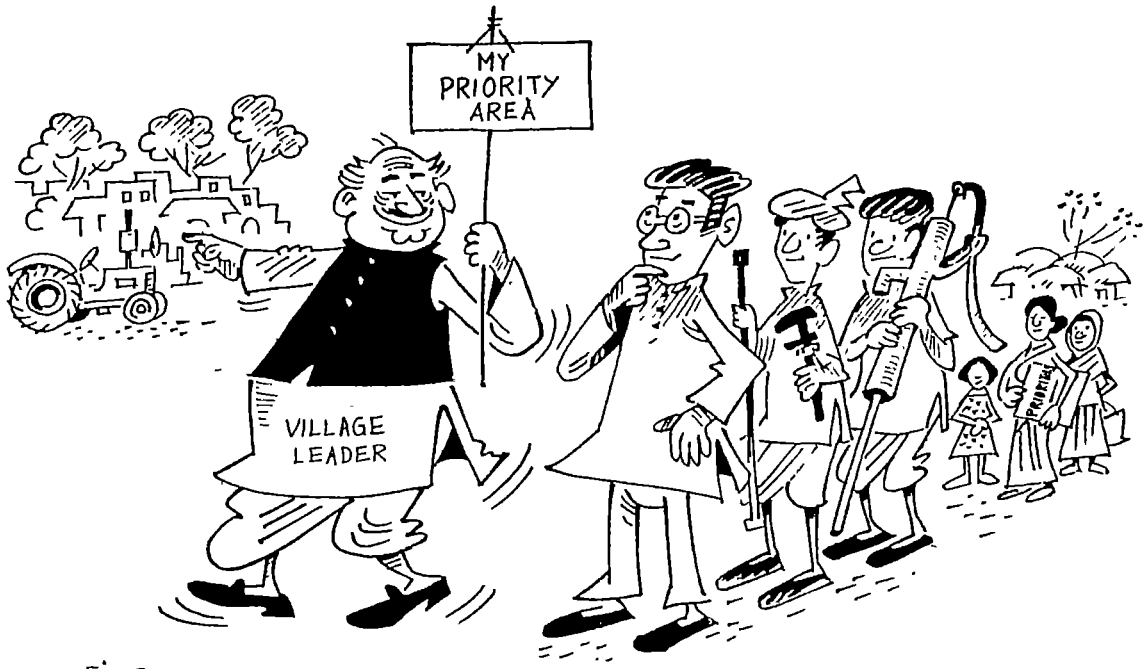


Fig. 5.4 VILLAGE LEADERS MAY HAVE PRIORITIES THAT ARE CONSIDERABLY DIFFERENT FROM THOSE OF OTHER GROUPS IN THE COMMUNITY.

TABLE 5.1

Three approaches to implementing drinking-water systems

	Agency managed (centralized)	Limited community involvement (people's participation)	Community managed (decentralized)
Flow of ideas	AGENCY ⇒ COMMUNITY	AGENCY ⇒← COMMUNITY	AGENCY →⇐ COMMUNITY
Basic assumption	Local people know nothing and can't learn new things	Local people have knowledge which can be used in design They can also provide labour for construction	Local people have management skills and quickly learn needed technical skills
How the need is realized	Agency decides community needs water	Local political set up decides community needs water	Community realizes own need
Who makes decisions	Agency	Agency and local leaders	Community
Strategy	Survey, design are done by agency staff Little time is spent in community. Design is done in office.	Survey is done by agency staff with advice given by local leaders on location of water sources, tank and tap stands. After design is completed in office it may be sent to community for information.	Community asks agency for survey. Local people assist and understand survey. Community makes decisions about design Design is prepared in the community, everyone is able to understand it
Construction	Construction is done by contractor hired by agency unskilled labour	Agency provides technician who organizes all work and does skilled work himself Community provides volunteer	Agency provides technician who teaches necessary skills. Community organizes all work
Maintenance	Agency provides for maintenance by placing own staff to look after own system	Maintenance is left for community to work out	Maintenance is organized by community who have skilled persons able to make repairs
Approval of designs Primary beneficiaries	Agency Agency–its 'good name' Contractor–profit	Agency Agency–its 'good name' Local leaders	Community and agency Community
End result	Dependence on agency	Continued lack of initiative	Self-reliance

Note: 'Agency refers to government or development agency which is implementing the drinking-water project

If water sources are too far away from hamlets for example, women are reluctant to carry the extra water needed for cleaning latrines.

Women are the managers of water and the managers of health. Not consulting them would almost certainly result in the failure of the programme.

Fig 5 5 COMMUNITIES WHERE TRADITIONAL SOURCES ARE POLLUTED CAN BE GIVEN HIGH PRIORITY FOR SERVICE.

In Kerala, women masons have been trained in latrine construction work by the State's Socio-Economic units (SEUs) in collaboration with the Kerala Water Authority.

ROLE OF THE GOVERNMENT

Generally speaking, the rural community in India has tended to regard the government and its representatives with whom they deal with as "providers" and "maintainers" of various facilities.

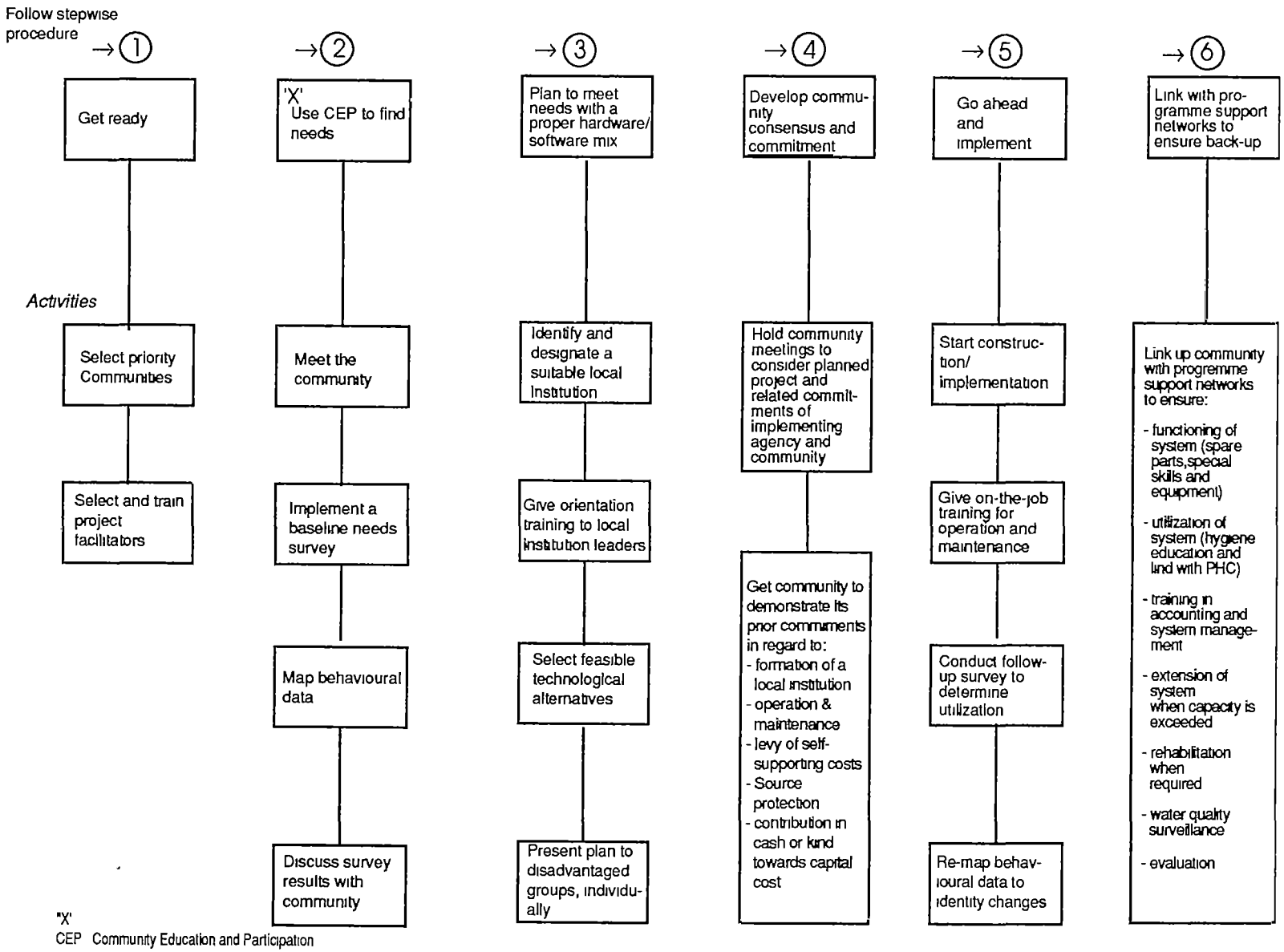
The role of the government, or more specially, its officials at all levels from village to the district would necessarily have to change from the attitude of "provider" to that of "facilitator" This means, the community as a partner in identifying and resolving water and sanitation problems Training and conscientization programmes for officials on a regular basis could be a useful step in reorganising the practical need for such a partnership.

More interaction with sociologists, village groups and non- governmental organisations would certainly help in suggesting new approaches to these officials as regards the community

In effect, if community participation is to become the foundation of water and sanitation efforts in particular and rural development in general, government officials need to be

- more open with the community

Table 5.2
Six-step planning procedure for community water supply and sanitation projects



"X'
CEP Community Education and Participation

- more accessible to them
- more willing to share information with them on aspects such as, what kind of technical, financial, institutional support is available to the community and above all.
- willing to interact with them on a day-to-day basis not merely as partners, but accountable partners

In purely bureaucratic terms, officials must be in a position to advise the community regarding the modalities and techniques by which the community can exercise its rights and seek redress of its grievances in the areas of water and sanitation. The government can advise the community:

- on the advantages of an integrated water and sanitation project
- on the various steps in a project cycle
- regarding the tasks involved in this cycle and how best the community could participate
- as to how a Village Water Committee could be formed and its possible composition
- in outlining its relationship (constitutional and functional) with other Panchayati Raj institutions
- by suggesting appropriate training programmes for community staff, and
- to identify and use with the help of the community, non- governmental organisations to act, where necessary, as intermediaries in these areas.
- as to how best water and sanitation issues can be incorporated into existing government schemes such as the Integrated Child Development Services (ICDS) or the scheme for the Development of Women and Children in Rural Areas (DWCRA)

However, this process of advice implies some change in the approach of government officials, who, by and large, still think of water and sanitation as two separate problems Again, the emphasis tends to be on hardware (handpumps, latrines, etc) or rather its presence as opposed to its optimal use. Software in the form of communication strategies and participatory training approaches must be given emphasis as vital means to the same end of better health and productivity of the community. So, until issues such as these are seriously addressed within the government, this partnership between the community and the government cannot be truly beneficial to either.

Fig. 5 6 Token Participation is not to be confused with active Participation In token efforts, the people are given no real choices, only standard designs that they must accept

ROLE OF NGOS

While approximately 144 non-governmental organisations (NGOs) are collaborating with the government in the area of rural water supply, there is no precise

indication of the degree of collaboration that exists in the rural sanitation sector. Research on the subject indicates that the response from the targeted groups, scheduled castes, scheduled tribes and other beneficiaries below the poverty line, is weak.

The reasons for these are:

i) An inadequate infrastructure to implement and monitor the programme;

ii) Financial backing is not sufficient;

iii) The poorest of the poor do not think that they need sanitary latrine.

So, even where latrines are constructed for the beneficiaries, they are often unused, serving in some cases as storage sheds.

The most important role that NGOs could play is as effective intermediaries between the government and the community. By and large, the fact that the staff of such NGOs are persons who have joined out of a sense of social duty makes them more motivated than the average government official. This helps to make the organisation more flexible in approach and dynamic in purpose.

NGOs, by working with the community, can;

- Create awareness regarding the government's water and sanitation programmes.
- Emphasize, through health education, the crucial need for the better health of the community which can be more assured through, safer water use and good hygienic practices.
- Help to create a sense of ownership of these facilities in the community through participation (in the form of cash and/or labour) in constructing and maintaining these facilities.
- Devise, in consultation with the community, appropriate training programme emphasizing the participatory approach.
- Help to carry out training programmes for government staff, on the basis of an understanding of the community's needs and aspirations.
- Serve to establish a closer and more effective working relationship between the government and the community - a three-way partnership.
- Reduce the financial and administrative dependence on the government through creating this sense of ownership.
- Emphasize the positive role that women can play in resolving water and sanitation problems and therefore, the practical need for them to be actively involved in all stages of a water and sanitation project - from identification through formulation and implementation to monitoring and evaluation.
- Help to create, as an intermediary, an effective network between the various rural development programmes operating in the rural areas - for e.g. DWCRA (Development of Women and Children in Rural Areas), TRYSEM (Training of Rural Youth for Self-Employment), DPAP(Drought Prone Areas Programme) and ICDS (Integrated Child Development Services). As water and sanitation issues tend to overlap virtually all such programmes, NGOs could suggest ways in which they could complement each other, such as for example, in the production of communication materials and in the holding of training programmes.

Most NGOs working in the rural areas would try to achieve the above objectives through interaction with the community on a day-to-day basis and through close contact with concerned government officials.

Fig. 5.7 FACILITATORS ATTEMPT TO CREATE A RELAXED ATMOSPHERE AND ENCOURAGE PEOPLE TO SPEAK. THEY FUNCTION PRIMARILY AS LISTENERS, WHILE COMMUNITY MEMBERS EXPRESS THEIR VIEWS ON COMMUNITY PROBLEMS.

The Council for Advancement of People's Action and Rural Technology (CAPART) was set up by the Government of India in 1986 The Council supports voluntary agencies/NGOs in rural areas through financial assistance related to the specific needs of the people and area.

NGOs risk creating an environment where the community begins to depend on them NGOs must try to avoid creating an "us" (community + NGO) versus them (government) situation Their role as intermediaries must avoid the exchange of one dependence for another. The idea of an equal partnership becomes important here.

CHAPTER - 6

HUMAN RESOURCE DEVELOPMENT

Human Resource Development means the professional including motivational development of the manpower engaged in a vocation, pursuit or practice in order to get optimum output from them This chapter is devoted to the issues emanating from human resource development for water supply and sanitation programmes in the country. While referring to water supply and sanitation programmes, three parties come into picture. (a) PHED which plays a very important role in improving the community health and quality of life as it deals with safe water supply and sewage facilities, (b) people or the functionaries who get benefited by these programmes; (c) professionals and trained manpower to deal with intermediate steps in course of execution of various programmes right from the stage of planning and conception of approach upto getting feed back.

PHED or Water Supply and Sewerage Board at the state level is responsible for investigation, planning, formulation and taking steps for implementation of water supply and sanitation programmes Installation of water supply schemes requires technical input Same is the case with its operation and maintenance in the long run because installation alone is not sufficient and it has to be duly supplemented by proper maintenance so that uninterrupted service could be afforded to the people. Apart from PHED, scientists and researchers who have specialised in this field also come to interact because they show improved or innovative ways of affording services and goods to the public with better efficiency and at optimal cost. Hence the need to emphasise on applied research and periodical updating of data and information so that new problems are duly informed, looked into and tackled.

At grass root level it requires an entirely different kind of approach because the water supply system is not merely a technical exercise of its installation but it has also to take into account the expectations of people and feedback from them.

INFORMATION AND COMMUNICATION

India being a typical example of developing countries with tremendous demographic handicaps like massive population, underdeveloped infrastructure facilities particularly in the field of health, sanitation, water supply, civic amenities, communication and low level of literacy resulting into general lack of awareness of the people, faces tremendous problems in dissemination of information and its acceptance by people because due to lack of awareness, the tendency of the people to believe what have been fed earlier and inbuilt resistance in accepting a new concept or a practice pose very difficult problems. In this backdrop, apprising general public of water supply and sanitation practices and matters relating to operation and maintenance of the installation is no easy task. For example, people affected with fluoride or arsenic poisoning do not really know that it is due to contamination of drinking water. The tendency is to ignore initial complications until it becomes unbearably serious health hazards. Such negligence results into further complications of the case. Hence the need to apprise the people even of something which is not yet prevalent but there is likelihood of its becoming prevalent or endemic.

As services with regard to health, water supply and sanitation etc. are essentially in social sector, the department cannot afford to function in isolation and yet achieve the task of reaching

out to people. They have to liaise with agencies which could be of help to them in their effort to afford reaching different services to the people. Hence the need to have a forum where people are drawn from different walks of services viz. PHED, Chemical Sciences, Social Sciences, Nutrition, Medical Sciences and the like who could appreciate the problems in wider perspective. It requires professional skill to deal with problems which relate to this sector. Since they do not come from uniform background, they require adequate reorientation to professionally manage the programmes to ensure that same reaches the target group in the desired fashion. In this chapter, issue of the professional reorientation and training needs in this regard are dwelt upon.

THE NEED OF TRAINING

Safe and adequate drinking water and proper environmental sanitation play important role in implementing the community's perception of health and hygiene. These basic amenities have to be provided at cost effective norms with scope of adequate operation and maintenance at the local level. It would, in effect mean decentralisation of the operation and maintenance which would particularly suit the vast rural areas of the country. The professionals engaged therein have to be trained and made aware not only of the technical advancement but also of the need of the people. In addition, they also have to acquire skills of approaching people with right perspective so that they not only do not antagonise them but they also become accessible with the new approach or idea. For this purpose, those who are already working in the field should be brought periodically for such refresher programmes which could update their knowledge about modern innovations and advances in science and technology.

This being a specialised task, there has always been a gap between demand of trained human resources and its supply. In fact this has prompted the VIII Plan Working Group to deliberate on the availability of trained manpower and upgradation of their skill to ensure better services to the people. The Working Group had recommended that training network involving such institutions at different levels has to be designed and developed. There has also been an observation that the human resource development is an organised learning experience in a definite time frame to increase the possibility of iimproving job performance. Learning experiences cover learning related to the present job, learning to prepare the individual for different but identified jobs including jobs involving new techniques and learning for growth of the individual.

In view of the limited financial and human resources coupled with demographic handicaps, diverse geographic climatic, socio- economic and cultural conditions, remoteness and even inaccessibility of the areas, different sources of water supply in different areas and inability of the centralised services to reach all these areas, there is a need of development of special skills and knowledge at various levels of personnel engaged in RWSS sector so that they could become effective media of delivering goods and also of attending to activities related to community involvement, health, education and sanitation. This also needs training and awareness among village level functionaries in particular and the rural community in general as they were expected to be involved in the process of administration of water supply and sanitation management at the micro level. Such a training is also needed to sensitise them to ownership of assets created and related issues. The most critical need is to convince the community for a behavioural change involving change in outlook that is, shift from traditional perception and generating consciousness about importance of participation and involvement in the process of operation and maintenance so that the assets created under various government programmes are perceived as their community asset and utilised optimally.

HUMAN RESOURCE DEVELOPMENT OF PROFESSIONALS

Water supply is often perceived as a high technology, high investment venture designed on a large scale and of course, designed to cater to the needs of a large section of the population But the high technology, high investment, bigger schemes have got certain disadvantages. Particularly rural India is comparatively inaccessible or is accessible with difficulty and where the concentration of population is not as much as in cities or urban agglomerations. Therefore designing a water supply system for an urban agglomeration is different from designing a scheme for a rural area from various points of view including the scale of the works envisaged at the the level of technology employed in these designs particularly concerining operation and maintenance, delivery system, financing the scheme and later, technical care of the entire installation. This whole exercise usually results in a high cost project with an unintended preference for creation of hardwares first which infact leaves the impression that the project was not prepared properly at the planning and conception stage. The project did not take into account, the needs of human resource development. It has often been observed that the formal technical education which usually ignores the low cost technology and related social science inputs results in practising engineers concentrating on high technology, high investment, large scale schemes. Perhaps this is inevitable because high tech schemes mean bigger challenges from technical point of view which give them greater professional satisfaction Ultimately it leads to a clear preference for a formal system which reinforces formal technical education. Not surprisingly even the non-technical decision makers at all levels also get used to this kind of conceptualisation and for them too, it is not easy to inculcate preference for low cost solutions for a variety of reasons which could be administrative, political, social and even cultural.

Although preference has come in for large scale schemes involving modern technology and high investment, it has also been observed that there has often been little understanding of low cost technologies for water supply and sanitation which are no longer in an experimental stage but have been sufficentely tested in the field.

Low cost technologies are quite often assumed to be obsolete. It it even misconceived that these days designs are based on primitive technologies These are not looked upon as devices which are competent to provide services at optimal cost. Certainly this is not to suggest that all the low cost technologies available are desirable to be employed in public service but to dub them obsolete would as well be a sweeping statement.

However, the human resource development of professionals engaged in technical exercises in the field of rural water supply and sanitation poses a set of specific tasks which are indicated in ensuing paragraphs.

Training of professionals in conventional water supply works As a matter of fact, most of the programmes in this sector are executed by the technical department, mostly the PHED or Water Board of the state /UT. They employ trained engineers who undertake investigation of a proposal, its planning and project formulation. Finally when the project is approved, the department also takes up its implementation in accordance with the official procedures. After having gone ahead with the installation of schemes, the department also comes into picture as the professional agency in charge of operation and maintenance. But operation and maintenance at grass root level, particularly when the services are thinly spread over a large area is not an easy task. It is comparatively an easier proposition for bigger installations but certainly not for a series of micro level installations. Therefore there is a need to train

local people to undertake preliminary repairs in order to ensure proper operation and maintenance of the assets and such other micro- installations which are not very complicated.

The problem of Micro level Water Treatment There have been reports of various types of contamination of drinking water which render the water source unsafe. Hence, before providing the water supply the water has to be treated. There are conventional treatment plants and methodologies. But the real problem crops up when treatment is sought to be for micro schemes like handpumps, dugwells etc. For example, chemical contamination by fluoride, arsenic, nitrate, iron and the like could be tackled comparatively easily if it relates to big plants. But the problem arises when these have to be tackled for village installations spread over a large area and are not easily accessible and communicable. Until recently, there were not many reports about contamination by fluoride. But now under the RGNDWM, efforts are being made to make people aware of the consequences of taking water contaminated by fluoride. In addition and treatment methods are also suggested to remove excess fluoride from drinking water. Similarly reports are there from certain parts of the West Bengal of contamination by arsenic and this problem too is being researched into. The Rajiv Gandhi National Drinking Water Mission has taken steps to stablise the treatment methods to remove excess iron from water and to remove brackishness of water. All these require frequent interaction with latest innovations in the field which would also result in the need of update for personnel and equipping them periodically with all the latest information. Hence the need to train them is a continuous one and not a one-time job. It is an ongoing process There are three levels of personnel involved in this field, firstly, it is professionals of the department or the engineers who would require a particular type of training and because of their technical background, they would be able to appreciate with greater comfort the latest researches and advancement in the field of water treatment, installation and maintenance. Next is the level of those who attend to operation works at the shop floor level. Whereas they may not require particularly theoretical background, they would certainly require "on-the-job-training" for dealing with maintenance of sophisticated installation or even new improved installations at micro-level. And finally at the grass root level, the local people with absolutely non technical background will have to be trained in order to make them aware of the practices with regard to use of assets, their maintenance at micro level and undertake minor repairs of defects which could be tackled at the grass root levels. Of course, the bigger defects involving specialised technical skills will have to be reported to the higher level.

Creation of awareness and dissemination of information

As mentioned earlier, the entire quantum of information concerned with implementation of programmes in water supply and environmental sanitation includes the technological upgradation in the existing installations of water supply and sanitation schemes, stabilisation of techniques of water treatment and distribution of other technical and professional inputs besides sociological inputs like proper dissemination of information with regard to the use of assets, use of services, their maintenance at the micro-level and other matters emanating from general water supply and sanitary habits at individual's level.

The dissemination of information with regard to community water supply and santiation programmes has three aspects which are indicated in brief in the succeeding paragraphs.

1. Ownership and Protection of Assets

This would include steps for protection of installed assets like handpumps, treatment plants etc. at the village level and creation of feeling among the members of the community that the services derivable from the assets are easily accessible to one and all without any discrimination, fear or favour. To achieve this objective, the people have not only to be informed well before taking up of the schemes; they may even have to be involved in identification of place or site for installation or drilling. It would gradually let in the feeling that the asset belongs to them. It has been the matter of experience that if the community is not taken into confidence, the object or the asset which is created under any scheme is usually perceived by people as something like a government property and in practice it is treated like an orphan. Once the community gets a feeling that the assets belong to them, it arouses the idea of taking care of it at the level of community itself. This could result in better operation and maintenance at the grass root level. People or the villagers could be trained in light mechanical works so that small defects in handpumps etc could be promptly rectified at their level itself. This would lead to the feeling among the people themselves that they not only own the assets, they could also repair it to their satisfaction which would help in maintenance of uninterrupted water supply.

2. Awareness about Environmental Sanitation

A very important aspect of communication is creation of awareness with regard to environmental sanitary habits. Cleanliness is an elaborate concept and it is not confined only to the use of safe water. In fact, the concept of cleanliness is a complete practice emanating right from the first activity of the day and continues all through and includes such seemingly insignificant things like cutting nails on time, washing clothes, disposing of effluents away from the handpump, maintenance of its platform; some know about safe water like saving it from contamination, use of clean hands, better sanitary habits, not allowing water to stagnate and serve as the breeding centre for anopheles mosquitoes etc. Whereas it is easy to say all these things, it is difficult to convince a villager because it involves attitudinal change The problem gets aggravated particularly when it is attempted to suggest an altogether new practice. Many communities lack the background knowledge that links improved health with better disposal; of excreta, which, being a part of the basic pattern of human behaviour, may not easily be modified It is under such circumstances the job of creation of awareness and communication becomer extremely tender, challenging and difficult.

3. The Carrier of the message

The objective of the message alone is not sufficient. The person who carries these messages to the people is also important Therefore the person who explains to the community or leads them towards change in water and sanitary habits has to be acceptable to the people and the people must feel that he is from among them. Otherwise, his words will not be heard, believed and followed This demands a certain amount of preparation and also makes the job itself somewhat professional because unless one is duly trained to tackle this very tender issue, he won't be able to drive the points home. And once the community is taken into confidence, things like reporting of breakdowns, taking initiative for major repairs, reporting bigger defects promptly and organising initial rectification activities will all depend upon how the community has received the message and the messenger

Training

As it has been elucidated above, training is a very important component in the whole attempt of human resource development. It has to be in three stages Firstly, training has to be designed

for the people at the conceptual level so that the changes required are evolved after adequate deliberations and necessary changes in the scheme itself are suggested without compromising with the basic objective and the quality of work. Secondly, training has to be arranged for the trainers who will train at the subsidiary levels and even at grass root level And finally, training has to be organised for the people who would work at the grass root level to deal with day to day problems which may or may not be significant contentwise but are perceived intensely. On the basis of people involved in water supply and sanitation schemes the training can be conceptually categorised into three broad groups.

1. Decision makers training Apart from training with regard to project formulation, implementation and maintenance and information and communication with community as a target group, it is of immense importance that the decision makers of any system are also equipped to take such decision which involve not only the change in financial, administrative, technical and perhaps political inputs but also the attitudinal changes. Under a given circumstance an option of going in for a particular technology may be an optimal choice. But the same may not help in another set of circumstances. Therefore, at any given point of time a decision with regard to either the policy or the execution of programmes under a declared policy shall have two basic dimensions. Firstly, the financial part of it including its recurring expenditure and finally the optimality part i e. whether it is desirable to have. Although sounding paradoxical it is true that sometimes a decision has to be based not essentially on the most desirable option but perhaps on an option keeping in view the contingency which is most likely to occur in future which underlines the need for perceptive appreciation of future probabilities. The premises on which a decision is taken with regard to welfare sector concerning the general community life may undergo change over a period of time and may even warrant revision of the policy itself with passage of time. Therefore it is absolutely necessary for the decision makers who are the administrators of the programmes to have full knowledge of the changing scenario, various technological options available, various financial options available, various options with regard to pattern of implementation that may be available and also options available with regard to possible alternative models to approach people and to convince them, that is to say, the medium of dialogue with people. This becomes little more pronounced when we talk at macro level. But programmes related to micro schemes may require elasticity to suit under diverse cultural, geographic and socio-economic background. Therefore, the pattern which would be successful in one part of the country may not essentially be suitable for another. And these things have to be properly analysed before deliberating upon the policy decision and also with regard to decision on implementation so that the decisions ultimately arrived at are not only free from fault but are also relevant, apt and opportune. This can be developed by way of suitable training requiring specific inputs mainly at conceptual level. Hence the need to train the administrators or the decision makers.

2. Technical Training: The information with regard to the research work particularly applied research which adds to the body of knowledge as far as technical know how is concerned or even results in technological upgradation of existing level of knowhow are mostly available at the level of university teachers or accredited institutions and professionals in the field. But the research findings may require rigorous testing in field conditions to make the module acceptable there. There are extremely developed and well researched technical modules. But a large portion of technical manpower including practising professionals and teachers is not fully aware of these advances. Therefore, there is a need for training of technical hands who would be drawn from various sectors like PHED, groundwater board, university teachers and from related fields like

medicine, nutrition, chemical sciences, fabrication, maintenance etc After having organised the training at the highest level to facilitate dessemination of conceptual information there has to have a cascading effect of the entire effort so that the message percolates down to those who translate these postulates into reality. In other words, it should percolate to those who are in charge of execution of schemes including those who are dealing with it at the grass root level.

3. Sociological Training Needs of the society are best evaluated by the society itself. However because of lack of complete information, the society at times may feel handicapped in this function because the premises on which it takes a decision may not always have empirical proof. Society may not be fully aware of the services or assets which could be optimally used to its benefit. Therefore there is a need to take into account the gap between the social perception and social developments. After evaluating the development in the field of technology, the modules to take those changes to the people will have to be prepared. Since it is crucial to approach the society in the right manner, the social scientists have to be trained how to approach the community with these messages of change. This indicates the need to inculcate the social science aspect in the entire training content and also in the course of project formulation.

In addition to aspects emanating from rural sociology like social mobilisation, pattern of social interaction, peoples' participation particularly womens' participation, culture, customs, taboos, habits and other social institutions and institutional preferences or barriers etc. also need to be kept into consideration while attempting to approach the society with a message which may require, interalia, attitudinal change

In a nutshell, one has to be adequately trained in communication, flow of information and confidence building among the community so that the weaker aspects of individual and community life are explained and well received.

One time efforts alone are not sufficient because the gap in research and development and actual practice remains almost a constant phenomenon despite the process being a dynamic one. There is a need for periodic updating of information as far as practising professionals are concerned This would apply to both social science and technical professionals. Hence the need for refresher courses periodically.

ITN ACTIVITIES IN INDIA

India has been selected as one of the countries where programmes under International Training Network (ITN) are to be taken up for implementation of human resource development activities. The programme in India has the following objectives:

- to develop in existing sector personnel, adequate conceptual appreciation, technical skills and capacity to motivate others
- to ensure that technical personnel understand and can apply the relevant technical developments
- to provide a system of regular in-service training to refresh and enhance current knowledge
- to familiarise staff with appropriate low cost technologies specially suited to conditions prevailing in the country

- to train grass-root level people to operate and maintain water supply and sanitation systems in rural areas:
- to bring about participation of communities in the planning, implementation, operation and maintenance of RWSS systems
- to develop a cadre of trained trainers and high quality training materials and to strengthen existing training institutions to implement the objectives listed below

    - Adequately strengthening existing technical staff at various levels especially in the States by carefully selecting institutions of repute as ITN Centres giving representation to various regions of the country
    - Following the general approach provided by ITN with necessary modifications to suit local requirement.
    - Integrating to the extent possible the activities of other Missions and organisations with ITN as far as HRD is concerned.

Proposals - Training Programmes

It is in the context and objectives of training through ITN in India, that the future proposals for the training programme under ITN and also the need for supporting services to integrate various activities at the central level are to be made.

For the ITN to be effective and successful, activities have to be seen in their proper perspective and have to be integrated with the rest of the human resource development activities within water supply and sanitation sector and with similar activities in related fields. Proposals therefore will draw heavily from the lessons learnt till now from various sectors and will also take into account short term and long term objectives of this sector.

To meet these requirements, the training programmes will try to equip the functionaries at various levels including those at the village and block levels. As a long term objective, it is proposed to introduce training for functionaries in Engineering Colleges and Polytechnics with the objective of bringing in necessary changes/additions in curriculum to incorporate the developments in the water supply and sanitation sector. The proposal is therefore directed at three levels as follows:

Training of District Level Trainers

First level of training will be for the selected mix of officers at the district level from PHE departments, Health departments, Social Welfare departments and Educational institutions of the district. This training will be done in batches of 25 trainers at one of the identified key institutions. The idea of bringing these groups is for close interaction and for developing each trainee for tackling various aspects of skills which are not readily available with them. During the training, they will get necessary skills to train grass root level workers in handpump maintenance, masonry work, for sanitary toilets and handpump platform, drainage construction work, pipeline fitting, pump repairs, health problems and also ability to repair equipments like defluoridation plants, and desalination plants. About six trainees from each district will be selected and given training as trainers in courses of six days duration. During the training, the trainees will also be familiarised with this Volume, which can be used by them as a reference document for day-to-day problems.

We need to train around 3000 district trainers in 10 key institutions to be equipped to perform this task in about six month's time.

Training for Village and Block level functionaries (Grass root level workers)

The 3000 trainers so trained will be the resource persons for training the village and block level functionaries. These functionaries will be withdrawn from the field level staff of PHED and local institutions including NGOs. The focus of the course of training is proposed to be Operation and Maintenance of various systems we use Other aspects like health, public participation etc., will also be covered in the courses The training will be of four days, duration and in a year 1,25,000 persons can be trained which would be nearly one-fifth of our requirement of achieving at least one trained person in every village.

Training for Professional Staff

The key institutions which are involved in the development of training programme for district level trainers will also provide training to the technical staff in the Engineering Colleges and Polytechnics as well as Public Health Engineering Departments on low cost water supply and sanitation technologies. Health, education and community participation will be covered as refresher courses It is expected that about 2500 persons will be annually trained in the 10 identified institutions. The State Governments and bilateral and multilateral agencies will also contribute towards development of training programmes.

Training Institutions

It is very essential to develop appropriate training institutions to impart training at various levels. While selecting the institutions to work with the National Training Network Programme institutions involved in similar training programmes earlier have been given preference. Similarly, those institutions who attend to work in the rural development with emphasis on development of human resources in the villages have been given preference. The broad functions of these institutions are:

1 To conduct refresher courses, short term courses and intermediate level courses in rural water supply and sanitation programme.

2 To conduct training for the trainers.

3 To undertake in-service training courses for senior level officials and professionals.

4 To design and run specialised courses directly or in association with the spècialised institutions.

5 To undertake action-oriented research and development in low cost appropriate technology suitable for rural water supply and sanitation and

6 To develop training materials using a range of media.

So far seven following institutions have been identified including the ITN Centre at Calcutta.

All India Institute of Hygiene and Public Health, Calcutta - ITN Centre

Gujarat Jalseva Training Institute, Gandhinagar - Key Institute

Environmental Sanitation Institute, Ahmedabad - Key Institute

SJ College of Engineering, Mysore - Key Institute

Gandhigram Rural Institute, Gandhigram - Key Institute

Institute of Engineering and Rural Technology, Allahabad - Key Institute

Motilal Nehru Regional Engineering College, Allahabad - Key Institute

Apart from seven these institutions, three more institutions are being identified to expand the training programmes. These institutions could be located in the following places to give coverage of the country more evenly, one in North Eastern region at Guwahati, second in Northern region at Delhi and the third in Central India possibly at Nasik Maharashtra.

Role of RGNDWM and other organisation

The RGNDWM in the Ministry of Rural Development, Government of India will play the major role in implementing and coordinating the human resource development plan and training programme It will be supported as required by PHED/Boards/State Governments and block/ village panchayats and International Organisations.

Proposed - Reference Centre

Science and Technology has been an integral part of the Mission activities. In order to bridge certain gaps and certain shortcomings in the programme a number of research and development activities are going on in the country Though, the R&D activities are going on, proper documentation of the good work being carried out is still missing. Apart from this, there are a number of field level researches going on in the country. All these require proper documentation and dissemination on a regular basis to the implementing agencies attached with the State Governments, Voluntary Organisations and even general public.

There are a number of developing countries which are also engaged in the research and developmental activities leading towards low cost appropriate technologies to be adopted in the rural environment. The documents/information made available are generally lost in the rush of work or are not readily available whenever asked for. All these suggest the need for creation of a reference centre where the information/documents could be stored and retrieved whenever desirable. It is planned to have a full fledged reference centre at the central level to support the Mission activities. The reference centre will aim towards:

- Collection of data/information from various sources such as Research Organisations, State Agencies, Voluntary Organisations, Field Level Agencies, International Organisation etc.
- Documentation of the data/information available from various sources
- Recording of the data/information into various sub heads to facilitate early retrieval

- Making available the data/information whenever desirable for further research, information and implementation of the programme.
- To making available the data/information to whoever desires such information.This will include Research Organisations, State Agencies, Voluntary Organisations, International Agencies etc
- To circulate a quarterly "News Letter" indicating the activities carried out by the Reference Centre with specified emphasis on the findings of the last quarter. This will lead to annual report indicating the short write ups on the findings during the year.

Expectations from International Training Network (ITN)

In the strategy and programme outlined above, the ITN has an active role to play in the overall development of human resources for the sector. The global networking should be able to help in developing and nurturing a Reference Centre for supporting the activities of the RGNDWM. Networking should help to learn from many of the successful and even not so successful experiments on various aspects of water and sanitation taking place in both developed and developing countries.

CHAPTER - 7

EVALUATING IMPACT OF DRINKING WATER SUPPLY AND SANITATION PROGRAMMES

There are very good reasons for evaluation which can be listed as follows;

- to justify the resources spent
- to determine the benefits
- to provide a mechanism to measure improvements

Since safe drinking water and sanitation are related to improved health, the desired impacts can be evaluated by monitoring the following indicators;

- Changes in people's understanding of health matters
- changes in people's attitude towards health matters
- changes in people's behaviour
- improved social conditions
- improved health status

Also, monitoring by external agencies tend to be inconclusive and more accurate evaluation is possible,

- by health educators or others engaged in the health education programme
- by people themselves
- by implementing agencies (construction teams)

The involvement in evaluation helps both the health teams and the implementing teams to know their own worth. Since the health impact from a project is slow in getting crystallised, an implementor evaluation generally indicates positive results even when a health team evaluator does not see any. So, the training of evaluators should provide for this differential to avoid wrong or unjustified conclusions.

The community also should be involved in the evaluation. This

- Overcomes common reluctance of villagers to speak freely about a project
- Results in improved use and maintenance of an integrated system
- Results in increased likelihood of long term health benefit
- Results in making data collection easy because community helps.

It is quite simple to understand what is to be evaluated. These can be

(i) Simple indicators:

- Whether the new facilities are working properly
- Whether they are accepted, used by the target community/others.

(ii) Behavioural change indicators:

- users are satisfied with new facilities:
- Maintenance of facilities is good
- Community displays knowledge of health matters.

(iii) Indicators of actual improvements in hygiene practices which show up in

- water use and water management
- hygiene and sanitation at the water use point
- kitchen practices
- Cleanliness of children

(iv) Indicators like

- What was learnt
- What was taught
- By whom
- Where, and to whom
- How

While it is simple to evaluate the impact of water supply and sanitation projects, it is equally simple to make assumptions and mistakes leading to wrong conclusions. It is necessary to avoid:

- Failure to evaluate even at a simple level
- Evaluations based only on measurement of effort and activity and not on impact and change in the community
- Failure to produce evidence which will strengthen and continue health and hygiene education
- Reluctance to carry out evaluation of failures (and reporting on them)
- Demonstrating that change has taken place, but provide no evidence to link the water supply-sanitation-health relationship
- Giving inadequate descriptions of the programmes, thereby making it difficult for others to assess them
- Not sharing with others the evaluation of success or failure
- Not allowing opportunities for participation in the evaluation process by other interested workers or the community

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