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FOR THE MILLIONS

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Water & Sanitation : and miles to go ...

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Contents

Our regular features have been dropped in this issue. We will resume them with the December issue.

EDITORIAL

As the Water and Sanitation decade draws to a close, there is pause for reflection. The objective of providing every Indian village with at least one safe drinking water source was an awesome challenge faced, especially when so little was known about what existed and the quality of water drawn from it. Harnessing what already existed in the country in terms of scientific and technological resources proved a major strategy for reaching the targetted objective. Backed by a multi-layered information system variously geared for use from village-level to central monitoring, science and technology drew within its ambit a whole gamut of approaches : hydrogeological surveys, drilling rig technologies, handpumps of improved varieties, plants for removing excess iron and fluoride and various water quality testing technologies from the portable to the stationary. Somewhere along the line, the need for social scientists was felt to bridge the gap between the provision of a safe water source and its cultural acceptance by the people. And in establishing the linkage between good health and clean water, its clean storage and use, the role of women assumed greater significance as chief decision-makers, users and protectors of a water source they made their own out of choice.

To influence choice when choice itself is embedded in deeply entrenched traditions must of necessity follow a slow and sensitive course. For a villager, purity is ritual purity, not chemical or bacteriological. This was best exemplified in a village in U.P. where water in a well is purified by removing a given number of buckets of water from it after a human being or animal is discovered to have drowned in it. For a village woman, as pointed out in this issue, water is clean if it looks clean, tastes sweet and is soft for cooking even if it comes from a highly polluted surface source. Clean handpump water could be rejected simply because it has a mineralised taste or is too hard for cooking. The entry points for influencing choice must therefore be thoroughly sensitive to a woman's needs. Where she wants the handpump is one important yardstick for facilitating use. The second suggestion made in another article is to work on raising awareness in a woman to a point where she can see that unclean water is'nt simply a carrier of germs engendering mild fevers and colds but a major killer of children through diarrhoea. Only as a major user, can her services then be sought in preventive maintenance. In the midst of bringing major interventions into people's lives, traditional systems of rendering water potable cannot be ignored either. As pointed out, safe water and the ubiquitous handpump have become so synonomous that traditional methods of rendering surface water safe through community slow sand filters and within homes have been neglected. Also, already existing sources that could be used again with repair were neglected in favour of the handpump.

Sanitation was tackled as well but with considerably less success. Between an expensive piped sewerage system which is exclusively urban-based and insanitary or non-existent sanitary conditions, a whole improved system of low-cost sanitation still awaits assimilation. Perhaps the answer also needs to be sought in what responsibility we assume towards the safe disposal of our wastes.

-- ***Neera Kashyap***

FOREWORD

Water is essential for survival and safe drinking water is necessary for good health. Lack of enough water in our body results in dehydration which in its extreme state can be fatal. Contamination of drinking water, with a variety of infective agents, is the major cause of morbidity and mortality of the people in our country and several other nations of the world. Growing population, deteriorating environmental conditions, poor sanitation and illiteracy add to and aggravate the problems related to inadequate water.

The issue of availability of adequate and safe water to the population has wide dimensions. I may stress that if, with the collective efforts of the people and the government, our population can be provided a minimum amount of its safe water requirements, several common diseases can be prevented. Such an approach will be worthwhile not only from a humanitarian, social and medical viewpoint but also from an economic angle as prevention of illness in countries where health care is the responsibility of the Government, results in substantial financial savings on the eventual treatment of illness.

There are several diseases which spread through contaminated water. Diarrhoea, including cholera, typhoid and jaundice, are three major water-borne diseases which top the list of the causes of ill health and high death rate in the developing tropical countries. They can be prevented by personal hygiene and protecting the drinking water from natural and man-made contaminants.

It is not lack of water but poor management of the available water which often results in large scale outbreaks of deadly waterborne diseases. While all efforts should be made to increase the availability of water, adequate attention to the following points is very essential:

(a) Prevention of contamination

(b) Proper "treatment' for drinking purposes

(c) Safe and equitable distribution

(d) Control of waste; and

(e) Personal hygiene at the point of utilization

In this issue, experts, have provided useful information which will help our readers to promote the management of safe drinking water and thereby supplement the efforts to achieve good health for the millions.

According to Indian philosophy, cleanliness is next to godliness. Poor sanitation is a major cause of ill health in the developing countries. Total intertia, no concern for inconvenience to one's neighbour, little public accountability and wrong conviction that it is only the government's responsibility to look after sanitation are the major factors leading to increasing environmental pollution and its adverse effects on health. Dissemination of information on sanitation through this issue of the magazine should help to stimulate and motivate the people to participate in improving sanitation.

-- Prof. B.N. Tandon,
Dean, All India Institute of Medical Sciences.

Women and Handpump Maintenance

With almost a million handpumps installed throughout the country, efforts continue to bring about improvements in the cost and operational effectiveness of a standard handpump. One result has been the recent birth of the VLOM handpump (India Mark III). Dr. J.C. SRIVASTAVA describes its enhanced benefits and the integrated system envisaged for its maintenance. With its reliability established, he hopes for a major participation of women in its preventive maintenance in their role as chief users and protectors of a water source.

In view of the physical, geographical, ecological and social diversities of rural India, reaching the maximum number of water-starved areas within the shortest span of time and with limited resources has been a challenging task. The community handpump water supply system has emerged as one of the socially acceptable and most cost-effective solutions. The following table shows the comparative costs of three significant systems of water supply in villages in India (Department of Rural Development, Government of India, New Delhi 1987).

Spot Source	Average per capita capital cost (Rs)	Operation and maintenance cost per litre of product water (Rs)	Power consumption per day of operation (KWH)
1. Open dug well	93.6	Negligible	-
2. Deepwell handpump	100	--do--	-
3. Piped water supply with public standpost	437.5	0.14	45

In view of the advantages of deep well handpumps in terms of installation, space requirement, uninterrupted supply of safe water and scope for decentralised maintenance, more and more people have started adopting it on a wide scale through drilled/bore wells. In many cases, the top of the dug wells were sealed and handpumps installed to obviate contamination. In the recent drought in India (1987), installation of handpumps had become imperative. Today, close to a million such pumps have been installed throughout the country. The scope of handpumps has been further enlarged as plants for the removal of excess iron and excess fluoride have been attached to them. Close to 5000 such community plants will be installed in the villages of India by 1990-91. The end objective, however, has been to achieve village level operation and maintenance of the handpumps by users themselves with technical support from water engineers.

India Mark-III VLOM Handpump

Since the development of a standard handpump (India Mark II) in 1976-77 continuous efforts are being made to bring about improvements in reliability, simplified operation and maintenance, cost reduction and standardisation. As a result of intensive R & D efforts and field trials, the VLOM handpump (India Mark III) took birth in 1987-88. The Bureau of Indian Standards has since prepared the code of practice for installation and maintenance of the VLOM handpump which is in the process of being finalised.

The significant features of the VLOM when compared with the standard model (India Mark-II) are as follows (UNICEF, INDIA, 1988):

1. Its repair takes on an average 50 per cent less time mainly due to easy access to below ground components. For example, for a 30 metre depth installation of the standard pump, the time taken to change the worn-out cup washer is about two hours as the riser pipe has to be removed; in case of VLOM, the riser need not be removed for replacing the cup washer, this taking just 30 minutes and without much strain.
2. It requires only five simple tools for repair, easily carried on a bicycle carrier with repair carried out with the help of one addtional person.
3. Its reduced spare-part replacement frequency directly leads to reduced annual spare-parts costs: the respective cost figures arrived at during comparison are Rs. 268.60 a year for VLOM as against Rs. 437.50 for the standard pump.
4. Its modified construction obviates the need for removing the handle assembly during repair.
5. Lifting of its connecting rod is easy as the movement of the upper

valve is arrested by a push rod thus avoiding lifting of the water column.

Shallow well handpump

To make the handpumps further cost-effective and women and children friendly, a modern shallow well handpump (operating up to a depth of 7 metres) has been developed (at the instance of the Mission) by MERADO (Madras), a mechanical engineering research organisation of CSIR. The prototype pump is now under extensive field trial and likely to be commercially produced soon. It is essentially a suction pump with (i) valve and plunger components made of plastic (corrosion-free and cheaper in cost); (ii) valve of sliding poppet design; (iii) fabricated pump body; and (iv) a top bush ensuring straight vertical motion of the plunger. Being cheaper than the India Mark-II family, it has potential for adoption as a family-owned handpump, thereby reducing the pressure on community handpumps. Field trial of the 'Tara' pump of Bangladesh is also in progress in India.

In areas with good rainfall, roof catchment rain water harvesting and water storage in ferrocement tanks have been introduced with the involvement of rural women, as a supplement to handpump water supply.

Integrated maintenance system

The community handpump being a mechanical appliance installed at an open spot for free use, it is subject to all sorts of handling and misuse. Also, any poorly maintained system suffering frequent breakdowns and delays in repairs loses its appeal and forces users to go back to traditional sources with all the associated hardships and health hazards. In view of these problems, an integrated management system for handpump maintenance was envisaged by:

i. ensuring availability of required manpower, technical supports, users' participation in handpump maintenance;
ii. exhaustive training of willing rural youth/artisans/women;
iii. an efficient supply of quality spares and a conveniently located delivery system to sustain village level maintenance and repair operation;
iv. state government's vital supervisory and technical support role;
v. operation-worthiness of the handpumps especially in critical seasons through a periodic verification plan;
vi. community participation with the involvement of women for maintenance and quick reporting of defects;
vii. environmental sanitation;
viii. awareness generation about the relationship between water and sanitation;
ix. cost-consciousness.

At present, varying types of

Credit : J.C. Srivastava

handpump maintenance practices are in vogue in different states of the country. In an attempt to ensure a viable maintenance system based on local conditions, pump population and limited financial resources, a two tier system was chosen. It consists of a mobile team staffed with mechanics at the Block level (covering about 100 villages) for 500 handpumps (as per present norms, one handpump is installed for 250 persons) and one caretaker for each pump at the village level. Here, the maintenance duties are shared between the village caretaker and the Block team. This system involves regular, routine and preventive maintenance. Since each handpump is numbered, the Block team can easily identify the location. In some states, the Block team makes regular inspection of all handpumps irrespective of any report of failure.

A voluntary agency (SWRC, Tilonia, Rajasthan) has introduced a one tier maintenance system where a local youth with technical aptitude is trained to repair handpumps. The trainees are provided with basic tools and assistance in obtaining bank loans for the purchase of spares as self-employed workers. Women have also been trained as handpump mechanics under this system. This model, however, has remained localised.

Preventive maintenance and the caretaker

A handpump caretaker at the village level is a volunteer who is either identified or nominated and then trained. This volunteer, generally a self-employed individual, attends to above-the-ground preventive maintenance and reports handpump breakdown to the Block team. Vital importance is attached to the selection of this caretaker by water engineers since he/she is the important link between the handpump and the Block mobile team. The caretaker is supplied with the required tools and stamped postcards for quick reporting and paid an honorarium of about Rs. 220/- per handpump per annum.

The preventive maintenance tasks expected of the village level caretaker include:

1. inspection of the handpump unit including the platform and drainage arrangement;
2. opening up the top cover, cleaning the moving parts with wire brush and kerosene oil and lubricating them;
3. removing the top nuts, bolts and washer and cleaning and applying protective grease;
4. inspecting and cleaning the platform and attending to waste water disposal arrangements and to simple repairs;
5. operating the handpump to check whether the discharge is normal and the pump is working smoothly;
6. checking the water quality;
7. assessing the water-table in the tubewell by ascertaining water level in other sources in the village;
8. reporting to the Block team for any failure. Preventive maintenance also includes environmental sanitation, chlorination of borewell, water quality testing and surveillance. At the instance of the Mission, a portable water quality testing kit has specially been developed to indicate (through visual colour comparator test) whether the quality of water is acceptable or not. If the instrument provides rejection signals this should be reported to water engineers. The test also covers bacteriological signals.

Water and sanitation committees in NGOs

In India, instances exist where women have formed their own groups to manage the water and sanitation needs of the village: the 'Pani Panchayat' of Gujrat and Palghat in Kerala are glowing examples. In some tribal areas, too, women have taken this initiative. In a panchayat, the water and sanitation committee, takes the responsibility of maintaining the health of handpumps and reporting to the Block team if the pump develops problems beyond its control. This committee also promotes kitchen gardening from the spill-over water of the pump.

In accordance with the VLOM objective, the central government recommended to state governments the formation of village level water and sanitation committees with sizable women's participation. The Centre's circular envisages a key role for state Public Health Engineering Departments (responsible for drinking water supply in villages) for working out modalities to implement the VLOM system through the existing infrastructure. A plan is emerging to fund village panchayats upto 10 per cent of the total water supply budget for the village for meeting maintenance costs against a part contribution from the beneficiaries. Wherever social conditions are congenial, (and by associating local voluntary agencies, women functionaries, activists and animators) women should be identified as caretakers of the handpump.

Women's role

Women in rural areas being the main users of handpumps are among the first to notice defects and for want of solutions are compelled to revert to their traditional sources of doubtful quality. Thus they suffer most if the handpumps go out of order. Because women's contribution in agriculture, animal husbandry, crafts and other productive activities are well known, their inherent human resource attracted the attention of rural water supply personnel for involving them wherever possible in a 'participatory maintenance' of handpumps. Their key role in the use and function of the water resources can be assessed from their influence as:

i. chief suppliers and users of water which includes a new supply system;
ii. acceptors or rejectors of a new source or technology;

Credit : J.C. Srivastava

A traditional source

iii. managers of conservation-oriented utilisation of water and protectors of water sources;
iv. change agents among women as ready communicators.

By and large receptive to new innovations, women featured as a potential group to be motivated and mobilised for promoting water supply and sanitation projects in villages.

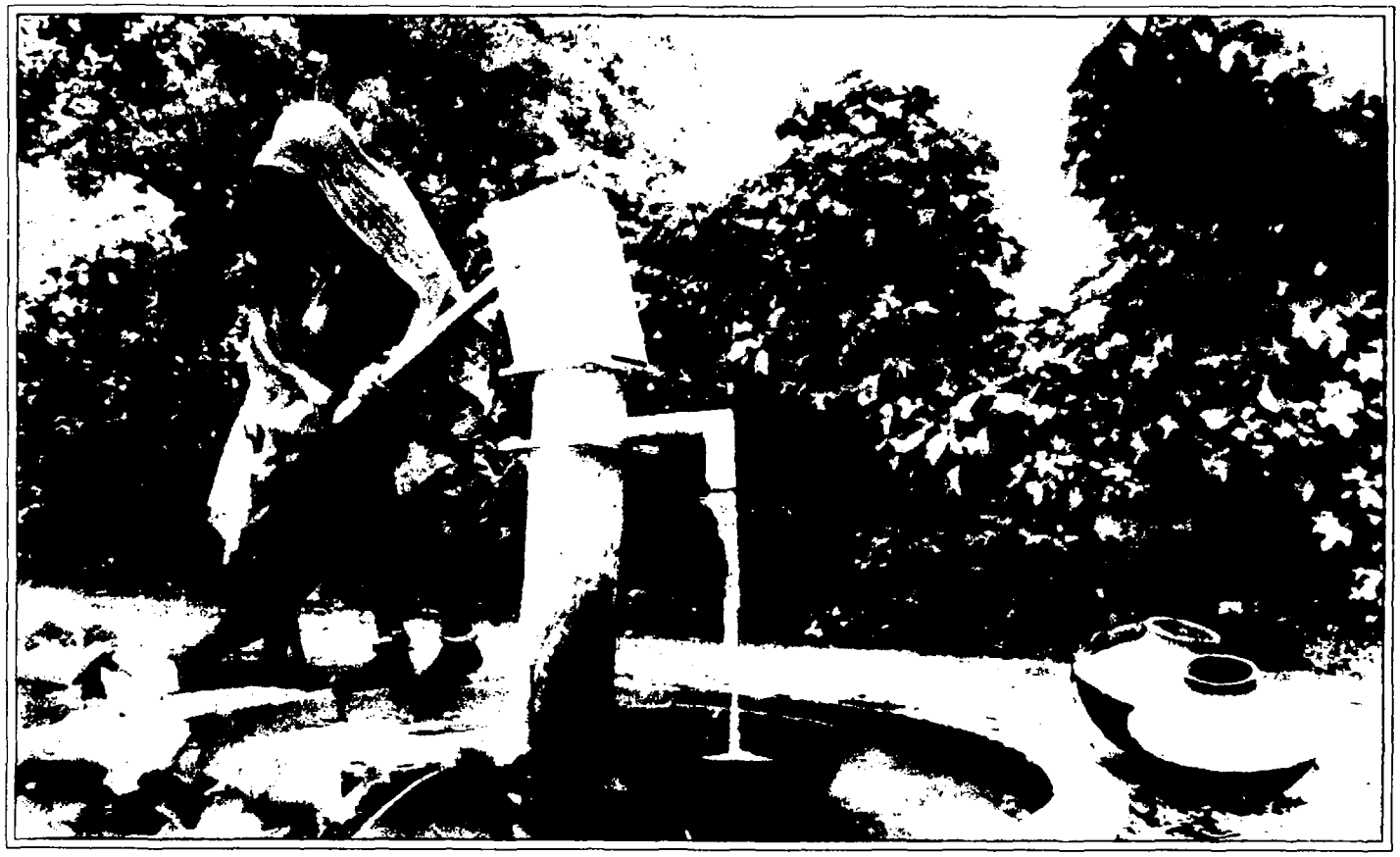
Participatory maintenance, as far as this study is concerned, covers involvement of women generally for preventive maintenance. SWACH, a voluntary agency at Udaipur, made a cost-benefit analysis of handpump maintenance vis-a-vis a woman's additional burden as handpump caretaker besides her multifarious traditional duties. It found that a woman's resources could not be stretched too far. Yet with the gradual installation of VLOM handpumps in villages (the project is under demonstration in seven districts of the country), and confidence generated in its reliability and dependability, women have felt attracted enough to support the new technology. Case studies of women caretakers at Dungarpur and Banswara panchayats of Rajasthan have indicated that there women could take charge of 30 handpumps. They maintained records of groundwater depth, pipes laid underneath, problems encountered in maintenance, spare parts used and the date of repair.

The arrival of geologists for geophysical surveys followed by a drilling team provided a natural entry point for arousing curiosity and drawing people into the later stages of participatory maintenance and environmental sanitation.

The entry point for approaching women was by way of messages oriented to saving the lives of their infants and children from water-borne diseases. Special health education programmes were thus designed through audio-visuals and folk media, integrating water into a complete plan for better health covering handpump maintenance, personal and domestic hygiene, safe water handling and storage along with solid and water waste disposal.

Action research featuring women in a decentralised participation of handpump maintenance should be area specific and compatible with their felt needs, priorities, education and income level. Far from looking at water as a resource in isolation, its safe and easy accessibility could be used as a common demoninator of development for upgrading women's education, skills, health and income.

The selection criteria for a woman caretaker may feature: (i) a local resident of the village (ii) one living in the vicinity of the public handpump (iii) a user of the pump (iv) preferred age group 18-30 years (v) able to read and write in the local language (vi) physically sound and active (vii) a participant in womens' group activities and health and sanitation programmes (viii) able to provide prompt feed-back about breakdown (ix) a social service



Credit : UNICEF

bent of mind and (x) generally acceptable to local community.

Cost sharing

As capital expenses involved for the implementation and maintenance of handpumps are provided by the central and state governments, community participation may mean different things to different people. Participatory indicators include financial support to operation and maintenance, labour contribution towards construction activities, provision of physical facilities, donation of land for drilling borewell/tubewell, construction of drain, soakage pit and sanitary latrines and help in maintenance of handpump, its platform and drainage. To this end, the community donates land and provides labour and physical facilities. Present thinking is, however, growing in favour of cost-sharing by the users for maintenance of handpumps under the supervision of village institutions (panchayat/water and sanitation committees). This is, however, a long term process requiring an intensive awareness campaign, appropriate messages and eventually developing a system of reliable and dependable community water supply with cost-consciousness.

Awareness generation

A successful rural drinking water supply system based on handpumps involves a combination of hardware and software technologies and management support elements matched in such a way that the community recognises the benefits of improved, safe and uninterrupted water supply; shares in participatory maintenance and the related cost and acquires skill and necessary inputs to sustain it. To maximise health benefits, parallel efforts in health education and environmental sanitation should also be planned. The integrated maintenance system, however, requires action-research in different geo-climatic regions of other developing countries as well for developing systems specially designed for low education and low income women. These systems should stimulate women's involvement, enhance their capacities in management, empower them with decision making and generate cost-consciousness. Awareness-generation in the community as a whole and in all ages could be followed by formation of water and sanitation committes with maximum women's participation. There is also the need for sensitising government functionaries (generally men) for considering women also as the target group for consultation and possible involvement in water and sanitation programmes. Through a sharing of experiences, these developments may perhaps help in reinforcing the relationship of water, health and sanitation in rural women of other developing countries as well to mutual advantage. ❑

-- Dr. J.C. Srivastava is a consultant to the National Drinking Water Mission.

Between Access and Consumption

A sociological review of rural water supply efforts in the past decade reveals that access to safe water does not necessarily imply consumption of safe water. In making this distinction, Dr. NILANJANA MUKHERJEE attributes it to a woman's attitude to what she considers safe and how far she must walk to use it. While implementors need to focus almost exclusively on women in deciding source siting and maintenance, important linkages still need to be made between health and what follows water collection: its transportation, storage and use.

On the eve of the Seventh Five Year Plan, the presence of more than two lakh villages without a source of potable water in India had rightly preoccupied the minds of planners and all targets were defined in terms of 'coverage' of villages and 'access' to drinking water sources. The water supply programme, seized with a sense of urgency to complete given coverage targets by 1990 has risen to the challenge and today (July 1990) less than 11,000 problem villages having no sustained source of drinking water or having water sources that are brackish, biologically or chemically contaminated remain to be covered. It is time now to pause and take stock of the results of this race against time, in view of plans for the coming decade.

Disease despite water

Water, specifically drinking water, can both be the sustainer and a virulent destroyer of life. Epidemics of nearly all gastro-intestinal diseases are carried through contaminated drinking water. Provision of safe drinking water is thus considered the single most potent community health protection measure. The goal of every drinking water supply programme unquestionably is to reduce population mortality and morbidity from water-borne diseases. Is it then reasonable to expect that when 'coverage' and 'access' targets for drinking water supply are achieved in India this year, water-borne epidemics would disappear and 2500 children will no longer die everyday from diarrhoea?

We know that such direct correlations are simplistic. There is no reliable evidence to show that over the past five years there has occurred a discernible drop in diarrhoeal incidence in the country. Millions of person days of productive work continue to be lost each year due to gastro-enteritis, dysentery, hepatitis, guineaworm infection, cholera or a host of other water-related diseases. This obvious discrepancy between the desired and the actual impact of the safe water supply programme on community health says something we can no longer ignore. Perhaps we are losing sight of the forest for the trees.

How appropriately are the basic problem and goal defined for the programme? Existing standards of community health indicate that the basic problem is that people are not consuming safe water. That some of them lack access to it is only a contributory factor, among several other factors. The principal goal therefore is to promote and ensure consumption of safe water by the people. Although the provision of safe water sources is undoubtedly the major needed input, it is far from the complete solution. In other words, to equate 'access to safe water' and 'consumption of safe water' is fallacious. The first need not necessarily lead to the second. The problem needs to be understood and redefined with full respect for its complexity.

Stating the task in terms of promoting consumption of safe water by people defines it in its right context as a human behavioral problem. It allows for a holistic cause analysis of various technological, economic and socio-cultural contributing factors requiring solutions.

To do this, the system has to learn to see itself in a different role, that of the policy maker, motivator, promoter of public awareness, resource mobilizer, the builder of local and non-government capacity for sustaining water supply and sanitation services but neither the exclusive provider of services nor the sole sustainer of it. It has to work towards a planned sharing of responsibility and authority with community organizations, voluntary agencies and the private sector, rather than attempting to carry the entire burden Atlas-like, until it becomes heavy enough to cause a collapse.

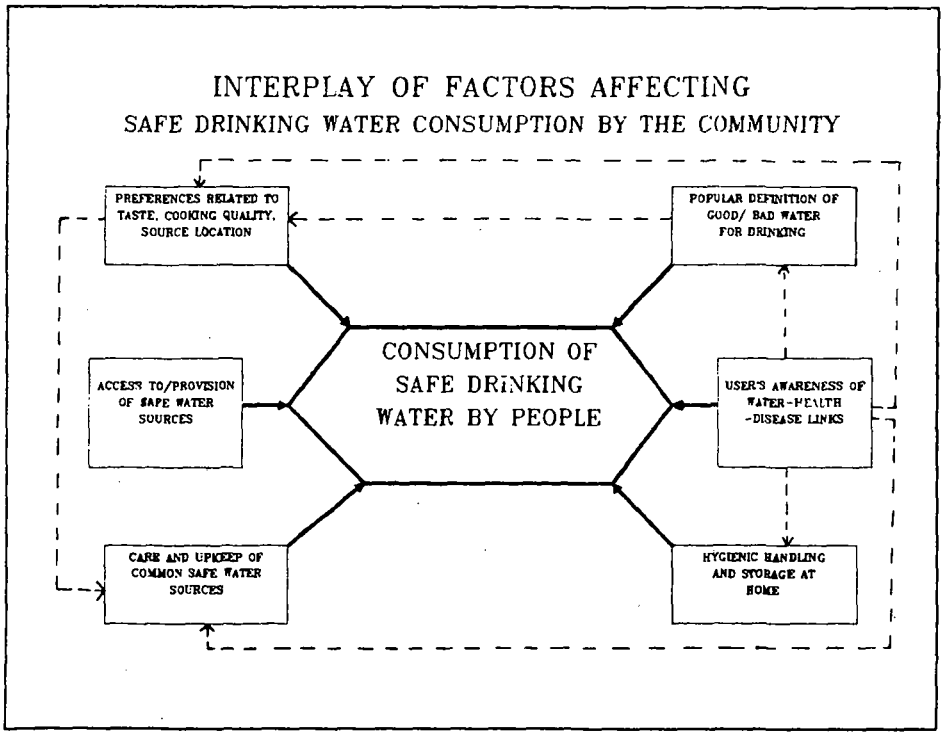
New quests needed

The new decade calls for new kinds of targets, procedures and indicators for achievement which relate to several other things besides the number of borewells drilled or latrines constructed. Programmes and projects in the 1990s need to be planned and evaluated on the basis of the extent of behavioral change they effect in the population for better hygiene, the extent to which users participate in planning and implementation and the extent to which women gain control over community water supply and sanitation systems as a result of

Credit : UNICEF

Bridging the Gap

development. Targets defined only in terms of physical coverage or access lead to technological and economic interventions with no inputs to ensure behavioral change. This paper is an attempt to illustrate why the problem and targets need to be redefined with a view to achieving Health for All for 2000 A.D.



The conceptual framework along side is a simplified depiction of interlinked factors influencing consumption of safe water by the people as analyzed from recent behavioral research data from rural areas of eight major states in India.[1] At any given time and place several usually interact to influence people's behaviour. It may be relevant to point out here that 'people' is to be read as 'women' most of the time since it is women who collect and manage water for the family in over 86 per cent households. It is the women's views, knowledge and preferences that determine the kind of water the family consumes.

What people drink is governed by what they consider good (implied safe) water for their drinking. The popular definition of good water is water which is clear to look at, sweet to taste and cooks food quickly. Highly contaminated water from open wells, rivers and streams will often fulfil these criteria. However, the pathologi-

Credit : UNICEF

Transporting and storing water.

cally safe chlorinated water or deepwell handpump water in certain regions has a mineralised/metallic taste. Water from such sources fails to meet the popular criteria and gets classified as 'unfit for drinking'. In addition, if these bacteriologically safe sources yield hard water in which pulses and grains take longer to cook, the woman has every reason to use oft-polluted but soft surface water sources for cooking, to conserve fuel which she has to toil long to collect everyday.

Evidence that these practises prevail is available. Despite widespread coverage of villages with deepwell handpumps, open dugwells continue to be the preferred and primary source of drinking water for 40 per cent people in villages. Nearly 25 per cent of all those who use handpumps never drink the water and 32 per cent never cook with it. In certain parts of the country like in West Godawari district, people walk long distances to collect drinking water from the river fully aware that it may carry germs, simply because it tastes good, although there are handpumps in the village.

Whether or not women use a particular water source also depends on its location. When safe water sources are sited in a village without first finding out where most of the village women would like to have it, the chances are that it will not be used by them. More than half of those who have access to deepwell handpumps in their village but still prefer to draw water from wells or rivers do so because the pump is located too far for their convenience. This is perhaps inevitable since the water supply implementors, working under the pressure of meeting numerical targets, seldom have the time or the inclination to confer with a large number of village women. Asking the male village head usually suffices for 'consulting the community' and the pump site ends up reflecting his convenience rather than that of the women.

Although two thirds of the implementors believe that women should be consulted for site selection, they agree that in reality this is rarely done. Paradoxically, the majority of the implementors report being satisfied with the present system for site selection!

Whose handpump?

Safe water sources like deepwell handpumps or improved sanitary wells remain safe only if preventive maintenance protects them from contamination and misuse. Cracked, broken platforms of pumps/wells, stagnant pools of dirty spill water around them and deposition of human waste and animal dung in the surrounding vicinity cannot but contaminate the groundwater. Only when the users understand this process and feel a sense of ownership and collective responsibility towards their common water source do they prevent this from happening. As matters stand today, 67 per cent of public handpump users consider them to be the government's property and only 24 per cent believe maintenance to be the users' responsibility. Evidently, the process used to install these assets in thousands of

villages was efficient enough to meet coverage targets but did little to foster the user's sense of involvement or ownership.

When a pump breakdown interrupts the supply of safe water, women have to fall back upon traditional, usually unsafe sources. They also have to trudge longer distances for longer hours to get water, at the cost of activities like child care, literacy classes or income generation. All that a woman can do at present is to persuade her husband/son/another male relative to inform the village head who will write to the District Engineer asking for a visit by the handpump mechanic or the mobile maintenance team. It may be weeks or even months before the handpump is repaired. None of those who are currently responsible for repair has to suffer the consequences of a breakdown. The only ones who do suffer i.e. women, have no say in the matter. In isolated projects like SWACH in Rajasthan or Lakhimpur Kheri District in Uttar Pradesh, village women trained as handpump mechanics have proved to be more effective sustainers of safe water supply, contradicting every official myth about women being unable to handle this kind of work. However, scepticism on the part of engineers running water supply programmes in the states is preventing large scale replication of such a step towards women's enpowerment.

Health and water use

Safe water at the point of collection passes through several stages of transportation, storage and handling before being consumed. Several routes of contamination are active in the interim period, with regional variation. In Uttar Pradesh, for instance, drinking water is collected in buckets and also stored in them. 41 per cent of these families leave the bucket uncovered. All kinds of utensils and hands are dipped repeatedly into storage pots to collect drinking water in 68 per cent rural homes across the country. On the other hand, long handled ladles are used in Manipur and in West Bengal and water stored in narrow necked 'surahis' which prevent hand contact as water is poured out. The collection and storage pots are usually scoured with mud which is a contaminating rather than a cleansing agent.

Popular awareness of the relationship between water and health is hazy and fraught with misconceptions. The majority link bad drinking water erroneously with fever, cough and cold or malaria. Only 10-18 per cent people across different states are aware of the link between drinking unsafe water and diarrhoeal diseases which kill upto an estimated 15 lakh Indian children under five every year. Popular ignorance of specific collection, storage and handling practices that contaminate drinking water seems to be cancelling out the benefits of providing safe water sources. A recent sample study in villages around Delhi[2], showed a 300-1000 per cent increase in bacterial contamination (MPN count of E. Coli) in water collected from deepwell handpumps and stored for 24 hours in different rural homes.

Improving public health through wider consumption of safe drinking water is a problem embedded in a vast social and cultural context. Strategies, interventions and targets set for addressing it have to reflect this contextual reality. The system responsible for addressing the problem has to equip itself to deal with all aspects of it, although to date, it had concerned itself only with the technological solutions.

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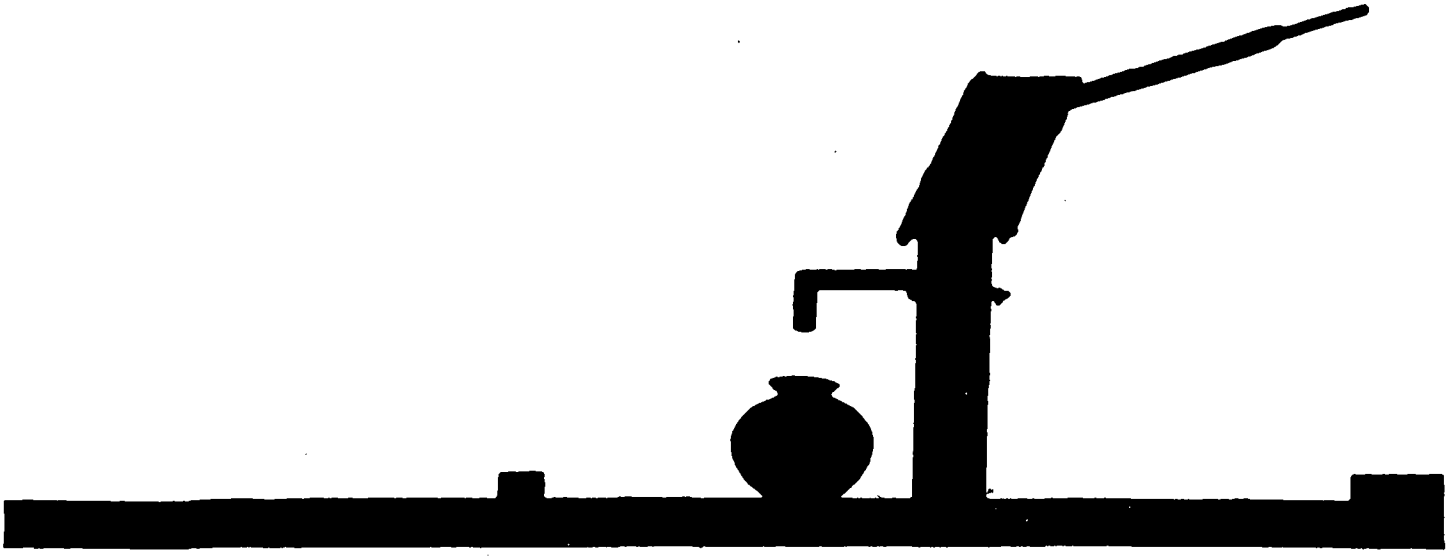


Is this water safe?

Prior to the National Drinking Water Mission's intervention, almost no reliable record existed of rural water sources and its quality. Dr. J.C. SRIVASTAVA describes the Mission's efforts to bridge the gap in conjunction with major scientific research organisations. The Water Quality Assurance Programme is viewed as an important step towards 'Health for All' through a diversity of means : portable water testing kits, stationary and mobile laboratories, establishing linkages between villages and scientific institutions and community participation through training.

At the beginning of the 'Water Decade', about 72 per cent of the rural and 31 per cent of the urban population in India had no protected drinking water supply. Water obtained from natural sources tended to be contaminated with biological pollutants, solid wastes and runoff from human habitats. Even clean water procured with great hardship got contaminated during handling, storage and use due to lack of personal and domestic hygiene. The diseases that resulted constituted a major cause of illness and death among humans, particularly infants and children. These health risks were further aggravated by chemical pollutants and excessive use of agricultural chemicals (fertilisers and pesticides) as effluents entering water bodies through seepage or runoff. (The total production of chemical fertilisers in India is 11 million tonnes (mt) and likely to touch 20 mt by the next decade. During 1987-89, farmers used 50,000 mt of pesticides which is likely to go upto 100,000 mt by 1990-91). Moreover, there was inherent brackishness, salinity and salinity ingress in a number of villages with excess fluoride in water found in 8700 villages of the country.

A study carried out in 1987-88 by the Toxicological Research Centre, Lucknow, revealed that even groundwater sources were heavily contaminated with bacteria. In Uttar Pradesh alone, out of the 1088 groundwater samples analysed from different districts, the following intensity of bacteriological contamination was noted:

Table 1

Number of samples analysed	Percentage of contamination observed
16	100
324	50 - 99
197	30 - 49
542	10 - 29
9	0 - 9

Technology for testing and analysing of bacteriological contamination is an important challenge in rural drinking water supply. Coliforms or pathogens capable of causing disease, must be detected in water. The thermotolerant coliform was noted to be an appropriate indicator of faecal contamination.

The role of the National Drinking Water Mission

Realising the urgency of maintaining acceptable water quality, a massive national programme of integrated drinking water management in villages was launched with the setting up of the National Drinking Water Mission (NDWM) by the Government of India in 1986. So far the water engineers responsible for drinking water supply in villages were more concerned with reaching the maximum numbers through piped water supply. There was lack of application of modern treatment technologies, quality control, social interventions and an integrated approach encompassing environmental sanitation and water conservation. Consequently, the scarce resources available were not maximised. There was practically no reliable record of water sources and water quality data. The meagre number of water testing laboratories mostly catered to urban areas. The necessity, therefore, was to broaden the concept of water supply management with regular water quality monitoring as an inbuilt priority. An integrated and multidisciplinary approach for surveying water quality status in rural areas was implemented through the Water Assurance Programme designed to introduce quality improvement and create alternative sources through the application of modern science and technology. As regards water quality assessment (WQA), the focus of this study, the Mission promoted systems for strengthening water testing facilities, creating mass awareness of the inter-relationship between water quality, health and family welfare and commercialisation of related hardware and inputs.

In order to gain first hand knowledge of water quality in villages and also as a priority action, scientific organisations of the country like the National Environmental Engineering Research Institute (NEERI), the Industrial Toxicology Research Centre

(IRTC), the All India Institute of Hygience and Pubic Health (AIIH&PH), the Defence Laboratory (Jodhpur), the Bhabha Atomic Energy Research Centre (BARC) were inducted to undertake water quality assessment in pilot areas of the Mission.

These activities are reviewed by a central coordination committee of the Mission chaired by a senior scientist of the All India Institute of Hygiene and Public Health.

Water quality standards

Drinking water of acceptable quality must be free from pathogenic organisms and chemical compounds having acute or long term adverse effects on human health. It must also be fairly clear, palatable, odourless, and not brackish (salty). In addition, water must not stain clothes washed in it or food cooked in it. In many places, these desirable properties cannot be achieved in totality, hence the Mission's alternative approach was to improve quality to a desirable level.

Standards for rural conditons

Water quality can be ensured only through regular monitoring and surveillance from the standpoint of physical and chemical standards, toxicity, bacteriological and virological standards and radioactivity. Essential and desirable tests to ascertain the suitability of water for drinking purposes in India, have been evolved by the Bureau of Indian Standards which provides for the reality of meagre water testing facilities in the country. It mentions the desirable limits and their background so that implementing institutions could exercise full discretion, relaxing specifications warranted by local conditions, particularly in rural and hill areas. The box above shows selected quality parameters of significance to rural water supply in India (BIS, 1983).

Under the 'Water Quality Assurance' programme, the above standard is under review to evolve a rational standard for meeting growing expectations about water quality. This review is expected to take into consideration such aspects as changing geo-hydrological cycles, multiple sources with varying quality of water, change in pollution and contamination, growth rate and variations in minimum needs due to development of new/alternative sources through Mission intervention, increasing testing infrastructure and water conservation techniques in villages.

Water Quality Parameters (Bureau of Indian Standards)

Characteristics (Maximum)	*Desirable limit*	*Relaxation in the absence of alternate sources*
1. Turbidity, NTU	10	25
2. Colour Hazen units	10	50
3. Total Disolved Solids (Mg/l)	500	3000
4. *pH Value*	6.5 - 8.5	9.2
5. Total Hardness (CaCo3)	300	600
6. Chlorine (Cl) (Mg/l)	250	1000
7. Sulphate (SO4)	150	400 (provided Mg 30)
8. Fluoride (F)	0.6 - 1.2	1.5
9. Magnesium (Mg) (Mg/l)	30	100
10. Iron (Fe) (Mg/l)	0.3	1.0
11. Manganese (Mn) Mg/l	0.1	0.5
12. Nitrate (NO3)	45	No relaxation
13. Calcium (Ca) (mg/l)	75	200

Quality assessment technologies

Water quality assessment for this study refers to testing of water samples from drinking water sources (both surface and underground) in 576,000 villages including community stand posts, handpumps and users' end. According to the 1987 figures, there are 422 districts divided into 5148 blocks covering 57,910 inhabited villages. Keeping the data of 'problem villages' in view, the Mission made a modest beginning of establishing water quality assessment laboratories in selected districts under the State Public Health Engineering Departments/Water Boards (87 stationary and 17 mobile laboratories) in the first phase. These laboratories are equipped with modern scientific equipment, facilities and trained manpower to focus on water quality assessment and monitoring in rural areas.

Stationary laboratories

Stationary laboratories perform the following functions:

- update drinking water sources data and prepare maps showing their location;
- ascertain water quality in villages having problems of contamination and identifying sources of contamination;
- prepare plans for collection of water samples and organise awareness camps;
- undertake spot examination or analysis in the laboratory;
- report the status of water quality to concerned authorities and village panchayats;
- receive reports from villages;
- organise consultation meetings with rural communities and women's groups and provide feedback to concerned public health engineers for remedial measures. The laboratories also undertake training in water quality testing and analysis.

Mobile laboratories

The mobile laboratory has been introduced for the first time by the Mission to reach remote villages and hill areas for water quality assessment. One prototype each was developed by the Industrial Toxicology Research Centre (ITRC), the National Environment Engineering Research Institute (NEERI) and Centre for Scientific and Industrial Research (CSIR) and field tested. The mobile laboratory is a van housing essential equipment for carrying out most of the tests on water samples in villages. The IRTC Lab costs Rs. 11 lakhs and is managed by four crew members and technicians. This laboratory has enough storage area and spares to operate independently (away from the stationary base-laboratory) for a period of 30 days. A generator, car battery and solar panel of the van take care of the requirements of power, where supply from the mains is not available (4.46 million out of 5.79 million villages (79.7 per cent) have been electrified by December 1989). The laboratory also undertakes bacteriological analysis (total coliform count and faecal coliform) by the multiple tube method.

Since the van cannot reach each source for spot sampling and analysis, it is taken to the nearest centralised location where samples and data collected from remote resources and sites are analysed. This arrangement has been found to be cost-effective with additional functional advantages. The analytical cabin being air conditioned, the fleet has an all season functioning capability and dust-free ambient atmosphere for analytical instruments.

The mobile laboratory performs practically the same functions as the district laboratory. It, however, announces in advance its time and travel route to villages so that local people could be involved in the identification of water problems and problem sources.

The following table presents the status of the water quality testing and monitoring laboratories set up by the Mission in different states and union territories (1990).

Region	Number of States and Union Territories covered	Number of new laboratories set up	
		Stationary	Mobile
East & North East	12	25	9
North	6	19	3
West	4	9	2
Central	3	13	2
South	5	17	1
Total	30	85	17

Portable water testing kits

To supplement the programme of these laboratories and to meet the urgent needs for on-the-spot testing and during emergencies, the Mission has introduced the use of portable water testing kits. These kits have been designed in such a way that basic parameters of water quality could be easily tested by a person with a short training. The kits are also used for simple bacteriological tests and applied for an accurate analysis of fluoride, nitrate and iron within the permissible range of these ions. These kits are commercially manufactured and marketed in India.

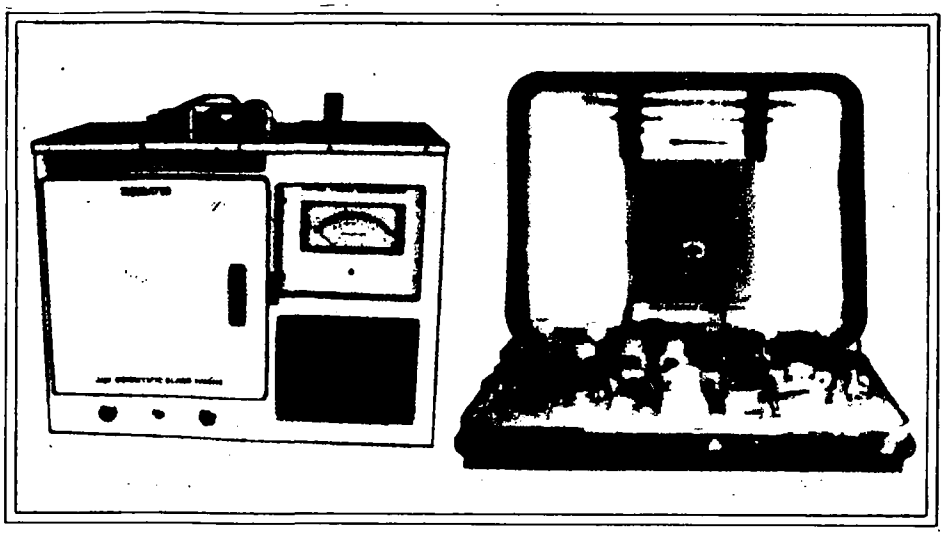
1. ITRC Kit

This kit consits of two main components: (1) a calorimeter for chemical tests with a three-step operation (insert, sample and read), designed for 100 water samples for quantitative analysis of fluorides, nitrates and iron and (2) a thermostatically controlled incubator for carrying out microbiological tests by multi-tube method. The incubator can be maintained at temperatures between 37 and 45 degrees C and holds a large number of culture tubes. The sensitivity range of the ITRC calorimeter is as follows:

Specifications: weight, 16 kg; size, 20x14x11 inches (50x35 x 28 cm); power requirement mains 220 V/1000 V, 50 Hz battery or 1 KVA generator; price Rs. 9000 (1990)

2. NEERI Kits:

(i) Rapid Aqua Tester: This kit offers



ITRC Water Quality Testing Kit

Ions	Sensitivity range* (mg/litre)	Indian standard (mg/litre)
Fluoride	0.1 - 1.4	1.5
Nitrate	0.06 - 1.4	4.5
Iron	0.1 - 1.8	1.0

**Higher concentrations could be estimated after appropriate dilution*

a visual comparator for rapid aqua test for iron, residual chlorine, pH and fluoride. A series of interchangeable discs containing colour standards show the exact colour change of different test samples. The disc is rotated till the colour of the filter in view matches the colour of the sample reagent. The 'read out' corresponding to this filter gives the direct concentration of the sample in 'ppm'. Readability range is 0.0 - 2.0 mg/l.

Specifications: weight 300 gm; size, 4x4x1.25 inches (9.7x9.7x3.1 cm) power requirement nil; price Rs. 3150/-.

(ii) Rapid Bacteriological Testing Kit: The kit facilitates on-the-spot bacteriological analysis of water based on the rapid (seven hours) pour plate technique. This helps in direct counting of visual colonies of faecal coliforms at the end of seven hours. It has a specially designed incubator which maintains the temperature of samples at 41.5 C with accuracy of ± 0.5 C.

Specifications: weight 10 kg; size 20x14x12 inches (49x34x30 cm); Power requirements, 60 W mains, battery or solar power; price, Rs. 6500/-

3. DL Kit: (Defence Laboratory, Jodhpur):

This light-weight and low cost kit has been designed for field application at site for either rejecting or accepting a particular sample of water (quantitative assessment falls beyond the scope of this kit.) It is capable of carrying out visual colour comparator tests for chemical examination for Cl, F, NO2, NO3, Fe++, Fe+++ and C12 and bacteriological examination for coliform and E-Coli.

This kit has been recommended for use in training, awareness-generation and quality monitoring by village institutions or NGOs and to pass the results to the laboratories.

Specifications: Weight 8 kgs; size, 10x10x8 inches (27x27x20 cm); power requirements, 220 mains/12 VDC; price Rs. 4,800/-

To demonstrate the use and utility of these kits, the Mission has plans to distribute a thousand kits to different states based on their specific requirements and the DL Kit to NGOs, panchayats, schools and women's institutions in villages. CAPART

Water Quality testing kit developed by Defence Laboratory, Jodhpur

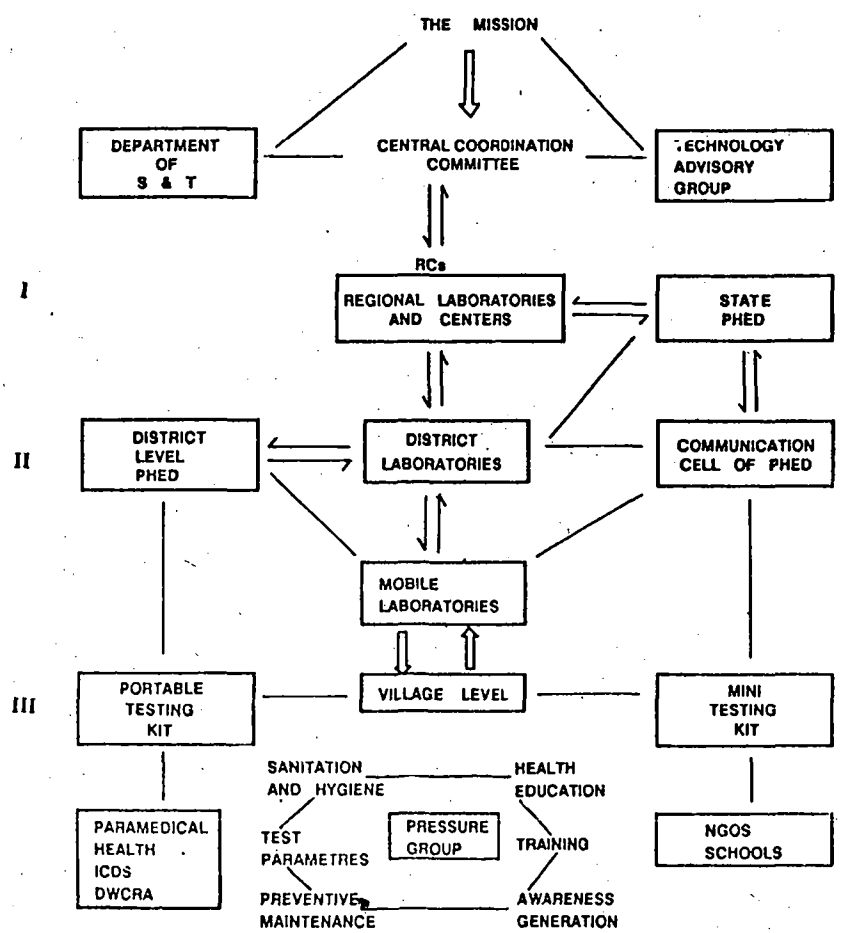
(Council for Advancement of People's Action and Rural Technology, New Delhi) has already provided 100 DL Kits to trainees from voluntary agencies.

Networking

The Mission approach needed a network to cover the entire country with homogenous linkages at various administrative levels viz., villages, blocks, districts and states on the one hand and scientific institutions on the other. In order to achieve these activities, five Regional Centres (RCs) were set up -- one each for East and North East, North, West, Central and South. To provide policy guidelines and coordination, the Mission has set up a central coordination committee on water quality monitoring surveillance headed by a senior scientist. This Committee also advises on location-specific solutions for water treatment. The RCs are expected to function as friends, philosophers and guides to state Public Health Engineering Departments responsible for drinking water supply in villages.

NATIONAL DRINKING WATER MISSION, INDIA

WATER QUALITY MONITORING AND SURVEILLANCE NETWORK



Community participation

Tremendous efforts were needed to create consciousness about the risks of drinking polluted water through the expediency of avoiding or treating the water and by learning the lessons of environmental sanitation. This also needed supportive inputs (hardware/ software) to implement this programme in association with village institutions, panchayats, water engineers and the scientific community. The Mission programme also includes strengthening the mass media base at the local level, sensitisation of water engineers and extensive use of the fleet of laboratories. The important role of rural women in this regard is also being emphasised because once convinced and empowered, they can greatly help in spreading the message. The state of Gujarat has taken a lead in promoting water and sanitation committees which have a representation of women as well.

Training

The Mission has planned training programmes in water quality awareness, for various groups:

- village level functionaries,
- rural youth, women's institutions, village panchayats, school teachers, and voluntary agencies (through CAPART)
- water engineers undertaking water quality assessment in their circle.
- chemists and technicians of calibration and validation of data, maintenance of database, development of test methodology and related regulatory functions.

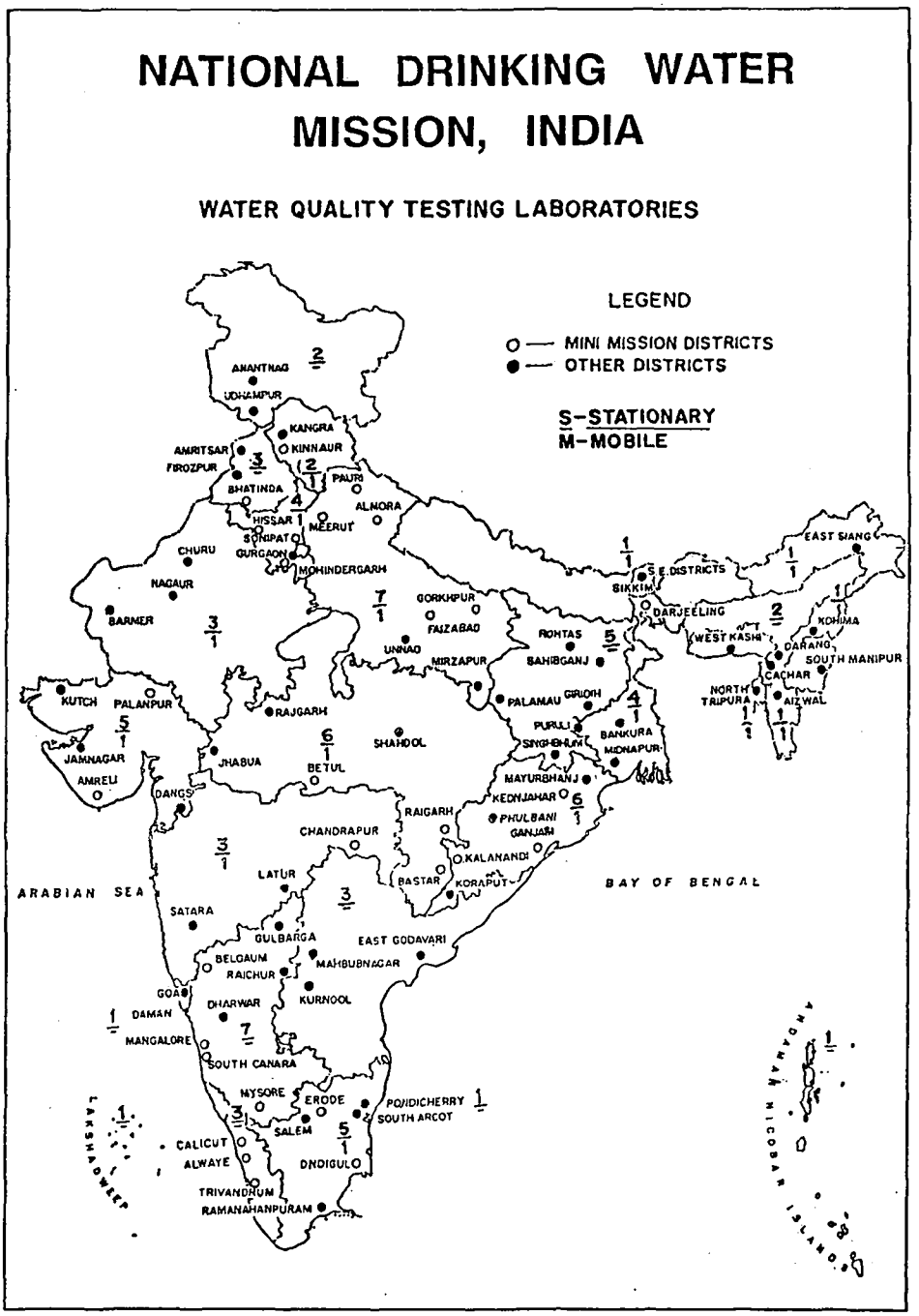
In order to deal with these levels of training, curriculum and teaching materials have been developed with an emphasis on the practical aspects of learning. Experience in conducting these training courses through scientific

organisations (Regional Centres and Laboratories of the Mission) holds great promise in the development of nation-wide trained manpower to support the Mission's programme.

Documentation

The Mission has released the following documents on the subject of water quality:

1. Laboratory manual on water analysis (NEERI, 1987)
2. Water technology laboratory (NEERI, 1987)
3. Training courses on water quality monitoring (DL, J, 1988)
4. Action plan for establishment of water quality testing laboratories, (NIDC, 1989)
5. Guidelines for establishment of water quality testing laboratories (NIDC, 1989)
6. Monitoring system for water mission (NIDC, 1989).
7. Standards promotion and water quality assurance for water mission (BIS, 1989).
8. National Drinking Water Mission -- Action Plan (1989-90)
9. Simplified procedures for physico-chemical and bacteriological analysis of drinking water -- a laboratory manual (ITRC, 1989)
10. Training course in water quality assessment (BARC, 1990),
11. Operational manual for water quality testing laboratories (NDWM, 1990)
12. Executive guidelines for implementation of water quality testing laboratories (NDWM, 1990).
13. Training and awareness programmes in water quality (NDWM, 1990).



Water quality assessment in rural areas is of vital concern to the National Drinking Water Mission which set itself the target of covering all the villages with at least one safe potable water source by the end of the Water Decade. It is too much to expect that the present network of laboratories and trained manpower will reach all the sources. The envisaged concept, however, implies creation of an awareness, a change, and a sense of urgency among the concerned to consider safe water a priority indicator of 'health for all'. Substantial progress has been made and yet much remains to be done in facing emerging problems. This decade's efforts could serve as an important touchstone for 'Water Quality Assurance' in reaching the overall goal of 'Health for All'. ❑

Information
A Complex Support System

The information required to monitor water supply in over 5000 blocks in the country has posed awesome challenges for planners. The system that evolved aimed at decentralised information management variously geared for use at the block, district, state and central levels. Dr. PRADEEP KUMAR describes its different modules designed to function in an interrelated system of information flow.

In a country as complex as India, rural water supply and sanitation will never be a completed business considering demographic changes, groundwater dynamics and ecological transformations, to name a few of the variables affecting targets and objectives. In view of the magnitude of the task undertaken by the Mission, in addition to its role in overcoming technical and technological problems, an information system can serve as an effective planning and monitoring tool in a manor nation-wide rural water supply programme. With a lakh partially covered villages still to be fully serviced with at least one safe and potable water source, the importance of an efficient Management Information System (MIS) cannot be over-stressed.

The national rural water supply programme in India involves a large number of people and organisations with a total outlay of over Rs. 2000 crores to be undertaken in over 5000 blocks. Since the basic information system required to monitor this progress was so immense and wide-spread, it was increasingly felt that the present manual system of keeping information could not cope with the requirement.

The objective of a new information system is to provide timely and accurate information on status of water supply in villages, details of sources and chemical content/contamination in water, quantity of supply and availability of alternative sources. These details could assist the centre and state governments to draw up meaningful project plans for improving the supply and purity of water to the rural community. In addition, it could also aid in decision-making in taking the necessary precautions for situations like drought, for setting up water treatment plants and for increasing supply through artificial canals, reservoirs and man-made tributaries.

This information system is not aimed at a highly sophisticated scale of operations covering a whole ambit of systems. Instead, designed for use at different levels, its objective is a decentralised and interrelated management system based on a realistic district-wise PC-based information system whose capabilities could be enhanced with time and use.

Objectives of the information system:

In designing an information system, it is necessary to identify:

- -- the geographical coverage of water supply
- -- villagewise status of water supply sources and quality
- -- population and its distribution within villages
- -- planning/works monitoring/financial management

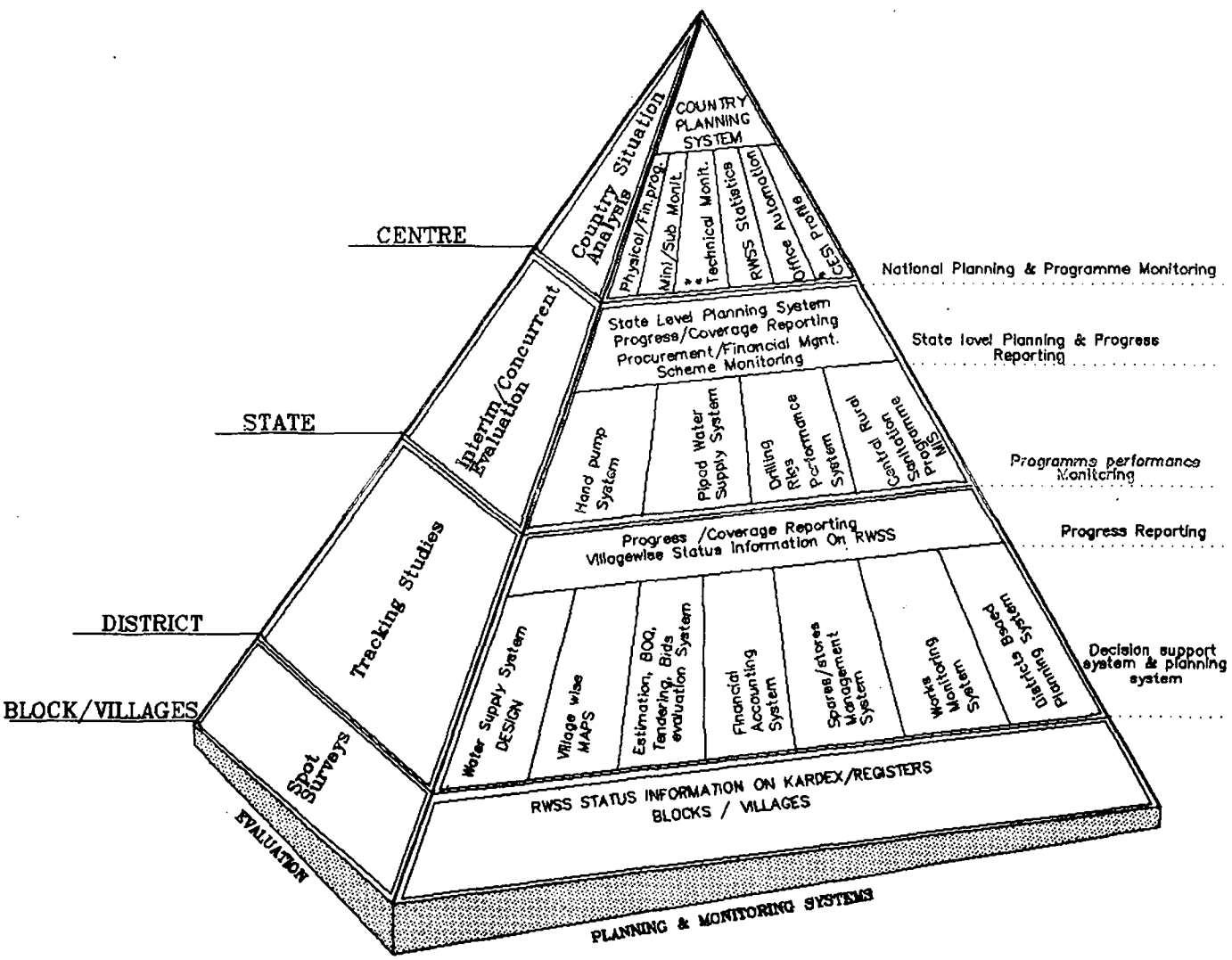
These information elements are necessary for monitoring target achievements, providing control and direction, improving efficiency and delivering timely results. The system is variously geared for use at the block, district, state and central levels.

Block/village level: With a large number of handpumps currently in operation all over the country, their operation and maintenance becomes very important. UNICEF has supported a pilot project to establish block-level data-base to facilitate all round maintenance of the handpumps. Begun three years ago in five districts of Andhra Pradesh, Orissa, Karnataka and Tamil Nadu, this project was recently extended to cover eight districts in Maharashtra and two in Gujarat. Popularly known as the Kardex system, this simple, visible, centralised data recording, retrieval and analysis system consists of a steel cabinet with sliding trays containing pockets with cards where information is entered, retrieved and analysed. These formats designed to incorporate details of social, environmental and community participation comprise cards recording information of handpump installation and their maintenance. Besides developing a data base to provide maintenance agencies with an effective base for providing prompt services, the ultimate objective of such a system is to involve communities in accepting ownership of these pumps, being fully responsive thereby to their operation and maintenance.

MANAGEMENT INFORMATION SYSTEMS

for

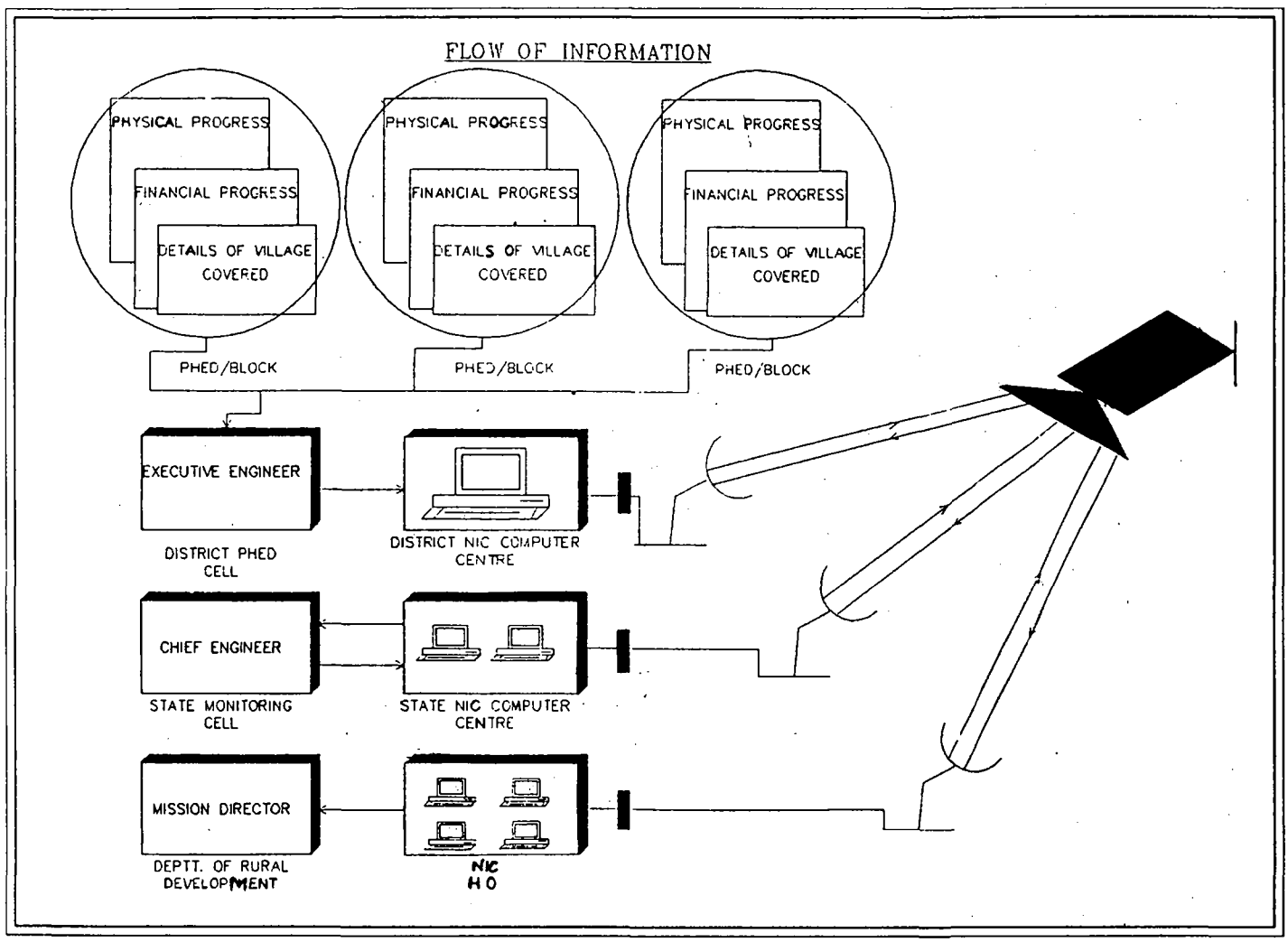
RURAL WATER SUPPLY & SANITATION PROGRAMME



District level: The district level MIS designed to monitor water supply programme within the district comprises two components:

-- a basic statistical module reporting on village-wise progress/coverage and maintaining baseline information
-- a second module acts as a support for decision-making in the day to day operations of district-level functionaries. This includes sub-modules for designs of water supply systems, cartographic presentation of water supply facilities, bids evaluation, stores/ spares management and works monitoring.

Each district will have communication links with state headquarters via NICNET (National Informatics Centre Network)for information flow between the states and districts.



State level: The state level MIS is designed to have three modules:

- -- a module for state level planning, scheme monitoring, progress/ coverage monitoring and financial/ material procurement.
- -- a module for monitoring performance of specific programmes viz. handpumps, piped water supply schemes, rigs performance.
- -- an interim/concurrent evaluation database -- for recording and analysing feedback received on implementation/performance and use of water supply facilities. The state level monitoring cell will support all district and state government departments as well. They shall have access to the centre via NICNET communication links.

Central level: The MIS designed for national level planning and monitoring shall assist the central government in preparing plans based on a country-wide analysis, monitor physical/financial progress of various states, compile national sectoral statistics and provide support for policy formulations (See Figure).

Implementation plans: A three-pronged strategy has been adopted simultaneously for systems implementation on an all India basis at the central, state and district levels:

Central level: Modules for implementation at the central level are already developed and are under implementation

State level: Modules for implementation at the state level are under development during Phase I. These shall be implemented in six states: Karnataka, Gujarat, Maharashtra, Kerala, Uttar Pradesh and Madhya Pradesh to be later extended to cover all states in India.

District level: A district based decision support system is under development and shall be implemented in Karnataka initially and then extended to cover other states in India.

The above information system, when fully implemented in the country, shall prove to be a vital tool for effective implementation of the water supply programme in rural India. ❑

-- Dr. Pradeep Kumar is Project Officer, MIS, UNICEF.

NGOs : Sharing the Burden

The voluntary sector is ideally disposed to take major initiatives in the field. Professor S. RAMACHANDRAN reviews its role in the past decade's efforts to maximise water supply in rural areas. In its thrust to test water quality and to generate awareness between health and a new and clean water source, there has also been neglect of traditional methods for achieving potability and the repair of existing sources lying in disuse.

Rural development is conceived as a process aimed at uplifting the economy of the rural people, from a state of stagnation or low productivity equilibrium to a more dynamic state of change, a higher level of living and a better quality of life. Productivity depends on the quality of life and this in turn is stimulated by better health. Sanitation is perceived here not only in terms of construction of latrines but also in a broader sense -- improvement in personal hygiene, a better kitchen environment and garbage and waste water disposal.

Non-Governmental Organisations (NGOs) are vehicles through which ordinary men and women are changing the world in which they live. Known also as Voluntary Agencies, they have the flexibility and capacity to initiate and experiment with new programmes, stimulate the interest of the community and also have the sensitivity to meet difficult problems in ways that the State cannot adopt. While some of these organisations are ill-equipped and understaffed, or staffed with inadequately trained people, and we even hear of reports of misutilisation of scarce funds, a good number of them are in a sound financial position, have a dedicated and well-trained staff and show a positive response to accountability.

Sharing the burden

In thousands of villages in India there is now a growing awareness of the need for development which is being kindled by voluntary agencies. In recent years, government sponsored activities in rural development have increased enormously. Provision of safe drinking water and access to sanitation are among the important rural development programmes which NGOs implement with CAPART's assistance. The rising expectations of the people, calling for simultaneous development in many sectors has led to an impossible burden on the government. NGO initiatives in the service sector on local rather than on national scales when added up, reduce this complex burden. The government has sought and received the support of voluntary agencies to supplement its efforts. Moreover, in a state wedded to democratic ideals, the people's initiative needs to be encouraged and protected.

By the end of the Seventh Plan, a substantially stable relationship between government and NGOs has evolved. Several ministries have special windows for voluntary agencies. CAPART is the autonomous organisation of the Department of Rural Development with a clearly defined role to motivate NGOs to implement projects for enhancement of rural prosperity and to galvanise the potential, particularly of those with roots among the weaker sections. Many of these projects had been the sole preserve of Government departments earlier. CAPART's success lies in identifying new and potential NGOs, the experience of several of whom was more in welfare type of projects rather than in rural reconstruction.

It was established at the United Nations Water Conference at Mar del Plata in 1977 that 'all peoples' whatever their stage of development and their social and economic conditions, have the right to have access to drinking water in quantities and quality equal to their basic needs.' As part of Government of India's efforts in the International Decade for Drinking Water and Sanitation, People's Action for Development (India), one of the two organisations which merged to form Council for Advancement of People's Action and Rural Technology in 1986, introduced the Accelerated Rural Water Supply Programme among NGOs working in rural areas to reach safe, potable drinking water to the problem villages of the country. The establishment of the Technology Mission for Drinking Water in villages, now known as National Drinking Water Mission (NDWM), gave the Programme the needed professional touch.

The Mission went about its task with conspicuous dynamism and can take justifiable credit for covering about 1.54 lakhs problem villages (roughly 85.7 per cent of the population) in the Seventh Plan (1985-1990). Yet, some 8439 problem villages with about two per cent of the population still face difficulties and NDWM is confident of covering these in the next two years. It is apparent that without a Mission approach and a professionally managed programme, we could not have achieved so much in such a short time.

At the cost of tradition

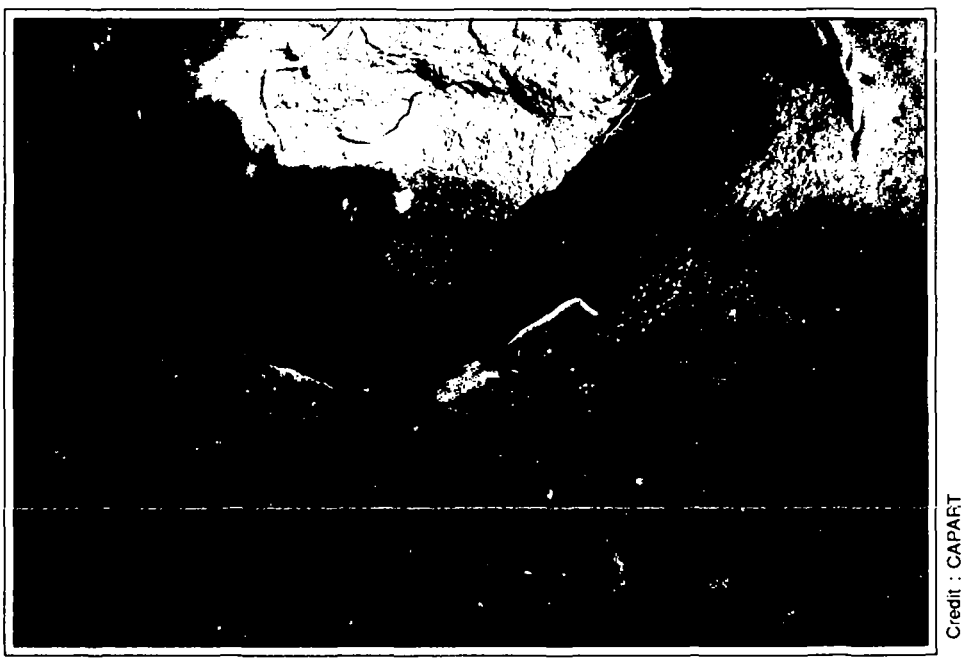
The National Drinking Water Mission straightaway identified 55 Mini-Mission Districts where the problem of providing adequate (40 lpcd and in desert areas 70 lpcd to provide for cattle also) quantities of drinking water could be tackled with a scientific, replicable and cost-effective approach. NGOs have contributed significantly and but for 15 Mini-Missions, are implementing the Programme. While one would have liked to see NGOs getting more involved in alternative sources of drinking water such as identification, development and improvement of traditional sources, water harvesting structures through the use of appropriate technology and materials, soil-water conservation and enhancing the potability of water with slow sand filters, most of them saw in the ubiquitous hand pump the easiest and safest route to health.

Alternative approaches need time-consuming and careful survey, planning, designing and estimating at a level of expertise that is yet to develop fully. Perhaps the general understanding that ground water is safer than surface water is so profound that the traditional techniques of making surface water potable by filtering either at source by a community slow-sand filter or at home by inexpensive domestic candle filters, though still very relevant, have apparently been neglected by NGOs in general. Moreover, indiscriminate use of handpumps has only helped to lower the ground water levels to alarming depths, preventing adequate recharge of the depleted water sources. Secondly, surface storage systems enable water to be conserved which could also assist by percolation the recharging of groundwater sources. In the event, more and more NGOs should study the possibility of implementing projects like percolation tanks, agri-film lined ponds in brackish water areas, check dams, gully plugs, contour bunds, contour trenches, tapping water from mountain springs, rain water collection and watershed development, in addition to augmenting storage in traditional village tanks and sanitary dugwells. It will also be economically sound if NGOs attempt to rejuvenate at least 50 per cent of the 'failed' handpumps instead of installing new pumps where failures have occurred. However, the glamour of the handpump would take time to wear off.

If CAPART's project approvals are any indication, over 80 per cent of the drinking water projects sanctioned have been for installing handpumps accounting for 87.5 per cent of the project-value. So, only one-eighth of the sanctioned value has gone for traditional and alternative water sources, although, under the objectives of NDWM, CAPART's assigned activity was to encourage precisely such alternative routes, taking advantage of the flexible and grassroots approaches of NGOs. One factor which influenced the installation of so many handpumps has perhaps been the signal success of the highly sturdy India Mark II handpump which is relatively trouble-free and the evolution of trained village mechanics for its maintenance, in addition to the Bureau of Indian Standards giving quality approvals and ISI marking to several manufacturers.

Health and a new water source

Health education is a necessary companion to any technology-based intervention, so that proper use and maintenance of the facilities are guaranteed. Users must be made aware of the links between water and health. The use of safe water supplies has to be explained to prevent people from reverting to water of questionable microbiological or biological quality. The contamination of water may also occur during handling and storage. Under the National Mission, 475 NGOs have, during 1988-1990, highlighted these in over 5000 Drinking Water Awareness Camps throughout the country. In these camps, NGOs have been informing people on how to demand and have access to water which once gained must be maintained. Traditionally, community dependence on government in maintenance has been so profound that once an asset created by government breaks down, the latter alone is expected to repair this. A great amount of attitudinal change is called for to make the community solely responsible for maintaining the system by providing



Credit : CAPART

A drinking water source at Trichy

for it financially as well as with locally developed skills. In the Awareness Camps, NGOs have used the media, newsletters, village meets, posters, slides, transparencies, models, puppet shows and video/audio-visual aids to communicate to the villagers the goals of the National Mission. It was widely recognised that people's participation, particularly that of women, would be critical, as women bear the brunt of transporting drinking water to homes and they are the worst affected by water-borne diseases in the family. The awareness programmes have therefore tried to integrate other disciplines like health education, water and soil conservation and the understanding that very little of the total water available in the planet is indeed suitable for drinking and so wasting water is to be avoided.

With all their abundant dedication and sincere attitudes, many NGOs still lack the scientific skill and knowhow on how to tackle complex rural problems. There is a substantial and immediate need to pool the technological knowledge available with NGOs and with National Laboratories/ Engineering Institutions/Scientific Bodies and to integrate such knowhow to make this quickly available to those who seek such information, so that voluntary organisations can work as effective instruments to mobilise people's action. CAPART is favourably placed, with its substantial computing and retrieving facilities, to disseminate this needed knowhow, once all relevant data is systematically compiled and stored.

TABLE 1

IMPROVEMENT IN CHILD HEALTH DUE TO CLEAN WATER AND IMPROVED SANITARY HABITS IN 20 VILLAGES

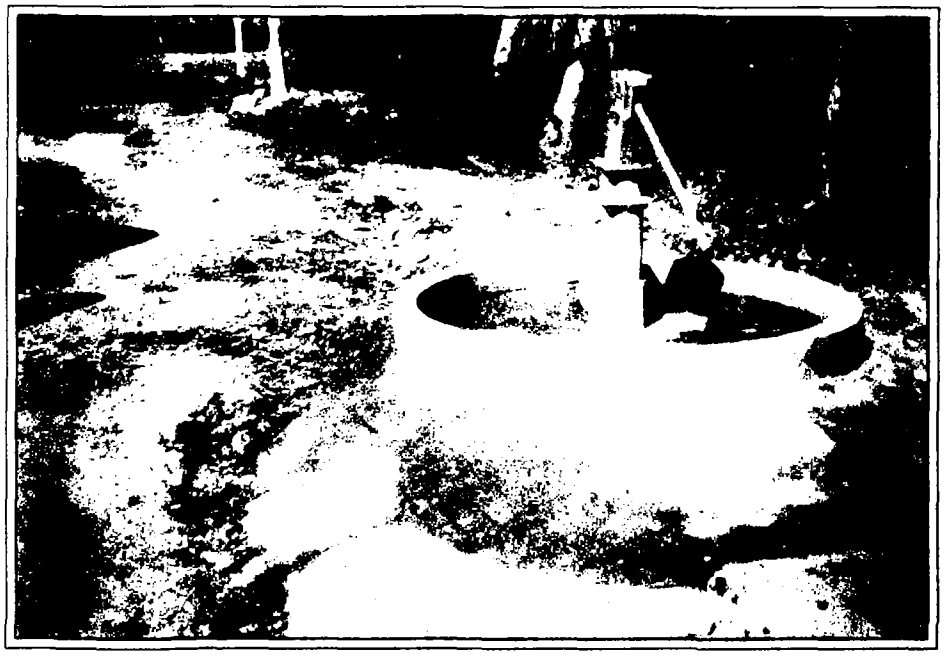
	1986	1987	1988	1989
1. Amoebiasis & Giardiasis:	125	138	83	89
	240	301	298	406
	52.08%	45.80%	28.10%	21.90%
2. Round worm Infestation:	201	150	79	154
	335	288	190	516
	60.00%	55.50%	31.10%	29.80
3. Hookworm Infestation:	139	130	112	152
	280	312	292	425
	49.6%	41.02%	38.30%	37.70%
4. Bacillary Dysentry	38	52	37	21
	192	327	309	276
	19.70%	15.20%	11.90%	7.60%
5. Enteric fever	40	35	26	16
	211	196	319	242
	19.90%	17.30%	8.10%	6.60%
6. Infective hepatitis	63	61	22	38
	271	318	197	413
	23.20%	19.10%	11.10%	9.20%

NOTE: The figures in the upper horizontal column indicate the number of patients against the total number of cases.

Courtesy, Saroj Nalini Dutt Memorial Association, 23/1, Ballygunge Station Road, Calcutta 700 019, West Bengal.

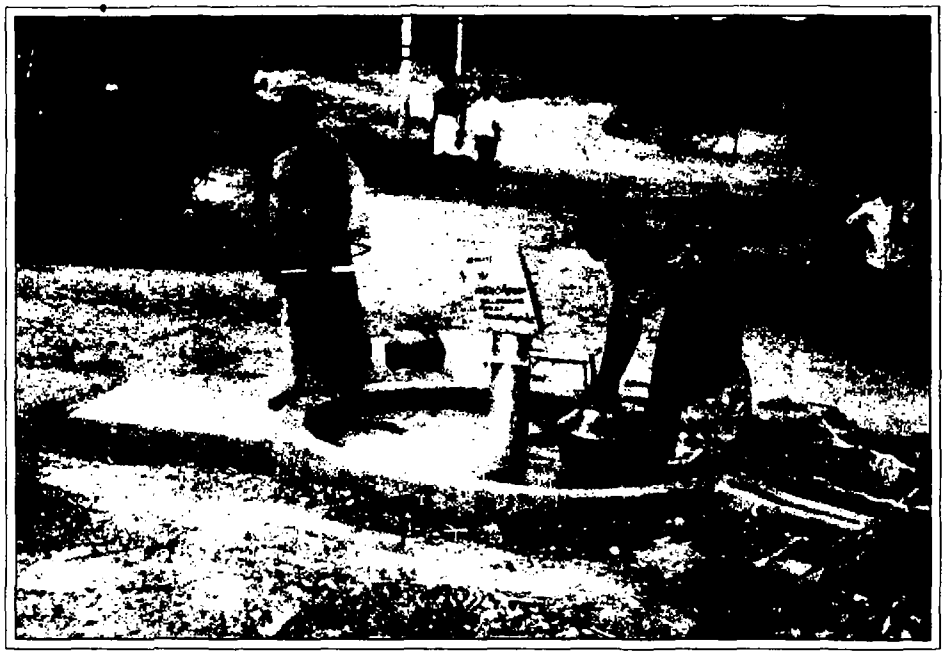
The link between claen water and proper sanitation need not be stressed as it would be stating the obvious. Bacteria-caused diseases are known to be on the decline wherever potable drinking water has been introduced to all families and sanitation improved. In a recently released document, a leading NGO based in Calcutta has reported significant improvements in child health due to clean water and improved sanitary habits in 20 villages of South 24 Parganas. Saroj Nalini Dutt Memorial Association of Calcutta which operates a Primary Health Centre in addition to implementing projects on Sanitation and Drinking Water, have given their findings in Table 1.

Both the quantity of water and its quality are important in safe-guarding human health and reducing the incidence of communicable diseases. In fact, quantity and quality are complementary. While the first priority is to



Credit : CAPART

Now a handpump installed with CAPART's assistance



Credit : CAPART

Hand pumps at Thekkamabikoilpatti in Kadavur Block

provide enough quantity of water (40 lpcd) there is no question that breaking the cycle of water-borne disease transmission requires the availability of safe and contaminant-free water. As many as 123 individuals from NGOs have been trained by scientists of the National Defence Laboratory, Jodhpur with NDWM-CAPART assistance in methods of testing water quality in villages through simple-to-operate water testing field kits. These NGOs who are involved in the surveillance of drinking water quality report to the district authorities for follow up action. Both water quality testing as well as awareness creation will be carried beyond 1990 when the International Decade for Safe Drinking Water and Sanitation would officially close. The work needed to make a measurable impact on water quality and to improve the health status in rural people has to go on till 100 per cent of the people have access to clean, pure and contaminant free water for drinking.

Problems in the field

It is necessary that the NGOs involved in the Drinking Water/Sanitation Programme become aware of certain problems and weaknesses which have come to light in implementing such a large-scale programme. Generally stated, these are:

- failure of sources due to inadequate scientific survey of sites and a lack of quality testing resulting in salinity, bad taste, etc.
- locating sources at one end of the village
- recharge of ground water is less than its withdrawal
- poor platform and draining resulting in contamination of precious water from the surrounding area
- due to non-involvement of the people, they do not have a sense of belonging
- since health education and awareness creation did not precede the installation of handpumps, the importance of the newly created source was lost on the people
- duplication and crowding of sources
- absence of a proper operation & maintenance system in many states. The community is seldom involved in maintenance and does not know how and when to participate. Lack of regular maintenance is one of the main causes of the fast dilapidation and disrepair of water supply systems.
- preventive maintenance just does not exist. It is known that 42 per cent of water supply schemes were found to give inadequate supply and 16 per cent cases had water quality problems.
- 81 per cent of water supply schemes in the country are based on ground water. Most of these draw water from shallow aquifers through open wells. Irrigation has come as a strong competitor. Of the total water, 77 per cent is used in irrigation and only six per cent in drinking water supply. Since irrigation pumps draw huge quantities of undergound water, drinking water supply wells suffer. The time has perhaps arrived to enhance legislative measures to control use of groundwater so that dynamic groundwater sources alone are used by irrigation sumps and static sources are reserved for drinking water.

While most of the weaknesses above need government action, NGOs can play a useful and substantial role themselves so that while covering 100 per cent of our problem villages, fresh problem villages do not come up. As partners with the government in rural development even beyond water/sanitation, NGOs are best placed to influence government policy in future Plans to improve the lot of their communities. ❑

-- S. Ramachandran was formerly Director, Council for Advancement of People's Action and Rural Technology (CAPART), New Delhi and in-charge of programmes like rural water supply and sanitation and recharging groundwater.

Urban Water : No Silver Lining

Urban demands for water are invariably more strident than rural ones, appropriating thereby the lion's share in financial outlays, institutional supports and feedback mechanisms. Yet none of these have resulted in the provision of quality services. Through an analysis of plan and performance, KASHYAP MANKODI examines the reasons for this failure.

Urban water schemes have received a disproportionately larger proportion of the thinking, planning and financial outlays devoted to drinking water problems vis-a-vis rural schemes, and yet, the magnitude of the problem even in urban areas is extremely serious. Hence, any new development planning approach that addresses itself to the poorer country cousin is bound to be confronted by extraordinarily difficult challenges and therefore every component of the approach - from its assumptions and orientation to its operational strategies - needs very careful scrutiny.

Let us first take a synoptic overview which establishes the main trend of priorities within the planning process with respect to the urban and rural beneficiaries of development. The table below shows the expenditure actually incurred through the successive five year plans on water supply (in crores of rupees) broken down into their urban and rural components for roughly the first three decades of planning.

It is clear from the table that though progressively larger investments continued to be made for water supply and sewerage in the successive plans during the first three decades, urban water supply and sanitation were given far more importance than those in rural areas. Though less than a fifth of the total population lived in towns and cities, close to two thirds of the expenditure on water supply and sanitation was for their benefit.

Plans and performance

The first Five Year Plan document noted that though the provision of protected water supplies had started at the same time in India as in England and USA, much less progress has been made in India. Only six per cent of the total population (or 48.5 per cent of the urban population) were provided with protected water supply, and only three per cent of the total population was served by sewerage systems. During this period an Environmental Hygiene Committee was set up which proposed a five year plan and in 1954 a National Programme for providing safe drinking water to urban areas was launched.

During the subsequent plans, the Central and State governments provided loans to municipalities and corporations to execute urban schemes and progressively larger investments continued to be made for water supply and sanitation. Schemes in the first two Five Year Plans were designed to provide safe water supply and drainage facilities to a total urban population of 15 million. Of the schemes launched during this period, 450 were to be completed by the end of the second plan period and the rest were expected to spill over into the Third Plan. Major schemes for the metropolitan cities were taken up during this period.

However, the Third Five Year Plan document noted that there were serious shortfalls in these schemes due to shortage of trained personnel, inadequate organization and planning and lack of materials like pipes, pumpsets and accessories. Based on the experience with the earlier plans, this plan document suggested careful scrutiny and phasing out of urban water schemes to avoid time overruns, a judicious selection of schemes for optional utilization of funds instead of

Plan	Expenditure	Rural	Urban	Total
1st		3	8	11
2nd		30	84	114
3rd and 3 annual plans		48	174	222
4th		194	380	574
5th (1974-78)		347	403	750

spreading them too thinly, and the strengthening of public health engineering services and the devolution of maintenance and part of the capital costs to municipalities. The effect of this reorientation combined with a relatively modest outlay was a greater stratification and concentration of resources in the larger urban centres. Neither the Fourth nor the Fifth Five Year Plan offered any fresh initiatives apart from the proposal to further intensify water supply to urban areas and the expeditious competition of spill-over schemes.

The draft plan for 1978-83 which was revised by the only non-congress government at the Centre noted the slow growth of water supply facilities during the preceding five plans and held the paucity of resources and the competing claims on available resources responsible for this situation. It pointed out that despite the investment of Rs.622 crores, only 64,000 villages covering only 10 per cent of the rural population had safe water supplies at the commencement of the plan. Though the urban situation was much better comparatively - about Rs.1050 crores having been spent on its improvement - 20 per cent of the

Size - Class		Total Number of Towns	Number Served	Total Population	Population Served
				(In Lakhs)	(In Lakhs)
I	Over 100,000	151	149	533.80	506.72
II	50-100,000	219	206	147.12	124.80
III	20-50,000	652	542	199.47	151.97
IV	10-20,000	987	649	139.61	85.04
V	5-10,000	820	423	61.97	31.71
VI	Below 5000	290	123	8.96	3.59
	Total	3119	2092	1090.93	903.83

Credit : UNICEF

Urban Water : a pipe dream?

Credit : UNICEF

At a colony for leprosy patients at Ujjain

urban population in 1229 out of 3119 towns did not have a protected water supply, and the existing schemes were badly in need of improvement and expansion. In keeping with its pronounced rural bias, this plan document also stipulated that in urban areas water supply and sanitation should be considered services to be paid for.

A really new thrust for water supply and sanitation came with the Sixth Five Year Plan (1980-85) which coincided with the International Drinking Water Decade Programme. This plan recognized that problems of urban development were inextricably linked with the provision of safe drinking water, that the total investment of Rs.855 crores by the central and state governments during 1951-74 betrayed insufficient appreciation of the magnitude and complexity of the problem, and underscored the urgency of finding lasting solutions. It also pointed out that the country could not afford to have expensive, sophisticated, or even uniform water supply services.

The overall urban situation, and especially that of the smaller and medium sized towns and cities continued to be quite unsatisfactory as the breakdown of towns by size-class which were provided with piped water supply upto 1980 shows. (See Table)

Though 67 per cent of the urban areas and 84 per cent of the urban population were provided with organized municipal water supply systems, the coverage within a given urban area was partial and uneven, even in the larger cities. The water supply needs of especially the smaller and medium sized towns were emphasized, since almost 90 per cent of the towns lacking organized water supply belonged to the class having less than 20,000 population. In these towns only 50 per cent of the population was served, thus revealing a bias towards larger cities, and within cities towards areas inhabited by more influential persons.

In the 7th Five Year Plan a provision of Rs.2988 crores for urban water supply and low cost sanitation and sewerage schemes has been made. It is anticipated that at the end of this plan period which will coincide with that of the International Decade, 86.40 per cent of the urban population will be covered by water supply and 44.70 per cent of the population by sewerage and sanitation.

Appraisal of performance

Like the proverbial slip between the cup and the lip, there is often a fatal gap between planning and performance. Even the seventh Five Year Plan document itself admits that "figures do not reflect properly either the adequacy of the water supplied or the deprivation of the urban poor". Before looking at some recent appraisals of

Credit : UNICEF

From a slum in Ujjain

the performance of urban water supply plans it should be stressed again that this state of affairs is despite the fact that urban demands and needs enjoy a higher priority vis-a-vis rural ones, because they are more visible, being, so to speak, right under the planners, policy makers, and the power elites' noses. Urban demands for water are invariably more strident and correspondingly more likely to elicit a positive response. The higher financial outlay, elaborate institutional arrangements and better feedback mechanisms are therefore only to be expected.

What then is happening to urban water supply in India today, and why? To begin with, the planning itself may be defective. According to M.N. Buch: "One of the basic services which has never been planned in detail in India is water supply. All city development plans make projections of the requirements of water for the city over a planned period. Suggestions are made for increasing treatment capacity and improving the distribution system. However, there is almost never any reference to the headworks and the source from which the water will be drawn, or what such drawal will do to the regional water management system..."

Secondly, in terms of resource allocation, it may be a tiny trickle poured into a large sieve. In 1958, the Third Public Health Engineers' Conference had estimated the total magnitude of water supply and sanitation schemes awaiting accomplishment to be of the order of Rs.900 crores in regard to the urban ones, and Rs.680 crores in regard to the rural ones. At their next conference two years later, this estimate had been revised. Apart from raising the issue of setting up Regional Water and Sewage Boards, the 4th PHE Conference had reviewed the magnitude of future programmes and forecast a revised estimate of Rs.1300 crores as the probable cost of providing satisfactory water supply and sanitation facilities in all urban areas

Though progressively larger investments continued to be made for water supply and sewerage in the successive plans during the first three decades, urban water supply and sanitation were given far more importance than those in rural areas. Though less than a fifth of the total population lived in towns and cities, close to two thirds of the expenditure on water supply and sanitation was for their benefit.

in the country while opining that about half the amount suggested earlier - or Rs.300 crores - should be adequate to cover the minimum needs of rural water supply and sanitation all over the country.

However, only three years later the Report of the Committee on the Augmentation of Financial Resources of Urban Local Bodies (Dr. Rafiq Zakaria Committee) concluded that additional resources worth Rs.99 crore per annum will have to be found for urban local bodies to enable them to augment essential services to levels which it considered essential and desirable. And only twenty years after that, the National Institute of Urban Affairs updated and revised these estimates to Rs.810 crores and pointed out that the resources that were required to provide these services according to the prescribed norms were massive and would call for recurring and non-recurring investments of very high magnitudes. Now essential services admittedly include other services besides water supply and sanitation, but it is significant that within a time span of only twenty five years the best part of what was earlier estimated to be sufficient to solve the problem once and for ever, was considered necessary to be spent *additionally, every year*, to bring essential services to satisfactory levels.

Quality of services

And what is the level of existing water supply and sanitation services in urban areas? In a detailed survey report published by the National Institute of Urban Affairs in 1986 on water supply and sanitation in cities of varying sizes, functions, and locations it was found that:

i) utilization ration of installed capacity for water supply is low

ii) upto more than half the total population of cities may not be served

iii) average per capita supply is lower than the recommended norms

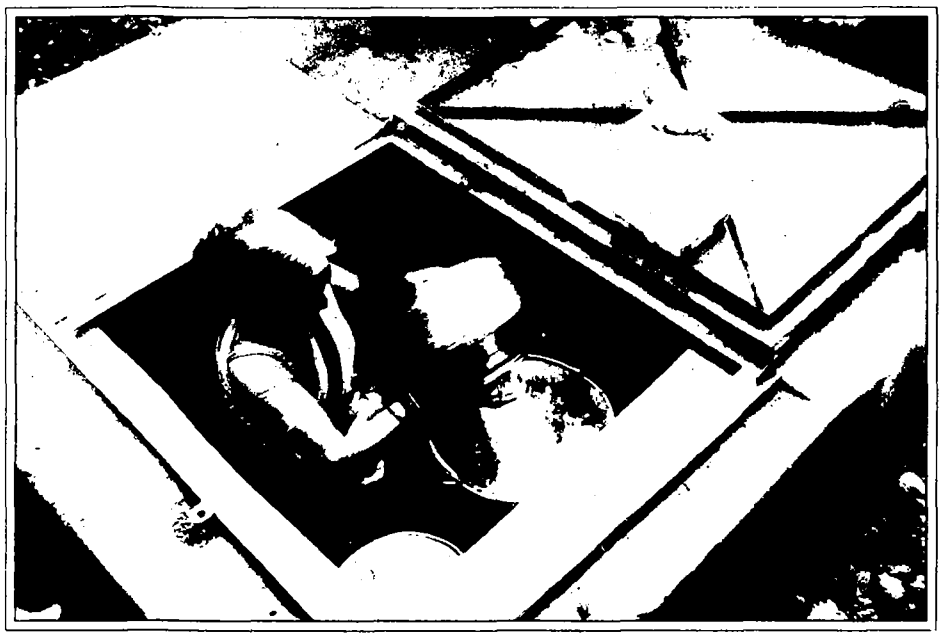
iv) facilities for full scale treatment of water did not exist even in a single city selected in the sample and therefore water quality was poor

v) even the gross averages of percentage of population served and per capita availability concealed serious intra-city disparities and that precisely those parts of cities where the percentage of population served was low, also had significantly lower per capita availability.

vi) on a conservative estimate between 30 per cent to 40 per cent of the water available was lost in leakages and wastage

vii) supply of water was poorly metered; upto 3/4th of the connections in some cities were unmetered while elsewhere half the meters were permanently out of order

viii) not surprisingly, water supply was not financially viable and what is



Credit : UNICEF

Collecting water from an underground tank, a resettlement colony in Indore

more, the collection rate of water tariffs was often quite low

ix) there was a paucity of technical capabilities and equipment and none of the sample cities followed any of the steps laid down in the guidelines of the Manual on Water supply and Treatment prepared by the Ministry of Urban Development of Government of India in 1976

x) staff, qualifications, deployment policies were all badly in need of rationalization

xi) supply of water everywhere was intermittent, infrequent, and at low pressure

xii) demands for water were both rapidly increasing as well as proliferating; in some metropolitan cities the percentage of deficit (i.e.difference between demand and supply) was as high as 65 per cent

xiii) there could be serious inter-annual fluctuations and most water supply systems had very low resilience or shock absorbing capabilities due to the virtual absence of back-ups and alternative sources

The diagnosis

The NIUA study was undertaken primarily with a view to identify managerial and organizational problems. Other studies have sought to go into the details of demographic growth, income, spatial and institutional settings and other features which influence the demand for, and the operational environment of the water supply and sanitation services, while yet others have looked at the problem from still other points of view. By way of summing up, one may mention briefly that various differential diagnoses have been suggested for a situation which is universally recognized to be rather unsatisfactory. These include, among others, the following:

i) Wider climatic factors like recurring droughts and depletion of water resources

ii) high rates of population growth, especially of urbanization

iii) perceptual constraints and lack of political will

iv) institutional break-downs, especially of local self government

v) defective legal and policy frameworks, faulty prioritization

vi) multiplicity of agencies and poor coordination

vii) low levels of efficiency, effectiveness, and equity

viii) resource constraints

ix) an attempt to balance expansion and maintenance of services that is doomed to fail

x) low levels of quality consciousness; thus according to the National Environmental Engineering Research Institute, 70 per cent of water in India is polluted while according to the World Health Organization, 80 per cent of all the diseases in India are waterborne or water related.

In a complex urban service system, there is no easy recourse to escape routes such as 'community participation' and 'consumer consciousness'. The onus must rest almost exclusively on the concerned authorities. Unfortunately, within a welter of deterioration covering population increases, old worn out systems of distribution, increasing resource depletion and inequitous biases, the system simmers from within. It is only in times of a major epidemic that we realise how close we live everyday to boiling point. Two good monsoons together with resource recharging might conceal the fact as is evident from the waning of media interest in urban water supply. But the malaise lies too close to the surface for comfort. ❑

-- *Kashyap Mankodi is a freelance consultant who has carried out a wide range of studies on the social impact of various developmental projects in the fields of health, irrigation, forestry and urbanisation.*

Sanitation : Low Cost, Low Acceptance

Between an expensive sewerage system and the open fields lies a whole improved system of low-cost sanitation. While its effectiveness has been proved beyond doubt, Dr. BINDESHWAR PATHAK enumerates the various obstacles that block its assimilation into our system.

Sanitation has a wide connotation. Human excreta, waste water, solid waste and even personal hygiene and housing are all directly connected with sanitation. The scope of sanitation may vary with the need and communities; but in a developing country like India, safe disposal of human excreta is the most challenging problem in the field of sanitation, both in rural and urban areas.

Researchers and scientists both in India and abroad have concluded that safe disposal of human excreta can bring about maximum improvement in sanitation and environment. The All India Institute of Hygiene and Public Health, Calcutta came to the same conclusion and observed in their investigation carried out at the Singur Research Centre that the mortality and morbidity rates were higher in villages with only tube well water supply facilities than where only low cost pour flush toilets had been provided. The best results were observed where both the facilities were available and the worst where none were present. Health statistics of the country also reveal that excreta-related diseases cause the highest number of deaths.

This article deals with the problem only of excreta disposal as its safe disposal is the prime need especially when there is a resource constraint.

History reveals that household privies were not suited to the culture and tradition of this country in the past, and therefore were not an essential feature of a house. Defecation direct on to the soil was a matter of habit and convenience. Even now, though in urban areas toilets are regarded as a part of the house, yet only 44 per cent of the houses have latrines and nearly half of these are bucket or dry privies.

Sewerage

The primary objective of public health engineers in converting traditional service latrines into water flush toilets has been environmental hygiene and protection of the community against health hazards. They have been advocating underground sewerage as the only safe and most effective means of achieving these ends.

Sewerage is the best system for disposal of human waste as it takes care of both human excreta as well as waste water from bathrooms and kitchens. Sewerage is, however, costly and neither the government nor the local authorities or beneficiaries can bear the capital or operation and maintenance cost. Excreta disposal through sewerage costs almost five to six times more than a pour flush system with twin pits (PF) which is an on-site system. Moreover it requires almost six times more water for flushing than the PF system and water is a scarce commodity.

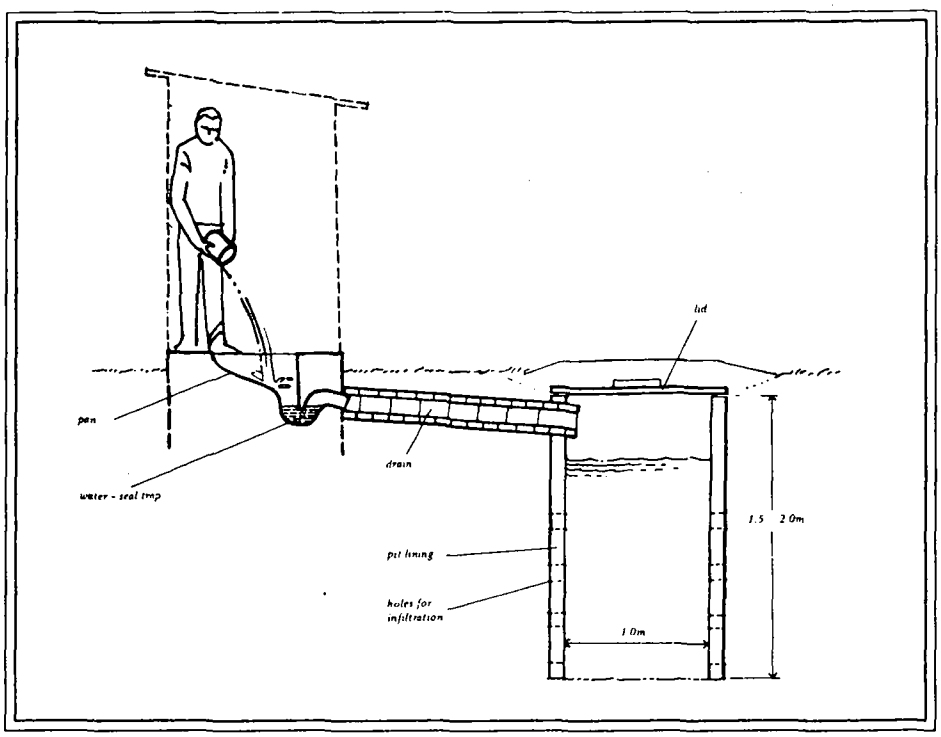
Although almost the entire Five Year Plan allocation for urban sanitation has been spent on sewerage systems, either on-going or new, yet there are hardly 232 towns and cities with sewerage at present. None of these sewerage schemes, however, covers the entire municipal city area, leave alone the adjoining suburbs included in the municipal limits.

In most towns and cities, even on the streets where sewers have been laid, houses have not been connected inspite of municipal laws making it compulsory for such connection, as people do not have money or do not like to spend it in one lump sum for the conversion; thus, insanitary conditions continue.

Another difficulty is the operation and maintenance of sewerage. After the introduction of sewerage in the town, the local authorities levy sewerage tax to which there is opposition because everybody has to pay it, whether one has a sewer connection or not. The maintenance cost of sewerage cannot be met from the tax even though it is high. The rate, however, cannot be increased as it is beyond the capacity of the common person to pay higher taxes. Due to the general budgetary constraint, local authorities are unable to maintain the sewerage system even with cross subsidy and the sewers are getting choked for lack of proper cleaning and maintenace. Moreover, since all the houses on a street are not connected, the household waste water along with some waste from the streets is let into the sewerage. Discharge of such waste and soil, and insufficient water for lack of house connections, is resulting in the chokage of sewers, making many of them defunct. The large sums of money spent on sewerage have thus become infructuous.

A sewerage project has to be completed substantially before even a

portion of the completed work can be made use of, while with individual on-site systems for each house, this difficulty is not encountered. One of the advantages of a pour flush system is that the maintenance is not a burden on the local authority. The daily maintenance is done by the housecowner. While the dry sludge which is to be taken out every three years, is safe for handling and can be taken out by any labourer as it is dry, and odourless like earth, the returns from the sale of the sludge are more than the cost of the labourer. Low cost sanitation (LCS) has the advantage that when there is any budgetary constraint and the work has to be stopped or slowed down, all the work completed can be used and people derive the full benefit, which is not so in a sewerage system.



A section through a pour-flush latrine with the pit some distance away from the squatting slab. Dimensions are in metres.

Septic tanks

Septic tanks, an alternative to on-site sanitation, cost almost two and a half to three times more than low cost pour flush systems. Septic tanks have many drawbacks in comparison with PF latrines. They have to be cleaned after one or two years. The wet sludge taken out is a health hazard and at times gets mixed up with fresh night soil and has an obnoxious smell. The sludge has therefore to be discharged at a safe place. Emptying the septic tank is thus not so easy and is a burden on the municipality. The traditional quantity of 14 litres of water is needed for flushing. The space required for a septic tank toilet is more than the PF latrine.

Low cost sanitation (LCS)

On-site sanitation with a pour flush two pit latrine popularly known as Sulabh Shauchalaya is acceptable and affordable by the majority of the population and easily available. Nearly 10 lakh dry/bucket latrines have been converted by adopting the PF system all over the country. Now a two litre flushing cistern has been developed, which can be fixed to the pourflush system and changed to cistern flush whenever desired. Thus, it has been possible to overcome one of the factors that led to the non-acceptance of the low cost PF system by the MIG and HIG population.

On-site sanitation was tried in rural areas in the 1950s and 1960s but did not succeed. The toilets were built with one pit and the second pit was to be constructed by the household when the first pit was filled. The pits were also not lined. The result was that many pits collapsed and the second pit was not constructed and people again started going out for defecation in the open. The people lost faith in the technology proving a great setback to the programme. It was Sulabh International, a voluntary social organisation, which showed that PF latrine with leach pits can be successfully constructed even in the most congested towns. This achievement of Sulabh led to adoption of low cost sanitation all over India. This system meets the technical, socio-economic and cultural needs of the people.

Constraints

Financing has undoubtedly been the major problem area in promoting the conversion programme of dry/bucket privies. Although low cost sanitation costs 1/5 to 1/6 of sewerage and 1/2 to 1/3 of septic tank, yet it has not made the desired progress because the approach of planning, administrative and technical authorities has been to give higher priority to sewerage. Till 1981, low cost sanitation had a very low priority. Even now, states either do not make provision for LCS or it is so meagre that it is not sufficient even to match the available central assistance, with the result that most of the states are unable to avail of the financial assistance offered by the Government of India.

Human resources: Engineers have been educated and trained in high tech and any engineering work which is grand and can earn applause attracts them. Thus, piped water supply system

or sewerage is their natural choice. Less technical men are attracted to the construction aspects of sewerage systems. Most of them are therefore indifferent to low cost sanitation.

Big contractors are not interested in taking up the construction of LCS. They prefer to go in for works where the margin of profit is higher. The NGOs also feel hesitant in taking up this work due to difficulty in finding a suitable and willing work force. Experienced and trained persons including the masons, leave the job of implementing the LCS and shift to other kinds of construction where the payments are more lucrative and prospects better. This applies to Junior Engineers and Assistant Engineers too.

Since pour flush toilets are to be constructed in individual houses, each toilet becomes a project by itself. As the construction has to be done at the convenience and to the satisfaction of the house owner and the work is scattered in nature, the labour and material inputs increase. Due to low turn out, low chances of wastage of materials and labour and a close surveillance by the house owner, the margin of profit is reduced considerably.

Financial assistance to beneficiaries: The financial assistance made available to beneficiaries should be such that they could afford to have a toilet in their houses. It has been observed that in many states, the rate of interest and the retiring period for the loans advanced to beneficiaries make the loan repayment instalments too high to be affordable by most people. It results in non-repayment of loans too.

Till now all the households, irrespective of their income, were getting 50 per cent subsidy and 50 per cent loan to cover the full cost of the toilet, upto sub-structure level in most states. The Government of India has now curtailed the subsidy and has related it to the income level of the household. The beneficiaries have also to contribute from 5 to 25 per cent of the total cost from their own resources. It has become a problem for most people to spare the money in one lump sum, which they could have paid in instalments.

Felt need: Most people who do not have a toilet or have a bucket/dry privy, belong to the economically weaker section and low income groups. For them, a sanitary latrine is not a felt need; they give priority to other necessities of life like food, clothing, shelter etc. A latrine gets very low priority as they are not aware of its importance and need. It has been observed that most of the latrines provided in rural areas with 100 per cent subsidy from the government are not used -- instead, the latrine cubicle is used for other purposes. This happened because the progamme was not supported by software inputs like sanitation education, motivation, publicity, communication, etc.

Legal support: The Technology Advisory Group of the World Bank had suggested adoption of bye-laws on sanitation in the feasibility reports prepared by it on low cost sanitation in order to give legal suport for expeditious implementation of the programme. The Government of India has also circulated these bye-laws to be adopted by the local bodies. But most of them have not so far adopted them. It is also observed that where such laws are available, enforcement is not possible due to public resistance. Mere formulation of law is not an end; it is equally important to enforce it by making available the alternative for bucket/dry privies and open air defecation which is affordable, acceptable and easily available.

Superstructure: It has been observed that at times when a bucket privy is to be converted, it becomes necessary to construct a new one at a more suitable place, which needs a superstructure. Many of the houses cannot afford to build it from their own resources, resulting in continued use of bucket privies. Similarly, a large number of toilets constructed in houses having no latrines are not used due to non-construction of a superstructure. Most of these houses belong to economically weaker sections who have no means to build a superstructure.

Methodology for construction: It is very bothersome and time consuming to run about getting the necessary approval of drawings, sanction of grant/loan from the local authority, arranging labour and materials and supervising the construction. Though people may be willing to have a pour flush toilet, all these problems prevent them from getting the latrine constructed. They will be happy to have an agency take the entire responsibility from the application stage to completion of toilet, including guarantee of the structure and its functioning. The householders also need education on use and maintenance of PF toilets. The local authorities and the government department do not have the necessary infrastructure to carry out this job. Only NGOs who are experienced in this field are best suited.

Community latrines: There is a large section of people in every town in whose homes there is no space for providing a toilet. For them, the only feasible alternative is properly maintained community latrines. Due to lack of resources, the local authorities are unable to construct community latrines in adequate numbers and even the existing ones are not maintained properly with the result that most of the people prefer to go for defecation in the open rather than using the community latrine. Most of the states do not have provision in their budgets or Plan for providing financial assistance to local authorities for constructing, operating and maintaining community latrines. ❑

-- Dr. Bindeshwar Pathak is Founder, Sulabh International and Chairman, Sulabh Foundation.

Sanitation -- More than Just Latrine construction

Far too often, sanitation is seen as 'latrine construction'. This narrow perspective, though, does not tell us why promotion of sanitation in rural areas has proved so difficult. ***Y.D. MATHUR and S. HUDA*** *discuss the variables involved.*

Sanitation is one of the important areas on which countries of the developing world are focussing attention to improve the living conditions and health status of their people. As part of its commitment to the International Drinking Water Supply & Sanitation Decade, the Government of India has set a target of 25 per cent coverage in rural sanitation for the period 1981-90.

An increasing political will was reflected and an action plan was developed in January 1986. The Department of Rural Development was made the nodal department for coordinating the rural sanitation programme and funds have been released under different rural development and employment generation programmes. UNDP/World Bank, UNICEF and other external agencies are collaborating in projects initiated in different parts of the country. Some reputed NGOs have come forward to contribute towards the promotion of sanitation. However, despite these efforts, the situation continues to be unsatisfactory and only about three per cent of the rural population are expected to be covered by 1990. This has created a situation where the health impact of a good coverage in the water supply sector is offset by lack of sanitation. Incidence of diarrhoea, worm infestations and other water excreta related diseases continues to be high. Nevertheless, a momentum in sanitation has been developed and the experiences gathered from ongoing projects have been critically examined for the identification of constraints and possible future approaches.

More than 'latrine construction'

Sanitation is often seen as a "Latrine Construction" activity. This concept has to be widened to include a package of health-related activities like proper disposal of solid wastes, waste water and the adoption of improved personal hygiene practices. The need is to bring about a behavioural change which demands considerable attention to the software component of the programme.

There is a lack of "felt need" and sanitation is not a priority within the rural community. It should be realised that "Health for all by the year 2000" cannot be achieved unless the people are fully oriented with sanitary practices in their daily life. The stress on awareness building needs to be strengthened to use it as the most powerful tool to promote sanitation.

Availability of alternative low cost options would allow people to choose what suits them best depending upon their affordability and cultural practices.

The development of area specific communication strategies would help to reach each and every family so as to make them convinced that sanitation is an obvious need of the community in terms of direct benefits like convenience and privacy. Also, the relationship between sanitation and disease can be better understood. Clear cut financial allocations are necessary for the information, education, communication and social mobilisation component of the sanitation programme.

Though enhanced priority has been accorded at the national level, sanitation demands still more attention by the planners and policy makers at the state levels. This needs to be reflected in terms of higher resource allocation and a well established infrastructure for the planning, implementation and monitoring of sanitation activities.

The established infrastructure may be further energised by arranging orientation courses and inter-state trips to different project areas with a view to becoming familiar with the various approaches being tried under varying situations.

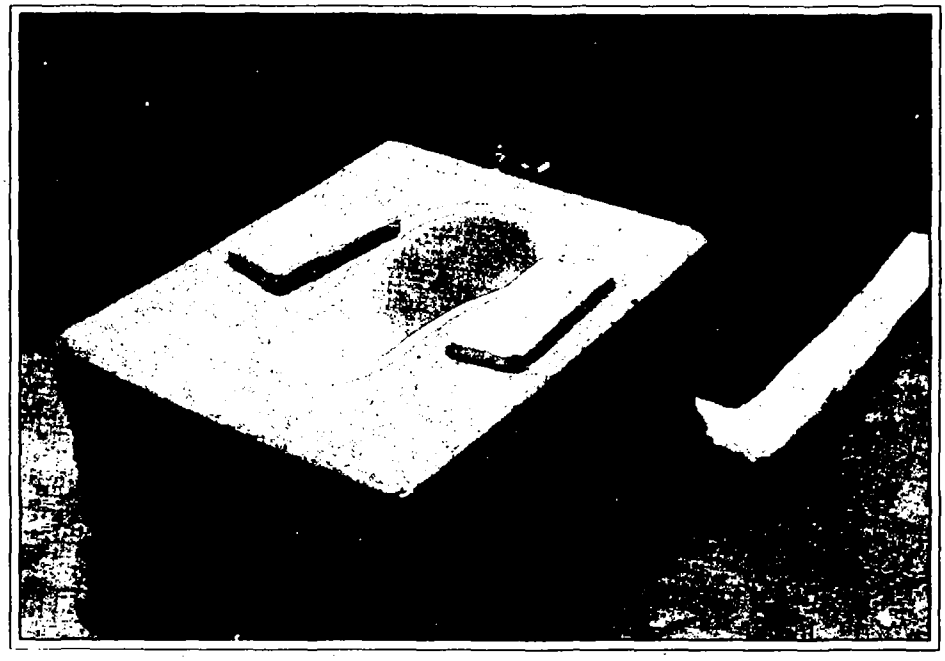
Awareness creation and community participation

The awareness creation and motivational activities need to be supported by a concurrent development of low-cost technology as well as effective community-based hardware delivery systems. Based on the available technological options, a fairly large

section of the rural community can afford to install sanitation facilities in their premises. Further research may help reach even a larger section of the people. Availability of alternative low cost options would allow people to choose what suits them best depending upon their affordability and cultural practices. There exists a need to extend the delivery systems nearer to, and within the transportation reach of, the rural population.

Community participation though much talked of, is very often not understood in terms of its practical implications. For project activities it should mean the involvement of the communities, particularly the women right from the planning stage to empowering them to take decisions. The programme needs to be "demand based" with "cost sharing" by all, even those persons below the poverty line. This will help imbibe a sense of participation and ownership which would go a long way towards the better usage and maintenance of the facilities.

Provisions of sanitation facilities should be planned for schools and anganwadis to complement the formal health and sanitation education of children. This will have the immediate effect of inculcating good habits amongst children, influencing the other members of the family and of reaching the ultimate aims of a new generation fully aware of the need and benefits of sanitation. Community latrines can be considered for places like markets, bus and railway stations having concentrations of floating population and where there is demand from local population.



Source : Appropriate Technology Report, 1980.

Squatting plate, pan and Soakage pit

Source : Appropriate Technology Report, 1980.

With Superstructure

NGOs have been playing an important role towards the promotion of sanitation activities particularly in the motivation and service delivery aspects. State Government implementing departments can gradually expand the involvement of NGOs and may even assign projects on a turn-key basis to them.

Promotion of sanitation can no longer be looked upon as the responsibility of a small group of technical personnel. A coordinated effort on the part of the various departments like health, education, rural development and engineering using some of the approaches outlined in the preceeding paragraphs could pave the way for a sustainable programme. Sanitation has to find a place in the mainstream of rural development activities. As our country's first Prime Minister, Pandit Jawahar Lal Nehru said: "The day every one of our countrymen and women get to use a toilet, I shall know that our country has reached the pinnacle of progress". The job is no doubt difficult but it can be done. ❑

--Y.D. Mathur is sanitation coordinator, UNICEF. S. Huda is Project Officer, Sanitation, UNICEF.

Completing the Circle -- Water, Health and Development

The Alma Ata Declaration in 1978 identified primary health care as the key to attainment of health for all. The use of safe water supply and appropriate sanitation is a key-stone of PHC. As the UN Decade for Water and Sanitation draws to an end, how close have these two sectors come? Dr. P.N. SEHGAL discusses.

The availability of safe and adequate drinking water and sanitary measures has a direct bearing on the working conditions and health of the people and their capacity for optimum production. There are very few investments which repay as much in health benefits as the provision of safe drinking water and sanitation. Both of these are pre-environmental control measures against the transmission of most water-borne diseases. This relationship is evident in the WHO statistics which show that about 80 per cent of all diseases in developing countries are related to unsafe water supply and inadequate sanitation, causing high infant mortality, low life expectancy and poor quality of life.

While access to safe drinking water and sanitation have been proven to be essential to good health, and while the availability of water is requisite for socio-economic development, there also exists a cause and effect relationship between water, health and development. These three elements form a complex system which will decide the course of future events. The accelerated development and orderly administration of water resources constitute a key factor in efforts to improve our economic and social conditions, especially in the developing countries. In 1980 the United Nations General Assembly formally launched the International Drinking Water Supply and Sanitation Decade (1981-90) with member countries making commitments to provide safe drinking water and adequate sanitation for all, by the year, 1990, if possible. We have to take stock of the situation and review what could be achieved and how to achieve the unfinished task.

In terms of socio-economic development, the resource lost as a result of illness is human labour. The impact of sickness can be measured in terms of deaths - loss of workers, disability - loss of working time, and debility - loss of productive capacity while at work. In the case of water-related illnesses, great costs are entailed in the share of a nation's resources - manpower and material - that are used to supply the health services and ancillary components made necessary by the prevalence of water-related diseases.

Water and Sanitation Related Diseases in India

A. *Water-borne diseases:* Cholera, gastro-enteritis, diarrhoeal diseases, dysentries, enteric fever/typhoid, viral hepatitis A, poliomyelitis. These diseases are spread by contaminated water, food or dirty hands.

B. *Water-washed diseases:* Scabies, lice, trachoma, conjunctivitis. These are prevalent due to insufficient water for washing and lack of personal hygiene in bathing and laundering.

C. *Water-based insect/vector transmitted diseases:*

Malaria, filariasis, dengue, Japanese encephalitis, guineaworm. These are carried or transmitted by insects living or breeding in or near water.

D. *Sanitation related diseases:* Helminthis diseases, tetanus.

E. *Water with high fluoride containing minerals* causes fluorosis.

The morbidity and mortality due to water and sanitation related diseases is not exactly known, as most of these diseases are not notifiable. The reporting of even notifiable diseases suffers, both in quality and quantity. These are all based on reports by states mainly from hospital data which do not reflect the true picture in the community.

In the recent epidemic of cholera in Delhi during June-July 1988, over 15000 cases of acute diarrhoea and vomitting were reported from the city's main hospitals, 600 of them were diagnosed as confirmed cholera cases and over 200 people died by July end. How many more suffered, how many died without reaching hospital is anyone's guess. The epidemic was restricted to the slums and resettlement colonies of the capital. The study revealed that in these colonies water supply was largely through ill-maintained shallow handpumps close to open storm water drains which also carried sewage. The water of shallow handpumps obviously got contaminated with sewage, resulting in the cholera epidemic.

Studies carried out in different parts of the country to assess the magnitude of the problem of diarrhoeal diseases indicate that children below five years of age in India, on an average suffer

from three episodes of diarrhoea, 10 per cent develop dehydration and one per cent require hospitalisation. In terms of actual numbers, the statistics are even more hard-hitting. 100 million children below five years of age may have 300 million episodes of diarrhoea per annum, of which 10 per cent i.e 30 million may develop dehydration and one per cent i.e three million, may require hospitalisation and may face death. The large number of diarrhoea bouts aggravates malnutrition among the affected children who are already on the lower mark of malnutrition status due to coupling of various socio-economic factors such as underemployment/unemployment, lack of education including health education, primitive housing, poor sanitation etc. The grim diarrhoeal situation is aggravated by the non-availability of community-based information about the nature and type of the diseases spread. The reduction in morbidity/mortality status due to diarrhoeal diseases will go a long way in attainment of our goal of Health for All by 2000 A.D.

Typhoid and paratyphoid fevers (Enteric fever) are rampant throughout the country but due to lack of laboratory facilities, these are very much under-diagnosed.

Viral hepatitis is endemic in most parts of the country. The biggest epidemic in the world due to infectious hepatitis occurred in Delhi during December 1955 to January 1956 when the Delhi Water Supply was contaminated with sewage from the Najafgarh 'Nallah' (drain). The total morbidity was estimated to be about 40,000 cases. The total number of persons who got infection without apparent symptoms could be ten times as high -- 400,000 in a total population of 18 lakhs.

Guineaworm disease is also a major water-based ailment. The Government of India launched the Guineaworm Eradication Programme in 1982-83. At present Guineaworm is present in some districts/villages of six states viz., Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra and Rajasthan. The improvement of water supply in the affected villages will accelerate the process of eradication of diseases from the country.

Existing organisation set up up for health education and hygiene practices

All health programmes, including their health education components, are implemented through the State Health Departments, which are headed by a Secretary. The Director/Director General of the State Medical and Health Services is the technical head of the Departments. Each state has a State Health Education Bureau under the charge of an officer usually of the rank of Joint Director of Medical and Health Services. The State Health Education Bureau through its various sections carries out planning, organising and directing state-wide health education activities as an intergral part

Credit : UNICEF

of Public Health Programmes.

At the district level there is a District Health Education and Information Officer and District Extension Educator for Health Education activities.

At the Block/PHC level there is a Block Extension Educator and Health Supervisor who also carries out health education work.

At the Sub-Centre level there is a male multi-purpose worker and a female multi-purpose worker, who, besides their routine primary health care services, are supposed to do health education work in the community. A sub-centre has a population of about 5000 in the plains and about 3000 in hill and difficult areas.

At the village level there is a village health guide for about 1000 population. She is not a government official but a volunteer trained in basic health activities.

At the periphery, there are multi-purpose workers with responsibilities for the delivery of primary health care. Though every health functionary is supposed to do health education work in the community, in actual practice they are so busy with the target-oriented programmes (such as Family Planning and Immunisation etc.) that the health education work on water-borne diseases is hardly taken up effectively.

Primary health care strategy and the role of health agencies

The Alma-Ata Declaration in 1978 which identified primary health care as the key to the attainment of health for all by the year 2000, included the provision of safe drinking water and adequate sanitation as one of its eight essential components.

Use of safe water supply and appropriate sanitation should constitute an element of primary health care to bring about improvements in health and not just the construction of more water and sanitation systems. An improvement only in water supply and sanitation will not bring maximum health benefits if other essential components of primary health care are disregarded. For example a lack of personal hygiene may invalidate the benefits of safe water, improper disposal of waste water and a bad irrigation system would increase malaria and other vector-borne diseases... Thus, a co-ordinated view must be taken in identifying related priority problems in environmental health.

A lack of personal hygiene may invalidate the benefits of safe water, improper disposal of waste water and a bad irrigation system would increase malaria and other vector-borne diseases...

Health authorities should carry out epidemiological studies to determine which are the communities and areas of high risk of water-borne or water-related diseases. They should also assume the responsibility for establishing appropriate quality standards for drinking water, set up and operate drinking-water quality surveillance programmes which should also provide advice on protection of drinking water sources and on sampling and analysis of drinking water used and reporting there on.

The Medical and Health Department and the Public Health Engineering Department must function very closely with each other at all levels to control water and sanitation related communicable diseases in the country. Health authorities must take the lead in epidemiological studies of water-borne and water-related diseases and inform the Public Health Engineering Departments as to where the water supply and sanitation efforts should be concentrated. Unfortunately, this close collaboration is lacking so far.

Health Education -- intersectoral approach

For evident reasons, primary health care has to be developed as an integral part of socio-economic development and with the full participation of the individual, family and community. The role of health planners does not end with the mere provision of safe water but it has to be seen that consumers accept it for their own benefit. The underlying assumption is that people will accept desired health practices only if they are aware. In India, which is characterised by low literacy, low per capita income and multilingual and cultural diversity, the vast majority of beneficiaries live in traditional rural societies with their own concepts of health and disease. They learn new ways of health behaviour through formal and informal education offered by the family, neighbours and health workers. Training in behavioural aspects and health education will equip them to undertake educational responsibilities in identifying social, cultural and economic aspects of the community and techniques, methods and materials appropriate to different learning situations. Such training will also prepare them with essential skills to plan, implement and evaluate health education as an integral part of health care programmes, including water and sanitation.

In addition to the health workers, for spreading the message of health education and hygiene practices effectively, co-operation and assistance of local, influential and respected leaders and persons (not necessarily elected representatives), will have to be enlisted. These people could be school teachers, village health guides, auxilliary nurse-midwives, local doctors, health workers, dais, anganwadi and balwadi workers, informal teachers, local social workers, members of youth organisations and mahila mandals, the local assistant postmaster or even the post man.

There is also a need for integration of the health education programmes

Credit : UNICEF

with not only the water and sanitation programme, but with other sectors, i.e., agriculture, rural development, education, social welfare and voluntary organisations which are directly or indirectly related to the health of the community.

Need for effective implementation and augumentation of the health education programme.

There seems to be a very poor linkage between implementation and planning of health education activities in the country. Although it forms an integral part of other health programmes and the functions of almost all health functionaries at various levels, actual implementation is very weak.

As of today no health infrastructure at the state, district or the primary health centre level exists for carrying out health education relating to water supply and sanitation. Health education is integrated with all health programmes and thus a common impression is that every worker at every level is supposed to carry out health education in his/her programme. But the fact is that health education gives distracted attention to this activity. Minimal involvement of non-government/ voluntary organisations in health education is a pointer to the fact that efforts are needed to impress upon these organisations the significance of health education which they should embrace in all their activities. Therefore, there is need for augmentation at all levels for effective health education and hygiene practices to make community participation a reality. There is need to earmark five to ten per cent of the total budget on water and sanitation for health education and human resource development.

Human resource development

The need for planned human resource development for rural water supply and sanitation is enormous as the problems are multifarious and the solutions vary widely from mechanical to chemical and biochemical to biotechnological. There is need to orient the health staff at all levels about drinking water, environmental sanitation, personal hygiene vis-a-vis the water-borne diseases in the community and to instil a sense of commitment in the staff working in the field. A series of orientation workshops/training courses may be one way of imparting this information.

The basic problem is to change the behaviour, attitude and those traditional practices which are wrong. To enable the health worker to communicate appropriately with the community, she should be imparted training so that she gains the essential skills in the field. The health worker's role is very crucial in that she has to convince the local people about the advantages of following hygiene practices which can result in a reduction in water-borne diseases -- a net advantage for the community in the long run.

Involvement of women

In most cultures, women perform a large proportion of tasks related to water collection, food production and food preparation. They also are usually the principal teachers of children in water and sanitation practices. There-

Credit : UNICEF

fore, women's participation in planning, implementing, maintaining and evaluating water projects is critical for long term health benefits.

Water quality surveillance

So far, drinking water supply projects have been implemented to meet the target of coverage of problem villages through supply of water, without looking much into the quality aspects of the water being provided. A systematic and regular water quality surveillance will ensure not only sufficient quantity of drinking water but will also determine its quality and the need, if any, for treatment. At present, though the public health staff of primary health centres are supposed to do periodic chlorination of wells with bleaching powder, there is no check to see if this is really being done. Voluntary organisations, science teachers and primary health centre staff could be trained to undertake prescribed simple tests of the potability of drinking water. These organizations can then ensure that the necessary modifications are done with little loss of time. Water quality surveillance should be regular and preventive in nature. District public health laboratories should be required/established to carry out bacteriological and chemical examination of the water.

Monitoring and evaluation

At present there is no agency, either at the centre or state level to monitor the impact of health education in water supply and sanitation on community health, water use and attitude, hygiene practices etc. Monitoring, evaluation and feed back for improvement by implementing agencies of rural water supply projects in general have not been given the attention they deserve. This should form an integral part of any water supply agency with separate cells at state and national level.

At the beginning of a project, a baseline survey or problem oriented diagnostic (KAP -- Knowledge - Attitude - Practice) study should be carried out in randomly selected villages, with respect to drinking water, environmental sanitation, and personal hygiene and the morbidity and mortality due to water-borne diseases, particularly diarrhoeal diseases, cholera, enteric fever, infectious hepatitis, poliomyelitis and guineaworm. The PHC and sub-centres should be directed to collect this data.

THE NUMBER OF WATER TAPS PER 1000 PEOPLE IS A BETTER INDICATION OF HEALTH THAN THE NUMBER OF HOSPITAL BEDS.

IMPACT OF SUFFICIENT, CLEAN WATER SUPPLY ON HEALTH

- -- REDUCED WATER-BORNE DISEASES
- -- DECREASED MORTALITY
- -- IMPROVED NUTRITION
- -- MORE SURVIVING AND HEALTHY CHILDREN
- -- REDUCED NATALITY
- -- MORE ENERGY FOR WORK AND LEARNING PARTICULARLY FOR WOMEN AND CHILDREN.

AT PRESENT PRACTICALLY NO HEALTH INFRASTRUCTURE AT THE STATE, DISTRICT, PHC AND VILLAGE LEVELS EXISTS FOR CARRYING OUT HEALTH EDUCATION RELATING TO WATER SUPPLY AND SANITATION.

THOUGH EVERY FUNCTIONARY IS SUPPOSED TO DO HEALTH EDUCATION WORK IN THE COMMUNITY, IN ACTUAL PRACTICE THEY ARE SO BUSY WITH THE TARGET ORIENTED PROGRAMMES SUCH AS FAMILY PLANNING AND IMMUNIZATION, THAT THE HEALTH EDUCATION WORK ON WATER-BORNE DISEASES IS HARDLY TAKEN UP EFFECTIVELY.

UNLESS GOOD QUALITY DRINKING WATER AND CLEAN WHOLESOME FOOD ARE CONCURRENTLY AVAILABLE TO THE PEOPLE, THE FULL BENEFITS FOR PUBLIC HEALTH WILL NOT BE REALISED.

EDUCATION IN GOOD HYGIENE PRACTICES CONSTITUTES AN IMPORTANT APPROACH THAT MUST BE EFFECTIVELY CARRIED OUT THROUGH PRIMARY HEALTH CARE SERVICES.

-- Dr. P.N. Sehgal is Consultant to the Voluntary Health Association of India. He was formerly Director, National Institute of Communicable Disease (NICD), Govt. of India.

Tilted Scales : The Effect of Poor Water Supply and Sanitation on Malnourished Populations

In developing countries, a poor nutrition profile can conjoin with poor water supply and sanitation to create an abysmal health situation. Prof. INDIRA CHAKRAVARTY establishes a clear co-relation between malnutrition, repeated bouts of diarrhoea and poor water and sanitation.

It has generally been assumed that improvement of water supply and sanitation plays a significant role in reducing high levels of morbidity and mortality that prevail in many poor countries. An understanding of the relationship between water use and health is not new. Frontinus, the water commissioner of Rome, mentioned that "other things being equal, a safe and adequate water supply is generally associated with a healthier population". Unsanitary environmental conditions, unhygienic disposal of feaces, use of contaminated open water source, overcrowding, malnutrition and low socio-economic status are ultimately the main contributory factors to incidence of diarrhoeal diseases. High diarrhoeal mortality and morbidity in low income countries are related to the availability of safe water for personal and domestic purposes and environmental sanitation. The problems associated with the availability of safe water and disposal of feaces in these countries remain grossly unattended. Moreover in developing countries the safe use of water has to be always linked to behavioural changes and such changes are possible only when safe water is available near homes. It is possible to introduce major changes in sanitary habits and practices through participation of women of the community in planning and implementation of rural water and sanitary programmes.

Health protection at the community level and its relationship with the environment and socio-economic development lays stress on the need for broadening the concept of the effects of water use and sanitation practices. In promoting the use of safe water and sanitation practices, a multidisciplinary approach is essential.

The general control measures for most water-related diseases include: improved water quality, water availability, excreta disposal, excreta treatment, personal, domestic and food

Credit : UNICEF

hygiene, sullage disposal and drainage. The effect of these control measures is listed in Table 2. The important conclusion from this is that the health impact of supplying clean water alone is limited. However, carefully designed programmes which combine water quality with improvements in water availability, sanitation and hygiene education have the potential to be successful.

A survey has been conducted by this Department (Dept. of Biochemistry and Nutrition, All India Institute of Hygiene and Public Health, Calcutta) in two villages of Midnapur district on the Lodha tribes of West Bengal, which clearly indicated the linkage between water, sanitation, morbidity pattern and nutritional status. Baseline data indicates that the prevalence of diarrhoeal disease and worm infestation in both the villages were more or less same. Invervention by provision of water supply and sanitation through tubewells and latrines in one of the villages showed a decrease in the incidence in diarrhoeal disease and worm infestation as compared to the village which was left as such, to serve as the control. The general nutritional status also improved. In the experimental village the prevalence of Grade-III malnutrition as per weight for age classification reduced from 10.3 per cent to 6.94 per cent after motivating the people to use safe water supply and sanitation facilities. However, in the control village the prevalence of PEM increased over the years of the duration of the study. This also indicates that alongwith nutritional intake, safe water and sanitation have an important role to play in determining the nutritional status of any population.

The Cholera Research Laboratory conducted four studies on the effect of the provision of hand-pump tubewells on the incidence of cholera and other diarrhoeal diseases in Matlab Thana, a rural area of Bangladesh. The studies indicated that those who use tanks to meet their needs for water have lower attack rates than those who draw their water from other surface sources. Khan et.al. (1975) examined the relationship of reported water use patterns to cholera attack rates. Khan's data, suggest that those who use tank water (tanks which connect with canals and receive tidal flow during the cholera season were omitted) for drinking, washing or bathing have attack rates from cholera which are lower than those for families, using other sources.

Credit : UNICEF

A report about "Diarrhoeal disease morbidity in children below five years in urban slums of Delhi" indicates the incidence of diarrhoea to be 7.9 episodes per child per year, in four urban slums of Delhi. The highest incidence (11.9) was registered in the slums which had the poorest sanitary conditions. As the survey was done during May and June, the estimated diarrhoeal incidence turned out to be unusually high. Morbidity of diarrhoea was significantly related with the use of water drawn from hand pumps, uncovered drains, as also habits of open defecation and high female illiteracy rates. Knowledge and use of oral rehydration therapy by the mothers were not found to be related to their educational level.

A study of the effects of a water supply system on local health attitudes and on the assessment and management of children with diarrhoea which compared those areas with a water supply system and those without in Nepal found that half (55 per cent) of the people used tap stand water supply, and the rest used water from an open contour channel. Children under seven showed severe diarrhoeal symptoms. About 46 per cent (93 children) had frequent and troublesome loose stools in the previous week. The availability of tap stands was associated with the knowledge that bad water and bad food were causes of diarrhoea. Health education should be directed at specific unhygienic practices. Latrines and the provision of better storage arrangements in the home can help decrease food and water contamination.

A child health community study carried out in Ethiopia in 1972-1973 indicated that children, aged under two, could have some kind of illness symptoms for 104 days of the year, of which 59 days were due to diarrhoeal diseases. In the study community, a large proportion of households lacked adequate housing and sanitation. Exploratory statistical methods showed personal hygiene and quantity of water to be powerful predictors of diarrhoeal disease. Intermediate technologies and community involvement are needed among other multidisciplinary efforts to solve child health problems.

Inter-relation between environment, diarrhoea and nutrition

Diarrhoea is one the commonest infections during childhood and can be due to many underlying causes, not all of which directly involve the gastrointestinal tract. Acute diarrhoea is a major cause of morbidity and mortality in infants and young children all over the world, more so in the developing countries. Encouragement of breast feeding, better food hygiene, improvement of nutritional status of children and good environmental sanitation are important strategies for lowering the incidence of diarrhoea. It is equally important to reduce the high rate of diarrhoeal deaths which is mainly due to loss of fluid and electrolytes from the body which is further aggravated by malnutrition. Diarrhoea in combination with malnutrition is the major killer beyond the first month of life.

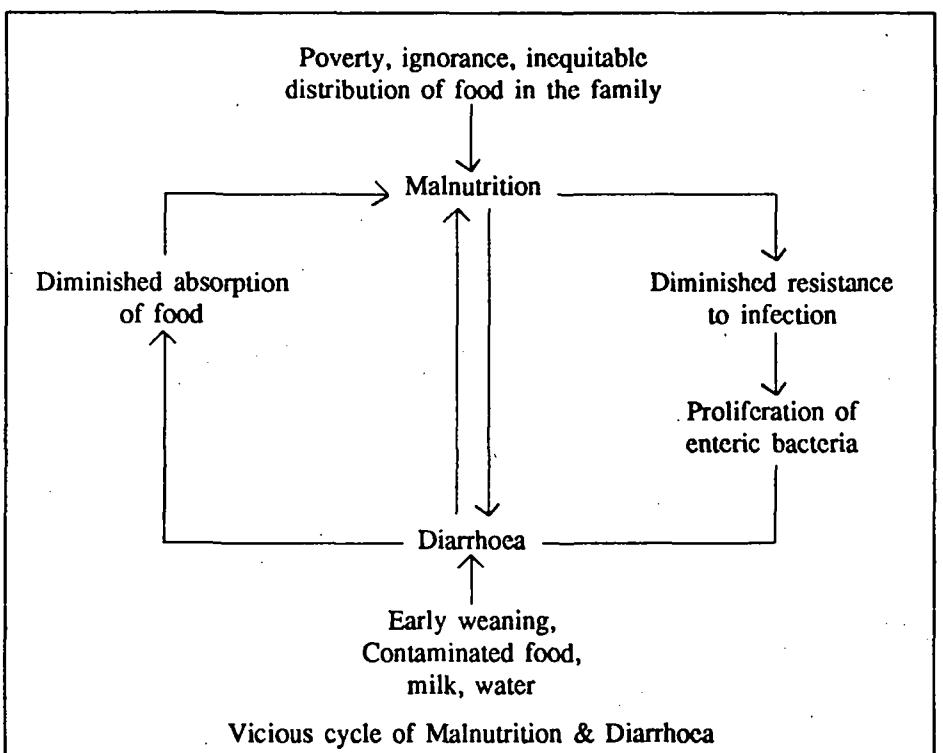
It is the child with multiple episodes of diarrhoea and particularly chronic diarrhoea, who suffers most severely from protein-energy malnutrition.

Diarrhoea has been shown to have a significant impact on nutrition. Most field studies identify diarrhoea as the major determining factor leading to malnutrition in the developing countries. It is the child with multiple episodes of diarrhoea and particularly chronic diarrhoea, who suffers most severely from protein-energy malnutrition. If diarrhoea becomes prolonged or is recurrent, the child becomes severely malnourished, since nutrients are also lost through stools.

Atrophy of the intestinal epithelium (lining of the intestine) in cases of malnutrition causes malabsorption as well. Repeated attacks of the disease lead to malnutrition which in turn leads to increased susceptibility to infections. This vicious cycle negatively affects the children's health and leads to retarded growth, missed learning opportunity and overall weakened nutritional status. Malnourished children are more prone to suffer from other infections also.

Data from numerous studies support the clinical impression that diarrhoea lasts longer and is more severe in malnourished children.

The Ministry of Health of Lesotho,



Vicious cycle of Malnutrition & Diarrhoea

Southern Africa, reported that 9.5 per cent of children under five years of age who were hospitalized for diarrhoea in 1984, died. The study group conducted two retrospective case control studies of children aged 24 months considering the degree of malnutrition. A high proportion of both, cases and controls in the study, were malnourished. This study identified children at high risk for death from diarrhoea.

A study was done to indicate the association betwen malnutrition and diarrhoea in rural Bangladesh. The study indicates the relationship between age and diarrhoeal episodes -- young children had more episodes. The difference in the number of episodes by nutritional status is not large. The incidence in the lowest nutritional group is about 10 per cent higher than that in the highest nutrition group (except in the short term (May - June) by weight for age and in the long term (May-December) by height for age.) The duration of diarrhoea of malnourished children measured by weight for age and weight for height was consistently larger than that of well nourished children for each of the periods. Duration of diarrhoea in the lowest nutrition group assessed by weight for age or weight for height was approximately 45 per cent higher than that in the highest nutritional status.

Credit : UNICEF

Table 1
Percent prevalence of anaemia by age and sex

Age (Yrs.)	Hyderabad (Rural)		Calcutta (Rural)		New Delhi (Rural)		Madras (Urban)	
	F	M	F	M	F	M	F	M
1-5	65.9		95.4		59.0		21.2	
6-14	65.3	65.0	97.0	96.1	69.4	72.4	15.4	12.3
15-24	69.2	38.8	96.7	90.1	63.5	65.1	20.7	9.9
25-44	71.4	30.1	96.5	88.6	71.3	57.3	29.1	3.3
>44	47.6		92.4		59.3		18.8	

Several preventive programmes are being promoted with varying degrees of success in different countries to control diarrhoea. One of the priority programmes is the International Water Supply and Sanitation Decade (1981-90), which aims at providing a good supply of drinking water facilities for disposing of human waste. Improvements in personal and home hygiene resulting in decreased faecal contamination of food and water are also important. There is no doubt that environment is the primary causative factor for diarrhoea.

Hence, for control of diarrhoea, water supply, sanitation and hygiene have to be first controlled.

-- Prof. Indira Chakravarty is Head, Dept. of Biochemistry and Nutrition, All India Institute of Hygiene and Public Health, Calcutta.

Table 2
Water and Sanitation related infections and their control

Infections	Importance of alternate control measures of public health importance						
	Water quality	Water availability	Excreta disposal	Excreta treatment	Personal and cleanlines	Drainage and sullage disposal	Food hygiene
1. Diarrhoeal disease and enteric fevers							
Viral agents	2	3	2	1	3	0	2
Bacterial agents	3	3	2	1	3	0	3
Protozoal agents	1	3	2	1	3	0	2
2. Poliomyelitis and hepatitis A	1	3	2	1	3	0	1
3a. Worm with no intermediate host							
Ascari and Trichriso	0	1	3	2	1	1	2
Hookworms	0	1	3	2	1	0	1

0 = no importance
1 = little importance
2 = moderate importance
3 = great importance

Table 3
Incidence of diarrhoeal diseases and worm infestation in water/sanitation covered and uncovered villages

Parameters	Control village		Experience Village	
	Baseline data	Resurvey data	Baseline data	Resurvey data
Source of Water for Drinking/ Domestic Purpose				
(i) Open dug well	100.00% (Drinking)	100.00%	25.25%	62.86%
(ii) Tube well	Nil	Nil	Nil	37.14%
(iii) Pond	95.12% (Domestic)	95.12%	74.75%	--
Sanitary Facilities Available	Nil	Nil	Nil	14.28%
Incidence of Diarrhoeal Diseases	28.65%	29.80%	27.27%	21.06%
Worm Infestation	80%	82%	85%	75.35%

Table 4

Incidence of deficiency disorders in water/sanitation covered and uncovered villages

Parameters	Control Village		Experimental Village	
	Baseline data	Resurvey data	Baseline data	Resurvey data
PEM				
(Weight for age)				
Normal	9%	12.28%	4%	9.72%
Grade I	31%	20.18%	29%	27.78%
Grade II	51%	40.35%	57%	55.56%
Grade III	9%	27.19%	10.3%	6.94%
Height for age				
Normal	52.3%	35.96%	45%	49.74%
Stunted	48.0%	64.04%	55%	50.26%
Vitamin A deficiency	75.59%	56.63%	70%	74.44%
Riboflavin deficiency	22.20%	32.63%	25.0%	24.09%
Vitamin C deficiency	11.8%	10.78%	12.5%	11.00%

Table 5

The effect of water source on cholera attack rates in Matlab Thana, Bangladesh

			Significant difference at 5% level?			
DRINKING		**% of families with cholera 1965-70**	**Canal**	**River**	**Tank**	**Tubewell**
	Canal	6.9% (27/389)	-	No	Yes	No
	River	5.6% (19/342)	No	-	Yes	No
	Tank	1.9% (18/962)	Yes	Yes	-	Yes
	Tubewell	5.2% (27/515)	No	No	Yes	-

			Significant difference at 5% level?		
WASHING		**% of families with cholera 1965-70**	**Canal**	**River**	**Tank**
	Canal	8.9% (35/395)	-	No	Yes
	River	4.1% (6/145)	No	-	No
	Tank	3.0% '50/1663)	Yes	No	-

			Significant difference at 5% level?		
BATHING		**% of families with cholera 1965-70**	**Canal**	**River**	**Tank**
	Canal	7.0% (32/459)	-	No	Yes
	River	5.4% (17/317)	No	-	Yes
	Tank	2.9% (42/1430)	Yes	Yes	-

Guineaworm : On the Road to Eradication

Guineaworm eradication has been one of the specific priorities of the National Drinking Water Mission. BONAVENTURE THORBURN discusses the extent of its spread in India, difficulties in identifying a patient for treatment and intervention strategies undertaken for its prevention.

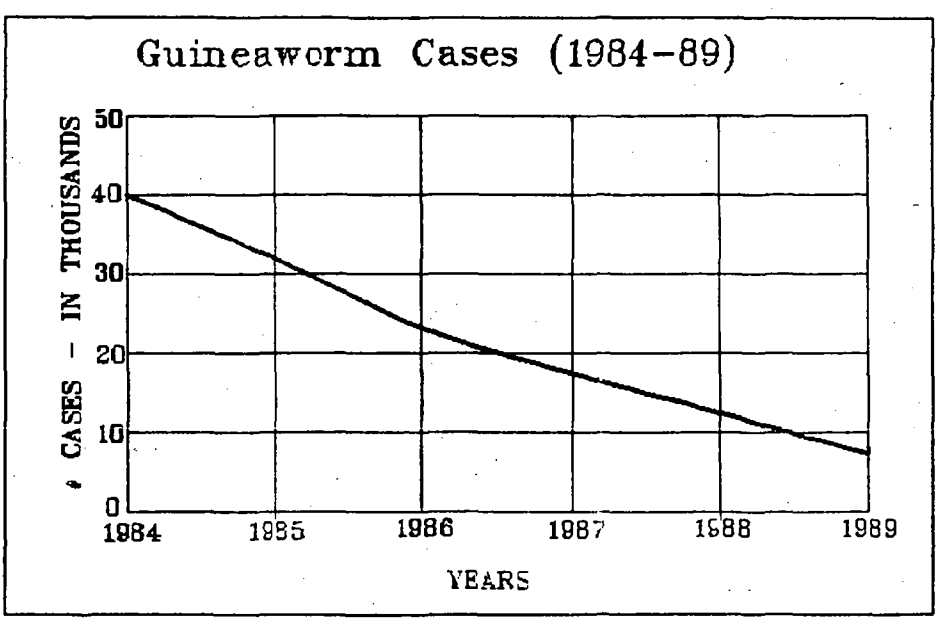
Guineaworm disease (medically known as Dracunculiosis or Dracontiasis) has scourged this planet since antiquity. In Africa alone, there are more than 10 million people affected with this disease each year. At the end of 1989 there were 7881 cases reported in India. Although India's Guineaworm is minute in comparison with Africa's, it must be eliminated to break the vicious recurring cycle of this human parasite. Guineaworm disease cannot be allowed to resurge, like malaria has.

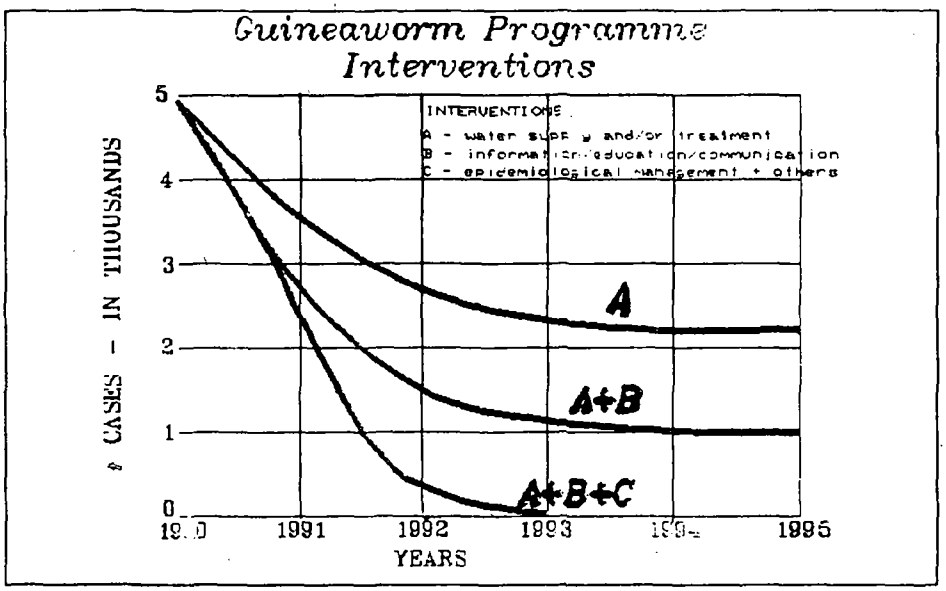
Guineaworm disease is contracted by drinking water which is infested with Guineaworm larvae. These larvae are not visible to the naked eye. Within a year, a full grown female worm or worms (the male worms die upon mating inside the stomach cavity) break through the skin in order to excrete their thousands of larvae. Due to a burning sensation caused by this ulcer formation under the skin, rural persons tend to bathe the infected area (usually the lower leg) in water. The water is usually the same traditional open pond or stepwell where they first contracted this dreadful and debilitating disease. Anyone (including the infected person) who drinks this re-infected water, continues the Guineaworm disease cycle.

India's rapid pace of development in the past few decades has provided a corresponding, rapid decline in Guineaworm disease. This decline was principally due to improvement of the drinking water supply infrastructure in rural areas. With a deep commitment of the Indian central and state governments to supply safe drinking water to all its citizens, almost all rural villages have now been serviced with at least one safe source of drinking water. This herculean feat was accomplished by mostly drilling tubewells and fitting the same with handpumps. Although almost all villages now have a safe water source, not all villagers can use that safe water source. Water use studies have showed that a handpump effectively services no more than 150 persons per day. With 1.6 million rural water sources and a rural population nearing 700 million, there are now approximately 440 persons per safe water source in rural India.

Due to the social structure of rural Indian villages, poorer low caste and tribal villagers live in hamlets remote from the main village. These people are not presently being serviced with safe water and continue to use traditional sources. These hamlets are the very places where Guineaworm is prevalent today. How do we reach these villagers and what control/ eradication interventions are required to stop the Guineaworm disease cycle in these areas?

The Ministry of Rural Development is the nodal authority on Rural Water Supply and Sanitation matters in India. Guineaworm eradication is one of the priorities of this ministry's Water Technology Mission. State rural water departments or organizations coordinate their Guineaworm eradiction efforts with the Medical, Health & Family Welfare Services and Rural Development Ministries. The medical ministry's National Institute for Communicable Diseases (NICD) assists the Guineaworm eradication programme with its epidemiological expertise to monitor the occurrence of Guinea-





worm in all endemic states of India.

According to NICD's data, reported Guineaworm cases have diminished from 39,792 in 1984 to 7,881 at the end of 1989. As shown in Figure 1, the number of cases initially reduced from 1984-1986 in a "straight-line-down" manner. In the latter stages of the eradication programme from 1986, it has started to undertake an exponential curve (where the reduction flattens out and never reaches zero).

This change is caused by the difficulty of programme implementors to effectively search out and treat the affected persons and/or treat/develop a drinking water source in the remote areas of rural India. As the cases become less, it is more difficult, for each case must be investigated and appropriate eradication interventions implemented expediently. There is a tendency for illiterate rural people to suffer the agony of this dreadful disease in silence which hampers the search effort. Monitoring of the Guineaworm programme revealed that it can take six months to one year to service the small infected hamlets with safe drinking water due to inaccessibility of drill rigs and other problems of logistics. With the disease reduction tending to level out and not reach zero, the programme had to adapt new strategies and interventions. Figure 2 proposes how the Guineaworm eradication programme could fail or succeed in the next few years, with the implementation of the following interventions (or combination of interventions):

A. Water Supply and/or Treatment
B. Information/Education/Communication
C. Epidemiological Management + other interventions.

Alternate interventions were introduced into the programme in order to protect rural people from infection or reinfection, until a safe water source was installed or until the guineaworm larvae were eliminated from the populace and the drinking water source. These interventions included, most importantly, community communication/information on awareness of the disease and how to avoid contact.

Some proven alternate interventions to the immediate supply of a safe drinking water source to a village include:

1. Awareness of the rural villagers of Guineaworm disease through Information-Education-Communication campaigns.
2. Provision and use of water strainers or filters
3. Insecticide treatment of the water source (usually a traditional step well)
4. Extraction of the worm before rupture of the larvae
5. Isolation and monitoring of the patient and of the probable area of rupture.

Final eradication programmes are presently using some or all of these interventions. These programmes are presently being implemented in the six states of India that continue to be endemic to Guineaworm disease: Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra and Rajasthan.

Voluntary organizations, such as Astha and Pledo in Rajasthan include Guineaworm eradication in their respective integrated development programmes. The Voluntary Health Association of India has assisted with studies on specific problem areas of community health interventions. UNICEF's SWACH programme in three districts of Rajasthan had been a testing ground for effective Guineaworm eradication interventions since 1986. UNICEF is further assisting the Water Technology Mission and the Ministry of Medicine, Health & Family Welfare Service with specific programmes in all the endemic districts of the states of Rajasthan and Madhya Pradesh. These two states contain 79.7 per cent of all India's Guineaworm cases.

Although 1990 was intended to be the year of Guineaworm disease elimination in India, this may not occur until late 1992. Three reporting years of no cases would provide a WHO certification of eradication in India, by 1995. This will depend on the successful search and treatment of all individual cases by the end of 1992. The timely use of appropriate Guineaworm eradication interventions will change the exponential rate of decline to that of a straight line rate to zero cases. Information sharing and coordination of programes by UNICEF, WHO and the Government of India will be essential for the eradicatioin of Guineaworm disease by 1995.

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Fluoride : Too Much Can Cripple You

Excess flouride in drinking water can lead to fluorosis, a disease that surfaces in a variety of symptoms. The sub-mission planned for its control had as its key thrust awareness-raising, disease identification through village level epidemiological surveys and launching preventive measures essential for a disease which has no cure. Dr. A.K. SUSHEELA and G.GHOSH describe the submission's strategy and warn against misleading publicity recommending fluoride-based toothpaste for better dental health.

Although India has had the problem of fluorosis for over 50 years, very little had been done to mitigate the sufferings of the afflicted until the National Drinking Water Mission was launched in 1986-87. It is estimated that nearly 25 million people are afflicted with fluoride poisoning due to environmental pollution.

In India, the magnitude of environmental pollution with fluoride unlike in many parts of the world, is greatly enhanced by use of fluoride contaminated water, food, cosmetics like toothpastes and even drugs. Due to the earth's crust being extremely rich in fluoride-bearing minerals, the water is naturally fluoridated. The maximum fluoride content so far detected is 38.5 ppm (mg/litre) in drinking water.

Drinking water containing fluoride ranging from 1.5 to 38.5 ppm can cause severe health problems. Initially, the health problems were known to exist in only four states -- two in the Southern and two in the Northern parts of India and nowhere else. But to-day, 13 states, nearly fifty per cent, are declared endemic for fluorosis and associated health problems as a result of drinking fluoride contaminated water. It has become an urban as well as a rural health problem, affecting the poor and rich alike.

Government efforts

What did the Government of India do to deal with this public health problem? Since the early 1930s, the major focus has been to promote basic researches, epidemiolgical studies and clinical research to understand fluoride action on body tissues and on health in its totality. Researches in this field are still being promoted by various national and international agencies.

Inspite of the fact that India has substantial fresh water resources, there is a chronic shortage of "safe drinking water" in the country. The shortage may vary from mild to acute, depending upon geographical, topographical, climatic and other factors. The spread of the disease from four to 13 states over a period of 50 years is mainly due to population overgrowth necessitating the use of more and more water; people digging tube wells indiscriminately anywhere and everywhere; and total unawareness of the importance of water quality for human consumption.

To tackle the drinking water problem on a war footing, the Government of India during 1986, set up a Technology Mission on Drinking Water and related water management with the Department of Rural Development as the nodal agency. The strategy adopted for visible results is to focus on Sub-Missions, countrywide. The major Sub-Missions operating are:

1. Control of Fluorosis
2. Eradication of Guineaworm
3. Removal of Excess Iron
4. Removal of Salinity and Brackishness and
5. Source Finding and Water Management.

The methodologies adopted are:

1. Purification of water
2. Improvement of technical methods
3. Improvement of materials and designs
4. Improvement of maintenance methods
5. Computerized management information system
6. Scientific source finding
7. Continuous monitoring and evaluation
8. Community involvement and
9. Awareness programmes.

This article focusses on the activities in the Sub-Mission on "Control of Fluorosis" and the programmes which are on in the various states to remove fluorosis and associated health problems. The health problems have by now attained a magnitude, which is roughly estimated to have afflicted 25 million people, perhaps with an equal number on its way to being affected. The task assigned and the funds earmarked by the "Water Mission" to achieve the objective of the Sub-Mission on "Control of fluorosis" viz. to provide safe drinking water, prevent and control fluorosis within a time frame is by no means a casual task. A total commitment on the part of the Public Health Engineers, doctors, paramedical workers, village level functionaries and voluntary organizations to work in a co-ordinated manner, is a unique feature of the programme. The best scientific talents and expertise available in the field of public health engineering, defluoridation of water and health science have been identified and brought together to work in an integrated manner, with the participation of the people themselves.

Control in three phases

The Sub-Mission on "Control of

Fluorosis" has a three phased programe specially designed keeping in view the limitations and the lacunae in educational programmes in the country. The programme has been implemented in 18 districts in eight states during the past three years, covering over 50,00,000 people. The activities of the various phases are based on the following objectives:

Phase-I To conduct training-cum-awareness camps, and update the information on fluorosis, drinking water quality and defluoridation procedures for doctors, Public Health Engineers, para-medical workers and governmental and non-governmental personnel.

Phase-II To launch epidemiological survey(s) in the affected villages, taluks and districts to assess the exact magnitude of the problem as well as to analyse the quality of every drinking water source in the area.

Phase-III To introduce appropriate measures to provide safe drinking water as well as to ameliorate, prevent and control fluorosis.

The Phase-I activities are essentially an update on fluorosis which includes information on clinical manifestations, diagnosis, early warning signs of fluorosis and procedures to identify subjects afflicted with fluorosis. Under field conditions, without having to carry out sensitive laboratory-based tests, besides educating the people on the importance of drinking safe water, water quality assessment and defluoridation procedures (both at the domestic and community defluoridation installations) are dealt with. A little over 5000 individuals which include doctors, Public Health Engineers and village level functionaries have been trained in this Sub-Mission over the period of three years. The need for the up-date is essential, as doctors and engineers during their training lay emphasis on western concepts and practices. It may not be out of place to mention here that some of the text-books on Public Health Engineering in India still describe procedures to *fluoridate* drinking water rather than to *defluoridate* it. Besides, the doctors graduating from medical schools in the country are not taught about fluorosis in great detail. Fluorosis is considered a disease which has no treatment or cure and preventive aspects are often neglected. It is also true in India that the disease was very often misdiagnosed as arthritis, spondylosis or ankylosing spondylitis. We are not surprised to note the statement in Chemical Engineering News, (Page 37, August, 1988) that most doctors in the U.S. have not studied the disease and do not know how to diagnose it. It therefore emerges that even in U.S. the early warning symptoms of fluoride toxicity/poisoning may not be understood at all.

During Phase-II, the endemicity of the villages/districts for fluorosis is identified by visits to schools and from dental check-up. White, yellow, brown and black tooth enamel discolouration, either in spots or in horizontal streaks, is the sign of occurrence of dental fluorosis. In such cases, the water is probably contaminated with fluoride and the location endemic for fluorosis. During the past three years, several epidemiological surveys along with water quality testing with a focus on fluoride have been conducted by professionals, after attending the update camps. Based on the most recent data, the following observations and corrective measures both for providing safe water and preventing the disease have been introduced during the Phase-III activities:

- In an area endemic for fluorosis, it is not necessary that every source of water is contaminated with fluoride. The good sources are identified, labelled and the people are educated to drink from the good sources only; the fluoride-contaminated sources are used for washing and cleaning purposes. If the yield of water for consumption is low, possibilities are also explored for mixing the water from two sources, thereby diluting the concentration of fluoride to permissible levels.
- Presently in the National Drinking Water Mission, we are accepting contamination upto 1.00 ppm as the permissible upper limit as we have no other alternative. However, we do create awareness among the people, that the less the fluoride in water, the better the health.
- We also have data in India to suggest that 0.4 ppm of fluoride in drinking water is causing mild, moderate and severe forms of dental fluorosis and therefore we are looking for water with less and less fluoride contamination.
- It is also a fact that due to atrophy of the body's muscle fiber and connective tissue including the oral cavity caused by the use of fluoride, people living in endemic areas lose their teeth at an early age; they look much older and those who can afford it, resort to the use of dentures.
- Muscular weakness, loss of muscle power and neurological manifestations leading to excessive thirst, a tendency to urinate more frequently, although the volume of urine is not too large, are not uncommon among the afflicted individuals.
- Severe and widespread gastro-intestinal problems viz. anorexia, pain in the stomach, intermittent diarrhoea, chronic constipation, gas formation and a bloated feeling in the stomach (non-ulcer dyspepsia) caused due to drinking fluoridated water have been confirmed. Changing the source of water with low levels of fluoride (below 1 ppm) provides relief from the gastro-intestinal problems within a period of two to three weeks. In areas endemic for fluorosis, gastro-intestinal problems alert suspicion of fluoride toxicity and are used as early warning signs for preventive measures to be introduced. The

A profile of a few districts in India revealing the number of people ailing due to fluoride toxicity are shown

Name of the districts and state	Total population and the number of people afflicted with different complaints			Range of fluorid in drinking water
Dharwad (Karnataka)	Total population examined	--	72,744	0.3-150 ppm
	Afflicted with:			
	Dental Fluorosis	--	12,266	
	Skeletal Fluorosis	--	3,747	
	Gastro-intestial problems	--	6,304	
Raichur (Karnataka)	Total population examined	--	1,50,215	0.2-7.5 ppm
	Afflicted with :			
	Dental Fluorosis	--	12,933	
	Skeletal Fluorosis	--	2,999	
	Gastro-intestinal problems	--	1,882	
Amreli (Gujarat)	Total Population examined	--	56,189	1.8-11 ppm
	Afflicted with :			
	Dental Fluorosis	--	9,919	
	Skeletal Fluorosis	--	6,762	
	Gastro-intestinal problems	--	245	
Gurgoan (Haryana)	Total Population examined	--	85,792	0.2-19.6 ppm
	Afflicted with :			
	Dental Fluorosis	--	6,970	
	Skeletal Fluorosis	--	600	
	Gastro-intestinal problems	--	200	
Kurnool (Andhra Pradesh)	Total population examined	--	14,91,791	0.1-9.6 ppm
	Afflicted with :			
	Dental Fluorosis	--	43,927	
	Skeletal Fluorosis	--	8,833	
	Gastro-intestinal problems	--	30,400	

damage caused to the human intestinal mucosa, due to drinking fluoridated water is extensive. Under the Water Mission, in the affected areas where there are no good source(s) of water, domestic defluoridation procedures are being popularized among lactating mothers as well as pregnant (expectant) mothers, besides erecting community defluoridation tanks for the public. Alternative source(s) of safe drinking water, either by bringing it in from a distance through pipelines (if economically viable) or through alternate under-ground sources are also being considered for implementation.

The reports published from India, by earlier investigators, have been substantially up-dated during the last 10-15 years. It is strange to note that the west invariably quotes Indian reports on fluorosis which are outdated. For example, an Indian report which appeared in 1970 in a WHO publication entitled "Fluoride and Human Health" indicates that one can get afflicted with fluorosis by drinking water contaminated with 20 ppm of fluoride if consumed for 10 years; this is most conveniently quoted by the pro-fluoridation experts of the western world suggesting that water with 2 ppm is safe to drink. The fact remains that even 2 ppm of fluoride contaminated water can cause crippling fluorosis, if the calcium content of the water is low and alkalinity high and if consumed for even a couple of years, leaving aside 10 years.

Harmful publicity

Intermittently, we also face problems in the country due to the World Health Organization's publicity for use of fluoride in the name of prevention of caries as "teeth are for a life time" (as though other organs are not!). WHO's recommendation to drink fluoridated water, to use fluoride toothpaste, use fluoride salts in cooking and have it available on the table for use with food which has been promoted as educational material for the past several years, has come under severe criticism in India. With the initiative taken by the Ministry of Health and Family Welfare (Govt. of India) during 1989, WHO has been asked to refrain from such publicity in India as it causes more damage than good to the people. WHO has also been asked to add a footnote to their pamphlets indicating that it is not applicable to India and other countries where excess fluoride is the problem. WHO headquarters in Geneva have also been informed through their Regional Office-at New Delhi of the Water Mission's efforts to defluoridate water as well as control fluorosis in India at massive expenditure. It would be worthwhile if such UN organizations would adopt a bifurcated policy in dental care appropriate to developing countries without imposing fluoride everywhere. In the developing countries, to prevent dental caries the need of the hour is not fluoride but adequate awareness of the importance of oral health and hygiene besides improving adequate calcium and vitamin C in the diet.

Credit UNICEF

Dental fluorosis in child

Some developing nations are now reporting on the unsuitability of WHO guidelines for fluoride concentration in drinking water. A recent report from Netherlands, based on a study in Senegal has shown dental fluorosis in children where fluoride in water ranged from 0.1 to 7.4 ppm, and prevalence of mild dental fluorosis is 68.5 per cent at 1 ppm of fluoride in drinking water. When fluoride exceeded 4 ppm, the prevalence of dental fluorosis reached 100 per cent. It has been suggested that the WHO guidelines for fluoride concentration in drinking water in Senegal are unsuitable and the upper limit should be reduced to 0.6 ppm (Lancet : 11, 223-225, 1988).

It is now quite gratifying to note that in India, WHO has extended support to the Water Mission activities, particularly the Sub-Mission on "Control of Fluorosis". WHO, during the early 1970s, was fully prepared to fluoridate India's water, but, because of the opposition they faced from Indian scientists, the scheme could not be implemented. Perhaps the support that is now forthcoming may be the beginning of a new era, when WHO may consider a totally different strategy for prevention of dental caries

in India and other developing countries instead of promoting the use of fluoride.

Toothpaste and fluorosis

It is unfortunate that the use of fluoride for prevention of caries, although formulated and brought out 50 years ago by U.S.- based dentists, is still being promoted the world over without questioning the rationale nor the health hazards which have been emerging due to fluoride poisoning. It has been show by Indian dentists that by use of fluoridated toothpaste for brushing teeth, in young and old, the serum fluoride levels are enhanced within minutes (Rajan et al, Fluoride in toothpaste : Cause for Concern, Fluoride 21:4, 1988; Rajan et al, Serum and Urine Fluoride in Tothpaste Users, J.Ind. Dent. Assoc. 59:137-142, 1987). The oral mucosa, rich in blood vessels absorb fluoridations rapidly. The sub-lingual blood vessels (the ones below the tongue) drain the stuff directly to the superior venecava and then to the heart. It is not true that toothpaste never enters the body unless it is swallowed/ingested. Fluoride does enter circulation directly from the oral cavity through the fine blood vessels of the mouth. Fluoride being a persistant bioaccumulator, even small amounts that enter through fluoridated toothpaste, are guaranteed entry, not only in children but even among adults and the cumulative or additive effects of fluoride are causing serious concern.

It has been discovered in India recently that there is no toothpaste marketed which is free of fluoride, whether labelled or otherwise. The amount of fluoride arising as a contaminant from the raw materials used viz. chalk, talc and calcium carbonate, may be as high as 800 ppm. It has also been observed in India as a result of extensive laboratory investigations that the fluoride is not mixed homogenously in the paste. When the paste is squeezed out from different depths of the tube, the amount of fluoride in the fluoridated brand of paste is highly variable. In none of the so-called fluoridated brands of the toothpaste, the quantity of fluoride in the paste is revealed on the carton or the tube. The expiry date of the toothpaste is never revealed either. These we consider unethical practices.

In order to ensure quality control procedures in manufacturing, a maximum contaminant rate of 800 ppm may be permitted in Indian toothpastes, but we insist on having a warning inscribed on the carton which should read: "Excess fluoride is injurious to health". This would alert the consumer to look for a paste with least fluoride contamination. We are also aiming at curtailing the false publicity for promoting the use of fluoride in the name of prevention of caries. Although children below the age of six years are not supposed to use fluoridated toothpaste, as per the recommendation of the Indian Council for Medical Research, invariably the advertisements are aimed at children, misguiding the public.

Perhaps due to the brain-washing publicity promoting fluoride for prevention of caries on television, radio and other print media, people do not quite realize the damage that excess fluoride can do to them. It has been shown that excess ingestion of fluoride leads to the accumulation of a particular chemical substance viz. dermatan sulphate, both in bone and teeth. The substance, on accumulation, tends to demineralize the area around, both in teeth as well as in bone. Such demineralized zones in the teeth get pitted and perforated in dental fluorosis besides being discoloured (Susheela, et al, Arch. Oral Biol., 33 10,765. 1987). The belief that cavity formation occurs only in dental caries is outdated. In fact, cavity formation may be aggravated in some due to excess ingestion or use of fluoride, leading to dermatan sulphate formation and ensuing demineralization of the tooth matrix.

In reality, by using fluoride for preventing caries, believing that it only makes the enamel strong, no longer holds good because fluoride also causes demineralization of the teeth which get pitted, perforated and chipped. In other words, the damage it causes to the teeth is never taken into account as it nullifies the age old concept that "fluoride is good for teeth."

Towards heart disease and cancer?

In addition to the above, fluoride induces cholesterol production in males and can also lead to blocking/calcification of blood vessels, specially in the region of the main vessel leading from the heart viz. the aorta, causing cardiac problems. This certainly means that the toxic effects of fluoride far outweigh its benefits in the Indian situation.

There are reports on high incidence of cancer due to fluoride in the U.S. (Cancer Mortality in Relation to Fluoridation and Population Changes, Data from 140 largest U.S. Cities from 1940-1980, Burgstahler, Int. Conference of the Fluoride Society, Utah, 1986). Data based on animal experiments from Japan and other parts of the world, also suggest that fluoride is cancer-causing (Mutation Research, 139, 193-941, 1984; Science of Total Environment 68, 79-76, 1988). These are serious problems that a nation ought to take into account before we start adding fluoride in massive doses to drinking water and toothpaste just because a few dentists, and of course the manufacturers, promote outdated concepts to promote the use of fluoride.

-- Dr. A.K. Susheela is National Co-Ordinator for Health Sector Activities, Sub-Mission on 'Control of Fluorosis', Technology Mission on Drinking Water. Dr. G. Ghosh is Director of the National Drinking Water Mission.

Coming of Age : The Handpump Programme

The ubiquitous handpump has been used as a source of drinking water for over a hundred years. Few people realise, though, how far we have travelled from the first, unstandardised prototype to the latest India Mark III Pump, says MANSOOR ALI.

Handpumps have been used as a source of drinking water for over a hundred years. Mostly this device has been a convenient means for rural households to meet their domestic needs. In India, the situation has undergone a gradual change in terms of dependence on handpumps as a community water supply source.

Historically, the deepwell handpump programme in India developed as a consequence of a severe drought in 1966 which affected a large population. The Government of India sought assistance from external support agencies to combat the situation in the hard rock areas which were severely affected. Some NGOs and UNICEF provided pneumatically operated drilling rigs to drill boreholes to locate water in the drought affected hardrock areas of peninsular India. While the drilling of borewells was very successful, the handpumps fitted on these borewells were of poor material/design and quality and hence, broke down frequently. These handpumps were locally manufactured, cast iron pumps which were meant for a family rather than community use.

The need for the development of sturdy and reliable community handpumps became necessary, if the handpump based water supply system was to succeed.

Handpump developments

In the late 1960s, various NGOs and handpump manufacturers carried out design improvements on the existing Dempster pump. By 1974, several designs were in the Market; of these, three different designs developed by NGOs in Maharashtra i.e. Jalna, Jalwad and Sholapur, were widely used in many states in India. These pumps did not have standardised drawings and hence the interchangeability of parts was not possible, even within pumps of the same design. In 1974 a spot survey was carried out to determine the status of borewells and handpumps in India. The survey revealed that at least 70-75 per cent of the handpumps were out of order at any given time. It gave clear indication to the government that, unless substantial improvements were made in the handpump design and it was standardised, the national Rural Water Supply Programme would be badly affected.

The Government of India had organised a handpump workshop in June 1975 to discuss various issues related to deepwell handpumps. The workshop unanimously recommended that a reliable and sturdy deepwell handpump be urgently developed to meet the rural water supply needs of India. As a result, a research and development project was initiated in Coimbatore in coordination with the Tamilnadu Water Supply and Drainage (TWAD) Board, Mechanical Engineering Research and Development Organization (MERADO), Madras, Richardson & Cruddas Ltd., Madras, Sholapur Well Service, Sholapur. The outcome of the project was a sturdy and reliable community handpump, named the "India Mark II Deepwell Handpump". Large scale field trials were undertaken in 1976-77 and it became evident that the India Mark II pump could be adopted as a national standard handpump.

To standardise and maintain interchangeability, the Bureau of Indian Standards (BIS), Government of India had brought out an Indian Standard IS:9301 on the India Mark II deepwell handpump, which was published in 1979. The development effort and field monitoring indicated a further refinement to the designs. Based on the feedback, the BIS revised the Indian Standard IS:9301 in 1982 and 1984.

Operations Research Group undertook a survey in 1984 to study the working of India Mark II handpumps in the normal maintenance system. The survey revealed that more than 45 per cent of India Mark II pumps are working satisfactorily at any given time. As the quality of handpumps is one of the main factors for success, UNICEF continued to support the Government of India on quality control of India Mark II Handpumps manufactured by Indian manufacturers, by introducing a third party inspection.

Although the India Mark II deepwell handpump is sturdy, easy to operate and reliable, it is difficult for users to maintain and repair. The below ground repairs especially need 3 to 4 semi-skilled persons, tools and tackles. Keeping in view the need to carry out most of the repairs at the village level, UNDP/World Bank and UNICEF initiated a Handpump Field Testing Project at Coimbatore in collaboration with the Indian government, TWAD Board and Richardson & Cruddas (1972) Ltd. Four and a half

years (1983-1988) of intensive R & D work and close field monitoring resulted in the development of two improved versions of the India Mark II pump, called the modified India Mark II pump and VLOM (Village level operation and maintenance) India Mark II handpump, later renamed as India Mark III pump.

These developments further improved the reliability of the pump components nd substantially improved the maintainability. Especially, in the India Mark III pump, most below ground repairs can be attended to by the village level (women) mechanics with little training.

Considering the need to have a reliable handpump for intermediate and shallow lift, a number of demonstration projects have been initiated to develop and field test a user-friendly Direct Action (DA) Handpump. The basic design is based on the TARA handpump developed and adopted as a national handpump in Bangladesh. It was proposed to field test and demonstrate around 600 DA handpumps in six states of India. The information collected from the field test will be used to refine the design.

Based on the above developments, the Bureau of Indian Standards had taken up standardisation of different versions of the Indian Mark II handpump and the Direct Action handpump to suit specific application areas. The following Indian Standards are in the draft stage and in the process of finalization in the near future:

1. Indian Standard for Extra Deep-well Handpump.
2. Indian Standard for Village Level Operation and Maintenance Handpump with open top cylinder (India Mark III).

Static Water level in Mtrs.	Handpump Design suitable
0-7	Suction Handpump
0-15	Direct Action Handpump
15-40	India Mark II and India Mark III Handpump
40-90	Extra Deepwell Handpump

3. Indian Standard for code of practice for installation and maintenance of deepwell handpumps (Part 142).
4. Indian Standard for Direct Action Handpump.

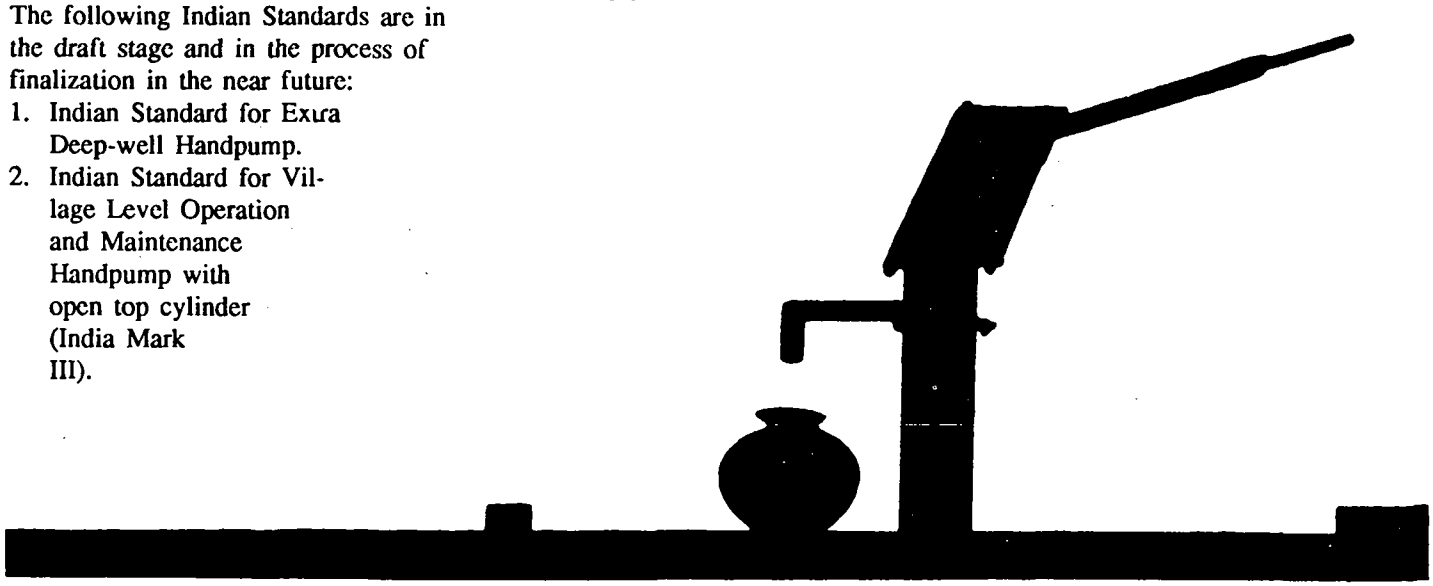
The different handpump designs available for different static water level application are given above:

A national Workshop on "Potential improvements in India Mark II Deepwell Handpump Design" was organised by the government in May 1990 in cooperation with UNICEF and UNDP/World Bank. The workshop unanimously moved to adopt and operationalise all the useful developments in handpumps and directed for further simplification of design to attain a handpump that could be completely maintained at the village level.

Future direction of handpump development:

1. Development of a reliable Shallow Well Handpump based on the existing pumps working in India.
2. Further development of the India Mark II and India Mark III pumps to improve the maintainability further at village level.
3. Development of Extra Deepwell Handpump so that it can cater to very deep set water level ares.
4. Development of special tools for handpump maintenance that are simple, weightless and are easy to operate.
5. Development of a village (women) based handpump maintenance system through motivation, integration and training at all levels.

Efforts are being made to make handpumps more user friendly, reliable and maintainable by user groups. It is also envisaged that modifications and improvements of handpumps will necessarily be taken up with women and young girls focussed on as the prime beneficiaries. ❑



'Water! We've Struck Water!'

It is one of life's great joys and perhaps one of the most satisfying experiences, to be present on a drill site when water is first "struck",says COLIN DAVIS. But how, exactly, is water drilled and what are the advances in technology that have taken place since groundwater was first tapped by simply using animal power and water-wheels to draw it from a shallow well?

Traditionally, groundwater was tapped by simply digging a shallow well and then using animals or humans to draw water from it by bucket and rope or by water 'wheels', as are seen in pictures of ancient Egypt, and can still be seen in Egypt and other parts of the world even today.

It was thought to be the Chinese who began to utilise groundwater by 'drilling' a hole (or bore), to greater depths than was possible by simply digging by hand. They invented the method known as percussion or cable tool drilling. This was a heavy drilling 'tool', shaped something like a chisel, which was attached to a long cable of steel (or perhaps rope in the early days), and this was simply raised and lowered repeatedly many times. On each downward stroke, the 'tool' bashed into the earth and formed a hole, or bore. Water was needed in order to make the earth that had been 'drilled' wet and slushy, so that it could he more easily removed from the bore as drilling progressed, by use of a 'bailer', which was lowered into the bottom of the bore to scoop out the waste 'cuttings'. If the bore was dry (before water was found) then water actually had to be poured into the bore so that drilling could progress. It is because of these features of this method that the system is known lightheartedly in the industry as the "Bash and Splash method", and interestingly, the method is still used today in some areas, and the percussion or cable tool drill rig is still manufactured.

Probably the main reason that the system has not long since been forgotten is that it is very cheap to buy the machine and to operate it. However, the performance of the system is now so slow as compared to modern methods that it is only used in perhaps five per cent of all the drilling that is carried out.

From the good old 'Bash and Splash', the industry progressed to drilling by rotary method. This consists of a steel drilling 'bit', attached to a drill pipe, which is then turned by the drilling machine in a clockwise direction looking into the bore and lowered progressively into the bore as drilling progresses. The 'bit' cuts the earth or rock as it is turned and the 'cuttings', (the waste particles that are churned up by the drilling bit), are pushed or 'flushed' up to the surface and out of the bore by fluids such as drilling "mud", or water, and more often these days, by compressed air. If the cuttings are not removed from the bore as drilling commences, then drilling is not possible as the bit will simply become choked up and it will bury itself -- not a very happy situation!

All rigs, even the 'Bash and Splash!' have a mast. This is nothing like a ship's mast. It is made from steel and has many designs, all of which finish up as a sort of tower, and the drill pipe is held inside or onto this construction and the mechanisms for turning and lowering (or raising) the pipe are located in or on the mast. The pipe can be turned either by a rotary table (or Kelly Arrangement) or by a rotation head (or top drive). The bit went through a number of design changes, such as some having tungsten carbide inserts which are better able to stand up to the rigours of hard rock drilling, and some being of a sort of fixed "wing" design, which are very good at drilling through softer formations, and many variations between these. But the real technological breakthrough has been with the developments of the "Down the Hole Hammer".

While the percussion machine raises and lowers a huge great tool into the ground, the Down the Hole Hammer has a piston inside a short hardened steel tube, which is raised and lowered by compressed air. In one end of the tube (preferably the end nearest to the rock to be drilled!) there is fixed a hammer "bit", and the piston strikes this on each downward stroke. The difference is that the percussion 'Bash and Splash" strikes the earth at about two times a minute, and the piston in the down hole hammer strikes the bit at about 1200 times a minute, which is rather more advanced technology!

With this method, it is possible to drill as quickly as six metres per hour or more, depending on the size of bore you want to drill, and the amount of compressed air being used. Each hammer has a certain requirement of compressed air which must be made available. In India, the most common compressors provide 150 PSI (pounds per square inch) of pressure at 450 CFM (cubic feet per minute) volume. Both parameters are important. The most modern versions of hammers now use 250 and even 350 PSI, at 600 to 900 CFM. While the initial cost of these compressors and hammers is greater than for 150 PSI, the benefit in terms of much faster drilling rate more than makes up for the additional cost.

Drilling progresses and earth is penetrated which has not been disturbed for millions of years. Some bores will be dry and will not 'yield' any water, but most bores are successful. The India Programme success rate is approximately 87 per cent. Of course one is never certain exactly how much water a bore may yield, although by using modern investigation techniques such as resistivity surveys and remote sensing using satellite imagery, it is possible to reduce the amount of bores which are dry, and also to get some idea of yield.

It is one of life's great joys and perhaps one of the most satisfying experiences, to be present on a drill site when water is first "struck", and is observed coming from the bore. A wonderful "hum" of happy anticipation comes from the villagers present, and one gets a feeling something like a big black cloud being blown away, to be replaced by sunshine, health and happiness.

In the height of summer, villagers may have to walk long distances to find a meagre water supply, in whatever condition, and so to have their own source provided within the village or in easy walking distance is indeed one of the greatest gifts than can be given. It has sometimes been observed that villagers may be so desparate for water that as soon as the handpump is installed they will begin to queue, without allowing the handpump team to make the cement base and waste channel.

The water is found in cracks in the rock or 'fractures', which are known as aquifers. These can also be bands of gravel or coarse sands which hold water, "water bearing strata".

The water may have come from many miles away from the drilled bore, or could have come from quite close by. The height at which the water level is observed is known as the height of the 'water table'. This table can be seriously lowered by over-pumping the source by too many pumps taking out too much water from the area, and also by periods of drought. Most water tables are affected by rainfall or lack of it. A bore may have a water level of a couple of metres from the surface, but the yield may not be great, perhaps only 300 litres an hour. An India Mark II pump, (which is the one used mostly in India) needs about 12 litres a minute for optimum use, or about 700 litres per hour. Other types of pump, such as electric submersible types, will need much more yield than for handpumps.

It is one of life's great joys and perhaps one of the most satisfying experiences, to be present on a drill site when water is first "struck", and is observed coming from the bore. A wonderful . . .

The latest technique to be introduced into the India programme is that of 'hydrofracturing'. This method uses water under great pressure to crack rock artificially, with the intention of extending the crack into a nearby aquifer (hopefully!) and thus getting water to run into the bore which has just been drilled. The hydrofracturing system is meant for use only in hard rock areas and is no use in soft sandy or clay areas because the high water pressure would destroy the bore.

A special type of expandible packer is lowered into the bore and then expanded hydraulically, thereby sealing the bore. Then water is pumped into the bore beneath the packer, and the pressure exerted acts upon the wall of the bore and weaknesses in the rock structure, to induce a crack in the rock, which is spread outwards by continued pumping water under pressure for several munutes. This process is repeated at intervals down the bore (starting from the top). As already explained, hopefully the cracks will locate a nearby water source which the bore may have missed. Another way in which this system works is to clean out cracks and fissures which may have become blocked either through the drilling process or by natural sediments, thereby allowing water to enter the bore and making it successful. At present, states using this system in India are reporting over 80 per cent success rates (converting previously failed bores into successful ones).

It must be remembered that it costs the same amount of money and time to drill a fail bore as a success one, and so it is important that the failure rate for a drilling programme is kept to the minimum.

Many of the bores left to drill in India are in the most difficult locations from an access point of view, and so equipment is now being specified which is able to travel into the most remote areas. Each rig is mounted onto a carrier truck, and it is the carrier which is being specified as an 'all terrain carrier', having four wheel drive and even four wheel steering, to allow it to traverse difficult landscapes.

Basically, it can be said that there is no strata today which cannot be drilled, using modern techniques and materials such as the foam and polymer already mentioned and also equipment such as Simultaneous Casing Systems, which actually cases (or lines) the bore as drilling progresses, thereby preventing the bore from collapsing during the drilling process and keeping it "open" afterwards. This system takes care of the difficult areas which have rocks or boulders in the strata, and prove to be very difficult or impossible to drill by normal methods.

This then has been a potted explanation of the bit and the bore (which undoubtedly may have been a 'bit boring' to some!). ❑

-- Colin Davis is Drilling Coordinator, UNICEF, New Dehi

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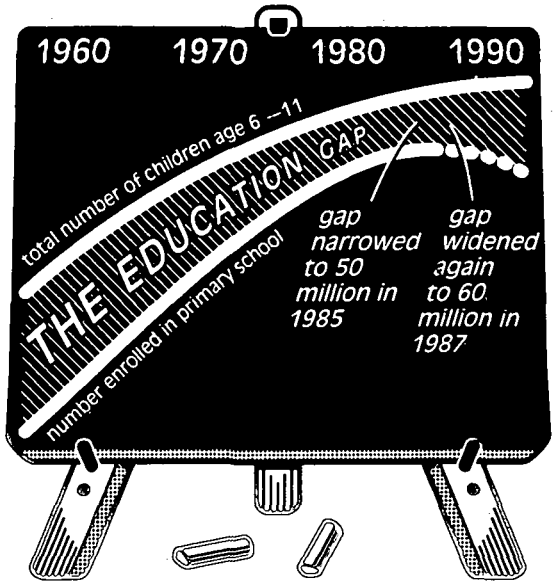
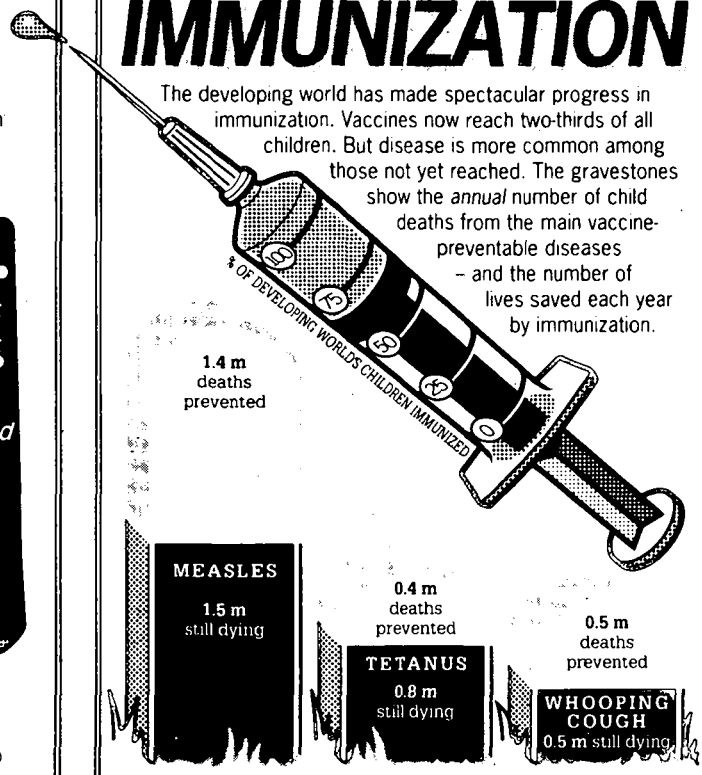
EDUCATION

After rising rapidly for decades, the proportion of the poor world's children enrolled in school is beginning to fall again under the impact of the debt crisis. High drop-out rates remain the biggest problem.



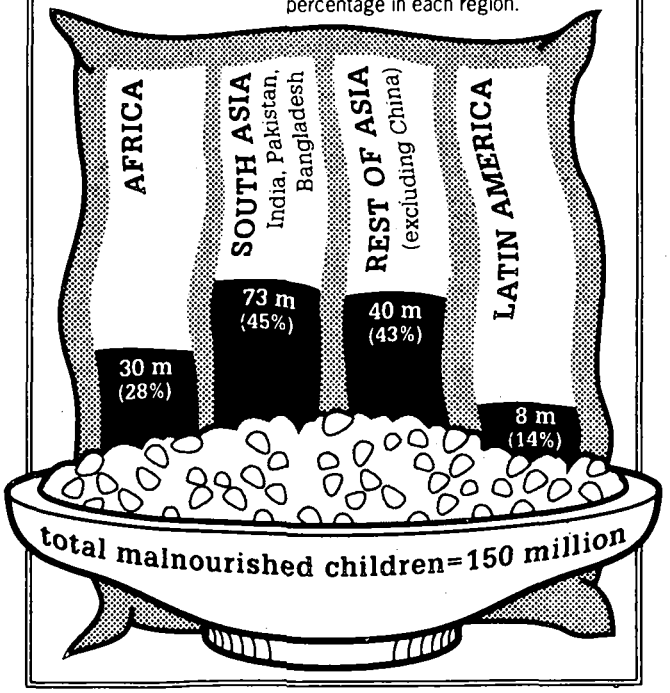
IMMUNIZATION

The developing world has made spectacular progress in immunization. Vaccines now reach two-thirds of all children. But disease is more common among those not yet reached. The gravestones show the *annual* number of child deaths from the main vaccine-preventable diseases – and the number of lives saved each year by immunization.



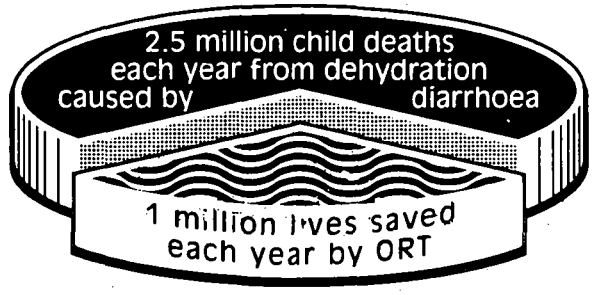
FOOD

A new global assessment by UNICEF shows a third of the developing world's children (under 5) are malnourished. The chart shows the number and percentage in each region.



ORT

Diarrhoea is the biggest killer of the world's children. Most victims die from dehydration – which can be prevented by oral rehydration therapy (ORT). ORT means giving plenty of fluids – rice water, soup, fruit juice, tea, coconut water, breast milk or oral rehydration salts (ORS). Even if dehydration begins, ORS (costing 10 cents) can almost always cure it.



The glasses show what percentage of the poor world's families use ORT when a child has diarrhoea.

Illustration Stephen Hawkins

ENGLISH

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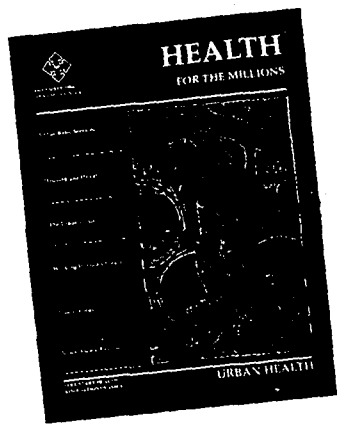

Every two months, HEALTH FOR THE MILLIONS keeps you in touch with the health and development scenario as it looks at issues of vital importance, both at the grassroots and health policy planning levels. We bring you a theme-based issue, together with a poster, research news, an information section that focusses on important news events, book reviews, information about new audio-visual aids, a list of selected organisations to help your nteworking efforts, a theme-based bibliography etc.

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