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12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

contents

Session 2a - Waste Disposal

Session 2b - Low Cost Sanitation

Session 3a - Water Supply

Session 3b - Administration, Finance and Training

Plenary Session 2

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WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

OPENING ADDRESS

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I feel privileged to attend this Conference.

In a gathering of this nature I need not dwell upon the importance of the programme for supply of safe drinking water and creation and improvement of sanitation facilities in the country. At official level, a conference was held in Delhi on October 16 and 17, last year to conduct a Mid-Decade Review of the Water Sanitation Decade Programme. This conference was attended by Secretaries, Chief Engineers and Heads of implementing agencies in-charge of water supply and sanitation. The objective of this conference seems to be wider and it is organised to ensure active participation of wide spectrum of people and organizations working in the field. Hence, the deliberations in this conference are expected to throw up suggestions not only from the official angle but from a comprehensive and total understanding of the situation relating to water supply and sanitation programmes. I welcome the holding of such a conference which is absolutely essential considering the importance of the programme.

Though the global programme for International Drinking Water Supply and Sanitation was adopted in the 31st Session of United Nations General Assembly in 1977 and 10 years' target for achievement of the objectives was fixed, in India the programme for drinking water supply and sanitation formed a part of the developmental programmes during the Plans undertaken much before the year 1977. However, the adoption of the Decade Programme not only highlighted the importance which the programme deserves, particularly in the developing countries, it was also instrumental in the arousal of the awareness of the dimensions of the problem in the world, particularly in the less developed countries. As is well-known the targets fixed for the programme which are to be achieved by the year 1991 in India aim at 100 per cent coverage for both rural and urban water supply and 25 per cent coverage of the population under rural sanitation and 80 per cent of the population under urban sanitation coverage. As against this, the actual coverage as on 31st March, 1985, as expected, would be 53.2 per cent for rural water supply, 81.2 per cent for urban water supply, 0.95 per cent for rural sanitation and 33 per cent for urban sanitation. These figures highlight the backlog which has to be covered and also bring to focus the need for redefining of strategies and revision of targets. According to a recent exercise the following revised goals have been suggested:-

WATER SUPPLY:

(a)	Urban	90 per cent coverage of population
(b)	Rural	85 per cent coverage of population

SANITATION:

(a)	Urban	50 per cent coverage of population
(b)	Rural	5 per cent coverage of population

In case of shortfalls, invariably the attention focussed is to the inadequacies of the financial outlays. It was anticipated that the capital cost of the decade programme, estimated at 1980 prices, was Rs.14,000 crores for the entire country. This figure has to be constantly up-dated in view of price escalation. To a large extent backlog is directly and mainly relatable to the inadequacy of outlays. I have no doubt that in case of non-fulfilment of the targets for the water supply and sanitation programme, the shortfall of adequate outlays matching to the requirements would be one of the principal reasons for failure to achieve the targets.

While admitting this, we have also to take stock of the realities. It has to be realised that there is an overall constraint of resources and the demand from competing spheres of development is growing keener and more intense. The major task of this conference should be to re-assess the targets for the 7th Plan taking the likely achievements at the end of the 6th Plan as the base and considering the availability of financial outlays which have been finalised by now. While this macro exercise would be helphul for the country as a whole, as the conference is being held in West Bengal, I expect the conference to go into the problems deeper as far as the achievements of targets and problems of West Bengal are concerned in the sphere of drinking water supply and sanitation programme.

The question which arises is: what measures could be taken to make up in the inadequacy of budgetary resources. I am afraid that the solutions which I am going to offer may not sound very new. It is necessary to derive full benefit of institutional financing. The proposal for creation of a National Financing Institution for water supply and sanitation sector is being pursued. Irrespective of the setting up of such an institution, available sources for financing of the programmes from banks, LIC, GIC, UTI etc., have to be tapped to the maximum extent so as to supplement the funds available from budgetary sources. It is also true that a consciousness of the importance of the programme has to be generated among the financing institutions and their procedures have to be adopted to the requirement of financing in this sector. This exercise has been undertaken in the Government of India.

While the shortage of funds may amount to a large extent to the non-fulfilment of the targets, yet it may not be the sole reason. As is well-known, best results are achieved by optimum utilisation of resources so as to produce maximum results. I have no doubt that all of us would agree that there is scope for taking measures to ensure that the available outlays are put to best possible utilisation so as to yield maximum results. In a developing country like India, with overall constraint of resources and competing claims from various development sectors, the demands from which are expanding and growing keener day by day, this exercise has to be done periodically.

While there are limitations to a complete realisation of this objective, yet it has been recognised that all our development programmes have to be cost-effective. The water supply schemes and sanitation, particularly in the rural areas at the present stage of development cannot be taken up as a paying proposition or even on a no-profit-no-loss basis. These schemes partake the nature of creation of basic infrastructure to improve the quality of life of the people. However, it is necessary to strive for making them cost-effective. Economising in the operation of the schemes to the maximum extent possible is one of the ways. Cost recoveries in all cases where these are possible is another important measure to be considered in this regard.

The importance of community participation and enlisting cooperation of women needs no emphasis. Water being an essential need equal in importance to food, water supply is integrally linked up with the life of man. It is the duty of the workers in this field to utilise this psychological link to ensure participation and closer interest of the beneficiaries in the water supply and sanitation systems. The role of the voluntary agencies is also crucial. They may not be able to contribute substantial resources in financial terms; nevertheless they can act as catalysts to generate interest and ensure people's participation and help in adoption of the programme as their own programme.

It has been our experience that the assets already created are languishing due to lack of adequate maintenance. The problem of operation and maintenance of the resources created during the past Plan periods as well as those which will be created during the current Plan is a matter of crucial importance. Adequate provision for maintenance and operation of the assets created should form an essential part of the financial projections. It is cheaper and better for the economy to pay attention to the proper maintenance and running of the assets created rather than to let them wither away and launch on creation of new assets to replace them.

One of the important topics which this conference could do well to discuss relates to the arrangement for maintenance of quality, standards and effective surveillance. The present arrangements are inadequate and it shall be our constant endeavour to upgrade them. It is also necessary to devote adequate attention to the expanding health education, building up of a reliable management information system for rural water supply, which could lead to proper utilisation and better up-keep of systems created on the part of the beneficiaries. Building up of a reliable management information system for rural water supply is also necessary. There are frequent complaints that the water supply systems break down and their repair takes unduly long periods. All this can be remedied by building up of a management information system.

One of the important aspects of the water supply and sanitation programmes is that of meeting the training requirements for the personnel engaged in the implementation of the programme. In this regard best use should be made of the training facilities which are at present available so as to ensure the implementation of the programmes on a reasonably efficient and sound level of performance. In the context of the projected expansion of the programme, both in terms of creation of new facilities and maintenance and operation of the assets already created, there is a need for assessment of present training facilities and institutions which have to be strengthened and supplemented, if necessary, by creation of new training institutions.

The programme of this nature which is vital to the raising of the quality of the life of people throws up problems, the solutions of which needs considerable R & D support. As a matter of fact there is considerable need for research in this sector. Uptil now, our sanitation systems have been based on consumption of large quantities of water. The entire systems are devised and based on western models. There is need for devising systems which could partially or wholly dispense with dependence on large quantities of water. Similarly, in regard to the water supply systems there is scope for research to adopt the present system to the needs of developing countries. The United Nations Development Programme assisted research-cum-extension project relating to the sanitation has a limited but useful role. There is need for widening of the range of R & D efforts.

This brings me to the need for greater regional and international co-operation in the programme of water supply and sanitation. There is need for exchange of information and results of research between the various developing countries. There are already several international and bi-lateral programmes in operation in the country in this sector. There is need for increased flow of assistance and for taking up projects more comprehensively so that they could have a visible impact of a more lasting nature in the situation. It has been recognised that sometimes emphasis on conditionalities defeats the very purpose of aid programmes. All these points have been debated in several forums and I thought it apt to make a brief reference to them in this conference.

I have highlighted some of the points of importance arising out of the theme of this conference. I look forward to a meaningful discussion in the conference on the issues arising out of the review of the decade programme and an agreed consensus in regard to directions in which the solutions of the problems can be taken up.

I look forward to fruitful deliberations and valuable recommendations of the conference which I am sure would help us all in facing the challenging tasks which we have in hand of ensuring a reasonable standard of availability of drinking water and sanitation facilities to every citizen in the country within a reasonable time frame.

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KEYNOTE ADDRESS

Professor John Pickford OBE

WEDC Group Leader

The organization of this Conference has been remarkable for collaboration. Here in Calcutta the arrangements have been made by the Institution of Public Health Engineers, India, and by the British Council Division of the British High Commission. We are all enjoying the magnificent hospitality provided through superb organization, with no less than twelve sub-committees to look after the details. I pay a special tribute to the joint secretaries, Mr S K Neogi of IPHE, India, and Dr Partha Ghose of the British Council.

Collaborating with the local organizing committee has been WEDC, the Water and Engineering for Developing Countries Group at Loughborough University of Technology, England. WEDC has been responsible for international - the non-Indian - affairs. We hold WEDC Conferences alternately in Asia and Africa. This is the 12th WEDC Conference; it has the largest number of participants and all seems set for it to be the best WEDC Conference so far.

Like other members WEDC, I go to many different countries in Africa and Asia. Often people in England ask me what place I most enjoy visiting. I find this difficult to answer. So many countries and cities are interesting, or present challenging problems, or have outstanding natural or man-made beauty. I am specially fond of Ghana in west Africa because I lived and worked there for six years. Nevertheless the place I like best is Calcutta. I have been here a dozen times in the past few years, and every time it gains a stronger hold on my affection. It is difficult to say why this should be. Perhaps the reason is given in the Conference souvenir programme - **Calcutta is a city of immense vitality.**

The date of this 12th WEDC Conference was chosen to be as near as possible to the mid-point of the International Drinking Water Supply and Sanitation Decade, 1981-1990. During the next three days we have much to discuss - much to learn from each other. How can we achieve more for people in rural areas and underprivileged urban communities as we move forward in the second half of the Decade? The two billion or so underprivileged people who still lack good drinking water and sanitation call for our efforts.

If we are to help these people our technology needs to be appropriate. Of course, all good technology should be appropriate, but most of the people to whom the Decade offers hope lack resources - they are poor. Consequently for both water supply and sanitation we must provide **low-cost technology.**

During the Conference we will give a great deal of attention to **operation and maintenance.** There is no value in providing pipes, pumps, latrines or treatment works if they soon become unusable. Similarly, there is no value in providing facilities if they are not what the people themselves want. Sharing in the planning of projects and programmes is part of **community participation,** quite apart from any resources of time and materials which the community gives.

These three aspects of Decade activity - low-cost technology; operation and maintenance; community participation - have already been stressed during the formal Opening of the Conference yesterday. There is another ingredient for successful implementation of water and sanitation schemes - **appropriate administration.** Resources of money, materials and people must be effectively co-ordinated by efficient organizations to obtain the greatest benefit - lasting benefit - to the underprivileged people of developing countries.

And so I conclude as I began with a call for collaboration - collaboration between the community and planners and engineers and development workers and international agencies and bilateral donors and local organizations and the ordinary people who so desperately need good drinking water and adequate sanitation in the second half of the Decade and in the years beyond 1990.

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H van Damme

People's Water and Sanitation Decade

INTRODUCTORY EXAMPLES

In the village of Ban Huay Yang Tai located in Korat Province of Northeast Thailand, the village development committee has opened a small co-operative grocert store run by volunteer women who sell dry goods, simple but effective medicines and oral rehydration packets for treating diarrhea. Next to the room is a one-room well-built shed for storing rice. During hard times, village families can borrow needed rice and repay it after the harvest. Although such co-operative activities are not uncommon in Thailand, what makes it truly remarkable is that the funds for building and supplying the stores came from profits made by the village development committee on the sale of water-seal latrine slabs and one cubic meter rainwater storage tanks. Every household has purchased its own sanitary latrine and enough jars to provide at least two litres of safe rainwater to drink to each member of the family per day. Moreover, the latrine and jar moulds, and finished products were made right in the village, and were based on designs developed in Thailand. Not too far away, sixth grade Thai schoolchildren are making similar rainwater jars and selling them to nearby villagers to earn money for their school development fund which includes health education and immunization programmes.

In the village of Belta in Tangail District of Bangladesh, five landless women have borrowed money from the Villager's Bank for purchasing cows, chicken, and a rice husking machine. With the money they have earned from the sale of milk, eggs and husked rice, they have purchased tubewells and pumps to provide their families with safe and convenient water. And, instead of walking long distances for water, they use their time earning money and lifting themselves out of poverty. These women and thousands more like them meet regularly with trained Bank workers to discuss family planning, disease prevention and other issues essential to their lives.

In the poor squatter's community of Baldia on the edge of Karachi, Pakistan, families are busy digging water-seal latrine pits, community drainage systems and are sending their daughters to ad-hoc neighbourhood schools for the first time. The schools are run by teachers who have received special training in sanitation and hygiene. These activities are being accomplished without government funds but with modest help from the University of Karachi, the local Junior Chamber of Commerce (Jaycees) with some technical support from UNICEF.

In Davo City in the Philippines and in Bandung, Indonesia, local charitable organizations have organized village families into self-help health programmes, have trained female volunteers in providing basic primary health care services, including improved household hygiene and environmental sanitation. In the village of Borojwada in India, village people are actively assisting in testing the acceptability and affordability of water from community slow sand filters, which they have had installed by their own choice. In Bourkina Faso, in Omo State, Nigeria, in Kenya and in Tanzania, as well as countless other places, strong community self-help projects are under way with the goal of protecting health and well-being through improved water and sanitation systems.

As diverse as each of these activities are, they all have certain important features in common. Each has discovered innovative and locally effective ways of addressing their people's most serious health problem, the lack of adequate amounts of safe water for drinking and other uses, and the lack of safe ways of disposing of human wastes. The key to success in each instance has been to create meaningful opportunities for community residents to be a part of developmental activities which they see as being important to their lives and priorities. Top-down planning is absent. Over-emphasis on technical solutions to human problems has been avoided. Women play central roles in each of these projects. Finally, there are reasons to believe that community people involved in these activities will emerge with a greater sense of self-confidence and ability rather than feeling even more dependent upon outside experts and resources.

THE NATURE AND EXTENT OF WATER SUPPLY AND SANITATION NEED

The philosopher, Durkeim, once observed that there can be no understanding without comparison. Yet it is difficult to compare mankind's need for improved water and sanitation to its other great needs: peace, and freedom from poverty, hunger, greed, ignorance and pestilence. In many respects, inadequate water and sanitation systems is as demoralizing and dehumanizing as the absence of any of those basic needs.

It is difficult to imagine how much tragedy is implied by the fact that 30,000 people in developing countries die each day as a result of inadequate water supplies and sanitation. That is over 10 million people every year, year after year. Most are infants and children under the age of five. But many are older children about to enter their productive years. Parents of young children, community leaders, teachers: none are exempt from diseases associated with water. One usually thinks of cholera and typhoid fever, of amoebic dysentry but can forget that the lack of clean water and sanitation is directly related to the spread of trachoma which damages the eyes of some 500 million people...., equivalent to the entire population of Europe. Consider 200 million people, equal to the entire population of the United States, with blood in their urine and their energy sapped from snail fever (called bilharzia or schistosomiasis). Consider the nutritional damage resulting from three-quarter of a billion cases of several diarrhea among children whose health is already fragile, whose energy is already reduced by heavy loads of round worms, hookworms, tapeworms and other parasites common to people lacking adequate sanitation. And beyond this tragic toll of death, disease and disability are the endless hours of carrying buckets of water from distant sources on the head and shoulders of women who could be making other valuable community contributions, or carried by children who can't be spared from these labours to attend school.

A few statistics may help to explain these conditions. It has been estimated that 73% of rural Africans lacked safe drinking water in 1980. This danger is further compounded by the fact that 67% of them lack safe ways of disposing of human wastes. The obvious

Region a/	Population 1980	Population 1983	Water supply 1980 Number	Water supply 1980 %	Water supply 1983 Number	Water supply 1983 %	Sanitation 1980 Number	Sanitation 1980 %	Sanitation 1983 Number	Sanitation 1983 %
Africa (Economic Commission for Africa)										
Urban	135	160	89	66	91	57	73	54	88	55
Rural	334	356	73	22	103	29	67	20	64	18
Total	469	516	162	34	194	38	140	29	152	29
Asia and the Pacific (Economic Commission for Asia and the Pacific) b/										
Urban	428	493	278	65	330	67	175	41	237	48
Rural	1 064	1 109	277	26	488	44	117	11	100	9
Total	1 492	1 602	555	37	818	51	292	29	337	21
Latin America and the Caribbean (Economic Commission for Latin America and the Caribbean)										
Urban	234	254	183	78	215	85	131	56	203	80
Rural	124	126	52	42	62	49	25	20	25	20
Total	358	380	235	66	277	73	156	44	228	60
Western Asia (Economic Commission for Western Asia)										
Urban	27	30	25	94	29	95	22	80	28	93
Rural	21	24	9	41	12	50	4	18	6	25
Total	48	54	34	69	41	76	26	51	34	63
Global totals										
Urban	824	937	575	70	665	71	401	49	556	59
Rural	1 543	1 615	411	27	665	41	213	14	195	12
Total	2 367	2 552	986	42	1 330	52	614	26	751	29

Sources: 1980: report of the Secretary-General concerning the Decade (A/35/367); 1983: WHO surveys (see para. 8 above).

a/ No comparative data are available for the region of the Economic Commission for Europe.

b/ Excluding China.

Table 1: Service coverage by region in 1980 and 1983 (Population in millions)

result is that such wastes are washed right back into ponds, and open wells/streams used for drinking. In the three years from 1980 to 1983, the proportion of rural African with safe waste disposal declined from 20% to 18% as a result of population growth. In rural South-East Asia, excluding China, these figures were 11% and 9%.

Sixty-six percent of rural people lacked safe water in 1983 and 91% lacked safe waste disposal. Resources are greater in urban areas where somewhat less than three-fourths of the people have safe water and half are protected by waste disposal systems (Table 1). But sanitary conditions there are worsening as people are forced to leave the land and crowd into cities to seek a livelihood.

THE DECADE RESPONSE

The importance of safe water and sanitation to human well-being is certainly no new discovery. As early as 2400 B.C., the people of the Sind, in present-day Pakistan, built cities like Moenjadaro which had pour flush toilets, covered town drainage, public baths and zoning regulations. Hippocrates observed in 400 B.C. that water contributes much to health, and the ancient Romans trained forerunners of todays sanitarians as health inspectors. But it was not until 1972 at the UN Conference on Human Environment held in Stockholm that worldwide attention was given to the urgent need for improvements. Later conferences such as Habitat and the UN Water Conference of 1977 in Mar del Plata, Argentina lead directly to the launching of the UN International Water Supply and Sanitation Decade as of 1981. Also of great significance was the International Conference of Primary Health Care held in Alma Ata in 1978 which recognized safe water and basic sanitation as necessary for achieving health for all.

In the years which have ensued since these conferences were held, some remarkable progress has been made. Over 60 nations have prepared specific water supply and sanitation plans. Another 30 are in the process of preparation. Bilateral assistance for water supply and sanitation has increased from only 1-2% in the '70's to over 7% now. World Bank loans sharply increased to over $810 million by 1983, while the U.N. Development Programme, the World Health Organization, UNICEF and other multi-lateral and bi-lateral agencies have also responded to the Decade's challenge as witnessed by Table 2. On the UN-side, the Steering Committee for Co-operative Action for the Decade is developing into an action stimulating body which by some is being seen as a good example of adequate co-ordination among programmes of the United Nations Organization.

But what is more important - and in my view the impact of the Decade should be measured by those facts - in country after country.... Brazil, India, Malawi, Haiti, Nigeria, Mali, Senegal, Sri Lanka and many more, major new programmes are under way. Programmes in many cases with a new approach, a new thrust which at present is being discussed and developed between the country governments and external support agencies (ESA's). A general awareness and agreement begins to develop, that three components of that new thrust are particularly important:

(i) Institutional Development: The water supply and sanitation sector institutions are limited in the amount of activities they can handle, due to constraints in their organizational structure and availability of own resources, funds and manpower. New and existing installations need to be maintained regularly. The generation of national funds through cost recovery, at least partially, is a vital step in ensuring operation and maintenance and the sector's viability. Therefore, if sector investments are to reach the objective of improved service coverage, it ought to be kept in mind that the institution's capacity needs to be developed in advance of construction projects;

(ii) Co-ordination of Assistance to the Water Supply and Sanitation Sector: In the present economic world environment, the flow of external funds to the water supply and sanitation

	1970-1979 (p.a.)	1980	1981 (x70/79 p.a.)
	(in millions of US Dollars)		
Bilaterals	2 419.0 (242)	715.3	803.5 (x3.3)
Development Bank and Funds	2 200.0 (220)	450.0	500.0 (x2.3)
World Bank	2 850.0 (285)	631.0	641.5 (x2.3)
United Nations	370.0 (37)	145.0	150.0 (x4.0)
Non-Governmental Organizations	300.0 (30)	110.0	130.0 (x4.3)
	8 139.0 (814)	2 051.3	2 225.0 (x2.7)

Table 2: Distribution of external support in the first year of the Decade

sector may not increase substantially in the foreseeable future. Nevertheless, external support agencies can help in optimizing the impact of limited funds, by co-ordinating among themselves and with government authorities their approach to the sector's development, thus streamlining their activities through co-ordinated support of recipient governments' sector policies;

(iii) Decade approaches: The focus of water supply and sanitation sector investments needs to shift from the traditional project approval to more cost-conscious, socially adapted programmes. Therefore, particularly the following so-called Decade approaches need emphasis:
- complementarity in developing water supply and sanitation;
- strategies giving precedence to under-served rural and urban population;
- programmes promoting self-reliant, self-sustaining action;
- socially relevant systems that people can afford;
- community involvement at all stages of project implementation;
- association of water supply and sanitation with relevant programmes in other sectors, particularly with primary health care, concentrating e.g. on health education, human resources development, and the strengthening of institutional performance.

The judgement of the impact of the Decade so far depends on which questions are being asked. The most important ones seem to be:
- are better approaches being developed, leading to more lasting and used facilities?
- are the benefits of water and sanitation being more appreciated and are facilities more desired by the people concerned?
- do the governments assume more commitment regarding water and sanitation, including the allocation of internal resources?
- do international agencies and bilateral donors take an increased interest in the sector?

The overall assessment based on the answers will undoubtedly depend on who does the assessment based on the answers will undoubtedly depend on who does the assessment. A point of fact is that the answer to all questions 'yes' in varying degrees. There perhaps lies the danger. Developments and actions may show a positive trend, but may not be enough in the long run. The more reason to forcefully pursue the three components beforementioned. It is up to all of us whether the Decade's present judgement will in the end lead to a self-fulfilling prophecy uphill or downhill.

WHAT MATTERS IS PEOPLE

At IRC the initial focus was on urgently needed technology, including handpumps, slow sand filters, public standposts and water quality. At present we are increasingly involved in the more human side of the Decade. That, in my view, is the other major impact of the Decade: new thinking and the development of alternative strategies. It is therefore that we and many others - in particular in the developing countries themselves - are involved in such issues as local participation, and questions as: how can women play more effective roles. At the IRC we are also concerned that valuable lessons learned over the years are not being disseminated to where they are needed and in usable forms. A programme for exchanging and transferring information has been initiated through a network of regional and country information points. Knowledge is also generated and transferred through demonstration projects, training activities and evaluation programmes. They include such aspects as human resources development, operation and maintenance, local financing, and, increasingly, strengthening of community participation in water supply and sanitation activities.

Community participation promised to be one of the most exciting and valuable of our undertakings as we and our colleagues throughout the world seek to achieve the goals of the Decade. It is no accident that UNICEF, WHO, as well as the IRC and countless other agencies and governments are beginning to realize that effective community participation is an indispensable pre-requisite for the attainment of their goals. The reasons for this are many. First and foremost, it has been estimated that the investments required to achieve the Decade's goals can range from \$300-600 billion dollars, depending upon levels of technical sophistication. An average of \$30 billion dollars per year for ten years is far more than is now being spent. Demand for scarce development dollars come from many quarters ... the military, agriculture, education, medical and others. Several droughts in 24 African countries, swelling numbers of refugees, unending wars within and between nations, economic upheavals, all draw heavily upon the world's scarce resources for development. To achieve the Decade's goals, people in the villages, town and cities of the developing nations will need to contribute their own resources, labour, sand, gravel, time and dedication. They must be counted on to volunteer their efforts, provide leadership, lubricate pumps, drain ditches, instill their children with hygiene habits, protect their food from flies and contamination, understand the dangers of human wastes, use oral rehydration therapy when diarrhea strikes, use effective medical techniques and so forth. Governments do not have and never have had the resources to "give" health.

They can only offer modest leadership and some

They can only offer modest leadership and some technical support to enable people to make healthfull sanitary practices their way of life. By participating as full partners in Decade activities, villagers and town people will have better opportunities for understanding complex relationship between what they do and the health for their families.

They will have opportunities to experience improving their own lives in a way which can lead to even broader development in other vital areas such as irrigation, agriculture, education and animal husbandry. They can discover new feelings of independence and a new sense of control of their lives, of power over their futures. They can assure that what is done is what they want to have done, not what some well-meaning official says ought to be done. They can draw upon their own skills, knowledge and insights which has helped them to survive over the generations.

There are dangers in placing so much hope in community participation. Government leaders shirk their own responsibilities for village improvements while continuing to spend their nation's resources on the needs of urban residents. They might not fully appreciate that community organization and education are complex and time-consuming processes which will require greater sensitivity, understanding and patience. They may find it painful to give up rigid bureaucratic practices and offer the kind of flexibility which a partnership requires. Most important of all, officials may be slow in realizing that community participation must mean more than simply allowing communities to select a spokesman or to decide who in the village will help to dig a ditch or who will donate land for a well. Rather, it implies a full sharing of decision-makingpower over such key issues as what will be done, when, by whom and under what circumstances.

Fortunately, water and sanitation people are not alone. Expectations for community support and participation are exactly the same as those discussed by primary health care planners, that is, full participation by each community in planning, implementating and evaluating all programmes intended to improve community health and well-being.

CONCLUDING REMARKS

In light of the importance being placed on community participation in water supply and sanitation programmes, and on the occasion of its 15th anniversary in 1984, the IRC held a Symposium in Amsterdam attended by invited social scientists, engineers, primary health care specialist, and many others from thirty-five nations. Half of the participants were women, and issues related to the role of women had strong emphasis. Some of the concerns and suggestions which emerged from the Symposium's intensive workshop are the following.

First, the participants were not satisfied with amounts of resources allocated for human resources development, community organization and education when compared to money spent on technology.

Second, new policies are needed which would re-allocate a greater proportion of funds for sanitation, since improved water is essential but not usually sufficient for preventing diseases associated with poor environmental sanitation.

Third, as far as the role communities can play it is imperative that they have meaningful involvement as full partners in all stages of planning, implementing, managing and evaluating improved water supply and sanitation. Tokenism is short-sighted and can only lead to frustration. Along this vein, careful community planning is needed to promote financial viability over time. Such planning must influence decisions about appropriate technology, revenue collection schemes, and how revenue is to be used for further community development. A positive attitude on the part of national and local authorities including non-governmental agency representatives, is a basic pre-requisite but one which does not often come easily.

Fourth, given the limited financial capacities of both governments and local communities to rapidly expand and improve their water and sanitation systems, innovative methods must be found for generating urgently needed resources over long periods of time. The cases of the People's Bank in Bangladesh and of Thai village committees and school making and selling water and sanitation products, referred to in my introductions, are only two examples of imaginative solutions. Others must be found, including greater use of the private sector.

Fifth, there must be a strive for agency participation in community projects rather than the other way around. It is up to each community to judge whether available technology is socially acceptable and financially affordable. The time has long past when such decisions can be made on the basis of engineering assumptions, experiences in distant places, or what happens to be available from donor agencies.

Sixth, women must be given far more central roles in all aspects of water supply and sanitation improvements. This included not only inclusion on planning committees, but making whatever provisions are needed to assure that they are fully able to contribute. Holding meetings at times convenient to women, including them in labour-intensive activities, sharing financial planning and revenue collections responsibilites, using their services as both volunteers and staff, and many other possibilities must be explored if the goals of the Decade are to be met.

And, finally, knowledge attained by people like yourself who represent the engineers, doctors, sanitarians, public health organizers programme planners, and many others must be shared more widely. The needs are far too great and the resources far too small for us to have to repeat each other's mistakes or re-discover effective approaches. The poet, Gibran, once said:

> "And when one of you falls down,
> he falls for those behind him,
> a caution against the stumbling stone.
>
> And he falls for those ahead of him,
> who though faster and surer of foot,
> removed not the stumbling stone."

REFERENCES

United Nations General Assembly Economic and Social Council (1985). Progress in the attainment of the goals of the International Drinking Water Supply and Sanitation Decade, Report of the Secretary-General. A/40/108; E/1985/49; 6 March 1985. United Nations.

International Reference Centre for Community Water Supply and Sanitation (1984). The local decade: men, women and agencies in water and development. report of symposium, 20-22 June 1984, Amsterdam, the Netherlands. The Hague, the Netherlands, IRC.

CWS/World Health Organization (1985). Asia regional resources mobilization profile. regional external support consultation, 21-25 October 1985, Manila, Philippines. Geneva, Switzerland, WHO.

World Health Organization (1983). Trends in external support to the IDWSSD. document prepared for the IDWSSD Media Encounter at Copenhagen. Denmark, 31 May-1 June 1983, Geneva, Switzerland.

12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

R W A Franceys

Handpumps or reticulation systems?

INTRODUCTION

Engineers are given the responsibility of providing the best quality service at the lowest cost. In many cases the least cost consideration has been taken as referring to the capital cost only. However, increasingly engineers are having to recognise that they must design for the lowest possible lifetime cost - that is the smallest overall cost for the lifetime of the installation including operation and maintenance costs as well as capital cost.

This is particularly important when considering the provision of clean water to the rural areas of the less developed countries. With an estimated eighty per cent of the people still living in the rural areas and with sixty per cent of these still without an improved supply there is a large amount of work outstanding. In order to make any impact on this situation, costs have to be kept to a minimum. With an estimated forty per cent of existing improved supplies out of action at any one time, operation and maintenance costs also have to be designed for the lowest possible cost to ensure a better chance of the funds being available.

Appropriate technology means the best and most economic technology for people in a particular situation. This requires an open approach to problem solving which may lead to unconventional solutions. This paper describes a Least Cost Analysis of the lifetime costs of two methods of providing clean water supply to the Terai Region of Nepal.

As part of a seminar for senior engineers from the Water Supply and Sewerage Corporation and the Department of Water Supply and Sewerage the participants were asked to investigate the lifetime costs of using a conventional pumped borehole with overhead storage tank and reticulation system compared with using tubewells and handpumps.

THE TERAI REGION AND SOURCES OF WATER

The Terai Region of Nepal is the five-hundred mile long strip of lowland bordering India. It is an area of marshy plain and thick jungle as well as an area of high agricultural productivity with a rapidly growing population. It is founded on the Indo Gangetic alluvium, an area with beds of coarse sands, gravels and boulders of varying thicknesses with shallow and deep aquifers, partly interconnected and confined, with an estimated tubewell yield of 50-100 m^3/hr (Raghunath 1982)

Hand dug wells and simple tubewells to an average depth of 30 m provide a most useful water source. The tubewells are sunk by the sludger method at an average rate of two wells per day with six men.

The larger centralised systems typically consist of one or two 200 mm boreholes approx 120 metres deep with induction motors and pumps feeding into an overhead tank and from there by gravity into a town-wide distribution network. In addition a standby generator will often be required in case of power failure.

DESIGN CRITERIA

This study follows the local standard design criteria of providing 100 litres of clean water per person per day. In the rural towns the design assumes that one quarter of the population will be served by individual household connections for an average of ten persons each. The remainder collect water from communal standposts installed at the rate of one per two hundred persons.

The population of the Terai is growing very quickly with considerable inward migration from the hills as well as from over the border. Standard design procedure is therefore to consider a growth rate of 4% per annum.

HANDPUMPS AND TUBEWELLS

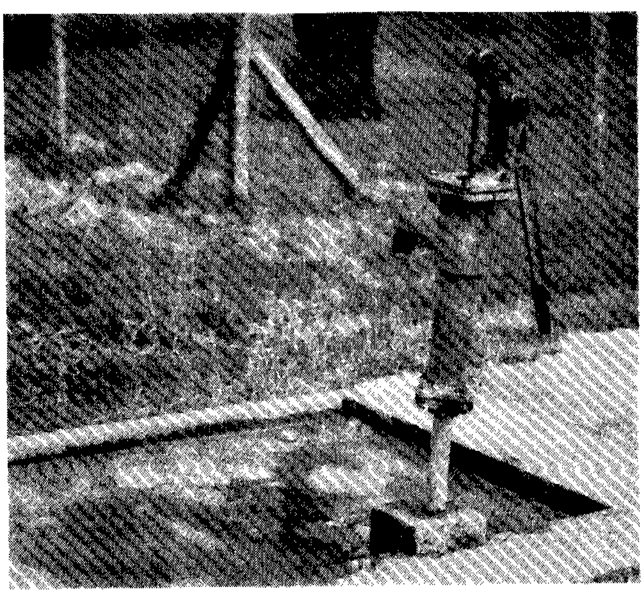
The sludger method of sinking tubewells is quick, cheap and requires little equipment. The skills required are easily learnt although there have been some problems in finding the right sand layers of the aquifer which may be only three metres thick. Though the water is free from carbonates which can block the slots the brass well screens have not proved to be durable. Various plastic alternatives have been tried and also different slot sizes experimented with in order to minimise sand collection.

The three metre section of 37 mm GI rising main supports the pump (which is mounted directly onto it) and also prevents mice from attacking the HDPE riser. The most commonly used pump is the Bangladesh New No 6 Pump which is a shallow well suction pump made primarily in Bangladesh but recently being brought into production in the Terai and Kathmandu under the sponsorship of UNICEF. It is constructed almost entirely from cast iron with the plunger having a moulded PVC cup washer and the check valve comprising a simple leather flap weighted with cast iron. The pump discharges onto a 1.8m square concrete drainage apron. There have been difficulties experienced with the large quantities of waste water which result from the pump area being used as a bathing site for upwards of 200 people and care is required by communities or households to prevent this ponding and becoming a health hazard.

The experience of UNICEF suggests a capital cost for each tubewell complete with hand pump of 3230 Rs (1984 prices, $1 = 17 Rs).

Where the pumps have been maintained on a voluntary basis very low costs have resulted. Where provision has not been made for maintenance , between 10% and 15% of the pumps have been inoperative after two years. Where an agency is responsible for maintenance, estimated costs range from 45 Rs per pump per annum for a group of over 2000 pumps up to 200 Rs per annum for 100 pumps.

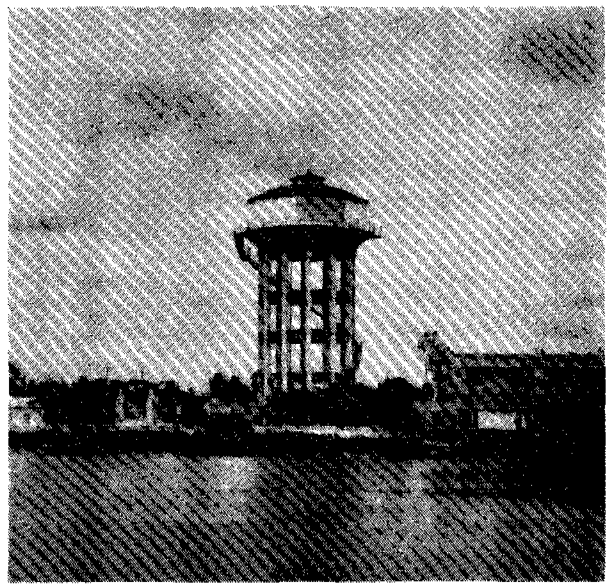
For the purpose of this analysis the handpumps have been assumed to have a life of fifteen years with regular maintenance and an overhaul at seven years including a new screen, a renewed hole and major spares.



Bangladesh No 6 Handpump

BOREHOLE, TANK & RETICULATION

The conventional centralised system already described is well understood by design engineers. For the purpose of this analysis 'as built' capital costs have been taken from a system designed for a future population of 12,000, costing 3.7 million Rupees in 1983.



Pump house and overhead storage tank

Capital costs for larger and smaller schemes have been calculated by using a scale factor of 'a' = 0.5 where Capital Cost equals a Constant times the Capacity raised to the power 'a'. Recommended values of the scale factor are a = 0.4 for elevated storage and a = 0.5 for distribution networks (EDI Ringskog 1983).

Other information suggests that future capital costs could be expected to be considerably higher than these figures. However this study assumes that recent costs for both hand pumps and reticulation systems are an accurate enough guide for the purposes described below.

The analysis has been carried out for a period of fifteen years being the design life of a pumped system recognised by various agencies. It is also the Optimal Design Period for a pumped elevated storage and distribution system using a Scale Factor of 0.5 and a Discount Rate of 10% in order to avoid the wastage of over designing a scheme that cannot be used to capacity for many years to come (EDI 1983).

The cost of installing a household connection is 425 Rs and of making a connection and building a communal standpost is 825 Rs. It is assumed that the main distribution network is installed at the same time as the pumping and storage system but connections are made to suit the demand of the growth in population. Similarly it is assumed that handpumps are installed to meet the population increase as it occurs.

The construction period for the smallest pumped scheme has been taken as two years and for the larger systems as three years with construction costs distributed equally over the period.

Operation and Maintenance costs for the pumped scheme have been taken as 3% of total cumulative capital costs per annum.

LEAST COST ANALYSIS

An estimate is required of the Discount Rate which should be the marginal social rate of return on investment. This can be difficult to ascertain and current experience suggests that a discount rate of between 8% and 10% is a useful operational guide (ODM 1977). This study has taken a figure of 10% whilst recognising that high discount rates tend to favour projects with relatively low capital costs and relatively high operation and maintenance costs (Baldwin 1983).

The analysis was designed to investigate the relative merits of using the two different technologies at comparable standards of service. This was considered over a range of town sizes, from initial populations of 850 with a design size of 1500 up to a town of 30,000 growing to 50,000 in fifteen years.

The Net Present Values of total costs over the fifteen year design period are tabulated below and illustrated in Figure 1. It had been anticipated that whilst the handpump option might be most economical for the villages the centralised system would quickly become more economical for the towns. This does not appear to be the case as the NPV curves for each alternative never cross - the handpump option is always more economical. Another situation was then considered whereby each household would have its own supply point, whether by handpump or from connection to the mains. This being taken as the ultimate standard of supply.

Table 1

Design Population	NET PRESENT VALUES: One Water Point per 200 for 75% & one per 10 for 25%		NET PRESENT VALUES: One Water Point per Household of 10	
	Reticulation System	Handpumps	Reticulation System	Handpumps
1,500	1,425,200	117,350	1,458,560	385,500
6,000	2,653,900	484,120	2,763,575	1,542,000
12,000	3,751,600	967,470	3,983,100	3,084,000
25,000	5,342,700	2,023,715	5,815,500	6,425,000
50,000	7,953,000	3,883,140	8,575,200	12,850,000

The results of this analysis as illustrated in Figure 1 highlight some interesting points:

For all sizes of design population the standard service with hand pumps can be provided for approximately half the cost of the standard service with reticulation system.

For populations under 17,500 the ultimate service with handpumps can be provided more cheaply than the standard service with reticulation.

For populations under 20,000 the ultimate service with handpumps can be provided more cheaply than the ultimate service with reticulation.

The ultimate service with reticulation can be provided for only 10% more than the standard service with reticulation.

There are also other factors which are less easy to quantify. It is worth noting that whereas a handpump used for only one household should have a long and trouble-free life, a centralised system commonly operates for only a few hours each day. Indeed, in the system investigated water was only available for two hours in the morning and three hours each evening.

Because of the problem of finding recurrent costs, fuel and spare parts are often in short supply. This can lead to loss of pressure in the distribution network and subsequent ingress of polluted water.

Notwithstanding these economic and technical advantages of using handpumps and tubewells, there is a major problem in ensuring their widespread acceptance as appropriate technology. To an engineer responsible for water supply there is only a limited interest or technical challenge involved. Designing an elevated water tank out of reinforced concrete and arranging contracts and supervising construction is a task well suited to an engineers training, whereas installing several thousand simple handpumps may not always be seen in the same light.

However, ultimately an engineer's skills will be judged by the quality, quantity and economy of the services supplied and if clean drinking water is the goal then in the circumstances described above, handpumps and tubewells look to be the most suitable solution.

ACKNOWLEDGEMENT

The author gratefully acknowledges the information shared with him by the engineers of DWSS, WSSC and UNICEF in Nepal; the contents of this paper do not necessarily reflect the opinions or policies of these organisations.

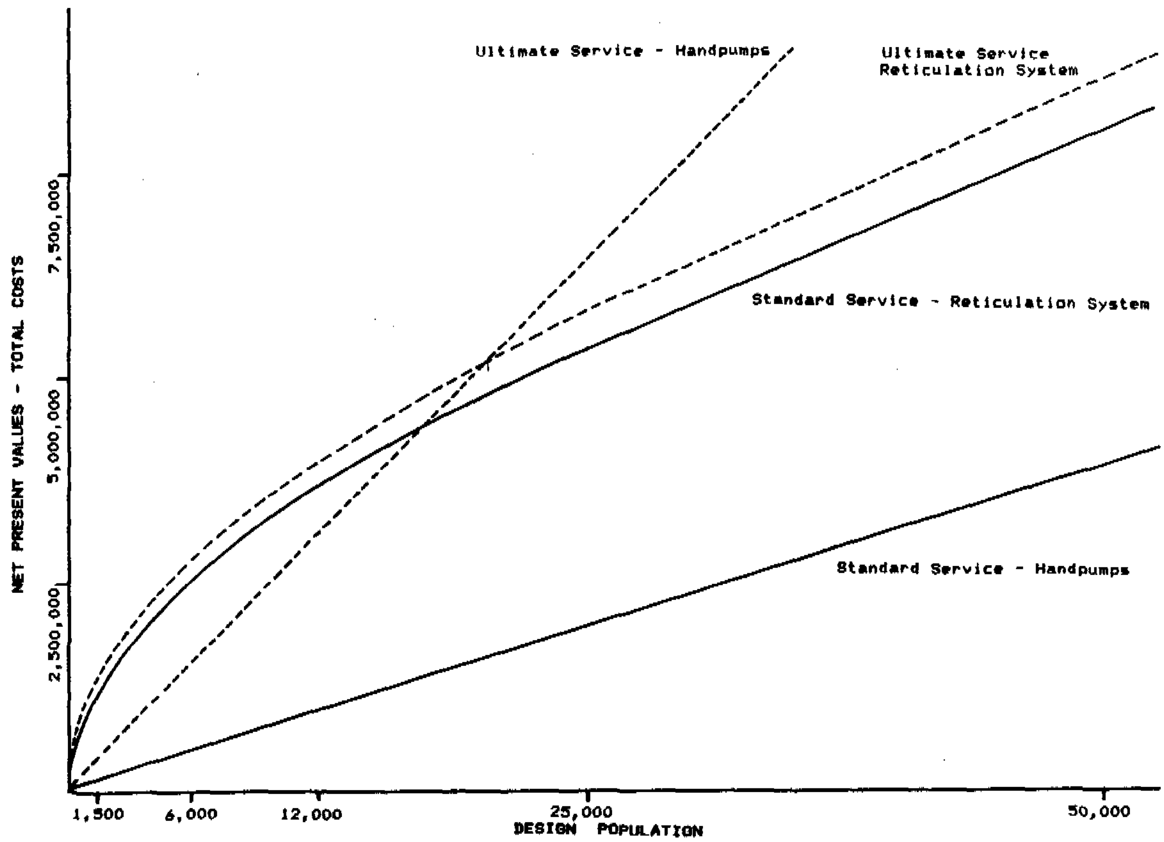


Figure 1

REFERENCES

1. BALDWIN G B. Why present value calculations should not be used in choosing rural water supply technology. World Development, 1983, Vol. ii, No 12.

2. RINGSKOG K. Cost benefit evaluation of a water supply project. Economic Development Institute, 1983.

3. OVERSEAS DEVELOPMENT ADMINISTRATION. A guide to the economic appraisal of projects in developing countries. London, 1977.

4. RAGHUNATH H M. Groundwater. Wiley Eastern, New Delhi, 1982.

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K Biswas

Low cost on-site excreta disposal

1. The Technology Advisory Group

1.1 In 1978, the United Nations Development Programme launched a Global Project, with the World Bank as executing agency, to translate the research findings into actual projects by the creation of a multi-disciplinary team of engineers, authropologists and health experts - the Technology Advisory Group(TAG). Inaugurated with a modest initial budget, the Project was remarkably successful in attracting support from developing country governments and ih mobilizing resources from the donor community, and was expanded in a follow-up International Project This Interregional Project (INT/81/047: Development and Implementation of Low.-Cost sanitation Investment Projects) is now active in many countries around the world including India.

1.2 TAG's objectives are to provide technical assistance in the development and implementation of low cost sanitation projects; to help find funds to finance the projects; to stimulate research and applied investigations into key unresolved issues; and to develop qualified local staff through training and dissemination activities.

1.3 Collaboration with other development agencies marks TAG's approach. TAG currently provides technical assistance to member governments to implement projects funded by a variety of multi-and bi-lateral donors through work done at TAG headquarters and also by its worldwide team of resident experts. TAG has, in turn, received support from these donors in terms of staff and funds to expand its network.

1.4 By persuading governments to support low cost but effective sanitation options, the fundamental change in conceptual approach is reflected today in a significant number of sanitation projects being implemented around the world with or without TAG assistance. Not dependent on large and costly central systems, these projects still provide the same benefits to the communities they serve. These new systems are of two principal types: the Ventilated Pit Latrines (VIP) in wide use in Africa and the pourflush latrine used in Asia. Far from being sanitation 'stop gap' technologies with short life expectancies, they are permanent, high-quality utilities. They correspond to the original design needs effectively, in that they economize in the use of scarce water, can be constructed with either low cost modern materials or local ones, are affordable now and can be installed almost at once, and are simple enough to be built by the people who use them.

2. UNDP and UNICEF Projects

2.1 The Government of India in the Ministry of Works and Housing decided (June 1979) that 110 towns (preferably with a population less than 100,000 000 and having water supply) be selected in the 7 states of Assam, Bihar, Gujarat, Maharashtra, Rajasthan, Tamil Nadu and Uttar Pradesh in the first instance for providing wherever possible low cost waterseal latrines with preparation of the Master Plan Reports including Preliminary Engineering and Feasibility Study for the 110 towns to the UNDP Global Project. The reports for all the seven States were completed in August, 1981. Encluraged by these studies, Government of India requested TAG(India) to prepare similar feasibility studies for another 101 towns in 14 States/Union Territories of the country under UNDP-India Project IND/81/014. TAG(India) completed these studies by May 1984. These two projects achieved the objective of developing a low cost solution to the problem of safe excreta disposal in the urban areas of the country. The demonstrated that the pourflush latrine with on-site disposal of human waste is an appropriate low cost technology.

2.2 UNICEF is currently providing substantial inputs to a Government of India sponsored project under the UNDP Umbrella (Project No.IND/84/016) to develop low cost sanitation technologies in the rural areas of the country. The Project begain in June, 1984, covers 3600 villages in 13 states and is executed by TAG(India) The Project will study the complex problems peculiar to the rural areas of the country: attitudes of the rural people to latrines vis-avis defecting in the open; institutional arrangements; delivery mechanisms; and affordability of the people which is considered very low in rural communities compared to the more affluent urban population.

3. The Low Cost Pourflush Latrine.

3.1 Pourflush waterseal leach pit latrines were first developed in India in the mid-1940s at the Singur field centre of the All India Institute of Hygiene and Public Health, Calcutta. In the mid-1950s the same system was adopted in the Research-cum-action Projects sponsored by Govt. of India (GOI) at Poonamallee (Madres), Najafgarh (DELHI) and Singur (Calcutta).

3.2 It was in the late 1950s that the WHO/UNICEF-sponsored project at the Planning, Research-cum-Action Institute at Lucknow, Uttar Pradesh which was supported by Govt. of India and the Govt. of Uttar Pradesh developed the design of the off-set system by placing the leach pit away from the latrine seat instead of underneath the squatting pan. The off-set system has the advantage that a second pit can be constructed before the pit in use becomes full; furthermore the squatting slab need not be removed, and a new latrine cubicle does not have to be constructed. Thus, the existing waterseal latrine can be used immediately after the first pit is full. The cover of the used leach pit is then transferred to the new one, and the used pit is covered with earth. This off-set system was also developed for rural areas; to save cost, the second pit and its cover were not provided in the first instance.

3.3 The design developed by TAG(India) for urban areas is based on the off-set leaching pit system with twin pits to be constructed at the same time, so that there is no later work involved in digging the second pit. TAG(India) developed the design and optimised it through several studies. TAG(India) was also instrumental in developing GRP and PVC squatting pans and HDPE traps.

4. Institutional, Financial, Social and Legal Aspects.

4.1 Past programmes of urban and rural sanitation in India have touched only the fringe of the problem. At the beginning of the International Drinking Water Supply and Sanitation Decade, only 27% of the urban and less than 1% of the rural population had access to sanitary latrine facilities. This does not mean that past programmes of sanitation have been failures. On the contrary, there are excellent examples of success both by Government and non-governmental agencies. Nevertheless, the multiplier effect of these programmes more in relation to the size of the problem and the needs is not in evidence. The Decade targets adopted by Central and State Governments to provide sanitary latrine facilities to 80% of the Urban and 25% of the rural population by 1990 do not seem to be anywhere near achievement.

4.2 This brings into focus some of the operational factors and issues which are crucial for a large programme. Some of the factors and issues are :

a) Political will and policy commitment

b) institutional and delivery aspects

c) financial arrangements

d) social marketing and

e) legal tools and instrumentalities.

4.3 It is apparent that political will and policy commi+tment for a large scale latrine construction programme have been inadequate, to put it mildly, in most States in India. Consequently, the outlays provided in the 6th Plan and expected in the 7th Plan (these two Plans encompass most of the Decade period) are meagre in relation to the requirements. Nonetheless, some are available from Government and semi-Government sources. Government of India's Ministry of Works and Housing has agreed to provide soft loans for low cost sanitation schemes under its programme for the integrated development of small and medium towns. Ministry of Home Affairs has launched a programme supported by grants for the conversion of insanitary bucket latrines into pourflush latrines with the objective of liberating scavengers from handling night soil. The Housing and Urban Development Corporation (HUDCO) and the Life Insurance Corporation of India (LIC) have funds available for sanitation schemes. State Governments like Andhra Pradesh, Tamil Nadu and Maharashtra have fair sized programmes of low cost sanitation.

4.4 Multi-lateral and biolateral agencies are showing growing interest in low cost sanitation. Low cost sanitation has been included in the World Bank assisted water supply and sanitation projects in Gujarat, Tamilnadu and Kerala, in the Bank assisted urban development projects in Kanpur and Madhya Pradesh and is proposed to be included in similar Bank assisted projects under consideration for Madhya Pradesh and Uttar Pradesh. The number of low cost sanitation units of TAG design installed all over India exceeds 1,25,000 and the total investment committed is of the order of Rs.113 crores from Govt. sources including Rs.55 crores in World Bank aided projects.

4.5 However, considerably more resources and policy commitments have to be made to break the back of the problem. Inclusion of Low Cost Sanitation in the 20-Point programme and launching of a Centrally sponsored programme on the lines of the accelerated rural water supply programme should give a fillip to sanitation efforts. Incorporation of latrine units compulsorily in housing schemes undertaken by Government, Housing and Urban Development Corporation, Life Insurance Corporation of India, General Insurance Corporation of India (GIC) etc. and in housing schemes of National Rural Employment Xxxxxxxx Programme (NREP), Rural Landless Employment Guarantee Programme (RLEGP) and the like would also go a long way in triggering off sanitation development.

4.6 For cost-effective use of available resources, the crucial aspects of implementation have to be considered. Several issues crop up at this stage. Sanitation schemes are historically the responsibility of local authorities both in the rural and urban areas. The local authorities have more direct contact with the people but their performance has been poor for several reasons most of which are well-known and documented to warrant repetition. State level organisations like PHEDs and Water Supply and Sanitation Boards are increasingly active in providing the basic services of water supply and sanitation. PHEDs and Boards have the expertise in engineering and technology. Low cost sanitation is not however entirely engineering or technology but is more a social programme reaching out to millions of households. The realities of programme implementation and the adequacies and inadequacies of different agencies involved in the sanitation sector should be recognised and counter-measures adopted if efficient sanitation programmes are to be launched on a mass scale. A division of responsibilities between the agencies involved - Local bodies, the State Directorates of Local Bodies, PHEDs/Boards - would be an obvious solution but then this pattern throws up the often intractable problem of coordinated and synchronised action on the part of agencies which are independent and operating under their own hierarchies and culture. More significantly, since LCS is basically a people's programme and requires effective and sustained communication with the people to change age-old attitudes, a new area of expertise- promotion, project support communications is crucial. It is doubtful whether any of these agencies possess the expertise needed in this area. Voluntary orgaisations have gained expertise in this area to a great extent but involving them in this aspect of a composite programme adds to the list of implementing agencies and further complicates the already serious coordination and management problems.

4.7 An equally important aspect of the programme will be the financial arrangements. To what extent can contributions from the people be expected ? It is likely that the better-off people can contribute but then most of them are prone to have latrine facilities already. The ability to contribute of the poorer groups consequently assumes importance. Surveys in a densely populated and relatively more "latrine conscious" State like Kerala show that the poor groups can contribute in the form of monthly instalments not exceeding Rs.10/-. An effective machinery for administration of loans and grants to the people and for recovery of small amounts in frequent instalments then needs to be installed. This raises the issue whether the local bodies or PHED can effect the recoveries and are adequately equipped for this operation.

4.8 In-kind contribution like offer of voluntary labour is considered possible from the poorer groups. But this again raises the issue of coordination and synchronised action. The experience of Shramdan in several States is anything but satisfactory. Besides, Shramdan complicates efforts at maintaining quality.

4.9 Providing legal backing to low cost sanitation schemes may not be much of a hurdle. Laws, rules and byelaws could be enacted and have been done in many States. The major hurdle, however, is enforcement.

4.10 Low cost sanitation has perhaps already sucessfully surmounted the technological problem - the technology has been researched, tested and proved. Extension of the technology requires political commitment and higher Plan priorities, backed by competent and sensitive institutional and management mechanisms;these seem to hold the key to translate the technology into efficient and successful field programmes.

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David Collett

The British water industry and the Water Decade: the experience of WaterAid

WaterAid came into being in 1981. It is a response by the British water industry to the 1980's Water Decade. Support - by the institutions and the employees of that industry - is the special feature which makes it a little different from other organisations. But WaterAid is not a subsidiary of the British water industry. From its inception it has been self-governing as a non-profit-making registered UK charity.

What was this new organisation created to do? Some people believed that it should be concerned simply with the climate of opinion in Britain. To disseminate information and to generate understanding about the needs which the Water Decade addresses might lead to a public opinion ready to support increased resources for the Decade (whether through its government or through voluntary contributions) and a water industry ready to lend its experience and its personnel to operational work, carried on by others, overseas.

But WaterAid decided that, though such development education is important, it is insufficient. What authority or experience would it bring to bear upon British opinion, if it was not itself engaged in practical work in the Third World? Indeed was there not a risk that it would pass to the British public the wrong messages? In particular it could fall into the trap of assuming that the solutions are largely those which Britain itself had been able to adopt at a time, some generations ago, of considerable industrially-based wealth.

And so the decision was taken, early in WaterAid's life, to become operational overseas as well as attempting to arouse concern in Britain for the Decade. But then two questions immediately arose. Could any significant resources be generated for this? And in what overseas circumstances should WaterAid respond to requests for its support? The answers to these two questions are of course inter-dependent, but they are best discussed consecutively in the next sections of this paper.

WATERAID IN UK

First, what support has been generated in UK? England and Wales have in all ten Water Authorities, each in its region responsible for the whole range of water and sanitation services. Between them they employ more than 50,000 people. Also there are 30 smaller Water Companies, concerned with water supply and not sanitation, and operating by agreement each in a part of one or other region. These Water Authorities and Companies have provided the UK framework for WaterAid's growth.

They have no legal power to give money, since this is collected wholly for services to their own rate-payers. Instead they provide valuable support in kind, such as free offices for WaterAid, and (more important still) they encourage the interest of their staff, and sometimes of their consumers too.

In 1982 each of the ten Water Authorities designated one senior member of its headquarters staff, who had volunteered for these extra duties, to become the focal point of all WaterAid activity in the region. These ten people have in the ensuing years developed each a network of anything from a dozen to a hundred WaterAid activists who, at divisional and workplace level, are a potent force both for development education and for fund-raising. Their efforts have been greatly helped by the vigorous co-operation of all of the industry's trade unions.

Slowly WaterAid's income has grown - from £25,000 in 1981-2 to £352,000 in the year ending last March. Present indications are that £750,000 will be raised in the year ending March 1986, and considerably more than £1,000,000 in 1987.

Almost entirely this is coming from voluntary sources. Several private-sector companies (for example manufacturers supplying the industry, and consulting engineers) have made donations. Small fund-raising initiatives by WaterAid activists are many and various: one young scientist from Thames Water took a week's leave for a sponsored run along the river's bank from its source to the sea; retirement gifts and wedding gifts are renounced, and collections held instead for WaterAid; ties and greeting cards have been sold; competitions with glamorous prizes have drawn in further people; and slowly WaterAid has become better known.

Supporters have also capitalised on their leisure-time membership of such as Rotary Clubs and churches. Several thousand talks and filmshows have now been given, contrasting the water services which most British people take for granted in their own homes, with the needs faced by the Water Decade - and suggesting what can be done to improve things. Films, tape-and-slide sets, publications and briefing notes are supplied to all regions for dissemination.

Early last year Wessex Water produced the first edition of an eight-page WaterAid newspaper called Oasis. This is now published twice a year, and distributed by the industry to each and every employee. It attempts further to inform and enthuse those who are seeking to engage the wider public in the concerns of the Decade.

The Wessex initiative concerning Oasis is illustrative of how a new organisation moves forward: a group of enthusiasts test out the viability of something which they want to do; the whole organisation then reviews the outcome and judges whether to implement on a national scale. Two other illustrations of this theme are worth recording.

Lotteries by payroll deduction. Following a pilot scheme run by Northumbrian Water in 1984, all ten regions now have a monthly WaterAid Lottery. The cost of a single share in it is ten pence a week or just over forty pence a month. The employee simply advises his or her pay office to deduct the cost of one or more shares regularly from pay until further notice. Attractive cash prizes are won each month. The net yield to WaterAid is above £100,000 a year.

Writing to the industry's consumers. The Water Authorities and Companies mail almost every household in Britain at least once a year with a water rates bill. North Surrey Water Company broke new ground in 1983 by enclosing a further leaflet explaining the Water Decade and inviting financial support for WaterAid. Several other Authorities and Companies have since taken the same step. Particularly where the consumer is allowed to make just one simplified payment by 'rounding-up' his water bill (the Authority or Company passing on the sum total of excess money to WaterAid) this is very simple and effective fund-raising. There are signs that up to five per cent of the population will so round-up, and this would yield several million pounds of income each year if eventually all ten regions approach their consumers in this way.

WATERAID OVERSEAS

Clearly the ground-swell of support described above was only going to come into being if people could see their efforts having some practical effect overseas. But what kind of practical effect? Without doubt there were some activities which would enthuse these potential supporters and some which would not. WaterAid's resources, now and in the future, are tiny compared with the multilateral and bilateral government donors. For it in a very small way to be doing work similar to theirs would not fire the imagination. An alternate approach was needed. And since WaterAid was based on the voluntary effort of concerned people, then a policy of supporting similarly concerned people overseas - through indigenous non-government organisations, women's movements, self-help committees and church groups - was attractive.

Projects of a human scale

So WaterAid opted from the outset for projects of a human scale, seeking to create basic improvements at points of acute need, and with those who would benefit directly involved in planning and execution. Now four years later, several hundred such micro projects have been supported, nearly always at a cost to WaterAid of less than £10 per person benefiting. Their range is predictable: hand-dug wells; the protection of springs; gravity-fed supplies to stand-pipes; the introduction of simple forms of non-water-borne sanitation; the rehabilitation of equipment and machinery out of commission through lack of spare parts; health education initiatives in schools and elsewhere. Credibility has demanded that in every case an independent person visit the proposed project, vouch for it to WaterAid, and subsequently monitor and report back on progress. Numerous engineers, doctors, teachers and aid officials have filled this role, acting as WaterAid's honorary assessors in places where it has no personnel of its own.

Small and informal organisations can often work in ways denied to bigger and more formal ones. Analysis by the World Bank's Technology Advisory Group clearly suggests that the ventilated improved privy, as developed through the Blair Laboratory in Zimbabwe, could sensibly be adapted for use in many other countries. But how can this wider dissemination occur? Partly perhaps it may happen through the actions of big organisations, including governments, setting up wide-ranging programmes. But change is at least as likely to occur through small groups of determined people as through governments. There is clearly a case for smaller organisations like WaterAid supporting such people - doctors concerned about their clinics, or teachers about their schools - in their efforts to test out the ventilated improved privy. This has happened in half a dozen different countries.

Such micro projects illustrate the potential of bottom-upwards development - through and by those who will benefit, rather than simply for them. Indeed I suggest that this is the essence of true development - increasing the capacity of the poor to change their own lives.

In the circumstances of the 1980s there is a further and more pragmatic reason for encouraging such bottom-upwards development. Governments throughout the Third World are greatly over-burdened. They are all the time struggling to do more than available resources will allow. Often their principal services have to be concentrated in the bigger centres of population. Yet hundreds of millions of those who are the concern of the Water Decade are dispersed in villages, hardly touched by public services.

Indigenous NGOs

From this WaterAid has concluded that it should be very ready to try to help increase the capacity of indigenous non-government organisations capable of multiplying this kind of bottom-upwards work in their own countries. Later this month I shall be talking with the committee of the principal women's organisation in Assam, the Assam Pradeshik Mahila Samittee (APMS). Over the last two years WaterAid has funded construction costs for twenty village wells undertaken by one or other member group of APMS. But could APMS now achieve a great deal more, if WaterAid could perhaps underwrite the appointment of specialist staff, and the transport and operating costs to make such staff effective?

In Africa this kind of institutional support often takes a different form. Shortage of skilled manpower leads to requests for British water engineers to be attached by WaterAid, so that the technical capacity of local organisations is increased. Of course such engineers must always play an on-the-job training role so that, sooner rather than later, they are no longer needed. This is proving to be another practical avenue through which goodwill among the people of Britain's water industry can be expressed. Currently WaterAid has engineers working with the development programmes of the church (in Ghana, Tanzania and Uganda),with a specialist water ngo (in Kenya) and with the government itself (in Sierra Leone).

In all of these cases WaterAid is committed to a programme extending over several years. But there are also instances where a shorter attachment is viable. In February and March an engineer will spend just six weeks visiting four hospitals run by the Baptist church of the River Zaire, drawing up detailed and costed proposals for basic water and sanitation improvements. WaterAid's role may then be complete. The Baptist church in other parts of the world is likely to provide the funding for implementation.

IMPLICATIONS

What are the main implications to be drawn from WaterAid's first few years? Engineers and other skilled people join the British water industry attracted by a public service ethos. But they come to realise that the great public health challenges in Britain were met by their grandfathers and great-grandfathers. Personally and professionally they are seeking a challenge and the Water Decade provides one. Is that why so many of them have the goodwill to lend their time and their experience to WaterAid? Could other of the world's richer countries start similar organisations and expect similar support? Could India's own water professionals start their own equivalent to WaterAid, whether focussed on needs in the poorer parts of their own country, or upon the many Third World countries which have not one tenth of India's skilled manpower or of its experience in simple and adaptive technology?

Any such new organisations might draw a few lessons from WaterAid's experience. They will need to be very clearly non-profit-making, and committed not to the selling of their own country's goods and services but to real development priorities as seen by poor communities and their governments. They will need sufficient humility to see themselves always as the minor partner in any work with which they associate, ensuring that the major partner - and hence the 'owner' of what results - is an indigenous organisation or group.

There is one final thing which others might draw from WaterAid's experience. It is this. There are many millions of human beings on this planet who despair of the failure of governments to resolve the world's most fundamental problems. Offered a channel through which they can help overcome some of those fundamental problems - and the Water Decade is clearly concerned with one of them - hundreds and then thousands of those people will come forward and play their part.

12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

P Wan

Strategies for sanitation - collaboration in India

1. INTRODUCTION

The unacceptably high infant and child mortality rates in India, particularly in rural areas, is a matter of concern. The national averages are 120 and 15 per 1000 births respectively. It is widely accepted that the improvement of sanitation is a necessary intervention to reduce the high sickness load and loss of life. The Government of India has set an objective of achieving 25 percent and 80 percent sanitation coverage in the rural and urban sectors respectively by the end of the decade. In its collaborative efforts, over the past three years, with the Government of India (GOI) to fulfill its objectives, UNICEF has made some encouraging headway particularly in raising awareness at national level. This has resulted in favourable response by policy makers and functionaries as well as of the community. The objective of this paper is to outline some strategies UNICEF has adopted in the promotion of sanitation and to relate some of the experiences gained.

2. APPROACHES FOR PROMOTION OF SANITATION

Against a background of massive poverty, high illiteracy and a lack of awareness, the interaction of sanitation activities with other developmental inputs, such as preventing diseases of children by immunizing them, early childhood education and income generation is necessary. Improvement of sanitation involves largely behavioural change through a change in attitude; hence, education, improved awareness and higher incomes are desirable change agents.

2.1 Sanitation as a Comprehensive Package

Sanitation is quite often misinterpreted as sanitary latrine *per se*. No doubt, exposed excreta as a result of open defecation, which is the rule rather than the exception, particularly in rural India, is the major source of disease transmission. However, behavioural change related to personal hygiene, food sanitation, home sanitation etc. are equally important to break the cycle of disease transmission. Hence, a comprehensive sanitation package emphasising on education and including wastewater and garbage disposal as well as smokeless chulhas (stoves) is promoted.

2.2 Target

Our focus is on the improvement of sanitation at child-related institutions in addition to individual households. In India, the vast network of primary schools and anganwadis (nurseries) catering for an estimated 70 million children offers a ready-made infrastructure to educate them and mould their habits. According to a 1982 survey (1), only 10 and 55 per cent of the rural and urban primary schools have any sanitary facilities. The coverage at the anganwadi centres is practically nil.

Sanitation activities benefitting individual households are integrated with water supply and other developmental schemes in order to maximise the various inputs aimed at raising the level of awareness through education and other social activities. In addition, sanitation in new housing schemes, combining the provision of a sanitary latrine with sanitation education is being promoted since a change in surroundings enhances the willingness of the new occupants to give up the age-old habit of open defecation.

The Primary Health Centres or Subcentres are also suitable institutions visited by large numbers of people. Schemes for the construction of sanitary latrines for usage by visitors and to serve as demonstrational units are being initiated.

UNICEF is currently supporting a rural feasibility study spread over thirteen states incorporating the construction of some 37,000 sanitary latrines. The study, which is due for completion in April 1986, is designed to assist the various state governments to promote sanitation programmes up to the end of the decade and further.

2.3 Education & Community Participation

There is a Chinese proverb which says, "If you plan for a day, sow rice; if you plan for a decade, grow trees; if you plan for a lifetime, educate the people." Improvement of sanitation which basically involves behavioural change should be seen as a long-term objective; hence education of the target group is of prime consideration.

In the context of sanitation schemes in primary schools and anganwadi centres, two-day orientation is imparted to headmasters, teachers, supervisors and anganwadi workers to strengthen their capability to improve sanitary practices of children, as well as to reach out to the community. In the household schemes, motivators from the community, such as youth club members, village leaders, teachers, etc. are given two-day orientation courses, supported by education materials, to equip them better for creating awareness and enlisting people's participation in the projects. A range of education materials including audio-visuals and booklets have been produced for advocacy as well as field application.

2.4 Technology

In a society in which forty percent of the people are reported to be living at or near poverty levels, the appropriate technology has invariably to be low-cost. The on-site excreta disposal system based on the pour-flush waterseal latrine having two pits used alternately is gaining wide acceptance by people using water for anal cleaning; in north-eastern states where solid material is used, the ventilated improved pit latrines are being promoted.

Soakage and garbage pits to dispose of wastewater and garbage respectively are introduced to improve the environment. Where appropriate, wastewater is discharged into vegetable plots. Simple bathing platforms attached to a soakage pit and provided with enclosures made of locally available material are promoted. The construction of smokeless chulhas made of earth and fitted with a pipe and minor accessories to eliminate the hazards of smoke are also being supported. The know-how on these simple technologies are transferred to the village level by imparting systematic training to the motivators and local masons.

Emphasis is placed on inculcating sanitary habits like hand-washing with soap after latrine usage and before handling foods, proper storage of water, food sanitation, etc. These interventions incur barely any cost and yet are highly effective in breaking the cycle of diseases.

2.5 Infrastructure Building

The weak infrastructure, both in support of sanitation education and of programme formulation through-to implementation, is a major constraint. In several states, we are advising and assisting in the building of this cadre of socio-technocrats through training programmes. Our focus is to forge a closer and more meaningful link between the educational and physical implementation. Closer collaboration between health and engineering departments is emerging.

Good non-governmental agencies are also being encouraged to incorporate sanitation as part of their developmental field activities. Business houses and the Scouts and Guides movements are beginning to promote sanitation.

3. EXPERIENCES

The response of the anganwadi and primary school staff on sanitation orientation has been promising, resulting in improved sanitation at these institutions. Where sanitary latrines have been constructed as part of the sanitation scheme, the usage and maintenance of the units at the anganwadi centres were good, while the response at the schools was somewhat mixed. The misuse of some school latrines by villagers nearby and the lack of motivation by some headmasters are constraints. The use of motivators, consisting mostly of village volunteers, to create public awareness has been quite encouraging although in a few cases the enthusiasm has decreased after the initial eagerness. This is partly a result of the lack of continued support by the implementing agency such as the slowing down of activities and poor workmanship leading to dissatisfaction among the intended beneficiaries.

Over the past three years, over 15,000 sanitary latrines including those at child-related institutions have been constructed with UNICEF assistance. The response to the construction and use of sanitary latrines has in general been good. Evaluations have indicated a level of usage exceeding 90 percent in some project areas. In a few cases, the initial response was, however, as low as 40-50 percent. In the latter case, the basic weakness has been the wrong and arbitrary selection of beneficiaries. The quality of work executed by the implementing agency, such as uncompleted work and poor workmanship, has also a significant bearing on the attitude of the beneficiaries in using the units.

Our experiences, drawn largely from the rural projects, show that the level of usage of sanitary latrines is not correlated with the level of education. This is supported by the variable usage level observed among high-literacy groups in Kerala, as well as the significantly higher usage by tribal communities compared to the more educated non-tribal population in Orissa. The interest in possessing a latrine does not vary significantly between lower and higher income groups. Women form the larger part of the user-population. The indication so far implies that the change of habits is brought about largely from self-motivation based primarily on the advantages of privacy and convenience.

The construction of garbage pits, soakage pits, bathing cubicles, simple drains, and smokeless chulhas is gaining momentum, particularly where the role of motivators and the implementing agencies are good. These facilities are being stressed as they are essentially do-it-yourself technologies and are very low cost.

The home chlorination of drinking water at a project area in West Bengal has demonstrated that childhood gastroenteric diseases can be reduced by as much as 80 percent over a 12-month period. This intervention is being supported where safe drinking water supplies are not yet available, and villagers draw their water from unprotected sources.

4. ANALYSIS OF CONSTRAINTS

The limited fund allocation at the Central and State levels consequent to low priority given to sanitation leads to inadequate infrastructure for developing and implementing sanitation schemes. This remains the major constraint. Lately some states have strengthened their capability for formulating, implementing and monitoring sanitation projects as well as to raise public consciousness on sanitation.

In an effort to stimulate and expand sanitation acitivities in the field, we are collaborating with non-governmental agencies to incorporate sanitation in their rural development schemes. The linkage between educating the project population and the physical implementation requires strengthening. Potential sanitation resources teams are given training with the objective of building up larger resources for training and orientation of village level motivators.

Besides low income, poor literacy, and sanitation not being the felt-need, a lack of financial subsidies compounds the difficulties to promote sanitation. The need for a large section of the population to generate its own resources has to be fulfilled if sanitation is to be propogated on a significant scale. UNICEF is initiating schemes on a demonstrational basis, aimed at the better-off groups, in which local masons are trained and either the beneficiaries can draw loans from a revolving fund or have to meet the whole cost of sanitary facilities.

5. CONCLUSION

For the last three years, our efforts have been directed at evolving a strategy to promote sanitation, in order to reduce infant and child mortality and morbidity rates. In statistical terms, our achievement is a drop in the ocean in the Indian context. However, seen against a background of long neglect, lack of funds, poor infrastructure and low awareness, the concerted effort can be compared to the germination of a seed. The encouraging response by many states and non-governmental agencies is expected to contribute and take the country closer to the goal which has been set for this decade.

REFERENCES

1. Fourth All India Educational Survey, publication by NCERT, India, 1982

Plenary Session 1

Chairman: Mr P Purnell-Edwards
Co-Chairman: Mr G Ahmed

Discussion

Professor J A Pickford OBE

Keynote address

1. Professor PICKFORD began the first plenary session of the conference by stressing the four points required to help the poorest people gain the benefits of the Decade. These were the need to use low cost technology with appropriate attention to operation and maintenance and participative community involvement along with appropriate administration.

H van Damme

People's Water and Sanitation Decade

2. Mr VAN DAMME stressed that people have to be involved in the planning and organisation of water supply and sanitation schemes from the beginning. Institutional development and the coordination of external funds to projects were important components but what matters for the decade is the people. Community participation to be successful required human resources development, full involvement of the people at all stages as partners, also with partnership responsibilities for finance and full recognition of the role of women.

3. Mr KARKI asked whether the author thought donors were really interested to help developing countries to meet their decade goal. He also commented that we are lacking behind to achieve decade goal but how can we meet the target, have you got any solution?

4. Mr VAN DAMME believed that donors generally wanted to help; several have certain conditions however.

5. Mr SEROO asked if any study has been made by the author about:-
(i) Total investment required worldwide for attaining 100% coverage of Water and Sanitation Decade.
(ii) Countrywise and donorwise resources being raised.
(iii) The resources gap.
What are his views about the same and his solutions.

6(i)Mr VAN DAMME replied that earlier studies on investment were done by both WHO and World Bank.
(ii)This information is generally available, but not altogether in summarised form. The 'Decade catalogue' (WHO) contains some of it.
(iii)There is some country by country information available, but not comprehensively published. Some data can be found in UN and WHO documents.

There is great dependence on approaches taken and technologies used. One important other aspect is maintenance, which, if properly conducted could lead to meaningful savings. The question cannot easily be answered within a few minutes, but the meeting certainly will give some answers.

R W A Franceys

Handpumps or reticulation systems

7. Mr FRANCEYS emphasised the point that engineers have to consider all possibilities when designing water supply schemes. With the use of figures from the Terai region of Nepal he showed how a better quality of water supply could be provided at up to half the cost of a conventionally engineered solution. However engineers have to be prepared to share their power and responsibility with others in order to make this possible.

8. Mr LLOYD commented that no attention was given to the different levels of utility benefits from handpumps and reticulation systems e.g. per capita water consumption will differ. Were financial constraints so tight that cost/benefit ratio was inappropriate or was cost/benefit ratio still weighted in favour of handpumps? Mr LLOYD also said that hand pumps can be upgraded to give the same level of service as reticulation e.g. by installing pump and storage tank or in-line electric pump. How did costs of two systems compare when benefits were equal? Reticulation has the potential to give greater equity among consumers, especially with falling water table and different aquifer characteristics in different areas. Some areas will experience difficulties while others may not. This will also be true for a reticulation system which has breakdowns.

9. Mr FRANCEYS replied that because the two systems under consideration were assumed to give the same benefits, that is the same design criteria of supply, a Least Cost Analysis was considered sufficient for this case. The author agreed that hand pump systems could easily be upgraded for the more affluent households and believed that this method would still show a considerable economic benefit over a centralised reticulation system as well as giving a better quality and more reliable supply.

10. Mr PARAMASIVAM asked how exactly some of the intangible factors like consumers' convenience, time and energy spent on collection of water have been accounted for when comparing the costs between the two systems?

11. Mr FRANCEYS suggested that because the main comparison was between a majority of the people drawing water from a standpost or a handpump, the significant intangible was in the pumping of the water. However this was offset by the 24 hr availability of handpump water whilst the standposts were only operating for 4 hr per day.

12. Mr GUPTA observed that the paper presents an appropriate strategy to meet the water supply needs of people in developing situations. The solution of 'Handpump' method has to be applied in the field on the basis of location-specific parameters and type of housing scheme in which the system is to be used. Any method of water supply for cost-benefits should be analysed as an integral part of a housing development. The appropriateness of a particular technology option will depend on the nature of housing and quality of life aimed at.

13. Mr MIR commented that the learned author has to keep limitations of geological formations in mind whilst advocating handpump technology and will he kindly comment on this. Mr MIR also asked about the operation of hand pumps in sub-zero atmospheres.

14. Mr FRANCEYS agreed that the results given were from a specific area and that different geological conditions would lead to different technological solutions. However he stressed the need to consider all available options in all cases as in the area studied the most economical solution was being ignored. The author was unable to comment on the operation of hand pumps in sub-zero temperatures but was later told that for deep lift pumps a very small hole in the riser main provided a satisfactory solution to the problem of freezing.

15. Dr NAG asked whether indiscriminate sinking of handpumps causes depletion of underground water layers or sinking of soil layers? He also asked whether there are any calculations as to how many shallow tubewells can be sunk in a definite area and how much water can be extracted per day?

16. Mr FRANCEYS replied that use of handpumps for domestic water supply did not appear to cause any difficulties with depletion of ground water levels. He understood that it was abstraction of water for irrigation purposes that led to problems. With regard to calculating available groundwater, there are well known techniques and theories for estimating potential abstraction.

17. Mr DAYAL commented that handpumps cannot work in all types of geohydrological conditions. This is only a typical example.

18. Mr FRANCEYS agreed that there were a very limited number of situations where handpumps could not be used but made the point that what was required from designers was the willingness to consider all available options rather than just the conventional approach which engineers had become comfortable with.

19. Mr SHARMA noticed that one speaker has remarked that "handpumps fall out in three years for want of maintenance". The other says that he found handpumps very easy for maintenance at the villagers' level. The two statements are rather contradictory. What is the basis that the author finds handpumps "really" easy to maintain by villagers. Mr SHARMA also wondered whether the author had taken into account the cost of drainage facilities around the handpump.

20. Mr FRANCEYS appreciated the importance of the question as he also had had experience of the difficulties sometimes involved in pump maintenance. However in this particular situation, the Bangladesh No. 6 pump in use was a suction pump where all moving parts were readily accessible at ground level. The spare parts required were also available in the local shops and therefore the author believed that these pumps were suitable for maintenance by community participation. Regarding the cost of drainage facilities around the handpump the author stated that this had been included as had also the cost of drainage for the standposts.

21. Mr MISRA observed that in a state like Rajasthan (India), the conglomeration of geological formations, geographical variations and climatological extremities, the water considered potable once, deteriorates in due course of time. Reasons are several viz the water is available as a floating lense in extremely arid regions supported on saline water, the alkalinisation leads to the influx of high fluoride concentration, mineralisation leads to the rise of nitrate concentration in water. What should be the best application to provide water to rural public in such situations, keeping in view the provisions of handpumps? The pockets of potable water are scarce and scattered.

22. Mr FRANCEYS was unable to comment on the particular requirements of Rajasthan. With the difficulties mentioned it could well be that a least cost analysis would show that handpumps are not the most suitable answer for domestic water supply.

23. Mr MAJUNDAR commented that when the question of providing protected water supply to people in such areas is considered, handpump is the ideal solution because with the funds available no alternatives can be thought out. But it can't be the final goal which, I think, should be pure water supply. Reasons are:- Tube wells are scattered all over the rural areas. These have to be maintained. But for some minor defects in the pumps often the tube wells remain out of commission. In the state of West Bengal having more than 100 000 tube wells in rural areas there is a regular programme for repairing of these tube wells. Under the jurisdiction of every police station (population 50,000) there are two repairing squads each with a mechanic and a helper. They go round from village to village in a roster and complete their area in three to four weeks. Thus any village does not get the service of this squad for the next two to three weeks after they visit once. Thus a large portion of tube wells remain out of commission at any time. I think the village consumers should be trained to attend to the tube wells when they go out of order.

24. Mr KARKI observed that community participation for maintenance and operation of handpumps is a most important factor, so you have to consider this point. Training for local maintenance workers is also an important factor.

25. Mr FRANCEYS agreed that where power over the water supply was devolved to the people, it was vital that they should be encouraged to participate in all aspects of operation and maintenance and that training must be provided where necessary.

26. Mr TALBOT asked whether the quality of water was compared between the reticulation schemes and handpumps i.e. did the handpumps supply potable water?

27. Mr FRANCEYS replied that the quality of water was not measured in this study. However the author believed that because of the intermittent supply in the reticulation system the quality of the handpump water would be superior to the water drawn from standposts.

28. Mr SARIATULLAH enquired about possible pollution in handpumps, if any, particularly with relation to closeness of low cost or open latrines.

29. Mr FRANCEYS replied that in this situation the water was being drawn from a confined aquifer at a depth of 30 metres and he believed that low cost latrines would not pose any problems. In general the author felt that where the standard criteria were used for spacing of latrines and handpumps there should not be any difficulties. However if the 'ultimate standard' of household handpumps was used alongside low cost sanitation then special care would have to be taken to ensure against pollution.

30. Mr BARMAN asked whether in the case of rural and low cost technology, handpumps made of bamboo were useful to the poorest people in the rural areas from the engineering point of view when accompanying UNICEF handpumps?

31. Mr FRANCEYS felt that all appropriate technologies should be considered and that a simple, cheap bamboo pump could be extremely useful in complementing the cast iron handpumps.

32. Mr CHOUDHURI commented that in Calcutta city we have street-side stand posts and handpump operated tube wells. Due to pilferage of taps, the standpipes waste water. In this context what is the view of Mr FRANCEYS on whether to go in for more standpipes or to go in for handpump operated tube wells in Calcutta?

33. Mr FRANCEYS felt that when conventional standposts wasted so much water the handpumps were a very useful alternative. He had been impressed during his short stay in Calcutta as to the number of handpumps that were available for domestic water use.

K Biswas

Low cost on-site excreta disposal

34. Mr BISWAS introduced the work of the Technology Advisory Group in providing technical assistance to the development of low cost sanitation projects.

35. Mr MIR commented that there were two constraints in low cost pour-flush latrines. One is that the high water table does not allow the leach pit to function efficiently and the other is the freezing of water seals in subzero temperatures.

36. Mr PARAMASIVAM asked what kind of sanitation system would be recommended in thickly populated hilly urban areas like Simla, hard rock areas and areas with high groundwater table which were liable to flooding during the rainy season?

37. Mr GHOLUP XEN commented that as land is very costly in thickly populated areas, is it feasible to implement low-cost sanitation for such urban populations?

38. Mr SARIATULLAH suggested that it would be helpful if the TAG Group appraised a completed Low Cost Sanitation Project in India with

particular reference to operation, maintenance and monitoring.

39. Mr BHARDWAJ commented that an integration of efforts of State PHED, Rural Development Dept, and Non Governmental Organisations providing the technical infrastructure, linking it with other development works and mobilising changes in attitudes of beneficiaries respectively, would be an ideal approach in providing low cost sanitary facilities in rural areas.

D Collett

Water Aid

40. Mr COLLETT explained the work of Water Aid and its growth in income and people's awareness of its aims. He stressed the organisation's desire to be involved in practical projects in developing countries. These had to be of a scale and nature that individual donors in UK could understand and relate to. He concluded with the challenge that countries such as India might also consider starting their own version of Water Aid.

41. Mr SHARMA commented that we have been talking all through about neglect of maintenance of water supply schemes. If more and more private connections could be promoted, the water-supply schemes would be financially better, self-supporting, and will indirectly also help the poorest as they would get an adequate quantity of water due to less wastage. Could therefore Water Aid help finance the capital investment on private connections in existing water supply schemes for those who may be prepared to pay the water charges but cannot foot the initial connection bill.

42. Mr COLLETT replied in the negative. There are many needs in the Water Decade and Water Aid can assist in meeting only a very few of them. Water Aid's money comes from voluntary donations by ordinary people. They expect us to spend that money directly on schemes which benefit the very poor.

43. Mr PARAMASIVAM asked what kind of pre-investment studies, if any, are carried out, before aid is made available to a project/receiving agency?

44. Mr COLLETT replied that most of Water Aid's grants are small, and considerable expense on pre-investment studies would not be justified. But there are various criteria which are always used in judging which organisations to work with. We base such decisions on on-the-spot discussion, not just correspondence. And when we are considering a non-specialist organisation such as a women's movement, we are quite influenced by how effectively they have worked in the past in other (non-water) sectors.

45. Mr HUGMAN pointed out that the British water industry has a well developed training programme. Would Mr COLLETT discuss how the facilities and experience of this programme could be applied to water industries in other countries. He also commented that Water Aid supports small projects implemented by NGOs. In Papua, New Guinea the proliferation of different organisations installing small water supplies has made the organisation of maintenance services very difficult. How is Water Aid ensuring that the projects they support are adequately maintained?

46. Mr COLLETT answered that W.I.T.A.(the Water Industry Training Association) can be contacted at 1 Queen Anne's Gate, London SW1. It is the specialist water industry body concerned with training - in Britain and overseas.

47. Mr COLLETT replied to the second part of the question by asking , could not Papua, New Guinea ask a national N.G.O. to coordinate and (where appropriate) standardise procedures? Should not those who are responsible for maintenance get together with those NGOs and welcome their initiation, but explain the problem of maintenance and encourage cooperation?

P Wan

Strategies for sanitation

48. Mr WAN outlined UNICEF's approach to the promotion of sanitation in India. The weakness of programme infrastructure was a constraint but closer collaboration was bringing results. People were self-motivated to change their sanitation habits through a desire for privacy and convenience. UNICEF was initiating schemes on a demonstrational basis in order to propagate sanitation for the majority.

49. Mr PARAMASIVAM said that the success of NGOs in water and sanitation programmes is mainly due to absence of 'rigid' rules and procedures that go with government agencies? Would you comment?

50. Mr WAN agreed. He also said that NGOs can afford to experiment on alternative strategies; they have the added advantage that any shortcomings can be remedied readily as they are in close contact with the community concerned. However the government "cannot" afford to fail - hence the rigidity in their approach. With a new venture such as sanitation, government departments should be

convinced to be more flexible and be open to considering various viable alternatives. The government would naturally have to play a leading role if sanitation coverage is to be realised on a significant scale.

51. Mr SARIATULLAH commented that in Bangladesh UNICEF has been supporting single pit waterseal latrines under "Rural Sanitation Programme". In rural areas sweepers are not available to empty the pit when filled up. As such users again go for open defecation, do you think UNICEF can adopt TAG-promoted twin pit latrines?

52. Mr WAN replied that in India UNICEF is promoting the two-pit system in order to do away with the handling of raw excreta by scavengers.

53. Mr KARKI asked whether the author had investigated the cleaning of the alternative pit after filling it? Can that disposal be used for farm manure?

54. Mr WAN answered that in several parts of India, the two-pit system has been in operation for long enough to require emptying of pits. The pit contents are either being used by the latrine owner as fertiliser or sold to farmers as manure.

55. Mr ADHYA commented on the use of latrines and latrine follow-up programmes.

56. Mr WAN said that the response of the community has been on the whole quite encouraging as far as latrine usage is concerned, considered against a background of long neglect and poor awareness. The main reason for using a latrine is privacy, and women are the main users. Relevant information to users on usage and maintenance is essential.

57. Mr DHAR believed that a rural sanitation programme with whatever low cost unit, will not be successful if it is not simultaneously supported with provision for useable water for ablution, which is not there in many villages in India.

58. Mr WAN agreed, unless the direct pit latrine is promoted. However, in India, except in some of the North-eastern states, the waterseal latrine is being favoured. The pour-flush system requires only 2-3 litres of water for flushing. Presently, the water programme is far ahead of the sanitation activities and hence a large section of the population do have adequate water supplies but no sanitation facilities at all.

59. Mr PAHILAJANI asked, with reference to the survey study on usage and literacy, whether any information is available as to why literate people in Kerala do not use the sanitation facilities available for them.

60. Mr WAN said that many literate people do use latrines. However it is true that some literate people being provided with latrines , do not use them or give up after a short while, probably because of the reluctance in changing age-old habit of open defecation.

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

A Mitra

Motivation in rural sanitation

INTRODUCTION

This paper attempts to record a few observations based on field experience ofmotivating the rural population to accept and adopt rural sanitation projects in West Bengal. It has particular reference to training and motivating of communities to accept and adopt the pour flush twopit sanitary latrine construction programmes such as the Feasibility Study Programmes of the UNICEF/UNDP/GOI (Govt. of India).

GOVERNMENT RURAL SANITATION PROGRAMMES

The Background

In 1983, the Public Health Engineering Department (PHED), West Bengal, began a rural sanitation programme i.e. the construction of the pour flush two-pit sanitary latrines in households. Over 3000 sanitary latrines were constructed in 1983-84 in four districts.

The latrines were constructed upto plinth level by the PHED in each selected household and the full cost was borne by the government. The beneficiaries had to construct the super-structure from their own resources.

New Programmes

The eagerness shown by the villagers encouraged the PHED to take up the UNICEF/UNDP/GOI sponsored Feasibility Study in low-cost rural sanitary latrine in West Bengal, which is currently being implemented in 5 districts, covering 350 villages.

The PHED will construct latrines in 300 villages. The All India Institute of Hygiene and Public Health and the Women's Co-ordinating Council (WCC), a voluntary agency, will each construct latrines in 25 villages to give a wider scope for study.

The WCC, a women's voluntary agency co-ordinating 80 voluntary organisations in West Bengal, has also been entrusted with promotional and communication support activities. This includes organising orientation/training programmes with the help of the PHED, for all functionaries connected with the programmes at state level, district level, block level and village level; — programmes devised to counteract some typical problems during the implementation of sanitation projects resulting from lack of adequate education and communication, particularly at village level.

Programmes
at
District Level

Integrated approach

It is important to motivate and ensure at all levels the participation of the Departments of Health Social Welfare, Rural Development, Education, Mass Media, the Panchayats and the community level workers, besides the beneficiaries themselves and voluntary organisations.

The personal involvement of senior engineers of the PHED and Govt. officials, the departments of Health, Social Welfare, Education, Panchayat, Rural Development, District Magistrates, Block Development Officers ensures the success of education/training campaigns.

At District and Block Level Programmes and Village Level Education/Training Camps we have found that motivated senior officials and leaders have offered to allocate funds for sanitation in their budget and extended all co-operation for sanitation programmes.

Block Medical Officer assists training

An integrated health, hygiene, water and sanitation programme would yield the best results in motivating the village community, raise the health status and improve the quality of life.

Social Welfare Department

The Social Welfare Department of West Bengal had also taken up schemes in ICDS (Integrated Child Development Scheme) Blocks in several districts for construction of the pour flush two-pit latrines in village Anganwadi Centres, with UNICEF support.

These latrines in institutions will be effective as demonstration units, for familiarising and training the community, particularly mothers and children, in the use and maintenance of latrines and for motivaing the community to adopt health and sanitaion measures.

The programme is being implemented through four voluntary organisations - The Ramakrishna Mission, Loke Siksha Parishad, Women's co-ordinating Council, Gram Seva Sangha, J.P. Institute of Social Change.

VOLUNTARY ORGANISATIONS

Voluntary agencies have many decades of field experience. They are now co-ordinating with the Government, local bodies and other N.G.O.'s to develop integrated well designed, but flexible, programmes making maximum use of locally available resources, community participation and involvement of women at all levels of education, training and implementation.

Voluntary agencies have an important role as feed-back mechanism, if trained in simple systems of monitoring and evaluation, utilising the services of village mahila mandals, youth clubs and community level workers.

EDUCATION AND TRAINING

Health

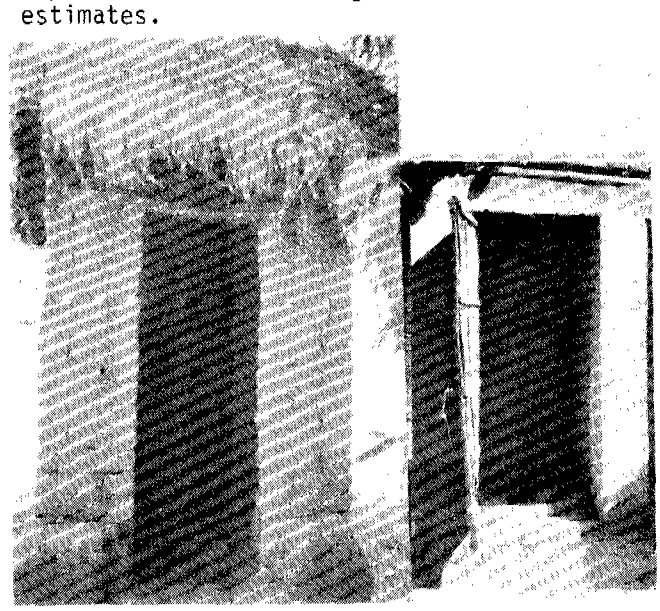
Health, hygiene and environmental sanitation education is an essential component of any rural sanitation project. Ideally a concurrent basic medical car input for children at regular intervals — perhaps through medical camps — could both educate and motivate active participation of the village community, particularly the women. It can also be the means of monitoring programmes.

A greater awareness and knowledge of health hazards related to open defacation motivates acceptance of sanitation programmes.

Simple technology

Education through visual aids in rural sanitation should include other aspects such as water pollution i.e. pollution of the ponds, wells, tubewells, construction of low-cost or no-cost soak pits and drainage systems, garbage disposal systems, home sanitation, personal hygiene, vector control etc.

Simple technology for self help, should form a part of education such as soak-pits , garbage disposal systems, construction of tubewell platforms, latrine design, construction site selection, super-structure designs and cost estimates.



Training

It is necessary to familiaries not only the village community but all personnel connected with the department of health, education, rural development, Panchayat, youth clubs, mahila samity's, school teachers, sanitary Inspectors, Gram Sevikas, ICDS project workers, ANM's, local doctors, with the simple message relating to the above subjects.

Village motivators can be drawn from among the community health workers, anganwadi workers, mahila samity members, youth club representatives, school teachers, and villagers who may be popular for their community service.

Men and women motivator's training

Education/training programme for village masons are very effective as they can become motivators and educators also. Government, contractors, supervisors, and other field personnel should be participants at education and training programmes.

In-field training should be given to village motivators to build up an infrastructure for community based programmes.

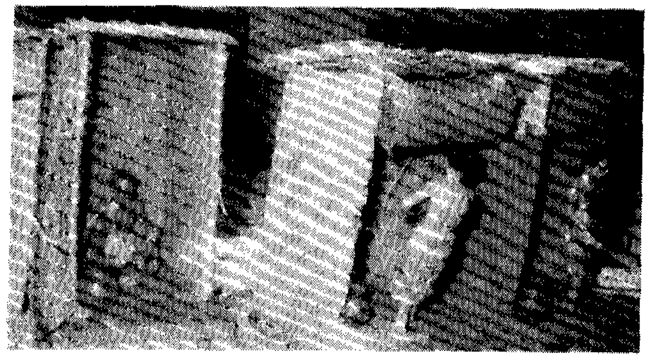
It is important that education/communicators are well trained to build up a rapport with people of different areas.

A simple system of monitoring should be built into the education training and motivation programme. A few simple questions should be asked to evaluate the effectiveness of the education and promotional campaign.

Group discussions and village camps are effective for education and motivation, however, house-to-house visits by communicators and motivators are essential to gauge the extent to which education has resulted in practice. In a household latrine construction scheme it is important to motivate the householder to construct the super structure, which is at their own expense, and ensure that it is used and maintained.

Communication Techniques

Various communication techniques can be used to sustain the interest of the village community. It has been found that the technical aspects of the two-pit latrine i.e. construction, design, use, maintenance, construction of different types of super structures etc. can be best explained through clay models, wooden blocks, posters, flip cards, photographs, slides etc.



Models on superstructures, use & maintenance

Video shows would be very effective media if voluntary agencies engaged in education campaign could have access to it. Mobile education units i.e. vans equipped with audio visual education material will be the most effective way of educating and motivating the maximum number at the minimum per capita cost. (WCC organise mini exibitions at all education/training camps).

Clay models on water polution

Education and motivation of community participation can be achieved through demostration of low-cost or no-cost environmental sanitation measures, such as, the soakage pit which can often be constructed with material lying around the villages, as we have done during a training programme for our communicators by UNICEF/TAG.

Demonstration of diarrhoeal management measures *such as the ORT which must* be incorporated into rural sanitation - education and training programmes, also has an immediate impact.

Slides showing enlarged pictures of hookworms, tape worms, round works, etc. in the human body and its relation to open defacation are effective.

The priorities of both men and women have to be gauged to assess which subject will be an effective entry point. Broadly, child health, water supply and other daily domestic problems are the starting points, but approaches are to be developed after assessing local interests and concerns.

Motivation of Women

The importante of the role of women as planners, trainers, educators and active participants in health and sanitation programmes has now been recognised. However, achieving the involvement of rural women in development programmes is a difficult tast.

It has been found that village women are largely reticent in involving themselves with matters of a technical nature and it is here that women voluntary workers are able to draw them out and explain to them the benefits of simple sanitary technology.

One of the objectives of WCC is to design, test and demonstrate techniques of motivating rural communities, specially women, to participate in community based health and sanitation programmes.

In order to motivate women's participation in sanitation programmes it is necessary to involve women in planning, education and motivation at all levels.

Much of the responsibility of maintaining home and environmental sanitation rests on women. Initially it is necessary to involve a number of women communicators who can train women motivators at village levels.

Women construct temporary super-structure

Over motivation of village communities

In latrine construction programme the degree of motivation to be achieved should be very carefully balanced with the available resources such as funds, material resources etc. Demand for latrines may be so far in excess that it becomes an obstacle in the efficient and smooth implementation of the programme. Unfulfilled commitments can be a detriment to the entire programme.

Motivating village communities for better health, hygiene, and no-cost or very low-cost environmental sanitation should be taken up on a massive scale.

CONCLUSION

In subsidised domestic latrine construction programmes it is very important to motivate the family to construct the super-structure immediately and they should be educated on various low cost or even no cost super-structure designs. Ideally the putting-up of the latrine super-structure and its use should be simultaneous and a system of monitoring is needed to ensure that the latrines are kept clean and well maintained.

Large amount of funds are required for meeting the targets of rural latrine construction but it is equally, if not more, important to create an infrastructure for education/training at all levels, particularly at village level for motivating the community to develop a higher standard of health, hygiene, home and environmental sanitation which is culturally acceptable and appropriate for them.

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

H R Paqui

Women's involvement in the Decade

INTRODUCTION

Integration of women in development has become a buzz phrase in recent times such that few programme officers draw up a project proposal without appending a token sentence, sometimes even a paragraph, regarding the importance of women in a given development project. While this procedure might satisfy the reviewing officer so that funding for the proposed project is approved, it certainly does not solve the critical issue of lack of women's effective involvements in programmes intended to benefit them. Time and again, this neglect has rendered many a development project more costly and less successful.

The International Drinking Water Supply and Sanitation Decade (1981-1990) which seeks to bring safe water and adequate sanitation to the world's poor majority, and which overlapped the United Nations Decade for Women (1976-1985), provides a great deal of scope for moving from rhetoric into concrete action, to mobilize women for effective involvement in development.

Recognizing the mutually supportive benefits of the success of the Decade on women's roles and of the women's roles on the success of the Decade, the 1980 World Conference of the UN Decade for Women adopted a strong resolution mandating "Member States, UN agencies, including specialised agencies, to promote full participation of women in planning, implementation and application of technology for water projects."

Subsequently, several public and private initiatives have been taken at the community, national and international levels, to help meet this challenge. These range from adoption of policy to enhance women's involvement and creation of a special task force of the UN system's Steering Committee for the Decade to develop strategies, recommend actions and draw up guidelines and checklists for women's involvement; provision by donors of financial, advisory and technical assistance to developing countries to support specific activities to enhance women's involvement; and, "rallying" of women around the water point to stimulate community self-help programmes.

Yet, many projects and programmes underway, and even planned, do not fully reflect a recognition of women as an important human resource. This is largely due to lack of commitment to and knowledge and experience of, how to promote and support women's optimal participation.

IT IS NOT ENOUGH.......

Experience has shown that unless backed by strong political and financial commitment, policies, strategies and action recommendations will not enhance women's participation. National governments, donors and the community people must undertake to plan and implement necessary programmes to assure systematic and thorough involvement of women. Aggressive and sustained consciousness-raising and information exchange programmes are crucial to stimulating and maintaining the required political and financial commitment.

Similarly, no matter how comprehensive guidelines and checklists are, they will not induce engineers and other implementers to expend the time and money needed to involve women and other community end-users. Equally important are: careful planning based on research and study findings on experiences in involving women; and, community self-help in water and sanitation.

Once the political and financial commitment has been obtained, implementers oriented/trained and community people mobilized, programmes can be initiated to involve women. For maximum impact, these programmes must be planned and executed as part of the overall water/sanitation projects and programmes, on a routine basis. Further, the extent of women's involvement should not be limited to mere provision of voluntary labour. Women should be involved in planning, implementation, operation and maintenance and evaluation.

PLANNING

Projects with the community participation approach consult community end-users about needs, preferences, and expectations and available options in order to reach agreement on all major issues. But by and large, communication is limited to contacts with community leaders -- usually men -- whose priorities do not necessarily coincide with those of women and other disadvantaged groups. In a few cases, a woman may be appointed to the village water committee where such exists, but her representation is often more token than effective, despite her vital knowledge and experience, based on her traditional role as water-bearer, manager and custodian of family hygiene.

Conscious effort should be made to facilitate women's effective participation in machineries for needs assessment, priority setting, resource allocation and technology selection by: appointing an adequate number of able and respected females -- including teachers, midwives and nurses to represent women in the planning committee. The representatives should be informed and encouraged to participate actively in committee discussions. The timing and locale of committee meetings, the language used and seating arrangements -- all have important implications for women's participation.

In very traditional societies where women's contact with outsiders is restricted, it might be necessary to consult community women at separate meetings or individually at home through community surveys prior to planning or as part of evaluation exercises. Women field workers -- preferably from within the community -- should undertake these special consultations in order to minimize resistance from the community.

IMPLEMENTATION

Women, the main users and beneficiaries of improved water and sanitation systems, have a major interest in successful installation of new systems. They are therefore more inclined to provide free labour for construction and to mobilize, and even coerce their menfolk, into assisting them. For example, it is reported in one African country that village women threatened to withhold their favours until the men helped them construct a self-help dam. It worked like magic. Use of community self-help for systems construction brings down the capital cost and allows for extension of services to a large number of unserved communities.

Project planners and implementers should enlist the assistance of women's and other local groups from an early stage, to mobilize community people for self-help in construction.

INFORMATION AND HEALTH EDUCATION

Installation of improved water and sanitation systems does not necessarily mean general and correct use. Many examples have been documented of widespread incorrect or non-use of systems for several reasons including: cultural beliefs and attitudes, taste preferences, ignorance of harmfulness of children's faeces and/or refusal or inability to pay in cases where tariffs are imposed on community water systems.

To overcome constraints to acceptability and proper use of improved systems and assure maximum impact on the intended beneficiaries, information and health education should be undertaken in conjunction with planning and construction of systems and not only when expected behavioural changes and health impact do not occur. Women and children, especially girls who assist with water collection and with baby-sitting, should be the main focus of these programmes. Participatory rather than didactic approaches should be used for joint identification and understanding of risks contributing to transmission of water-related diseases. Once women become aware, for example, that high infant mortality is mainly due to lack of safe water, they might be more inclined to participate more actively in action programmes.

In many cases, exposure to maternal and child health and family planning programmes will provide significant motivational entry points for the introduction of water and sanitation projects.

OPERATION AND MAINTENANCE

The World Health Organization estimates that 40 to 80 per cent of handpumps break down within three years of installation due to lack of proper operation and maintenance. Breakdowns have resulted in frustrations for women who have to walk even longer distances to another source or to revert to the traditional sources which are often polluted.

Women should, at the earliest stages of project formulation, be identified and trained in simple repair and maintenance as they are the first ones to know when a system is malfunctioning before total breakdown and are affected most by these breakdowns. Light and simple handpumps should be used to facilitate maintenance and repair by women.

CONCLUSION

Since women are involved in all activities of rural and urban communities, their involvement in the provision of safe water and sanitation can help facilitate changes which inevitably accompany introduction of innovative concepts and technologies into a community. If improved water and sanitation projects are to be successful, they must go beyond technical issues, and include action plans and techniques to make full use of human talents at all levels. New ways will have to be sought and applied in order to achieve a more balanced participation of men and women in all development activity.

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

Ian Smout

Village participation in Madura, Indonesia

INTRODUCTION

This paper describes two programmes being carried out on Madura Groundwater Project in Indonesia. The first programme comprises local consultation during the survey and design of village level irrigation systems, and the second is the training of farmer representatives to manage and operate these systems themselves. Both programmes aim to achieve effective village participation in a major government project. They are well received and seem to be proving successful.

THE MADURA GROUNDWATER PROJECT

The aim of the project is to develop groundwater resources for irrigation (and to a lesser extent for domestic water supply) in Madura which is an island off the north east coast of Java in Indonesia. Some 55 tubewell irrigation systems are already in use, and another 45 are to be constructed under the current phase of the project. This is being implemented by the Groundwater Irrigation Division (P2AT) within the Ministry of Public Works, with finance from the Government of Indonesia, the EEC and the UK. A typical well is 100m deep, with a turbine pump and diesel engine. It is designed to pump about 60 l/s from a dynamic water level of between 5m and 35m, depending on the site, to irrigate an area of some 40 ha, divided into seven blocks. The project includes the construction of canal systems over this area, to deliver water to outlets which each supply about 0.25 ha. Main crops are paddy rice and tobacco.

Before each tubewell is commissioned, the project appoints and trains an operator to run the pump and engine, and it also organises the formation of a water user association (called HIPPA) made up of the 100 to 150 farmers with land in the tubewell command area. They elect a chairman, secretary, treasurer, water baliff and seven block leaders. The general educational level is low, but most of these HIPPA officers can read and write.

For the first two years after commissioning the project pays the operator's salary and supplies diesel etc for operation, but after that the tubewell is handed over to the HIPPA and the government provides only maintenance and repair services for the tubewell pump and engine. A flow chart for the development of a typical tubewell is shown in Figure 1.

OBJECTIVES OF THE PROGRAMMES

The overall objective of both these programmes is to improve the standard of the operation and maintenance of the tubewell irrigation systems by the villagers, and to increase their agricultural production.

Objectives of the Consultation Programme

The following detailed objectives were set:

- that a large representative group of villagers know the project's plans and timetable and understand their consequences ;
- that the plans are discussed and modified in the light of local comments ;
- that the tubewell irrigation system is considered to belong to the village;
- that the villagers take an active interest in the quality of the civil works.

These objectives are to be achieved through a series of meetings at the 45 new sites.

Objectives of the Training Programme

These may be stated as follows:

- that the tubewell irrigation system is operated efficiently;
- that the system is maintained in a satisfactory condition;
- that the HIPPA officers know their duties and perform them responsibly;
- that the HIPPA collects charges for operation of the tubewell and maintains financial viability.

These objectives are to be achieved through a series of meetings at the 55 operating tubewells and the 45 new sites.

FEATURES COMMON TO BOTH PROGRAMMES

Approach and Communication Methods

A similar approach was adopted for both programmes. This follows closely the

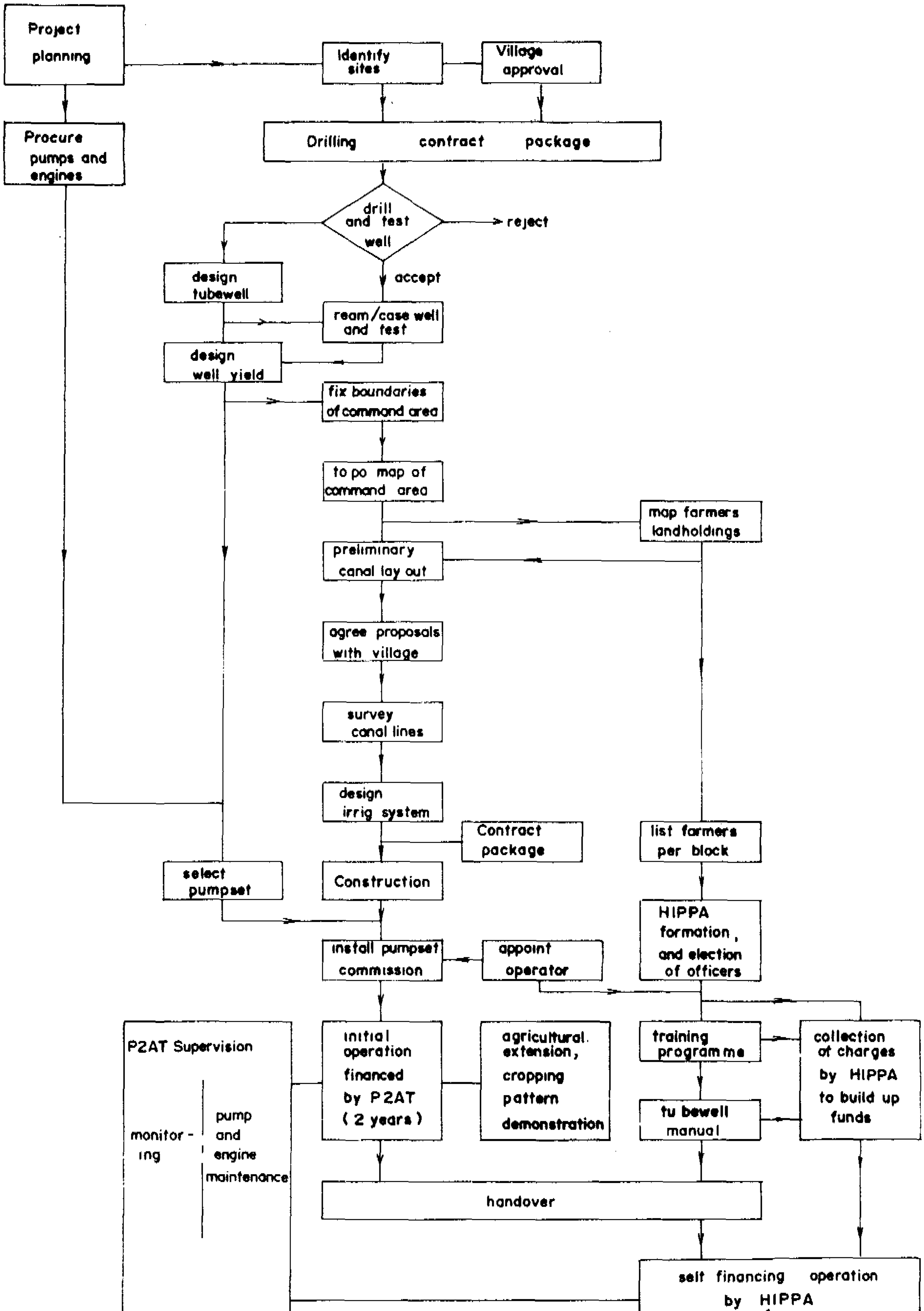


FIGURE I . SCHEMATIC DIAGRAM OF DEVELOPMENT OF TYPICAL TUBEWELL approach recently developed for training low level irrigation staff in East Java (Ref 1). The consultant organised and trained a mobile team of local staff from the agriculture and tubewell operation subsection of the project. Arrangements are made for the team to visit each tubewell according to a schedule, and for villagers to attend at the agreed meeting place in the village. The photograph shows a typical situation. The team follows a standard programme, with minor variations as found necessary. They present previously prepared material which comprises both standard items common for all tubewells, and site-specific items about this particular tubewell. All the material is directly relevant to the villagers, and it is presented in the local Madurese language or in a mixture of Madurese and Indonesian. The team also receives the villagers' reactions to the project's proposals, and details of other problems and requests. Some of these can be dealt with in discussion or after inspection of the situation in the field, others are taken back to the office for further investigation and discussion.

An important part of each programme is a field visit to another tubewell which is operating successfully. The villagers are usually able to talk to the operator, water baliff and farmers on the demonstration tubewell.

Equipment

The basic equipment for the programmes is an overhead projector (OHP), a flipchart and stand, and a generator.
The OHP is used for the presentation of prepared material, which is written and drawn partly on continuous acetate rolls, and partly on individual photocopied transparencies of maps, forms etc. This proved to be very successful. With the acetate roll, the presenter is continuously prompted, while the screen display reinforces the message. Similarly by projecting coloured up photocopies of maps the presenter can explain proposed canal layouts etc clearly to groups of villagers and note their suggestions.
The flipchart is used for structuring and recording the feedback from the villagers, and for site-specific flipcharts which are left with the villagers, covering topics such as recommended operating speeds and charges.
The generator, with a 30 m long cable and a voltage stabiliser, is essential because most of the villages do not have electricity.
Additional equipment is used as follows:

- video recorder and monitor, to show films on construction and water management prepared on the project tubewells;
- film projector, and slide projector;
- portable wireless microphone/amplifier.

Photo : Training Programme, Madura Groundwater Project

DESCRIPTION OF THE CONSULTATION PROGRAMME

The consultation programme was set up in August 1985, prompted by the experience gained in the training programme, and using the same equipment and much of the same material. The content of the programme is shown in Table 1.

By mid-November 1985, the programme had been carried out on a back log of 14 sites, most of which had already reached the design stage. It is continuing on sites at earlier stages of development.

Table 1. Consultation Programme

Day 1 (after drilling and testing well)
1. Tubewell irrigation (film/slides)
2. Command area boundaries (OHP)
3. Timetable for this site (flipchart)
4. Planned organisation and finance (OHP)

Day 2 (after preparing preliminary layout)
1. Demonstration tubewell (field visit)
2. Canal alignment (OHP)
3. Timetable for this site (flipchart)
4. HIPPA organisation, duties, charges (OHP)
5. Construction, water management (videos)

DESCRIPTION OF THE TRAINING PROGRAMME

The training programme started in July 1985, after two months of preparation. The trainees comprise the HIPPA officers, the operator, and the village head together sometimes with several leading farmers. They are paid a small daily allowance (about £1), and the village head is paid to provide meals and drinks. Several hundred people usually see the film.

The content of the programme is shown in Table 2. This standard programme had been carried out on 30 sites by mid-November 1985. It is followed by preparation of a tubewell manual which gives recommendations on management and operation of the tubewell.

Table 2. Training Programme

Day 1
1. Water management (OHP/flipchart/video)
2. Existing problems (flipchart/field)
3. Demonstration tubewell (field visit)

Day 2 (1 week later)
1. Feed back on problems from Day 1.
2. Operation costs/charges (OHP/flipchart)
3. HIPPA structure, officers duties (")
4. Summary of conclusions etc. (flipchart)
5. Film : Drama about a water baliff.

CONCLUSIONS

The consultation and training programmes are making a major impact, though improvements are still needed in order to fulfill all the objectives. The approach is successful, and can be recommended for use elsewhere. The key elements are :

- the programmes are conducted in the villages;
- the content is directly aimed at the participants interests;
- the basic equipment of OHP, flipchart and generator enables the necessary detail to be communicated;
- the programmes are carried out by local staff, in the local language.

Village participation has led to requests for major changes which shows the need for consultation at an early stage. Requests have also been made for minor changes which are more easily accomodated. Nevertheless all these items increase the design staff's work load.

The standard of the programmes is crucially dependent on the ability and motivation of the staff who carry them out and on their rapport with the villagers. In setting up such a programme it is important to mobilize these staff and provide them with the necessary support in terms of planning and programming, official approval, equipment and finance, prepared material, training, supervision and back up. Their status within the project is also important, so that they can persuade other staff to act on villagers' problems and requests.

ACKNOWLEDGEMENTS

The author wishes to thank Mr Tjetjep Sudjana BIE, Project Manager of P2AT East Java and Ir. Wahyu Hartomo, Sub-Project Manager of P2AT Madura, for their support in setting up these programmes, and also thank the project staff who are working hard to carry them out.

REFERENCES

1. Burton M.A., Ir. Darsun Kartodredjo, Arief Effendi, Ir. Tjahyo Santoso, I.K. Smout. Training in Water Management - A Practical Approach for Managers and Operators in East Java, Indonesia. Paper submitted to the 13th Congress of the International Commission on Irrigation and Drainage, Rabat, 1987.

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D K Banerjee

Water pollution and human health

Water is said to be the most common but the least understood solvent. It has unique physical and chemical properties which have allowed life to evolve in it. To quite Szent-Gyorgyi (ref.1) "That water functions in a variety of ways within a cell can not be disputed. Life originated in water, is thriving in water, water being its solvent and medium. It is the matrix of life". All biological reactions occur in water and that being so, pollution of water becomes significant only when it affects living or biological systems. Generally, the reference point for identifying and assessing pollution is the impact it has on human interests, the most important of these being health.

The primary area of concern over the years about water contamination and its ecological ramification has been the transmission of disease via the water route. Increasing developmental activities, both agricultural and industrial, though imperative for improving the quality of human life have added to the water contamination problems. Some of these activities merely increase the levels of contaminants already existing in water through natural processes, others generate pollutants of a new kind which normally do not exist in nature. The latter are more hazardous to human health since the biological adaptions against them have not been developed (ref.2).

The most common but the most significant aspect of water vis-a-vis human health is the drinking water, which is one of the most important elements of human nutrition, whether consumed directly or through food and beverages. Drinking water characteristics vary regionally because of varying surface and ground water qualities and attempts have been made in recent years to investigate whether they can be correlated with regional differences in morbidity and mortality (ref.3). Apart from the incidence of water borne diseases like diarrhoea jaundice, typhoid, dysentry, cholera etc., epidemiological studies have helped in understanding the correlations between drinking water quality and a variety of diseases such as cardiovascular and circulatory system problems, dental and skeletal fluorosis, goiter formation, nitrate toxicity including methemoglo binaemia and so on. There is even evidence to suggest that lead contamination from the pipes carrying drinking water may increase blood-lead levels and this may cause physiological problems like aggressiveness and delinquency (ref.4).

Many epidemiological studies have been conducted, particularly in USA and Britain, to investigate the correlation, if any, between drinking water characteristics and cardiovascular diseases. Schroeder et al (ref.5), in a comparison of 94 large cities in USA found confirmed correlations between potassium, sodium, other ions and arteriosclerotic heart diseases, but no association regarding hardness, calcium and magnesium. No association has been firmly established between regionwise mortality from heart diseases and water hardness. There are many factors which are indirectly related to water hardness, and in turn, could be related to regional differences in mortality and morbidity from cardiovascular diseases (ref.3).

Water hardness has also been investigated vis-a-vis diseases of the circulatory system and other health parameters but no statistically confirmed correlations have been established (ref.6). Soft water has been sometimes held responsible for high cardiovascular mortality because it often dissolves large amounts of metals, eg. cadmium, lead etc. from the supply pipes but this hypothesis is neither confirmed nor refuted. This confusing picture may be explained by the fact that water hardness is a sum parameter of water quality and does not take care of the presence of various individual ions which may be different in soft and hard waters and which may be contributing towards cardiovascular diseases (ref.3).

A contaminant of concern in drinking water is fluoride. This is one of the contaminants that occurs naturally in some surface and ground waters as well as has anthropogenic sources eg, aluminium industry, super phosphate manufacturing plants etc. Drinking water is the main source of supply for human fluoride consumption. Levels of 1-25 mg/l are common in many sources of drinking water in India (ref.7).

The daily fluoride intake with food by humans is approximately 0.2 to 0.5 mg. although the total intake may vary considerably depending on the individual food habits, water intake, the variations in fluoride concentration in drinking water and other food constituents (ref.3). At low concentration fluoride is beneficial to human health and reduces dental caries. Therefore, WHO recommended fluoridation of drinking water supply in 1969 and laid down a value of 1.5 mg/l above which mottling of teeth may occur. At 3-6mg/l, skeletal fluorosis may occur. It is estimated that 20 million individuals are at present suffering from this disease in India, particularly in those areas which do not get treated water supply. An equal number may be affected in later years because of the chronic intake (ref.7). This crippling disease mostly affects the vertebral column, pelvic girdle and ribs. Skeletal fluorosis is caused because of the antagonistic nature of fluoride in relation to calcium; it holds calcium as a complex, preventing or reducing its absorption into the human skeleton; similarly, as an antagonist of iodide, chronic absorption of fluoride may interfere with the physiological function of the thyroid gland and lead to goiter formation (ref.8). Persistent intake of fluorides over a number of years can adversely influence soft tissues as well, the most important manifestations being gastrointestinal, neuromuscular, respiratory and cardiovascular symptoms as well as allergic skin lesions (ref.9).

Drinking water is a natural carrier of iodide. WHO recommends a daily optimum iodide consumption of 150 to 200 µg. Lack of iodide impairs the production of the amino acid thyroxine in the thyroid gland which, in turn, leads to an increase in the level of thyroid stimulating hormone in the blood and growth of thyroid gland, i.e., goiter formation. Thus in goiter prone areas and there are many such areas in India - iodide may have to be added in drinking water. Since this would amount to forced medication, iodide is added to common salt as an option.

Nitrogen and nitrates provide good examples of complex interactions and pathways within the environment, apart from water pollution per se, which can affect human health. Normally the nitrate level of ground water is below 10 mg/l, but increasing amounts of organic refuse - both anthropogenic and natural - and nitrogen fertilisers from intensified agricultural practices have increased the nitrate levels in ground waters considerably (ref.10). This would increasingly affect drinking water quality. For the total intake of nitrate, again drinking water plays a major role. Nitrate toxicity has been distinguished in three types, viz., primary toxicity, secondary toxicity, after its reduction to nitrate and tertiary toxicity, through formation of nitrosamines (ref.3).

Nitrate ion itself, in concentrations normally found in drinking water and food, does not pose a great threat to human health. However, intake of larger quantities of nitrate (> 2 g) and nitrate levels in drinking water above 10 mgN/l may cause concern. The deleterious effects on health are irritations of mucous membranes of stomach and intestines leading to vomiting, nausea and blood in stools (ref.11). WHO has established a tolerable daily intake of 5 mg. sodium nitrate per kg body weight, but has found no evidence of a relationship between gastric cancer and consumption of drinking water containing upto 10 mg N/l (ref.10). Nitrates have been held responsible by many researchers for hav ing an effect on the cardiac functions of man and a recent study has indicated a corelation betwen high nitrate levels in drinking water and hypertension (ref.12).

Nitrite, which is the reduced form of nitrate and can be formed in zinc or iron pipes of the supply system or during the preparation of food and drinks with water possessing high nitrate content or with the help of the enzyme nitrate reductase and bacteria in the stomach, is more poisonous (ref.3). The manifestation of utmost concern is methemoglobinaemia in infants leading to cyanosis, similar to carbon monoxide poisoning, or in more severe cases, even death. WHO had prepared an exhaustive report on the harmful effect of nitrate on infants (ref.13) and there are many investigations on methemoglobinaemia reported in literature.

Apart from these, nitrate toxicity acts through the formation of nitrosamine compounds, a number of which are usually effective carcinogens and can be toxic, mutagenic and teratogenic also (ref.3). Nitrosamines are formed in the human stomach as the reactions are favoured by the pH range there, and may be responsible for gastric cancers. However, this has not yet been confirmed (ref.10). However, two case studies in Colombia and England show a direct correlation between nitrate in drinking water and incidence of stomach cancer (ref.14, 15).

There is another important group of water contaminants which affects human health and these are toxic heavy metals. Following increasing industrialisation and other activities involving metals, contamination of water by toxic heavy metals has assumed significant importance as most of the industrial effluents are discharged into surface waters. It has been established by experimental and clinical studies that long term or chronic exposure to low doses of metals, as for example, by intake of contaminated water can lead to more complex situations than the well established acute manifestations of metal poisoning. There is firm evidence to link five metals, viz, As, Cr, Ni, Be and Cd and their compounds to human cancer although many more compounds have been found to be carcinogenic in animal studies (ref.16). Of course, it has become now increasingly clear that one should not talk about carcinogenicity of metals but of some metal compounds and compounds of the same metal may highly differ in toxicokinetis and toxic-dynamics; they may carry essentially different health risks (ref.17). It must be added here, however, that certain metals in trace quantities are essential for health and water is the main source for them. Also, there are modifiers which protect against the toxic effects of metals. Indeed, some of them are essential to a certain degree even for survival.

Health risks to man from water emanate not only from water borne diseases or ingestion of water contaminated in other ways, but also from amenity aspects like bathing or swimming in polluted waters as well as from waste and effluent reuse. The most important function of water treatment and supply is, of course, prevention of occurrence of water borne diseases. Public water supplies must obviously be safeguarded against any risk of exposure to harmful chemicals. Due to the complexities of various reactions and pathways of pollutants, the magnitude of immediate and long term health hazards posed by a particular quality of water cannot be fully assessed. The quality of water itself depends on so many local conditions, WHO has, therefore, been avoiding the use of the word "standard" in global terms and prescribing "guidelines" embodying microbiological, biological, inorganic, organic, radioactivity and organoleptic parameters. Increasing pollution of surface and ground waters bv proliferation of chemicals, particularly synthetic organic compounds, over the years has also been given special attention in these guidelines. (ref.10). However, there is little information on potential mechanisms of infection or minimum infective doses of various pollutants and intensive epidemiological studies are needed in these areas.

References

1. SZENT-GYORGYI A. Bioenergetics, Academic Press, New York, 1958.

2. BHATIA B et al, Environment and Natural Resources, Society of Biosciences, Muzaffernagar, 1985.

3. SONNEBORN MANFRED et al, Health Effects of inorganic drinking water constituents, including hardness, iodide and fluoride, CRC Critical Revs. in Environ. Control, 1983, 13, 1

4. PURDY S E et al, Effect of lead on tetrahydrobiopterm synthesis and salvage: a cause of neurological dysfunction, Intern.J.Environmental Studies, 1981, 17, 141.

5. SCHROEDER H A et al, Cardiovascular mortality, municipal water and corrosion, Arch. Environ. Health, 1974, 28, 303.

6. PFLANZ M et al, Einfluss der Harte des Trink-wassers auf den Blutdruck und andere Gesundheits-parameter, Forum Umwelt-Hyg. 1973, 27, 53.

7. SUSHEELA A K, Environmental pollution by fluoride, 13th Confce.of the Intern. Soc. for Fluoride Research, New Delhi, 1983.

8. NIETSCH B, Bemerkungen über den Zusatz von Fluoriden und Phosphaten zum Trinkwasser, Gas, Wasser, Warme, 1967, 21, 229.

9. KHOSHOOT N, Integrated approach to fluoride pollution, 13th Confce.of the Intern. Soc. for Fluoride Research, New Delhi, 1983.

10. WADDINGTON J I. The work of WHO in the field of water pollution, Water Poll. Control, 1985, 84, 148.

11. SIMON C et al, Über Vorkommen, Pathogen und Möglichkeiten zur Prophylaxe der durch Nitrit verursachten Methämoglobinämie, Z. Kinderheild. 1964, 91, 124.

12. MALBERG J W et al, Nitrates in drinking water and the early onset of hypertension, Environ. Pollut. 1978, 15, 155.

13. POWNS E F. Cyanosis of infants caused by high nitrate concentrations in rural water-supplies, Bull. WHO, 1950, 3, 165.

14. WOGAN G N Et AL, Environmental N-nitroso compounds: implications for public health, Toxicol. Appl. Pharmacol. 1975, 31, 375.

15. HILL M J. Bacteria, nitrosamines and cancer of the stomatch, Br J. Cancer, 1973, 28, 562.

16. NELSON NORTON, Comments on the carcinogenicity and mutagenicity of metals and their compounds, Toxicol. and Environ. Chemistry, 1984, 9, 93.

17. ZIELHUIS REINER L. Occupational and environmental standard setting for metals: more questions than answers. Toxicol. and Environ. Chemistry, 1984, 9, 27.

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R Andersson

The situation of women and children in Tanzania

INFANT AND CHILD MORTALITY RATES IN TANZANIA

The most dramatic signs of the serious problems affecting children and women in Tanzania are the high infant and child mortality rates. Before articulating the role which the Water and Sanitation Sector has in this, it is a need to highlight the major issues at stake:

Total Population of Tanzania,1985:	22 million
Total Land Area :	945,000 sq km
Average Annual Growth Rate :	3.2%
No of children below 5 years :	4.4 million
No of Births :	1.1 million
Infant Mortality Rate (IMR) :	137 per 1,000
No of Infant Deaths :	145,000 per year
Young Child Mortality Rate :	94 per 1,000
No of Young Child Deaths :	95,000 per year
No of Improved Water Projects:	6,900
Estimated Number of the Rural Population Served with Water :	8.4 million(38%)
Estimated Number of Households with Latrines :	3.0 million(67%)

It should be noted that still births and early failures of pregnancy are not included in the IMR estimates, but occur in 50-100 per 1,000 pregnancies.

From population censuses in 1957, 1967 and 1978 estimates of infant and young child death rates are shown below:

Year	IMR (per 1000 live births)	Out of 1000 born No of children who die before 5th birthday
1957	190	--
1967	160	260
1978	137	231

Source: 1978 Population Census, Bureau of Statistics

Infant and child mortality rates have fallen. Nonetheless, the infant mortality rate of 137 per 1000 indicates clearly that there is a serious problem.

While the causes of deaths of children older than one month are most frequently related to the environment, the causes of high perinatal and neonatal mortality are primarily the result of the poor health and nutritional status of the mother. In order to design the most appropriate programme to reduce high infant and child mortality rates, it is therefore very important to know the age-specific mortality rates.

WHY DO CHILDREN DIE IN TANZANIA?

The high infant mortality rate is the end result of a long range of processes in society that manifests itself in a high degree of malnutrition, high prevalence of disease and inadequate food intake. The processes in society that cause young child deaths have beer explicitly systematized at:

immediate level
underlying level
basic level

About 50 per cent of all infant deaths occur during the first month of life.

This suggests that the poor condition of mothers is one of the MOST IMPORTANT IMMEDIATE CAUSES of young child deaths. The relatively high proportion of perinatal complications and mortality suggests that emphasis should be given to improving the conditions of women, especially during pregnancy: poor health and malnutrition of the mother, often linked with excessive workload during pregnancy, together with inadequate maternity care, antenatal and delivery care and children spaced too closely, result in high prenatal and early mortality rates. Maternal mortality is about 4 per 1000 deliveries, which could be reduced substantially with improved pre- and perinatal care.

It is estimated that 50-60,000 children die of dehydration from diarrhoea each year and another 50,000 or more die of immunicable diseases. Diarrhoeal diseases accounts for 7 per cent of children's deaths in hospitals. It is most common among children 18-24 months of age. About 15,000 children die each year of measles, and it is estimated that about 5-10 per cent of the under-five population has respiratory infections at any time. In most cases diseases and malnutrition interact, reinforcing each other's negative impact on the child. This increases the fatality rates of diseases very much. About 2.2 million children are moderately malnourished and about 330,000 children severely malnourished.

The underlying causes of diseases and dietary factors that are most strongly related to young child mortality are potentially many and often interrelated. In a specific community, however, it is often possible to identify the most important ones and to understand their interrelationships. The underlying causes have been systematized in the three following groups:

1)	Health Water Sanitation	- Basic services which - serve to reduce the - incidence and fatality of disease.
2)	Household food Security	- Necessary conditions for securing individual nutritional intakes.
3)	Child care, Community development, Education	- Services and activities that directly improves the conditions of children and women and that indirectly increase the utilization of other services.

The underlying causes of young child deaths are themselves results of processes in society. These processes, or BASIC CAUSES, are determined and influenced by the material and social conditions of production together with political and ideological factors.

Survival of young people must be the most basic of all human needs. In that sense poverty can be defined as a situation where young children die. But poverty is seldom measured by mortality rates. Most often income per capita is used. By both criteria Tanzania is a poor country:

The fact that most food is still produced by rain-fed hoe agriculture has a direct effect on household food security, dietary intake, nutritional status and child survival.

The sexual division of labour is the most important aspect of the social conditions of production in Tanzania. Almost all communities in Tanzania are characterized by rather rigid sexual division of labour and a patriarchal organization, often within an extended family formation and with the man controlling the main resources.

Women are not only the prime producers of food, but they also have responsibilities for homekeeping and food preparation, child care, provision of water and firewood. The heavy workload of women and their lack of control over the main household resources including land, are the MAIN BASIC CAUSES of deaths of young children in Tanzania.

If women gain more control over resources, and if more of the resources controlled by men were diverted towards improving the condition of children and women, young child death rates would definitely go down in Tanzania.

The laws in Tanzania protect women to a large extent and enforce the 'EQUALITY OF ALL HUMAN BEINGS' against the traditional ideology contained in customary law. But in the interpretation and use of the law, the traditional ideology of legitimizing the sub-ordination of women persists. Some laws, noteably those related to work protection and land inheritance still legitimize discrimination against women.

Child death rates in Tanzania are high, and they can be substantially reduced if people are aware of the important causes and actions which may be taken to prevent them. Parents are the most important actors:

fathers who can share more of the work of the household so that their wives may rest more, especially when they are pregnant

Mothers who need more time to care for their young children by feeding them more frequently, getting them immunized and giving them oral rehydration when they are suffering from diarrhoea.

The fact that these important actions are not being taken is partly because parents are unaware of the frequently fatal consequences of their lack of action.

DEVELOPMENT OF THE WATER AND SANITATION SECTOR

In 1971 the Government embarked on a very ambitious programme to provide all people in the rural areas with clean, potable and adequate water within a distance of 400 meters. This target was to be met by 1991. After half the plan period had elapsed, the situation could be summarized as follows:

1) 33 - 42 per cent of the rural population has access to improved water supplies compared to 10 per cent in 1970;

2) only half of the population who have access to improved water supplies are actually using them;

3) an increasingly large portion of new water schemes are not working because of inadequate maintenance, lack of spare parts and lack of fuel;

4) the construction of new schemes is probably keeping up only with population growth.

Improved sanitary practices have been encouraged by adult literacy campaigns and universal primary education. During the ten years between 1968 and 1977 households with a private pit-latrine increased from 23 percent to 56 percent of the rural population. However, it is now known to what extent these latrines are being used.

UTILIZATION OF IMPROVED WATER SUPPLIES

Concerning the quantity of water, the planning target for the rural water sector has changed from 45 to 25 litres/capita/day. Studies during the Water Master Plans the mean consumption (carried home) has been estimated to be presently 15 litres/capita/day. The consumption rate is an important parameter when designing piped water supplies. The total cost of a water system may differ as much as 40 percent depending on what is the per capita consumption rate. Distance to source of water also influences the amount of water used. A study carried out in Tanzania summarizes the conclusions about the factors influencing per capita water collection as follows:

1) higher income families generally use more water than low income families;

2) school education has a positive influence on water consumption;

3) large families use less water per capita;

4) families with many children use less water than families with few children;

5) families with a large number of females use most water;

6) families with longer walking distances use less water than families who live near water;

7) users of tap water use more water than users of traditional sources.

Households with easy access to water, i.e. less than 10 meters from the tap, on average collect 3 to 4 times as much water as the average for other households with a longer distances to the taps. Further, they consume 2-3 times as much water for personal hygiene per capita as households with more than 10 meters from a tap.

UTILIZATION OF IMPROVED LATRINES

If the utilization of improved water supplies is low, utilization of improved latrines is probably even lower. In the mid 1970's as a result of epidemic outbreaks of cholera, the government made it compulsory for every household to have a latrine. However, it is well known that in many areas the latrines were constructed but very rarely used. In a socio-economic study for three regions in Tanzania most people claimed that they use their latrines, but observations did not substantiate the claim. Similar observations have been made in two other regions. These studies revealed that:

1) less than half of the children below 2 years used the latrines;

2) almost 80 percent of the people used the bush while working in the fields;

3) at night the latrines were not used unless they are inside the house area.

CRITICAL ANALYSIS OF THE WATER AND SANITATION SECTOR

The political decision that every Tanzanian household has a right to easy access to clean drinking water is a logical interpretation and reflection of the socialist ideology expressed in the Arusha Declaration of 1967. The strategy launched in 1971 was based on these important assumptions:

1) development costs would be on average Tshs 220 per capita, irrespectively of the source of water;

2) piped water and diesel driven pump schemes would be the main technology;

3) the central government should have the primary responsibility for both the construction and the operation and maintenance of the projects implementation;

4) If water were to be available within 400 meters, this source of water would be used because of the higher quality of the water from this source compared to traditional sources.

The first two assumptions are interconnected. Development costs rose beyond Tshs 220 per capita, although they were brought down again when the more affordable shallow well technology was introduced. Only Tshs 1.4 million was allocated during the 1970's instead of an estimated Tshs 2.6 million. Taking inflation into account, allocations in real terms were much less than those which had been planned for.

Only 40 percent of improved water schemes have been found to function adequately. Lack of proper maintenance, diesel and spare parts are the main reasons for this. There is therefore a great need to rehabilitate all schemes not working at present. To rehabilitate schemes to supply the areas originally intended will require Tshs 500 million, (US$ 30 million).

The funds required to construct new water schemes, rehabilitate old ones, maintain and operate all schemes for all of the people and their livestock by 1991 are estimated at Tshs 10.9 billion, (US$ 700 million). This estimate assumes a 25 percent overhead cost. This is Tshs 2.9 billion in 1970 prices. Over the last 10 years Tshs 1.4 billion have been allocated to the water sector, or Tshs 0.8 billion in 1970 prices.

The conclusion from this analysis is that; even if the budgetary allocation for the water sector increases dramatically the proposed technology mix is not affordable and the 1991 goal cannot be met. This implies also that *the third assumption cannot hold*. Even with a change of the technology mix, the central government cannot take the whole burden of financing improved water schemes. Although improved water supplies are often the highest priority of villagers, they expect the government to provide improved water. The role of villagers themselves in the development of rural supply schemes has been quite limited. They have contributed labour during construction. When completed, the schemes are operated and maintained by the government. Villagers have been passive receivers of new schemes. They have little or no responsibility for the schemes which they regard as government property.

When a water point runs dry, women revert to traditional sources rather than involving themselves in repairing the broken point. Even when water schemes do provide water, women may still prefer traditional sources. The official estimate of coverage of 38 percent of the rural population holds only if women perceive traditional sources to be clearly inferior to water from a new scheme. Unfortunately, views of women have been rarely considered in the design and implementation of new water projects. Problems of operations, maintenance and user acceptance of water projects have been known for many years, yet the role of villagers has remained largely unchanged for the last 15 years.

Improved water supplies are usually judged by improved quality, quantity, convenience and reliability. If a major impact of improved water supplies on child death rates is through reduced workloads for women, increased convenience is very important. Several studies in Tanzania have shown clearly that this is exactly the opinion of the women themselves. This leads to a most important policy conclusion, that; the almost complete lack of involvement of women in the development of strategies, planning, implementation and management of water projects must be changed.

The basic conclusion of all this must be that instead of replacing existing systems of water supplies, a systematic assessment and improvement of these systems should be made, together with the minimum necessary construction of new schemes. The most important implication of such a strategy is that women must be in the forefront of planning, implementation, maintaining and monitoring all improved water schemes.

A large proportion of Tanzanian households have a private latrine. There are, however, doubts about the extent to which these latrines are actually being used. An evaluation of the Wanging'ombe rural sanitation project in 1982 suggested minimum characteristics of a satisfactory latrine as;

1) it must have a durable and structurally safe squatting floor

2) it must have an adequate provision for the control of smells and houseflies; for pit latrines this is best achieved through the installation of a screened vent on the pit of the latrine

3) it must provide adequate privacy for the user; this can be achieved through the provision of stable walls and a roof together with a door or a modesty wall

4) it must be affordable to the villagers.

The experience in Wanging'ombe shows that with the provision of materials valued at Tshs 200-300 per household (US$ 18), villagers constructed improved latrines that would cost Tshs 2,000-3,000 (US$ 180) if all the labour had been hired.

The fact that children under two years of age do not use the latrines poses a special problem. It is known that excreta of small children is especially dangerous for spreading diseases. New ideas are needed to solve this problem.

In summary, the experience so far suggests that health education, improved sanitation and water supplies must always be considered together in order to achieve an impact on child survival and development.

PRIORITIES IN WATER AND SANITATION SECTOR TO ACHIEVE THE OUTCOME OBJECTIVES

In all rural development projects aiming at reducing the rate of young child deaths improved water supplies should be considered as potentially effective interventions.

In Tanzania, reductions in child death rates as a result of improved water supplies may come about more through a reduction of the workload of women than a decrease in water-related diseases. However, this may not be the case in every community. Therefore, it is important that the causes of infant and child deaths are identified and analysed in a specific area, before the best intervention can be planned.

Information about existing user choices, possible improvements plus additional complimentary water sources should form the basis for discussion with the villagers, especially women.

A new strategy will necessarily have to recognize and fully involve women in the planning, implementation and management of water projects. If the full role of women is realised , water development will become more of a community development effort rather than a technical intervention. Such a strategy would have the following benefits;

1) it is more likely to be affordable, because it would be less likely to involve expensive technology

2) it would not divert too much from accepted traditional patterns; emphasizing the improvement of existing practices instead of their replacement is more likely to get popular support

3) it would make it easier to involve women in the planning and management of water projects; as the main actors in identifying existing sources and user choices women will obviously be the main collaborators.

The first step in the process would be to organize and mobilize the women in the community to make an inventory of the existing sources of water, user preference and patterns. Then the possibilities of improving existing water supplies should be explored. Improvement of existing sources of water could be of many types. Deepening and lining wells, installing aprons and hand-pumps, etc. The construction of shallow wells or gravity-schemes would provide complementary sources not substitutes.

The following priorities therefore should guide development in the water sector

1) community activities to improve local water supplies;

2) village participation in planning, implementation and management of improved water supply projects;

3) strengthening of planning, supervision and monitoring at all levels, from national to village level.

The <u>first priority</u> implies that the development of local supplies should be based on women's views about water improvements, that assistance should be given to increased village capacity to improve present sources. It may cover support for an inventory of existing sources, training assistance, education programmes, a hygiene campaign, assistance and provision of materials not readily available locally.

Support for improved water schemes may cover training assistance and educational programmes. However, the delivery system and implementation process need to be much more coordinated with villagers' willingness and ability to participate on one side and district and regional functional capacity on the other side.

The <u>third priority</u> means that the capacity to implement village or multi-village water projects has to be increased. At the national level, support may be provided for research for a water strategy, and for monitoring and evaluation. At regional and district levels, it may also cover administrative assistance and educational programmes, campaigns and support to cross-sectoral coordination. Co-operation with organizations working in the field should be encouraged. At village level local maintenance systems need to be developed and encouraged.

The choice of technology should consider the following order of priorities

1) improvement of traditional sources

2) wells with handpumps (shallow or medium deep wells)

3) gravity schemes

4) renewable energy driven pumped schemes, e.g. hydraulic rams, wind power and solar power

5) electric driven pumped schemes

6) diesel driven pumped schemes

Human excreta are the principal vehicle for the transmission and spread of a wide range of communicable diseases. Some of these diseases rank among the chief causes of sickness and death of children. Dehydration because of diarrhoea is one of the main causes of death among young children. Other diseases, such as hookworm infection and schistomiasis, cause chronic debilitating conditions and make children more likely to die from acute infections.

Provision is being made to include health education and sanitation in major support programmes. Through research projects, studies and pilot projects basic knowledge about conditions and pre-requisites for local participation in health, sanitation and water supplies is being gained.

Research on water-use patterns, water storage and handling should be supported. Women would be the target group for and participate in this research. Information about hygienic practices, water handling and use should be included in the curriculum of primary schools. Women should be encouraged to participate in educational activities linking water and sanitation programmes. However, it is important that these activities are not considered as "women's projects". Men too must understand the causes and effects of poor hygiene and health in order to participate in reducing child death. The fact remains that most of the formal decisions in Tanzania, at village as well as at household level, are made by men.

The choice of interventions should consider the following order of priorities

1) one latrine for each household;

2) as a next step, gradual improvements of existing latrine tvpes using locally available materials;

3) promotion of more permanent latrines should be done as and when economic conditions allow;

4) for demonstration purpose improved latrines that are likely to be affordable for most households should be built;

5) improved types of aprons, soakways and washing slabs at water points should be adopted.

Session 1a

Chairman: Mr Roger Andersson

Co-Chairman: Dr Sindhu Phadke

Discussion

Mrs Aloka Mitra

Motivation in Rural Sanitation

1. Mrs MITRA described her experiences in motivating rural communities in West Bengal to adopt twin pit pour flush latrines. She emphasised the need for involvement at all levels, and described the training programmes and methods.

2. Mr HANS van DAMME (IRC) asked what experiences Mrs MITRA had had regarding the reactions of men - particularly engineers - to greater involvement of women at community level and at project management and principals level.

3. Mrs MITRA replied that her experience, and that of her colleagues, at project management level had been of co-operation and mutual respect, particularly with the engineers of T.A.G., India and the Public Health Directorate of West Bengal. These groups had ensured the active participation of women from the planning and decision-making stage right down to the implementation of projects at village level. Senior officials at different levels had also been helpful. In her experience, with the right approach, the reaction of men at community level had always been welcoming towards them and men were actively assisting her and her colleagues to involve womenfolk in all sanitation programmes.

4. Mr RATRA asked about the level of implementation of the latrine programme.

5. Mrs MITRA replied that the latrine construction programmes were at different stages. Some latrines were already in use whilst others were under construction.

6. Mr RATRA then asked about maintenance of the latrines and whether training and appraisal had been undertaken.

7. Mrs MITRA answered that training programmes were being conducted before and during implementation to prevent the occurrence of typical maintenance problems such as cleaning of pans, choked drain and superstructure defects. She added that women generally adapted themselves well, but often had problems training family members such as children and the aged.

8. Mr NEAUPANE (UNICEF, Nepal) asked how motivators had been selected, trained, motivated and supervised.

9. In reply Mrs MITRA explained that motivators for government-supported programmes were selected with the assistance of the Block Development Officers, the Health Department, the Social Welfare Department and the Panchayats, from among their community level workers, youth clubs, school teachers etc. They were trained at block level through two-day basic training programmes and then at village level through training camps.

10. Mr NEAUPANE then asked what types of health activities were essential to motivate for sanitation.

11. Mrs MITRA said that the answer would vary according to the needs of the particular area. She suggested the following list of some possibilities: health education using visual aids; demonstration of low-cost water purification methods; health camps for deworming children and primary treatment of intestinal diseases; demonstration of oral rehydration therapy; teaching management of diarrhoeal diseases to promote understanding of the relationship between health, hygiene and environmental sanitation. She added that provision of potable drinking water was a prerequisite.

12. Mr GUIN (All-India Institute of Hygiene and Public Health) commented that he did not think that overmotivation was undesirable. The organisation or agency in charge of execution might be put in difficulty temporarily until funds were available for completing the project, but strong public motivation was necessary to press the political leaders to allocate an appropriate budget without delay.

13. Mrs MITRA responded that her comment on over motivation was relevant to subsided domestic sanitary latrine construction programmes only at village level and did not relate to latrines in institutions or motivation at decision making levels: available resources might permit the construction of only a few subsidised domestic latrines in a village initially. If a very strong demand were created for the latrines through motivating the whole village, the difficulty in selecting only a few of the applicants and the reaction of those not selected might even result in the withdrawal of the programme. Mass motivation programmes should be for community based no-cost or low-cost health, hygiene and sanitation measures.

14. Mr SMOUT (Sir M MacDonald & Partners) asked whether women's participation should

preferably be attempted through women's groups or through mixed community groups.

15. Mrs MITRA replied that where there are no voluntary women's groups the appeal must be to the whole community. She added that women school teachers and midwives were good contacts. When a general meeting was called often no women came, though women were gradually becoming more involved. Different approaches were appropriate for different groups.

Hilda R Paqui

Women's Involvement in IDWSSD

16. Ms PAQUI urged that women's participation should not merely be given a token mention in project proposals, but that determined efforts should be made to involve women at all stages of the project cycle, in order that the aims of water supply and sanitation projects should be achieved.

17. Mr HANS vanDAMME asked how an engineer could "sell" the idea of women's involvement to (a) fellow engineers and (b) project principals and politicians.

18. Ms PAQUI suggested that the following arguments could be used: Women's involvement results in

- more appropriate plans and designs
- hygienic use of water and sanitation schemes
- better functioning of systems
- reduced burdens
- improved health
- increased productivity

She called on planners to stop paying lip-service to the value and need of involving women and to promote and support concrete programmes that will involve women.

19. Mr van DAMME also wondered how participants of this conference could help to achieve greater involvement of women.

20. Ms PAQUI replied that the failure rates of water supply and sanitation schemes were an indication of the need to involve women more. Participants could help by arguing the case at meetings, by using training opportunities and by gathering information. The World Bank/UNDP training programme includes material to help alert engineers to the need to involve women more.

21. Mr SMOUT's earlier question (para 14) was also asked of Ms PAQUI

22. Ms PAQUI answered that ideally the approach should be through mixed community groups to ensure a balanced participation with complementarity of men and women, but that in very traditional societies it might be preferable to mobilise women through their own organisation to minimise resistance.

23. Mr SMOUT then asked for some examples of successful women's participation, and how these were organised.

24. Ms PAQUI gave the following examples:

- In Pakistan, 70% of the households in the Baldia slum area have built latrines. This mainly resulted from the work of women sanitation promoters who mobilized women and other community groups for self-help in this effort;
- In Angola, Bolivia, India, Lesotho, Malawi and Sri Lanka all report considerable declines in vandalism and breakdown and water systems following training of women waterminders. Support was provided by husbands and other family members who cared for children to enable to enable wives to undertake training outside their villages and a woman hydrogeologist in Malawi deliberately trains women waterminders as a routine part of installing handpumps.
- In Ngusuria (Kenya) and Surigao (the Philippines), women identified development as a priority need and mobilized themselves for self-help in this effort. Relieved of the arduous daily climb to water sources, after helping plan and construct gravity-fed water schemes, women in these two areas now have spare time to undertake nutrition and adult education courses.

Other examples can be found in a UNICEF/UNDP booklet "Insights from Field Experience" available from UNDP Information Division, Dc 1 - 1902, IUN Plaza, NY NY 100 17, USA and IRC/UNDP Annotated Bibliography & Literature Review on Womens Participation in Community Water Supply and Sanitation from International Reference Centre, PO Box 93190, 2509 AD, The Hague, Netherlands.

25. Dr Sindhu PHADKE added the following comments on women's involvement:

A. In some cases the entry point to the involvement of women may well be other than Water and Environmental Sanitation, for instance, women may be interested in seeking assistance for construction of a Community Centre, prevention and treatment of diseases and ill health among their children, income generating activities etc and may later on get interested in Water and Sanitation activities.

B. The factors in motivation for promoting Water and Environmental Sanitation activities by women may be different in specific cases.

(i) Women in Manipur (India) leave their villages for petty trades and selling of vegetables and other goods every morning and return in the evening. They need washing facilities throughout their stay in the town. This has led to construction of sanitary latrines attached to

women's markets.
(ii) In Mizoram (India) women have to spend long hours walking over hilly terrains for collection of water. Furthermore, as trees are cut privacy becomes difficult. These circumstances lead to very high motivation among women for water and sanitary latrines nearer their homes. At present, there is no problem about motivating women for participation in Water and Environmental sanitation. The problem generally is our inability to cope with their enthusiasm.
C. While women's organisations can and do participate in Water and Environmental Sanitation activities, they frequently do not have adequate administrative, managerial and technical resources. It is here that Government agencies have to meet them more than half way in providing adequate support in these areas.

26. Mr WATT(Bradford University) commented that community health involved more than water supply and sanitation and that community participation could cover a wide range of issues. Land ownership was also an important issue in many rural communities.

27. Ms PAQUI responded that community participation required going into a village with an open mind, ready to accept the villagers' own priorities. There was no one issue to be considered alone, but an integrated approach was required. The initial entry point could be any one of a variety of needs.

Ian Smout

Village participation

28. Mr SMOUT described a project concerned with consultation and a training programme, both being parts of a groundwater project in Indonesia. The objectives, schedules and equipment used were all discussed. The programmes have led to requests for major changes.

29. Mr ANDERSSON asked whether any studies had been done on the risk of bilharzia as a result of the scheme.

30. Mr SMOUT replied that bilharzia was not a problem in Indonesia.

31. Ms PAQUI queried the level of sophistication of the villagers concerned, wondering if they were able to read and understand maps.

32. Mr SMOUT agreed that villagers had difficulty in understanding maps, and added that engineers and technicians found difficulty explaining locations and modes of operation of canal or pipe systems without maps. The overhead projector proved a valuable means of communicating layouts to large audiences. If familiar features such as roads, schools, mosques etc were included on the map, the villagers could understand where the canals would be more easily. Marking canal lines with pegs by surveyors in the field also helped make the villagers aware of the proposals.

33. Mr KARKI (MPLD, Nepal) asked if the villagers were involved in the identification and construction of the schemes.

34. Mr SMOUT replied that some tubewells had been drilled following village requests, and that in other cases project staff had identified possible sites from a technical point of view, and checked with the village before drilling. The consultation programme described in the paper took place after successful drilling (the success rate was about 50%). The villagers did not contribute any labour or cash for construction of the project. At an earlier stage it had been intended that the smallest channels would be constructed by the villagers, but achievements had been patchy and inadequate. Therefore funds were provided for constructing these channels, with the intention of using village labour. However registered contractors had to be employed because of government regulations.

35. Mr GHOLAP (Maharashtra W S & S) asked who (i.e. government or beneficiaries) was bearing the capital cost of the irrigation projects in Indonesia.

36. Mr SMOUT answered that capital costs were paid by government assisted by aid agencies for both surface and groundwater irrigation projects. The contribution from farmers was limited to the construction of small channels, as required, to distribute the water to their fields.

D K Banerjee

Problem of water pollution in relation to human health

37. Mr BANERJEE reviewed the impacts of various impurities on human health, concentrating mainly on inorganic pollutants such hardness, fluoride, nitrates and heavy metals.

38. Mr BASU asked whether fluoride levels around Delhi of over 1.5 ppm were causing problems and, if so, what was being done to remedy the situation.

39. Mr BANERJEE answered that the fluoride

was naturally-occurring and that there were cases of fluorosis. This complaint was difficult to detect in the early stages; the urine test was not conclusive. He added that 16 states in India had reported fluoride problems and that the All-India Institute of Medical Science was monitoring the situation in Delhi and elsewhere.

40. Dr NAG (Calcutta University) commented that one common source of contamination of wells in villages in West Bengal was the indiscriminate use of dirty buckets and rope. (A common pail and rope should be provided at each public well.) Therefore, in spite of periodic chlorination the quality of water in most public wells was doubtful and the incidence of waterborne diseases high. The users themselves should be informed of the need and motivated to use a common bucket and rope for drawing water from the public wells.

41. Mr ANDERSSON said that there were places in Tanzania where the fluoride concentration was 10 ppm, and in such places the children had deformed bones.

42. Mr BANERJEE added that Kenya had a high background fluoride level and that fluoride toothpaste had been banned there.

Roger Andersson

The situation of children and women in Tanzania

43. Mr ANDERSSON discussed the health and mortality statistics for children in Tanzania and related them to the provision and use of water supply and sanitation, highlighting the lack of involvement of women in planning and implementation in these fields.

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R Paramasivam, V A Mhaisalkar

Appraisal of rural water supply in India

1. Introduction

As part of 'Decade' activities, the Central Public Health and Environmental Engineering Organisation (CPH & EEO), Ministry of Works & Housing, (since bifurcated) Govt. of India requested the National Environmental Engineering Research Institute (NEERI),Nagpur, to undertake a comprehensive evaluation of completed rural water supply schemes in India. Sixty-six representative water supply schemes from eleven states were critically studied with a view to identify technological,administrative, financial and socio-economic constraints in effective implementation, operation and maintenance of the schemes, Schemes serving population groups below 1000 and between 1000 to 10000 persons and which have been in operation for atleast 2-3 years were evaluated. The type of schemes included hand pump tubewells and piped water supply systems with distribution through only public stand posts as well as through public stand posts and individual house connections. Summary data of schemes selected for study are given in Tables 1 and 2.

Field Study

The study consisted of field visits to villages for on-site observations, collection and analysis of water samples, personal interviews with villagers regarding degree of service, health status, environmental sanitation etc., and discussions with engineers of State Public Health Engineering Departments and Local officials. Proformae developed and field tested for the purpose were used for collecting information. Relevant data for seventeen reference villages were also collected to compare the impact of providing organised water supply on the health status of user community.

3. Assessment & Evaluation

In-depth evaluation was made of rural water supply systems covering various aspects such as design norms source of supply and source protection and reliability of yield, treatment, distribution, operation and maintenance, degree of service, financial management, community participation and health impact. Salient observations of the survey and recommendations arising thereof are presented below :

3.1 Organisational Set Up

Public Health Engineering Departments (PHEDs). Water supply and Sewerage Boards undertake planning and implementation of water supply and sewerage systems in the States. In some of the states, there are more than one agency to implement rural water supply programmes. In such cases, there is lack of effective co-ordination among the various agencies.

3.2 Planning & Implementation

- Criteria for classification of villages are decided at national state level but norms for priority differed from state to state.

- Objectives setforth with reference to adequacy and reliability of yield at the source and degree of service have not been fully met. Many of the sources tapped for the schemes dry up in summer when the need for water is greater.

- Demands of users for a higher level of service have not been met in many systems(eg.no provision for house connections though the consumer is willing to pay).

- Delay in according administrative and financial approval for taking up the designed schemes has been noticed.

- Soundness of initial construction of tube wells, stand posts as well as overhead reservoirs has been lacking.

- There is no organised system of evaluation, monitoring and feed-back of completed rural water supply schemes to guide future planning and design.

3.3 Operation & Maintenance

- Systems maintained by local bodies are not found satisfactory while those maintained by PHED's are costly.

- Irregular electric power supply, particularly during summer, adversely affects the degree of service.

- Performance of India-Mark II deep well hand pumps has been found satisfactory.

- Batch disinfection of water supply using bleaching power has not been regular and/or effective.

- Bacteriological quality of samples (Table 3) obtained from surface sources and open dug wells is unsatisfactory while that of tube wells fitted with hand pumps is better.

- Community participation is lacking in operation and maintenance.

3.4 Financial Management

- Financial Allocation by states as well as the centre for rural water supply programme is very much short of the actual requirements.

- The resource mobilisation by state governments for water supply is inadequate and therefore they look to the centre for grants.

- Financial contribution by the village community, wherever applicable, is often not realised due to the poor financial condition of local bodies-

- Collection of water charges wherever levied has been satisfactory only in those villages where no alternative source of supply is readily available to the consumer.

- When distribution is only through public stand posts, collection of water tax, wherever levied, is poor.

- When the operation and maintenance is looked after by any government agency, the allocation of grants for the purpose from the governments is not commensurate with the requirement.

3.5 Health Aspects

- Village-wise record/information on morbidity and mortality due to water-borne diseases is conspicuously lacking at Primary Health Centres (PHCs).

- Knowledge and awareness of the role of water in transmission of diseases have been found to be poor.

- Environmental sanitation in general is poor in villages and open field defecation is common.

- Motivation, health education and community participation are lacking.

3.6 Community Participation

- Lack of community participation in implementation and management of water supply schemes results in inefficient maintenance, low level of service and poor collection of water tax.

- Wherever alternative sources of water are available and the degree of service is poor, there is a general apathy on the part of the villagers towards the public water supply. This can be largely rectified by involving the community at all stages of planning, implementation, operation and maintenance of water supply schemes.

3.7 Constraints

- Scarcity and non-availability of materials in time.

- Inadequate allocation of funds for capital works.

- Lack of trained personnel for operation and maintenance.

- Inadequate funds for operation and maintenance.
- Outmoded administrative and financial procedures causing delay in implementation.
- Financial powers of Chief Engineers and other senior engineers not commensurate with professional capabilities and responsibilities.
- Non-availability of adequate data on health aspects for meaningful interpretation of health impact.

4. Recommendations

1. The 'Decade' target will be difficult to achieve unless water supply (and sanitation) is treated as a core sector and resource allocation matches with the magnitude of the problem.

2. The drinking water supply and sanitation programme should be closely coordinated with programmes in related sectors like rural development, health, irrigation, education, and social welfare to maximise the benefits to the people.

3. In order to coordinate and help the state efforts and formulate national policies and provide guidance, the organisational set up at the national level is grossly inadequate. As strong organisation similar to the Central Water Commission should be created which might be designated 'National Commission for Water Supply and Sanitation'.

4. Water supply is primarily a state subject. Nevertheless, the states look to the centre for funds. It is essential to have norms clearly indicated for classification of villages and allocation of funds at the national level. During execution of schemes, each state should have sufficient flexibility, provided the national norms are adhered to.

5. A separate agency/department is required at state level with its functions decentralised at district level. While the former will be responsible for policy decisions, financial allocation, monitoring and over all coordination, the latter will be the implementing agency (preinvestment studies, design, execution as well as operation and maintenance of the systems)

6. The district level organisation should consists of engineers, district collector, medical health officer, elected representatives, officials of other sectors of development like agriculture, industry with suitable infrastrure.

7. The criteria/norms adopted for the design of rural water supply schemes do not reflect the real situations obtained in many villages. There is an urgent need to review the norms and develop suitable design guidelines for intermittent water supply.

8. Smooth flow of construction materials like cement, steel, pipes and specials to the district level agency should be ensured. Use of plastic pipes be specified to obtained economy and reduce demand on conventional pipes.

9. In view of the experience that water supply schemes handed over to local bodies (Panchayats) generally suffer for want of trained personnel and professional supervision, all the water supply schemes should be entrusted to PHED/district level agency for operation and maintenance.

10. The three-tier system of maintenance of hand pumps evolved in Tamil Nadu, with minor local modifications could form the basis for wider application in all the states. Local persons should be encouraged to participated in the operation and maintenance of water supply systems.

11. Statutory provisions should be made for levy of water tax on the beneficiaries and ensure return of part or whole of the expenditure on operation and maintenance. Any deficit should be made good through grants by the state government.

12. Direct monetary returns, if any, from a rural water supply project is closely linked to the level of service provided by the water agency. Water distribution through house connections creates an awareness among the users, that water when provided through a tap in the house has to be paid for. While

the socio-economic conditions of the user community play an important role in the acceptance of this philosophy, wherever the situations are favourable, provision for house connection service should be made rather than a blanket ban.

13. Monitoring and evaluation and feedback for improvement by implementing agencies of rural water supply projects in general have not been given the attention it deserves. This should form an integral part of any water supply agency with separate cells at state and national level.

14. Training centres should be established at district level or at the existing institutes (ITI) for operators of rural water supply schemes. These centres should have fulfledged workshops to undertake on payment basis minor as well as major repairs of machinery and equipment commonly used in water supply systems.

15. While there is a great deal of political awareness among the rural population, their knowledge, attitude and practice towards use of water supply, sanitation and personal hygiene are far from satisfactory due to lack of motivation and effective health education which should form an integral part of rural water supply programmes. Health guides from amongst the villagers be selected, trained and appointed for the purpose.

16. Community participation should be ensured from planning to implementation as well as continued operation and maintenance. This can be achieved by proper motivation through an integrated and multi-disciplinary team of engineers, health and medical staff, social workers, revenue officials and local leaders.

17. Existing information system at state and national level are grossly inadequate. A suitable system invorporating modern data collection, processing and retrieval system, should be created urgently with suitable linkages at state and national level.

18. Each state should have a research and development wing attached to the Public Health Engineering Department/Boards. Atleast two per cent of the total investment for the projects in the decade programme should be earmarked for R & D.

19. Health education through mass media like radio-television, films should form part of the total programme.

Table 1 - Village Water Supply Systems Evaluated

Sl.No.	State	Number & type of systems selected for study: Tubewells with Handpumps, <1000 popul.	Tubewells with Handpumps, >1000 popul.	Piped water supply with PSP only, <1000 popul.	Piped water supply with PSP only, >1000 popul	Piped water supply with PSP+HC, <1000 popul.	Piped water supply with PSP+HC, >1000 popul.	Reference Villages	Total No. of Villages
1	Andhra Pradesh	-	2	1	1	-	2	2	6
2.	Gujarat	1	1	-	1	-	3	1	7
3	Haryana	-	-	1	4	-	-	1	6
4	Kerala	-	-	1	1	1	1	1	5
5	Madhya Pradesh	2	1	-	-	-	3	1	7
6	Maharashtra	-	-	2	1	-	4	2	9
7	Orissa	2	1	-	1	-	2	1	7
8	Rajasthan	1	1	1	1	-	1	2	7
9	Tamil Nadu	2	-	1	1	-	2	1	7
10	Uttar Pradesh	1	1	1	1	3	-	1	8
11	West Bengal	1	1	3	3	-	-	4	12
	Total	10	8	11	15	4	18	17	83

PSP - Public Stand Post HC - House Connection

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Table 2 - Classification of Schemes According to Operation & Maintenance (O & M) Agency

Sl. No.	State	No. of Schemes	Type of Scheme: Hand Pump	PSP	PSP+HC	O & M Agency: Local Body	PHED/ Board
1	Andhra Pradesh	6	2	2	2	6	-
2	Gujarat	6	2	1	3	3	3
3	Haryana	5	-	5	-	-	3
4	Kerala	4	-	2	2	-	4
5	Madhya Pradesh	6	3	-	3	3	3
6	Maharashtra	7	-	3	4	7	-
7	Orissa	6	3	1	2	-	6
8	Rajasthan	5	2	2	1	1	4
9	Ramil Nadu*	6	2	2	2	4	2
10	UttarPradesh	7	2	2	3	-	7
11	West Bengal	8	2	6	-	2	6
	Total	66	18	26	22	26	40

* O & M by TWAD but cost-borne by Local Body.

Table 3 - Bacteriological Quality of Rural Water Supply in India.

Sl.No.	Source of Supply	Treatment: Yes	Treatment: No.	No. of Samples	Coliforms +ve	%	-ve	%	E.coli +ve	%	-ve	%
1.	Hand pump tube wells	-	21	36	20	56	16	44	13	36	23	64
2.**	Tube well with Power Pumps	9	7	28	21	75	7	25	17	61	11	39
3.	Open dug wells	5	3	15	14	93	1	7	12	80	3	20
4.	Surface sources (Spring, Canal, River, etc.)	21	2	59	39	66	20	34	32	54	24*	46

* 3 Values missing

** in 3 cases dug well & tube well water mixed for supply

NOTE : Except in case of Handpumps, Samples were collected from PSPs.

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A K Biswas and others

Coastal zone water supply schemes - West Bengal

INTRODUCTION

In line with the United Nations goal for providing potable drinking water and effective sanitation for all, a decade programme has been undertaken by various Government of the world. India is actively participating in this programme. West Bengal being an enlightened state has drawn her own programme of work relating to decade activities. Factually the state Government was so much seized with the water supply problems of the Rural areas, they embarked upon a scheme of Accelerated Rural Water Supply in West Bengal since 1977-78. Of the many facet of such work the programme relating to Coastal Zone (which is predominently saline) is taken into considerations in this paper. This paper deals mostly with the evaluation of Rural Water Supply Schemes ofthe Contai Area, District Midnapore with Special relevance to quality of water, quantity, health status, socio-economic condition of the villages located within the area.

OBJECTIVE

The immediate objective was to assess the water quality, made an evaluation of the existing gaps and inadequacies, and to recommend for effective implementation, operation and maintenance of the existing water supply schemes in the study villages so that benefit is maximised.

MATERIALS AND METHODS

Durmut (population 2504) and Betalia (population 970) villages were selected as study villages (where organised piped water supply through public stand post exists) and Fauderchawk (population 387) was selected as a reference village (where there was no organised water supply system). The study period was for two years (1980 and 1981). Water samples were collected six times, once in each season, from all the three above mentioned villages. All physico-chemical and bacteriological analysis of water samples were done as per APHA Standard method (1). Along with the quality analysis, engineering data and information on health status as well as quantity of water supply were collected to have a greater insight into the problem.

WATER SUPPLY AND HEALTH STATUS OF COASTAL AREA.

Essentially the coastal zone in and around contai Municipality is extremely a saline zone. Surface water tapping and exploitation are also not suitable for potable water. To overcome such difficulties in one hand and simulteneously to provide adequate potable drinking water at the rate of 54 lpcd (12 gpcd) to 93,000 population (Projected population) the Public Health Engineering Directorate of West Bengal embarked upon digging deep tube wells (15.6 cm. diameter, 180 meter deep - 2 nos. in each of the five zones) from the sweet water zones about 10 km. away. Ground water from each zone is pumped to overhead reservoir (capacity 2,72,400 Liters) with a staging hight of 20 Meter and intermittent water supply is provided to the villagers. As per prevailing norms each stand post caters the water need of 250 people. Consumption of water in the study villages were observed to be 40 lpcd (8.8 gpcd). Water is distributed from overhead reservoir through public stand post which are fed by gravity flow, first through a 300 mm diameter C.I. Main and then through a 80 mm Diameter A.C. branch pipe. Normally water supply was seen to be provided for 2 hours in the morning and 2 hours in the evening. Overcrowding at the PSP'S was the main difficulty in fetching the water and this is followed by the distance that the villagers have to travel to get potable water. Water from PSP are mainly used by the villagers for cooking and drinking purposes and the rest of activities are carried with water from shallow ponds. Even through about 70% population was literate, still it was observed that most of the villagers were not aware of hazards of waterborne and infectious diseases. Immunization practices to prevent certain waterborne diseases are almost non-existant. The problems get further aggravated because of power failure and low voltage and at that time reservoirs are empty, consequently PSP'S are non-functional. Under such conditions most of the people will resort to using shallow pond water even for drinking and cooking purposes. Dysentery and Diarrhoea and worm infestation were common ailments in these villages. Compared to the study villages water quality of the reference village was observed to be worst from health status point of view.

RESULTS

Results of selected physico-chemical and Bacteriological parameters of the water sample collected and analysis both from study and reference villages are given in Table I.

TABLE I. Water quality of selected villages in COASTAL ZONES

Parameters	DURMUT		BETALIA		FAUDERCHAWK	
	Range	Average	Range	Average	Range	Average
ph	7.5-8.2	-	7.5-8.2	-	7.4-7.8	-
TDS	604-668	639	568-662	617	152-1264	384
T. ALKALINITY ($CaCo_3$)	302-361	323	304-361	336	32-292	112
T. HARDNESS -do-	304-365	332	308-361	342	41-360	133
CARB HARDNESS -do-	302-361	323	304-361	336	32-292	112
NON-CARB HARDNESS -do-	2-24	9	0-14	7	2-80	32
CALCIUM -do-	147-190	170	160-190	175	22-165	65
MAGNESIUM -do-	136-177	160	140-194	166	21-149	59
CHLORIDES (Cl)	123-150	135	132-151	143	21-354	87
SULPHATES (SO_4)	23.2-37.5	28.55	25.0-32.5	28.04	5.01-187	42
T. IRON (Fe)	0.08-0.42	0.168	0.04-0.18	0.11	0.22-3.44	1.63
RESIDUAL CHLORINE (CL_2)	Traces	-	Traces	-	N.A.	-
BACTERIOLOGICAL (MPN/100 ml)						
Coliforms	0-790	215	0-23	10	20-2400	1250
F. Coliforms	0-33	14	0-23	8	0-1700	680
E. Coli	0-13	4	0-4	1	0-490	320
F. Streptococci	0-13	5	0-4	1	0-330	159

(All values except pH are expressed in mg/1)

From the critical analysis of the data presented it could be observed that in both the study villages total dissolved solids of water was high and other parameters were more or less within the permissible limits. In the reference village, iron content was observed to be comparatively higher and the other parameters were well within the permissible limits. Bacteriologically water quality in both study villages and also in reference village were unsuitable as potable water. Total coliforms count in Betalia was observed to be 0-23 MPN/100 ml and that of Durmut was 0-790 MPN/100 ml. High total coliform count of 20-2400 MPN/100 ml. was observed in the reference village Faudarchawk. *F. Coliforms, E. Coli, F. Streptococci,* values of water analysis from reference village were much higher as compared to the corresponding values of study villages - Durmut and Betalia.

DISCUSSIONS

Along with water quality studies health status and water supply position of the study and reference villages were undertaken. In general villagers were quite responsive and respondent percentage varied from 68-84 where educational level was arround 70%. Open air defication was the common practice and 85-90% of the people were going into the field for easing themselves.

Aesthetic sense of the people was observed to be excellant and almost cent percent of the people will wash their hands after defication and these 74-97% of the people were using mud to clean their hands after ablution.

In respect of health education it was noticed that the local people (25-30%) were ignorant about the adverse effect of drinking unsafe water.

Dysentery and diarrhoea were observed to be very much predominent and the morbidity rate was as high as 65-79%. The concept of immunization were poor and during illness only 17-30% of the people will go to Health Centre for treatment. The remaining majority will go to private medical practioner for treatment under compelling circumstances.

Even through people were poor, still majority of them will prefer to call on private practitioner in preference to Primary Health Centre/Govt.Hospital. An enquiry into this situation revealed that the facilities at Govt. Institution could not be availed by most of the people because of distence, non availability of medicine, Doctor and for other constrains. Cholera and typhoid innoculation ranged from 8-26% only. Polio, T.B. Vaccination of the Children were also observed to be very low. Other details on Health status and water supply are summerised in Table 2.

TABLE - 2. Some relevant data/Information on Health Status and water supply position of the concerned villages.
(All figures are in percentage unless or otherwise stated)

I T E M S	DURMUT	BETALIA	FAUDERCHAWK
1. Educational background of the respondent			
- Illeterate	25.4	30.2	30.4
2. Sullage is disposed off in			
- no organised system	76.2	63.5	78.3
- ordinary pit	11.2	-6.3	17.4
- connected to drainage	17.5	-	-
3. Domestic garbage and refuse are disposed off - throwing arround the house	38.1	22.3	39.2
- Pit in the house premises	34.9	34.9	21.8
4. Fingernails were observed to be properly cut and cleaned	46.1	44.5	30.5

TABLE - 2 (Contd.)

ITEMS	DURMUT	BETALIA	FAUDERCHAWK
5. People's knowledge about drinking unsafe water causing diseases is known to	66.7	73.1	69.6
6. Villagers knowledge on water borne diseases			
- Cholera/Gastroentitis	20.6	27.0	30.4
- Typhoid	12.7	7.9	21.7
- Dysentery/Diarrhoea	66.7	65.1	78.3
- Infectious hepatitis	4.8	-	13.1
7. Habit of the people is to take daily bath but its importance is attributed to			
- personal hygiene	38.1	42.9	17.4
- Freshness	73.1	53.9	82.6
8. Villagers beleive that control of diseases by immunization is possible to the extent of	46.1	44.5	47.8
9. Recurrence of three types of waterborne diseases during last 3 years are reported by villagers to be			
- Dysentery/Diarrhoea	79.4	96.8	91.3
- Worm infestation	76.2	88.9	78.4
- Typhoid	3.0	3.2	4.4
10. Reduction in illness after introduction of water supply to the extent for the following diseases (as reported by villagers)			
- Dysentery/Diarrhoea	47.6n	61.9	N.A.
- Typhoid	2.0	2.0	N.A.
- Cholera	23.8	7.9	N.A.
11. Quantity (in liters) of water obtained daily.			
- morning	24.2	30.9	N.A.
- evening	18.5	22.6	N.A.
12. Time (in minutes) spent in fetching water on an average			
- morning	50	50	N.A.
- evening	45	40	N.A.
13. Difficulties infetching water is attributed to			
- over crowding	95.3	96.8	N.A.
- insufficient pressure	30.2	61.9	N.A.
- Distance too long	19.1	30.2	N.A.
14. Breakdowns in water supply is attributed to			
- Electricity	95.3	87.3	N.A.
- Machinery	15.9	4.8	N.A.
- Organisation	22.3	6.4	N.A.
15. Villagers fetch water during breakdown from			
- Shallow pond	100.0	100.0	N.A.
16. Villagers attribute benefit of water suuply to- labour reduced infetching water	49.2	82.5	N.A.
- more time available for work	31.7	60.4	N.A.
- reduction in illness	73.1	82.5	N.A.

(Forms only a part of questionnaire used during the study)

CONCLUSIONS

Taking the condition of these villages and other 83 villages spread over 11 States in India, NEERI recommended certain norms for percapita rate of water supply (lpcd) which is given a Table-3 (2).

TABLE 3. Recommended per-capita rate of supply (lpd)

Description	House connections	Public standpost/hand pump
Drinking	5	5
Cooking	3	3
Ablution	10	6
Bathing	20	15
Washing utensils and house	15	10
Washing of clothes	20	15
Flushing	8	6
	81	60
Leakage/wastage at 10%	8	6
	89	66
Say	90	70
Cattle need including leakage/wastage	20	20
	110	90

This norms may not be very suitable to all the villages in India but serves as a useful guide lines for future programming and to improve upon the condition of the existing one. Needless to mention that all the three villages mentioned above were getting inadequate water for their various uses. It is desirable that to improve upon the existing condition at least one PSP'S (with 2 taps) of "waste-not type" for every 150 persons be provided. Furthermore, supply be maintained at adequate rate (12 lpm per tap) at all the PSP'S for 2-3 hours in the morning and 1-2 hours in the evening at timing convenient to the consumers at least. The bacteriological water condition of the study villages can be improved upon by adopting effective chlorination and by constructing suitable platform with proper drainage arrangement at PSP'S. The competent authority should also ensure that ground water withdrawal and pumping the same to overhead reservior are not interrupted for failure of power, low voltage etc. If this is not taken due care off then the marginal benefits that have been offered will also not be meaningful. In order to make the scheme more effective, it is recommended that the following measures should be adopted.

- Community participation in water supply and sanitation programme should be encouraged so as to improve O & M at water supply system.

- The community has to be made aware of the benefits of environmental sanitation through a regular programme of health education and motivation.

- A programme for rural sanitation with a limited demonstration latrine programme should be undertaken immediately.

Unless and until water supply programme is matched with the appropriate sanitation practices, the health of the villagers are not likely to improve. Where possible arrangement may be made to provide water supply in the household at consumer cost and many of the villagers are willing to pay for it.

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REFERENCES

1. American Public Health Association : Standard Methods for the Examination of Water & Waste-water, 14th ed., Washington, 1975.

2. NEERI Report on Evaluation of Rural Water Supply Schemes in India, NEERI, Nagpur, 1982,

12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

E G Thomas, A Hayes, N J Hoover, N D W Lloyd

Refugee water supplies in Somalia and Sudan

SUMMARY

The Register of Engineers for Disaster Relief (REDR) has over the last five years sent 70 engineers on missions of three months' duration to 10 countries worldwide for 8 international agencies. The water supplies and to a lesser extent the sanitation programmes in the semi-arid zones of North-western Somalia and Eastern Sudan were just two of the many schemes conceived and implemented by REDR engineers, public health specialists and medical teams from the Non-governmental Organisations (NGO's).

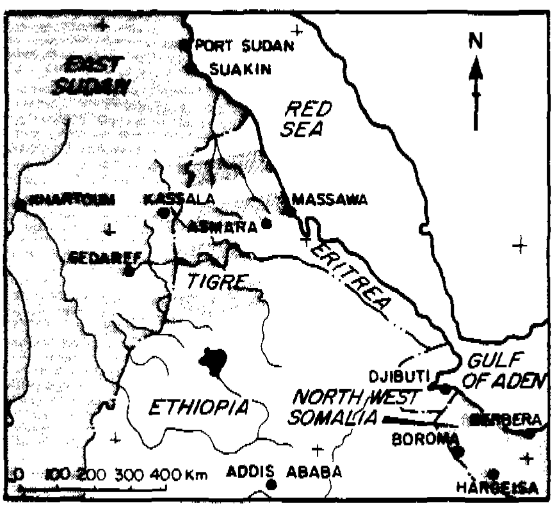

FIG 1. REGIONAL MAP

Both programmes were large scale, each serving around 400,000 and 200,000 refugees respectively, and had to be implemented immediately and progressively, requiring a high degree of improvisation and the sound application of both high and low technology. The "appropriate technology" ranged from hand dug wells sited with information from a small water proving rig, to boreholes drilled using large commercial rigs. Wells were variously equipped with diesel, solar and hand pumps. Polluted surface water supplies were filtered, stored and simply chlorinated. Aquifers were tapped using infiltration galleries, and were enlarged artificially through the construction of "saturated sand storage dams".

The health of large refugee communities can be improved by the development of relatively <u>low cost</u> water supply and sanitation <u>solutions based on the application of 'appropriate' low and high technology</u>

For convenience Parts I and II of the paper are subdivided into the three development phases used in the OXFAM Refugee Health Care Guide (1). These are:

(a) Initial Assessment - "To determine the health and nutrition needs ..."
(b) Initial Relief Phase - "To respond to the specific health problems.."
(c) Consolidation Phase -"To set up a health care system which will attempt to maintain an appropriate level of health .. not markedly superior to that available to the local non-refugee population ..".

PART I - NORTH-WESTERN SOMALIA REFUGEE WATER PROJECT

1.1 Introduction

This part of the paper covers the general development of the water supply programme, in the 9 large refugee camps of NW Somalia.

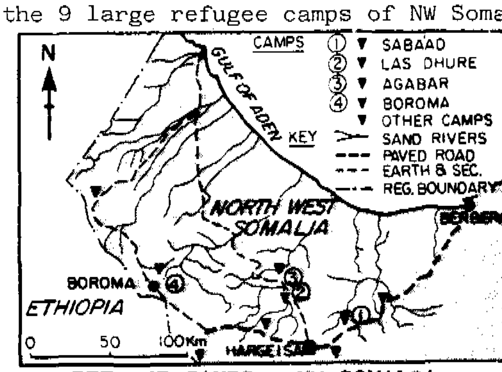

FIG 2. REFUGEE CAMPS - NW SOMALIA

In 1980 the United Nations High Commissioner for Refugees (UNHCR) asked OXFAM to be the implementing agency for water supplies in these camps where the water supply situation was most acute both in terms of quantity and quality. The state of health was described as hazardous.

1.2 Initial assessment

1.2.1. <u>Alternative sources</u>. These were investigated in 81 by a REDR engineer working as OXFAM's team leader.

After eliminating the possibility of making permanent connections to existing town supplies, (townspeople were short of water), or of developing new deep boreholes sources (past experience suggested that a thorough hydro-geological survey would first be required), it was decided in the first instance to consider developing the shallow groundwater in the Wadis (sand rivers) to their fullest potential. These ribbon aquifers were the traditional sources for waterholes and were already being used by the refugees.

1.2.2. Sand rivers as a source The team leader had previous experience of 'sand river' development in Botswana (2,3), was aware of the development of 'saturated sand storage dams' on such rivers in neighbouring Namibia (4,5), and realised their potential, even as a long term source.

Although the saturated sand in the ribbon aquifers in NW Somalia was typically only 1 to 3 m thick, thus having low unit water storage and being subject to high evaporation loss, this was compensated by the frequent recharge of the aquifers. Discussions with local people revealed that in the areas of the camps where catchment areas were frequently several hundred km^2 in extent, the sands were recharged by floods several times per year. This was confirmed by a study (6) which revealed that major floods were mainly generated by rainfall 'thresholds' of intensity equal to or exceeding 24 mm/day, indicating on rainfall records of 20 years that there were unlikely to be less than 4 'threshold' events in a year, and that only once in 40 years would the aquifer not receive any usable replenishment at all. Furthermore the aquifers near the camps were recharged over the greater part of the dry season from the sub-surface outflows from extensive aquifers further upstream. The water was generally of low salinity and good bacteriological quality.

It was concluded that a system based on the construction of shallow wells and infiltration galleries along the sand rivers, supplemented by saturated sand storage dams, could supply drinking water to most camps at a rate of about 5 l/hd/d during the most critical drought period in years of normal rainfall.

1.3 Initial relief phase

1.3.1 Developments Immediately after the assessment, the camps were replanned to discourage the pollution of the 'sand river aquifer'. Refugee housing was moved away from these sources, and refugees were directed to use designated 'defaecation fields' or build pit latrines on a family basis.

Typically at camps with populations of more than 30,000, 10 to 15 wells between 2-3.5 m in diameter and 3.5 - 6 m in depth were dug in the river terraces and underlying basalt rocks along a 3 km river frontage. Wells gave an average yield of only 10 m^3/d during the dry season (5 l/hd/d) and it was therefore necessary to control average consumption to this level through a policy of minimum distribution within the camps. After deepening using Pionjar hand held drills, wells were lined with Armco culverting and infiltration galleries made from locally available 200 mm dia rigid plastic pipe slotted by hand. Water was pumped directly to steel and plastic tanks at the wells and distributed to standpipes nearby.

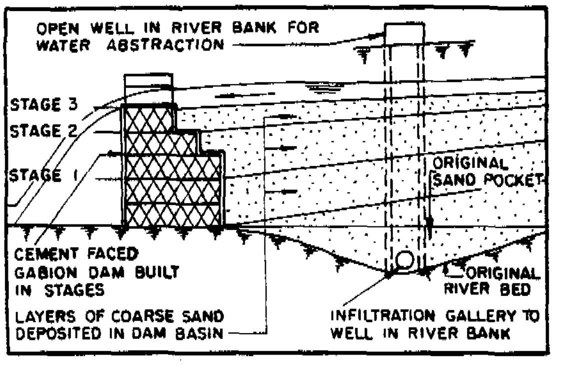

FIG 3. STAGED DEVELOPMENT OF SAND STORAGE DAMS

1.3.2. Sand storage dams These were started in the outlets to the ribbon aquifers Las Dhure and Sabaad camps. They had an immediate beneficial effect, since they were impermeable structures keyed to the existing rock barriers, of diverting the whole subsurface flow to the wells. Later on, the coarse sand and gravel river bed loads built up to cill level over the flood season. Thus the aquifer storage capacity was increased artifically and the water below 1 m depth protected from the effects of evaporation. The reliability of the aquifer as a source increased dramatically even by an initial 1 m heightening of the 50 m wide structures (6).

1.4.1. Consolidation phase. This took the form of the further development of the shallow groundwater using open wells and sand dams, following premature and unsuccessful attempts by others to locate deeper groundwater in any quantity. Diesel pumps were supplemented with 25, SEI 250 solar pumps at times when fuel was in short supply. These units typically delivered 2.5 l/s at a lift of 5m. Evaluations of solar pumping stations for both irrigation and water supply have been undertaken (7, 8), but not in refugee camp situations where they have considerable potential. Simple back-up water chlorination facilities were provided at all camps.

The sanitation systems have been slow to develop for largely social reasons. Fortunately the Somalia sun has been found to be a great steriliser during the dry season.

1.5. Assessment of project

This project confirmed "sand rivers" as potential sources of good quality and moderately reliable quantities of water for refugee water supplies which have to be developed quickly This lead in part to the development of the OXFAM water kit as standard disaster relief equipment (9).

The shallow well programme designed originally for a life of five years has provided water to 400,000 people at an initial capital cost of £2 per refugee, with an annual equipment replacement and maintenance cost of £0.5 per refugee (10, 11).

"Saturated sand storage dams" have exceeded the highest expectations as an aquifer improvement technique.

PART II - EASTERN SUDAN REFUGEE WATER PROJECT

2.1. Introduction

This part of the paper describes the typical problems and solutions associated with the water supplies, and to a lesser extent the sanitation, in the refugee camps of Eastern Sudan and in the adjacent areas in Eritrea and the Tigre province of Ethiopia.

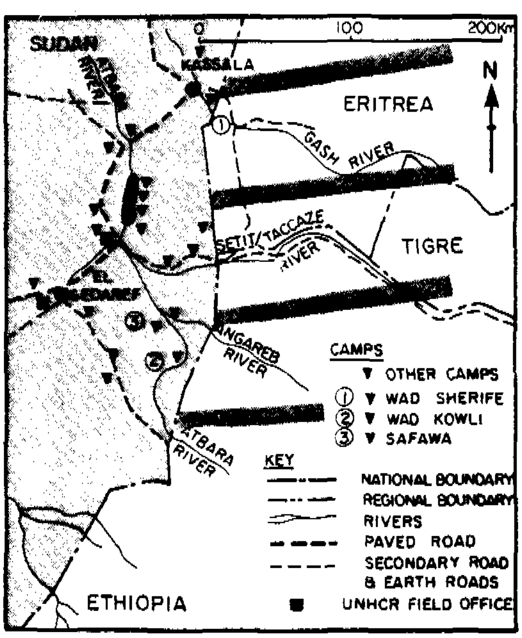

FIG 4. REFUGEE CAMPS - E. SUDAN

In January 85 about 200,000 refugees from Eritrea and Tigre were congregated at 20 camps; 70,000 being at Sherife, 25,000 at Wad Kowli, and 20,000 at Safawa. The camps were initially sited by the first refugees, who, once inside the host country, decided to travel no further than the first available water source.

During February 85, with refugees still in a debilitated state after a three to five week journey on foot to Sudan from a famine and war stricken area, and with these refugees taking water from stagnant pools located in the river bed and having no sanitation facilities, the overall mortality rate at Wad Kowli was 8.6 deaths per 10,000 per day. For children under five, the rate was 22.2 deaths per 10,000 per day. Although it would have been difficult to have distinguished between the mortality and the morbidity attributable to polluted water and/or lack of proper sanitation, it was against this background of crisis that UNHCR and COR (Sudanese Commissioner for Refugees) called in OXFAM to establish and maintain the "best possible water supply systems in the main camps". Similarly the IRC (International Rescue Committee) were asked to initiate a sanitation programme at Wad Kowli.

2.2. Initial assessment

The assessment of the water supply and sanitation situations was undertaken in January 1985 by the OXFAM/REDR and IRC engineers and specialists. At Wad Kowli water was taken directly from polluted surface pools in the rocky river bed, and at Wad Sherife the supplies were dependent on a single borehole and shallow wells supplemented by an unreliable and costly emergency tanker supply from a good quality source 30 Kms away. There was little prospect of 'sand river' exploitation as in Somalia, the area being covered by impermeable black cotton soils

It was decided to speedily develop the local sources of water to supply the whole camp populations at an absolute minimum rate of 5 l/hd/d with water of improved bacteriological quality, and provide basic improvements to both storage and distribution. For this work OXFAM immediately requested a team of REDR engineers to work with associated NGO's to install various packages from the OXFAM Water kits (9) held in store in the UK and airfreighted to the Sudan.

2.3. Initial relief phase

2.3.1. OXFAM water kits. High priority was attached to the installation of packages from these kits. The design population for each kit was fixed at 5000, but larger populations could be served by multiples of these basic package units. The basic capital cost of this system was £2 per refugee per year.

These kits were designed to handle raw water with reported typical faecal coliform bacteria concentrations per 100 ml ranging from 10-100,000 for rivers, 1300-1900 for ponds, 5-10 for protected wells and 0-100 for boreholes. The normal seven packages were as follows:

a) well construction package covering shallow wells up to 10 m in depth to boreholes even greater than 40 m in depth.
b) pumping packages for wells and boreholes.
c) storage package consisting of corrugated steel tanks with butyl rubber liners.
d) floating surface water intake package.
e) sub-surface abstraction package.
f) treatment package incorporating settlement, slow sand filtration and chlorination.
g) distribution package including pumps, pipes and standpipes.

2.3.2. Development of the water sources. At Wad Sherife camp the REDR engineer found that the existing local water supplies comprised one borehole fitted with pump and standpipe giving 8 m^3/h, and hand dug wells. There were also five unused boreholes, two of which were fitted with hand pumps, all situated in a proven aquifer close to the camp consisting of a 20 m thick stratum of sand and gravel overlying the granite basement. The water table was 10 to 20 m down. Despite being capped with a 10 m thick layer of silty clay, the aquifer was recharged annually via a connection from the Gash river. The water quality was good but tended to be slightly saline near the camp.

Unfortunately the potential of this proven aquifer had not been appreciated earlier by the authorities, and largely unproductive efforts had been made to develop alternative sources on much less favourable sites. High priority was given to rehabilitating the 5 unused boreholes originally drilled by the Dutch Government (KADA), and the siting of a further 5 250 mm dia boreholes in the proven aquifer. Also to obtaining the essential compressor, surge plunger, baler, screens and test pumps which had been lacking in the earlier abortive drilling programme.

The existing wells were rehabilited in 6 weeks by KADA, and when fitted with borehole pumps each produced between 30 m^3/d and 120 m^3/d thus ensuring a total of 500 m^3/d to the population (7-8 l/hd/d). The 5 additional boreholes were later drilled to the granite basement at 30 m depth using minimum bentonite, properly screened and developed and fitted with Mono lift pumps to provide the badly needed standby capacity. Since there is always the risk of pumping rates exceeding the natural recharge rate it will be necessary to continually monitor the factors. This is doubly necessary in emergency situations but is rarely appreciated by non-engineers.

2.3.3. Water distribution and sanitation. At Wadi Kowli camp IRC's sanitation specialist found a desperate public health situation. Refugees were taking water directly from pools in the river bed, though chlorine tablets were being added to individual containers as they were carried away. Relief took the form of improving the health of the refugees through feeding programmes, medical services, and clean water and sanitation provision.

Initially water was trucked-in from a relatively unpolluted source 30 Kms away which fed 9 OXFAM storage tanks with a total capacity of 450 m^3. Later water was pumped directly to these tanks from an infiltration gallery set 2 m below the bed of the Atbara river. Using the appropriate packages from the OXFAM water kits this water was filtered, chlorinated and fed to standpipes by gravity and pumped to clinics, hospital and feeding centres.

Sanitation was limited at this stage to the demarkation of 'defaecation fields' and spraying in hospitals, feeding clinics and feeding centres.

2.3.4. Water proving rig for well programme. In the mountain areas of Eritrea and Tigre, on the main migratory routes of the refugees to and from the Sudan, impressive and far sighted programmes of 50 wells, infiltration galleries, sand dams and surface dams have been undertaken. The wells, often 20 to 30 m in depth and 5 m diameter have been excavated using hand tools and explosives in hard precambrian rocks to locate the limited points of fracture and weathering where water might accumulate. Each well has taken months to construct and has often intercepted dry season flows of only 5 m^3/d. A DANDO 110 hydraulic rotary rig, is now being used to prove the supplies of water in advance of the well digging teams to ensure success. The specification for this rig required a coring and down-the-hole hammer drilling capability to 50 m depth in hard crystalline rocks, and an augering capability for the 'sand rivers' down to 20 m - an example of just one of the innovative water resource investigation and conservation techniques presently being tried.

2.4. Consolidation phase

This is in the very early stages at camps like Wad Sherife and Wad Kowli. Plans have however been made to improve all the emergency works, to develop the existing and new sources using the appropriate level of technology, and to train workers to maintain and improve these systems. Environmental health personnel are being trained to encourage the building of pit latrines, garbage collection, clothes washing and delousing.

Limited consolidation has begun in the areas of bordering Eritrea, where steps are being taken to reabsorb refugees returning home after the rains. In parallel with the well programme already described, a parallel programme of deep borehole drilling is underway using a rotary rig with down-the-hole-hammer capability to depths in excess of 200 m.

2.5. Assessment of project

This project illustrated how an NGO like OXFAM with limited technical capability, but with the support of REDR engineers and other specialists, was able to implement a large water programme. The timely availability of the OXFAM water kits was a key factor in the programmes ultimate success.

Drilling programmes must be preceeded by proper hydro-geological investigations so as to avoid abortive work, and once developed must be professionally monitored. Without the water project the earlier life saving efforts of the medical teams would have largely been wasted. Sanitation is recognised as being the most difficult part of any health programme. Regrettably it is often accorded low priority by non specialists, despite the fact that the lack of safe disposal of faeces is a major cause of refugee ill-health and can lead to potential epidemics. Sudan is no exception in that there is a gap between 'recommendations' and the 'approval and implementation' by the authorities.

CONCLUSIONS

These schemes illustrate that there is rarely just one approach to refugee water supplies and sanitation. Plans have to be modified constantly because of changing circumstances, requiring a flexible attitude on the part of REDR engineers. If refugees moved, water points had to move; if existing local interests were threatened by the water abstractions for the refugees, alternative services had to be developed quickly. There were set-backs to the programmes, but these were eventually overcome. Gradually but steadily the water supplies were improved and the sanitation facilities formalised, and in consequence the Works contributed in large measure to the long term improvement in Refugee Health.

REFERENCES

1. OXFAM MEDICAL UNIT. Practical guide to refugee health care. June 1983.
2. THOMAS E G & HYDE L W. Water storage in sand rivers of Eastern Botswana. FAO April 1972.
3. FAO - Irrigation and drainage paper No 37 - Arid zone hydrology pgs 256 to 260 FAO Rome 1981.
4. WIPPLINGER O. Storage of water in sand. Namibian Dept of Water Affairs 1958.
5. BURGER S W & BEAUMONT R D. Sand storage dams for water conservation. Southern Africa Water Year Conference 1970.
6. SIR WILLIAM HALCROW & PARTNERS/OXFAM. North -west Somalia refugee water supplies interim report. August 1982.
7. SIR WILLIAM HALCROW/ITDG. Small scale solar pumping system studies for World Bank. 1981 - 1983.
8. KENNA J & GILLETT B. Solar water pumping handbook. I T Publications 1985.
9. GRAHAM N J D & TOWNSEND G H. Appropriate water supply systems for disaster relief. Public Health Engineer October 1983.
10. THOMAS E G. Somalia refugee camps put sand and sun to good use. World Water. March 1983.
11. LLOYD N D W. Improvision the key to refugees' health. New Civil Engineer March 1981.

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

Donatus M Ishengoma

Water supply in semi-arid Tanzania

WATER SUPPLY IN SEMI-ARID TANZANIA

1.0 INTRODUCTION

We are at the Midst of the United Nations Water Supply and Sanitation Decade. In Tanzania, 49% of the total population have access to the provision of clean Water.

In this paper, the Water Supply position of the Nations' 20 Regions is shown, indicating that some Regions rank much lower than the National Average.

The paper gives special attention to the three Semi-Arid Regions of Arusha, Shinyanga, Singida and Dodoma where live-stock keeping is the main activity of the people thereby calling for a redifinition of our Water Supply objectives.

2.0 BACKGROUND

The United Republic of Tanzania is situated close to the Equator in the Southern Hemisphere between lat. 1°S and 11° - 30°30 E and 40°E.

Tanzania mainland has an area of 937,062 km² out of which 53,483 km² is water and 223,844 km² is semi-arid land.

Tanzania's climate is essentially equatorial type generally modified by topography, latitude and the Indian Ocean. This phenomenon has basically characterized Tanzania into three Agro-Economic zones namely:-

Zone - 1: Semi-Arid Central areas of Tanzania with rainfall less than 500 mm/annum

Zone - 2: Coastal and Western areas with rainfall between 500-1000 mm/annum

Zone - 3: Highland areas with rainfall above 1500 mm/annum

According to the National census of Tanzania Mainland of 1967 and 1978, the total population was 12.00 million and 17.00 million people respectively. The net change is 42.5% with an annual growth rate of 3.2%. The growth rate in Urban areas is estimated between 6-10% per annum.

3.0 STRATEGIES ADOPTED FOR DEVELOPMENT OF WATER SUPPLY PROGRAMME

In 1971, the Government launched a 20 year Water Supply programme aimed at providing all the people in rural areas with clean Water within 400 metres from each household by 1991 (in line with the UNWSSD)

In an effort to achieve this target the Government adopted various strategies These strategies include:-

- Conducting investigations to identify potential water sources particularly those which can be developed on low cost basis)
- Training of Water Engineers and Technicians so as to make available the required manpower for implementing the programmes.
- On the job training of village water Technicians(craftsman).
- Rehabilitation of existing schemes
- Introducing easily maintained systems such as windmills, shallow wells etc. wherever technically feasible.

4.0 SITUATION AT MID DECADE

Due to various constraints, only 49% of the Total population have access to clean water. The major constraints include interalia, lack of foreign exchange for the importation of necessary construction materials, equipment, fuel etc.

Table 1 below gives the picture of the Water Supply position by the end of 1984

TABLE 1: WATER SUPPLY SITUATION IN TANZANIA

REGION	DONOR	% Age of Total pop. Served
* Dodoma	-	79.3
Dar es Salaam	-	75.0
Mtwara	FINNIDA	66.1
* Singida	-	61.4
* Arusha	-	59.0
Kilimanjaro	-	57.0
Coast	-	56.1
Morogoro	Netherlands	54.2
Tanga	W. Germany	49.9
Iringa	UNICEF, DANIDA	49.4
Lindi	FINNIDA	40.0
Mwanza	SIDA	37.0
Mbeya	DANIDA	36.5
Tabora	-	36.0
Kagera	SIDA	32.0
Rukwa	NORAD	30.0
Mara	SIDA	28.0
Kigoma	NORAD	25.0
Ruvuma	DANIDA	23.0
* Shinyanga	Netherlands	22.6

* Semi-Arid Zones of Tanzania.

(Source: Water Engineer Conference Arusha, 1984)

Note: There are villages which are served by natural streams or sources established by individuals which are not indicated in table 1.

TABLE 2 WATER SUPPLY IN SEMI-ARID TANZANIA

REGION	POPULATION	AREA km²	WATER SOURCES					
				UNDERGROUND		SURFACE		
			Springs	Boreholes	Shallow wells		Gravity	Dams
Dodoma	972,005	41,311	-	[illegible]	5.2		-	21.6
Shinyanga	1,568,257	50,764						
Arusha	1,190,000	82,429	-	25.0	25.9		32	18.2
Singida	[illegible]	49,340	5	57	45.0		-	-
Total	4,430,262	223,344						

SOURCE: WATER ENGINEERS' CONFERENCE ARUSHA, 1984

Table 1 reveals that most of the recent do donor assisted Regions rank low in Coverage, but such a situation could be exdue several factors as:-

(i) implementation of Water schemes in some of the donor assisted regions has hardly been going on for more than two years.

(ii) a number of donor have felt the need to assist in areas where the water supply situation was already critical.

5.0 WATER SUPPLY IN THE SEMI-ARID REGIONS

The semi-arid regions of Tanzania (Shinyanga, Dodoma, Arusha & Singida) occupy 240% of the Country with 22% of the total population(Ref. Table 2).

Unlike the rest of Tanzania, these areas were traditionally characterised by dryness, overgrazing, nomadic culture of the inhabitants (who were mainly herdsmen).

In order to make the Water Supply programmes effective in these areas, the Government had to try and resettle them in "Ujamaa Villages".

6.0 CONSTRAINTS

There have been several constraints in the construction and up-keep of water supplies in the semi-arid Regions mainly due to:-

- inadequacy of funds
- lack of construction materials
- lack of suitable water sources
- lack of working facilities (transport, tools and machinery)
- lack of qualified and competent manpower
- lack of fuel (diesel)
- non-availability.

These constraints have made the service level to go down such that the actual number of people enjoying the service is very much lower than the one in Table 1 (due to projects which are malfunctioning).

The Ministry of Water in Tanzania is charged with the responsibility of supplying water for human consumption while livestock watering is taken care of the Livestock Development Authority (LIDA).

However, this creates a discrepancy because it is very difficult to separate livestock from human beings, and thus difficult to expect any"self help" response to a project intended only for domestic Water Supply.

7.0 RECOMMENDATIONS

- Donor assistance should be sought assist these Semi-Arid regions faced with an acute Water shortage.
- There is a need to redefine the duties of the Ministry responsible for Water Supply such that livestock watering be included.
- In order to achieve the 1991 target, low cost options should be considered wherever technically feasible.
- The Ministry of Water through its Central stores (Kurasini) should try to stock most of the construction materials, equipment etc. hence obscervering standardization.

Conclusion

It can be realised from the information that this programme has been quite expensive and time taking as Franklin' argues, but without this programme the Ministry would have taken longer time to achieve its present stage. The World wide economic crisis which has hit seriously the developing countries has also affected Tanzania in the implementation programme of water for rural areas by 1991 as envisaged earlier. But despite of all these problems Tanzania has been able to provide nearly 40% of the 6.9 million population living in rural areas and in terms of manpower requirement the Ministry has provided at least three to four Engineers in each of the twenty regions in the country. Some Engineers have been posted to work up to District level. The idea is to send the experts to the villages where they can work close to the people and understand their problems.

There are no plans now of Training large numbers of Engineers outside the country but this does not mean that the Ministry is self sufficient in Manpower requirement. The Ministry will continue to rely on the allocation of few Engineers who have been trained locally or sometimes abroad.

ACKNOWLEDGEMENT

On behalf of the Tanzania Government The Ministry of Water Energy and Minerals would like to thank the Swedish International Development Agency (SIDA), for its financial support to the programme and to the Government of India for making the whole programme successful.

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Shecou-Bah Kabbah

The improved bailer well

INTRODUCTION

This paper, gives a brief account of project activities, and discription of the Improved Bailer Well, and other related information of the Rural Sanitation Research Phase I and II Project.

It was observed during the initial phase of this Research that despite the presence of other ongoing development Projects within the selected villages, the local people appreciated the dangers associated with drinking water from streams and rivers, that were used for disposal of material and human wastes.

As demonstrated by the Results, the core objective of the project was an attempt to break the chain of transmission of human excreta and water related diseases, through preventive rather than curative measures within selected village samples. It was hopeful that the combination of bailer wells VIP Laterines and the health Education component of the project, would serve as eye opner to full health benefits in the rural areas of Sierra Leone and other third World Communities.

The local participation and initiative demonstrated by the communities in the construction, maintenance and uses of the facilities during the period of this project have shown clear indications that the new behaviour patterns have made the people to start self initiations of social obligations and responsiblities, for building a healthy community, as they seem to identfy with the improved latrines and wells.

The basic health education aspect of the Research have facilitated awareness for health practice among neighbouring villages, who are requesting that the facilities be extended to their communities. It is also hopeful that the experiences gained and lessons learned by common effort have greatly influenced individuals and families to realize their health needs and problems in relation to the community as a whole.

BACKGROUND

Poor environmental condition in many third world rural communities seriously impede efforts to improve health status of their populations. Simple sanitation intervention such as the provision of intervention of safe, adequate water supplies and sanitation facilities and improvements in general hygiene are means of improving community health. However, many developing country governments are constrained in their efforts to design and implement such programs due to limited human and financial resources. Local Non-Governmental organizations (N.G.Os) are being called upon increasingly to respond to this situation.

In this regard, a vigorous awareness has been sipping into the minds of our rural communities and the need for collective responsibility have gradually become evident through the efforts of the community development council in Bo, Southern Province of Sierra Leone in order to answer to our health and general sanitation problem, the council has embarked on rural sanitation research in the Tikonko Chiefdom, Bo District which is one of the most affected areas. Lack of clean drinking water, poor wells, lack of proper latrine facilities, ignorance of proper Health education, contaminated rivers and springs etc. have offered correct solutions to the problems. After a period of feasibility studies in collaboration with the IDRC representative the Ministry of Social Welfare, the Ministry of Development and Economic Planning, Ministry of Health, the Paramount Chief, Elders and Subchiefs of Tikonko Chiefdom, the research commenced in December, 1982 with the pilot centre at Lembema village, nine miles from Bo Town.

COMMUNITY DEVELOPMENT COUNCIL- CDC

The community Development Council (CDC) an indigenous, non profit non-governmental organization (NGO) was found in 1980. The primary emphasis of this NGO is to assist rural communities in becoming self-sufficient through a range of community based and community- supported activities. In 1982, the CDC received an IDRC grant to investigate the extent to which active community participation and hygiene education could motivate people to construct and maintain their own water supply and sanitation facilities (RURAL SANITATION RESEARCH SIERRA LEONE)". The project demonstrated that communities can take responsibility for constructing and maintaining their own sanitary facilities, improved enviromental conditions and reduce hazards to health.

As a result of the perceived benefits of the project, neighbourring communities have since requested the community Development Council to expand the project activities to their communities. As a relatively young NGO with very limited resources, the Community Development Council has requested IDRC support for a phase II study project to replicate and evaluate the impact of the strategies used in phase I. Based on the experiences gained in Phase I, improvements will be made to the Bailer wells and the Improved VIP Latrines, to enhance their acceptability and technical performance. The proposed phase II has been approved by IDRC. In this phase the CDC (with the help of a consultant) will evaluate the impact of these interventions on the health status of the communities involved. The project will continue in fifteen new communities identified for Phase II.

COMMUNITY PARTICIPATION

Much has been written in development literature about the role and potential impact of community participation Yet it appears that community participation is often nothing more than volunteer (free) labour. Community members are rearly actively involved in the actual planning, implementation evaluation of project activities. However, it is generally agreed that the success of a project requires the active involvement of the community in all aspects. This project therefore has provided an opportunity to study the role and impact of active community participation in the planning, construction, proper utilization and evaluation of water supply and sanitation facilities.

The contnuous requests by almost the total enlightened people of the Tikonko Chiefdom, together with the energy, experience and self help ambitions of the project leader of the CDC, have made it much easier to develop co-operative spirit in the minds of the peoples and no sooner the trumpet of self help blasted all hands went on deck. Before their collective willingness by the local people, there had been long years of Health Education dialogues between the CDC and the people and also much voluntary teachings on Rural Sanitation and general Community Development took place in the Court Barries and school rooms as well as open spaces during the dry season.

In 1980, about mid February, a sort of awareness got so much hold on the local people that they approached their local chief who in turned brought their request to the Paramount Chief. Incidentally the CDC has already been formed and in operation with Rural Technology, adult and Health Education. The matter was actively reviewed by the CDC who soon learnt that a General Rural Sanitation must be embarked upon in order to save the chiefdom from mortality rate especially in children. But thus the idea of a Rural Sanitation Research was born.

Community Involvement Technics

During this research, it was observed that, to ensure effective community participation in the development of village water supplies and sanitation facilities, it is necessary that the community be involved from the planning stage onwards. It is important that the community takes an active role throughout the development of their own water and sanitation facilities, so that they feel it is their own achievement and that they can claim responsibility for its planning and construction. This should ensure proper use and maintenance of the facilities provided when the development of the facilities has been finalised.

THE IMPROVED BAILER WELL

The water supply and sanitation techniques developed and constructed in Phase I is now being improved upon in the present project. The Improved Bailer well is simple in design, easy to construct, requires minimal maintenance. The community latrines are based on a design developed in Zimbabwe at the Blair Research Laboratory. Both technologies máximize the use of local materials and provide relatively low-cost and parctical solutions.

WATER IS LIFE GIVER! WATER IS A KILLER! (water is a good servant; and could be a bad master if you allow it to be). This slogan is being used by our village Health Educators during our Basic Health Education Exercises.

This Bailer well design is the newest type of well in Sierra Leone. It is an attempt to design a water retrieval system for village level use. It's selections is based on the following advantages; sanitary design low-cost effective, low maintenance appropriate to local conditions and durable.

The design which emerged has become known as the Bailer. The system can be adopted to hand dug village wells or installed with boring equipment. Each has its advantages and drawbacks. Hnad dug village well technology exists in many forms in Rural Sierra Leone and to modify these capabilities toward the Bailer system should not prove difficult.

The design is a plan of a hand-dug well known as Bailer, which has been constructed in eighteen (18) villages in the southern province of Sierra Leone, during the CDC phase I and phase II research project. This study has been an attempt to eliminate earlier problems of village water sources and it was also an attempt to present a bucket well which shall be as technologically appropriate, as inexpensive, durable, sanitary and culturally acceptable by the people.

CONSTRUCTION

A well approcimately 1m (3ft) in diameter is dug by hand. The aquifer is penetrated to the greatest depth possible 2m (6ft) being the minimum depth. After satisfactory digging, culvert molds 2'6" x 2'6" constructed with ½" and ¼" iron reinforcement and concrete mixture of 1:2:4 were lowered. Four culvert in each well. A 150mm (6") layer of clean sand is placed at the bottom of the well to act as filter. 150mm (6") plastic pipe is lowered into the well. This pipe is perforated at the base 3m (9ft) to increase sippage into the pipe. A concrete sealing with a centre hole of (6½") diameter is placed at the top of the top-most culvert. The shaft is backfilled with clean gravel up to 4m (12ft) from ground level. These act as filter. The shaft is sealed with 150mm (6") layer 1:2:4 mixture of concrete. The rest of the shaft is backfilled with soil removed from the hole up to 150mm (6") off the ground level. The bucket fitted with plastic tube and has a single valve at the bottom and its capacity is the same as the normal bucket. (30cm).

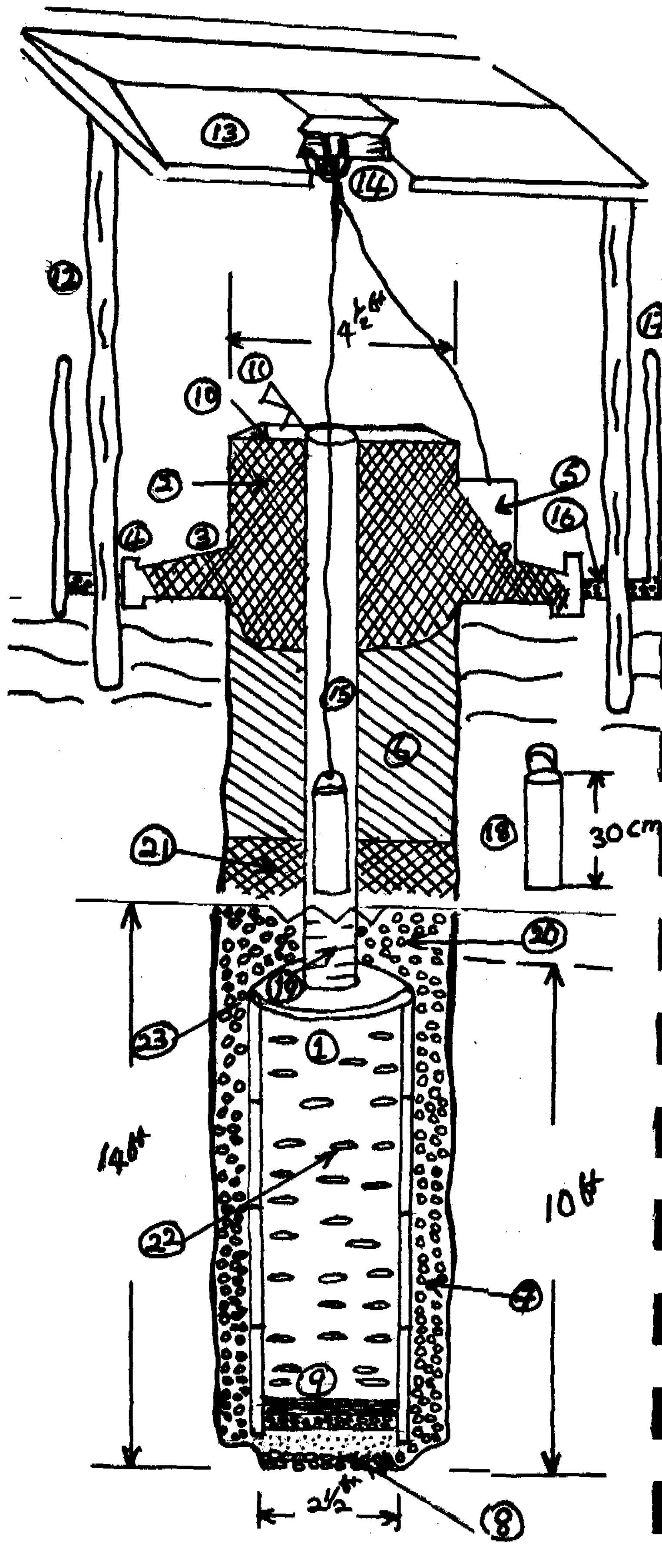
Although the initial capital investment for the construction of the above well may be high for either a submersible pump or drilling machine should they prove necessary. The actual unit cost for constructional materials per Bailer system, keeps on having a steady smooth rise, because of problems with high cost of goods, transportation and services, of required materials, equipments and staff transportation; due to the devaluation of our currency and fuel shortages, these issues have made cost of goods, transportation and services sour everyday. In 1982, the unit cost per Bailer system falls in Le 600.00 range for 40 feet depth 1983, the unit cost went up to Le 1,700.00, in 1984 the unit cost per Bailer system now range at Le4,200.00.

Mechanically the system has few weakness or points of volunerability the Bailer device, with minor maintenance and repair should last for years. It is possible that local bucket makers could imitate the design to further the availability of the device. Maximum utilization requires maximum penetration in to the aquifer and here we need to consider seriously the options before us. The basic hand dug well with bucket-bailing cannot attain the necessary depth desired. Yet is totally local imput. The submersible pump is an aid to bailing and may permit significant penetration. The boring method requires little local imput yet gives maximum penetration in the least time.

In the attempt to provide suitable drinking water for all there is a place for the Bailer.

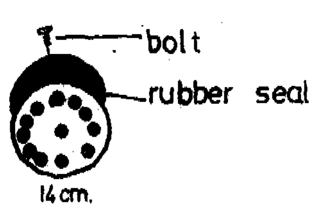
FEATURES OF IMPROVED BAILER WELL

1. Reinforced concrete culvert lining of shaft.
2. Concrete retaining walls for well Head.
3. Concrete apron
4. Drainage Rim.
5. Rope and bucket storage box with drainage hole.
6. Earth return back to fill up hole.
7. Gravel back fill (in aquifer)
8. Foundation stones for base.
9. Sand gravel and stones filters.
10. Reinforced concrete, cover slab partialy.
11. Hinged wooden door cover.
12. Supporting "Y" Bush pools for shelter.
13. Cross beam and Roof.
14. Bucket pulley.
15. Common Rope and Bucket.
16. Surrounding gravel bed.
17. Bush stick fence.
18. Bailer Bucket.
19. Culvert Seal
20. Sand and gravel 4ft above Culvert seal.
21. Concrete (1:2:4) Water seal.
22. Perforation on culvert lining.
23. PVC pipe with perforation.

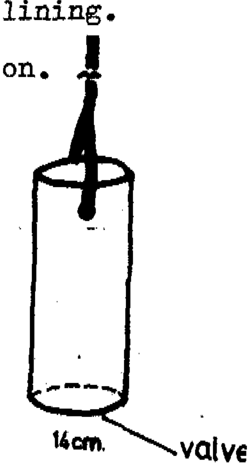


THE "BAILER"

THE BAILER BUCKET



valve bottom view



WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

C Nakau, D Rowsome

The evaluation of a handpump

INTRODUCTION

Papua New Guinea is one of seventeen developing countries participating in a global project concerned with the testing and development of rural water supply handpumps. The project is funded by the United Nations Development Programme (UNDP), Division for Global and Interregional Projects and is being executed by the Water Supply and Urban Development Department of the World Bank. Its principle aim is to "support the global effort to provide, reliable, low-cost water supply systems to serve those in dire need of adequate sources of water in rural and urban fringe areas (ref.1)". According to its chief, the Rural Water Supply Handpumps Project will "provide the necessary technological basis for the development of new, low maintenance and cost-effective handpumps for installation in developing countries (ref.2)".

At its inception in 1980 the Project was directed at laboratory testing, field trials and technological development of handpumps. By 1984 the concerns of the Project had broadened due to the recognition that handpump design cannot be approached in isolation of economic, social and institutional considerations. The articulation of these thoughts provided a healthy stimulus to the Papua New Guinea Handpump Testing Programme to go beyond its original 1983 terms of reference that emphasized the technical evaluation of handpumps. Indeed, a growing realization arose that an evaluation of a more comprehensive nature was required if Papua New Guinea was to successfully employ handpumps on a large scale.

THE EVALUATION PROCESS

Whilst the technical assessment of a new technology is recognised as important, the successful design and employment of this new technology depends to a large extent on non-technical factors. The Papua New Guinea Handpump Testing Programme (PNG Programme) is in the midst of an evaluation process which acknowledges this truth. The evaluation process is therefore attempting to address not only technical considerations but economic, social and cultural, institutional, and health considerations as well. In the PNG Programme these separate evaluations are being co-ordinated by the Appropriate Technology Development Institute (ATDI) of the Papua New Guinea University of Technology. The information obtained from these evaluations will help to effectively integrate the handpump into rural Papua New Guinean society. This has required a multidisciplinary approach which makes as much use as possible of government professionals, university departmental staff and students and UNDP/World Bank consultants. The wider participation and interest in the PNG Programme lays a good foundation for the handpump's future. More importantly, a comprehensive evaluation of a new technology such as a handpump is essential if that technology is to be promoted with any degree of confidence. However due to the pressing needs that exist in rural Papua New Guinea, as well as other constraints such as limited funds, it was felt that the evaluation process could not be too elaborate or time-consuming.

TECHNICAL EVALUATION

Initial Handpump Selection

In order to conserve finances, human effort and time the PNG Programme took advantage of the results of a programme of ground water development carried out in Malawi from 1980-1982. A seminar co-sponsored by the Malawi government, the United Nations and the World Bank in December 1982 enabled a research engineer from the ATDI to observe a number of field-installed handpumps that included the well-known Blair Handpump of the Blair Development Institute in Zimbabwe. The Blair Handpump design was carried back with the thought that it had potential to meet some of the needs in Papua New Guinea. It also seemed likely that it could be manufactured in Papua New Guinea thus reducing dependence on expensive and hard to maintain foreign-manufactured handpumps.

Since one of the long range objectives of the UNDP/World Bank Project was to promote handpumps that can be manufactured locally, focusing the PNG Programme on such a handpump seemed like a logical decision to make. The resultant handpump now being tested is one of four handpumps in the UNDP/World Bank Project that are derivatives of the Blair Handpump. Forty-five PNG Blair Handpumps are now being field tested. It was beyond the resources at that time to evaluate a greater variety of handpumps. Fortunately there are 76 models of handpumps being tested world-wide in the UNDP/World Bank Project and the test results will soon be published for the benefit of all.

Field Monitoring

This is an indispensable exercise in the evaluation of a handpump. It provides a good idea of how that particular unit might survive in real life situations. Carefully chosen test sites, representative of the various geographical settings in the country are important especially if the number of test sites is small. The PNG Blair Handpump has therefore been installed on coralline islands, in areas of heavy gravels, clay and volcanic sand. They were installed either over hand-augered boreholes or hand-dug shallow wells. Due to remoteness, some sites are monitored infrequently and irregularly. The majority of sites are however monitored on a monthly basis. This is the main monitoring activity - recording such things as ground water level, a flowmeter reading, volumetric efficiency, sanitary conditions surrounding the well and preventive and corrective maintencance performed.

In the 20 months of monitoring none of the PNG Blair Handpumps have broken down. This may sound like an impressive record except for the fact that the flowmeters register an average daily throughput of only 0.5 cubic meters per day and that the volumetric efficiency has dropped from an average of 0.84 to 0.73. At the present rate of usage it is estimated it would take 5 years to obtain 1000 hours of usage. It was therefore proposed to accelerate the wear process by a laboratory-administered endurance test.

Only occasionally were the pumps observed in use as the peak hours of water collection were outside of normal working hours. This lack of observed usage inspired a study where university anthropology students would live in a village to determine who the main users were, how the pump was used and what type of water collection containers were used. The observation and questioning of the users assisted in the ergonomic design of the present version of the PNG Blair Handpump.

Laboratory Testing

During the initial phase of the Rural Water Supply Handpumps Project, The Consumers' Association Testing and Research (CATR) Laboratories in the U.K. were contracted to carry out tests on handpumps. Since 1980, twenty-three handpumps, manufactured in both developing and developed countries, have undergone a battery of user trials, performance tests and endurance tests. Each pump also underwent a detailed engineering assessment. Although not as indispensable as field testing, laboratory testing is nevertheless valuable in predicting or authenticating field results, often at a minimal cost to the programme.

It was felt that before the PNG Blair Handpump could be certified by the ATDI for widespread use in Papua New Guinea a series of tests similar to those administerred by the CATR were required. Of particular importance it was felt that an accelerated endurance test was required. The CATR administers a 4000 hour endurance test whereas our field-installed pumps had only received an average of 400 hours of usage. The ATDI, therefore undertook this venture constructing an 8 metre high testing tower with research funds from the University of Technology. Proving a home-grown technology, in-country, may have some positive psychological effects on the final acceptance of the handpump by government leaders and the general public.

Operation and Maintenance

Regardless of handpump some maintenance will always be involved in keeping it in satisfactory operating condition. The long range objective of the UNDP/World Bank Project - to develop handpumps which conform to the Village Level Operation and Maintenance (VLOM) principle-recognizes this.

The prospects of the PNG Blair Handpump attaining the VLOM standard seemed promising. However due to the complete absence of breakdowns in the village setting there were few opportunities to test whether a village caretaker could maintain the PNG Blair Handpump. To compensate for lack of actual breakdowns in the field, a workshop on the installation and maintenance of the PNG Blair Handpump was carried out in February 1985. Thirty candidates, one from each community government area in Morobe Province attended. They were all young men with a grade 6 to 10 level of education. Very few of the course attendees had any difficulty at all in assembling or installing the handpump. Each attendee also fabricated and tested an actual piston/foot valve. This workshop therefore enabled the ATDI to state with reasonable certainty that the PNG Blair Handpump has good potential for reaching the VLOM standard.

The VLOM concept suits PNG very well due to the inaccessibility of a large portion of its rural areas. The village caretaker, backed up by a district technical officer, may prove to be the most efficient and effective maintenance mangement system for Papua New Guinea.

ECONOMIC EVALUATION

Handpumps are strongly promoted by the World Bank as they often provide one of the simplest and least costly methods of supplying rural populations with water. Obviously the handpump with the lowest initial cost, fewest wearing components and requiring the least maintenance would be the most economical alternative. The PNG Blair Handpump with its one moving part, standard UPVC plastic and galvanized iron pipes and fittings and ball valves using glass marbles results in an initial capital cost of about 40 kina (1 kina = 0.71 pounds sterling) for both above and below ground components. This is an affordable amount for a small village.

For a cost analysis and comparison of different handpump designs, all the relevent life-cycle costs should be considered. According to Environment and Development in the Third World (ENDA), the cost factors which should be taken into account include "initial capital costs, economic life, cost of replacement of vital parts involving lump sum, annual maintenance and operation and rate of discount (ref.3)". Presently maintenance data on the PNG Blair is sparse and data on the other pump models being tested world-wide is not readily available either. With the completion of the laboratory endurance and field tests an economic evaluation will then be possible.

There are of course other economic benefits indirectly resulting from better health and greater convenience. These anticipated benefits are intangible ones and difficult to assign values to. They are however real and important economic considerations requiring in-depth study in order to assess the full impact of the handpump.

SOCIAL AND CULTURAL EVALUATION

A water pumping device for a community water supply is a small technical device in a complex economic and socio-cultural system. Water supplies, being a vital need, are often vested with deep cultural meaning and traditions. In Papua New Guinea the situation is even made more complex with over 700 distinct language and tribal groups, often with quite varied beliefs and customs.

Since an effective handpump installation project is a blend of technology, institutions and people, understanding the social and cultural background of the people deserves generous attention.

The UNDP/World Bank Project recognizes this and provides a form to help assess social and cultural factors. Guidelines for using this form state that it should be administered by an anthropologist to ten percent of the households in a village. It is recommended that this is done at least twice a year, once during the rainy season and once during the dry season. It attempts to document water usage patterns and user views since the ultimate success of a handpump installation will depend on user acceptance.

Teams of anthropology students administered the forms several times throughout the PNG Programme. This necessitated staying in villages several days at a time. People volunteered information quite freely and seemed to appreciate this outside interest in their views. The anthropology students were eventually able to modify the Project form in order to better suit the Papua New Guinea situation.

The overall results have shown that the rural populations have strong attachments to their traditional water sources and have some mistaken beliefs about handpumps. These two factors may explain the lower than expected handpump usage rates. These overall results also led to the important conclusion that an input of health education is vital if the full potential of a handpump is to be realized.

INSTITUTIONAL EVALUATION

There have been some timely policy-related developments in Papua New Guinea which should help a technology like the PNG Blair Handpump establish itself. Firstly, the responsibility for rural water supplies was transferred from the Department of Works to the Department of Health. This is widely seen as a wise move since effective water supply is inextricably linked with health education and sanitation activities. Concurrent with this came the adoption of a new National Policy for Rural Water Supply and Sanitation. Many who had input into the policy were involved with or aware of the Papua New Guinea Handpump Testing Programme. The policy contains statements which give priority to simple schemes that can be constructed, operated and maintained by the community and that technologies used be of standard designs as far as possible. The policy also has the intent of increasing the capabilities of provincial and community governmental bodies for installation, management and maintenance of water supply and sanitation systems. There is also the intent to conduct necessary health education programmes and water quality monitoring

Rural Water Supply and Sanitation Surveys are now being conducted in a number of Provinces by the Department of Health and the World Health Organization. The provincial plans which result may call for the wide-scale deployment of a technology such as the PNG Blair Handpump. While these surveys are taking place, the Department of Health is assessing what human and financial resources will be required to meet its new mandate.

Even though there may not be sufficient structure at present to implement a large scale rural water supply and sanitation programme, national policies now exist which will permit such a programme to be built.

HEALTH EVALUATION

Of the many benefits that can be derived from a properly utilized water supply, improved health is undoubtedly the most important. Water supply alone however cannot be expected to bring the desired health benefits unless accompanied by the practises of "personal hygiene, health education, sanitary excreta and waste disposal (ref.4)". This truth must be recognized if the potential good effects of the handpump are not negated by poor sanitation. Sanitation is therefore a vital consideration for the success of any future handpump installation programme. For this reason it was thought necessary to evaluate the health factors surrounding the use of handpumps. This exercise would help ensure that the health benefits of a VLOM handppump could be maximized in the village setting.

The most basic question to be dealt with concerning the PNG Blair Handpump was whether or not it was delivering good quality water. Each test site underwent bacteriological and chemical water quality tests. These were compared with water quality results for the alternatively used traditional sources. The contrast in results was very dramatic showing that most handpump sites satisfied both the WHO and Papua New Guinea standards, whereas many traditional sources in use were grossly polluted.
Although results were predictable, it is believed that it was an important exercise to perform in-country. The results could be used as a tool in the health education process of Papua New Guinea citizens.

To evaluate what health impact the PNG Blair Handpump was having, it was decided to study one representative village in great detail. It was proposed to compose a team of engineering, medical and anthropology students to study the water usage patterns and assess the health status of that community. This study, now in progress, will result in a detailed layout plan of the village indicating the location of all households and water sources. A house to house survey will then try to link water usage patterns with the health status of various households. The preliminary findings of this study seem to indicate that the PNG Blair Handpump is not having any noticeable impact as people still prefer to use river water for washing and drinking and there are no pit latrines. These findings were quite sobering but will be useful as baseline data for comparison purposes once good water supply, health education and sanitation practices are in effect.

Other health-related factors presently being considered are concerned with the hardware and peripherals of a handpump installation. These include the design of a sanitary wellhead, concrete apron and soakaway and other facilities that may complement a handpump installation such as a bucket shower facility or a washing slab. These peripherals can encourage the more effective use of the handpump and result in increased health benefits.

CONCLUSION

Papua New Guinea's involvement with the UNDP/World Bank Rural Water Supply Handpumps Project has been a very profitable one. The Project provided a good foundation for carrying out technical, economical, social and cultural evaluations of the handpump. Since the PNG Handpump Testing Programme was being carried out with a view to the early and wide-scale employment of a VLOM handpump, the ATDI initiated institutional and health evaluations as well. The health evaluation in particular was thought essential as it underscored the need to employ the handpump in the context of a sound programme of water supply, health education and sanitation.

Carrying out these separate evaluations resulted in a wide participation of Papua New Guinea professionals and village people in the development process. A comprehensive evaluation carried out in-country makes sense when it is realised that citizens of that country will have to live with the decisions made.

By the time Papua New Guinea is ready to implement a large scale rural water supply and sanitation programme the PNG Blair Handpump will be shown appropriate or inappropriate for meeting some of the existing needs. If proven by the evaluation process outlined above it is felt that the PNG Blair Handpump could be employed in Papua New Guinea with a high degree of confidence and effectiveness.

REFERENCES

1. ARLOSOROFF S. Rural water supply handpumps project. The World Bank, Washington, D.C., December 1984.

2. ARLOSOROFF S. World Bank presses on with handpump testing programme. Waterlines, Vol. No.3 January 1983, 28-30.

3. HOFKES E.H. Water Pumping for rural supply. ENDA Third World Document Series, No.21-81 - June 1983, 38-44.

4. BALLANCE R.C. and GUNN R.A. Drinking-water and Sanitation Projects: criteria for resource allocation. WHO Chronicle, 1984, Vol. 38, No.6, 243-248.

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T N Lipangile

Wood and bamboo in water conveyance

INTRODUCTION

Modern Water Engineers and Scientists have higher advanced and sound knowhow on the use of conventional materials e.g. plastics concrete - steel etc. in building water conveyance system. These materials are technically known and learned upto University level.

Some Developing countries are faced with severe scarce of local and foreign funds to meet their targets of implementing water supply and irrigation schemes due to explosive cost rise of construction materials upon which are often imported.

Wood and Bamboo forests are abudant and climatecaly many developing countries can grow these forests within a short time and become substitute to conventional materials.

The technology of Wood and Bamboo is appropriate Technology, cost saving and the use of local labour.

THE TECHNOLOGY OF BAMBOO PIPING MATERIAL

Bamboo pipes, are made out from bamboo stems which are cut from our forests. Bamboo is a tropical plant. These Bamboo are two types in Tanzania, Bambusa Vulgaris and Arundinaria Allpina. All growing between altitude 0-1500 metres and 1500 to over 2000 metres respectively. One hactre can contain about 5,000 bamboos and can fully mature after 4 years. The length of uniform section is about 4 metres. The inner tube varies in diameter for each stem of bamboo, size ranging from 38mm, 50mm, 63mm, 80mm, 100mm and 125mm recently some 250mm and 300mm bamboo have been reported grown in India, Burma and China respectively. The bamboo specie is Dondroca/amus giganters and Dendrocalamus sinicus.

Manufacture of Pipes. The bamboo pipe is made out by hollowing the internodes which are naturally pluged at interval of every 100cm and 50cm.

This drilling operations is done manually by special drilling tool of orga design attached to a long steel bar which operates half way and then turned the other side for the same. Bamboo pipes are reinforced by Galvanised wire about 3mm thick spaced about egery 50mm interval in a form of knot provides a cross sectional support for pressure sustain.

Pressure. Bamboo pipes have the following capacity:-

(a) Arundinaria Allupina non reinforced with wire outside spacing 5cm 1.5 atmospheres all working pressures.

(b) Bambusa Vulgaria non reinforced with wire 4.0 atmosphere. Reinforced with wire outside spacing 5 cm, 6.0 atmospheres, conventional plastic pipes class "B" its working pressure is 6.0 atmosphere. Bamboos pipes are sensitive to water hammer impact. The correct location of impacts are determined during first trial of running water in the pipe. In this portions stronger materials e.g. plastic are used.

Hydraulic 'Properties'. Discharge pressure meassurements were conducted by the hydraulic laboratory, University of Dar es Salaam. The average value of Manning's (n) and Hazen - Willim's (c) rougnness cofficient were determined and found to vary between 0.013 - 0.016 and 75 - 90 respectively.

The lower (n) galue and the higher (c) value correspond to good node removal. For design purposes the Division adopts a value of (c) between 70-75. This is because presently pipes are not centrally precessed which makes control of quality unreliable. In future some bamboo pipes might be lined with tar inside which will improve the flow efficiency as well as might provide interior protection against decay.

Construction of Pipe Lines. In construction bamboo pipeline the following stages of activities are performed stage by stage:-

stage by stage:-

(a) a four metre bamboo pipe are cut at the forest.

(b) They are transported to construction site and stored under running water. While the internode opened to enable bamboos sink in water as a pipe. This cleans the pipe from unpleasant smell (desapping) washing is done for six to eight weeks.

(c) Bamboo are reinforced with wire and ends shapened to adopt a pollythene joint.

(d) Bamboo pipes are (dried seasoned for at least a week at air tight place to prevent craking followed with hot or cold tar coating to prevent rotting. For these pipes which requires copper sulphate treatment before tar coating bamboo pipes are first submerged in a pool of copper sulphate solution for number of weeks prior coating tar inside and outside.

(e) Bamboo pipes must be barried in the ground to prevent cracks and damage. Therefore excuvation of trenches of width 60 cm and depth 100 cm is required. Solution of aldrin and dealdrin 0.5% is applied in the trench surface.

(f) Pipes are laid one after another joined by means of pollythene (P.E) tube about 15 cm long by slightly warming the tube. The end of pipes are placed tight in the tube, as the pollythene cools it contracts and hardens to fit the bamboo pipes. The pipe are kept far away in contract with preservative by placing unpreserved soil around the pipe. The trench is finally backfilled. C.C.A. treated sawdust can be glued in the surface of bamboo to prevent termites attack as well. The use of insecticides is taken as a temporary solution only.

<u>Life time.</u> A well preserved bamboo pipe can last 10 to 20 years.

<u>Fittings.</u> All fittings e.g. Elbow - tees - Water points are made out of wood blocks.

<u>Results of Operating Schemes</u>. We have about 30 gravity operating schemes of which are performing well, after studing and resolving some of the problems encountered e.g. termites attack, fungi rot, material handling during construction of schemes. Solutions:-

(a) Termites problem has been resolved by soil treatment;

(b) Fungi rot has been resolved by providing constant water saturation, constant and intermitent chlorine application and tar coatings outside, also impregnation of copper sulphate in bamboo culm, followed with tar coatings outside and inside.

(c) Cracking of bamboo between forest to construction site and during construction this hage been resolved by protecting bamboos by submerging them under water, keeping them under shade and coating them with tar.

Some schemes have given constant water suppiy to the village population of each 2,500 people for a period of nine years and eight years respectively and are still functioning. The used preservative is tar coating outside and constant water saturation with intermintent chlorine dose to prevent fung rot and soil treatment (insecticide) for termites.

Some few schemes operated for five years only and failed. The treatment adopted was soil treatment (insecticide) against termite and constant water saturation inside the pipe. The tar was not applied on outer surface thereby making direct contact with ground.

<u>Transportation System</u> - This is done by lorries for long jorneys and hand carts at the village.

Maintanance of Operating Schemes. Daily maintanance work is done by two villagers selected among the villagers during construction time one seven ton lorry can carry three hundred bamboos which is enough for small pipe extension and maintanance in the village for five years, maximum burst repairs one pipe a month. Spare bamboos pipes are stored in river or sterilized water pond. They are kept safe against cracking and insect attack.

The village system is logged by a performance return sheet indicating monthly bursts, leaks, insects attacks and stock of spares and chlorine. The report is submitted to headquarters monthly for monitoring.

HEALTH ASPECTS

In nature bamboo used are non toxic materials. Fungis are prevented by water contact and chlorine destruction. Care is required when preservative are incorporated in the system. If insecticides is used to treat pipe line trenches all preservatives are fixed to the ground where there is no chemical movement. The pipes are kept far off from direct contant with preservative. The water quality is excellent. Water analysis conducted in Tanzania and Abroad had shown the acceptable water quality within "WHO" limits. The acceptable drinking water tar / Bituminous lining in the interior of bamboo pipes is:-

(a) P.F. 4
(b) Aquaseal
(c) Bittuos. All are products of Great Britain.

ECONOMICS OF BAMBOO PIPES

The 63 mm diameter pipes are about 4 times cheaper to compare with local plastic pipes with the same diameter. The cost factor in determining bamboo economy is adoptability of suitable preservative, since this has been found the most dominant factor. According to independent SIDA Evaluation Mission June 1983, on Wood/Bamboo Project in Tanzania, the cost of manufacture purchase, installation and transport per metre of 63mm bamboo pipe diameter is $2.3 while plastic is $5.1 with the same diameter. The bamboo pipe is assumed to have been treated with preservative copper Chrome Arsenate.

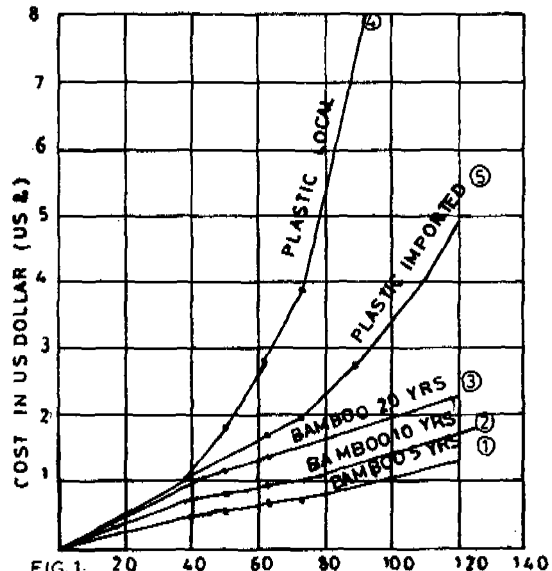

FIG.1 PRICE COMPARISON FOR YELLOW BAMBOO AND PLASTIC PIPES PER METER LENGTH PRICE 1985

WOODEN PIPES AND TANKS

The present woodstave technology started developing in the United states of America in the 1860's. In Canada, Sweden and Norway this technology is still applied to day. Although Tanzania Wood/Bamboo division adopted this technology it has nevertheless carried out investigations to ascertain actual carrying capacity for the locally manufactured staves and safety of water carried through or stored in woodstave structures treated with the toxic wood preservative C.C.A.

In Tanzania pine timber is mainly used as a result of its chemical retention. This technics in Tanzania has been succesful. Pipe lines up to 60 cm have been constructed and village water tanks up to 45 m3 have been also constructed. All these schemes are operating very satisfactory.

<u>Hydraulic Properties</u>. According to Scobey (1916) the C - valve indetermining flow characteristic in wooden pipes is Hazen Williams formule C - Value 120. Also tests conducted at University of Dar es Salaam hydraulic Laboratory recommended the use of C - valves of Hazen Willimg 70 to 115. The tested pipes were given laboratory approvel of 6 bar pressure carrying capacity.

<u>Manufacture of pipes and tanks</u> (Pipes sizes 15cm to 5m and tanks from 22.5m3 to 1,500m^3).

Timber staves are milled to the true Inner and outer circle of the true radius of the pipe to be made. Tongue and grooves are also milled along the edge.

The manufactured staves are preserved with water born preservatives e.g. C.C.A. (Copper Cromium Arsenate). This treatment guarantees the life span of about 30 years in ground contact. The water quality of preserved wooden materials is perfectly good. Water analysis was conducted in Tanzania and University of Delft Nertherlands.

<u>Construction of Pipe Lines</u>. In building up the pipes continous stages are laid side by side, each stave is butted against the one immediately preceeding it. Thus making the stave contious without any joint in the pipe. Staves are held firmly on place by steel bands. Tanks are constructed simillary but in vertical way.

<u>Economics of Wooden Pipes and tanks</u>
Both pipes and tanks are cheaper to compare with conventional material e.g. steel and plastic pipes. In Tanzania a recently constructed Irrigation pipeline of 60cm diameter and 365 in length costed 420,000 TAS where as the same would have costed 630,000 TAS and 1, 1,125,000 TAS had it been constructed of respectively concrete or steel.

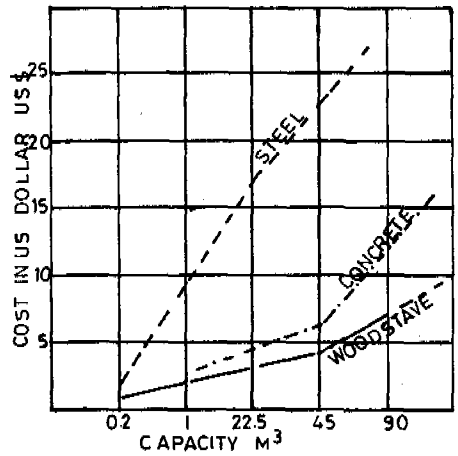

FIG. II CONSTRUCTION COST FOR GROUND LEVEL WATER TANKS

REFERENCE:

1. LIPANGILE, T.N., JACOBS, Peter and LUNDBORGE, Nills - Main Final Report - Woo/Bamboo Project 1978 SIDA Stockholm Sweden.

2. DR. GOKCESU, Suhan - Laboratory Investigation for Determining Hydraulic Design for Bamboo and Woodstave pipes - 1980 University of Dar es Salaam.

3. MESSRS. BRONKONSULT, AB - Evaluation of Tanzania Wood-Bamboo Technology, Final Report June 1983. (Engineers Economists - Planners c/o. Per sundberg Vag 1-3, S-18363 Taby - SWEDEN).

4. LIPANGILE, T.N. - Wood/Bamboo Paper presented to Rural Hydraulic Development A.P.C. Countries and Mediterranian Basin at Marseilles France June, 1984 (Wood/Bamboo Project Office - Iringa Tanzania).

5. MSIMBE, L.G. - Wooden and Bamboo Materials in the implementation of Water Tanzanians - 1985 (WEDC for 11th Conference) Water and Sanitation in Africa - 1985.

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

H Darmarajah, S Hugman, A Leva, J Johns, G Peke

Field testing water quality in Papua, New Guinea

INTRODUCTION

For rural drinking water supplies in tropical areas one of the most important measures of water quality is the number of faecal coliforms per 100 mL (ref.1). However, the standard tests for faecal coliforms are relatively expensive. They require very close temperature control during incubation, and can only be carried out by someone trained in laboratory techniques.

A simple field-test for detecting faecal pollution in drinking water has been proposed (ref.2). The test uses a cheap, easily prepared, dried media contained in a 20 mL sterile sampling bottle. The sample, collected directly in the bottle, requires no preparation before incubation. Incubation can be between 30 and 37 deg.C.

This cheaper and simpler field-test appears to be more suitable than the standard test for measuring water quality in low-cost rural water supply schemes, where access to laboratory facilities is poor. However, little information is available about how it performs.

The paper compares the results from the field-test with results from a standard method for faecal coliforms. The field-test is compared with the results for concentration of faecal coliforms because, in tropical areas, these have been shown to be better indicators of faecal contamination than total coliforms (ref.3).

The limitations of the test are then described. The quality of water from different types of sources tested during this work is presented, and recommendations are given for use of the simple field-test in rural water supply schemes.

METHODS

Simple field-test

The method used is similar to that given in reference 2.

The incubation medium is made by dissolving 20g of peptone, 1.5g of dipotassium hydrogen phosphate, 0.75g of ferric ammonium citrate, 1.0g sodium thiosulphate, and 1 mL of teepol in 50 mL of distilled water. This is sufficient for over 50 tests.

The sample bottles are McCartney bottles which hold at least 20 mL. Sufficient folded absorbent paper is placed in each bottle to absorb 1 mL of media. This volume of media is added to each bottle. The bottles are then capped loosely, sterilised, and finally dried.

The test involves filling the bottle with about 20 mL of sample and replacing the cap. It is then incubated between 30 and 37 deg.C. for 12 to 18 hours. If the contents of the bottle turn black during the incubation period then the test is positive and the water is considered contaminated.

Faecal coliform test

A membrane filtration test was used to determine unconfirmed faecal coliforms (ref.4). The filter papers and media were supplied by Millipore Corporation and Difco, respectively.

Sampling area

A hand-pump testing project sponsored by the World Bank, and carried out by the PNG Department of Works, Department of Health and the Appropriate Technology Development Institute, is taking place in the Markham Valley near Lae (ref.5). This project included a water quality monitoring programme, and most of the results in this paper come from that area. Additional results come from settlements in Lae, and from rural supplies in the Western Province. All samples were collected during 1985.

EVALUATION OF THE FIELD-TEST

Method

Samples collected for faecal coliform determinations were also analysed using the field-test. In this way 122 samples were analysed by both methods. The samples were transported to the laboratory in insulated containers, and both the faecal coliform test and the field-test were carried out on the day of sampling.

In addition to this comparison with a standard test, the conditions used for the incubation were examined. This is important if the test is to be used in the field. In PNG overnight air temperatures can fall below 20 deg.C, and stringent incubation periods are often inconvenient.

Twenty two samples were used in this part of the investigation. Each sample was used to fill six replicate field-test bottles. Each replicate was then incubated at a different temperature (6,15,20,24,30 & 37 deg.C). The bottles were inspected at three times, after 16, 19 and 24 hours of incubation. The positive results obtained under the standard incubation conditions (as used above) are assumed to be correct. Different results are therefore taken to be either false positives or false negatives.

Results

Comparison of the field-test with the standard test for faecal coliforms gave the results shown in Figures 1 and 2. The field-test tubes which gave a negative result (no discolouration) were closely correlated with with low faecal coliform numbers. Almost half of the samples contained no faecal coliforms (FC), and 94% contained 10 or less FC per 100mL. Only three of the samples contained more than 10 FC per 100mL, and the highest concentration found was 72 FC/100mL.

The field-test tubes which gave positive results (discoloured), tended to be more highly contaminated. However, a significant number of the samples which gave a positive result contained only low numbers of faecal coliforms. Twenty per-cent of the samples contained less than 1 FC/100mL, and 37% contained less than 11 FC/100mL.

The temperature of incubation has a strong influence on the number of positive results which were obtained. At low temperatures (less than 20 deg.C.) bacterial growth was inhibited and no positive tubes were observed. At temperatures above 20 deg.C the number of positive tubes increased with temperature. The highest number of positive samples were found at 30 and 37 deg.C. This indicates that at lower temperatures there will be more false negative results.

The incubation period also influences the number of positive results. At 37 deg.C. the same number of positive tubes were observed after 19 hours incubation as after 16 hours incubation. After a further five hours of incubation an additional seven tubes became discoloured. Long periods of incubation are therefore likely to increase the number of false positive results.

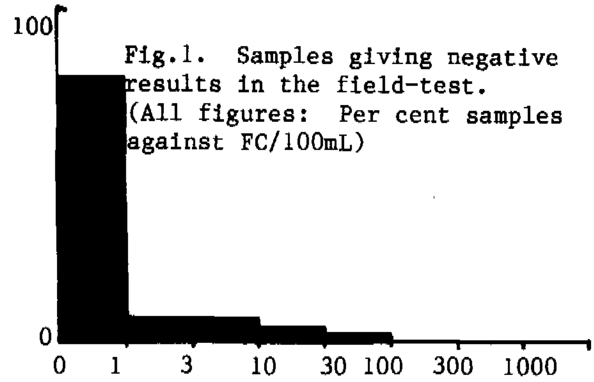

Fig.1. Samples giving negative results in the field-test. (All figures: Per cent samples against FC/100mL)

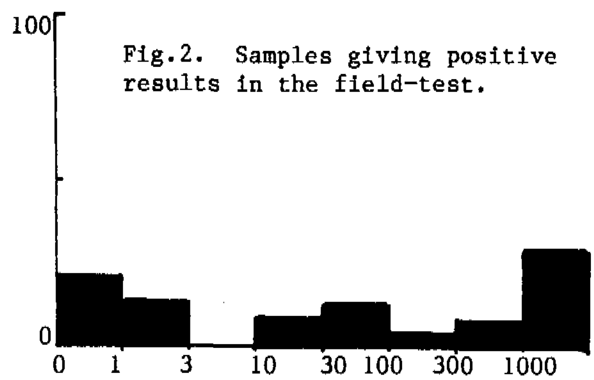

Fig.2. Samples giving positive results in the field-test.

Discussion

The results of the comparison between the field-test and the standard test for unconfirmed faecal coliforms show that samples which give a negative result with the field-test are likely to contain less than 10 FC/100mL. This is in agreement with the results found by Manja etal (ref.2). They found that in 554 samples which gave negative results with the field-test, 99% contained 10 or less FC/100mL.

They also found that the main discrepancies between the tests were in samples with low concentrations of faecal coliforms. They attributed some of these discrepancies to the normal variability of the standard test method at such concentrations.

World Health Organization Guidelines and Papua New Guinea national standards (references 1 and 6) recommend that water supplies should contain no faecal coliforms per 100mL. However, in many rural areas this is impossible to achieve within present economic constraints. Less stringent local water quality objectives must therefore be adopted. Some authors have suggested that 10 FC/100mL is a satisfactory objective (refs.2,7).

The field-test can be used to screen water sources to identify those which meet such a criteria. However, since the test may give a significant number of false positive results, a preferred water source which does not pass the field-test may then need to be analysed for faecal coliform.

To avoid false negative results the field-test tubes must be incubated between 30 and 37 degrees centigrade. Such a range of temperature can be maintained in the field by a battery operated air incubator, by an insulated container containing warmed water, or by keeping the tubes close to one's body.

Over-long incubation will produce more false positive results. However, incubation periods between 12 and 20 hours seem acceptable.

QUALITY OF RURAL WATER SOURCES

The main purpose of the sampling programme in the Markham Valley was to determine whether the water quality provided by the shallow-well handpumps was significantly better than that for the traditional water sources. The pumps are similar to the Blair design and are sited directly above the wells. This could have resulted in contamination of the well if the seal around the pump-head was inadequate.

Results

Over 250 samples from different water sources were analysed during the study. The results have been classified according to the type of source, and are presented in Figures 3 to 9.

The shallow-wells with handpumps (Fig.3) were found to give the best quality water, 92% of the wells had less than 11 FC/100mL.

The other non-traditional improved type of supply, rainwater collection from galvanised roofing (Fig.4), also provided fairly good quality water. Of all rainwater supplies 68% had less than 11 FC/100mL. The quality of water depended to some extent on the type of storage provided. Storage tanks which were were enclosed or had lids (Fig.5) provided better quality water; 83% of these contained less than 11 FC/100mL. Only 43% of uncovered tanks (Fig.6) had such low concentrations.

In contrast, the traditional sources tended to be more contaminated. Only 58% of seepage pits and springs (Fig.7), 14% of drum wells (extremely shallow open wells) (Fig.8), and 4% of streams and rivers (Fig.9) met the criteria of a maximum of 10 FC/100mL. Many of these type of sources were extremely contaminated, having over 1000 FC/100mL.

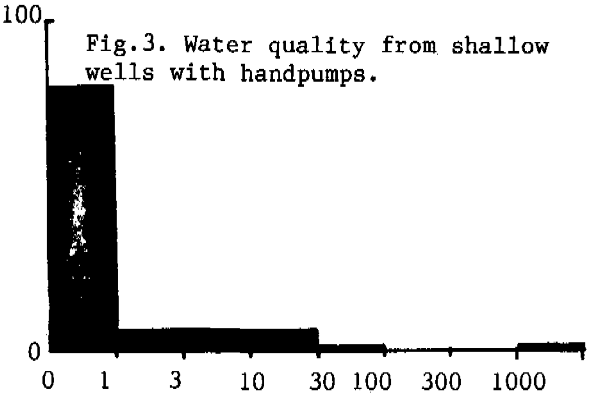

Fig.3. Water quality from shallow wells with handpumps.

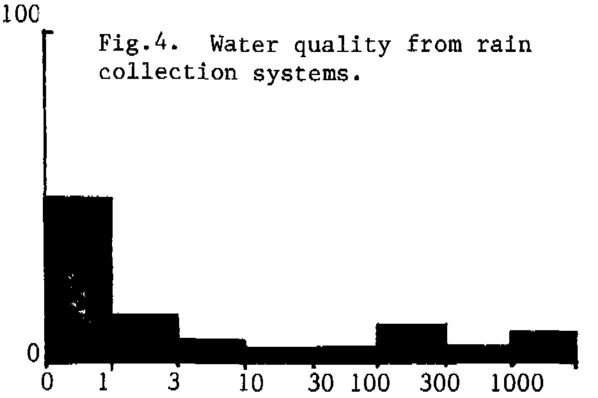

Fig.4. Water quality from rain collection systems.

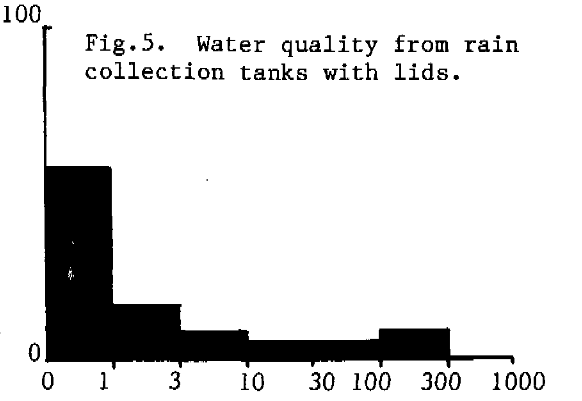

Fig.5. Water quality from rain collection tanks with lids.

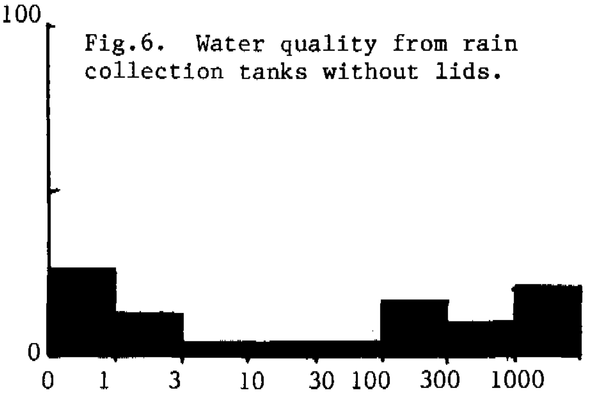

Fig.6. Water quality from rain collection tanks without lids.

Discussion

Previous studies have demonstrated, as does this one, that many rivers and streams in PNG are grossly contaminated, with high faecal coliform concentrations (refs.3,8,9). They

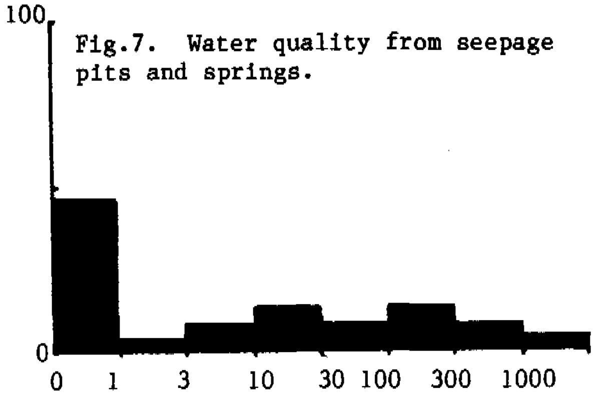

Fig.7. Water quality from seepage pits and springs.

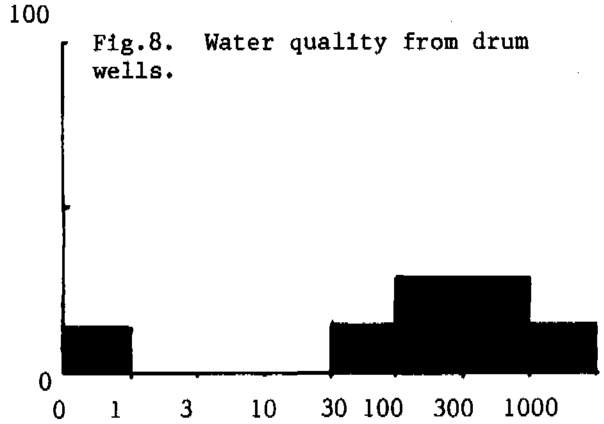

Fig.8. Water quality from drum wells.

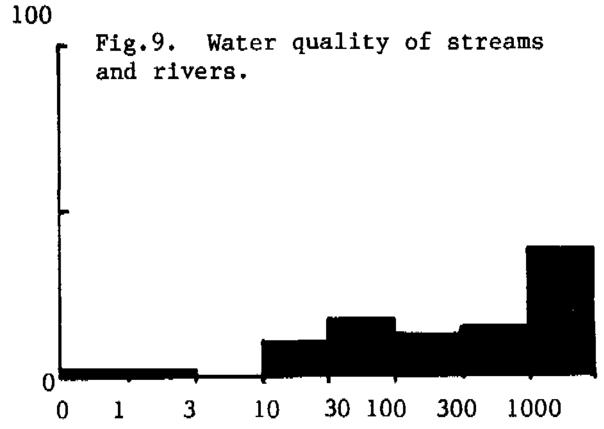

Fig.9. Water quality of streams and rivers.

are often not suitable for community drinking water supplies.

The best quality water is provided by "properly constructed and situated wells" (ref.10). Despite early fears about the quality of the pump-head seal on the PNG Blair pump, this present study shows that the wells are adequately protected against contamination.

The quality of water from such wells has been found to be so good that (if proper care is taken in siting and construction) there is little point in carrying out regular water quality tests.

Properly constructed rainwater collection systems, with enclosed storage tanks, can also provide good quality water. However, the per capita capital cost tends to be much higher than for hand-dug shallow wells.

RECOMMENDATIONS

Use of the field-test is appropriate for low-cost rural water supply programmes, where standard faecal coliform tests are difficult to carry out routinely.

Properly constructed shallow-wells with handpumps give good quality water. Little benefit is gained from testing the quality of water from such wells.

In Papua New Guinea gross faecal contamination of surface water is extremely common. Surface water used as a source for an improved drinking water supply should therefore always be tested. This will permit the elimination of those sources which present the most serious public health risks.

REFERENCES

1. WORLD HEALTH ORGANIZATION. Guidelines for drinking water quality, Vol. 1, Recommendations. Geneva, 1984.

2. Manja, K.S., Maurya, M.S., and K.M. Rao. Bulletin of the World Health Organisation, 1982, 60(5), 797-801.

3. Feacham, R. Papua New Guinea Medical Journal, 1973, 16(3), 213-217.

4. APHA/AWWA/WPCF. Standard methods for the examination of water and wastewater, 15th Ed. New York, 1980.

5. Nakau, C., and D. Rowsome. The evaluation of an appropriate hand-pump for Papua New Guinea. WEDC 12th Conference: Water and Sanitation at Mid Decade: Calcutta, 1986.

6. PNG Department of Health. Drinking Water Quality Regulation. Government Printer, Port Moresby, 1984.

7. Feacham, R., McGarry, R. and D. Mara. Water Wastes and Health in Hot Climates. John Wiley, Chichester, 1978.

8. Feacham, R. Report No. 132, School of Civil Engineering, University of New South Wales, 1973.

9. Bargh, B.J., and J.J. Baru. Science in Papua New Guinea, 1982, 9(1),27-37.

10. Lane,A.E., Medical Journal of Australia, 1967, 1, 385.

Session 1b

Chairman: Professor N Majumder
Co-Chairman: Mr E K Y Dovlo

Discussion

D N Basu

The evaluation of rural water supply schemes

1. Mr BASU gave a comprehensive review of Rural Water Schemes dividing them into Regional and Village projects. He said that the implementation had been studied in detail and emphasised that the time factor is more often critical than cost. This time over-run in turn increases costs. The reason for delay is not necessarily lack of funds, it is more lack of management and bad planning in physical aspects. There are procedural delays also. The State designs need to be examined and delegation of decisions "lower down" the line management will be vital if the speed up of schemes is to be achieved. A very lively discussion followed including formal questions and interchange of shades of opinion.

2. Mr MIR asked why the author had not said anything about appropriate service levels determined by them.

3. Mr BASU responded that there is some reference to this subject on the paper. Planning norms of 55 lpcd usually followed for rural water supply schemes are often not relevant or compatible with actually observed situations. Either because of inequitable distribution of water among villages at different reaches or higher than expected rate of losses, the concept of average lpcd has limited meaning. Both for the purpose of achieving an appropriate monitoring system of operations and more equitable system, a proper water accounting system with installation of proper measuring devices is a necessity.

4. Mr SINGH asked what solution was suggested to short cut procedural delays in case of contractor's failure to do the work in a time schedule? He also asked what Technical wing was suggested for Operation and Maintenance of Rural Schemes (Regional W/S/S) and how it can work - when more than one Department is involved.

5. Mr BASU replied that the first question is not explicitly dealt with in the paper. However the paper draws attention to the need for a review of contract management procedures to reduce delay. The need for decentralised decision-making process and settlement of disputed tenders or contracts needs to be emphasised. In answer to the second part of the question, as a part of an on-going study by the organisation (sponsored by Gujarat Water Supply and Sewerage Board) on study of operation and maintenance of rural water schemes, the two alternatives for maintenance of village water supply systems are being studied. The first one is to centralise the current system (maintenance by Panchayat) with better access to maintenance facilities and training. The other alternative is conceived in terms of a Central Maintenance Organisation under an appropriate statute.

6. Mr BHARDWAY commented that any detailed planning, however detailed it might be, cannot be successful until rate of flow of finds is certain. In our financial planning system in state plans, we cannot ensure an anticipated inflow of funds as planned. This seems to be the biggest reason of time and cost overruns rather than proper administrative management. He then asked whether in the study the author came to some conclusion regarding role of people's past operation in Organization and Management of rural W/S/S?

7. Mr BASU said that while agreeing with financial constraint as a major one, this is not the only reason for non-realisation of targets. Time over-runs due to management and procedural problems can be evident from a simple analysis of contracts executed. Large inventories (eg pipeline) lying unutilised for a long time due to improper activity sequencing or procedural bottlenecks and unspent budget are not rare examples. Community awareness and participation is very essential. The way it can be achieved is through extension efforts (a proper education programme) and involvement of voluntary organisation in an integrated and extensive manner.

8. Mr SHARMA asked when investments being made at present are far too short of demands, how do we expect to gain by speeding up execution or cutting down delays. Time is the essence but availability of resources is essentially the dominant factor relating to planning commensurate with resources. I do not agree that other aspects are larger constraints as compared to the financial constraint.

9. Mr BASU replied that the question is more or less the same as that of Mr D BHERADWAJ of PHED, Rajistan. Without de-emphasising the importance of financial resource constraint which is not merely a state/regional problem but a national problem and has to be viewed as a problem of resource allocation among competing demands on national priorities, organisational and procedural constraint are, by themselves, important and worsen the already unsatisfactory situation with regard to availability of financial resources.

R Paramasivam and V A Mhaisalkar

Rural water supply in India

10. Mr LLOYD asked the author to clarify column headings to Table 1 with respect to summary tables of results which would be useful, giving the proportion of nominal capacity in operation, cost recovery figures and health/ morbidity figures.

11. Mr LLOYD commented that Recommendation 9 seems in conflict with earlier assessments of government efficacy in O & M, and need for community participation. Is this a recommendation based mainly on PHED/district agency engineers' stated views, or is it considered view of NEERI team?

12. Mr PARAMASIVAM explained that the column headings should read as follows: Tube wells with hand pumps, Column 1 <1000 popn, Column 2 >1000 popn. Tube wells with piped water supply , with PSP only, Column 3 <1000 popn, Column 4 >1000 popn. Tube wells with piped water supply with PSP + HC, Column 5 <1000 popn, Column 6 >1000 popn.

13. He went on to say that more summary tables and results are given in the report "Evaluation of Rural Water Supply Schemes in India" obtainable on request to Director, NEERI, Nagpur 440020, India and that the recommendation at 9 is the considered view of NEERI.

14. Mr SEROO asked what has led the authors to conclude that batch-disinfection by bleaching powder has not been effective? Has any study been made for a comparison of water quality (bacteriological) between shallow wells and deep tube wells?

15. Mr PARAMASIVAM answered that it was observed in a number of cases that disinfection of water supplies was done by adding a solution of bleaching powder once in 2-3 days into the service reservoir. This was not found effective. The main focus of the study as far as water quality was concerned was the bacteriological quality of water supplied. No stress was laid on a comparison between water quality between shallow and deep wells.

A K Biswas and others

Coastal zone water supply schemes in West Bengal

16. Mr BISWAS read the paper to the audience.

17. Mr SHARMA noticed that per capita consumption is stated to be 40 lcpd. Was this entirely through stand posts or private connections also existed? If 40 lpcd could do, why 90 lpcd is recommended?

18. Mr BISWAS replied that per capita supply of 40 lpcd is only through PSP's, no house connection exists. Already inthe paper it was mentioned that the supply is inadequate and NEERI often surveyed villages spread over 11 states, recommended 90 lpcd should be maintained where the scheme will design for PSP or Hand pump.

19. Mr JENKINS observed that in saline areas of Nookhali, Bangladesh, experience with very shallow tube-wells located adjacent to ponds has been very encouraging. Has this been considered in India?

20. Mr BISWAS replied that it is a good suggestion but it was found that bacteriologically water is unsafe as potable water if we sink the tube well near shallow ponds in the saline area like Contai where sweet water is only available beyond the depth of 800-1000 ft as per Geological Survey of India report. In our study village as well as in reference village shallow ponds which are used for other uses other than drinking and cooking are only of 3 to 4 ft deep. Beyond this also salinity exists.

21. Mr BASU asked whether any study has been made regarding the behaviour of the underground aquifers in the area. He also observed that under Barasat Division, PHEDTE, piped water supply has been provided in four islands of riverine areas of Sundarbans. Where elevated reservoirs have been omitted and also the single taps,instead low level service tanks with four to eight taps have been provided at intervals of 500 metres which has found general acceptance in the area. This system is also less costly. Studies are also being done under Barasat Division, PHEDTE regarding improvement and also about nature of underground sweet water aquifer in this area.

22. Mr BISWAS said that we could not study the behaviour of the underground aquifers as it was not in our scheduled programme because our objectives were different.

23. Mr JENKINS commented that shallow tube wells (depth 6 m) adjacent to ponds have given good drinking water in saline coastal areas of Bangladesh. Soil type is silty loam to 4-5 m, then sandy loam. Provided the pond penetrates the sandy loam, a fresh water layer develops on top of saline ground water which can be tapped. 10-day monitoring of 20 wells for 1 year shows some fluctuations in salinity, but always < 6000 μS/cm. Coliform counts of samples shows pond levels >200/100 ml and well levels <2.2/100 ml. Costs are $35/well, pump and sinking. Detailed results of 300 wells will be circulated soon.

E G Thomas and others

Refugee water supplies in Somalia and Sudan

24. Mr LLOYD described how the "Register of Engineers for Disaster Relief" had a computrised list of over 400 Engineers who had been interviewed and pre-selected for calling whenever the N.G.O.'s required them. They had received training in Disaster Engineering. It is a registered charity in the UK and its office will shortly be at the Institution of Civil Engineers, London. He described how REDR operates and showed slides of some of their operations in refugee camps. There were a number of people in the audience who requested more information and who would like to be able to call on the REDR for help.

D M Ishengoma

Water supply in semi-arid Tanzania

25. Mr ISHENGOMA emphasised two main areas in his introduction. The Strategies para 3.0 and the Constraints para 6.0 and elaborated on both these issues.

26. Mr DAS said that environmentalists have cautioned that nomadic tribes in semi-arid zones should not be rehabilitated in permanent homes, otherwise there will be other ecological problems. The best way to utilise semi-arid zones for human habitation is by nomadic tribes.

27. Mr ISHENGOMA replied that he agreed with this argument. However, this brings us to the fact that the Government has had to find ways of providing the basic water requirements to nomadic people and at the same time allowing them to continue with the activities of cattle grazing in search for grazing ground. Therefore things like cattle troughs and drinking water points will have to be provided in a way so as to allow such movements in a manner preplanned and provided for by the Government (an indirect form of village settlement).

Shecou-Bah Kabbah

The improved bailer well

28. Mr KABBAH introduced his paper describing the deterioration of hand pumps in his country until wholesale replacement was the only way forward. The bailer well was designed to provide water from the existing wells without polluting them. This system has the great advantage that when sufficient funds are available to provide hand pumps they can be installed in place of the bailer with NO structural alterations. If the hand pump then breaks down the bailer can be used again until it is repaired. This prevents the use of polluted sources during repair times.

29. Mr KAPUR asked how would the author revive the bailer well if discharge of water reduces (due to choking of media or other reasons) after a few years?

30. Mr SHECOU-BAH KABBAH answered that in order to clear choking of the underground filtration of the shaft, you can use simple air pressure and bail the water out of the well with the bailer. Choking is not likely to occur due to the type of soil selected for well location.

31. Mr DAS asked what are the maintenance requirements of a bailer well? Do you get all materials such as cement indigenously in the country?

32. Mr SHECOU-BAH KABBAH said that the bucket, called the bailer, is the only part which is likely to need some amount of maintenance after a few years. This can be done by the water users themselves. They can change the valve and repair the buckets.The valve is made out of rubber from inner tubes of car tyres. The materials such as cement and pvc pipes are locally manufactured in Sierra Leone.

C Nakau and D Rowsome

The evaluation of a hand pump

33. Mr NAKAU introduced his paper describing the evaluation process, dividing the analyses between Technical, Economic, Social and Cultural, Institutional and Health evaluation. He showed slides of the pump in use in the field.

T N Lipangile

Wood and bamboo in water conveyance

34. Mr LIPANGILE introduced his paper by briefly giving the advantages of the "replaceable" materials and showed slides of the material in use. He also described the wood stave technology for larger pipes and tanks. There were a large number of questions, written and from the floor. Only a few were answered because of shortage of time at the meeting.

35. Mr GUIN asked.Is there any lining of the wood/bamboo pipe? What is the 'C' value for Hazen Williams formulae? Have any tests been done for water quality carried by bamboo/wood pipe and if so, what is the result?

36. Mr LIPANGILE replied that the wood/bamboo pipes are lined. These lines are:-
aqual seal supplied by M/S Shell of UK,
PF4 supplied by M/S Shell of UK,

Bittous supplied by M/S Dove of UK . All of these linings are bitumastic coatings approved by British National Drinking Water Council.

37. Mr LIPANGILE said that the 'C' values are as follows:- a) Unlined bamboo pipes - C = 70, b) Bituminous bamboo pipes - C = 90, c) Unlined - C = 120, d) Lined - C = 140 (similar to PVC pipes).

38. Mr LIPANGILE said that Water Quality tests were carried out both at the Government laboratories in Tanzania and Overseas (Netherlands Delft University). The results of the tests were as follows:- Chemical tests:-
(i) Bamboo pipes - no toxicity was found from bamboos in natural form. When trenches were treated with insecticides to prevent termite attack, no contamination was detected in the water, because the chemical is fixed in the ground, the pipes are coated with bitumen lining exteriorly and interiorly and unpreserved soil is placed in between the pipes and the preserved soil. The water quality found in bamboo systems was similar to that in plastic water systems (no contamination). In addition to this, there is no direct contact between flowing water and preservatives. In general, the water quality achieved by bamboo/wood systems is within the approved standards of WHO.
(ii) Wooden pipes and tanks - No toxicity was found from the wooden pipes in natural form. Water tanks were preserved using copper chrome arsenic. The results of analysis conducted showed no water contamination since the preservatives are fixed perfectly into the wood. However, the stored water in wooden tanks should not remain stagnant for periods exceeding 45 days i.e. it should be flushed before use. In addition, the interior of tanks can be coated with bituminous coatings. In this case water can be stored indefinitely without any adverse effect. For wooden pipes (used for water supply, irrigation, culverts, sewerage etc) no chemical leaching was detected. For drinking water wooden pipes, more care was required and hence the interior of the pipes were lined with either a polyethylene film or bituminous coating in order to ensure that the drinking water had no contact with preserved wood.

39. Bacteriological Examination from samples collected at various points along the bamboo water supply conveyance system (preserved and unpreserved), it was found that no harmful bacteria grew inside the system. However, analysis of some samples of unpreserved bamboos was conducted and showed some traces of fungal growth after a long duration. These fungus have no detrimental effect for human consumption other than the decay of pipes. Fungal growth can be prevented by the use of preservatives e.g. (i) bituminous linings, (ii) impregnation of copper sulphate or borax acid (iii) chlorination in running water (intermittently or constantly) and (iv) to some extent, constant water saturation of the system.

40. Unpleasant Smell. Inside bamboo fibre, there is an unpleasant smelling jelly. It is however harmless to human beings. In order to remove this smell, bamboo pipes must be submerged in flowing water for a maximum period of 8 weeks immediately after cutting. Alternatively the pipes may be sterilized by strong doses of chlorine (up to 10 mg/l) for a period of approximately 24-48 hours, then flushed with water after sterilization. For pine wooden pipes no smell has been experienced.

41. Mr RATRA asked how do you compare the economy and useful service life of wood/bamboo piping system as against successful technological development and adoption of plastics piping system in developing countries including Tanzania.

42. Mr LIPANGILE replied that in determining the cost competitiveness and viability of both wood/bamboo and conventional systems, two aspects were considered:-
(i) Cost per running metre in comparison of wood/bamboo and plastic/steel pipes e.g. a 75 mm diameter bamboo pipe against a similar size of plastic pipe at similar hydraulic gradient and flow as well as wood and plastic pipes under similar conditions.
(ii) Economical lifetime of both systems.
(A) Bamboo systems
(i) Cost per running metre:- A well preserved bamboo pipe with an expected lifetime of 20 years is 3-4 times cheaper than a conventional plastic pipe locally manufactured in Tanzania. Bamboo pipes are 10 times cheaper than steel pipes.
(ii) Economical lifetime:- In 1983, an independent evaluation mission (M/S Brokonsult) was appointed by the Swedish Government to evaluate wood/bamboo technology in Tanzania. As a result of this evaluation, the mission concluded that:- if a bamboo water supply scheme serves for a lifetime of 10 years, it is cost competitive in comparison to a plastic system (in fact, some bamboo schemes in Tanzania have touched 10 years of continuous service).
It has been found that when bamboo forests are close to construction sites, it becomes more economically advantageous even if less cost preventive methods are used to achieve a service life of 5 years only.
As per SIDA evaluation mission, the economical lifetime of wooden pipes is 20 years.
(B) Wooden systems
(i) Wooden systems are cheaper than conventional structures e.g. concrete masonry and

steel. For smaller village tanks, the wooden structures are cheaper by approximately 100% and for larger capacity tanks, they are cheaper by approximately 500%.
(ii) Small wooden pipes up to 75 mm diameter are almost equal in cost comparisons with plastic materials. But for pipe sizes beyond 150 mm diameter, wooden pipes are much cheaper and very cheap at larger diameters above 200 mm diameter.

43. Mr DAYAL asked about the effect of chlorination or disinfectants used in bamboo and wooden pipes.

44. Mr LIPANGILE said that the effect of using chlorine in bamboo water systems when not interiorly preserved was as follows. Chlorine doses ranging between 0.25 mg/l and 4.0 mg/l have been found effective in destruction of fungi. However excessive doses (over 5.0 mg/l) can cause oxidization of the interior pipe surfaces with consequent surface decay. Bamboo, being an organic material, can absorb 0.5 mg/l of chlorine per Km in running water for pipe sizes up to 75 mm diameter. This reduces the chlorine available designed to work as a disinfectant. Therefore the recommended method of applying chlorine in bamboo systems is by flushing intermittently (say, once a month or once every 3 months.

45. Mr PARAMASIVAM asked from the point of conservation of forests, would you like to recommend large scale use of wood pipes?

46. Mr LIPANGILE replied in the affirmative for the following reasons:
a) Bamboo forests in Asian, African and other countries grow naturally. Also, there are already established Government organisations to develop bamboo forests, some of which are sponsored by international organisations e.g. the International Development Research Centre of Canada, IDRC. The bamboo forests can grow fast and become ready for use after 3-4 years only. The most commonly known bamboo species useful for bamboo piping are:-
i) Bamboo vulgaris (yellow-green striped bamboo)
ii) Arundinaria alpina (green mountainous bamboo)
iii) Dendracalamus sinicus (huge bamboo - found in Asia).
b) Pinewood (soft wood) specie has been proved useful timber for making wooden tanks and pipes. These forests are artificially planted and grow faster ready for use after 12 years only. Hence in both cases, the problem of deforestation is not foreseen.

47. Mr CHAKRABARTY asked considering the stability is it better to use the wooden materials in water supply compared with the other materials generally used at present. Also, it will be cheapest economically, not initially but finally, to use the wooden materials for the purpose of culverts, drains etc rather than the R.C.C. or iron pipes.

48. Mr LIPANGILE thanked Mr CHAKRABARTY very much for his recommendations and support to the wood/bamboo technology of Tanzania and commented that wood/bamboo water systems (irrigation pipelines, road culverts etc) have already been constructed, tested and used successfully in Tanzania for the past 10 years.

49. Mr JENKINS observed that while wood and bamboo possibilities seem very good if prices are low, in countries where prices are high, corrugated PVC might be considered at about 1/3rd the price of uncorrugated pipe. This is being successfully tested in Bangladesh.

50. Mr LIPANGILE said that there is no technical/economical data in support of your argument for use of corrugated iron materials as opposed to wood/bamboo materials. Corrugated iron materials are minerals and developed to be materials from sophisticated steel industries. On the contrary, wooden and bamboo materials are close to villages and with minimal use of cheap chemicals, these materials have proved to be very cheap in comparison with the conventional materials.

51. Please note that Mr Basu's presentation to the Conference of 'The evaluation of rural water supply schemes' was given verbally and there is no written paper included in these Conference Proceedings.

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

P R Thomas, K N Ramamurthy

Biogas for low income housing

INTRODUCTION

The petroleum price hike in the seventies created a severe economic stress in many developing countries resulting in the limited availability of funds for housing, water and sanitation projects. Such increased energy prices cause increase in the cost of living and other economic problems. The major victims are middle and low income groups both in the urban and rural areas. Also, the task of planning a new low income housing with adequate sanitation and services is becoming increasingly difficult due to the shortage of funds and acute shortage of housing. This leads to poor sanitation facilities and also restricts the availability of an affordable energy source for cooking and lighting purposes. Furthermore, the use of charcoal and wood is on the increase for household facilities and as a consequence many nations are facing severe deforestation problems. Hence with the need to look for alternative sources of energy coupled with the growing concern for environmental sanitation, resulted in the consideration of a process of digesting organic matter under anaerobic conditions which also produces a flammable gas, called Biogas. It is essentially 50-70% methane and the balance contains a substantial portion of carbon dioxide and traces of nitrogen, hydrogen, oxygen and hydrogen sulphide.

GENERAL CONCEPTS OF BIOGAS

The potential of biogas as a renewable source of energy has been recognised by the end of the 19th century in England where the gas was utilised for street lighting "(ref. 1)". In recent years biogas technology has received attention especially from developing countries and there are at present about seven million biogas digesters in China, while large numbers are also being used in India, Thailand, Nepal, Philippines, Fiji and Korea. Biogas plants are most commonly used to digest domestic sewage and/or animal dung. However, a wide variety of other organic materials can serve as feedstocks including agricultural plant wastes, water hyacinths, agro-industrial by-products and municipal garbage. Since biogas plant types vary in performance depending upon climate, feedstock and scale, it would be appropriate to develop a model to match the specific feedstock and climatic conditions. Although the construction of biogas plants is mainly to obtain a source of energy, other benefits to an urban or rural environment include supplies of excellent fertiliser, sanitary waste treatment and improved public health.

LOW INCOME COMMUNITIES

The major problems facing the low income communities in many countries are enormous increase in the cost of living, shortage of low cost houses, rise in diseases due to poor sanitary conditions and lack of service facilities. Even where low cost housing is provided, there are no appropriate water and sanitation facilities and the roads are in a poor state with no lighting. The level of income of the people is so low that they cannot afford to pay for the conventional energy sources needed for the day to day activities. In many areas, usually public latrines are provided because of economy but the price is paid in terms of the consequences resulting in low standard of sanitary conditions by misuse of these facilities and defecating in open land. Also, cramped housing is often shared with goats, cows, pigs and other livestock and the problem of disposing animal waste remains unsolved. Disposal of excreta has to be carried out either by conventional sewerage system or with alternatives such as "vault toilets", "pour flush" latrines, septic tanks, pit latrines and aqua privies. The services connection of a low income housing scheme to the existing or extended conventional sewerage networks may not be feasible because of cost and other constraints. Improper disposal of excreta not only pollutes the environment but also spreads epidemic and parasitic diseases.

Due to the many complex aspects of environmental sanitation and protection of good health both in urban and rural setting among low income groups biogas technology appears to be the most appropriate alternative for the disposal of excreta as well as a source of providing cheap energy. India with its rural population of more than 500 million people is giving special consideration for community-type biogas plants where the toilets are connected to the digester either in urban low cost housing schemes or in a village set up. One example is the large community type biogas plant established at Masudpur Village south of Delhi, which supplies cooking gas to about 60 houses and helps the villagers with improved sanitation and also provides manure for agricultural purposes.

SOCIO-ECONOMIC IMPLICATIONS

Although there are advantages, certain problems such as economic, social and lack of community participation had made the biogas systems a failure in many communities. Many of the limitations of a community or family to adopt biogas technology lie in the family traditions and cultural beliefs. For example in countries like India, Sri Lanka and Haiti, cultural superstitions among certain society prevent the successful implementation of biogas technology. In certain cases, insufficient knowledge and planning have resulted in the construction of many faulty digesters. Community education and participation are necessary to combat the lack of technical understanding at both urban and rural levels. In many low cost housing schemes it is evident that the people own television sets and radios, and newspapers are popular as in other parts of the country. The use of the media - television, radio and newspapers is therefore appropriate means of relaying information about sanitation and the advantages of biogas technology. Also, schools, markets, community centres and other public locations are ideal places to publicise the benefits of this technology.

China's success in building seven million biogas digesters is mainly due to community system and the way the government encourages biogas development. Each community has a committee of 5 to 10 people selected by the farmers, that makes decision for the entire community. People are assigned to the specific tasks of cleaning and operating the digesters. Many constraints are overcome by the fact that the biogas project is instituted at the community level and the people are cooperative with those in charge. There are also many biogas extension offices set up within different provinces to train biogas technicians.

Public health aspects of waste disposal include concern about the transmission of pathogenic organisms and the problems caused by improper disposal of waste water. Many types of human pathogens are largely eliminated by passing through a digester. Compared with other waste disposal methods commonly used in low income areas of developing countries, anaerobic digestion should not create any new or additional health hazards. Despite the fact that certain pathogenic organisms can pass through the digesters, significant community health improvements have been recorded in developing countries. For instance in China, the number of people infected with hookworm disease decreased from 63.8 to 5 percent in one community and dysentery was practically eliminated in another community "(ref. 2)". Economic advantages could be identified in areas where there had been a reduction in the purchase of electricity, fossil fuel or fertiliser and also in the saving of money and time in treating dysentery, typhoid and worm diseases.

RADIAL DESIGN CONCEPT FOR SITES AND SERVICES

Sites and services programme envisages development of building sites with the provision of infrastructure including water supply and sanitary facilities. The cost of infrastructure in providing the utilities will depend on size and shape of the plots and the road layout. A radial layout pattern has been tried for the various sites and services schemes in Tamilnadu, India "(ref. 3)" where the individual sanitary core units of a group of plots are arranged around a central point (Fig. 1) from where a single service connection is provided. This eliminates the necessity of carrying the network of utilities along length of the plots. From this central core area, the utilities are directly made available to each of the plots in the circular group of radial flats.

The sanitary core units in each of the plots of the groups are connected to a single manhole located in the central core area and disposal is facilitated through a service passage formed between the radial sides of two of the plots in the group. This brings about reasonable savings in service connections. Similarly the distribution of water and electricity could also be facilitated through the central core area. In certain cases when a biogas digester located at the centre supplies gas for cooking and lighting thus minimising the fossil fuel energy use and pipings in the low cost housing.

CONCLUSION

Biogas production from human excreta especially as a community type, has a significant potential in developing countries at present, and in the future for producing a cheap source of energy and

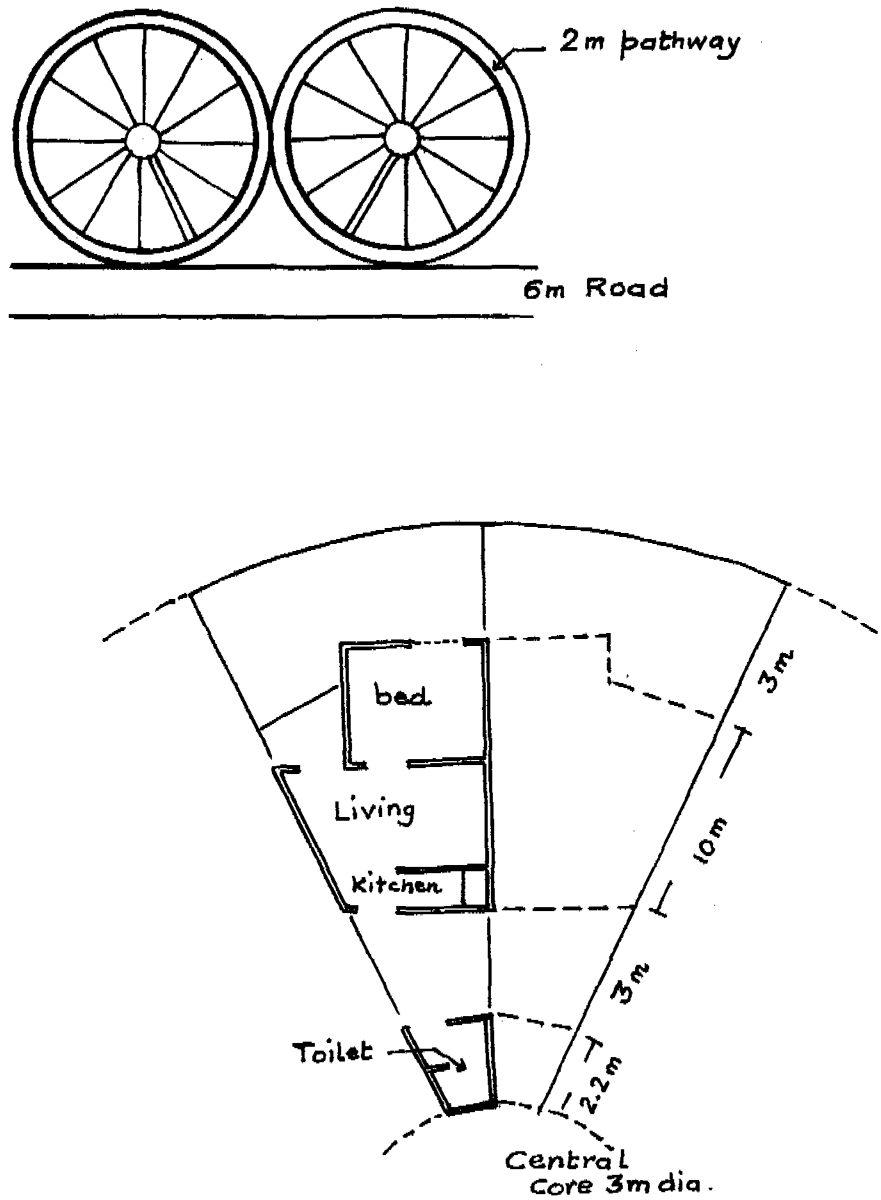

FIG. 1 RADIAL DESIGN CONCEPT FOR SITES AND SERVICES

increase in environmental sanitation. Biotechnology deserves more widespread support and to achieve this the communities need to be convinced through education by the relevant authorities about the enormous benefits of this technology.

REFERENCES

1. NATIONAL ACADEMY OF SCIENCES, Methane Generation from human, animal, and agricultural wastes, Washington, D.C., 1977.

2. ELLIS T.G., PARKIN G.F., and GUROL M.D. Potential of biogas in developing countries. International Symposium on Environmental Management for Developing Countries. Istanbul, July 1984.

3. RAMAMURTHY K.N. Housing policy and programme. United Nations Seminar on Housing for the Low-Income Population Group of South East Asian Countries. Bandung. Indonesia, November 1981.

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Abul Basher M Shahalam

Septage collection system economics

INTRODUCTION

The progressive development of sanitation facilities in growing areas, and the sequential stages of such developments with time are of great interest to the sanitation planners. Such unplanned and uncontrolled spontaneous developments of sanitation facilities provide valuable information about the society awareness for sanitation requirements, society initiatives to participate in sanitation projects, people's willingness to pay for the sanitation services, operation experiences, appropriateness of such technology and economics of the services.

The paper contains the economic characteristics of an intermediate sanitation system in a rapidly growing area in Jordan. The present system of sanitation in the area includes individual on-site septic tanks with private sullage-solid-mix collection by mobile tanks mounted on trucks. The contents are disposed of in an anaerobic pond for final stabilization. The pond is provided by municipal authority without any charge.

LOCATION AND SYSTEM BACKGROUND

This private septage collection system operates in the city of Irbid and its sub-urban areas. The city of Irbid is located at the northern border of Jordan. Until 30 years ago, the population of the city with its surroundings remained below 10,000. During fifties, sixties and seventies, the city has grown rapidly. The city is presetly the center of Irbid Governorate and is the center of country's largest university. The present population (1980) of the city with its surroundings is about 150,000. Among the adult (above 25) inhabitants of the area, 60 percent finished 8 years of schooling. Traditional Arab life style and way of united family living still exists. An average family has 21 members and an annual income of 4,000 J.D. (1 J.D. = 2.75 dollar).

Personal interviews with local elders revealed that about 50 years back, there was no defined sanitation facility within the area. About 30 years back, people started to use pit latrines. Since 20 years, single vault septic tanks started to be constructed with new houses. During the early development, solid-liquid septage would be carried away by donkey driven tanks to valleys away from the locality. Since 1975, by law every house must have septic tank or underground sewage disposal facility and such facilities need to be approved by the municipal engineers.

SEPTAGE MANAGEMENT SYSTEM

About 90 percent of the existing households in the Irbid area is served by septic tanks. The soil condition in the area is not suitable for sullage leaching systems. Hence a growing need for service to remove the septage was realized. At the demand for services, people interested in business started buying tank-trucks to serve the households for payments. Thus a free enterprise of private service developed.

Usually, the owner of the truck drives the vehicle with a helper and attends household calls. The names of the vehicle owners are registered with the municipality and appear in the local telephone directory.

Septage removal service thus remains as a commodity and the houseowners and truck operators bargain freely over the rate for the service. Hence a spontaneous rate has been evolved under competative economic market. Presently the rate varies from 5 to 6 J.D. per call. The physical and economical characteristics of the system appear in tables 1 and 2 respectively.

There are about 7,000 septic tanks for 150,000 people. Fifty percent of these septic tanks have some kind of soak pits attached to them. Average number of truck calls for each septic tank with pits is one per month when the number of calls for septic tanks without soakpits is three per month.

OPERATION AND MANAGEMENT

Though the tank-trucks are owned by private individuals, however, they are registered with the municipality and their operation is closely supervised by the city municipal engineer and his staff. The municipality has no jurisdiction over truck ownership, vehicle maintenance, vehicle service schedule, service charges, limitation of service area and the number of customers. The principal supervision job of the city is to control the septage spillage, proper dumping of tank contents in the pond and the maintenance of the ponds. The city personnel involved in the system are Mayor(part-time), a full time sanitary engineer and four field staff including two with some public health background.

In case of on-route breakdown of a truck, the driver is supposed to call another truck to empty the tank contents at the owner's cost. The truck owner is penalised for any spillage of tank contents on roads or any other place other than the designated ponds. The trucks receive servicing in specified maintenance garages. These garages are very few in number and are located in the truck servicing section of city industrial area which is away from the city residential areas.

As the trucks are free to travel anywhere to pick up the waste, usually there is not any defined route for a truck. However, due to the local aquintance of the truck owner and his interest in operating in his locality, it was found that without very few exceptions, a truck usually maintains an area of service.

The truckers do have a tendency to accumulate calls so that the tank will be filled before it makes a trip to the pond. However, there is always a chance of his loosing his customer in cases of much delay. It was observed that nearly 50 percent of truck trips are

Table 1. Physical Characteristics of Irbid Septage Management System

Item	Description	Quantity	
1	Year, full fledged septage collection system started	1975	
2	Total number of household served	30,000	
3	Total number of septic tanks	7,000	
4	Area served	216	sq. Km.
5	Number of tank-trucks serving the area	70	
6	Volume of each tank-truck	6-9	cu. m.
7	Average number of tank-trucks working per day	60	
8	Tank-trucks receiving garage services per day	10	
9	Average distance travelled by each truck	50	Km.
10	Stabilization pond (anaerobic, unlined, earthen)		
	Area	100,000	sq. m.
	Depth	2	m.
11	Personnel		
	Private		
	a. Truck drivers	140	
	b. Helpers	140	
	City		
	a. Sanitary Engineer (part-time)	1/30	(one day per month)
	b. Pond attendent	1	
	c. Pond guard	1	
	d. Public-health inspector (part-time)	2	(30 days per month)
12	Time interval between septage pick-ups	10-30	days (2 calls per septic tank per month)
13	Tank-truck operation time	24	hrs.
14	Maximum length of pump hose in trucks	40	m.
15	Maximum distance from truck stop to septic tank	35	m

Table 2. Economical Characteristics of the Septage Management System

Item	Description		Quantity	
1	Tank-truck capital cost (usually Mercedese 5-6 yrs. old, bought from Germany)		5,000-10,000	J.D.
2	Fuel (100 liter per day per truck, diesel)		8.3	J.D.
3	Cost per truck call		5-6.6	J.D.
4	Personnel salary:	a. Driver	200	J.D./month
		b. Helper	120	J.D./month
		c. Pond attendent	150	J.D./month
		d. Pond guard	80	J.D./month
		e. Sanitary Engineer	20	J.D./day
		f. Health Technician	5	J.D./day
5	Average maintenance cost per truck per month		35-45	J.D.
6	Cost for land (Pond)		1,000	J.D./hectare

made with tanks partially full.

The trucks operate during day and night. Night calls are made where the truck drivers are *familiar with the locations of the septic* tanks.

COST

The cost of a household for cleaning the septage depends on the number of times a septic tank needs to be cleaned within certain time. On average, each septic tank needs cleaning twice a month. Based on the average cost of 5.8 J.D. per call, the cost per household of 21 people (average number of people per septic tank) is 11.6 J.D. per month which amounts to 32 U.S. dollar. This amount is directly for tank-truck service. Customers do not directly pay or are charged for municipal services. The municipality part of the operational cost is nearly 250 J.D. per month. This cost is met from the municipal general annual budget. However, when this cost is distributed over 7,000 customers, the cost per customer is insignificant.

At an average of two calls per month per septic tank, total number of expected calls is 14,000 per month i.e. 467 calls per day. Assuming equal number of calls for each truck, the number of calls for each truck is 8 per day. Daily income of a truck at 5.8 J.D. per call amounts to 46.4 J.D.. Bare operational cost of a truck is nearly 4.6 J.D. per day. Hence a truck owner receives nearly 8.3 J.D. each day. At this capital return rate and at an interest rate of 10 percent, the average capital cost on a truck may be realized in three years.

WORKERS' HYGEINE

A health related survey indicated no reports of unusual sickness or absence in work amonst the truck drivers and helpers.

While on duty, the drivers and the helpers use hand gloves and work clothes which they leave in trucks before returning home. The municipality provides hygeine and helth advisory services to drivers and helpers. They are advised to take precautionary immunisation from government medical centers free of charge.

DISCUSSION

Irbid septic tank septage collection and disposal is an unique example of how private business interests may be utilized with benefits in programmes which are long known to be public burden. The problem of sanitation is treated as collective public problem and in many parts of the world, it is entirely managed by public agencies.

The treatment of the tanker services as a free commodity and maintaining the bargaining position for the septic tank owners have resulted in a balanced and economically healthy service rate for the system. Apparently a $32 dollar bill per month for sewage appears to be too high in comparison to worldwide estimated rate of $9 per month per household[1]. However, the number of household members is about 4 times more than average household size anywhere else. Considering this factor, the sewage cost in Irbid is reasonable.

Recently some truck route scheduling study indicated that some saving in truck operational, may be acieved if the trucks travel only through specified set routes. However, such advisory comments were not effective as the truck drivers and owners are free to operate without any organized controls, administration or pricing system.

In year 1980, the city of Irbid has undertaken the project of phase construction of a conventional sewage collection and treatment system. The project feasibility study mentioned several pluses in favor of the conventional pipe-network sewage collection system including the economic feasibility. Household sewage service cost was estimated to be 11 J.D. per month per household. Assuming that a household at best will be willing to pay 3 percent of its income for sewage service, the average household income in the service area should be more than 367 J.D. per month. Household income projection indicated that such income level will be achieved before the pipe-network sewage collection system starts operation. In case, incomes fail to reach the target, some Government economic subsidy will be necessary.

Irbid sewage management system passed throuh an ideal course of sanitation development. In developing countries, such sequential development of sanitation facilities probably is the most desired solution considering capital shortcomings and lower personal incomes. In sequential developments, the economic standard of the people goes up along with the attainment of higher users' comfort and hygienic safety.

Early planning of such sequences of developments are of much interest to the national planners. For determination of such time sequences of appropriate facilities, some relationships are needed to be developed, which relate the personal income, minimum sanitation standard and community desire for comfort. The following is an expression based on household income and facility cost on customers and was found to be very much representative of the natural time sequences of sanitation development in Irbid area. The relationship may be used if present household income and estimates of user's costs for various sanitation facilities are known.

$$\frac{C_i (1+a)^{n_i}}{f} = H (1+b)^{n_i} \quad (1)$$

where:

C_i = present monthly hosehold cost for ith mode of sewage facility;
a = cost index yearly increase in fraction of previous index (average);
b = income index yearly increase in fraction of previous index (average);
H = present monthly household income;
f = fraction of household income people are willing to spend for sewage facility(3% appears to be a fair assumption ?);
n_i = number of years in future after which ith mode of sewage facility will be economically feasible.

It is obvious that whatever the reason may be, if a community decides to adopt a sewage facility before its economical due time, the system needs to be subsidized financially from country's internal or external sources.

REFERENCE

1. J.M. Kalbermatten, D.S. Julius and C.G. Gunnerson,'Appropriate Technology for Water Supply and Sanitation : Technical and Economical Options,' World Bank Technical Report, December, 1980.

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D Ghosh, I Banerjee, S Bhattacharya

Sewage treatment and fisheries in urban fringes

It is only recently that the scientists have begun to regard waste as a resource. A major rearrangement of the building blocks of urban waste engineering is yet to take place, but changes in attitudes and willingness to rethink are very much in evidence. Urban waste is no longer a sanitary problem to be dealt with summarily. On the contrary recycling it in the hope of achieving hitherto unknown benefits is now the subject of serious scientific inquiry.

The culture of conserving a resource and using it as many times and in as many ways as possible has been seen to thrive among the poor. There is primafacie an inverse relationship between affluence and affinity with recycling. Discoveries over which scientists in advanced countries congratulate each other have in fact been in effective use in the villages of the less developed parts of the world. Examples of this are the fisheries and garbage gardens of east Calcutta which have lived in perfect symbiosis with the city for the past fifty years : taking sewage and refuse and providing in return fish and fresh vegetables.

IDEAS AND INTERESTS :

A recent World Bank report describes the 2,500 hectares of fisheries in east Calcutta as the single largest system in the world to use sewage. China has a total of 670 hectares divided among 42 cities, the largest being a 160 ha unit at Changsha. According to the report, other countries having similar fisheries are Germany, Israel and Hungary. What is not mentioned in the report is about the two other systems of recycling that co-exist in east Calcutta :

1) the practice of using garbage to grow vegetables and
2) channelling effluent from the sewage treatment fisheries to agriculture.

The total area covered by these three systems is more than 12500 hectares. The largest urban waste recycling system that we have in the east of Calcutta is not merely the fisheries using sewage but the total recycling region. The villagers depend on the time-tested practices for perpetuating these systems and in fifty years or so an unique non-formal skill has been developed.

The interest in east Calcutta's waste recycling ecosystem should be understood in the context of a search for development alternatives, for locally adapted, appropriate modes of development rather than transplantation of alien models. Too often planners look abroad for ideas without realising the appropriate principles and practices flourishing in their backyards. Eco-development entails bringing together creative techniques with the ways in which people perceive and approach the issues of quality of life and environmental changes that are in the forefront of planning debates. Human and ecologically sound planning requires an integration of such understanding with suitable techniques and procedures.

Urban waste, particularly sewage, have long been deposited in marshes and swamps adjoining the cities.

Sewage Treatment Fisheries in East Calcutta

Garbage Farms in East Calcutta

However a purposeful study of the wetland ecosystem in treating waste water did not commence before 1970. Almost at the same time a separate set of studies for examining the waste recycling capabilities of sewage fed fisheries came into being. For returning solid waste directly to agriculture, however, very little organised information is available.

The significance of the waste recycling region in environmental rescue is manifold. It takes the city's sewage and garbage and supplies a major share of the city's requirement of fresh vegetables and fish. Furthermore, these recycling systems provide excellent natural biological treatment of waste and that too for a city where no working waste treatment plant exists. The region conceals one of the biggest laboratories in the world for sanitary engineers to standardize and develop least cost alternatives in municipal waste management that would ensure maximum recovery of nutrient available in waste.

The responsibility to protect the largest urban waste recycling in the world should now be shared by all of us with those farmers. If so much has been achieved without any formal recognition of the virtue of recycleing one can imagine what would have been the results with the right kind of control and support the system needs.

The strength of these recycling systems must have been generated from the economic viability inherent in them and their contributions towards the well being of the society. In return the villagers have to depend essentially on nature and flourish in a system where we offer little support.

ORIGIN, GROWTH AND DECLINE :

During the later part of the last century the once active Bidyadhari river on the eastern fringe of Calcutta and other distributaries of the Hugli were silting up. When the river was active, it was under the tidal influence of the Bay of Bengal, which resulted in flooding of the area. Gradually the tidal influence stopped due to silting and the spill area of the river became an agglomerate of stagnant pools of water - both brackish and rain water. Around 1930's this spill area was gradually converted into sewage fed fisheries and Calcutta sewage became the main source of water (non-brackish) supply in these low lying areas.

The first commercial nature of sewage treatment fisheries began in the year 1929. Mr. B.Sarkar, an imaginative entrepreneur, made the first attempt to produce sewage grown fishes commercially in a large tank (1000 hectares). In his second attempt, in the subsequent year 1930, Mr. Sarkar succeeded in this culture of sewage treatment fisheries. The name of this fishery is 'Nalbal Fishery' (Bheri), and is now run by a State enterprise. Since 1930 these sewage treatment fisheries grew all over the wetland area east of Calcutta. There was however, a desperate need for an alternative source of water and for this the role of city sewage was quickly appreciated and utilised. The fisheries introduced raw sewage as its input and released highly purified effluent (Ghosh 1983) through the internal grid of drainage channels, excavated and maintained by the entrepreneurs.

The growth of these fisheries are linked with the natural systems as well as the anthropogenic interventions. The Bidyadhari river had a gross cross-sectional area of barely 173 sq.mtrs. in 1830 at Bamanghata. It rapidly increased to 1230 sq.mtrs. in the same area in 1883. The whole region was the spill area for the river Bidyadhari. But after the construction of a series of artificial cuts that joined the Bidyadhari and the Kulti Gong, more spill areas and spill channels were thrown into the basin of the river Kulti - the only outfall recepticle for Calcutta sewage. Moreover, free spill into the Salt Lake were curtailed both naturally and artificially. The Bidyadhari dwindled her sections from 1230 sq.mtrs. in 1883 to 425 sq. mtrs. in 1904. By 1928, it further reduced its sections to barely 200 sq.mtrs. after which the river was officially declared as useless by the Bengal Government either for drainage or for navigation purpose. In consequence, the brackish water fisheries were converted into swampy land and the entire fish production in this region was to stop. Just at this time in 1930, Mr. Sarkar successfully performed his experiment to grow fishes using city sewage. The news of such success spread widely. But the sewage fed fisheries could not grow on a widespread scale. Because of the swampy character of the region and failure of the drainage system, the whole region could not be reclaimed as fisheries immediately. But in 1940, the Bidyadhari could no more carry the city's sewage which began to accumulate. This could not continue for any length of time. The irrigation engineers of the state suggested to avail of the stormwater(SW) Channel as an emergent measure. This was completed in 1939.

With the clearance of already collected water, the fisheries of the eastern wetland started using sewage. This was further accelerated after the construction of the Dry Weather Flow (DWF) Canal. The bed level of DWF canel was much higher than that of the SW canal and when sewage was allowed to pass through the DWF canal it began to gravitate automatically into the fisheries. All the earlier fisheries of both the North Salt Lake and the South Salt Lake were converted into sewage treatment fisheries by 1942-43.

The sedimentation tank at Bantala began to function from the 1st May 1945 and the fisheries were getting about 80% silt free sewage. This phenomenon boosted up the interest of the fishery owners to use this sewage for the fisheries. Soon after the sewage-fed became the only type of fisheries in this region. Till 1956 these fisheries were undisturbed.

During the World War II some portions of the North Salt Lake area had to be vacated for the use of the military. These regions are mainly Tihura Nayabad, Kheadaha, Deora. But after the war was over the villagers returned to their own land and the fisheries were in full swing again. Except for this short period there was practically no odds for these fisheries. But in 1956, a land acquisition notices was served on the North Salt Lake fisheries by the Land Acquisition Collector, Government of West Bengal for the expansion of the city. The same notice was served for the South Salt Lake Fisheries in 1957. These notice are not formally invalidated by the authority who worked for the scheme in this area. Thus an atmosphere of uncertainty had been prevailing all over the region. For this the entrepreneurs became shy. As a result the work of desilting in these fisheries was stopped. Approximately 10 cm to 15 cm of desiltation was necessary for these fisheries after every 5-6 years. But since this work has not been done for a pretty long time, the bed levels of these fisheries are rising and as a result the production of fish is reduced.

Furthermore, for the development of the Salt Lake City (3000 acres) and for the Baishnabghata complex (1000 acres) fisheries land is lost in two phases of urban sprawl. Similarly, for the expansion of the city about a thousand acres of fisheries land was converted . Thus for the expansion of the city so far about 5000 acres of fisheries land is lost.

ECONOMIC APPRAISAL :

The efficiency of resource recovery based landuse was further established as we made an economic appraisal of an integrated resource recovery project on the waste recycling region covering over 12500 hectares. The present appraisal is based on a conservative estimate of benefits derived from an integrated fishery and agriculture system using the Calcutta sewage. The purification of sewage, which takes place through the system is not considered in the benefit estimation.

Total Project Cost	:Rs.1134 Lakhs
Period of implementation	:5 years (1986-87 to 1990-91)
Expected life of the Project	:20 years

(1£-Rs. 17.00, 1$ = Rs.12.14
1 million = 10 lakhs.)

Economic Costs :

(a) The tentative annual investment layout is as follows :-

Year	Cost(Rs. lakhs)
1986-87	344
1987-88	389
1988-89	377
1989-90	12
1990-91	12
	1134

(b) Annual average recurring costs : Rs.413.00 Lakhs.

For estimating the benefit cost ratio (i.e. the ratio between the present value of the benefits and the present value of the costs) the time series of both the returns and the costs have been used. Some of the benefits will start accruing partly during the implementation period itself. An estimation of annual benefits accruing from different years have been made for our purpose for two different alternatives (alt. A & alt. B) under two assumption where for alternative A the yield forecast for fish is 7 ton/ha and increased employment for 2.5 persons/ha for 350 days while for alternative B the same is 10 ton/ha and increased employment for 3 persons/ha for 350 days. It is expected that some of the benefits will start accruing from the third year and this alongwith the others will progressively improve over the implementation period and full benefits will accrue from the 6th year.

It is also assumed that the project cost remains the same for both the alternatives. It is possible that the villagers use their labour in alternative uses and due to their formal engagement in the proposed project work other productive activities and hence output are affected. But in a labour abundant economy like ours, for the sake of convenience, it is further assumed that the off-project wage opportunity is negligible or zero and output forgone is nil.

The benefit cost ratio has been calculated on the basis of a standard 10% discount rate; but in view of the strong inflationary pressure prevailing in the country a 15% discount rate has also been tried with.

The economic appraisal of the project establishes that it is well conceived from the economic point of view. On a very conservative estimate of direct benefits alone the B-C ratio appeared to be 1.48(10%), 1.26(15%) and for an optimistic assumption the ratio came out to be 2.12(10%), 2.06(15%). These direct benefits included only the increased value product and services which could be unambiguously quantified. Apart from the direct benefits, it is necessary to consider all other benefits accruing from the project like indirect benefits (arising from processing) secondary benefits flowing closely from the project like increase in trade and transport associated with increase in agricultural and fish output, induced benefits like increased activity expected from increase in population and employment (multiplier effect) and finally social benefits consisting of the increased welfare of the community brought about by the project. However, in view of the difficulties in quantifying the volume of profit from these activities all the above benefits have been excluded (which are likely to be quite substantial) while calculating the benefit cost ratio from the discounted stream of benefits and costs. The project therefore obviously deserves special attention and a very high priority.

REFERENCES :

EDWARDS, PETER. Aquaculture : A component of low cost Sanitation Technology, The World Bank, Washington, 1985

FUREDY, C. & GHOSH, DHRUBAJYOTI. Resource-conserving traditions and waste disposal - the Garbage farms and Sewagefed Fisheries of Calcutta. Conservation and Recycling, 1984, Vol.- 7, Numbers 2-4, 159-165.

GHOSH DHRUBAJYOTI with SEN, A.K. Sewage Treatment Fisheries in East Calcutta Wetlands, Report to the Department of Fisheries, Government of West Bengal, India. 1983.

12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

B B Thakur, D N Dey, K J Nath

Storage and primary collection of urban solid waste

INTRODUCTION

Ten million people living in an area of 1500 Sq.K.M in and around the city of Calcutta, known as Calcutta Metropolitan District, are fighting a battle, yet to be won,for improved environment in respect of adequate safe water supply, drainage, sewerage, housing, solid waste management and a lot more. Inefficient management of any one of the facilities may cause serious health hazards in the community.

Solid waste management has proved itself to be a very important constituent of environmental pollution in large, small and medium towns.

In the year 1976, a study was initiated to assess the deficiencies in, and recommend remedial measures for, solid waste management systems of thirty odd small and medium towns of Calcutta Metropolitan Districts. The population of these towns ranges between 50,000 to 5,00,000.

The study team has made the following general statement regarding SWM in small and medium towns :

" Inadequate and inefficient collection and disposal of municipal solid waste has become a serious health hazard for the urban community in most of the cities and towns in India by way of soil, water and air pollution, contamination of food, propagation of flies, rats and other disease causing pests, flooding, water logging and mosquito breeding. In the small and medium towns of India, the problem is worse due to the presence of unlined open drains used for the disposal of rain and sullage water. These drains are often used for defecation and urination. Uncollected solid wastes find their way into these drains, blocking their flow and fouling the overall urban environment. Putrifying heaps of garbage and rubbish on the streets and stagnant and septic sullage water in the open drains are two distinct and disagreeable features of urban environment, the inhabitants of small and medium towns in India have learnt to live with it ".

THE DEFICIENCIES IN THE PRESENT SYSTEM

a) At present there is no house collection system. Also adequate number of community containers are not provided. As a result collection is made from open road side dumps. The wastes are scattered by scavengers and animals. Rats contaminate food. Fly larva migrate and pupate in the vicinity. The water sources are contaminated through percolation of leachates from decomposing and putrifying garbage. The resultant contamination of food, water and soil spreads cholera, jaundice, typhoid and other pest borne diseases.

b) If solid waste is not cleared regularly it ultimately clogs the road side open drains meant for rain and sullage water. The stagnant water in the drains favours mosquito breading. Moreover the wastes from the drains are to be cleared at a much higher cost.

c) At present waste is collected from road side dumps into ill designed hand carts and again dumped into bigger heaps to be picked up with rakes and buskets into trucks. This system entails wastage of labour and time for the vehicle. Over and above, the labour -s are exposed to health hazards.

d) The transport vehicles used in the municipalities are not suitable in respect of labour and vehicle productivity. The skilled man power and workshop facilities are not available in the smaller municipalities. Consequently about 30 to 60 percent vehicles remain out of order at any instant of time.

e) The method of disposal of Solid Waste in municipal towns is by filling up privately owned low lands in a hapazard insanitary manner with potential health risks to the community.

Though many of the municipal towns need additional resources in the solid waste management sector yet it has been observed that due to the use of inappropriate primary collection and transport vehicles the quantity of solid waste collection is not commensurate with the current expenditure for the purpose.

PROPOSED SYSTEM

Stress will have to be given on the following four points for the improvement of the system :

a) The road side dumps and double handling will have to be eliminated by introducing house to house collection or at least collection from community containers in pedal tricycles carrying 6 to 8 numbers of 40 litre G.I.Bins. This change will minimise health risk of the labourers and increase per capita waste collection to 350 to 400 gms.

b) Simple type of transfer stations will have to be introduced for the purpose of transfer of refuse from the bins of the pedal tricycle into the waiting skips or trailers which will eliminate the chance of contact of refuse with the ground and improve vehicle and labour productivity.

c) Introduction of carrier container system will separate out the prime mover from the carrier. It has been found that the carrier container system of transport can make much more trips/day with an optimal combination of pedal tricycle containing bins as primary collection vehicle,than that of trucks. This can reduce transportation cost by about 50 percent.

d) A low cost labour intensive, mannually operated, 'Wind Row' composting method, in addition to sanitary land filling, is proposed. This will reduce the load on valuable lands required for dumping solid waste.

The system outlined above is not a rigid one. The design of community containers, house hold bins, transfer stations, transport vehicles as well as frequency of collection may be suitably changed within the broad frame work outlined above.

PRIMARY COLLECTION VEHICLE

A brief outline of the existing condition and the proposed system have been given. Now, we shall restrict our discussion to only primary collection vehicles, which play a vital role in SWM.

Different types of primary collection vehicles are in use for solid waste management. Most common amongst those are the following :-

a) Conventional box type hand carts carrying no refuse bins.

b) Box type hand carts with three wheels.

c) Hand Carts for carrying 2/4/6 numbers of bins.

d) Tricycle with box vans.

e) Framed tricycle vans for carrying 4/6/8 numbers of bins of 100/50 /35 litre capacity.

f) Light weight motor vehicles.

g) Animal Carts.

Among the above mentioned primary collection vehicles the following were tried in different pilot study areas for the purpose of collection of solid wastes from houses/community bins.

a) A light motor vehicle (Dumper)

b) Pedal tricycles - container carrying type.

c) Pedal tricycles - box type.

d) Hand Carts - Container carrying type.

The feasibility of (1) Power Hauler (8 to 10 H.P) and (2) Animal Carts which are being used in some municipal towns under C.M.D.A were also examined, for a comparative evaluation.

The dumpers with a carrying capacity of 2 M^3 (1 to 1.2 ton refuse) were operated for house to house collection in two wards of Rajpur, a rural municipal town,where the density of population is less than 10,000 per Sq. K.M. It was found that for house to house collection the optimum crew size would be 2. However, it was found that 3 to 4 pedal tricycles would cover the same area and collect the same amount of refuse, as the dumper, in a relatively lesser time. Capital cost of dumper being more than six times than that of four pedal tricycles, the system will be counter productive.

It has been observed that the box type hand carts, now in use, would not fit in any model of urban solid waste management system, which aims at achieving better standards of environmental sanitation and higher productivity. In case of existing box type of hand carts there is no other alternative than to dump the refuse on the road prior to its transfer into the transport vehicles, which results in double handling. This fouls the environment, creats health hazards, significantly reduces system efficiency and vehicle and labour productivity.

In the pilot project modified hand carts for carrying six to eight containers were tried. It was observed that such carts would not be effective unless population density is too high, more than 30,000/Sq.km and roads are too narrow. Animal carts would add to the management problems of the municipal authorities apart from polluting the streets with animal dung. Time of clearance by animal carts are also higher than that with pedal tricycles.

In different pilot study areas in the CMD, pedal tricycles, box and container carrying type, were used for primary collection. Container carrying type were found to be by far the most cost effective and efficient mode of primary collection. Box type pedal tricycles could be used only in cases where there is no need of transfer into secondary vehicles. Here refuse is used for filling local low lying areas within the city. Only under such conditions box types would function better than container carrier type.

It has been found that pedal tricycles carrying 6 to 8 containers of 40 to 60 litres capacity, are the most optimum for house to house collection as well as collection from community bins, for urban situations typical of Calcutta Metropolitan District (CMD) area. Introduction of pedal tricycles with containers will be appropriate for the following reasons :

a) They will enlarge the command area of transfer stations, thereby reducing secondary transport by motor vehicles. This will result in considerable reduction in cost of vehicles, fuel, oil etc.

b) They will eliminate double handling and open dumping and increase vehicle and labour productivity further by reducing trip time by 300%.

c) They can be manufactured locally and do not require skilled manpower for operation and maintenance.

d) Most municipal towns lack workshop, and garaging facilities and cannot maintain sophisticated motorised transport vehicles and hence non-motorised, non fuel consuming and non-polluting tricycles should be an ideal choice.

Use of power hauler or dumper can be thought of only if individual routes leading to a transfer station, contribute more than one ton of refuse. Such situations may arise only for a very high density of population, with high rise buildings and each transfer stations serving more than 30,000 population. For municipal towns in CMD area, primary collecting vehicles for serving one transfer zone of 10,000 to 15,000 people, carrying capacities above 500 Kgs. were found to be counter productive.

TRANSFER STATIONS :

Optimal and appropriate combination of primary collection vehicles and crew and secondary transport vehicles, depends primarily on appropriate selection of primary transfer stations. For every urban situation in respect of density of population, vehicle routing, land use characteristics, there is an optimal size of transfer station which will optimise total cost. Based on the experiences of pilot studies in CMD area, it was found out that one primary transfer station would be required for every 10,000 to 20,000 people, for population densities varying between 10,000 to 30,000 per Km2 .

Larger transfer stations would required larger fleet of primary collectors, while smaller ones would increase secondary vehicle requirement. When pedal tricycles are used as primary collectors, the area under one transfer station should be limited to 0.1 Km^2 . Hence, for areas with higher densities of population, optimal size of transfer station is likely to be somewhat larger.

Primary transfer-stations proposed for municipal towns are essentially a ramp, by the side of which a large container/skip/trailer could be placed, so that primary collectors (pedal tricycles) would directly deliver the wastes into the skips, without dumping them onto the ground. This is also the point, where prime movers(Tractors) would exchange the trailers/containers/skips.

For optimal transport economics primary transfer stations must be located, as far as possible, centrally in respect of the collection areas and primary collection vehicles routes. Routing of the collection crew should also be done, so that amount of garbage collected per Km travelled be maximised. However, in more cases than not, adequate areas may not be available at best of locations, and compromises on this account has to be accommodated in the design by adjusting and altering primary collection vehicle routes.

This must be noted, that by Primary Transfer Station we mean locations where primary collection crew would transfer their wastes into transport vehicle, as distinguished from Transfer Stations, which are required when the disposal ground is too far away (10/15 km) from the towns. Even primary transfer stations may not be required in small towns, where the disposal ground is within 3/5 Kms. In bigger towns also wastes from wards closer to the disposal ground may be carried direct to the disposal ground by primary collection vehicles themselves.

Session 2a

Chairman: Mr Tony Allen
Co-Chairman: Dr P R Thomas

Discussion

P R Thomas, K N Ramamurthy
Biogas for low income housing

1. Dr THOMAS introduced his paper by explaining that developing countries are trying to provide maximum shelter at minimum cost. With regard to sanitation, communal toilet facilities are cheaper but tend to be fouled and then people are likely to defacate outside the building. Biogas should be considered for low cost housing because farmers can use the manure from animals, garbage and kitchen waste as well as human faecal matter as feedstock to produce gas for heating.

With a radial housing design with a central biogas plant fed by kitchens and toilets pointing towards the centre of the circle expensive pipe runs can be minimised.

2. Mr PRASAD observed that community water seal toilets in residential areas should be avoided as far as possible. If they are essential in certain public places, some attendants should beprovided to look after such toilets.

3. He than asked Dr THOMAS - what is the quantity of water used per person for flushing the toilet? What is the rate of loading to the digester? What is the rate of gas production/day? How is the digested sludge taken out of digester? What about the presence of pathogens in the digested sludge? How should one ensure the safety of farmers using the digested sludge in the field?

4. Dr THOMAS replied that in a low cost setup, the quantity of water used per person for flushing the toilet will vary because in many cases they use buckets or cans to flush. The amount needed will vary according to the quality of faecal matter as well as the roughness of the squatting pan. It is not possible to give a numerical value of loading rate because this will depend on the type of feedstock. It is preferable to use the highest possible rate since the digester can be smaller and less volume of material can be handled or heated. Rate of gas production is usually expressed as cubic metres of biogas produced per/kg of volatile solids. Typical yields are 0.3-0.7 m^3 of biogas/kg of volatile solids. If it is an intermittent process the digester is usually manually emptied. With continuous process the digested sludge is taken out through an outlet pipe. Many of the pathogens are largely eliminated by passing through the digester. Compared to the other techniques practised in rural areas or in low income communities, biotechnology should not create additional health hazards. Safety of farmers could be assured by educating the farmers about general hygiene and public health. Although pathogens are eliminated in the digestion it will be better if the farmers practised hygiene.

5. Mr DAS asked Dr THOMAS to explain the details of the toilet design. Will it be the same type as in water carriage system? The ablution water and urine will tend to dilute the excreta to be used in biogas plant. He also asked what was done with the sullage and water from the bathroom and washings?

6. Dr THOMAS said that toilet design is normal water flush latrines. Water is used with the feedstock to produce 5-10% of dry solid. Sullage water has to be disposed separately because soap etc will disturb the process.

7. Dr BASU asked whether the use of Biogas (where night soil is used) can cause any social problem? He also asked how often the failure occurs and what was the organic (matter) loading?

8. Dr THOMAS replied that if the society is not educated about the advantages of biogas technology, it is likely that in certain countries the community eating food cooked using biogas may be socially rejected by another section of the community. This can be overcome by adequate health education and information about biotechnology. Failure occurs
1) Due to clogging of influent and effluent channels
2) Sludge and scum buildup reducing the productive capacity
3) Sudden temperature or feedstock changes - such as addition of hot water and cold water. Feedstock should be constant
4) Toxins in feedstock - acid,alkalies, disinfectants.

The loading rate is the concentration of volatile solids in the digester. It is usually expressed as a percentage for continuous digestion as the weight of total volatile solids added/day to the total weight of volatile solids. M = digester rate, O = use highest possible loading, yield = 0.3 - 0.7 m^3 of biogas per kilogram of volatile solid.

9. Mr ALLEN said that recent proposals in Kenya for low-cost housing schemes have suggested using a septic tank or a biogas tank and to convey the liquor from those tanks to further treatment through small bore pipes. Could the characteristics of the liquor

cause problems with treatment systems, especially pond type?

10. Dr THOMAS replied that this was not the case. Ponds are quite efficient either to treat raw sewage or partially treated sewage. Depending on the organic loading, the pond types and arrangement should be decided.

11. Dr BHATTACHARYA congratulated the author for his paper and asked whose responsibility was the maintenance of the biogas units built on community concept? Did you experience any difficulty in the operation and maintenance of the biogas units?

12. Dr THOMAS answered that responsibility should lie with the people themselves, i.e. biogas technology should be incorporated with community participation. He also said that there were problems due to biogas leaks from digesters made of brickwork. Recently plastic bags have been used successfully by a West Indian farmer. There were also difficulties with corrosion of iron and steel parts.

13. Dr COAD asked Dr THOMAS to discuss the operation aspects of the communal biogas digesters in the radial plots. Who is responsible for maintaining the plants? Have any such plants been built, and if so have there been any operational problems?

14. Dr THOMAS replied that in the radial plots the biogas digesters located at the centre supplied gas for cooking and lighting. The toilets at the rear of each lot are connected to the digester. As the feed enters the digester it is monitored once or twice a month to see that the dry matter contents are about 5-10%. In some instances cowdung is mixed with human waste in the feedstock and in these cases the digesters are located outside the radial plots. The maintenance of the plant is carried out by 4 or 5 people from the housing units itself. Each one is delegated a particular task in the operation and maintenance. For any complicated problem these people contact the local technician for the area. These plants are built and successfully operated in Tamilnadu, India. The operational problems are given in the answers to Dr BASU.

A B M Shahalam

Septage collection system economics

15. Professor SHAHALAM introduced his paper and requested development of toilet facilities in developing communities that were biased towards those techniques which were most convenient such as flush toilets. He reiterated that the basic aim was to minimise health hazards. He gave the example of Jordan where four houses were connected to a septic tank but the soakaways were not successful and so the tanks had to be emptied twice a month.

16. Tank trucks were used for emptying which were privately owned. The cost of collection was about $32 per month per septic tank, which worked out at approximately $8/month per household. It was found that people were willing to pay up to 3% of their income for sanitation.

17. Dr COAD asked the author to suggest why septic tanks with soakage pits need such regular visits (approximately once a month)? Do the soakage pits become clogged or is the water table close to the ground surface?

18. Professor SHAHALAM replied that about one third of the septic tanks may have some effluent soaking system. However, due to hard rocks within a meter of the ground surface, soaking systems do not work properly. Yes, there is problem of clogging of the drainage system.

19. Dr BASU commented that the author had mentioned that 3% of family income for sewage service may be available based on some assumption. He asked how this figure was arrived at? what uses were being made of the sludge from the septic tanks?

20. Dr BASU also asked Professor SHAHALAM to elaborate a little on the nature of "penalty" and $9 septic tank cost seems to be too low.

21. Professor SHAHALAM replied that, as the price of service (truck call) resulted from free bargaining situation, it was assumed that prevailing cost of about $32/household/month is the amount which a household is willing to pay for the service. This amount of $32 is about 3% of the area average household income. The solids and liquid both are transported to the dumping pond. Presently there is no economical use of the sludge.

22. For spillage and truck breakdown on way, the municipality has a regulation that the truck driver of the broken truck should call another truck for relief and pay the amount necessary to empty his truck content and transport it to the pond. Truck driver should clean the spillage before leaving the spot. Failing to do so, the driver is liable to appear in municipal court on charge of causing public nuisance. The cost of $9/household/month for septic tank system was taken from a reference. However, it is noted that this figure must be from experiences before 1978/79.

D Ghosh, I Banerjee, S Bhattacharya

Sewage treatment and fisheries in urban fringes

23. Dr BHATTACHARYA presented the paper and encouraged participants to learn about the recycling of waste in villages where all waste is consumed.

24. Mr BANERJEE asked whether it was likely that Calcutta sewage contains injurious elements viz arsenic, chromium, copper etc. He also asked whether a study has been conducted on fishes produced in sewage or fed with sewage contains those elements? If so what is the result of the study.

25. Dr BHATTACHARYA answered that a study has been carried out by Department of Fisheries through Jadavpur University and the results show no cause for alarm in this respect.

26. Mr BIJOYKUMARINGH said that it was stated that solid wastes are dumped in an assigned area of Calcutta and are used for manuring cultivation of vegetables.
(i) Is this solid waste free from hazardous materials like hospital waste?
(ii) Are we sure that the vegetables growing on it will not suck objectionable chemicals harmful to health?

27. Dr BHATTACHARYA replied that hospital waste is avoided. He also said that we are not sure about most of the food items we take that are grown elsewhere. Most of them are exposed to similar or greater contaminating hazard.

28. Mr HUGMAN commented that the financial success of the proposed project depends on the economics of fish production. He then asked Dr GHOSH to describe the methods of production, in particular

a) species of fish
b) method of stocking
c) method of harvesting
d) system of marketing:- do consumers object to sewage-bred fish?

He also asked how the cost/benefit analysis compares to classical methods of treatment, thus releasing land for reclamation.

29. Dr BHATTACHARYA said that the authors had these answers. But then this answer falls under the review of another or more technical papers on the same topic. We are ready to discuss.

30. Mr SANYAL said that the increasing sewage may carry pesticides and other toxic things which may affect fish life. How are you overcoming this problem?

31. Dr BHATTACHARYA replied that this problem is no more than what other parts of the country encounter. We are ready to learn from them who have done some successful research in this context.

32. Mr RAMAPRASAD observed that the present system can be taken as a temporary phase of sewage collection and disposal. He then asked what is the total land area occupied by these fisheries and the cost of the handling per land day or per day? What is the total quantity of sewage? Due to rapid urbanization in Calcutta, the city may spread to this area soon. If so, what is the planning made for future need?

33. Dr BHATTACHARYA said that these points are taken into consideration by the competent authority of the State of West Bengal.

34. Mr NAG commented that there is extensive practice of paddy-cum fisheries which is also sewage fed in the wet lands of East Calcutta. The silt of this sewage water greatly increases paddy production also. Has this factor been taken into account in the study?

35. Dr BHATTACHARYA answered that we know about this. Farmers also know it and apply this experience. This is important.

B B Thakur, D N Dey and K J Nath

Storage and primary collection of urban solid waste

36. Mr ISHENGOMA asked how do you ensure that transfer of refuse on rickshaw does not cause pollution as a result of wind blowing it from the carrier and spilling it all over the place?

37. Mr THAKUR replied that there is chance of pollution of the environment due to spilling and wind blowing. But we have not taken care of the possibility because we are aiming at stage development as there is possibility of managerial problem regarding labour management if they are asked to do a lot more than their existing working schedule. These improvements will be introduced gradually with motivation.

38. Mr THOMAS commented that most of your garbage is transported in open containers through the populated areas. Do you think it would be better for closed containers especially when the collection is every 2 or 3 days? He also asked whether there was the problem of scavenging at your disposal sites and what was the composition of organic matter in your solid waste?

39. Mr THAKUR answered that the collection is done on alternate days. Putting lids to community containers will not be successful at the first stage. We have kept this improvement in our mind. It will be introduced in stages. There was a problem with scavengers and the solid waste contained 35 to 40% of organic matter.

40. Mr MUKHERJU noted that the author suggested to continue both the previous system of disposal and also with van. Most of Municipal Authority in metropolis uses trailer/ tractor vans for disposal. It is often found that the roads in disposal point are in such condition that it might be difficult, rather impossible, to take a three wheeler to the disposal point in place of a four wheeler. Has the author thought of any improvement or having any reserve path/road for those vans in disposal point.

41. Mr THAKUR replied that three wheeler will be economical for both primary and secondary transport if the distance of disposal ground is within 5 Km. If it is more than 5 Km secondary transport system (fuel powered) will be economical. Improvement of roads up to disposal ground has been recommended for the municipalities where it is needed.

42. Dr COAD asked the author to explain why 6 bins is a better load than 8 bins for a tricycle rickshaw. Does the rickshaw system involve a reduction in manpower? Is the concrete bin that is emptied using a spade the preferred type? Are metal communal bins stolen or damaged?

43. Mr THAKUR answered that 6 bins will be better for pedal tricycle operator due to ease in pulling it. 8 bins are also used for towns with better roads. This method did result in reduced manpower. Metal bins are damaged and displaced by stray animals easily. Also metal bins are costly. We do not have experience of metal bins stolen in pilot areas.

44. Mr SINGH suggested that for solid waste collection the big containers can be placed at public places at appropriate distance and individual householders be asked to put the garbage in paper or plastic bags and deposit these bags at public containers. These containers may be lifted and carried by trucks or tractors to disposal point and replaced by another container. This will relieve the man of pulling garbage on tricycle/rickshaw.

45. Mr SINGH also pointed out that the solid disposal should be further mechanised, i.e. separation, screening, grinding and then disposal on landfilling areas. The toxic waste should be incinerated. Has the author examined these issues? How far can they be used in Indian conditions?

46. Mr THAKUR replied that we have tried the system. It is not successful in the socio-economic condition of the towns. The paper and plastic bags have alternative use for the population concerned. Also removable bins get damaged and displaced by stray animals. Also the cost is more. Otherwise the system is very good and practiced in developed countries. The cost of increased mechanisation is prohibitive for the towns under purview. The mechanisation was tried in a small way for the disposal part but it was not cost effective.

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A K Adhya, S K Saha

Filling characteristics of latrine pits

1. INTRODUCTION

The fullfledged piped water supply and sewerage system being just a dream in the vast rural areas of the country, the leaching pit type latrines are still amongst a few answers to the problem of excreta disposal in vast majority of the rural India and will continue to be the practical solution through a good many years to come. Successful excreta disposal programme will obviously call for, among others, a knowledge of filling characteristics of such leaching pits in various conditions.

Unfortunately field data on filling characteristics of latrine pits are too scanty, particularly in Indian conditions. Because of certain complex inter-relationship between the leaching rate of the pit and the fluctuation of water table and also the change of soil condition of the pit due to mechanical clogging of the soil pores and or formation of zoogleal film, it would possibly be more prudent to rely on field data. A complete study was, therefore, under taken in typical rural condition in the rural practice field of All India Institute of Hygiene & Public Health, Calcutta in order to throw some light on the filling characteristics based on field observations. The referred practice field is located at "Singur" block in the District of Hooghly of the State of West Bengal and falls on the Gangetic belt. The present paper high lights some of the findings of the above study.

2. OBJECTIVE

The principal objective of this study was to find out the rate of filling of such pits and to predict the optimum cubic capacity/capita and minimum depth required for a leaching pit to last for a minimum period of 4-5 years.

Incidentally the study would throw some lights on the nature of filling, effect of water table, rate of sludge accumulation, extent of consolidation of sludge, which would all influence the life of a pit.

3. MATERIALS AND METHODOLOGY

The study was designed within the facilities available at the Rural Health Unit & Training Centre, Singur. Twelve latrines scattered in 7 villages were constructed in different periods of time. The past experiences were not indicative of a great deal of variations in soil composition or the water table conditions in major parts of the operational area of Singur and so the 12 latrines constructed were not considered insufficient to reveal the filling characteristics in the area. No statistical parameters were used in the selection of sites for location of pits and the sites were picked up on the basis of participants' co-operation.

3.1. General and constructional features

In 11 cases the latrines were "R.C.A." type where the pit and the seat are separated, whereas in one case the pit was below the seat and referred as "dugwell" type. Except in one, all the pits were provided with protective linings of earthen rings because of vulnerability of the pits to collapse due to high water table condition usually prevalent throughout the area. The leaching of the pit was ensured by keeping the rings open jointed or dry jointed. One pit was kept unlined to see whether there was any marked effect of non-lining on filling characteristics. The pit was covered with R.C.C. cover. A small 2" (51 cm) square opening with removable concrete lid was kept in the cover slab for measurement of liquid and solid depths of accumulation in the pit. In case of dugwell latrine the concrete squatting plate, 3'-0"(91 cm)dia and concrete pan with in-built water-seal was used. Two observation holes, 1½"(3.8 cm) square were kept in the squatting slab on either side of the pan with removable cement concrete lids fitting to the grooves provided on the top edges of the holes.

As a prerequisite of the study soil analysis as per wet method was carried out in 5 places. The above analysis was carried out in order to have a rough idea of the clay; silt; sand content in the area. The M.I.T. standards viz. clay as smaller than .005 mm., silt greater than .005 mm., and sand greater than 0.05 mm. were used.

Percolation tests, based on "Ludwig's" method were conducted at about all the Sites. The test was conducted for 0'-2' (0.06m), 2'-4' (0.6m-1.2m) and in some cases 4'-6' (1.2m-1.8m). The latrine pits were located exactly on the same place where percolation tests had been conducted.

For each latrine pit an observation pit 4" (10.16 cm) dia, lined with dry jointed perforated clay pipe and provided constructed for measuring unaffected water table.

3.2. Measurement techniques adopted

In view of prolonged observations to be taken by field workers comparatively simple device were adopted in taking various measurements. Measuring wooden telescopic graduated sticks consisting of two 6'-0"(1.83 m) ones, the narrower one sliding on the outer larger ones were used. The stick would be inserted through the observation hole made on the cover slab of the pit and gently and slowly pushed down through the liquid and solids till it refused to sink by the gentle pressure of the hand. At this point of refusal to sink, it was presumed that the bottom of the consolidated sludge mass/was reached. The stick would then be gently and quickly withdrawn so as not to scour the sludge sticking on to its surface. As the graduated stick would come out, reading against the top of the wetted portion would be taken and the reading on the top of the black sludge, sticking on to surface would then be taken quickly before the slimy sludge starts falling back and clear the surface of the yard stick. The reading on top of the wetted portion gives the depth of the total liquid, the reading to the top of the brownish portion gives the depth of sludge. The depth of the pit would also be noted against the fixed reference mark on the cover slab and thus the depth of the consolidated mass could also be computed by subtracting this depth from the original depth recorded prior to using of the pit. In each of the cases the mean of the three reading were recorded.

3.3. Determination of use-position

This was possibly the most difficult determinants because of its complete dependence users' co-operation. For this purpose a small board was hung on the wall/door of each latrine and a smple record-sheet was fixed on it. The record-sheet had well-marked 31 rows, each row is placed against a date of the month. Each row would represent each date and would contain the records of that date. Each person using the latrine would have to simply put a stroke mark just before or after using the latrine. Thus the first user would put the first stroke against a particular date, the next user would put another stroke beside the first one and so on. For facilitating the ticking a lead pencil was already tied with a string fixed on to the recording board.

Thus a complete record of the use position during one month would be available. The filled record-sheet would be replaced with a fresh one at the end of the month. Weekly (towards the beginning) and fortnightly (later on) checking on the users ticking accompanied with health education in negative cases were maintained through out the period of study.

4. OBSERVATION AND DISCUSSIONS

The particulars of the latrines viz. type, volume, actual duration, percolation rate, soil characteristics and the rate of filling are presented through table 1. The actual no. of users, as presented in table 1 have been computed by taking average of all the figures obtained from monthly charts showing number of daily users. The pit was reckoned to be filled up when combined liquid and solid level in the pit reached the top of the pit and the pit was no more usable and was taken as the actual duration of the pit. The average rate of filling is then calculated for each pit, as presented in the table 1. The rate of fill varied from a minimum of 0.00258 (0.073 litres) cft/capita/day in latrine pit no. 1 to a maximum of 0.00721 (0.204 litres) cft/capita/day in pit no. 8 with an average of 0.00453 (0.128 litres) cft/capita/day from all the pits whose data were complete. The interesting observation was that the rate at which the pit gets filled up has been found to vary with actual duration, the rate of fill being inversely proportional to the actual duration. This is probably because the longer digestion period gives greater opportunity for the sludge to undergo more complete digestion thereby effecting reduction of volume to a tangible extent. The authors therefore suggest that the rate of filling for a range of actual durations would be a more scientific parameter to be used. The relationship between the rate of filling and actual duration is elucidated in greater detail under "Conclusion".

The percolation rate does not seem to have a tangible effect on the rate of filling probably because of the modified condition of the pit after repeated use for a considerable time.

Table – 1.

Table showing actual aonditions of the experimental pits and their duration characteristics.

	pit 1	pit 2	pit 3	pit 4	pit 5	pit 6	pit 7	pit 8	pit 9	pit 10	pit 11	pit 12
Soil (@:Si :S)	1:2.26 :0.73	1:8: 1.15	1:2.2 :1.14	1:8 :1.15	– – – – n o t			k n o w n – – – –				
P.Rate (Min/Inch)	7.65	43.1	5.18	x	28	—	5.7	56.1	8.2	—	9.0	—
Type of latrine	RCA	RCA	D.WELL	RCA	RCA	RCA	RCA	RCA	RCA	RCA	RCA	RCA
Lined/ Un-lined	Lined	Un/	lined	lined	lined	lined	lined	lined	lined	lined	lined	lined
Volume of pit In cft (Cu.m)	45.30 (1.282)	49.90 (1.412)	45.65 (1.292)	52.2 (1.477) 12.2 (0.345) aft. 4½yrs.	35.3 (0.998) 12.5 (0.354) aft. 1.10 yrs.	39.2 (1.109) 7.75 (0.219) aft. 2.7 yrs.	42.8+ (1.211) 7.85 (0.222) aft. 2.10 yrs.	59.60 (1.687)	48.6 (1.375)	53.9 (1.525)	47.3 (1.338)	57 (1.613)
No. of Users per day	6.5	8.0	5.0	9,0	8.0	6.15	6.65	6.34	6.93	8.82	9.13	11.18
Actual duration	7.50 yrs.	6.58 yrs.	3.50 yrs.	6.71 yrs.	4.50 yrs.	5.71 yrs.	4.08 yrs.	3.62 yrs.	3.71 yrs.	2.62 yrs.	4.58 yrs.	4.08 yrs.
Rate of filling in cft(litres)/ capita/ day	.00258 (0.073)	.00263 (0.074)	.00296 (0.084)	.00472 (0.108)	.00372 (.105)	.00570 (.161)	.00721 (.204)	.00526 (0.149)	.00648 (0.183)	Not calculated		

The measurements taken on (a) total depth of liquid and solids in the pit (b) depth of free water table (c) depth of sludge accumulation and (d) depth of the consolidated solid mass for all the pits have plotted in arithemetic graph paper and monthly variations of each of the parameters shown there. These graphs are not presented in the paper for lack of space.

4.1 Total liquid depth and the depth of free water level

Except for pit No. 1 which was almost a dry pit, in all other pits the liquid depth fluctuated in accordance with the fluctuation of the free water table in the pit. But a closer examination revealed that in the initial stages there was hardly any difference between the level of free water and that of the liquid of the pit whereas with the passage of time a difference in these two levels gradually builds up and rises to a considerable extent after 2 to 4 years time. During the initial stage the pit can continue even if the top of the pit is just a shade above the free water level; whereas in the later stages the depth of the pit must be more than the free water table plus the difference between the liquid depth and the depth of free water.

TABLE = II

Table showing the maximum difference between the highest level of liquid and the highest free water table in cm. (ft. & inch)

Pit No.	Difference between liquid and free water levels between						
	0-1 yr.	1-2 yr	2-3 yr.	3-4 yr.	4-5 yr.	5-6 yr.	6-7 yr.	7 yr. & above
2	20.32(0'8")	0	2.54(0'1")	2.54(0'1")	17.78(0'7")	68.58(2'5")	N.K	-
3	2.54(0'1")	0	-	-	-	-	-	-
4	0	27.74 (0'11")	2.54 (0'1")	2.54 (0'1")	30.48 (1'0")	76.2 (2'6")	101.6 (3'4")*	-
5	33 (1'1")	-	149.8 (4'11")	134.02 (4'5")	-	-	-	-
6**	7.62 (0'3")	61 (2'0")	5.08 (0'2")	63.54 (2'1")	104.14 (3'5")	48.26 (1'7")	-	-
7	27.74 (11")	27.74 (0'11")	22.84 (0'9")	53.34 (1'9")	-	-	-	-
8	15.24 (0'6")	10.16 (0'4")	50.8 (1'8")	71.12 (2'4")	-	-	-	-
9	22.86 (0'9")	15.24 (0'6")	35.56 (1'2")	91.44 (3'0")	-	-	-	-
10	33 (1'1")	119.38 (3'11")	N.K	-	-	-	-	-
11	0	38.1 (1'3")	-	-	61 (2'0")	-	-	-
12	7.62 (0'3")	10.16 (0'4")	71.12 (2'4")	10.16 (0'4")	10.16 (0'4")	-	-	-
Average	11.78 (4.64")	28.19 (11.1")	36.32 (1'2.3")	54.61 (1'9.5")	53.34 (1'9")	65.20 (2'1.67")	-	-

* After completion of 6th year in pit No.4 at first a difference of 1m 1.5cm (3'4") was noticed. After 7 months passed 6 years. another rise of water level commenced when the difference shot upto 1m 77.8 cm (5'10") resulting in filling up of the pit.

** In pit no. 6 after the lapse of 2 yrs. the pit depth was increased by 48.26 cm (19") by raising the pit over the ground; allowing thereby extra static head to be built up which might have permitted additional seepage to occur-and the pit meanwhile got one month's rest.

Due to repeated use, the soil conditions undergo changes - its porosity, permeability etc. get modified; at the same time the pit contents also suffer a good deal of changes - its viscosity and suspended matter content increase. In effect, a considerable difference between the top level of the liquid in the pit and that of the free water builds up and some difference is maintained during use. In table II the differences between the highest water table and the corresponding liquid level have been depicted. It may be seen from the table that the commencement of tangible difference between the free highest water table and the corresponding highest liquid level in the pit starts at different times in different pits. The average valu es suggest that by the second year the difference is 30-48 cm (1'0") whereas the highest difference is over 63 cm (2'1"), 5 to 6 years after commencement of the pit. But possibly one would be more interested to note the highest differences of such levels that was obtained at any point of time in each of the pits and this value varied from 48.26 (1'7") to 1m 19.38 cm (3'11") averaging a value of 84.45 cm (2'9.25") above the highest free water table in the pit.

4.2 The behaviour of the consolidated solid mass.

It was observed that a considerable time was really taken to have a steady build up of a consolidated sludge mass leading to reduction of volume of the pit. However, sporadic building up of consolidated mass varying from small amount of a high order have been found to occur in almost all the pits. However, the steady value, varying in each of the pits was observed to occur after lapse of a lowest period of 1.25 yrs. to a highest value of 4.92 yrs. (except in pit No. 1) the average being 2½ yrs. The maximum value of depth of consolidated sludge was found to vary a great deal viz 7.62 cm (3") being the lowest, 106.68 cm (3'6") being the highest one, the average of highest and the lowest value works out to be 52.32 cm. (1'8.6"). However, the average rise of consolidated sludge mass after a steady value is reached, taking all pits together, works out to be 19.86 cm. (7.82 inches).

5. CONCLUSION

5.1 The latrine pit should be regarded as filled up when at any particular point of time it cannot accept any further load. This is not necessarily due to the complete filling of the pit with solid sludge. Such a condition is generated due to the complex action of fluctuation of water table, modification of permeability, change in viscosity of the liquid mass in the pit owing to solid sludge accumulation.

5.2 Again the sludge accumulation has been observed to fluctuate to a great deal and it reaches a steady value after a passage of a considerable time viz. about 2½ years, when it starts rising.

Therefore, observation for a comparatively short period on the formation of solid accumulation and trying to predict the rate of fill does not seem to be a correct method of finding out the rate of filling of a latrine pit. A prolonged field study is essential in order to correctly assess the actual rate of fill.

5.3 From the observations it is found that in water table pits a build up of a difference between the free water table and the liquid level in the pit is generated, possibly because of the modified conditions of the pit liquid and that of the soil conditions. This difference between the liquid level and free water table level tends to increase with passage of time and after attaining a high value of 84.49 cm. does not seem to vary much even if the pit lasts for a much longer period. Thus in order to fully utilise the pit, the top of the pit must be at least 84cm. (2'9") to 91cm. (3'0") above the highest free water table in the place.

5.4 The rate of filling of the latrine pit has been found to be dependent on the actual duration of the pit i.e the period through which it gets filled up. The rate of filling is found to vary inversely with the actual duration. In other words the longer a pit serves/ the lesser is the rate of filling. The relationship in the form $R = \frac{1}{Kt^n}$ where R is rate of filling in cft/person/day, t=actual duration of the pit in years and K and n are constants.

From the observed data and the curve of best fit the value of the constants have been determined and K is found to have a value of 47.5 and n has a value of 1.05 Thus the equation is finally of the form.

$$R = \frac{1}{47.5\,t^{1.05}} \quad \ldots\ldots\ldots(1)$$

The plot on observed data and that based on the above equation are found to run very close to each other. It is further observed from the above that the effect of actual duration is more pronounced with low values of t i.e upto 4-5 years after which the effect is dampened out.

5.4.1 The average rate of filling of 0.000128 cu.m. (0.00453 cft)/capita/day based on actual observation works out to a capacity requirement of 0.0454 cu.m (1.606 cft)/capita/year or 0.227 cu.m. (8.03 cft)/year for 5 membered family. Hence a 76.2 cm.(2'6") dia and 3m 4.8 cm. (10') deep pit is expected to last for a period of 6 years for a family size of 5. The top of the pit, however, should be more than 84 cm. (2'9") above the highest free water level for full utilization of the pit. This is in fairly good agreement with what was believed earlier in Singur area that the average life of a dugwell of RCA latrine pit is about 5 years serving an average family of 5 members.

5.4.2 The authors would suggest different values of Rate of filling of the pit corresponding to the ranges of duration in typical high water-table alluvial soil as in table III, the values having been computed as per the equation (1) above

TABLE - III

Actual duration expected in years	Rate of filling in cft/cap/day(litres/cap/day)
1&less	0.02 (0.56)
2-3 yrs	0.0085(0.24)
4-5 yrs	0.0044 (0.12)
6 yrs & above	0.0026 (0.07)

5.4.3 Most of the pits are usually intended to last about 4 to 5 years and hence the filling rate of .0044 cft i.e 0.12 litres per capita per day which is incidentally also quite close to the average of the observed values is recommended for general use.

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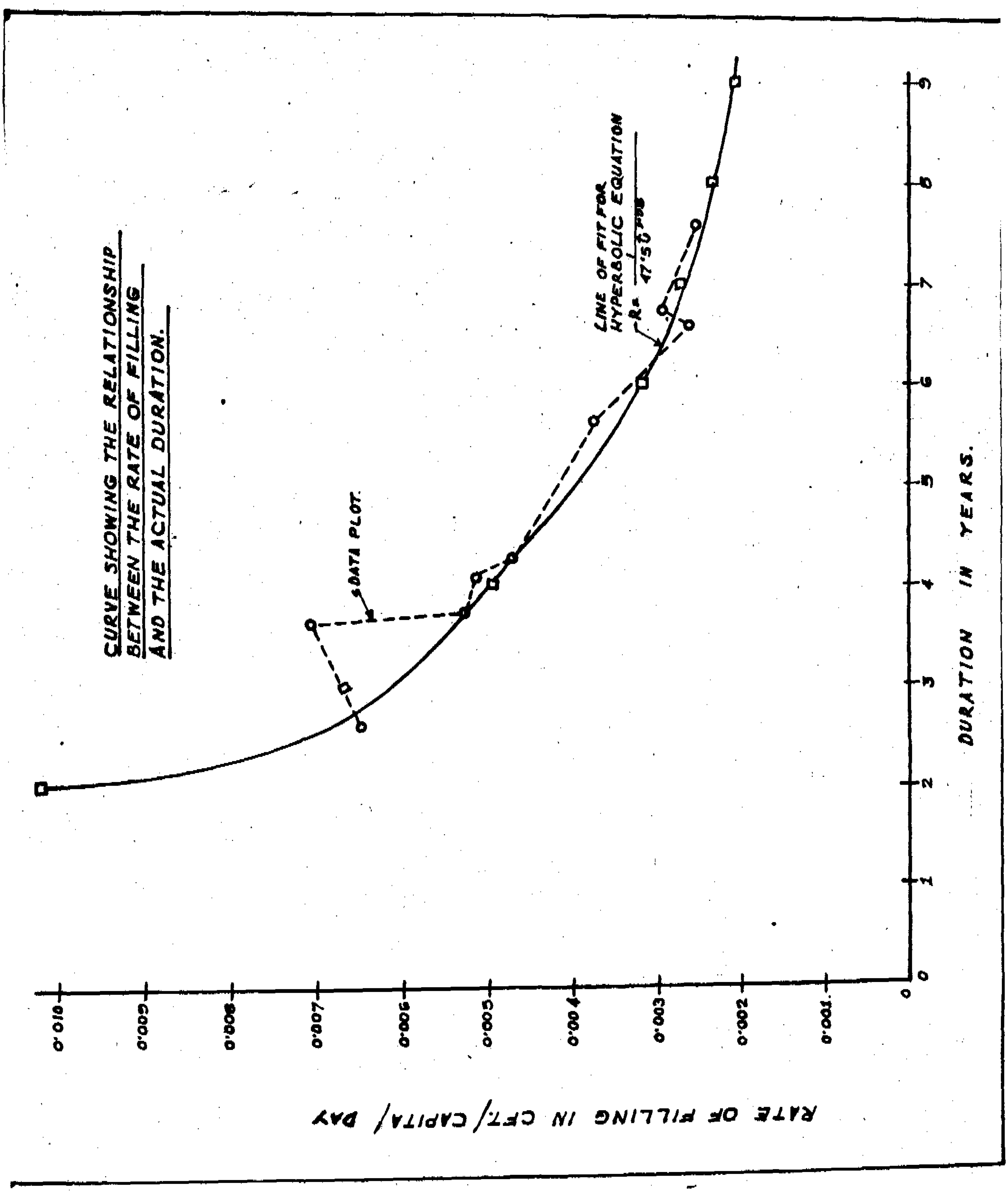

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

D K Ghosh

Environmental sanitation problems, India

INTRODUCTION

The major challenge for the provision of safe water supply and excreta disposal facilities in India at present appears to be in the rural and urban-fringe areas where majority of the people lack adequate access to safe water and sanitation facilities. In fact, water/sanitation related diseases continue to be a major health problem in such areas.

An attempt has been made in this paper to identify the problems and probable reasons for not properly materialising the potential social, economic, and health benefits of water supply and sanitation programmes in these two areas. The paper also suggests measures which, in the opinion of the author, may contribute to the solution of these problems. Further, major water quality problems arising from agricultural practices, potential solutions and control measures required, and research activities needed have also been indicated in this paper.

MAJOR HEALTH PROBLEMS

As regards community water supply and sanitation, conditions in rural and urban-fringe areas in India are much worse than those in urban areas. The urban-fringe area, however, resembles the rural area in its conditions but is even worse off sanitationwise, because its population usually has no choice between alternative water supply sources, has worse housing conditions, and lacks the open field for waste disposal and thus has a greater health risk. The diseases related to a lack of proper hygiene and sanitation is a major health problem in such areas. In fact, there is urgent need of curbing morbidity and mortality due to transmission of mainly gastro-intestinal diseases. The following statistics on the health status in Nepal (ref.1) illustrate this strong sanitation component (in parentheses : figures for industrialised countries) :

- out of 1000 new born, 130-170 (8-40) die before the age of one;
- the mortality rate is 22 per 1000 (10) ;
- 50% of all deaths occur among children before the age of five ;
- 30% of deaths among children between the age of 0-5 years are caused by a lack of proper sanitation, i.e. mainly due to transmission of gastro-intestinal diseases ;
- 30-40% of the children admitted to hospitals suffer from diseases caused by a lack of proper sanitation ;
- prevalence of worm infection is high, i.e. :
  1-11% among children of 1 year
  10-80% among children of 1-5 years
  20-100% among children of 5 years.

A survey in a number of towns in Central Nepal showed that 40-100% of adults suffered from worm infection. Apart from these dangers of poor sanitation, increasing population densities in urban-fringe areas of India further aggravates the problem.

AGRICULTURAL PRACTICES AND WATER QUALITY PROBLEMS

Another point worthy of focussing the attention is that little or no notice is taken at present of the large quantities of wastes generated by the agricultural sector and that of the agricultural chemicals introduced in large scale to rural environment. There is a great dearth of information concerning the exact role of irrigation return flows in the surface and groundwater quality problems. Agriculturists have viewed this as a natural consequence of the many processes involved in irrigation of crops.

Whenever water is diverted for irrigation use and applied to irrigated cropland, surface runoff from irrigated land and deep percolation are the major contributors to irrigation return flow. These sources are the conveyors of dissolved salts, plant nutrients, sediments, pesticides, and other pollutants to the stream drainage system (ref.2). The surface irrigation return flows usually contains only slightly higher salt concentrations than the original water supply. The major portion of the dissolved solids, generally increased nitrate content, is present in the water percolating through the soil of the irrigated cropland. Since water is diverted many times from the major rivers for irrigation use and the return flow mixes with the natural flows in the river ; the river flows show a continual degradation of quality in the downstream direction. In a study (ref.3) of Agricultural Research Service, Fort Collins, Colorado, USA, the average annual loss of nitrogen to groundwater under irrigated row crops was estimated at 29.6 to 35.6 kg/ha.

SOLUTIONS AND CONTROL MEASURES

Potential solutions

The unsatisfactory health situation is caused to a large extent, by a lack of proper hygiene and sanitation. Provision of safe water alone will, therefore, be not effective in preventing water/sanitation related diseases unless it is accompanied by proper disposal of excreta and other wastes. Health education stressing personal hygiene and sanitary handling of food must also be given high priority. It is pertinent to mention in this regard that in many locations in India, where need for improved water supply arises, an increase of water quantity for bathing and washing is also required in order to improve personal and domestic hygiene. Hence stress is also needed on the water quantity for washing, bathing and drinking rather than qualitative (drinking) aspects of water only, so that the role of improved water supply may have desired health benefits.

In this context it may be mentioned that disease transmission is also dependent on a person's and society's behaviour, social norms, and religious or cultural habits. Incidentally, in India, local, cultural, and socio-economic conditions are usually of decisive importance. Integration of behavioural and cultural dimensions into the planning and implementation of water and sanitation programmes seems very much needed. The planning and implementation authorities of such programmes should, therefore, look into this aspect. Involving the community, particularly women, in water and sanitation projects shall help in this aspect ; since a community is more likely to cooperate in the implementation, operation, and maintenance of new systems if it has had a say in the preparation of the plans. Such joint planning based on an investigation of the local situation shall have the desired health impact. Recently, a methodology has been proposed by WHO (ref.4) for assessing benefits to health from water supply and sanitation projects. The method permits the conversion of community and project information into a numerical form, thus simplifying the project appraisal process prior to the allocation of resources to project implementation.

Further, for achieving adequate project viability, it is necessary to achieve maximum construction quality and system maintainability. It will be helpful to strengthen local capability, for example, through training of motivated or assigned local personnel to cater for operation, preventive maintenance, minor repairs etc. Promoting community interest by establishing a maintenance committee to control activities of local maintenance workers shall also help in this aspect.

Control measures

The most important measure for the prevention of the spread of water/sanitation related diseases is the sanitary disposal of human excreta and protection of water supplies. The standard form of rural sanitation in developed countries is the one based on septic tank and soakage pit or trench. The treatment and the disposal of septage is, however, difficult and the necessary routine of pumping out septage once in 3-4 years is considered a dirty job (ref.5). Sanitation facilities for rural and urban-fringe areas in India will normally necessiate on-site sanitation systems such as low-cost pour-flush waterseal latrines (ref.6) which can be readily adapted to meet the needs of different areas particularly where water is used for ablution. Ventilated improved pit latrines (ref.7) may also be used instead of traditional (unventilated) pit latrines. These traditional pit latrines have a bad smell and substantial number of flies and other disease-carrying insects may breed in them. The practice of bucket service latrines shall be altogether stopped and replaced with waterseal latrines. It may be rather advantageous to have stabilization ponds for the disposal of sewage originating from the densely populated urban-fringe suburbs of cities, if the community can afford the sewerage system required for carrying the sewage to the stabilization pond.

For the provision of adequate drinking water, perhaps handpumps installed in wells, where groundwater of appropriate quality is readily available, provide one of the simplest and least expensive means of supplying drinking water to rural areas. Even in the urban-fringe suburbs of cities and towns such systems may serve the purpose. In a recent report (ref.8) activities essential for the success of rural and urban-fringe handpump programmes, including community participation, caretaker training, and proper construction of wells and bore holes have been reviewed.

As regards agricultural wastes, including animal and poultry wastes, it seems over 150 types of diseases are spread by animals and animal products, including manure (ref.9). It appears that biogas production from animal wastes, and composting of agricultural wastes may serve as control measures for this problem. It may be mentioned here that the biogas plants set up in India and other South-East Asian countries are considered mainly as rural sources of energy. Perhaps, the biogas workers themselves have not correlated biogas with sanitation in their overenthusiasm for a source of rural energy, despite the fact that biogas is a by-product of sewage treatment. However, an integrated recycling of dairy farm waste for improved sanitation, energy, fodder, and all round development of the environment has also been reported (ref.10). Reports on the application of organic manure for improved crop production (ref.11) and algal regenerative system for single-family farms and villages (ref.12) are also available. While many workers have made limited studies on different aspects of rural development and a few on integrated farming systems, it seems a total approach to the environment taking simultaneous attention to the social and economic problems thrugh application of appropriate technology in an integrated manner is necessary. Possibilities of improved sanitation, energy in the form of biogas production, manure in the form of compost, utilisation of farm sewage for irrigation, and other social, economic, and health benefits may thus materialise. TOLBA (ref.13) has also discussed the significance of environment as a whole in the matter of health.

It should be mentioned here that prevention and control of quality degradation of water resources due to irrigation return flow will usually be both difficult and expensive. Important methods which can, however, be used to control irrigation return flow quality may include restricting irrigation development in areas of potentially high salt pick-up, regulations on the use of fertilizers or agricultural chemicals, and irrigation scheduling to ensure that proper amounts of water are applied at the times required by the plants.

RESEARCH NEEDS

From the earlier discussion it seems research efforts in the following area will be useful :

1. Investigation regarding the relationship between on-site disposal and groundwater quality is urgently needed, since the two solutions to the population's need viz., increased use of groundwater and on-site sanitation systems may conflict, particularly with certain combination of hydrogeological conditions.

2. Although a 'rule of thumb' separation of 15 metres between groundwater supply installations and

on-site sanitation units is widely adopted, investigation towards understanding the complexity of the processes operating in the unsaturated and saturated zones, and the heterogeneity of permeability is very much needed.

3. Development of prediction techniques which describe the quantity and quality of irrigation return flow is very necessary. This will help making long-range projections of water quality in a receiving stream due to irrigation projects.

4. Research efforts are also needed towards biological ways of reducing the dependence of rice farmers on chemically-fixed nitrogen fertilizers. Rice being the staple food of almost two-thirds of the world's population, biological nitrogen fixation as an alternative will help reducing the effects of chemical fertilizers on the environment.

CONCLUSION

The need for the provision of adequate supplies of safe water and adequate sanitation facilities is widely acknowledged. Yet water supply and sanitation programme do not always have the desired health impact. Neither do the potential social and economic benefits always materialise. It seems, however, that community participation in water supply and sanitation projects may contribute to the solution of these problems.

Further, increased use of groundwater and major construction programme utilising on-site sanitation systems will be needed to improve adequate water supplies and sanitation facilities in rural and urban-fringe suburbs of cities and towns in India. The extensive use of unsewered disposal systems may, however, cause severe groundwater pollution problems and thus reduce the anticipated health benefits of providing sanitation facilities. Groundwater quality monitoring programme should, therefore, be established whenever on-site sanitation systems and water supply wells and boreholes are to exist side by side.

Finally, in a country like India where majority of the people live in villages, no environmental reform will be meaningful unless the rural masses are made aware of the need for abatement of environmental hazards in rural communities. However, in India, local, cultural, and socio-economic conditions are usually of decisive importance. Nevertheless, continued sanitation education, with simultaneous attention to the social and economic problems, is likely to lead better sanitation practices.

REFERENCES

1. STRAUSS M. Community water supply and sanitation programme of the western development region of Nepal. IRCWD News, No. 18/19, December 1983
2. GHOSH D K. Water quality problems arising from irrigation return flow. Jour. Inst. Engineers (India), PH, Vol. 54, No. 2, 1974
3. STEWART B A. et al. Agriculture's effect on nitrate pollution of groundwater. Jour. Soil and Water Conservation, Vol. 23, No. 1, 1968
4. WHO. Maximising benefit to health - an appraisal methodology for water supply and sanitation projects. WHO Offset Document ETS/83.7, 1983
5. KOLEGA J J. et al. Septage wastes pumped from septic tanks. Transactions of ASAE, Vol. 15, No.6, 1972
6. ROY A K. et al. Manual on the design, construction and maintenance of low-cost pour-flush waterseal latrines in India. TAG Technical Note No. 10, The World Bank, 1984
7. MARA D D. The design of ventilated improved pit latrines. TAG Technical Note No. 13, The World Bank, 1984
8. ARLOSOROFF S. et al. Handpumps testing and development - Report No. 4 (World Bank Technical Paper No. 29), 1985
9. MATYAS Z. Animals and man. World Health, October 1978
10. PAUL T M. Proper utilization of farm wastes. Indian Dairyman, Vol.22, No. 8, August 1970
11. AMES G C W. Can organic manure improve crop production in Southern India. Compost Science, March/April 1976
12. GOLUEKE C G. et al. An algal regenerative system for single-family farms and villages. IRCWD News, No. 10/11, October 1976
13. TOLBA M K. Man and the environment - cause and effect. World Health, June 1978.

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

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Integrated rural water supply and sanitation programme

Client: National Water Supply & Drainage Board/Danish International Development Agency.

Consultant: Kampsax-Kruger, Copenhagen, Denmark.

1: BACKGROUND

The rural water supply and sanitation programme in Matale and Polonnaruwa districts in Sri Lanka which is financed by DANIDA, (Danish International Development Agency) started in 1981 with a Planning Phase. During this Phase, some 1,300 villages in the area were visited by teams who for each village made an assessment of the needs and the solution which would be appropriate for the village in terms of improving water supply and sanitation.

Based on this village inventory, where needs were weighed and cost estimates made, a priority list, based on need/costs, was worked out.

This list was the basis for the deliberations of the Governments of Denmark and Sri Lanka and the Executing Agencies when determing the total number of villages (300) which could receive assistance under this programme, given the limited funds available.

The allocation of funds, signatures on Contracts, Government Agreements etc., were ready by mid 1983, and the implementation of the programme started immediately afterwards in 1983.

The Implementation Organisation, National Water Supply & Drainage Board and Kampsax-Kruger faced the task of planning and executing a programme involving more than 1,000 Boreholes for Handpumps and approximately 24,000 latrines in 300 villages.

The organisational aspects of accomplishing this task before the expiry of the Project by 30th April, 1987 is discussed below.

A flow chart - fig. 1 shows the interrelationship and the time involved for a typical village between the sections.

2: DRILLING OPERATION AND HANDPUMP INSTALLATION PROGRAMME

2:1 General Approach

The drilling operation and handpump installation programme is characterised by the following main features.

A: Production Speed

The necessary production rate of one borehole per day per drilling rig has been achieved under the current programme. This includes the installation of a handpump with a concrete apron for each. (See Fig.2)

B: Priority On Sociological Criteria

Primarily the location of a borehole is based upon sociological criteria. Thereafter it is tested for its hydrogeological suitability. Only if hydrogeological conditions are unsuitable a compromise is sought for by a joint team of Sociologists and Hydrogeologists.

C: Village Participation

Although the entire drilling operation (down the hole hammer) is highly technical, villagers involvement is important and therefore encouraged. Cleaning sites, assistance with apron installation and involvement of the future handpump caretaker is stimulated as much as possible.

D: Transfer Of Technology

Two workshops with training facilities have been established in the project area. Here intensive training in handpump maintenance is given. The drilling supervisors conduct courses in class rooms and in the field, on how to operate and maintain the drilling rigs and related equipment.

2:2 Planning

Thorough planning and efficient communication is the basis for the large number of wells completed each month. (approx. 60 with two rigs).

After the siting of all wells (see section 2:3) when an A.G.A. division has been completed, the Hydrogeologists prepare two documents for the drilling supervisors:

a. Travel route for each rig.
b. A drilling instruction sheet for each borehole.

Three days prior to the drilling rig's arrival a Hydrogeologist places a wooden peg at the selected site and requests the villagers to clean the area.

The drilling operation is normally completed during one afternoon and the next morning (see below). The following day a handpump installation crew constructs the concrete apron and install the handpump to a depth determined by the drilling supervisor.

Two weeks later when the geochemistry is back to normal, the chemist will analyse samples in the field (for Co2, PH and Iron)* and collect a sample for detailed analysis in the office laboratory.

All collected data are stored in a ground water data bank and data pertaining to pump performance and water quality are updated each time the well monitoring team visits the site. (approx. once a month during the project period).

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*Due to a high iron content in the pumped water and aggressive ground water (high Co2 and low PH) a special programme has been established in order to monitor the water quality.

2:3 Siting Of The Boreholes

Siting of boreholes involves two phases:

A: Planning and organising of a detailed village survey.

B: Locating sites for drilling.

Detailed Village Survey

The Sociologist and the Hydrogeologist visit villages and study the physical set-up of the village, the number of houses and their locations.

The Sociologist then decides the location where boreholes should be situated and the necessary number of boreholes. This information is recorded on a village map and handed over to the Hydrogeologist.

2:4 Locating Sites For Drilling

When the Sociologist has decided the sociologically most suitable locations of the tube well, planning of hydrogeological and geophysical investigations takes place.

The geological features which normally imply safe yield are fractured/fissured and weather zones of precambrian basement crystalline rocks. The Hydrogeologists goal is therefore to localise such zones in the project area.

To achieve this a study of geological and tectonic maps, aerial photographs and landsat imageries is carried out. Study of water quality from existing sources is also important e.g. when predicting the quality of water in the new boreholes. These studies are mainly done in the office and the general geological and geomorphological model of the area is tested by field reconnaissance.

Following this, a geophysical investigation is carried out.

Variation of a selected physical property of the subsurface is measured in relation to the variation of hydrogeological properties. Electrical resistivity methods and very low frequency electro-magnetic methods have proven useful in this project.

Up to now the number of successful boreholes, i.e. wet boreholes yielding more than 0.5 m3/hr., in the Metamorphic rock is 90%

When siting of the boreholes is completed a location data sheet is prepared for each borehole showing the exact location of the borehole, required drilling depth, estimated depths to water bearing zones and depth of overburden (for estimating the length of casing required etc.). Finally a route through the A.G.A. division is prepared showing all the villages proposed for drilling indicating the sequence of drilling in order to minimize the logistic problems.

2:5 Drilling Operation

The drilling rig demobilises from the completed borehole around 12.00 o'clock and proceeds to the new site, (as indicated on the Drillers Instruction Form). A 6" hole is drilled in the overburden, and penetrates the first meter or so of the weathered hard rock. A 5" P.V.C. casing is installed in the borehole and the lower part will be cemented if required.

In case the casing itself can provide sufficient seal drilling will cotinue. Otherwise next morning (7.00 o'clock) drilling operation continues with a 4" bit in the P.V.C. casing through the hardened cement to a depth, average 50M, until sufficient discharge is obtained (0.5M3/hr.) The hole is abandoned if dry (maximum depth 80M). Demobilization is at 12.00 o'clock and the procedure is repeated on a new location.

2:6 Recording Of Data

A simple computerised data storage and retrival system has been developed. During the drilling operation a pre-printed computer form is filled out by the supervisor, these forms with a sample box of cuttings are delivered (every 5 days) to the office and analysed by the Hydrogeologist. All relevant data regarding hydrogeology, drilling and geochemistry are entered in the data bank. All parameters can be retrived in any required combination.

3:0 SOCIAL AND CULTURAL ASPECTS OF BUILDING TOILETS

The Sanitation Programme has the following main characteristics:

- Strong material incentive is offered - cash in hand.
- Limited resources available and selection criteria of villages and families create a competitive atmosphere around the programme which increases motivation and encourages participation.
- Family status and prestige is given to having a toilet, this is as a strong, if not stronger motivating factor than direct health benefits to most villagers because having a toilet is associated by villagers with material and social development and progress.
- Maximum use is made of local technical knowledge and resources.
- The Project Team functions as a "watchdog" against discrimination, bias in the distribution of plates and other malpractices.
- Volunteer Health Workers (VHW's) from the village who are loyal to Project Principles and Goals play a key role in the "Village" administration of the sanitation programme, and in progress reporting and monitoring. The VHW is also a valuable "informant" regarding any malpractices occuring in his/her village.
- The VHW is also the principal Data Collector regarding the functioning and use of the toilets after completion.

Problems Encountered

The programme has not been without its problems and "mistakes". Among some of the most important are:

- There is a strong "over-response" to the programme, putting the Project in a defensive position with regard to potential beneficiaries and producing some resentment among those being "left out" of the programme.
- Lapse of time between delivery of Squatting Plates in the Village and distribution has already resulted in added pressure on the health worker to distribute plates before having a meeting with the recipients to explain the conditions of the programme.
- Because of the immediate administrative demands of the programme, there has been a shortage of time for conducting independent monitoring and evaluation of the programme. Because of heavy work load of professional staff at the Project Office, as much as possible of the "field work" involved in monitoring and evaluation will be done by the Volunteer Health Worker, who is a full-time resident of the village.
- Caution should be exercised in attempting to replicate the programme in other organisational/cultural settings, since the programme, being part of a foreign-funded and administered project is "high-resource" and money and organisationally intense, advantages which other programmes/projects may not enjoy.

4:0 SANITATION PROGRAMME

4:1 General Approach

The principles related to technical matters which have been adopted for this part of the programme are:

A: All households without sanitation facilities should be offered a latrine from the project.

B: The Sanitation Programme should not be introduced in a village before adequate water supply is available.

C: The design should be kept so simple that the ordinary villagers can construct the latrines themselves.

D: Locally available materials should be used where possible. Where prefabricated items are used they should be produced within the project area to generate income for the target group.

4:2 Overall Planning

Before establishing a water supply (normally a handpump) the Sociological unit will collect applications from eligible villagers. These applications are collected by Voluntary Health Workers (VHW) as described in Section 3. After the Sociologists have processed the application a request is made to the technical section for the number of Squatting Plates to be delivered in the village and where these plates shall be delivered.

4:3 Delivery Schedule

In order to ensure early delivery, a delivery plan is made, based on the requests received. This plan also serves to minimize transport costs. The suppliers of Squatting Plates receive their delivery schedule at the end of each month. To facilitate the suppliers long term planning they have each received a standing order of the number of plates they are expected to supply each month.

4:4 Distribution

After delivery to a village has taken place the VHW arranges for the successful applicants to collect their Squatting Plates. For easy transport the plates are octagonal so that they can be rolled.

4:5 Construction Of Latrines

A very simple type of water sealed pit latrine (See Fig. 3) is being promoted. This enables the unsophisticated villager to construct their own latrine without being assisted. Where villagers express the wish to construct a more sophisticated latrine such as VIP or off-set latrines, the technical advice and guidance is given by the Implementation Organisation.

4:6 Subsidies

The target group belongs to the poorest part of the population. It is therefore necessary to give a cash subsidy covering the cost of materials.

This subsidy amounts to Rs. 500/= (20 US$) and is paid in two installments. The first installment Rs. 200/= (8 US$) is paid when the pit has been dug and the Squatting Plate has been placed.

The second installment Rs. 300/= (12 US$) is paid when the superstructure is completed. The total average cost of each latrine is approx. Rs. 750/= (30 US$) including transport but excluding extra lining in low lying areas.

4:7 Technical Advice

Quality control of the Squatting Plates is carried out by the Technical Assistants who also ensure that the correct number has been delivered. They advice the villagers on technical matters and supervise their work, making sure that the specifications are met. They also certify the completion of each step of the construction.

Each Technical Assistant is responsible for the supervising of approximately 15 villages.

4:8 Payment Of Subsidies

At agreed intervals each village is visited by a Payment Team. Apart from payments the team is responsible for carrying out sample checks as a control for the certificates issued by the Technical Assistant.

All payments are made in the presence of a Village Official who certifies the identity of each recipient.

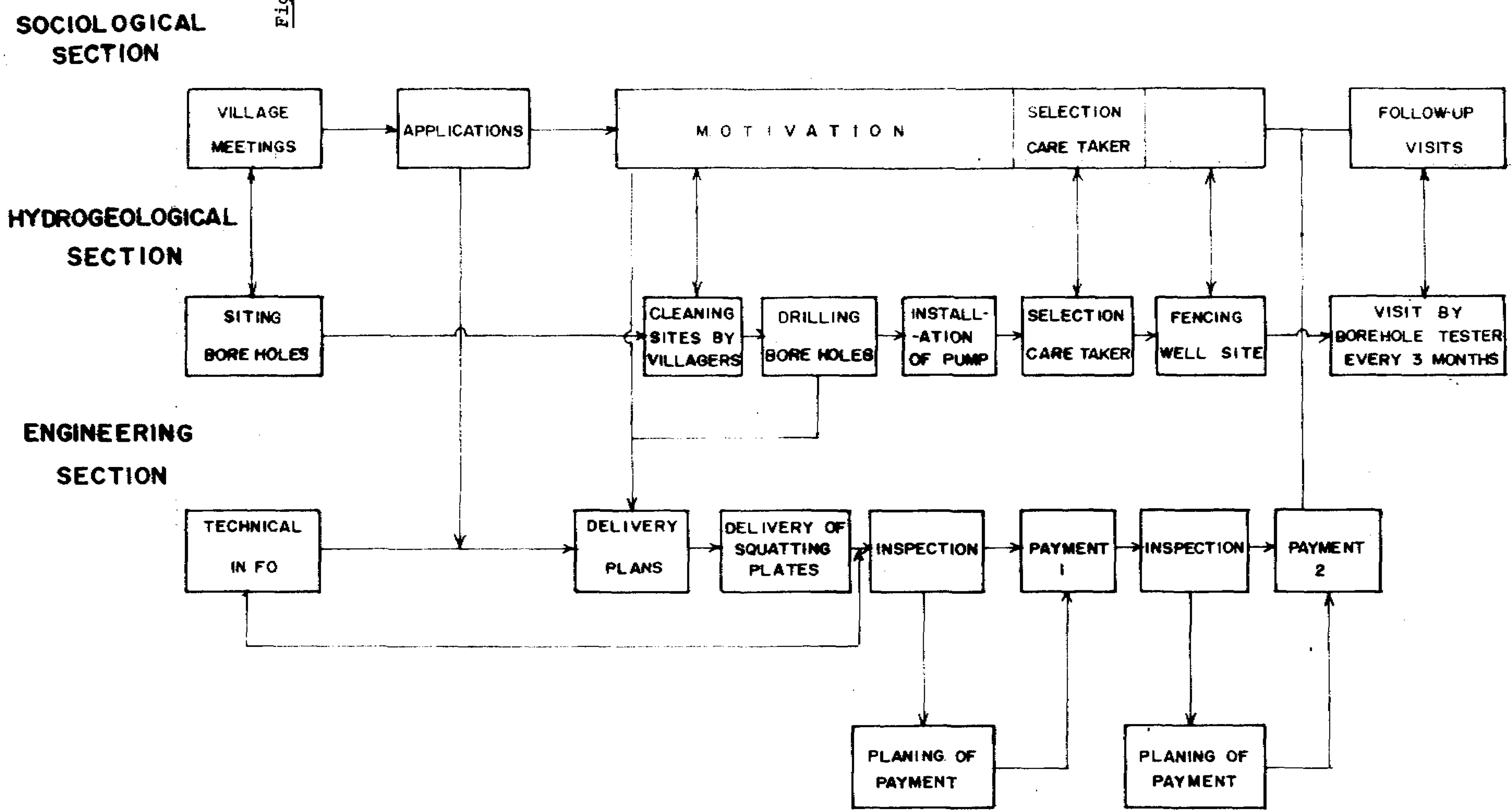
Depending on the size of the villages and the distance of travelling it is our experience that each payment team can make approximately 1,000 payments per month, corresponding to a completion rate of approx. 500 latrines monthly.

4:9 Achievements So Far

Using a total staff of less than 15 full time employed, an average of 1,000 completed latrines per month has been achieved with a maximum of 1,500 latrines in one month.

Close co-operation between the technical and sociological staff and a high degree of community participation and motivation is essential for success. The Implementation Organisation is expecting to complete 24,000 latrines in approx. 2 years.

Figure 1



WATER SUPPLY AND SANITATION PROGRAMME

FLOW CHART SHOWING ACTIVITIES FOR A VILLAGE

TYPICAL TIME SCHEDULE FOR COMPLETION OF ONE BOREHOLE WITH HANDPUMP

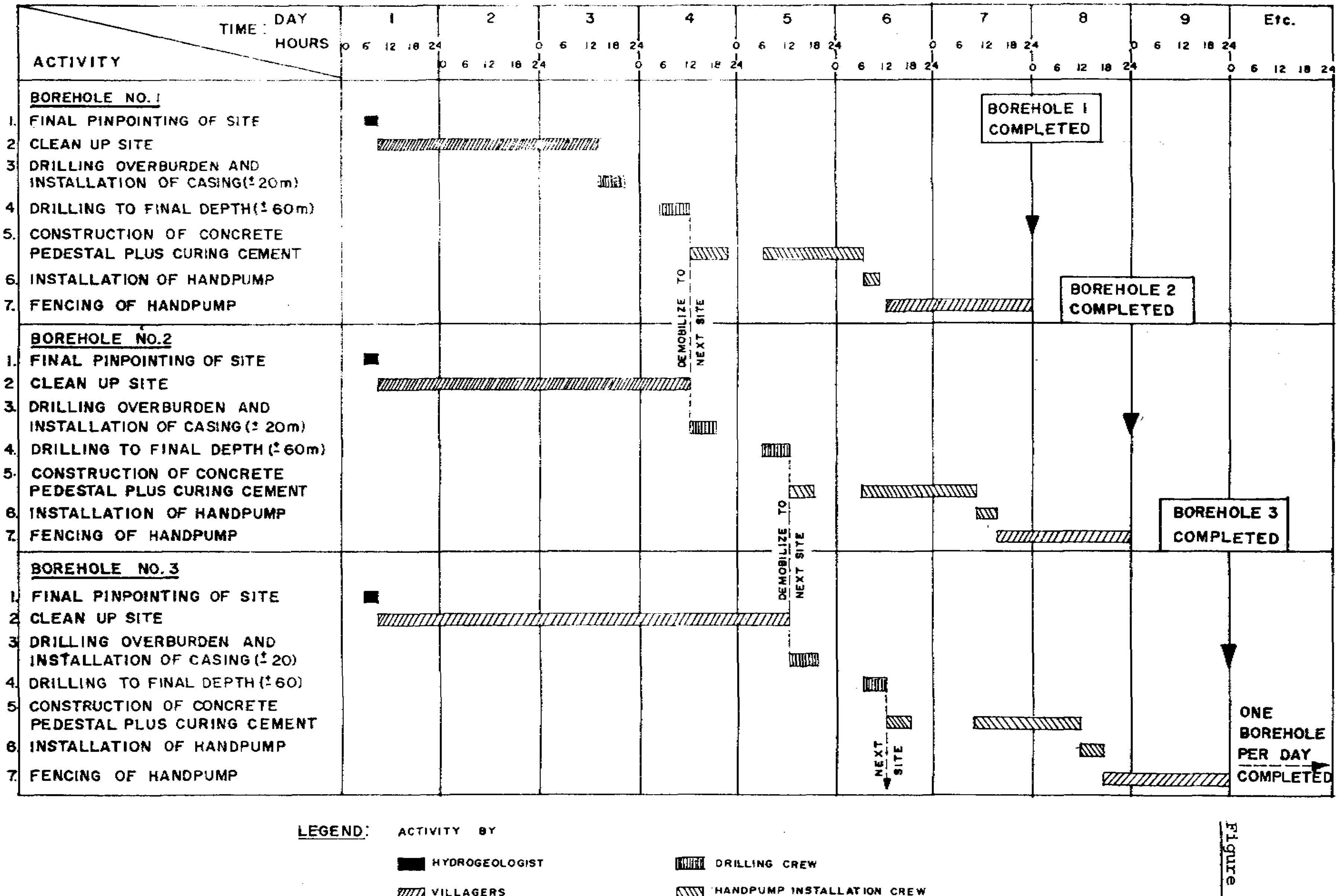
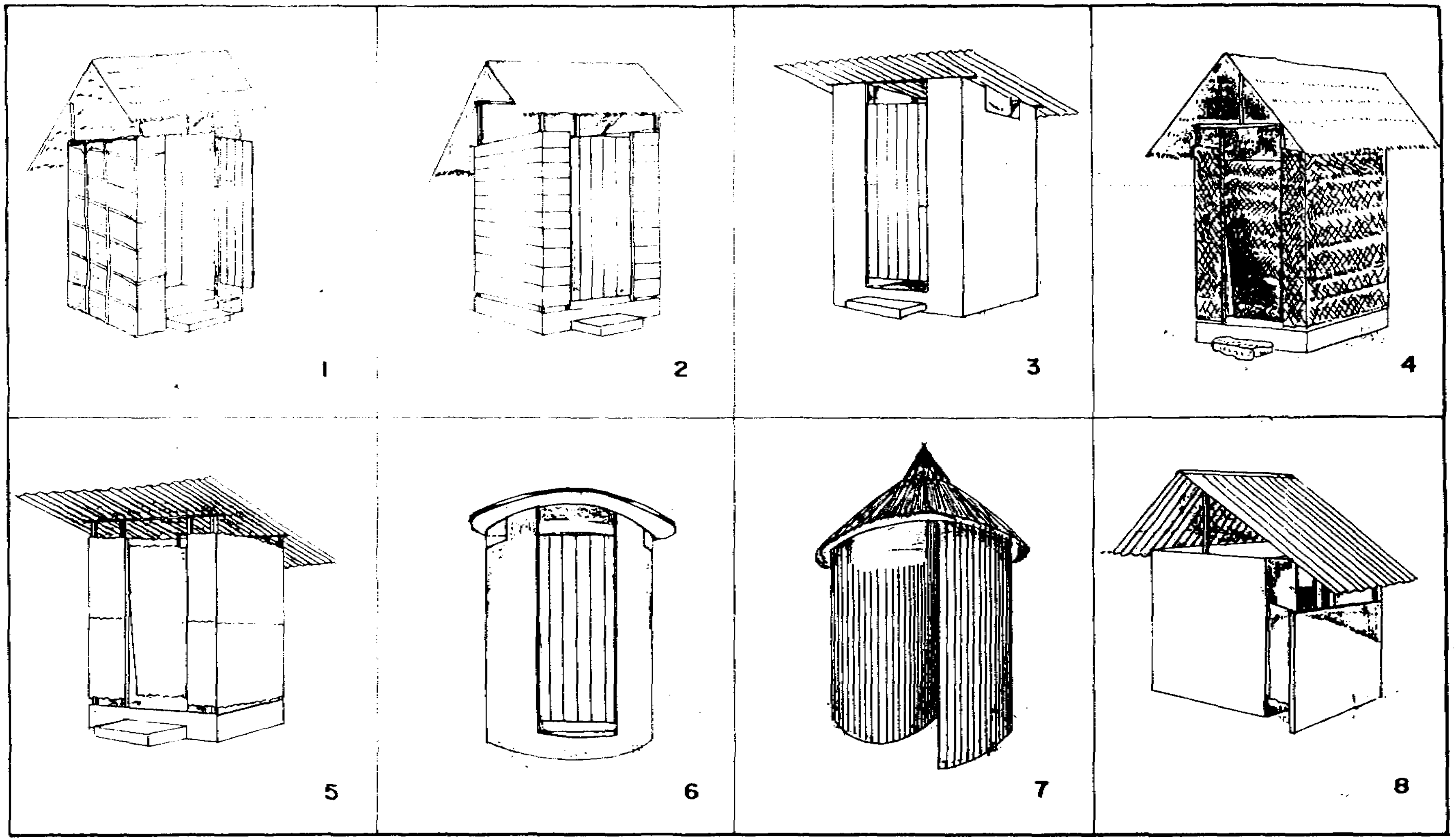


Figure 2



EXAMPLES OF RECOMMENDED SUPERSTRUCTURES FOR VILLAGE SANITATION

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

Khaketla, Ramonaheng and Jackson

Schools sanitation in Lesotho

INTRODUCTION

1. This paper focuses on the experiences of the Urban Sanitation Improvement Team (USIT) in improving sanitation in the schools of Lesotho. USIT is a multi-disciplinary team in the Ministry of Interior which is mainly concerned with domestic sanitation but has increasingly been involved with sanitation in schools. USIT has worked with a variety of delivery systems but has found that the most successful, in terms of long-term operations and maintenance, was where the communities first took the initiative to build improved latrines at their schools.

PREVIOUS EXPERIENCE IN LESOTHO

2. Between 1974 and 1980 the Ministry of Health, through its Health Inspectorate, undertook a Primary Schools Sanitation Project funded by UNCDF. The project achieved less than 20% of its targets for a variety of reasons: inappropriate latrine design, lack of manpower and logistical support, and poor response from the community (construction was planned to be by self-help). Furthermore, of those latrines that were built, virtually none are still in use and maintenance of the remainder is very poor. There had been very little motivation of the community and no user education (ref.1).

3. In 1981 and 1982, some improved latrines were built in schools under an IDA-funded Urban Development Project. The schools were merely informed that the latrines would be built, along with new classrooms, and no commitment to maintenance was required of them. Subsequent user education was given, with mixed results. We found that, despite our efforts in the project-aided schools, the impact of our user education has been limited: latrines are still not cleaned properly, nor are they used by all the students, doors get broken and urinals remain blocked. The main factor appears to be the degree of interest shown by the school manager and staff of each school.

4. Since then, USIT has declined to take the initiative in schools sanitation but responds as efficiently as possible to requests for assistance (see below). The result is, with a few puzzling exceptions, good quality school latrines built by the schools and their communities together with a high level of commitment to maintain the latrines in good condition.

USIT PROCEDURE

5. When a school has seen the need for sanitation and has contacted USIT, a visit is made to meet with the school management, usually represented by the head teacher and the chairman of the school committee. We explain the recommended sanitation technology and, most importantly, we get the management to understand that we will only help them with latrine plans and supervision of construction if they will ensure proper use and maintenance after completion. This approach is then conveyed to the rest of the staff and committee.

6. This initial contact is very important: decisions must be made by the school management and information is collected by USIT team members. To assist this decision-making we have prepared a tape-slide programme which covers most of the points to be discussed. It is entitled "Sanitation, Hygiene & Health in Our Schools"; it explains the main reasons for improving sanitation, it draws attention to the need for proper maintenance, and points out the decisions that must be made by the school management before construction begins.

7. So that USIT can provide a school with plans and cost estimates to meet its needs, the school must provide certain information:

- No. of students and staff (male or female, day or boarding?)
- Plans for future expansion,
- Availability of water (for hand-washing)
- Ground profile (eg depth to rock),
- Sources of funding,
- Community involvement (eg arrangements for labour, skilled/unskilled?).

8. Even when a school is motivated to put a large effort into improving its sanitation there is frequently a shortage of hard cash. Certain items such as stone for walls could be obtained locally but schools aspire to a structure of concrete blockwork. Other materials must also be purchased: pipes, cement, reinforcing steel and roofing sheets. In some cases funding is obtained from an NGO such as a foreign embassy special fund or a church organisation. The schools also organise fund-raising activities and make arrangements for contributions in kind (materials and labour) from students, their families and other members of the community. Further contributions may be obtained, by way of skilled and unskilled labour, through the voluntary Lesotho Workcamps Association.

9. USIT technical staff normally supervise construction activities through site visits at four critical stages:

- When the site has been chosen and the pits marked out for digging, the team goes over detailed plans for the cover slabs with the builder. They also help him to make moulds, and the mixes for the slabs are controlled.

- The next supervision visit is when the pits are dug and foundations are to be laid. Our staff assist the builder in setting out foundations and marking centre lines for substructure blockwork.

- When the substructure is complete, the placing of cover slabs is supervised. The team also helps to mark out the superstructure blockwork.

- On the final visit all finishing touches are done. Checks are made on the arrangement of seat covers and plugs (to ensure proper use of the alternating pit principle), vent pipes must be vertical and fly screens in place, cover slabs should be well mortared. Plastic posters are fixed in each cubicle (see figure 1).

10. When construction is complete and final inspection is made we ensure that, before the school latrines are used, we give user education to all the students and teachers. A second tape-slide programme has been prepared for this. It is shown to one or two classes at a time. A question-and-answer session follows, after which posters are given out (see figure 2). These serve as reminders of the "10-Point Programme for School Health", referred to in the tape-slide programme.

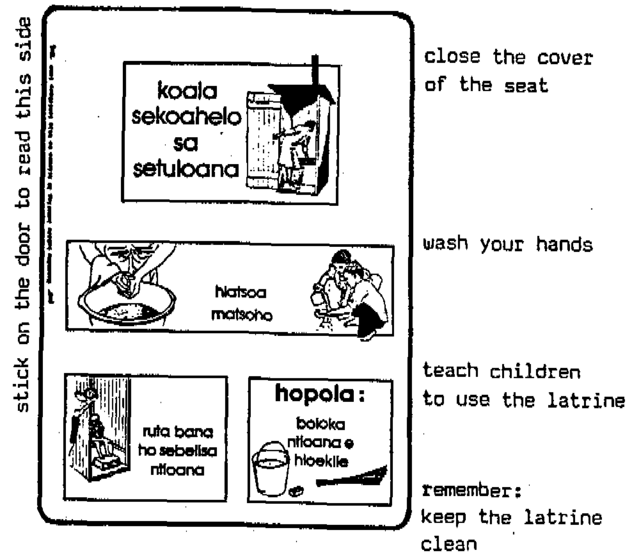


FIGURE 1: User Education Poster (Normal Size A4)

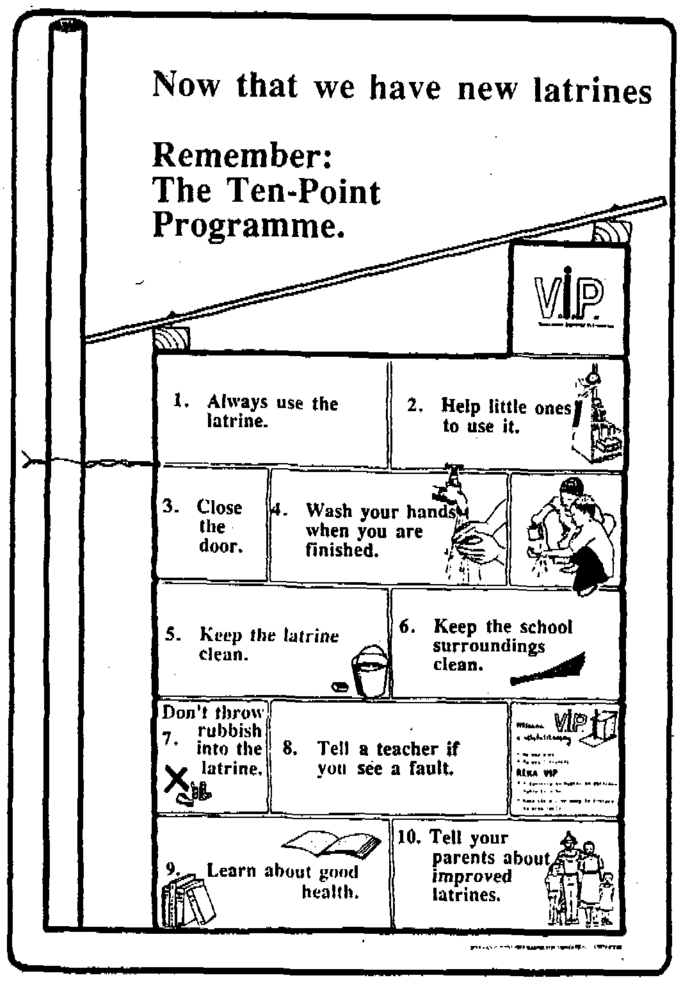


FIGURE 2: Ten-Point Programme (Normal Size A1) (Original in Sesotho)

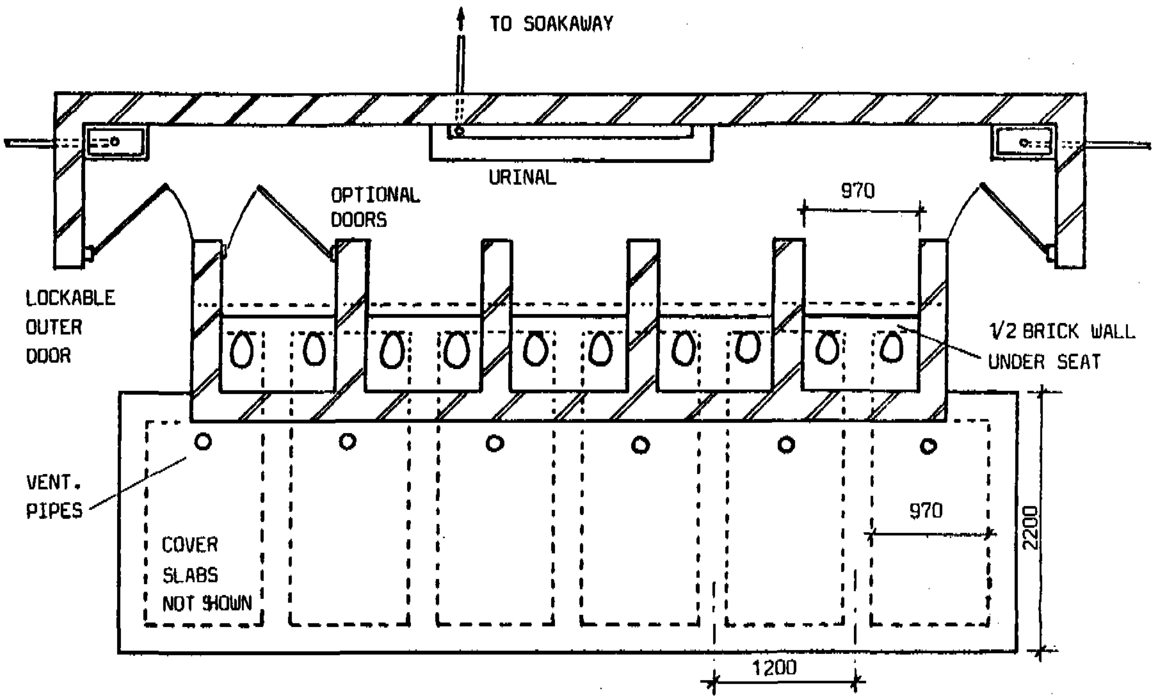


FIGURE 3: Multiple VIDP latrine for schools

WORKING PRINCIPLES OF VIDP LATRINES

11. Schools are normally advised to build multiple latrines of the type called VIDP (Ventilated Improved Double Pit) latrines. These have been found to be appropriate since their construction eliminates the need to dig very deep pits (Lesotho is very rocky) and there is no need to dig new pits when the first ones are full (see figure 3).

12. The working principle of a double pit (or alternating pit) latrine is that first one pit is used and when full it is closed to rest while the second pit is in use. When the second pit is nearly full, the contents of the first will have decomposed and can be emptied without danger from pathogens. The empty first pit can then be used again. The pits are designed to take at least 3 years to fill up.

PROBLEMS ENCOUNTERED

13. Some schools find it very difficult to raise the necessary funds to build the substantial structures proposed. We have tried offering cheaper designs but virtually all of the schools desire a permanent good-looking structure with low running costs. Even when external funding is arranged, it usually entails contributions from the community. These can sometimes take a long time to arrange, leading to intermittent construction and difficulties in supervision.

14. A number of technical problems have been encountered. Doors are a problem. They swell and do not close properly and are subsequently blown off by the wind. We advise schools to avoid them wherever this is acceptable. Urinals become blocked easily. Our latest design avoids the normal trap in favour of a grease trap/settlement tank (the size of a small manhole) before the soakaway. We have also had some ventilation problems. We prefer to use 150mm dia. PVC pipes but these are not readily available. The 100mm pipe works adequately most of the time but we receive occasional complaints.

15. Many of our problems are "institutional", for example:

- Local builders claiming to be able to read drawings and then proving that they cannot;
- Builders not present when the USIT supervisors visit the site (often over long distances);
- Builders, or other "responsible" parties, making unauthorised changes out of ignorance of the operating principles of a VIDP latrine;
- Poor co-ordination with an intermediary (eg. an architect) who produces a sub-standard product without further reference to USIT; An external agency (such as the World Bank, aided and abetted by the Ministry of Education) "gives" latrines to a school without securing the necessary commitments to maintenance, or budgeting for user education.

CONCLUSIONS

16. School sanitation may well have a good demonstration value as the pupils, in a learning atmosphere, come to understand the benefits of good sanitation and health. They could, in turn, have a positive influence on their older relatives to do the same at home. But if the same latrines have not been built well, are not properly used and maintained, and are a health hazard; this could have a very negative impact on the community and on the cause of sanitation as a whole. Our experience has taught us how important it is for the recipients of sanitation improvements to be committed to the proper use, care and maintenance of hygienic sanitation facilities, so that others might desire similar improvements.

17. Any attempt at a schools sanitation project should be undertaken with extreme caution - as mentioned above, the results may be the opposite to what was intended. Project sponsors and implementing agencies should retain as much flexibility as possible. They should avoid "production targets" which might tempt project staff to pursue construction in preference to participation. Communities should be encouraged to come forward and demonstrate that they are sufficiently motivated to take part in the project (perhaps a set of demanding criteria will be needed); and user-education is essential.

18. The authors wish to express their gratitude to the Overseas Development Administration of Great Britain for supporting the presentation of this paper.

REFERENCES

1. BECKER S.,CROSS EPW. & READ GH. Lesotho Primary Schools Water and Sanitation Project. TAG/UNCDF 1981.

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WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

P S Rajvanshy, S R Mendiratta

Sanitation and health education in Rajasthan

The International Conference on Primary Health Care, held at Alma-Ata Kazakhstan in 1978, described the essential elements of primary health care and cited foremost among these activities an adequate supply of safe water and basic sanitation. The urgency and importance of these needs led the United Nations to arrange an International Water Conference in Mar del Plata, Argentina, in March 1977, to discuss community water supply and hygienic excreta disposal systems. The Mar del Plata Plan of Action called for the designation of 1981-90 as the International Drinking Water Supply and Sanitation Decade. The Decade has been launched at the special session of the United Nations General Assembly on 10th November, 1980 and in India the Decade has started from Ist April, 1981 being the first day in the financial year of the Decade. Government of India as well as the Government of Rajasthan are fully committed to the International Drinking Water Supply and Sanitation Decade and intend to provide safe and adequate water supply to all. In Rajasthan 100% population will be covered with safe drinking water supply arrangements and 80% of the Urban and 25% of Rural population will be covered with sanitation schemes. Upto the Vth Five Year Plan we have concentrated our efforts to provide water supply to 100% urban population. Now the rural water supply is given the highest priority and more and more funds are allocated by the Government of Rajasthan (under MNP) as well as by the Government of India (under accelerated rural programme). The implementation of increased number of water supply schemes in rural communities will also call for the need of effective and economical waste water disposal systems. If the arrangements of disposal of waste water are not done, insanitary conditions and pollution will prevail, resulting in health hazards. The sanitation of rural communities have been assigned low priority to cover only 25% of rural population because a huge capital investment is required for providing facilities. In order to tackle the problem of rural sanitation on a large scale so as to provide sanitation facilities to the maximum rural communities in coming Decade, Low Cost Technology seems to be the only workable solution. The other major control measures are to provide improved housing, to identify and eliminate the breeding sites and to deliver health education to the rural people.

2. LOW COST SANITATION TECHNOLOGIES

(A) Household sanitation technologies

(i) Pit Latrines : It consists of large hand-dug pit, covered with a squatting slab made of timber. When it is full, another pit is dug nearby and a new shelter built on top. The shelter consists of screen wall only. Usually there is no roof. Where the soil and ground water conditions are right, the pit latrine is an excellent solution to problems of excreta disposal. A vertical vent-pipe of 15 cm dia, covered by a fly screen, will greately reduce the amount of fly breeding and escape of any flies that do breed.

(ii) Pour flush latrines: Pour Flush (P.F.) latrines have water seals beneath the squatting plate or pedestal seat and are available in many different designs. The two basic types are : the direct discharge and the offset pit design. In both these designs, approximately 1 to 2 litres of water (or sullage) are poured in by hand to flush the excreta into the pit. Since this type of PF latrine is free from both odour and fly and mosquito nuisance, it may be constructed inside the house. Wherever space permits, two pits should be constructed. When the first pit is full, the PF unit can be connected to the second pit. The design capacity 0.40 m^3 per person, per year can be used.

(iii) Compositing Latrines : There are two basic types of compositing toilets : continuous and batch. In continuous composting toilets, the humus has to be removed at the correct rate and only a minimum liquid can be added. Even if these conditions are met, fresh excreta may occasionally slide into humus pile and limit the potential reuse. For this reason, continuous compositing toilets are not suitable for developing countries. Double vault compositing (DVC) toilets are most common type of batch compositing toilt. There are two adjacent vaults, one of which is used until it is about three quarters full, then it is filled with earth and sealed and the other vault is then used. Ash and biodegradable organic matter are added to the vault to absorb odour and moisture. The composting process takes place anaerobically and requires approximately one year to make the compost microbiologically safe for use as a soil fertilizer. A small quantity of water is required to clean the squatting plate, only the absolute minimum of water should be added to DVC toilets.

(iv) Aquaprivies: The conventional aquaprivy toilet consists essentially of a squatting plate, situated immediately above a small septic tank that discharges its effluent to an adjacent sockpit. The excreta are deposited directly into the tank, connected to squatting plate where they are docomposed anaerobically in the same manner as in a septic tank. There is a gradual accumulation of sludge (Approx. 0.03 to 0.04 m^3/user/ year) which should be removed when the tank is two-third full of sludge. The tank volume is usually calculated on the basis of 0.12 m^3 per user. Desludging is normally required every 2 to 3 years, when the tank is two-third full of sludge. The liquid depth in the tank is normally 1.0 to 1.50 meters in household units. The water used for flushing is 4.5 litres/capita/ day and the volume of excreta is taken as 1.5 litres per capita per day. Thus, the sockpit is designed for 6 litres per capita/day basis. The sidewall area of the sockpit is calculated assuming an unfilteration rate of 10 litres per sq.metre per day.

(B) Community Sanitation Technologies

(i) Bucket latrines : The traditional bucket latrine consists of a squatting plate and metal bucket located in small compartment immediately below the squatting plate. The excreta are deposited into the bucket which is periodically emptied by through labourer or scavanger into a large collection bucket, which when full, is carried to a night-soil collection depot; from there the night-soil is normally taken by tanker to either trenching ground or burial. The bucket latrine system is not a form of sanitation and should be used as a short term measure and in the long-term they should be replaced by some other sanitation facility.

(ii) Vault and Cartage system : The vault toilets are similar to the P.F. toilets except that the excreta are discharged into the sealed vault that is emptied at regular intervals. Preferably the vault should be emptied by vacuum tanker.

(iii) Sanitary Blocks : The sanitary blocks can be constructed in rural communities. One toilet compartment can be used by 25 to 30 people. The toilet compartments should be arranged in separate blocks for men and women. The ideal type of toilet for rural communities is pour flush toilet. These are preferred in high density areas (over 1000 people per hectare) where a sanitation block can serve 200 to 500 people and they should not walk a distance more than 100 meters.

(iv) Sullage disposal : There are four kinds of sullage disposal systems : (1) disposal by tipping in the street, houseyard or garden, (2) on-side disposal in soakways, (3) disposal in open drains (4) disposal in covered drains or sewers.

* Tipping sullage on the ground in backyards or gardens may create breeding sites for mosquitoes and may also create muddy and unsanitary conditions.

** Sullage disposal in properly designed and constructed ground seepage pits causes only a low risk to ground water pollution, because the risk of microbiological and nitrate pollution of ground water from sullage is very much lower than the sewage.

*** Sullage disposal in open drains, such as storm water drains, promotes the breeding of mosquitoes. In the areas of seasonal rainfall, the drains are liable to become blocked with garbage.
**** Sullage disposal in closed drains or sewers is expensive, but has no special health problems unless it is eventually discharged without treatment.

Out of all the above facilities pour flush latrines are mot suitable for night soil disposal provided the soil conditions are permissing. The studies conducted in various States (Gujarat) have revealed that the water and soil pollution does not take place if soil conditions are permissible. The arid and semi arid areas of Rajasthan favour adoption of pour flush latrines.

3. Reuse of Excreta : The human excreta in whatever form, should be regarded as natural resource to be conserved and reused rather than digested. The following are the major reuses :
(i) Agricultural reuse : This may be accomplished by the application of sewage, sludge or night soil on the land. The fertilizer from the composting latrines can be used for agriculture. There are health problems associated with the reuse of raw sewage in human food production, as such it is widely used for growing fodder crops for animals. The effluent may also be used to produce crops even not intended for consumption by animals.
(ii) Aquacultural reuse : Three main types of aquaculture are found :
(a) fish farming; (b) algal production; and (c) macrophyte production.

(a) Fish farming : The raising of fish in ponds enriched with human and animal excreta greatly enhances the total fish yield and the fishes are less prone to disease.
(b) Algal culture : Instead of growing fish in waste enriched ponds with large algal populations, it is possible to harvest the algae directly. The advantage is that harvesting at a lower trophic levels ensures for higher yields of biomass and protein.

(c) Macrophyte culture : Many water plants are used as food or animals feed. Some of these are harvested wild, while some are cultivated. Plants include water spinach, water chestnut, water bambook, lotus etc.

Biogas production : When organic wastes are digested anaerobically, a mixture of methane, carbondioxide, and other gases is given off. This gas has become known as 'Biogas' and can be produced on various scales by various different technologies. The gas is used primarily for domestic cooking and lighting. The biogas plants are fed with diluted animal feces, with or without vegitable refuse. The effluent slurry is reused for agriculture, or it could be used to enrich fish ponds. The dung from one medium sized cow, or similar animal, may produce around 500 litres of gas per day and the calorific value of this gas may be around 4-5 kilo calories per litres. Whereas the human excreta can produce 30 litres of biogas per person daily. The gas plant is more useful for the farmers who own five or six heads of cattle. They can get the necessary quantity of dung required for the preparation of gas. This solves the problem of fuel and lighting for one family. The initial outlay in setting up a Gas plant is high but its cost is recovered in 5 to 6 years in the shape of manure and gas. Thus the fuel problems of village can be solved by gas. The gas burns without smoke and generates much heat. The gas is odorless. Its light is cool and white as moonlight.

In Rajasthan where rural population does not consume fishes, it is advisable to recommend the construction of the community Biogas plants for disposal of wastes of such houses who can not afford to have independent individual units.

5. Sanitation and health protection of the communities :
(i) Health : The human factors contributing to diarrheal diseases are : (1) Indiscriminate elimination, (2) Contamination of food and water supply.

It has now been established that the control of communicable diseases particularly the water-borne ones is more effective by implementing sanitation schemes than water supply schemes. The diseases caused by improper sanitation and lack of health education, have the following consequences on the health :

(a) Lowered health due to diarrheal diseases,lays open the individual to other infections,respiratory gastro-intestinal,etc.

(b) Diarrheal and other infections lower resistance,aggravate the status of the already malnourished populations.

(c) Result in high infant mortality.

(d) Retard mental and physical development.

(ii) Social,psychological and cultural aspects for acceptance of sanitation programme : How people react to excreta disposal schemes or arrangements depends both upon deep rooted cultural values and quite mundane matters of cost,convenience, or comfort. Several health benefits can only be expected to occur if latrines are properly used and maintained. Changes may be required before some systems are acceptable.These are,of course, situations in which effective excreta disposal will not be achieved unless people come to have some new understandings of the health hazards associated with improper excreta disposal and the measures that can be taken to avoid them.

(iii) Health education and community participation : In order that the huge investments that are made on sanitation programme become more effective it is necessary to create awareness,interest and motivate people to adopt, use and maintain the facilities provided for. Often it has been observed that good technical designs and properly executed schemes on sanitation have failed because of inadequate response from the people. The technology recommended should be such that it is acceptable to the people and it encourages use of local material and manpower.The following are the steps to be taken for formulation and implementation of health education programme :

(a) A report on the social,psychological and cultural factors involved in the acceptance, use and maintenance of water and sanitation systems embodying recommended strategies for health education intervention should be prepared.

(b) Guidelines, based on the above should be framed.

(c) A manual should be prepared for the use of workers in health educational methods and procedures as applied at village and community level;

(d) Delivery of health education programme in selected communities on the basis of (a),(b) and(c);

(e) An evaluation report on the impact of water and sanitation and health education interventions on the health status of the community should be prepared.

(iv) Delivery of health education programme : The health education programme should be undertaken to inform,motivate and adopt new understanding,new attitudes and new practices. The conventional methods of informing,motivating and enabling adoption, do not go far enough because of the following limitations:

(a) Limited role of information and mass communication,

(b) Lack of credibility of the media,

(c) Lack of social support and opportunities to evaluate,trial and adopt,

(d) Education is often equated with information. A-V aids and mass media are blamed for not being effective in diffusion of innovation.

(v) Evaluation of health education programme : The following studies are conducted to evaluate the impact of health education programme on (i) the communities willingness to accept,use and maintain the water and sanitation facilities,and(ii) the impact of combined water supply and sanitation facilities and health education inputs on the health of the communities :

(a) Study comprising use of water supply and sanitation facilities before and after the health education interventions,to determine the effects.

(b) Epidemiological studies before and after the water supply and health education to evaluate their impact on the health of community.

(c) Socio-cultural study to evaluate the effect of the health education programme on water use behaviour.

12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

B Pathak

Bihar and the urban sanitation Decade target

Mid-term appraisal of the Decade achievement in this country has indicated that hardly 25% of the urban population were covered with safe sanitary latrines by March 1965. Another survey in the past has recorded that about one-third of the urban households had no latrines and another two-fifths depended on bucket latrines which require scavengers to clean them and transport the excreta on head for disposal. Only a quarter of the urban households is provided with safe sanitary latrines. The goal for the Decade was to cover 80% of the urban population with sanitation by March 1991. Reviewing the progress made in this sector during the Sixth Five Year plan period and the proposals included in the Seventh Five Year plan, a consensus is emerging to search alternative achievable goals. Exercise for setting alternative goals have already begun.

Seeing the plight of the scavengers carrying night soil on their heads, Mahatma Ghandi said much before independence - "I may not be born again, if it so happens, I would like to be born in a family of scavengers so that I may relieve them of inhuman, unhealthy and hateful practice of carrying head load of nightsoil."

Even after three and a half decades of planned development, it has not been possible to eliminate it. A number of Committees and Commissions at various levels have unanimously recommended to eradicate this stigma but the largest number of the scavengers engaged in this hateful job in the world are still found in this country. Even now about four to five millions dry latrines are estimated to be in use engaging more than 0.25 million scavengers for carrying night soil for disposal. Since 1974 programme of conversion of dry latrines into Sulabh Shauchalaya has been continuing in the State of Bihar. About 0.15 million dry latrines have so far been converted and about 5000 scavengers have been relieved from this demeaning work. They have been retained in their services on some other jobs by the local bodies without loss of their earnings.

In spite of this accomplishment, an assessment indicated that as on 1.4.85, 1,92,000 dry latrines still existed in 162 urban units in the State of Bihar.

It will be the greatest achievement of the U.N. Decade if all the existing dry latrines are converted into Sulabh Shauchalayas thus providing safe and sanitary latrines to more than a million of urban people and relieving about 10,000 scavengers from this demeaning work once and for all.

With these objectives the State Government of Bihar has decided to get all the dry latrines converted into Sulabh Shauchalayas within the Seventh Five Year Plan i.e. by March, 1990. The freed scavengers and their dependents are proposed to be rehabilitated in some gainful employment. Specific programmes in this regard have already been taken up. A sum of Rs. 190 millions has been provided in the State Plan for the period 1985-9.

An exercise done to work out financial requirements indicates that conversion of all the

TABLE - I

ANNUAL PHYSICAL TARGET AND FINANCIAL REQUIREMENT OF CONVERSION OF DRY LATRINES INTO SULABH SHAUCHALAYA

YEAR	TARGET	FINANCIAL REQUIREMENT		PROVISION IN THE STATE SECTORAL PLAN (Rs. in Lakhs)	UNCOVERED GAP (Rs. in lakhs)
		UNIT COST (Rs.)	TOTAL REQUIREMENT (Rs. in lakhs		
1	2	3	4	5	6
1985-86	33000	1200.00	400.00	300.00	100.00
1986-87	39000	1300.00	507.00	400.00	107.00
1987-88	40000	1400.00	560.00	400.00	160.00
1988-89	40000	1500.00	600.00	400.00	200.00
1989-90	40000	1600.00	640.00	400.00	240.00
Total VI Plan	192000		2707.00	1900.00	807.00
			100%	70%	30%

T A B L E - II

STATEMENT SHOWING YEARWISE BREAKUP OF TRAINING OF FREED SCAVENGERS

Y e a r	Target of conversion of dry latrines (NOS)	No. of Freed Scavengers (NOS)	Training cost per scavenger (Rs)	Total cost of Training of Freed scavengers (Rs. in lakhs	Remarks
1	2	3	4	5	6
1985-86	33000	1650	5400.00	89.10	
1986-87	39000	1950	5400.00	105.30	
1987-88	40000	2000	5400.00	108.00	
1988-89	40000	2000	5400.00	108.00	
1989-90	40000	2000	5400.00	108.00	
TOTAL	192000	9600		518.40	

existing 1,92,000 dry latrines into Sulabh Shauchalayas by March 1990 will require Rs. 270.7 millions. Provision in the State Plan for the Seventh Five Year Plan on this programme has been Rs. 190 millions, which is about 70% of the total requirement. The remaining 30% i.e. Rs. 80.7 millions is expected to be made available by the Ministry of Welfare, Government of India as grant or through HUDCO as loan. The annual target, financial requirement, State Plan provision and expected grants from the Government of India have been shown in Table I.

Servicing of dry latrines has been continuing to be a traditional profession. Scavengers, who are engaged in this work, will of course be retained in their services till their age of superannuation but there will not be any scope of employment for their sons and daughters once dry latrines are eliminated. Accordingly they need to be moved to some other vocations. Because of weak social and educational base this group need special attention for making them suitable to compete with others for jobs or to seek self employment. Since they have their moorings in urban setup, they are generally not interested to move to rural areas.

For imparting practical training to the sons and daughters of the freed scavengers, a project has been launched and it is under implementation. About 600 boys and girls belonging to this community are being given training in the following trades:-

(1) Typing
(2) Tailoring
(3) Motor Mechanic
(4) Driving
(5) Leather works
(6) General Mechanic
(7) Cane work
(8) Carpentry

The training is being imparted by the Research & Rehabilitation wing of the Sulabh International, Patna with 100% financial support from the Government of India.

The duration of the course is about one year. During training, each trainee gets a stipend of Rs. 300.00 per month for meeting hostel expenses. After training, some will get jobs like others if and when there are vacancies. The others will be encouraged to earn wages by being self-employed.

They will be given loan from the Bank under various ongoing programmes. The annual approximate number of the trainees and the cost involved during the Seventh Five Year Plan period has been worked out which is shown in Table II.

Ministry of Welfare, Government of India has been bearing the 100% cost on this subhead as an outright grant to the State Government.

The total cost of this programme conversion and training in Bihar during the Seventh Five Year Plan period comes to Rs. 322.45 millions. Achievement of the goal by the end of the Seventh Five Year Plan will need an assistance of Rs. 80.70 millions which is only a quarter of the total requirement. The annual breakup is being furnished in Table III.

T A B L E - III

STATEMENT SHOWING FINANCIAL REQUIREMENT, PLAN PROVISION AND ASSISTANCE/LOAN REQUIRED FOR CONVERSION OF DRY LATRINES INTO SULABH SHAUCHALAYA AND TRAINING OF FREED SCAVENGERS

(Rupees in lakhs)

Year	CONVERSION PROGRAMME			TRAINING PROGRAMME		TOTAL OF THE TWO PROGRAMMES			
	Total financial require-ments	Provision in the State plan	Expected Central assistance/ Loan	Total Financial require-ment	Assistance from the Central Govt.	Total finan-cial Requir-ements (2 + 5)	Provision in the State Plan (3)	Provision in the Central Plan(6)	Assis-tance/ Loan require (4)
1	2	3	4	5	6	7	8	9	10
1985-86	400.00	300.00	100.00	89.10	89.10	489.10	300.00	89.10	100.00
1986-87	507.00	400.00	107.00	105.30	105.30	612.30	400.00	105.30	107.00
1987-88	560.00	400.00	160.00	108.00	108.00	668.00	400.00	108.00	160.00
1988-89	600.00	400.00	200.00	108.00	108.00	708.00	400.00	108.00	200.00
1989-90	640.00	400.00	240.00	108.00	108.00	748.00	400.00	108.00	240.00
TOTAL	2707.00	1900.00	807.00	518.40	518.40	3225.40	1900.00	518.40	807.00
Percentage	100%	70%	30%	100%	100%	100%	58.90%	16.07%	25.03%

*** Grant Expected from Ministry of Welfare, Govt. of India/ Loan from HUDCO.

Session 2b

Chairman: Mr A K Roy
Co-Chairman: Dr B Pathak

Discussion

A K Adhya and S K Saha

Field study on filling characteristics of latrine pits

1. Mr ADHYA explained the methods used to determine the rate of filling latrine pits. He then discussed the findings with the help of the attached graph which indicates that rate of filling falls off as the time period of the use of the pit increases. He also pointed out the importance of the difference between the pit liquid level and the free water table which can reach a maximum of 910 mm.

2. Mr BASU DHAN asked should a pit be so designed that it would last for four-years and for this the rate of filling is optimum? But as per Sulabh, the suggestion is to use one pit for two years and use the sludge as manure. Would you co-relate?

3. Mr ADHYA responded that no optimum value of rate of fill was suggested. It was mentioned that the rate of fill varies inversely with actual duration; for an average life of 4-5 years the rate was also average and in the order of 0.0044 cu ft i.e. 0.12 litres/capita per day. Again the suggestion of Sulabh International to use one pit for two years and use the sludge as manure was possibly because a minimum period of one year is essential for destruction of all viable pathogens in the pit, whereas 2 year period's rest would be desirable to ensure inoccuosity of the manure. Therefore, the considerations being differently based, a correlation is redundant.

4. Mr HEYNEN commented that in various parts of India and SE Asia there will be a difference in food intake over the year. This will result in a variation of stool volume. Is the author able to shed some light on the influence of variation of food type and food intake on the filling rate in other parts of India?

5. Mr ADHYA replied that the variation of volume of stool due to variation of food type and food intake in different parts of India does not seem to be significant. The extreme variation of food habits in different parts of the globe is likely to produce perceptible difference in volume and possibly character of the stool, which in turn could influence the digestion and extent of sludge. But such influences would have only a far-fetched effect on filling character, since, as has already been pointed out that the pit is reckoned to be filled up when combined liquid and solid level in the pit reaches the top of the pit and such a condition is not due to filling of the pit with solid sludge.

6. Mr D C BHARDWAJ asked the author to explain the method of arriving at the number of users/day. He also asked whether the atmospheric temperature had any effect on the filling rate?

7. Mr ADHYA stated that this is explained clearly in the main paper, although it was not brought out during presentation. It was, however, explained on the spot. Since there was not a good deal of fluctuation in the ambient day temperatures in the area so as to affect digestion characteristics to a great deal over the years the correlation between temperature and filling rate was not attempted in the study. Therefore, effect of atmospheric temperature on filling rates, if any, is not predictable within the scope of the study under reference.

8. Mr D GUIN asked if Mr ADHYA had analysed with different lining materials or without lining material for the pits? He also asked what should be the height of inlet pipe from the bottom of soak pit and whether any chokage problem had been experienced in the inlet pipe? If so, what preventive measures were suggested?

9. Mr ADHYA replied that we did not try different lining materials. Out of the 12 experimental pits 11 were lined with burnt clay (earthenware) rings and one pit was kept unlined. There is no such standard on the maximum or minimum height of inlet from the bottom of the leaching pits as such. However, the inlet pipe level should correspond to the design level of the combined liquid and solid in the pit so as not to put inlet pipe under surcharge. The bottom of the pit would then be guided by the practical limitations of digging and the design capacity of the pit. No chokage problems were encountered in the study pits. As a preventive measure on such pour flush type latrines, the pit should not be constructed too much away from the seat - preferably with 1 to 1½ m, and the connecting pipe should not have too flat a slope. The other precautionary method would be to make sure whether the inspection chamber is provided. In case there is chokage, it can be cleared off from the inspection chamber.

10. Mr R PARAMASWAM commented that it should be expected that the climatological factors, particularly rainfall, ambient temperature, humidity etc will influence the rate of filling. Were these taken into account and if so how do they affect?

11. Mr ADHYA replied that the rate of filling has been computed on the basis of prolonged observations over the years consisting of summers, winters and monsoons. Therefore correlation of climatological factors and rate of filling could not be undertaken in the same study. Such correlation can be established only when the study can be taken up in extreme climatic conditions in different places, soil conditions remaining comparable. For the same location such climatic changes would influence the water table, percolation rate etc. The effect of water table has been shown, whereas no definite influence could be established with change of percolation rates, as explained in the body of the paper.

12. Mr S A JAGADEESAN asked what are the precautions to be adopted from the leach pits in hard rock areas?

13. Mr ADHYA said that in impervious rock formation the pit, if feasibly dug, may not function as leaching pit at all. It may act as a septic tank there. In that case arrangement for effluent disposal like subsurface drainage etc may have to be provided. At any rate the fissures or crevices must be avoided while constructing leach pits in such formation. In unavoidable circumstances a thick sand envelope may be thought of.

14. Mr A K Roy asked whether there was any difference in the lined and unlined pits for the collection of sludge?

15. Mr ADHYA said that in the study under reference except for loss of some cubic capacity of the pit owing to the part caving in of lower region of the pit, no other effect was noticed. As far as collection of sludge (presumably digested one after filling of pit) is concerned the authors feel that there would not be any perceptible loss of sludge or enlargement of pit in case of unlined pits because the sludge would be rather loosely packed and would be perceptibly different from adjoining earth of the pit.

16. Mr M N SHARMA commented that in certain areas the subsoil water table is very high. Construction of a soakage pit is likely to contaminate the drinking water sources like hand pumps and shallow wells located in the same vicinity. What remedial measures should be adopted to protect such drinking water sources.

17. Mr ADHYA replied that the first protection is to locate the leach pits at least 15 m away from the source of drinking water, in general. However, this entirely depends on soil character, and in alluvial soil the safe distance could be 8 m. {Ref. "The risk of pollution of ground water from borehole latrines" by Subrahmanyah K & Bhaskarau, T R published in Indian Med. Gaz. 85, 418, 1950}. However as a remedial measure, sand envelopes are suggested. A study is being undertaken by Prof. K J NATH and others, all India Institute of Hygiene and Public Health in this respect at present.

18. Mr SARIAT ULLAH asked: did you observe any action of decay on clay rings due to contact with sludge? What would be the life of clay rings as pit lining? What is, normally, the thickness of the solid when a filled up pit is allowed to settle until another pit is filled up?

19. Mr ADHYA commented that I have not observed any action of decay on well burnt clay rings in contact with sludge through my 21 years of experience in low cost sanitation. It is the constant contact with the liquid - not sludge as such, that might make the clay rings vulnerable. But if the clay rings are well burnt it should last long enough from a practical point of view. In fact, I have observed pits with clay rings to last for over 25-30 years in the area. Solids thickness is normally not measured unless one has a specific objective to do so, and such measurement had not been taken by us so far. However I feel there should be a tangible reduction of volume owing to the subsidence of the loose matters inside the pit, although the major reduction due to escape of volatile matters, leaching of the liquid matters would have already taken place.

D K Ghosh

Environmental sanitation problems, India

20. Mr GHOSH reviewed the major health problems relating to inadequate water supply and sanitation in the rural and urban fringe areas of India. In considering solutions he emphasised the needs for improved sanitation such as the Ventilated Improved Pit Latrines and the pour flush water seal variety. He also stressed the requirement for continued sanitation education in order to realise the benefits of improved water supply and sanitation.

21. Mr RAJENDRA DAYEL asked whether in view of the research work which is required to determine the probability of the water table becoming polluted by nitrogenous products, would it be wise to go in for pit latrines indiscriminately as a means of low cost sanitation?

22. Mr GHOSH replied that indiscriminate use

of pit latrines is not advisable. With certain combination of hydro-geological conditions the need for such on-site sanitation systems may conflict with the groundwater quality requirement. I think the widely adopted 'rule of thumb' separation of 15 metres between groundwater supply installations and on-site sanitation units shall be checked by groundwater quality monitoring whenever on-site sanitation systems and water supply wells are to exist side by side.

23. Mr C B KARKI commented that the involvement of the community should be not only in the planning stage, it should be a continuous practice in construction and O & M works also. Appropriate technology should be applied especially in rural area.

24. Mr GHOSH agreed with the questioner. It should be the practice to involve the community (particularly women) at all stages of such programme. In fact, the community is more likely to cooperate in the implementation, operation and maintenance of new systems if it has had a say in the preparation of the plans. Such joint planning based on an investigation of the local situation and utilisation of appropriate technology shall have the desired health impact.

H A M Hoefnagels, Dharmagunawardane, C Pendley, O J Krabbe, S V Senaratne

Integrated rural water supply and sanitation programme

25. Mr HOEFNAGELS explained the water supply and sanitation project which he is currently engaged upon in Sri Lanka. He distributed additional papers to the delegates, certain details of which are included here. In his presentation, Mr Hoefnagels emphasised the speed of operations with two bore wells being completed each day as well as thirty latrines.

26. Dr COTTON commented that iron is a great problem in groundwater in parts of Sri Lanka, rendering the water unacceptable for drinking in many areas. Is there any follow-up to investigate how many villagers resort to traditional sources for drinking? Is the sanitation accepted and widely used when installed? Who selects what type of latrine to use e.g. shallow pit, deep pit, raised pit etc?

27. Mr HOEFNAGELS replied that in our project area the iron content in the groundwater is low, namely only 4.6% of the wells show iron content above 1 mg/l. However iron content occurred by corrosion of GR riser mains and pulling rods, gives high iron in the well water. We have successfully remedied this by putting non-corrosive submerged pump parts in the wells.

28. Mr FRANCEYS asked what type of handpumps had been installed and how reliable had they been?

29. Mr HOEFNAGELS said that Mark II India hand pumps had been used. They were performing very well; however there had been some problems due to the modification of the GI riser main to a non-corrosive PVC riser main.

30. Mr PHILIP HOWARD asked what is the average cost for a water supply in a village and how much of this cost are villagers required to contribute toward this system completion?

31. Mr HOEFNAGELS replied that one complete well plus pump costs SL Rps 40,000 (Approx 1 US $ = 27 SL Rps). No financial input is requested from villagers, but in a latter stage a contribution of 1 SL rupee will be collected each month from a user family.

32. Mr ANDREW JENKINS asked if there is a possibility that a village has no feasible well site and so nothing will be done; why not check this before arousing expectations?

33. Mr HOEFNAGELS said there is a misunderstanding here. First the hydrogeologist will be consulted whether a well is possible, only thereafter will the villagers be requested to ask for a latrine.

34. Mr LLOYD asked if you were designing a new phase of the project, what time scale would you recommend and what system would you want to introduce to encourage participation of the beneficiaries?

35. Mr HOEFNAGELS replied that we should go along the same line, as up to now villagers participation is considered by us as very good.

36. Mr SARIAT ULLAH asked whether there was any attempt to observe pollution effect when there was intensive low cost latrines near the hand pumps?

37. Mr HOEFNAGELS stated that we have at random analysed 100 wells for contamination. Only one showed contaminated water because of an unnoticed latrine only 6 metres from the well. Our limit is no latrine within a radius of 30 metres from the well. This shows (under our geohydrological conditions) satisfying results.

38. Mr KARKI asked whether the caretakers were paid by the Project or by the users?

If they were paid by the community was it by water tariff or voluntarily?

39. Mr HOEFNAGELS said that it has been proven in the project that "the status" of being the village caretaker is sufficient to keep him motivated; no financial incentive is required.

40. Mr PATEL asked what was the percentage failure of boreholes that have been found as suitable sites by hydrogeologists. He also asked what was the quantity of water from a tube well that would be considered as suitable for drilling a borehole at a particular village.

41. Mr HOEFNAGELS said that there was a 90% success rate with 10% dry boreholes. The quantity required was 0.4 m^3/hr.

Khaketla, Ramonaheng and Jackson

Schools sanitation in Lesotho

42. Mr KHAKETLA described the experiences of the Urban Sanitation Improvement Team in improving the schools of Lesotho. With the use of slides he illustrated the construction phase of school latrines and also the health education requirements.

43. Mr AETYNEN asked how many students do you take per latrine unit? Do you have a different ratio of student per latrine unit for dayschools and boarding schools? (This question assumes that students of day school may have already passed stool at home and that therefore maybe a lesser number of latrine units would do in the case of day schools.

44. Mr KHAKETLA replied that our latrines are designed such that we allow 15 students/latrine for boarding school. 30 students/latrine for day scholars.

45. Mr GUIN commented that pits are shown close to each other. I think the absorptive capacity of soil will be reduced, so they will be filled shortly. As the latrines are without water seal there will be fly and smell nuisance. How can the pits be cleaned, when they are constructed underground and fully covered by squatting slab at top.

46. Mr KHAKETA answered that normally, open vertical joints are left on the first five courses of the sub-structure to allow for seepage. These are dry-pit latrines - hence they are called Ventilated Improved pit latrines. As you have seen on the slides each pit is provided with a vent pipe and all holes leading to the pit are sealed. There are cover slabs at the back of the latrines which are removable.

47. Mr RANJITKAR asked what is the cost of the school latrine? It seems very costly, so why not adopt low cost technology. I think the ventilation pipe of the pit must be coated by black paint for proper functioning.

48. Mr KHAKETLA admitted that the cost of these latrines is high but as pointed out some schools, especially urban schools, prefer to have permanent structures rather than temporary cheaper latrines which may fall apart in a short time. The technology here is still low cost compared to the flush toilets, for example. We have had no problems with white or grey p.v.c. pipes because of the prevailing winds. Moreover Lesotho is at a very high altitude - about 1,500m above sea level.

P S Rajvanshy and S R Mendiratta

Sanitation and health education in Rajasthan

49. Mr RAJVANSHY presented his paper and discussed the range of sanitation technologies available. He also explained the use of excreta and went on to discuss the role of health education and community participation.

50. Mr SAHA commented that all the appropriate technologies under discussion are useable only in low density developments obtained in rural areas and in smaller towns. What in your opinion should be the appropriate technologies for our high density, low rise urban areas? What should be done for the waste waters from kitchens, bathing places etc which though not hygienically that harmful, result in obnoxious filthy pools of water and ultimately result in health hazard at least through mosquito breeding?

51. Mr RAJVANSHY replied that if the space for construction of leaching pits is available either inside the premises or outside the premises the low cost pour flush latrines can even be constructed in high density low rise buildings. If this is not feasible other technical options are septic tanks, low cost sewers and conventional sewerage system.

52. Answering the second part of the question Mr RAJVANSHY said that the soakage pits can be constructed for disposal of waste waters from kitchen and bathroom. If the street drainage arrangements are there, the waste water can be discharged into street drains through house drains.

53. Mr BASU DHAR MEPH said that in the reuse of human excreta the suggestion has been made for Biogas plants. He then asked whether any study had been made regarding economic viabilities in respect of users and also if Biogas plant for a single family is not possible - then community latrines have to be constructed; do you think community latrines will be acceptable in villages?

54. Mr RAJVANSHY replied that no study has been made. However a subsidy is provided by the Government of Rajasthan for construction of bio-gas plants in rural areas. The community latrines are acceptable in rural areas also specially by the women for whom going for open defacation is difficult and unsafe.

55. Dr PAHALAZANI of HUDCO introduced the work of his organisation, particularly the loans for sanitation which are given at 6% interest in order to pay back 50% of the project costs. HUDCO is now involved in 56 projects in 7 states.

B Pathak

Bihar and the urban sanitation Decade target

57. Dr Pathak distributed his paper to delegates and showed a video describing the work of Sulabh International.

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

D Fouzdar, B Hansen

Tradional hand-drilling tools of Orissa

Indian Decade Programme is by and large, a continuation of the similar programme by the Public Health Engineering Department and its equivalent that began with the Bihar Drought of 1967. These programmes, particularly in the southern peninsular states (area south of entire Ganga valley) began as drought relief measures to provide drinking water in the rural areas. The borewell and handpump device chosen for the indian villages are although quite simple technological tools - the handling of this technology has rather proved that the programme of past two decades have created a clevage between the locally existing technology of slow drilling devices of various types and the alien technology of fast rigs that more or less invaded the scene during the past 20 years.

The technology of drilling tubewells existed all over India in the form of hand boring-particularly for the soft formations. Only few of them, are known to the outside world,e.g. the 'Bamboo scaffolding (hydraulic percussion) methods used in Bengal delta (Ref) and 'Bamboo tubewells' of Bihar driven by the hand boring methods. Less known are the hand percussion tools of various designs that work both in the Gangetic valley as well as in the crystalline rocks. CALYX drill, a semi mechaniced form of rotary drilling are extremely effective and versatile even today. The hand boring techniques of Orissa are labour oriented and simple. They are effective in many respects. The local groups have the basic knowledge and confidence to carry out the job. The technology is easily acceptable by the rural community as they understand & grasp it. The tools can reach even the most un-accessable areas and a number of these units can be mobiled to participate in the large drinking water programmes. Apart from its being slow - all other inherent weaknesses of this drilling technique can be over-come by inducing a few new scientific and technological supports. The marriage of modern scientific/technological ideas with the traditional technology is highlighted in the present paper. The programme has been supported by the Danish International Development Agency (DANIDA).

The support scientific and technological package chosen to upgrade the technology of hand borings consist of (i) identification of fresh & saline layers by conducing electrical logging of the bore (ii) reaming to ascertain proper fixing of well assembly (iii) use of developed drilling gels in the most collapsing formations and wherever else necessary(iv) sealing to protect fresh water layers from the salinity and (v) back washing and surging of the borewell properly to develop it into a drinking water well.

The use of traditional technology may not be cheap at least as far as the financial schemes of the implementing agencies are concerned. All these additional support measure obviously add cost to the total job which works out to be only marginally less than the prevailing cost of the job by the fast drilling machines. Yet using this traditional technology has its advantages. Some of these advantages are realistic only in the Orissa context but some of them undoubtedly are universal for example :

(i) It brings a wider group of local community to participate in the programme in form of skilled and unskilled labours.

(ii) The users/beneficiaries of the installations (tubewells and handpumps) find this approach favourable for their easy adaptation.

(iii) More local people get employment.

(iv) It promotes self help measures which in turn may help effective maintenance of the installations.

(v) It also promotes less utilization of petroleum based consumables.

The methods, techniques and technical data has been presented in the main text of the paper

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

S Huq, Md A Hossain

Fibreglass vs stainless steel screen

INTRODUCTION

In 1984 Associated Engineers and Drillers drilled and installed 55 deep tubewells in the Upazilla of Dhamrai in Dhaka district and Manikgonj Upazilla in Manikgonj district under a contract from the Bangladesh Agricultural Development Corporation (BADC). The project was funded by the International Development Association (IDA) of the World Bank. The area is part of an extensive flood plain of the river Ganges at an elevation from 6m to 100m above sea level. The alluvial plain contains a network of river channels, both active and passive. During the monsoon large areas are flooded but during the dry season the majority of the areas dry out and cultivation is limited to areas adjacent to surface water and where deep tubewells are available. The climate is tropical and humid with a wet south-west monsoon from June to November. During the remainder of the year a cool, dry north-east wind blows from central Asia, bringing the lowest temperatures and humidity around November/December. The climate gives rise to three main seasons: (1) Winter (November to February), dry, cool (temperature 7 to 29°C), (2) Summer (March to May) dry, hot (30 to 40°C) humid (60-85%) stormy and (3) Monsoon (June to October) heavy rainfall, hot, humid. The aquifer consists mainly of sands and coarse sands between the depths of 200-300 feet overlain by a semi confining bed of finer grained mixed materials with generally low permeabilities. The aquifer deposits are considered to be in hydraulic continuity throughout the region and are sufficient for extracting required quantum of water by deep tubewells in practically all areas.

MATERIALS AND METHODS

The deep tubewells were drilled using reverse circulation, tractor mounted hydraulic drilling rigs. A bore hole of 22 inch diameter was made and the fixtures lowered to the appropriate depths. The tubewells were developed and tested at 3 cusecs and the pumping water level noted. The tubewell fixtures consisted of:

(1) 80-90 ft of 14 inch diameter upper well casing made of Mild steel (MS) Pipe,

(2) 50-150 ft of 6 inch diameter lower well casing made of Galvanized Iron (G.I.) Pipe

(3) 60-120 ft of 6 inch diameter Screen of either stainless steel or fibreglass.

The type of screen used in a particular tubewell depended on which type of screen was available with BADC at the time of installation. A bail plug of 6 inch diameter G.I. Pipe was also installed. The fixture design and type of screen used were noted and the actual draw down at 3 cusec test pumping was measured. The specific draw down was calculated.

The stainless steel screen used was continuous wire wound type with an area of opening of 20% to 30%. The fibreglass screen consisted of slotted fibreglass pipe with an area of opening of 12% and slot width of 1-1.5 mm. The stainless steel screen was imported from Japan, UK and Australia and fibreglass screen imported from India.

RESULTS

The data from the 35 tubewells using stainless steel screen are presented in Table 1. The results showed that the mean length of screen used was 80 ft while the length of lower well casing was 104 ft and the mean total depth of the tubewells was 272 ft. The mean draw down at 3 cusec test pumping was 31.11 ft and specific draw down 10.36. The data from the 20 tubewells using fibreglass screen are presented in Table 2. The results showed that the mean length of screen used was 108 ft while the length of lower well casing was 75 ft and the mean total depth of the tubewells was 270 ft. The mean draw down at 3 cusec test pumping was 20.5 ft and specific draw down 6.83.

DISCUSSION

It is clear from the results presented that there was no significant difference in the total depth of tubewells whether the screen used was fibreglass or stainless steel. Thus there was no difference in drilling costs.

The mean length of stainless steel screen used was 80 ft while fibreglass was 108 ft. Thus on average a tubewell will require 25% less screen if stainless steel material is used instead of fibreglass. However, the length of G.I. Pipe lower well casing in the case of the tubewells using stainless steel screen was almost 40% higher than in the tubewells using fibreglass screen. Thus any saving in cost of screen due to reduced length in the case of stainless steel is more than offset by the increased G.I. Pipe lower well casing required.

The mean actual draw down and specific draw down in the case of tubewells using stainless steel screen was over 50% higher than those using fibreglass screen. Thus the tubewells using stainless steel screen will require more energy to extract an equivalent amount of water. This will mean higher long term fuel and running costs to the farmers using tubewells with stainless steel screen.

CONCLUSION

The results of this study indicate that considering the aquifer condition in Bangladesh the use of stainless steel screen in deep tubewells does not result in any savings in drilling and material costs even though stainless screen with more area of opening is used per tubewell. Furthrmore the actual and specific draw down in the tubewells with stainless steel screen being higher, the long term running and maintenance costs will be higher for the tubewells with stainless steel screen compared with tubewells with fibreglass screen. It is therefore recommended to use greater length of low cost fibreglass screen where suitable aquifer is available and restrict the use of costly stainless steel screen to areas where the depth of the aquifer is limited to 60-80 ft only. From past experience such limited aquifer depth is found in only 3 to 5% of the areas.

Table 1 : Design and performance of thirty five deep tubewells in Dhamrai and Manikgonj upazillas using stainless steel screen

Tubewell No.	Length of Screen (ft)	Length of Lower well casing (ft)	Total depth of tubewell (ft)	Drawdown at 3 cusecs (ft)	Specific drawdown
1.	60	120	268	32.46	10.81
2.	60	110	258	36.83	12.27
3.	70	95	253	30.125	10.04
4.	60	120	268	35.71	11.90
5.	60	100	248	40.88	13.62
6.	70	105	263	24.92	8.30
7.	80	130	298	29.87	9.95
8.	80	85	253	26.62	8.87
9.	80	110	278	29.08	9.69
10.	80	58	226	23.79	7.93
11.	90	95	273	21.33	7.11
12.	90	120	298	22.75	7.58
13.	80	115	283	24.62	8.20
14.	80	120	288	35.00	11.66
15.	100	140	328	29.25	9.75
16.	80	80	248	32.25	10.75
17.	80	120	288	33.67	11.21
18.	80	80	258	26.04	8.68
19.	80	85	253	41.00	13.67
20.	80	80	248	37.33	12.42
21.	80	90	258	26.29	8.76
22.	80	115	283	38.58	12.86
23.	80	102	270	24.00	8.00
24.	80	90	258	33.67	11.22
25.	80	100	268	34.50	11.50
26.	80	90	258	35.87	11.96
27.	90	70	248	24.21	8.07
28.	80	90	258	29.37	9.79
29.	110	80	284	37.67	12.56
30.	90	117	295	23.75	7.92
31.	80	100	268	34.92	11.64
32.	80	80	248	34.83	11.61
33.	80	172	340	48.67	16.22
34.	80	127	295	27.00	9.00
35.	90	142	320	21.92	7.29
Mean	80	104	272	31.11	10.36
Maximum	60	58	226	40.88	13.62
Minimum	110	172	340	21.33	7.11

Table 2 : Design and performance of twenty deep tubewells in Dhamrai and Manikgonj upazillas using fibreglass screen

Tubewell No.	Length of Screen (ft)	Length of lower well casing (ft)	Total Depth of tubewell (ft)	Drawdown at 3 Cusecs (ft)	Specific drawdown
1.	100	96	284	18.58	6.19
2.	120	50	263	19.62	6.54
3.	120	40	248	17.46	5.82
4.	100	95	283	19.58	6.52
5.	120	60	268	19.58	6.52
6.	120	40	248	18.37	6.12
7.	100	93	281	20.54	6.84
8.	100	40	228	17.67	5.89
9.	100	75	263	20.17	6.72
10.	90	105	283	25.71	8.57
11.	100	40	228	15.42	5.14
12.	120	105	313	23.25	7.75
13.	120	40	248	29.33	9.77
14.	90	153	331	24.25	8.03
15.	90	85	263	23.00	7.66
16.	100	95	283	22.42	7.47
17.	120	70	278	19.42	6.47
18.	120	40	248	18.46	6.15
19.	100	93	281	20.54	6.85
20.	120	65	273	16.50	5.50
Mean	108	75	270	20.50	6.83
Maximum	120	153	313	25.71	5.14
Minimum	90	40	228	15.42	9.77

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

S Ghosh

High turbidity direct filtration by contact flocculation

1.0 INTRODUCTION

Sand filters have been used for clarification of dilute liquid suspensions in municipal water supply for over a century. Due to the advancement in the design of coagulation and sedimentation processes, conventional treatment plants have been able to considerably reduce the suspended solids load in the filter influent. Thus, the filters are operated solely to polish the water.

In recent years a lot of attention has been turned towards filtration research. It has been found that the process of direct filtration possesses a few disadvantages, primarily its inability to handle raw water of high turbidity and its incapability to effectively perform under high operating flow rates.

One fairly recent development in the area of porous media filtration is the utilization of the bed for the purpose of coagulation, flocculation and floc removal. The new process is called "Contact flocculation" due to the occurrence of flocculation of particles while they are in contact with the bed.

In this study, the performance of the contact flocculation system, comprised of a flocculator bed followed by a standard dual media filter was compared with that of the direct filtration system.

2.0 LITERATURE REVIEW

2.1 Direct Filtration

Past research efforts on direct filtration have shown that the process is incapable of handling water of high turbidity. Roebeck et al (1964) "(ref. 1)" concluded that with relatively clear water (turbidity $<$ 25 NTU) the flocculation and sedimentation steps of conventional treatment plant design could be omitted if dual media filters were being used. Culp (1977) "(ref.2)" has also recognised the possibility of applying direct filtration to municipal plants with good results if the raw water turbidity and color are each less than 25 units.

2.2 Contact Flocculation

Contact flocculation is a process whereby a water containing a dilute suspension of suspended solids is passed through a granular medium in such a manner that they form larger particles that are either more settleable or more filterable than in the original suspension.

Electrokinetic effects exist simultaneously between the filter bed and the particles themselves. Smith (1967) "(ref. 3)" found that only particle bed interactions take place when particles were filtered without any coagulant. He also noticed that interactions between particles (flocculation) play a great part when coagulants were added. Ghosh (1958) "(ref. 4)" and Borchardt - O'Melia (1961) "(ref. 5)" concluded that adding certain ions causes flocculation and formation of larger particles which can be subjected to sedimentation.

It was seen that the available information on contact flocculation is relatively meager. This study was undertaken to provide a better understanding of the contact flocculation process and to compare its performance with the direct filtration process.

3.0 MATERIALS AND METHODS

A pilot scale water treatment plant was fabricated to collect the data necessary for evaluating the parameters involved in the study. A schematic diagram of the experimental set up is shown in figure 1.

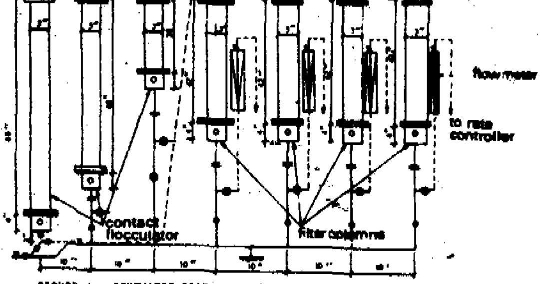

FIGURE 1 : SCHEMATIC DIAGRAM OF EXPERIMENTAL SET-UP

Raw water from the storage tank was fed to the contact flocculators by a centrifugal pump. Three contact flocculators of 14", 38", 51" bed depths were each followed by a standard dual media filter consisting of 12" of sand overlaid by 18" of anthracite coal. Another standard dual media bed was operated independently to evaluate the performance of direct filtration. The three contact flocculation units will be referred to as system 1, 2 and 3 respectively and the single dual media filter as system 4 in the following sections. In this manner the contact flocculation process was compared with that of the direct filtration method.

The flow rates of effluent from the filter columns into the rate control chambers were adjusted by the rate control valves and measured by the flow meters. Samples of the influent raw water and effluents of the dual media filters were collected at the inlet to the rate control chamber. Head losses through the contact flocculators as well as the head loss across the dual media filter were measured by either pressure gauges or by mercury manometers.

The media specifications for the contact flocculator beds and the specifications of the sand and the anthracite coal used for the dual media filter beds are presented in tables 1 & 2 respectively.

For all filtration runs, a liquid cationic polymer (Purifloc C-31, Dow Chemicals Corporation) was used. A dosage of 9.0 mg/l for the above coagulant was used for all experimental runs. This polymer dose was selected after performing a trial run at varying dosages of 1-12 mg/l to determine the dosage for best filter effluent. The raw water turbidity for this particular run was maintained at 100 NTU and the filters were operated at a flow rate of 5.0 gpm/sq.ft. The lowest polymer dose that produced an effluent turbidity of less than 0.5 NTU in all the four filters was chosen as the optimum polymer dose. This value was 9.0 mg/l.

All the systems were operated until break through was observed. The final break through of a particular run could happen due to either the turbidity of the effluent water or the head loss through the filters being too high. A turbidity level of 0.50 NTU was adopted for the break through point in turbidity. A system was shut down when the head loss built up reached a value of 12 psi corresponding to 27.7 feet of water. This value was used as the break through point with respect to head loss.

Table - 1

Media Specifications for Contact Flocculator Bed

Range (mm)	Geometric Mean (mm)	Porosity	Shape Factor
2.80 - 4.75	3.65	0.388	1.21

Table - 2

Media Specifications for Dual Media Filter Beds

Media Type	Effective Size (mm)	Uniformity coefficient
Sand	0.60 ± 0.05	1.60
Anthracite Coal	0.912	1.63

4.0 RESULTS AND DISCUSSION

The contact flocculation systems and the single dual media filter were operated simultaneously to compare the performance of the two systems. Different filtration runs with influent turbidity of 100 and 200 units and flow rates varying from 2.5 - 10.00 gpm/sq.ft. were carried out to evaluate the performance of each system. The run times and filtrate volumes produced by the systems are summarized in tables 3 and 4.

The single dual media filter (system 4) was found to be inadequate in handling high turbidity water. A run time of 24.0 hours could never be obtained by the single filter. Consequently the filtrate volumes produced by the dual filter was very small compared to the contact flocculation system for each filtration run (refer to table 4). The deepest flocculator produced run times of 2.5 to 3 times that of the single filter and correspondingly a lot greater removal than the dual filter. As observed by

Table - 3

RUN TIMES (Hours)

Description of Run	System - 1	System - 2	System - 3	System - 4
100 NTU and 2.5 gpm/sq.ft.	46.0	26.0	-	14.0
100 NTU and 5.0 gpm/sq.ft.	29.0	23.0	15.50	13.0
100 NTU and 7.5 gpm/sq.ft.	10.0	8.0	4.50	2.80
100 NTU and 10.0 gpm/sq.ft.	4.25	3.25	1.25	-
200 NTU and 2.5 gpm/sq.ft.	19.0	13.0	7.0	7.0
200 NTU and 5.0 gpm/sq.ft.	4.0	2.0	1.0	1.0
200 NTU and 7.5 gpm/sq.ft.	0.75	0.0	0.0	0.0
200 NTU and 10.0 gpm/sq.ft.	0.50	0.50	0.0	0.0

Table - 4

Volume of Filtrate (Gallons)

Description of Run	System - 1	System - 2	System - 3	System - 4
100 NTU and 2.5 gpm/sq.ft.	338.70	191.44	-	103.08
100 NTU and 5.0 gpm/sq.ft.	427.0	338.70	228.26	191.44
100 NTU and 7.5 gpm/sq.ft.	220.89	176.71	99.40	61.85
100 NTU and 10.0 gpm/sq.ft.	125.17	95.72	36.82	0.0
200 NTU and 2.5 gpm/sq.ft.	139.90	95.72	51.54	51.54
200 NTU and 5.0 gpm/sq.ft.	58.90	29.45	14.73	14.73
200 NTU and 7.5 gpm/sq.ft.	16.57	0.0	0.0	0.0
200 NTU and 10.0 gpm/sq.ft.	14.73	14.73	0.0	0.0

previous researches, this study also proves that the dual media filter can operate efficiently only if the influent solids concentration is low.

The most important criteria determining the efficiency of a filter is the quality of the flocs produced. The influent suspension that is fed into the dual filter directly is a cloudy, turbid suspension which shows no floc formation. No flocculation takes place in the bed. In direct filtration, the particles were removed by straining or sedimentation inside the media voids. The clay particles quickly fill up the void spaces and the filter is seen to get clogged up very rapidly. This causes the head loss to build up very quickly.

On the other hand, the contact flocculation system is seen to adequately handle raw water turbidity upto 100 NTU. The experimental results show that the contact flocculators could be successfully operated upto a flow rate of 5.0 gpm/sq. ft. The contact flocculators use larger size media than the dual filter. When using the larger media and high operating flow rates, the filter bed acts as a contact media that promotes flocculation of the suspension into larger particles that pass through the bed to be removed by filtration. Agglomeration of the particles into larger suspended matter and the production of filterable flocs inside the contact flocculator bed cause the system to operate efficiently. The dual filter bed is incapable of producing any in-bed flocculation. Floc formation in the filter is regarded as a major removal mechanism by other researchers.

Culp (1977) "(ref. 2)" had stated that the direct filtration process may not be applicable to raw water having turbidity greater than 100 units. Because of the short time between application of the coagulant and filtration, more operator vigilance is required.

5.0 SUMMARY AND CONCLUSIONS

The performance of the contact flocculation unit comprising of a contact flocculator followed by a dual media filter was compared to that of the direct filtration system. The results of the contact flocculation system was observed to be far superior to that of direct filtration. The filter run times and filtrate volumes produced by the contact flocculation system was 2.5 to 3 times more than that of the direct filter. The direct filtration process did not promote in-bed flocculation and was incapable of handling high turbidity water.

6.0 REFERENCES

1. Roebeck, G.G. Dostal, K. A. and Woodward, R.L., 1964, Studies of Modifications in Water Filtration, 'Journal American Water Works Association, pp 198-213. (article from periodical).

2. Culp, R. L., 1977, Direct Filtration, Journal American Water Works Association, pp 375-378. (article from periodical).

3. Smith, C. V. 1967, Electrokinetic Phenomenon in Particulate Removal by Rapid Sand Filtration, New England Water Works Association 81, 170. (article from periodical).

4. Ghosh, G. 1958, Mechanism of Rapid Sand Filtration, Water and Wastewater Engineering, 90, 147. (article from periodical).

5. Borchardt, J. A. and O'Melia, E.R., 1961, Sand Filtration and Algae Suspensions, Journal American Water Works Association, 58, 1973. (article from periodical).

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

E W Lindeijer

How to develop distribution control

CONCLUSIONS AND CONDITIONS

01. The RFR - a product of appropriate technology - restricts the flow-rate at the point of distribution. With the help of the RFR distribution periods can be increased without increasing the volume of supply. The results are lower peakfactors and an increase of the pressure level in the distribution network.

a. The RFR is a potential tool to develop and maintain a high degree of water supply equitability of (integrated) piped w.s. distribution systems, both urban and rural.

b. The RFR is a potential tool to develop and implement (integrated) piped w.s. distribution systems progressivily, that is in progression/in harmony and in pace with the development of the necessary allied activities to w.s. like drainage and income generation.

c. The RFR is a potential tool to exploit and develop piped w.s. self-reliantly.

If properly prepared and implemented - both technologically and socio-economically speaking - the developer can and should issue certain guarantees for self-reliance in operation, maintenance and repair (O/M/R).

d. The RFR is a potential tool to rehabilitate existing piped w.s. (distr.) systems. After leaks have been repaired proper distr. control can be enforced and a fair distribution of the (available) water established.

e. The RFR is a potential tool to lessen the need for private (household) storage and water-tanks as the need for intermittent supply ceases.

f. The RFR is a potential tool to decrease water losses that result from intermittent supply (high distr. factors and violent destructive flow conditions).

02. So, potential savings are at stake - both for the consumer and the Water Supply Undertaking (WSU) c.q. Government - as the result of proper distribution control and continuous supply. Besides that the quality of the water can be better guaranteed.

03. There are however, as always, a number of conditions that must be fulfilled in order to realise the above conclusions.

One is proper inspection. Another is the recognition that every beneficiary should be in the position to pay for the services offered.

This means that income-generating activities have to be developed along with w.s. and sanitation.

04. New circumstances may require some research before applying the RFR on a large scale. Codes and guidelines may be needed.

INTRODUCTION

05. Water supply equitability is a notion used here to express appropriate service level of (piped) water supply. Appropriateness means adjusted/attuned to the real needs, to the safe (waste water) absorbtion capacity of the environment and to the ability of the beneficiaries to pay for the services rendered.

06. Appropriateness contemplates graduality in development If the target group is used to a consumption of say 5 liters per capita per day (lpcd) it is bad to suddenly give much more than that without considering the ill-effects of the water that will return as waste,. Supply-rates have to be built up gradually and in tune with the development of drainage and/or the re-use of the waste waters. This is called progressive water supply.

07. Waste water can be used for many purposes. Particularly in arid and semi-arid regions where there is a tremendous need for mini-irrigation to water vegetable beds, seatlings and fire wood! Waste water in backward drought-prone areas offers a whole range of possibilities for income generation to individual families as well as to the subject community as a whole. Integrating such allied activities will make water supply more viable and meaningful. This is what is meant with integrated water supply.

08. If waste water /sullage and spill) is drained onto dirt-roads it becomes a nuisance and a danger to (public) health. Especially in drought-prone areas waste water becomes endemic and the abode of death as unhygienic conditions develop (new) deseases and epidemics. With the help of the RFR integrated piped w.s. can be developed progressively and economically. Particularly when the RFR is applied to render continuous w.s. service (rather than an intermittent supply), substantial savings can be expected.

DISTRIBUTION CONTROL of piped w.s. systems.

10. Distribution control is the key to w.s. equitability.

11. Under well-developed circumstamces proper distr. control is realised. The supply is continuous, quality assurance and reliablity are good and inspection services are effective. And, consumers pay their metered consumption (meter tariffs).

12. Under less-developed circumstances proper distr. control is a matter of appropriateness.

13. In many countries there are two types of distr. control (fig. 1):
- onset control and
- tail-end control.

14. When the distribution is controlled at the onset of a distr. network - or parts thereof - it is called "onset control". The flow may or may not be monitored.

15. When the distribution is controlled at the distr. points - the tail ends of the distr. network - it is named "tail-end control". The flow may be metered or restricted.

16. The main purpose of distr. control is to establish a fair distribution of the (available) water and to collect revenue. If both onset- and tail-end meters are applied water losses in the distr. system can be "measured" too.

17. Of the two, tail-end control is far the most effective. Without it the abuse of water will be abound and sufficient reason to apply intermittent supply after wich problems start to accumulate. Short distribution periods lead to high distribution factors, violent pressure fluctuations and violent flow conditions capable of damaging the mains. Taps are left open and many try to collect as much water as they can. Those who can effort it will invest in private water-tanks. Every time the supply is interrupted polluted water enters the mains through leaks, cracks and crevices. Water losses increases and hygienic conditions deteriorate.

18. So, keeping the mains under pressure must be strived after. That implies continuous supply and proper tail-end distr. control.
Under developing circumstances - e.q. lack of test benches and repair facilities - proper tail-end control is very difficult to achieve with watermeters. The RFR and the appr. technology that comes along with is more effective.

PROGRESSIVELY INTEGRATED W.S.

19. In many a rural environment piped w.s. is foreign and difficult to understand. It was brought upon the beneficiaries as a gift. But the community got stuck with it. Instead of improving the living conditions it was soon recognised as the Trojan horse that started to effect the precarious balances of rural life adversely. While subsidies for O/M are increasingly difficult to come by the commhnity will be further improverised.

20. In order to counter such sages in minor it is the developer's obligation to ensure that w.s. contributes to the sensuous balances of communal life. It is therefor important to identify for every village the necessary allied requirements and activities, such as

- drainage and sanitation
- preventive healthcare measures
- health education, community participation
- training of local operators
- effective inspection and O/M services and
- income generating activities

that have to be developed along with the w.s. in order to make it meaningful and self-reliant.

21. Depending upon the local circumstances the planner must determine the proper pace of the integrated developments. Also the proper sequence of activities is important.

22. This implies that integrated w.s. development has to be synchronised programmatically. With the help of the RFR (permissible) distribution-rates can be easily adjusted at the distribution points in the turn of an expert's hand (par. 27b). The owner can not increase the flow-rate. Yet, he can clean the RFR and use it as a valve (par. 27a).

23. In case of intermittent supply, the permissible distr.-rates can be increased/decreased by increasing/decreasing the distr. periods (par. 28).

24. As soon as the permissible distr.-rates cover the demand the need for flow restriction subsides. The WSU way than change the RFR's for water meters to save energy. This is a matter of costs as w.meters will require a hydraulic test bench and a repairshop.

APPLICATIONS OF THE RFR.

The RFR

25. The RFR is developed by WISA , Arnhem, the Netherlands(1). In Dec. '84 the company won the Eutraplas Price for it in Brussels. The properties of the RFR are determined by the capacitor assembly that controls the flow-rate. All cap. assemblies (25-1,000 l/hr) are colour coded and fit in the same housing. Within certain pressure limits the flow-rate is maintained at 15% accuracy. Below that pressure range the flow-rates drop.

26. The RFR consumes more energy than the water meter. The pressure drop over the device is substantial. Contrary to the water meter, the RFR dams the water up at the cost of the flow-rate. This benefits the pressure level in the distr. network.

27. a. While in operation the owner can (always) flush the RFR clean by turning the Splindle 180°, this reversing the flow in the cap. assembly. Turning it 90° it will stop the flow.
b. Only qualified operators should change the colour-coded cap. assembly. After changing the flow-rate the RFR is sealed again against tempering (inspection). Same for flushing the RFR.

c. Unique is the property to maintain a constant flow-rate independent of the pressure in the main as long as the hydraulic pressure difference over the device does not drop below a certain value. (fig. 2).

Progressive water supply (par. 19-24)

28. Example 1 (rural/drought-prone). A village (pop. 1,000) is to be supplied with progressively integrated piped w.s. The beneficiaries are used to consume less than 5 lpcd. There is no drainage nor sanitation facilities, no trees nor firewood nearby and thus no agriculture. Cattle, goats and camels form the lifeline.

a. The feasibility study by a socio-economic appr. technology unit (SEAT-unit) reveals that the beneficiaries need water all-right, but, not drinking water but mini-irrigation for vegetables, fodder and firewood is what they see as their first priority. For, dr. water thay can get grom far. Besides, irr. water can also be drunk!

b. A piped w.s. is designed for 30 years and 2,000 people. The SEAT-unit concludes that the implementation has to be integrated with
- a cattle watering programme
- a mini-irrigation programme
- preventive health care measures
- " " " education and
- a training programme for local operators, vegetable gardening, fodder-, firewood- and
- a production programme for gee and butter-milk.

The community will participate in the various activities. The SEAT-unit will guide the allied activities while the subject W.S.U. will implement construction work. Note: no need for sanitary facilities.

c. The implementation of the w.s. component (W.S.U.) distinguishes two phases
1. the first construction phase (75%)
2. the exploitation and progressive dev. phase (25%).

The first phase provides 75% of the hardware, sufficient to cover the first 15 years. As soon as the 75% is commissioned that part of the w.s. scheme will be exploited as follows (progressively):

1st year	10-15 lpcd	community to dev. cattle throughs, first veg. beds, gee and buttermilk for own consumption only
2nd year	20-25 "	vegetables and seatlings for firewood. Drainage.
3rd year	30-35 "	irrigation of firewood
4- 5 year	40-45 "	fodder dev.
6-10 year	50-55 "	harvesting for own consumption and cash
11-15 year	75 "	stabilisation.

d. After 5 years the w.s. scheme must be self-reliant with all beneficiaries contributing to the cost for O/M. First 5 years no house connections.
Second 5 years max. 25% connections
Third 5 years max. 50% connections.

e. Public fountain (cont. supply/200 people). See for typical solutions fig. 5 and 6 resp. for permissible consumption ranges 10-50 lpcd and 50-150 lpcd. Fig. 5: solution for household water only. As soon as more than 30 lpcd is supplied water will be used at the public site for bathing, laundrying, cattle watering and -washing. These activities require appropriate facilities and the waste water should be used to develop watering of vegetable beds, seetlings and bush for firewood (mini irrigation). Household water is returned as sullage and should either be re-used or properly drained into e.g. private soak-pits.

f. House connections (fig. 7 and 8). For supply rates below 100 lpcd RFR's should be applied to serve at least 25 people (say 5 households). This situatation refers to A, fig. 7 and 8. In order to collect one's quota, each house should install a 100 l. tank that can be filled during the night (Sa). As soon as the supply is increased beyond 100 lpcd each house can be provided with it's own restrictor and situation B applies. Private storage, Sa, will be max. (600 l) for RFR's 75-100 l/hr. So, each house should install a standardised 500 l tank protected with a float-valve.

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S Jindal, R C Singh

Coagulation and flocculation by polyelectrolytes

INTRODUCTION

Coagulation is an important unit process in water treatment. The primary purpose of coagulation is to reduce the the turbidity of water to the point where sand fitters can remove the balance without excessive clogging. Another purpose of the coagulation is reduction in bacteria, viruses and other microorganisms as well as various specified and unspecified dissolved solids. Coagulation can reduce the total bacterial count by 65 percent (1-2). Efforts must be made to improve it further because it is desirable that terminal chlorination has to deal with as small number of microorganisms as possible. In fact it should be regarded as a final safe guard, rather than a method of removing organisms from water. The unsatisfactory state of affair in water treatment in developing countries like India is occuring on account of the fact that process precedding the chlorination, like coagulation and filtration, are neglected in the found hope that chlorine will take care of all the organisms.

The conventinal metal salt coagulation is being substituted by polyelectrolytes for the reasons that these are more efficient, give a very tough floc resulting in an increased settling and filtration rate with reduced fragmentation of the floc, sludge produced is thick, compact and less in volume which is easier to handle. The cost of the chemicals are expected to be halfed(3-5). Alum sludge alone is posing a great problem for disposal all over the world. Till now the use of synthetic polyelectrolytes in the treatment of water has not been able to gain grounds in the developing countries due to their non-avilability and fear that these may be toxic and water treated with them may be harmful for the human consumption. But now-a-days standards have been laid down by International authorities such as WHO, EPA, of the USA etc. so that they may be used without harmful effects to human beings (6.7). A recent survey shows that all the three types of polyelectrolytes i.e. cationic, Anionic and Monionic are in use in water treatment in technically advanced countries like U.S.A.(8) as a primary co-agulants or coagulantaids (9-12). To obtain the maximum removal of colloidal and suspended particles through the coagulation, use of polyelectrolytes is a very successful solution. In the words of Adin, Bahuman and Cleasby (13)-

"The conclusion which may seen heretical to some, is that alum is unlikely to be used as a sole flocculant in modern treatment systems, which obviously tend to use higher rates than in past and want to reduce their sludge disposal problems. The use of polyeletrolytes either alone or in combination with alum has become inevitable".

The use of polyelectrolytes enables production of water of very low turbidities (0.1 JTU) which has a great public health importance in the inactivation of virus by chlorination (14). Besides this the treatment capacity can be increased tremendously by 100-200 percent (15).

In view of the above circumstances it has become of vital importance to evaluate the efficiency of polyelectrolytes vis-a-vis metallic coagulants in removing turbidity and bacteria, so that the effect of substitution of polyelectrolytes in place of metallic coagulants in water treatment may be judged in this respect. Till now very information is available for the effeect of these synthetic polylectrolytes on bacteria.

The purpose of the present work is to to study the relative efficiencies of the convertional coagulant i.e. alum and polyelectrolytes for the removal of bacteria and turbidity by flocculation in chemically defined water and the effects of coagulant dosages, pH, initial concentration of bacteria and external turbidity on removal efficiencies of these two and to extend the existing knowledge of the mechanism(s) involved in removal of bacteria from water by coagulation and flocculation.

MATERIALS AND METHODS

E.Coli was selected as the model bacteria for this study because it is the indicator of bacteriological pollution of water.

Pure E.Coli strain was obtained from the Deptt. of Microbiology, AIIMS, N Delhi. It was cultured on Mac Conkey's Agar slauts at 37°C± 1° for 24 hr. ± 1 hr. The cells were taken into 0.85 percent sterile saline solution and centrifuged for 10 minutes at 5,000 rpm. Cells were washed 2-3 times to wash off the medium adhering to the cells membrances. The centrifuged cells were resuspended in sterile deionized water and were diluted in different concentrations as required at the time of experiments according to their optical density. A standard curve was drawn for the relationship of bacterial enumeration was done by standard plate count method on nutrient agar plate (16). The plates were done in triplicate.

Reagents : All the three polyelectrolytes is cationic, MAGLOC 851, anionic MAFLOC 900 & nonionic MAFLOC 720 were obtained from MAZER chemicals Inc, Illi, U.S.A.. These all were EPA of USA approved for the use in potable water. A lum of BDH was used. Stock 1% solution of the polyelectrolytes were prepared and diluted at the time of experiments. Alum solution of 10 mg/ml was prepared every week. Kaolinite earth clay was used as the source of external turbidity. The clay was suspended in the deionized water and stirred for 6-8 hrs. after which it was left for 24 hrs. & the supernatant was collected. It was again dilluted with deionized water as required at the time of experiments. pG was adjusted by 0.1 N H_2SO_4 and 0.1 N NaOH. All reagents used were of analytical grade of BDH. All the solutions were sterilized before conducting the experiment. All the glassware were cleaned with chromic acid and Teepol solution. Finally these were rinsed with deionized water and sterilized in an hot air oven at 200°C for 2 hrs.

Coagulation studies were performed using a Jar test apparatus on the following types of the samples - (a) Controlled E.Coli suspension (early log growth phase) (b) Synthetic turbidity with Kaolin (c) Mixed suspension of E.Coli & Kaolin. The experimental parameters varied to study their effects on the removal efficiencies were (i) Dosage of the coagulants (ii) ph (iii) External turbidity (iv) Initial input concentration of bacteria.

Jar test were conducted for all the experiments by flash mixing for 2 minutes at 100 rpm, flocculation for 20 minutes at 10 rpm & quiscent settling for 30 minutes. Samples for the bacterial enumeration, turbidity & ph measurements were withdrawn by a pipettee at the middle of the supernatant after the quiscent settling. The first beaker in all theexperiments was kept as the control & no coagulant was added. Readings of the control were used to compute the percept removal of bacteria & turbidity.

The optimum dosages of the alum & polyelectrolytes were obtained by the coagulation studies using a pH range of 5 to 9.

The effect of input bacterial conc. on the removal efficiencies of these coagulants was studied at the optimum dosages & optimum pH observed. Effect of external turbidity was observed using the constant bacterial input concentration in between 270-280 colonies/me to avoid the enumeration problem as well as to avoid experimental mistakes due to low counts.

To find out whether the removed bacteria could be regenerated, settled flocs were resuspended in sterile deionized water & stirred for ½hr. Samples were pipetted out for the bacterial enumeration.

In a definite bacterial concentration (280/ml.) different dosages of polyelectrolytes were added, the samples were mixed very gently & incubated at 30°C for 24 hrs. to observe if toxicity is associated with polymers or the monomev. After incubation plate count was done to enumerate the bacterial conc.

RESULTS AND DISCUSSION

Fig.1 & 2 show the percent removal

of coliform bacteria & turbidity by alum, Fix. 3 & 4 show the percentage removal of bacteria & turbidity using cationic polyelectrolyte at different ph & different dosages.

In case of alum it was found that 45-50 mg/l is the optimum dose for the maximum removal of bacteria & turbidity both & for the best floc formation. Maximum removal of bacterial was 88% at lowest of the pH range studied i.e. 5-2. It is observed that pH has got an pronounced effect on removal efficiencies in case of alum. As ph increases, percentage removal decreases & beyond ph 7.0 there is a sharp reduction in percentage removal of bacteria & turbidity both (as in fig. 1,2). A reduction from 88% at ph 5.2 to 80% at ph 8.2 & further to 60% at ph 9.2 is observed. The turbidity removed by alum was 96% at ph 5.2. It reduces to 82.5% at pH 8.2 & further to 71% at ph 9.2.

In the case of polyelectrolytes it is observed that bacterial removal exceeded ded the turbidity removal. Effect of ph is rather small. Neutral ph is the optimum pH value where we get the maximum percentage removal. As the pH increases or decreases the percentage removaldecreases but the cecrease is more pronounced in acidic range. In the case of polyelectrolytes exact monitoring of the dosage is very essential, beyond the optimum dose the percentage removal of bacteria & turbidity starts decreasing (as in fig. 3,4).

It is observed that only the eationic PE is of promising use out of all the three tried. In the case of cationic PE the optimum dose is 0.45-0-5 rpm at pH 7.2 as shown in fig.3. It removed greater percentage of bacteria 94.5-95.0% while only 87.5% of turbidity is removed. Floc obtained by this polyelectrolyte (PE) was very big, tough having a 50% less settled volume as compared to alum, which is one of the great advantages of PEs use.

Nonionic PE also gives good removal but the dose required is very high as compared to cationic PE. while the amonic is completely non-effective in the dosages range tried. Higher dosages were not tried because it is not economical as well as it affects the visocosity of water. Fig. 5 & 6 show the percentage removal of bacteria & turbidity with nonionic & amonic PEs at pH 7.2 at different dosages. It is observed that nonic PE can remove 76% of the bacteria & 73.5% of turbidity & amonic PE could not go beyond 7.5% removal of bacteria and was totally noneffective in removing turbidity. From fig, 7 & 8 it is infered that the presence of external turbidity has got a remarkable influence in all the cases. More presence of 50 NTU of external turbidity increased the percentage removal of bacteria from 88 percent to 97 percent at pH 5.2 in the case of Alums & from 85 to 98% in case of cationic PE. The same was applicable to nonionic PE too, reaching up to 80 percent from 76 percent. In our studies higher external turbidities were also tried and it was found that the efficiency of the removal was further increased but the increase is not so significant.

Further the experiments were conducted to observe the effect of initial bacterial concentration on removal efficiencies because different waters may have different bacterial concentration. It is observed that the percentage removal increased as the initial concentration was increased b but the optimum dose was also incr eased a little bit as shown in the table No 1. The effect is more pronounced in the case of cationic polyelectrolyte.

The resumpension of the floc gave a recoverh 70.75% in the case of alum while very less could be recovered in case of polyelectrolytes.

It is also observed that the PEs are neither toxic nor nutretive to the bacteria in the range used.

MECHANISM INVOLVED IN REMOVAL OF TURBIDITY :

The removal pattern of bacteria using alum agrees with the previous studies (17). It is observed that in the case of alum, bacterial removal paralleled the turbidity removal. Alum undergoes rapid hydrolytic reactions and form hydroxy products in the pH rang 5-6 ,which form a Aluminium-Colloids precipitate which aggregate to form flocs thus removing the turbidity and bacteria. It is obtained in our experiments that the dosages of alum depended more on the turbidity than on bacterial counts. Higher percentage removal of bacteria at higher dosage can be explained on the basis of trapping between the flocs of turbidity.

The interaction of bacteria- Al(III) is superficial, it may be adsorption or a very low energy chemical bond (if at all it is formed) so that it can be broken by sterring only as 70-75% bacteria could be recoved as in Table (2).

P olyelectrolytes remove the turbidyt ity by either the (i) charge neutralization or (ii) bybridging in between the turbidity particles and the segments of the polymer chain (18). Both the mechanisms may be operative to together depending on the conditions . In bridging the polymer chai n is adsorbed on the bare surface of the particle and bridges between them with the aid of free segments of the adsorbed polymer to form a three demensional agglomerates of sufficient size to be settleable.

SPECIAL MECHANISM PROPOSED FOR T THE BACTERIAL REMOVAL BY POLYELECTROLYTES :

It is observed that percentage removal of bacteria is higher than the percentage removal of turbidity which shows that the bacteria are nor act ing just as a colloidal particle and their biological structure has got some influence on flocculation by PEs. The surface of the bacteria is somposed of a variety of proteins, lipids, polysaccharides and nucleic acids in the form of cell wall,capsules, flagella. The composition of this surface changes as their physiological conditions alter, thus it is very difficult to give a confirmatory mechanism(s) for the cell flocculation by PE.

It can be postulated that the polyelectrolytes added as flocculant is interacting with the cell surface with any of the groups present on the cell wall components. The interaction may be either a chemical bond formulation or a co-ordinate complex formation. As the recovery of bacteria is very less from the performed flox leads to believe that there is a strong interaction.

Once the PE interact with the surface of bacteria the other branches of the polymer chain can interact with the bare surfaces of the available bacteria resulting in a big floc.

The cationic PE were able to flocculate bacteria more efficiently, it appears that in the interaction of PEs with cells, electrostatic forces help in flocculation by bonding the positively charged segments of polyelectrolyte to the bacteria surface. The hypothesis confirms the uneffectiveness of anionic PE in removing the bacteria. There may be some charge repulsion which inhibits this polyelectorlyte bacteria surface interaction or the polymeric materials excreted or exposed at the surface of bacteria may be interfering with the anionic PE and preventing the complex formation resulting in non flocculation. The mechanism applies to monionic PE also explaining why we get the removal by this PE.

Requirements of higher dosages of PE for the optimum removal of bacteria in higher co input concentration further supports the mechanism. It can be assumed that a certain fract ion of the surface of the cells has to become covered with extended polymer segment and as more of the surfa ce material is there, more dosage would be needed for the complex formation.

Phenomenon of Overdosing : Can also be explained on the basis of the above proposed mechanism.The exeessive amount of the polymer will cover the bacterial cell completely by complex formation, making a single cell stabilized and leaving no bare surface for the floc formation.

Workis in progress to confirm this mechanism by isolating the bacterial component which interact with PE.

CONCLUSIONS

The following conclusions can be drawn from the paper:

(i) Cationic polyelectolytes are the most effecient flocculants in removing bacteria.

(ii) Removal of bacteria is more as compared to turbidity by cationic polyelectrolyte while in case of Alum more turbidity can be removed.

(iii) The optimum pH for the polyelectrolytes is 7.2 which is an added advantage, no pH adjustment has to be done.

(iv) Optimum dose of cationic PE is very less as compared to Alum thus saving the cost of chemicals.

(v) Nonionic and anionic PEs are of little use for the removal of bacteria.

(vi) The only disadvantage of PE being one should be very careful while dosing and must follow the International standards.

....

TABLE 1 : EFFECT OF 'INPUT' BACTERIAL CONCENTRATION ON REMOVAL EFFICIENCY

S. No.	Name of the coagulant	Conc. of bacterial input in Col./	Optimum dose	% removal obtained
1.	Alum	50	40	86.5
		100	40-42	87.0
		250	42-45	88.0
		500	50	88.5
2.	Cationic Polyelectrolyte	50	0.35	90
		100	0.40	92.5
		250	0.45	95.0
		500	0.55	98.0

TABLE 2 : RECOVERY OF BACTERIA

Name of the Coagulant	Recovery after ½ hr. sterring
Alum	72-75%
Cationic PE	15-17%
Nionic PE	10-15%
Anionic PE	Could not be performed

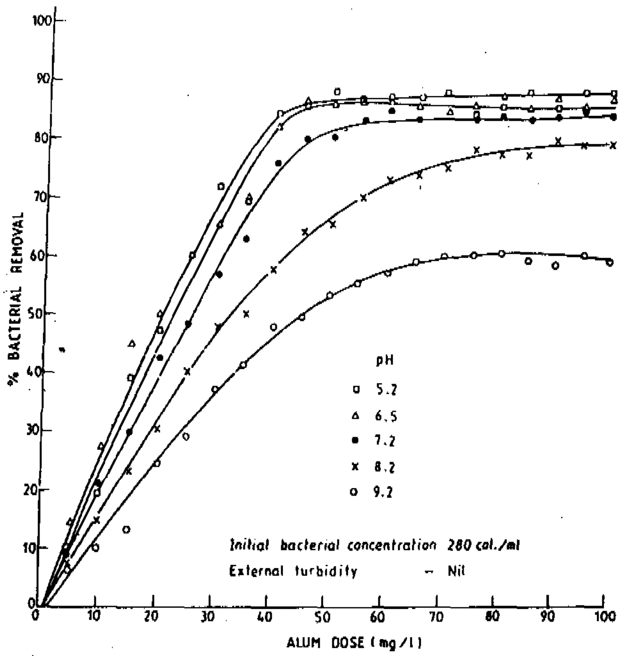


FIG.1. REMOVAL OF BACTERIA AT DIFFERENT pH AND WITHOUT TURBIDITY USING ALUM AS A COAGULANT

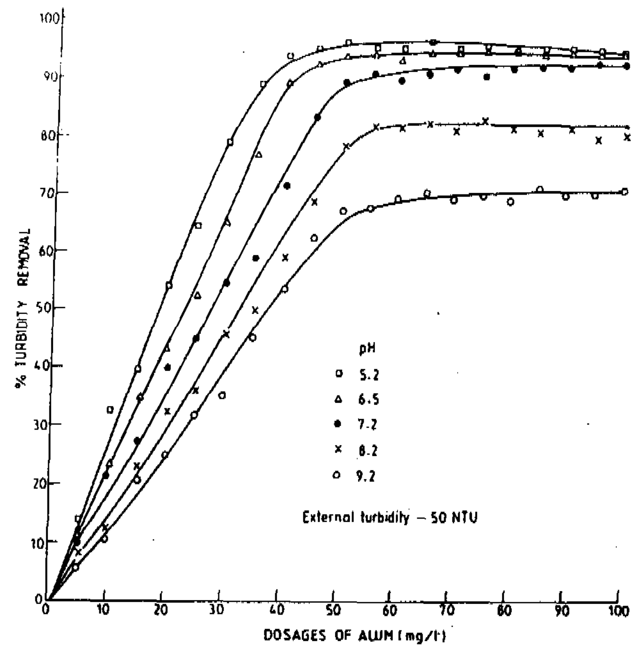


FIG.2. REMOVAL OF TURBIDITY AT DIFFERENT pH AND DIFFERENT DOSAGES OF ALUM

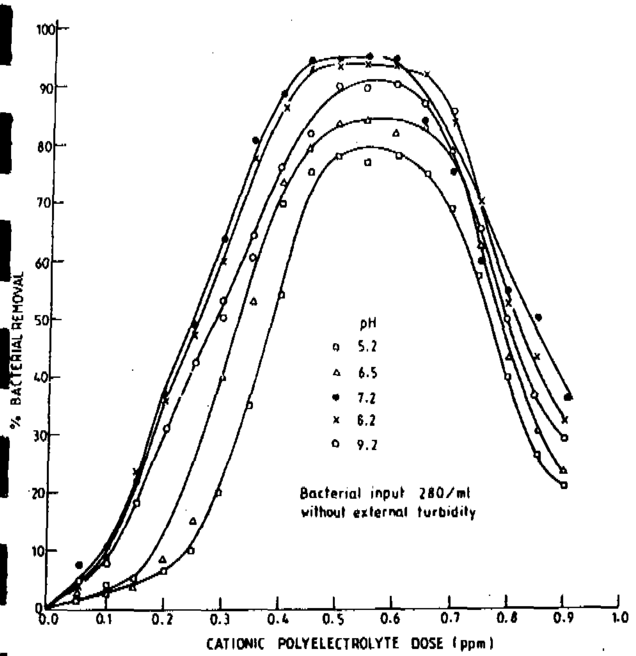


FIG.3. REMOVAL OF BACTERIA AT DIFFERENT pH USING DIFFERENT DOSAGES OF CATIONIC PE

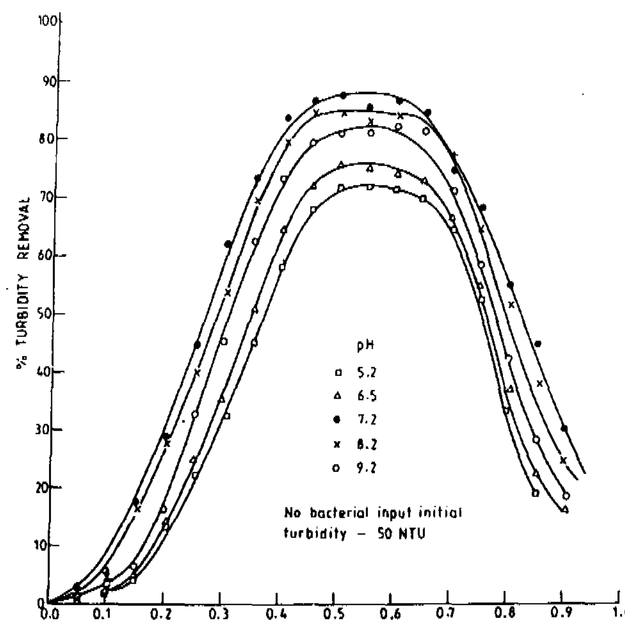


FIG 4 REMOVAL OF TURBIDITY AT DIFFERENT pH AND DIFFERENT DOSAGES OF CATIONIC POLYELECTROLYTE

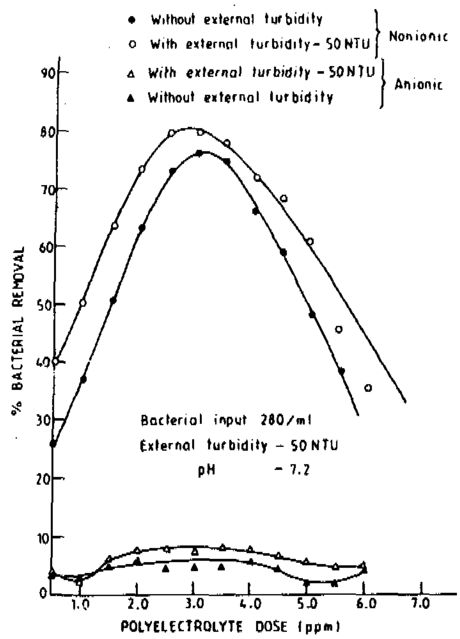


FIG. 5. REMOVAL OF BACTERIA USING NONIONIC AND ANIONIC POLYELECTROLYTES AT DIFFERENT DOSAGES

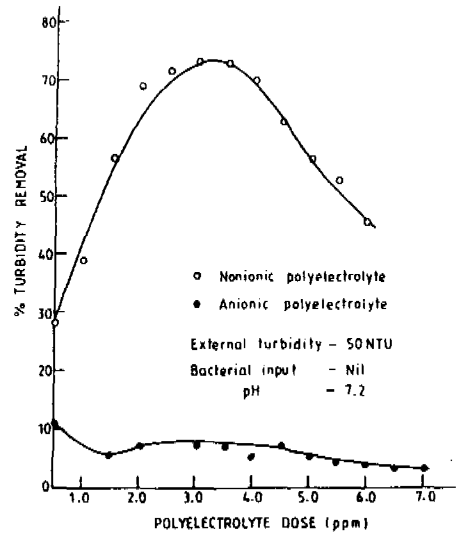


FIG. 6. REMOVAL OF TURBIDITY AT DIFFERENT DOSAGES OF NONIONIC AND ANIONIC POLYELECTROLYTES

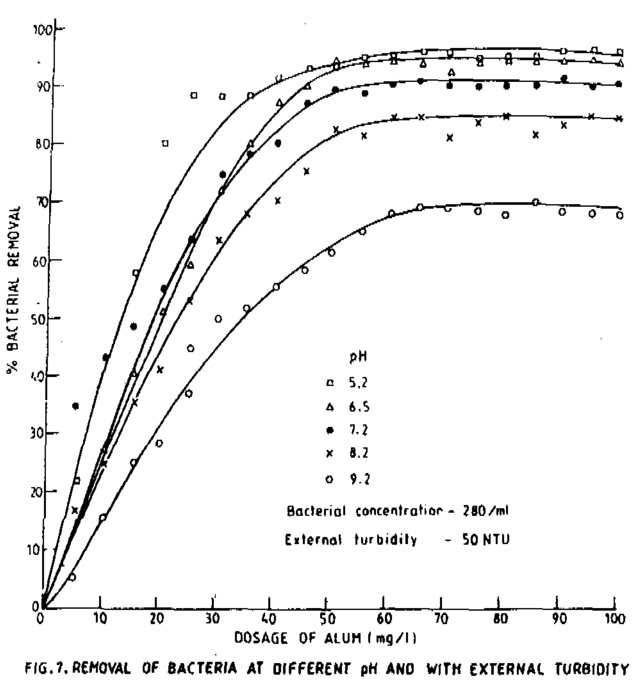


FIG. 7. REMOVAL OF BACTERIA AT DIFFERENT pH AND WITH EXTERNAL TURBIDITY OF 50 NTU USING ALUM AS A COAGULANT

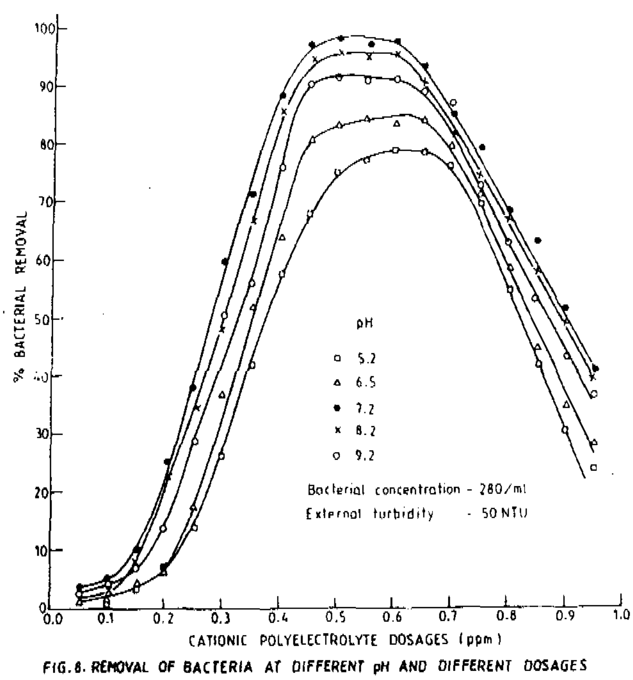


FIG. 8. REMOVAL OF BACTERIA AT DIFFERENT pH AND DIFFERENT DOSAGES USING 50 NTU OF EXTERNAL TURBIDITY

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

Somnath Som

A novel water system

INTRODUCTION

Barangay Water Program (BWP) is the 'novel' one. Government of the Philippines (GOP) and the United States Agency for International Development (USAID) are jointly funding this rural water supply program. The program has been in operation since 1978 and is scheduled to be terminated by the end of 1985 (time of this writing is August 85) A new USAID financed project is expected to serve the rural water sector in future. Under this program during the last 6.5 years, approx 600,000 people has been provided with water supply services through more than 1100 completed projects. BWP's potential beneficiaries could be as large as 1.2 M people.

This paper will describe briefly the program concentrating mainly on the special features that constituted its 'novelty'. A rather detail presentation is made about using standard designs, drawings and forms.

It is to be mentioned that the opinions and conclusions expressed later are the author's own, and not those of either USAID, BWP or Sheladia Associates, Inc. The procedures, numbers and other facts cited in this article are from BWP's manuals and internal documents though. The author is currently engaged as an engineering consultant to USAID/Philippines for this project.

WHY CALL IT NOVEL

The American Heritage dictionary defines 'novel' as something 'strikingly new, unusual or different'. This program is definitely an unusual one with its approach and objective being different from other water supply programs. This is a water supply program where water supply is NOT the MAIN objective even. It's primary objective was to develop the institutional capabilities of the local government units (LGU) like provincial or city governments. And developing institutional capabilities have helped in tapping the vast human resources of the LGUs, which in turn have helped the program to become one of the most successful water supply program in the country. Another novel idea was to introduce the system of the users paying for their water, a concept which is rather alien in the rural areas of the Philippines. A project is not considered viable unless it is determined that the potential users are capable (and willing) to generate enough revenue to meet at least the operating expenses of the system.

PROGRAM DESCRIPTION

The program is administered as a special project of the Ministry of local Government (MLG) by a Manila-based project management office. This office is also referred to as 'BWP' in this text. BWP implements the program through the LGUs with the help of its own staff and the assistance of several consultant groups.

BWP offers three levels of services. Level I service provides handpumps to a cluster of houses with 30-120 people. Levels II and III services provide water source, storage tank, distribution system and public faucets (for Lv II) and individual house connections (for Lv III); are designed to provide 60 and 100 liters/capita/day (avg) respectively for communities upto 10,000 people and are usually referred to as 'water systems'.

When the barangay (or village) people feel the need of a water supply system they approach to the LGU officials who conduct the necessary feasibility and preliminary engineering surveys to determine the suitability and viability of the project. When BWP approves it as a viable project, LGU prepares the final design and contract (or construction) documents. BWP approves the final design and issues orders to proceed with the construction. The LGU then enters into a contract with a contractor for the construction of the system or proceeds with the preparation of constructing it under the administration. Majority of the systems are built by the contractors though. Construction monitoring is done by the LGU with the help of BWP, USAID and the various consultants. At the end the LGU accepts the project from the contractor if found acceptable during a joint inspection of the contractor, LGU, BWP, USAID and one of the consultant group. The project is turned over to the consumers, represented by their Rural Waterworks and Sanitation Association (RWSA), by the LGU at a later date. Subsequently the contractor is paid by the LGU, the LGU is reimbursed by the GOP through MLG/BWP and GOP is reimbursed by the USAID.

During this period of construction related activities, institutional development works were going on also. The community was being organized to form its own Rural Waterworks and Sanitation Association (RWSA). They were being trained in community participation, management-operation-maintenance of water system, special skills like bookkeeping, budget preparation, etc. They are expected to, and often do, take part in the feasibility survey, preliminary engineering report, final design and final inspection.

A provincial or city evaluation team (PET or CET) is to visit the turned-over projects periodically to monitor the activities and to help manage the system.

NOVEL FEATURES

Strengthening LGUs:

One of the main objective of BWP was to strenghthen the institutional capabilities of the LGUs. A water supply program was chosen as a means to achieve that goal. In order to build a water system, the LGU has to learn and practice the activities related to project identification, planning (both short and long term), design a project, implementing the same, and a whole lot of other development related activities. As usual BWP's experience has been mixed: some LGUs have done better than others. Improvements in the institutional capabilities of the LGUs have helped in the growth of project development and impelementation. The most important part of this feature is that BWP would leave a very potent legacy in the form of several institutions who are not only capable of delivering a water systems but also equipped to handle other developmental projects.

Water Bills

Traditionally in the rural areas of the Philippines, people has considered water as a free commodity because it is a gift of GOD. It is the duty of the authorities to provide water, free of charges of course. Over the years the meager resources of the Government has been strained very much to pay for that 'free' service. BWP program was initiated to educate the people so that they accept the idea that they are obliged to pay for the services related to the delivery of water, just like they do for electricity. It seems that majority of the people has accepted the concept and willingly pay a monthly fee. That fee is supposed to cover the operating expenses and monthly amortization amount. Sometimes the fee may be less than that, but definetely more than what is needed for all operating expenses. Here also the result is mixed: some RWSAs are able to collect more than others. That difference is partly due to the lingering attitude about free water and partly due to economic conditions, quality of service and RWSA leadership.

Standard Designs, Drawings and Forms

Most of the people involved in the BWP program were inexperienced in the design and construction of water systems. There has always been a heavy turn-over of personnel involved in the program resulting in the loss of trained and experienced staff. A procedure had to be developed so that even these inexperienced staff (engineers and others) can deliver a safe and good water system. Standard designs, drawings and forms were some of the design aides developed to assist the staff. It involved in predesigning many components, drawing standard details for many common items and developing forms to lead one step-by-step through a complicated analysis. Bulk of the work can be accomplished easily by judiciously choosing and assemblying these elements. It is like buying a suit (with the closest fit) off the rack and when making minor alterations to it. The finished product will be reasonably good without the services of a master tailor for every individual client.

Standard designs were produced for many major components within BWP's context.

A storage tank is a major and important component of any water system. Both on-ground and overhead, steel and concrete, type tanks have been used in BWP projects. It takes lot of time and skill to properly design one. So standard designs for the storage tanks were developed and distributed to the LGUs for their use. Now any engineer, even the inexperienced ones, can easily design one by knowing only the required capacity and height. Capacity may be determined by the number of beneficiaries and height, from the hydraulic analysis of the distribution system. All he has to do is to use the table shown in Fig. 1 (Elevated Steel Tanks) and other related designs to produce a detailed and complete design of an overhead steel storage tank within a short period of time. The designer is advised to choose the next higher size and height from the table in case the required ones are not on the standard set.

Cable suspensions are used to cross a natural low area like a river or a deep gorge which is quite common in rural water supply systems as many times a distant spring is tapped as the source of water to avail of a gravity-fed supply. Cost of pumping water is one of the most critical factor in the survival of a rural water system. But again the design of that is usually beyond the capabilities of most of the engineers involved in the program. But now they can design the right structure easily by using Fig. 2 (Cable Suspension) and related design. The design has been made for both concrete and steel supports.

Friction loss tables have been developed showing the various types of pipes and the related friction losses. The design flows have been listed at small increments. An example is shown in Table 1, Friction Loss for uPVC pipes. A designer may determine the friction loss for any combination of flow and pipesize of uPVC pipes from this table. He is advised to use the next higher flow if his design flow is not listed in the table. Sacrificing a little bit of accuracy the designer eliminates the tedious process of using nomographs, which they are less familiar with anyway. Similar tables have been developed for PE and GI pipes also.

This paper refers to only two or three examples of using predesigned components due to space limitations. Even the cited examples are just one small part of the whole design. BWP standard design includes designs of wells, slow sand filters, office buildings, and numerous others in addition to those mentioned above.

Standard details have been developed for various items encountered in a rural water system. These include all the structures for which standard designs have been prepared and others. BWP's book of Standard Designs and Drawings contain more than 150 sheets. Each structure is detailed as needed. Most of the time a designer can just photocopy the standard designs and details and mark the appropriate ones being used. For example, from these standard drawings, one can produce all the necessary construction drawings of an overhead steel storage tank of say 68,000 liter capacity, 8.1 meter high, with details like reinforcement of the footings, column-tank connections, pad plate for the overflow pipe, etc. without knowing much about the design of a storage tank.

Standard forms were developed for feasibility survey, preliminary engineering report, construction inspection checklist, final inspection checklist, etc. Lack of space prevents showing examples of these forms. But these forms were developed so that one can analyze a complex condition or perform a detailed task without proper appreciation of all the rationale behind them.

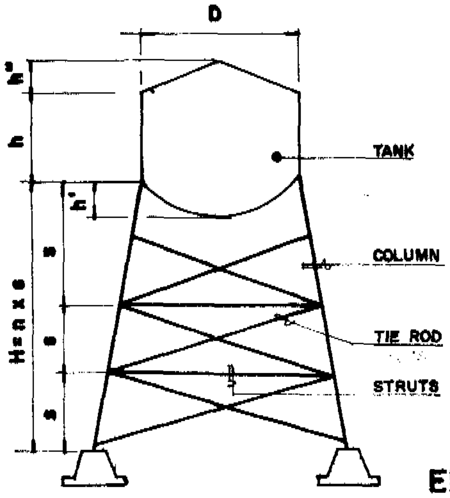
TIPS FOR FUTURE PROJECTS

The success (or even the viability) of any country depends on the historic situations at the time of political, social, economical and technical conditions there. Yet there are enough 'universal' features in the rural water supply area to transcend the site-specific constraints. Judicious modifications of the details must be made though. BWP's experience may be reviewed from this perspective and may be gainfully used in other projects, as it should be.

An active and alert community participation is necessary for the success of any program. It is imperative to develop the social and organizational institutions first rather than emphasizing on the speedy construction of as many projects as possible. But these institutions need not (and can not) develop fully before launching construction phase. People become more interested in any program when they see the physical dimensions of the program and start enjoying it's benefits. All trainings must be provided on a repeatative basis over a long period of time. Level of service has to be compatible with the liking and expectations of the people. BWP tried to introduce a relatively inexpensive low pressure low flow (0.4 lpm) system. It was abandoned due to consumer rejection despite its cost advantage. Lv II services should be considered only as a temporary phase. Every Lv II project completed under BWP has undergone transformation of various degrees to Lv III. System components, mainly distribution system, became inadequate and quality of service deteriorated. It resulted lower consumer satisfaction and sometimes even threatening the viability of the projects. Wells should be installed with outmost care. Any savings in the cost of well construction resulting from compromised quality is a false one. Many times more would have to be spent later to restore proper service. For the ultimate viability, a project must be self-sufficient; it can not depend on the dole-outs of external agencies. Maintenance activities should have equal, if not more, importance as construction activities in any program. Above all a knowledgeable, interested and dedicated leadership is essential for the successful fruition and implementation of any program.

CONCLUSION

This paper was neither intended to, nor did, portray a complete picture of the BWP program. Four pages are not enough for that. The program has seen its share of success and failures. This paper has focussed only on a small area of the program by trying to expound on the idea of having standard designs, drawings and forms and using them advantageously. Using those allowed the inexperienced engineers to be productively involved in the design without jeopardizing the safety of the system. Non-engineers may also use the various forms and follow step-by-step to arrive at a reasonable conclusion. Experienced staff may use these to save time



TANK SIZE

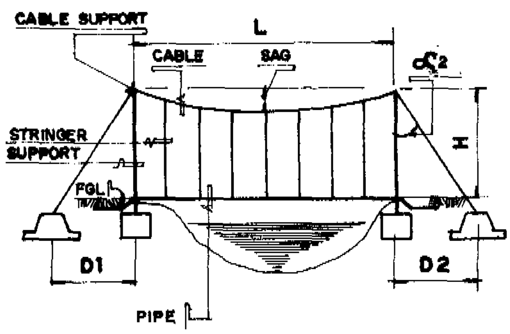
CAPACITY liters	DIAM. D (m)	HEIGHTS (m)			PLATE THICKNESS	
		h	h'	h"	bottom	shell & roof
22 700	2.9	2.45	1.45	0.5	7mm	5mm
68 000	4.20	3.65	2.10	0.70	7mm	5mm

SUPERSTRUCTURE & DIMENSION

TANK CAPACITY (liters)	height H(m)	S (m)	n	column	strut(mm) ∠'s	tie rod (mm)
22 700	6.6	2.2	3	W6 x 20	76x76x6	22
68 000	8.1	2.7	3	W8x24	100x90x8	30

ELEVATED STEEL TANK

FIGURE 1



CABLE STRUCTURE

L(m)	PIPE DIA. (mm)	CABLE			STRINGER		H (m) min.	α_2
		sag (m)	dia (mm)	length (m)	nos.	dia(mm)		
20	150	1.0	13	20.13	9	6	1.5	35°±
30	200	1.2	16	30.13	14	6	1.7	35°±

NOTE:

BOTH CABLE SUPPORTS MUST BE AT THE SAME ELEVATION

CABLE SUSPENSION

FIGURE 2

TABLE 1

FRICTION LOSS uPVC PIPES,(1) m/100m

FLOW Q, LPM	DIAMETER mm								
	75	90	110	125	140	160	180	200	225
50	0.15	0.06	0.02	-	-	-	-	-	-
100	0.54	0.21	0.08	0.04	0.02	-	-	-	-
150	1.15	0.44	0.16	0.09	0.05	-	-	-	-
800	-	-	3.57	1.91	1.09	0.51	0.40	0.21	0.12
900	-	-	4.44	2.37	1.36	0.71	0.49	0.24	0.14
1 000	-	-	5.39	2.88	1.65	0.84	0.59	0.29	0.16

NOTE:

(1) NOMINAL DIAM. SDR 18 PIPES

E X A M P L E S

and reduce the chances of mistakes and omissions. These also provided a degree of standardization in an otherwise vastly decentralized project. It is difficult to measure the adverse effects of using those predesigned elements. One potential risk may be the lack of incentive for the LGU engineers to know the whys and hows. That attitude has to be overcome by proper trainings. On the otherhand, BWP experience shows that the LGU engineers have become more interested to learn the details after using the standards. The author wants to conclude this paper with the hope that these discussion would be of some help to somebody.

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

K J Nath, S D Badrinath, S N Kaul

On-site water treatment

ABSTRACT

Water Supply Programmes in many developing countries have evolved gradually. A wider variety of onsite system designs are available for trea-tment of surface water. The type of treatment systems built often reflects the experience and preference of the designer. The various criteria for selection are public health considerations, cost, ease of operating and maintaining the treatment system. This introduces the necessity to initiate and follow up organised studies on novel water treatment techniques at a level that could be considered well within the scope of technical and equipment resources of the developing countries. In this paper, authors present experimental details of upflow clari-flocculation unit with cost consideration.

INTRODUCTION

Water should be filtered and protected against contamination to prevent from water-borne diseases. The approach of World Health Organisation is that the International Water Supply and Sanitation Decade (1981-1990) programmes must contribute to the implementation of health care. Water supply, storage and treatment should be associated with other areas of health development.

Water treatment has the object of removing undesirable dissolved, suspended and toxic or pathogenic materials from water. Many scientific processes are available. A wide variety of onsite system designs exists from which, proper selection of the most appropriate treatment techniques is required for a given raw water conditions. The primary criteria tor selection of one design over another is the protection of the public health. Second criteria are cost, ease of operating and maintaining the system. To achieve these goals, the developed countries are using units involving several new mechanical features, such as, heavy duty pumps and advanced water treatment methods. These methods, however, require skilled attention and are therefore inappropriate for developing countries.

The conventional rapid sand filter with its pipe gallery and filter rate controllers do not provide middle level communities due to frequent breakdown of the mechanical units, viz. gadgets used for back-washing operations, rate controllers etc. Obviously this indicates the need to try out a modified adaptation of these new processes at a level that could be considered well within the scope of available technical equipment resources in addition to cost considerations. The studies reported in this paper were undertaken in this context and aim at developing appropriate technology for effective method of treating surface water for middle community levels.

LITERATURE REVIEW

Upflow solids contact clarifier which is used for water treatment, basically functions like a sedimentation basin. The earliest known units in the country were reported to be used in industry in conjunction with softners in 1933(1). Since then only occasional applications were reported for community uses. However, the literature from abroad indicates certain precise developments under various trade names(2). These are sophisticated and their performance have been reported(2). The use of upward flow pebble bed clarifier which has been developed under similar lines has also been reported by Sparham(3), where this concept was extended to the field of polishing treatment of wastewater effluents for solids removal. In the background of the encouraging results obtained from the above unit treatment processes, it was decided to undertake a pilot plant study to evaluate the design of a upflow clariflocculator.

EXPERIMENTAL SET UP

The pilot plant illustrated in Fig. 1 includes the basic unit operations such as, flash mixing, flocculation, clarification and filtration and introduces the concept of progressively reducing velocities of flow through this unit.

The squarish unit consists of a hopper bottom inclines at 60° to horizontal with rectangular brick work of 1.5 m x 1.5 m x 2.65 m.

The unit is filled up with the available local material of broken stones and pebbles. The grading and the depth of coarser materials are detailed in Table 1.

TABLE 1 - MEDIA COMPOSITION

Media Size (cm)	Depth (m)	Specific Gravity
10.0-12.5	0.75	2.65
5.0-10.0	0.30	2.65
2.0- 4.0	0.30	2.65

The combined porosity of the media works out to 0.47. A perforated PVC pipe grid of 50 mm and 37 mm was laid at a height of 0.3 m over the pebble bed. Water depth of 1 m over the rock pebble was maintained in the plant design. A stoneware pipe of 0.3 m dia. for 0.6 m height with control valve arrangement was used as an alum doser.

FUNCTIONAL CONCEPT

In operation, raw water with coagulant enters at the hopper bottom and rises through the bed of granite stones and rock pebbles.

A 10.0 to 12.5 cm stone layer helps in mixing and micro-floc formation. The subsequent layers help in promoting a mutual collision of flocs and their coalsence. Because of the gradual increase of the cross sectional area of the tank, velocity of flow gets progressively

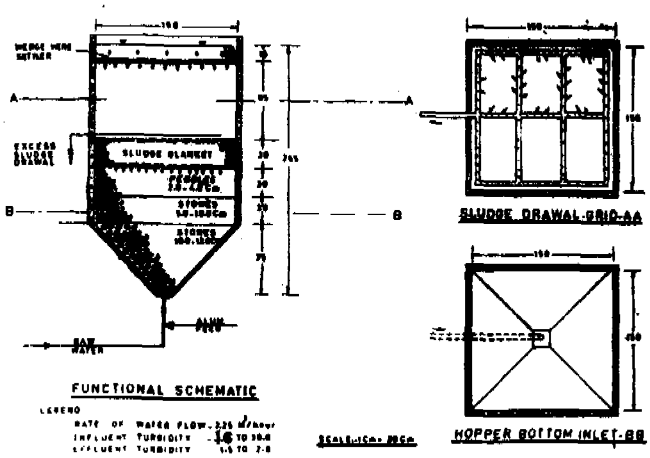


FIG. 1

decreased in its passage through the plant. This helps in further agglomeration of the flocs which remain suspended in a condition of equilibrium on exit from the media so long as the upflow velocity of the water equals the settling velocity of the floc particles. The newly formed flocs get continuously absorbed on older flocs and this allows only the clarified water to escape from the tap.

However, an excessive accumulation of these flocs is found to lead to a gradual deterioration in the quality of the final water. Under such conditions, the excessive sludge is removed by the opening valve of PVC pipe grid system at intervals which are usually once in 15 days.

RESULTS AND DISCUSSION

The experiments were carried out in three phases, using surface raw water having turbidity levels of 16-30 mg/l. In the first phase, the flow rates of 32, 35 and 45 m^3/day were tried with two independent alum doses of 30 mg/l and 35 mg/l. Turbidity and temperature variations were recorded for about 25 days for each combination of flow and alum doser. The temperature of the raw water during experiments was in the range of 32°C and 38°C. Jar test experiments were conducted to fix optimum alum dose. The optimum alum dose was in the order of 40-50 mg/l. The microflocs attract the newer flocs in the void space and therefore, the alum dose was tried still at lower levels. The results indicated that with an alum dose of 30 mg/l, the average per cent turbidity removal was of the order of 60, 67 aand 58 per cent for the flow rates of 32, 35 and 45 m^3/day respectively. With the increased alum dose of 35 mg/l, the percentage removals were of the order of 63, 65 and 65 respectively. When an optimum alum dose of 50 mg/l was tried, there was an excessive formation of sludge flocs from the sludge blanket zone. This indicated that a suitable combination would be 35 m^3/day flow rate with 30 mg/l alum dose or alternatively, 45 m^3/day flow rate with 35 mg/l alum dose.

In the second phase, fly ash in combination with alum dose was tried to the above successful combination. The results of these studies indicated that a slight improvement in turbidity from 67 to 70 per cent was obtained with 35 m^3/day flow rate with alum dose of 30 mg/l and also the carryover flocs were minimised in this system.

In the third phase of experimentation, a screen mesh with 0.125 mm square openings was used over the top of the sludge blanket. The mesh was fixed to a peripheral wooden frame which was introduced into the unit, at 150 mm below the effluent launder. The results were found to be encouraging as shown in Fig. 2, which indicates higher turbidity removals. The unit under these conditions was found to be satisfactory from operational and maintenance point of view. The cleaning of the screen when found necessary was achieved by lowering the water level in the unit upto the sludge blanket.

COST CONSIDERATIONS

The treatment cost for this unit is of the order of Rs. 0.45/m^3 for effluent turbidities in the range of 1.5 to 2.0 mg/l with raw water turbidities of 16-30 mg/l. Under similar conditions, conventional treatment involves clariflocculation and filtration and costs Rs. 1.00/m^3. Further such minimal turbidities as 1.5 mg/l could not be arrived by the conventional treatment system. The benefit cost function for both these systems, considering the per cent turbidity removal and the unit cost/m^3 compares at 9:2 indicating a reasonably good degree of performance and reliability of proposed process.

CONCLUSIONS

1 The method developed can effect turbidity removals of about 85 per cent with effluent turbidities in the range of 1.5-3.0 mg/l from raw water turbidities of 16-30 mg/l.

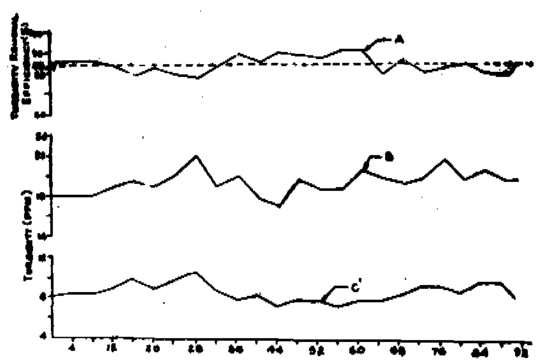


Fig. 2: Performance of the unit with Wedge Wire Settler At 35 m^3/day, 30 mgl Alum dose
A—Turbidity Removal, B—Influent Turbidity, C—Effluent Turbidity.

2 The unit encompasses all the basic unit operations, like flash mixing, flocculation, clarification and filtration in a single unit. The cost of treatment by this experimental unit will be around Rs. 0.45/m^3 as against Rs. 1.00/m^3 for conventional clariflocculation and filtration units.

3 Multiple units can be provided for large capacities, if need be.

ACKNOWLEDGEMENTS

The authors are thankful to the All India Institute of Hygiene and Public Health, Calcutta and the Tamil Nadu Water Supply and Drainage Board, Madras for providing necessary facilities for carrying out the experimental study.

REFERENCES

1 Arceivala, S.J. 'Upflow Solids Contact Tanks' Proc. Symp. on Problems of Water Treatment, CPHERI (India), 1964, 265.

2 Badrinath, S.D. 'An Economical Upflow Clarification Unit for Surface Waters with Low Turbidities' IWWA, 1977, July/Sept., 233.

3 Sparham, V.R. 'Improved Settling Tanks Efficiency by Upward Flow Clarification' J. WPCF, 1970, 802.

Session 3a

Chairman: Mr Venugupalan
Co-Chairman: Mr U N Mondal

Discussion

D Fouzdar and B Hansen

Traditional hand drilling tools

1. Mr FOUZDAR in presenting his paper said that he was saying nothing new but making use of well tried and tested methods. The programme commenced in 1967 and the resources of each village are being used. Every village has artisans who have a skill to be used. He described the logging of boreholes and described how lenses of "sweet" and "saline" water exist in the sand of coastal deposits.

2. Mr CHAKRABORTY asked what type of logger is used as the sophisticated electrical logger is not indigenously available. He also commented that the use of gravels in tubewells meant for handpumps will enhance cost.

3. Mr FOUZDAR answered that they used an ABEM logger which can be operated using a SAS 300 terrameter. The readings are taken at a regular interval chosen carefully on the basis of driller logs. Later it is plotted on graph papers and interpreted. I understand that UPTRON has fabricated some loggers in India. 16" normal and 64" normal can be used even for large diameter bores. Depth would depend on various factors. We are normally drilling up to 200 m which is less than the length of the cable provided with the logger. We are in touch with the ABEM who may supply us 300 m cables.

4. In reply to the comment Mr FOUZDAR said that as saline sealing has to be done, the bore has to be reamed. When reamed the annular space in the aquifer zone has to be filled in by a porous material. We hope that the methods, materials and specifications would be further simplified before they are standardized.

5. Mr PATEL asked what is the average depth of the hand drilled tubewell and optimum yield? What has been the experience and success rate of tubewells that have been sealed to separate fresh water layer from saline water?

6. Mr FOUZDAR replied that the normal depth is around 200 metres. In some cases the bores are extended up to 300 metres. Since the normal yield is much higher than the capacity of a handpump (approximately 25 litres per minute) the yield aspect is not posing any problem. We have no information on optimum yield. The result of sealing is very satisfactory. All these tubewells are being monitored to notice the change in the yield if any. The samples are tested in a highly sophisticated chemical laboratory(of PHED Orissa, strengthened by DANIDA).

7. Mr SOM asked is any effort being made to record and tabulate the findings from the well logging. If so, are any maps being prepared from these data?

8. Mr FOUZDAR answered that the DANIDA project directorate has a well equipped water resource division manned by hydrologists and geophysicists who are systematically storing all the data that is being collected in course of their operations. Maps are being prepared.

9. Mr PASRICHA said we understand that apart from saline water, a fair percentage of bore wells have high iron content. In order to make water potable, iron has to be reduced. What progress has been made in this regard.

10. Mr FOUZDAR replied that DANIDA is presently in the process of developing an iron removal plant. The considerations are (i) it should be simple in the village context. Technology and maintenance should be within the capacity of the village residents; (ii) it should be self-sufficient requiring least support from outside in way of consumables, services and support.

11. Mr RANAR asked what advantages are found in reaming the wells to 300 mm ϕ when the well screen is 60 mm ϕ and pumping is done through a hand pump.

12. Mr FOUZDAR said that presently the details of improvisation are in the process of innovations. Maybe at a later stage we would be in a position to simplify. The reasons for 300 mm reaming are:
(i) creating sufficient area in the annular space of the borewell to pass communication line for the saline sealing.
(ii) creating sufficient area in the bore for fixing the well assembly and filters in the most appropriate manner.

13. Mr RAVDAL asked the author to describe some of the hand-drilling tools/methods used and to detail to some extent how they are made and what materials are used.

14. Mr FOUZDAR believed that this information is described in the paper.

15. Mr PRASAD asked whether DANIDA is assisting every private contractor in Orissa in water logging operation, while drilling tubewells. If so whether such assistance is free of cost.

16. Mr FOUZDAR replied that the logging is done departmentally. The contractors do not have to pay anything for the logging.

S Huq and Md A Hossain

Fibreglass versus stainless steel screen

17. Mr HUQ gave details of sources and described screens. He compared headlosses, costs and lengths of screens. Stainless steel need only be used where the aquifer depth is limited.

18. Mr CHAKRABOSH asked in this comparative study between F G Strainer and stainless strainer, what shape and size of slots have been chosen in each type of strainer?

19. Mr HUQ replied that the stainless steel screen are continuous wedge wire wound around some ribs which gives a continuous spiral slot. The fibreglass screens consist of discontinuous helical angle slots cut in fibreglass pipe.

20. Mr PATEL commented that you have highlighted on cost aspects. However your comments on the expected life of fibreglass screen as against stainless steel screen would be appreciated and your comments on scope for PVC screen or experience of the same would be interesting.

21. Mr HUQ said that so far in Bangladesh, deep tubewells have been in use for about 10-15 years during which time both types of screen have been alright. It is claimed that SS screen has a longer lifetime than FG screen but in Bangladesh we have not had a problem of material failure yet. PVC screens are used in shallow (4" in dia.) and hand tubewells (1½" dia.) at lower diameters but not for deep tubewells (6 or 8" dia.)

22. Mr BANERJEE asked whether a comparative study between fibreglass strainer and stainless steel strainer has been made regarding their effective life? If so, what is the result?

23. Mr HUQ replied that we have been using fibreglass screen since 1973 and S.S. screen since 1975-76. The life of tubewell with fibreglass screen haslasted till today and performance with fibreglass screen is satisfactory. Recommended life of tubewell with fibreglass is 15-20 years and with stainless steel is 15-20 years.

24. Mr SENGUPTA asked what is the longevity of GI pipes which is used as blank pipes. In Tripura, we are using slotted ERW pipes as screens in deep tube wells. Slotted ERW pipes were found to be quite good in deep tube wells. Moreover slotted ERW pipe (screen) is cheaper than fibreglass screens. These ERW screens have about 14% opening. Would the author tell anything about ERW slotted screens.

25. Mr HUQ answered by saying that we have not used much slotted ERW pipe due to lack of response to international tenders for procurement of screen. To our knowledge there is no reason for not using ERW slotted pipe.

26. Mr CHAKRABORTY asked why are you using stainless steel screen, though the cost of fibreglass is 100% cheaper than stainless steel and all are imported materials and the average depth of the tubewell in both cases is nearly the same.

27. Mr HUQ replied that the choice of materials is done by international consultants who usually choose to specify a mix of fibreglass and stainless steel screen.

28. Mr SOM asked why the louvre type screens were not used? He also wondered whether it has been used in any other project? If so, any conclusive trend and/or inference.

29. Mr HUQ said that it has not been used to our knowledge. The types of screen used are specified by international consultants who have not specified this style.

S Ghosh

High turbidity direct filtration by contact flocculation

30. The Author described his experimental work carried out. He concluded that Contact Flocculation enables the direct filtration of water with turbidity exceeding 100 NTU's.

31. Mr SIMS asked have you any knowledge of a treatment plant in operation using contact flocculation?

32. Mr GHOSH said that the information on contact flocculation is relatively meagre. It is still in the research stage. The author feels that a pilot plant study should first be carried out on the water that is desired to be treated before constructing a full scale treatment plant. I don't know of any particular treatment plant using contact flocculation

33. Mr PARAMASWAM asked whether any primary metal coagulant was used in the studies? If only a polymer was used what were the reasons

for the same? Perhaps a different dose of polymer for the sand filter could produce better results, all other conditions being the same.

34. Mr GHOSH replied that a number of different polyelectrolytes were studied on the jar test apparatus to choose the best polymer for the filtration runs. The polyelectrolytes studied were cationic, nonionic, anionic and of the solid and liquid type. A lot of research has been carried out on direct filtration and it is widely accepted that direct filtration only performs appreciably well if the influent turbidity is less than 25 NTU. Thus a different dose of the polymer might not help to change the filter performance drastically.

35. Mr BAILEY asked whether the author considered placing a cap over the final filter and pumping water through, in the manner of traditional pressure filters with addition of coagulant? What would be the increase (%) in running cost over traditional accruing from 9mg/l polyelectrolytes.

36. Mr GHOSH said that the filter (single filter) gets clogged up very soon and the head loss rises up. In a short time, the power required to drive the water through the filters is very high and the run has to be stopped as the system gets unstable. So the modification suggested by placing a cap over the final filter is not envisaged to extend the filter run by much. The polyelectrolyte is extremely cheap. It was given free to us by Dow Chemicals Corporation of USA. So the running cost for 9.0 mg/l is not expected to be great.

37. Mr SARIATULLAH asked what would the ultimate production cost of clean water per gallon be at the plant when "direct filtration method" is used. Would you please make a comparison with the sand filter method costing in India.

38. Mr GHOSH replied that sand filters are used in India to polish the water and this is preceded by the steps of coagulation, flocculation and sedimentation. Direct filters are not used in India. The cost and space requirement are going to be much less for direct filters as compared to conventional water treatment. But as has been mentioned in the presentation, direct filters are technically incapable of performing appreciably well if there is no pretreatment.

39. Mr MISRA asked what is the frequency of regeneration of contact flocculating beds? What is the amount of backwash water required for it? Could you assess the percent reduction of bacterial load/organics in these studies.

40. Mr GHOSH answered that contact flocculator beds, because of the increased pore space, were very easy to backwash and the filters could be cleaned to a high efficiency. Hence replacement of the media need not be done very frequently. For about 30-50% bed expansion as required for backwash of filters a pressure of only around 8 psi was required to be maintained. The filters were cleared in only about 10-15 minutes of backwashing. Reduction of bacterial load was not studied in this project. Although bacteriological reduction is envisaged, the efficiency is expected to be less than that observed for turbidity removal. The process of disinfection by chlorination etc cannot be eradicated.

E W Lindeijer

How to develop distribution control

41. Dr LINDEIJER described distribution control by flow restriction at the system ends using the reversible flow rate restricter. He went on to state that there is no health improvement by the provision of a wholesome water supply unless sanitation is also included. In fact the reverse may be the case. A graph was displayed illustrating the malarias may increase during the drier seasons. Water Supply should not be provided where it cannot be paid for and where it will not generate enough income for operation and maintenance.

42. Mr BASU commented that in India imposition of taxes on water is difficult even in urban areas - let alone rural areas. Are taxes collected for water supply in both urban and rural areas and are these water projects fully viable? If Dr Lindeijer's statistics are true we are in for great trouble, because at the end of the decade we shall hopefully be able to supply potable water to 100% of rural population (without taxes of course) but provide sanitation facilities to only about 20% of this rural population. The question is if the situation is really that explosive was it not thought out while formulating the Decade programme at the International level?

43. Dr LINDEIJER replied that the RFR opens the opportunity to simplify the tariff-system and thus the collection of the revenues due: the RFR allows for flat-rates and a simple administration for revenue collection. The statistics are certainly alarming particularly for the drought-prone areas all over the world where a number of new diseases (notably malarias and hookworm) have developed and caused numerous deaths. However the data are very unreliable as mentioned. Besides that, official data are very difficult to come by as the result of obvious reasons. So we are forced

to use commonsense to conclude that water supply may become the abode of death - if not properly integrated with drainage, health education, community participation and sanitation if required - rather than hard data that is too difficult to come by.

44. Mr KUMAR asked about the construction of RFR. What are likely to be the maintenance problems? Mr KUMAR also asked whether in systems with low pressure, could this function, as the pressure loss in RFR is large? Is it available locally in India. Could you give names and addresses of suppliers from India and abroad.

45. Dr LINDEIJER referred the questioner to Annex I of paper "The use of the RFR......." October 1985. With respect to low pressure systems the author believed the RFR would work at the cost of flow-rate and accuracy. The RFR was not yet available in India. WISA (Ltd), Arnhem, The Netherlands is planning to start producing it in India this year. Approx cost say 75% of comparable bulk-flow meters or less.

46. Mr DAYAL asked what devices are proposed to restrict the pressures in the earlier reaches of the pipeline distribution system; so that enough pressure is available at tail ends.

47. Dr LINDEIJER replied that applying the RFR should commence at the zones where the pressures are already high enough to allow for the pressure loss generated over the RFR. Then the pressures will increase in the lower zones eventually allowing RFR's to be installed there also. By installing RFR's we should work from high to low pressure zones and never the other way around.

48. Mr RAO asked what is the actual mechanism by which the regulator works? Is it to be installed at every junction in the distribution system?

49. Dr LINDEIJER answered that the pressure in the main controls the opening of and the flowlines around it such that the flow-rate remains. The RFR constant (flexible rubber ball around the capacitor) is only to be installed at the distribution points (called the tail-ends of a distribution network). However it can be applied to control pressures in valleys and building high-rises.

50. Mr LAMAL observed that in the hill areas in Nepal, there is the practice of supplying untreated water. Sometime the source has got lime.When lime flows in the water it is deposited inside the pipe and finally it blocks the pipe. Please suggest any method to flush this deposited lime inside the pipe.

51. Dr LINDEIJER replied that flushing is not really possible unless extra chlorine for instance is added to dissolve the lime deposits. A better way is to make lime to settle out before it enters the pipeline(s). Depending on local circumstances there are various ways to accomplish this and reference is made to literature on this.

52. Mr CASEY asked Dr LINDEIJER to elaborate on the income generating activities which could be associated with water supply provision.

53. Dr LINDEIJER replied that very significant examples can be given of both failures and successes of income generating activities. It is not easy. It requires proper feasibility study of production and marketing and transportation as the case may be. A very important condition that must be fulfilled is the issue of proper guidance at grass-root level. What one needs is the right grass-root level organisation dedicated and motivated to do just that. Informal education programmes, training, transportation, marketing etc may be needed, particularly when the income generating activities are reaching beyond the micro-economic balance of the village itself (in other words if produce is generated for markets outside the village). In the first place income generating activities must focus on improving the micro-economic balance within the village before 'exports'-oriented activities are planned (in other words cost saving activities are income generating/income saving activities). Note: Water supply and Sanitation offer excellent opportunities for income saving/generation but it requires early identification and awareness-building.

54. Mr PATEL commented that we have seen at the mid decade that provision of water from hand pumps not installed correctly is source of carrier of diseases due to uncontrolled spillage of water, at this stage what is the scope for further development and supply of groundwater utilising deep well pumps such as submersible, jet pumps, turbine etc where power source is available i.e. is there a trend for improvement in rural water supply internationally utilising more improved systems.

55. Mr PATEL also stated that it is our opinion that within cost constraints and keeping in mind decade obligations, provision of the water should be through tap from overhead tanks through pumped technology.

56. Dr LINDEIJER agreed but recommended that whatever improvements you plan that the beneficiaries are indeed going to profit from it such that they can maintain the improvements properly. So appropriate solutions may have to be developed so that the target group can understand the improvements and appreciate them. Training and proper inspection may be needed. Much depends on the local circumst-

ances as to what and how one should execute/ realise the improvements. Make always sure that improvements are no cause for further impoverisation but real incentives to further thought, indigenous action and consequently further improvements initiated indigenously.

57. Dr LINDEIJER also agreed with Mr PATEL's second point. Because improvement of public health is in fact only possible once the water is flown into the houses if the environmental conditions and drainage facilities allow that. What is set out above remains of course in force.

58. Mr GANGULY asked the author to elaborate on the functioning of flow restriction.

59. Dr LINDEIJER asked the questioner to refer to the paper "The use of the RFR.......", October 1985 and went on to say that the upstream pressure controls the opening in and the flowlines around it in such a way that a fairly constant flow-rate is maintained through that opening.

60. Mr ALLEN made an observation on tariffs. In Kenya all supplies are metered to individual properties and payment procedures are very effective because if you don't pay, the meter is removed!

61. Dr LINDEIJER felt that this was fine, but suggested that experience showed that meters do not adequately contribute to a just distribution of water supply.

S Jindal and R C Singh

Coagulation and flocculation by polyelectrolytes

62. Mr JINDAL made reference to the graphs contained in the paper to explain the comparisons made. He concluded that Polyelectrolytes are very efficient at removing bacteria but alum is more efficient for turbidity removal.

63. Mr DAS asked the author to explain why anionic polyelectrolyte was not being effective in removing bacteria in the light of the hypothesis stated by you.

64. Mr JINDAL replied that we have proposed a special mechanism for the removal of bacteria that is interacting with the bacteria cell wall components in which it may be that the positive charge of cationic polyelectrolyte helps, while the same may not be true for anionic polyectrolyte. Their negative charge is hindering the removal of this binding and this charge repulsion inhibits the bacterial surface interaction with the anionic polyelectrolyte. However the polymeric materials excreted or exposed at the surface of bacteria may be interfering with the anionic polyelectrolyte and preventing the complex formation resulting in no flocculation

S Som

A novel water system

65. The author said that more than one million people had been reached by the scheme. The need to pay is being established. There are three levels of supply:-

Level 1. Hand pumps
Level 2. Standpipes and closets
Level 3. Individual connections

Villages will have to generate funds for maintenance. His key words were - "Go and do it!"

66. Dr BASU asked what percentage of water loss is now in vogue for Level 2 system? What amount of "Peso"/m^3 is to be paid for 1000 litres of water by the users?

67. Mr SOM answered that there is 20-30% water loss. Unfortunately this is based on a very limited study. I suspect in many systems, the loss is more. The cost is different in different communities and is determined by individual systems. P 20-30/10 m^3/m is rather average. Currently P1 = 0.65 Indian rupee.

68. Mr MUKHERJEE asked as you have mentioned that people of the Phillipines consider water is a free gift by God, how you have convinced them to pay for the same? Whether by a) imposing the same by law, or b) convince them why they need to pay? If so, how? Mr MUKHERJEE also asked how much you are charging them? Is that payment sufficient for maintenance only or is it also sufficient for capital cost recovery?

69. Mr SOM said that the people were motivated by public meetings, training and showing failed examples. There is no law about it. With regard to charging Mr SOM said that it is determined by the individual systems. P 20-30/10 m^3/m is rather average. Ideally the fee is determined to pay for a part of the capital cost as well as all maintenance and operation cost. Until recently it was doing so. Lately, for most systems, repayment of cost is lacking.

K J Nath, S D Badrinath and S N Kaul

On site water treatment

70. Mr BADRINATH presented the paper by describing in detail the experimental treatment unit and the results obtained. He concluded that treatment costs were about half that of conventional plants and very effective.

71. Mr SIMS asked how is the surface of the sludge blanket observed? Does the wedge wire obstruct observation? Does the coarse aggregate at the bottom of the hopper clog?

72. Mr BADRINATH answered that there was no difficulty in observing the sludge blanket. The aggregate did not clog and even if it did so it is very easily backwashed.

12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

A M Thabit

Training of Tanzanian engineers in India

TRAINING OF ENGINEERS IN INDIA

ABSTRACT

The training of Engineers and other professionals in specialised fields is an expensive programme. It is even more expensive in developing countries where shortages and lack of well qualified teachers, training materials, teaching aids and equipment are not available.

Tanzania like any other developing country was faced with shortage of Engineers and other professionals when it became independent in 1961. In 1970 when the country had decided to launch a massive programme of trying to provide clean and potable water to her people by the year 1991 the situation with Engineers available in the Ministry had not changed very much.

This paper therefore attempts to explain how the Ministry of Water, Energy and Minerals (MWEM) achieved this programme by launching a crush Training Programme of training Engineers outside the country. It gives an account of how the idea was conceived and explains how financial support was obtained from Swedish International Development Agency (SIDA).

BACKGROUND

The Party and the Government had met to draw up a Five Year Development Plan (FYDP) for the year 1971-75 and also review the social and economic development achievement of the country during the past ten years of independence.

At the end of this meeting, both the Party and the Government agreed that provision of clean and potable water to her people living in rural areas should be given priority. The Five Year Development Plan had stipulated that all Tanzanians should have access to clean and potable water within 400 metres reach by the year 1991.

This important decision had great significance to the Ministry which is responsible for the implementation of water projects in the country.

Immediately the Ministry was asked to present a paper to the Cabinet which would outline how this proposal would be achieved by the year 1991.

The paper presented described the various bottlenecks in the implementation of water projects. Lack of sufficient and local qualified Engineers and other professionals in the Water Sector became evident. The Ministry proposed to the Government that alternative means of training Engineers outside the country at a fast rate should be considered. This is because the number of Engineers allocated to the Ministry through the High level Manpower Allocation Committee (HMAC) of the Ministry of Labour and Manpower Development (MLMD) could not satisfy the high demand of Engineers for the Ministry to meet the target.

FINANCIAL SUPPORT

The proposal to train Engineers outside the country was accepted by the Government. But considering that this would need considerable amount of funds to meet the cost of training in foreign exchange it was necessary for the Government to seek for financial support from International donors. The Royal Swedish International Development Agency (SIDA) agreed to provide financial support for the programme. SIDA agreed also to meet the cost of travel for the students including tuition and maintenance allowance for the students during the whole period of training.

Having now been assured of the funds the Ministry started to identify and locate suitable institutions outside Tanzania which would be ready to accommodate large numbers of students at one time and whose medium of instruction was English language. The element of cost was also considered.

UNIVERSITY OF ROORKEE-INDIA

University of Roorkee probably one of the oldest learning institution in India was found to be suitable.

Roorkee is situated north east of the Capital New Delhi and 120 kms. away towards the famous Ganga River. The University agreed to take a batch of 129 undergraduate students for a Bachelor of Engineering (B.E.) Degree in Civil Engineering with special emphasis in Water Resources Engineering. A four years 'Tailor Made' programme to suit Tanzania environment was prepared and later on approved and accepted by the University of Dar es Salaam Faculty of Engineering, the Ministry and the University of Roorkee.

What followed next was the selection of suitable candidates for the course. A Senior Lecturer from the University of Roorkee was deputed to come and conduct the selection together with some senior Engineers from the Ministry. A survey was conducted through the records of the Ministry of Education of students who had completed 'A' level education in 1974 and were by regulation serving a one year compulsory training in the National Service (JKT). Consideration was also given to candidates who had previously obtained excellent results in the Full Technicians Certificate (FTC) course obtained from Technical Colleges. The final selection resulted in picking 129 students.

When all other formalities were completed with the Government the first batch of 129 students accompanied by one official from the Ministry left for India in August, 1975.

MECHANICAL AND ELECTRICAL ENGINEERING COURSE

It was immediately realised that in the construction, operation and maintenance of any water supply system the services of both Mechanical and Electrical Engineers is always essential. Therefore training of Civil Engineers alone would not have been meaningful in the implementation of projects without them. Therefore in 1976 another batch of 30 students was selected and sent to the same University for undergraduate degree course in Mechanical Engineering.

Four years later another batch of 75 students was sent to India for both Electrical and Mechanical Engineering degree course. But admission to the University of Roorkee this time was interrupted by students who were admitted from other African countries. The Ministry had to find other suitable Insitutions within India which would admit the students.

The students were then placed in three different colleges as follows:-

- PSG College of Technology Coimbatore 30 students
- Birla Institute of Technology (BIT) Ranch 20 students
- BMS College of Engineering Bangalore 25 students

There are very few students now left in India who have not completed their degree course although some had to be dropped from the course on various grounds (See Table I).

This programme of training big numbers of students in India had now started to attract other Ministries and Organisations in the country. The Ministry of Communications and works, The Textile Industry, Ministry of Industry and Trade only a few to mention are among the Organisations which had sent large numbers of students to India for various professional Training.

FOLLOW UP AND GRADUATION

Throughout the training period of the students in India there has been quite a lot of correspondence between the College authorities and the Ministry including exchange of visits. A number of Senior Staff from the Ministry have visited the students in India either to solve some problems which came up or to see the progress of the students in general. Likewise some teachers from Bangalore, Coimbatore and Ranchi Colleges have also visited Tanzania.

During the graduation ceremony of the first batch in June, 1979 at the University of Roorkee, the guest of honour was the Hon. Al Noor Kasum, Minister for Water, Energy and Minerals.

TABLE 1 SUMMARY OF STUDENTS POSITION SENT TO INDIA

Name of Institute	No of Student sent	Year	Field of Eng.	No of graduates	Year	Students Dropped	Remaining	Remarks
University of Roorkee	129	1975	Civil Eng.	122	1979	7	-	NIL
University of Roorkee	30	1976	Mech. Eng.	25	1980	5	-	-
PSG Coimbatore	30	1980	Elect.	22	1984	8	-	-
DIT Punch	20	1980	Mech.	16	1984/ 1985	3	1	will complete Jun. 1986
PES Bangalore	25	1980	Mech.	7	1984/ 1985	3	15	will complete June 1986

CONCLUSION

It can be realised from the information that this programme has been quite expensive and time taking as Franklin' argues, but without this programme the Ministry would have taken longer time to achieve its present stage. The worldwide economic crisis which has hit seriously the developing countries has also affected Tanzania in the implementation programme of water for rural areas by 1991 as envisaged earlier. But despite of all these problems Tanzania has been able to provide nearly 40% of the 6.9 million population living in rural areas and in terms of manpower requirement the Ministry has provided at least three to four engineers in each of the twenty regions in the country. Some engineers have been posted to work up to District level. The idea is to send the experts to the village where they can work close to the people and understand their problems.

There are no plans now of training large numbers of engineers outside the country but this does not mean that the Ministry is self-sufficient in manpower requirement. The Ministry will continue to rely on the allocation of few engineers who have been trained locally or sometimes abroad.

REFERENCES

1. THABIT A M. Professional training programme in the Ministry of Water & Energy. Paper presented at the IEA, December 1980.

2. FRANKLIN R. Water Works Management, 1983.

3. Report - Regional Water Engineers Conference, 1984.

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WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

Z Ahmed, Nigel D W Lloyd, Md Sariatullah

Local government training in Bangladesh

INTRODUCTION

The recently created Local Government Engineering Bureau (LGEB) has an establishment of 13,317 staff, with 525 offices (see Table-1). It has been formed by combining the upazila staff of three departments: Works Programme Wing (WPW), Department of Public Health Engineering (DPHE) and Public Works Department (PWD). Its staff are responsible for all engineering works by the local government bodies, including rural water supply and sanitation. It has a Training Unit which is largely funded under foreign aided programmes. The detailed context and history of the LGEB training programme are described at the end of this paper.

TABLE 1: GOVERNMENT POSTS IN LGEB

Nr.	Designation
	HQ
1	Engineering Adviser (Chief Engineer)
4	Superintending Engineers
2	Executive Engineers (XEN)
4	Assistant Engineers (AE)
4	Sub-Assistant Engineers (SAE)
42	Support staff
	Other staff provided under individual projects
	District
1	XEN
1	SAE
4	Support staff
	Other staff provided under projects (in some cases)
	Upazila
1	Upazila Engineer (UE) of AE rank
3	SAE
1	Draftsman/Estimator
1	Surveyor
4	Work Assistants
4	Mechanics (for rural water supply)
1	Electrician
13	Support staff
	Other staff provided under projects (in some cases)

Training courses are given to both officials and members of the public involved in LGEB construction. Courses for LGEB staff cover the basic engineering skills involved in planning, feasibility, site investigation, design, construction and maintenance, the socioeconomic factors related to rural works, plus government rules and procedures and management topics. Practical training is also given to project implementation committees and labourers in order to improve construction standards and reduce misuse. Specific training courses are run by the individual programmes, such as training for groups of labourers in manufacturing culvert pipes and construction of culverts, as an employment generating activity. The total numbers of trainee course days provided under LGEB are shown in Table-2.

Since 1984 LGEB Training has been coordinated and carried out by a donor-assisted Training Unit. The Training Unit consists of a small HQ unit in rented accommodation, and a District Training Officer (DTO) to assist the XEN in training matters in the district.

The PWD & DPHE both have their own training institutes (but no posts specifically for training), which have not been transferred to LGEB. Training for DPHE staff is largely performed with the assistance of a UNICEF project. At the same time as the LGEB

TABLE-2: GROWTH OF LGEB TRAINING COURSES: ANNUAL TRAINEE DAYS

Year	Programme				Total Trainee Days
	SPWP	IRWP	ZRMI	CARE	
1980-81	1,554	-	-	-	1,554
1981-82	2,164	135	-	-	2,299
1982-83	1,506	2,604	-	-	4,110
1983-84	2,149	4,052	1,920	4,461	12,582
1984-85	5,991	16,847	1,584	4,410	28,832
Planned:					
1985-86	-	34,656	465	-	35,121

Training Unit is acquiring the capability to give training in rural water supply and sanitation, it is availing itself of UNICEF's assistance. UNICEF is continuing the training to the same staff, but now under the new department, LGEB.

TRAINING METHODS

The training courses are practical, 'hands-on' and job-orientated. Where possible, after trainees are given a brief introduction to the topic by a trainer, the major activity is to carry out that activity under realistic field conditions. For example a group of 5 SAEs with an AE as trainer, will be taken to a site in a road requiring a small bridge or culvert, and will be given one week to survey the site, investigate soil conditions, calculate the design flow and structure size, select a suitable standard design, modify it to fit the site, prepare full working drawings, estimate quantity and cost of all items and prepare tender documents and all other items required before tender. Similarly for a concrete slab a small group under a trainer will check the reinforcement, shuttering and materials, mix the concrete, measure the slump, place the concrete and compact it, take test cylinders and organise curing. The emphasis is on learning by doing the task correctly.

Initial priority has been given to training the technical staff in rural works, and the accounts staff. Wherever possible courses are residential, and optimal course size is 35, although courses of over 50 have been successfully held. Optimal group size for practical work is 5 with a trainer. Courses are intensive and are limited to 2 weeks. Each course has the DTO and XEN as 'top trainers' monitoring the performance of each group and ensuring that trainees do things in the correct way. Courses are held at the end of the monsoon, when staff can be spared from their routine duties as project preparation and construction work are not yet under way. This has not proved a limiting factor in practice. Training is performed with the same types of equipment as the trainees have in their upazilas. Staff are gathered together from all upazilas in a district for a training course; they are provided food and accommodation and a daily allowance. Participants are provided with a printed copy of course materials for future use. Each participant's course file is also returned after scrutiny.

The UE trainers have all attended a Training of Trainers course: 1 week to become familiar with the contents of the course which they will teach, and 3 days grounding in teaching methodology (preparing objectives, processes of learning, communication, motivation, assimilation, feedback, testing, preparing lessons) followed by 3 days in which each UE prepares and gives a short lesson to his group of 10 UEs. The course acts as a model of how the lessons may be given, both when they are learning in the 'technology' week and when they observe the practice lessons of their fellow participants. A major aim is to break the pattern of "talk and chalk" lectures and replace it with practical field work.

The Project Preparation and Implementation field course for technical staff (PPIC) is prepared by DTOs and TSs. This ensures that the experience of past courses and on-the-job training is fed back into improved and relevant course design. It also provides an incentive to the DTOs to ensure the success of "<u>their</u> PPIC course" when it is given in their district. Similarly the TOT course is largely designed and run by the Training Unit and it is focussed on teaching the PPIC contents; which again enlists the commitment of the Training Unit to its success. Equally important, the courses are being prepared by local officials (not foreign expatriates), which minimises problems of communication and means that the Training Unit becomes self sufficient and able to produce its own training courses without external assistance.

As well as formal courses, DTOs and UEs are encouraged to assist the technical staff to perform their routine duties in the same way as they have been taught on the courses. This 'on-the-job' training takes place during the project preparation and implementation seasons. By acting as trainers, the UEs have a detailed knowledge of the course contents and a commitment to ensure the staff adopt them; it provides the DTO with feedback on the effectiveness of the courses.

For the technical staff to have the confidence to adopt new methods and standards, it is necessary to practise using these methods under realistic conditions; description and understanding are often not enough to change long-standing working practices. Examples of new techniques are: compaction of earth works, detailed site surveys by levelling instrument and field classification of soils.

The professional development of the UE is assisted by the training activities. Most UEs are either promoted diploma engineers or fresh graduates. There is often no other engineer in the Upazila with whom the UE can discuss engineering matters: status inhibits admitting ignorance to subordinate staff, most upazilas have poor road or telephone connections to the outside.

Training has been largely funded through a bank account, is replenished directly by the donors and operated by Government Officers.

It has proved very rapid and flexible.

PROBLEM AREAS

Ironically, perhaps the greatest problem in institutionalising a mechanism for achieving change (which is surely the ultimate goal of a training unit) is the uncertainty and change in its environment. As the parent organisation metamorphosed from RWP to WPW to LGEB (see below), the role of training unit has had to be adjusted. Naturally one needs to observe how things will work in practice before rushing into creating posts and approving budgets. This is particularly true when it is a function which has not existed before. The donor agencies are keen that Government should follow its recognition of the need for training in the Strategy and Policy, by assuming the responsibility and establishing posts. Government has indicated its intention to do so.

Projects and even donors have their separate identities, their peculiarities, obsessions and constraints; and they rise and fall. Donor-aided programmes are invaluable for trying out and refining an institution because they do not have the same constraints of universality, rule and precedent. But it is difficult to coordinate a jigsaw of donor inputs to give a unified and continuing national training programme. It is also not simple to transfer from TA funding to Government; salaries and service rules often mean that individuals will not transfer, it is anomalous to have TA and Government officers filling identical posts in different places, the TA funding mechanisms which operated successfully can rarely be matched within the Government system. The LGEB Training Unit is still finding its way through these problems.

The purpose of training is to improve the performance of the LGEB, as measured in the quality of the infrastructure that it constructs and maintains, and the socioeconomic development that it makes possible. However, training is only one input into the complex system within which the LGEB engineers operate. It is not enough to alter people's skills, knowledge and attitudes, if they cannot alter their behaviour because of factors outside their control. These factors are such diverse elements as the lack of: adequate staff numbers, appropriate status and conditions of service, financial and administrative powers, transport and running expenses, equipment and office supplies, appropriate administrative procedures, timely finance, local leaders who will act on technical advice, the willingness to innovate or take risks that accompanies insecurity and poverty, standard designs and specifications, skilled contractors and artisans, suitable forms of contract. Fortunately, progress is being made on all these and many other fronts.

For these reasons, it is difficult as yet to evaluate the impact of training on behavioural change and improved infrastructure.

INSTITUTIONAL CONTEXT

Local Government in Bangladesh is principally at the union, upazila, zila (district) and pourashava (municipality) levels (Table-3). This system results from a comprehensive reorganisation of the administration carried out from 1982-84 which devolved power to the upazila (previously called a thana) and replaced 71 sub-divisions and 22 old districts by a single tier of 64 new districts.

The Local Government Engineering Bureau provides the engineering staff to upazila parishads (councils) and districts. The headquarters is within the Local Government Division of the Ministry of Local Government and Rural Development & Cooperatives. It has grown out of the temporary Rural Works Programme founded in 1962, which was reconstituted as the permanent Works Programme Wing (WPW) in 1982. In October 1984 WPW was again recast as the LGEB, combining all upazila technical staff previously provided under the older and larger Public Works Department (PWD) and Department of Public Health Engineering (DPHE).

At Upazila level LGEB has four functions:

- physical planning (previously WPW)
- rural water supply and sanitation (previously DPHE)
- public building e.g. offices, storage facilities, staff quarters (previously PWD)
- small-scale rural infrastructure e.g. rural and feeder roads, bridges, irrigation and drainage channels, flood

TABLE 3: LOCAL GOVERNMENT UNITS

Tier	Nr.	Typical Population
National	1	100 million
Division	4	25 million
Zila (district)	64	1.5 million
Pourashava (municipality)	78	50,000
Upazila	460	250,000
Union	4,472	25,000
Village	85,650	1,200

control embankments, small sluice gates, rural markets (previously WPW).

At district level LGEB is almost exclusively concerned with district and feeder roads and bridges. The XEN also has an advisory, supervisory and monitoring role to the UEs in the district. The PWD and DPHE maintain a separate identity at this level.

The national headquarters monitors and assists the work in the lower tiers and performs the following functions:

- determining policy
- recruitment, posting, promotion
- distribution of central government funds including donor-aided projects
- technical guidance, preparation of manuals, standard specifications and designs
- monitoring and evaluation of upazila development activities
- special projects, action research, management of consultants
- promoting training activities at all levels

Several foreign aided projects have supported LGEB's activities, notably the following have assisted with training: UNDP/ILO/Swiss Special Public Works Programme (SPWP), the SIDA/NORAD/DANIDA Intensive Rural Works Programme (IRWP), and USAID Zila Road Maintenance and Improvement Programme (ZRMIP), the DANIDA Noakhali Integrated Rural Development Programme (NIRDP) and the USAID/CARE/WFP Food for Work Programme.

TRAINING SINCE 1980

The Beginnings

From 1980 until 1985 SPWP started a training programme for RWP/WPW/LGEB staff in 4 old districts. This training made extensive use of expatriates: a Training Adviser and UN Volunteers. Courses were given annually to the technical staff of their districts and upazilas. From 1982 IRWP expanded this training into 6 more old districts and (after the completion of SPWP) took over its training activities in those 4 districts to ensure continuity. IRWP also provided a Training Adviser and carried out training on a common basis with SPWP. ZRMIP had a more restricted interest in the road-related activities at the district level, and so ran independent training courses under a Training Adviser in 3 of the 10 SPWP/IRWP districts. CARE provided teams which gave technical training courses in the remaining 12 districts in 1983 and 1984.

LGEB Training Policy

In 1984 the Training Advisers prepared a "Long Term Strategy and Plan for Training in Works Programme Wing" which was accepted by Government and published as offical policy. This unique document has been widely distributed to other departments. The Strategy set out the way ahead on training matters, based on:

- coordination of all training activities within WPW
- conformation of all training built upon agreed training modules
- decentralisation of training: 22 District Training Officers (DTO) to organise training courses, using UEs as trainers for technical subjects
- a strong WPW HQ Training Unit as the overall policy maker and to design courses provide support and course materials to DTOs, run central courses and supervise training in the districts

Within 6 months the creation of LGEB had made the strategy obsolete. The number of technical staff and disciplines and districts had all grown threefold. The Secretary of the Local Government Division has requested a new LGEB Training Policy which is currently being prepared. It will continue in the same directions as the Strategy, with DTOs implementing a common decentralised training under an HQ Training Unit. It will also cover the wider aspects of staff development including a coherent policy for attending courses provided by others, both in Bangladesh and abroad.

Implementation of the Policy

IRWP and SPWP began to implement the Strategy by appointing DTOs in the 10 districts as Technical Assistance (TA). Government provided a Training Officer at HQ and IRWP supported him with TA staff. The DTOs were managed on a common basis by the Training Unit, preparing and running common courses for UEs, technical staff, accountants and project implementation committees (an alternative to implementation by contractors using public participation). Outlines were prepared for donors suggesting a form for the training component of prospective programmes. A management course was run for LGEB HQ staff (Government officers, local TA staff and expatriate advisers) jointly funded by IRWP, SPWP and ZRMIP. Technical training courses were run by LGEB for the upazila staff of the Ministry of Relief and Rehabilitation who implement the Food for Work Programme of rural road construction.

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

A K Bhunia

Training needs for the Decade programme

1. INTRODUCTION :

Water supply and Sanitation Decade (1981-1990) is half way through. For West Bengal it is from April, 1981 to March, 1991 in conformity with the fiscal year. The Decade objective is to provide :

a. Safe drinking water to all;
b. 80% sanitation to urban population and
c. 25% sanitation to rural population.

The programme is a massive one and there is serious shortage of technical manpower to implement this gigantic programme costing about Rs. 13,320 millions. There is also a large communication gap at all levels and at the receiving end people in general are not aware of the programme and they are also not mentally prepared to accept the programme particularly the low cost sanitation one.

In view of the serious shortage of professionals mainly Engineers and the Technicians, it is imperative that the Training Programme be intensified so that we can produce skilled personnel to tide over this manpower constraint.

2. BASIC DATA :

Information furnished in Appendix - A.

3. CONSTRAINTS OF THE DECADE PROGRAMME AND PROPOSED MEASURES :

April, 1981 - March, 1985 has been designated as the Phase - I of the Decade Programme and the following constraints were experienced during the Phase - I Programme :

a. Inadequate resources;
b. Insufficient manpower at different levels in the Sector Organisations;
c. Procedural delay in land acquisition and
d. Poor socio-economic condition of people to support self-financing scheme.

During Phase - II of the Decade Programme it may not be possible to remove all the above constraints. It might be required to formulate national policies to remove some of the above constraints.

Manpower at different levels of the Sector Organisations should be sanctioned in conformity with the work-load at different stages of the work programme ranging from Survey, Investigation, Planning, Execution, Monitoring, Evaluation, Operation and Maintenance. A National policy also requires to be formulated and detected to set up certain norms for the sanction of different categories of personnel according to the work programme. Land Acquisition procedure is to be streamlined for execution of the schemes within the time frame. Long term economic measures to be adopted at the State and National level to improve the socio-economic condition of the people to support self-financing scheme. Health Education and Community Participation Programme is to be assigned a higher priority, so that people in the urban as well as in the rural areas become conscious and aware not only of the necessity of safe drinking water but also of the sanitary disposal of human excreta.

4. MANPOWER STATUS AS ON MARCH 1981

4.1. Professionals :

	As on March, 1981 CMA	As on March, 1981 Non-CMA	No. added during 1981 - 85
1. Engineers (Degree)	172	200	88
2. Engineers (Diploma)	327	932	96
3. Economists/Financial Analysts	1	-	-
4. Accountants	-	6	21
5. Social Scientist/ Health Educators	39	23	-
6. Sanitary Chemists/ Biologists	5	-	-
7. Hydrogeologist/ Geologist	-	1	-

4.2. Technicians :

	CMA	Non-CMA	No. added during 1981 - 85
1. Draughtsman	44	79	44
2. Plant Operators	38	55	-
3. Mechanics/Electricians/ Fitter/Plumbers	1507	126	-
4. Drillers	-	53	188
5. Laboratory Technicians	14	1	-
6. Surveyor/Others	201	10	68

5. MANPOWER REQUIRED

5.1. Professionals

(Top figures are for CMA and Non-CMA figures are in the bracket)

Category of Staff	Yearly requirements					
	1985-86	86-87	87-88	88-89	89-90	90-91
1. Engineers (Degree)	646 (724)	646 (724)	646 (724)	646 (724)	646 (724)	646 (724)
2. Engineers (Diploma)	1700 (1886)	1700 (1886)	1700 (1886)	1700 (1886)	1700 (1886)	1700 (1886)
3. Economists/Financial Analyst	3 (2)	3 (2)	3 (2)	3 (2)	3 (2)	3 (2)
4. Accountants	79 (163)	79 (163)	79 (163)	79 (163)	79 (163)	79 (163)
5. Social Scientist/ Health Educator	15 (25)	15 (25)	20 (30)	20 (30)	20 (30)	20 (30)
6. Sanitary Chemist/ Biologist	8 (38)	8 (38)	8 (38)	8 (38)	8 (38)	8 (38)
7. Hydrogeologist/ Geologist	2 (3)	2 (3)	2 (3)	2 (3)	2 (3)	2 (3)
8. Others						

5.2. Technicians

Category of Staff	1985-86	86-87	87-88	88-89	89-90	90-91
1. Draughtsman	77 (163)	77 (163)	77 (163)	77 (163)	77 (163)	77 (163)
2. Plant Operators	100 (224)	102 (228)	102 (228)	102 (228)	102 (228)	102 (228)
3. Mechanics/ Electricians	100 (740)	100 (750)	100 (760)	100 (770)	110 (770)	123 (777)
4. Fitters/Plumbers	12 (1200)	12 (1200)	14 (1200)	14 (1200)	14 (1200)	14 (1200)
5. Drillers	14 (66)	14 (66)	14 (66)	14 (66)	14 (66)	14 (66)
6. Laboratory Technicians	14 (16)	14 (16)	15 (30)	15 (30)	15 (30)	15 (30)
7. Others Surveyors	(114)	(114)	(114)	(114)	(114)	(114)

6. NEED FOR TRAINING :

The proceeding Tables indicate that there would be a large scale requirement of professionals and technicians to complete the Decade Programme within the time frame. The existing engineering colleges and pllytechnics producing degrees and diplomas can hardly cope up with this requirement. Under the exigency of circumstances, the only option left with the authorities concerned with the implementation of the Decade Programme is to go in for large scale training programmes, so that the skilled personnel can be utilised after rigorous training in the existing training Institutes.

Within the State of West Bengal, there is only one State-level training institute viz., Institute of Local Govt. & Urban Studies (ILGUS). This Institute is also in its infancy and has just crossed over the teaching trouble. The Institute runs mainly on guest faculty. The Institute is going to receive an autonomous character with a big administrative set up with its head-quarter at Bidhan Nagar (Salt Lake City - New Calcutta).

Besides this, there is another Institute viz., Administrative Training Institute (ATI) under the administrative control Home (PAR) Department, Govt. of West Bengal. That Institute is primarily responsible for imparting administrative training to the service personnel. In addition to this, there is a Training Centre within the Calcutta Metropolitan Development Authority (CMDA) which is meant for in-service training of CMDA personnel. Likewise Corporation of Calcutta, the biggest local body within the State has also another Training Centre which is meant for in-service training of Calcutta Corporation personnel.

7. CONCLUSION :

Logically the conclusion is, therefore, to strengthen ILGUS which is the only State-level Training Institute within the State of West Bengal. Since the programme is spread over the entire State, it would be available to open up Regional Training Centres of ILGUS under the administrative control of the Local Government and Urban Development Department, so that the training programme could be undertaken on a regional basis. This is required in the interest of successful timebound completion of the Decade Programme.

APPENDIX - A

BASIC DATA

1.	Area of West Bengal	: 87,853 Sq. Km.
2.	Location	: Between the latitude of 86°-35' to 89°-33'E Between the longitude of 21°-33' to 27°-14'N
3.	Population of West Bengal (1971) (1981)	: 44 million : 55 million
	(a) Rural Population	: 75%
	(b) Urban Population	: 25%
	(c) CMA	: 19%
4.	Population Density (1971) within CMA Rural	: 10,987 / □ km. : 398 / □ km.
5.	Local Govt. Structure : (1971) in CMA.	: 3 Municipal Corporations 31 Municipalities 63 Non-municipal Urban areas 544 Urban Units (16 urban communities)
	Outside CMA (1971)	: 118 Urban Communities. 37, 530 Villages.
6.	Portion of piped water supply (1.4.81)	: 792 Villages 3 Urban Communities in CMA 66 Urban Communities Outside CMA.
7.	Portion of Sewerage Facilities (1.4.81)	: 6 Urban Communities outside CMA.
	within CMA	2 Municipal Corporations. 3 Municipalities 1 N. A. A.
8.	Position of Rural Sanitation	: Almost non-existent.
9.	International Water Supply & Sanitation Decade in West Bengal.	: April 1981 - March 1991.
10.	Decade objective	: a) Safe Drinking Water to All. b) 80% Sanitation to Urban Population. c) 25% Sanitation of Rural Population.
11.	Objective in Physical Terms	: a) To provide new Water Supply to 25,243 Villages; to 69 Urban Communities. b) To provide new Water Supply c) To augment service level in 65 Urban Communities. d) To install Sewerage System in 10 Class I Urban Communities. e) To provide household latrine with septic tank to 23 Urban Communities.

12. Target Population in million. :

	Augmentation	New Scheme
a) Urban Water Supply	8.665	7.576
b) Rural Water Supply	-	43.302
c) Urban Sanitation	-	10.750
d) Rural Sanitation	-	12.563.

13. Fund Requirement : in millions of Rupees

	Upto 6th Plan	March '86 MARCH '91	Total (Decade Requirement)
a) Urban Water Supply	Rs. 860	Rs. 1760	Rs. 2620
b) Rural Water Supply	Rs. 680	Rs. 4330	Rs. 5010
c) Urban Sanitation	Rs. 480	Rs. 4580	Rs. 5060
d) Rural Sanitation	-	Rs. 630	Rs. 630
	Rs. 2,020	Rs.11,300	Rs.13,320

14. Organisation : a) Public Health Engineering Dtc. Govt. of West Bengal
b) Municipal Engineering Dtc. Govt. of West Bengal.
c) Calcutta Metropolitan Development Authority.

15. Income Level (Source : Bureau of Applied Economics & Statistics) : Rs. 1302.80 (1977-78 yardstick) Based on the poverty line at Rs.65/- percapita/month in 1977-'78 prices with a minimum daily caloric requirement of 2400/person in rural areas and the poverty line at Rs.75/- per capita/month in 1977-'78 prices with a minimum daily caloric requirement 2100 in urban area.

16. Percentage of Population below the poverty line : a) Rural - 58.94
b) Urban - 34.71
c) Combined - 52.54.

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P N Gholap

Village water supply in Maharashtra State

OBJECTIVE AND THE NEED -

The objective of this project is to provide safe, potable and adequate drinking water to 17112 identified villages of Maharashtra. Out of 35778 villages, as per 1971 census,about 17112 villages have been identified as problem villages as on april 1980.

The State Government decided to provide water supply to these villages during VIth Five Year Plan period of 1980-85. In India the responsibility of providing water supply facilities to the population in the urban and rural areas vests with local bodies with the financial assistance from the State Government while the overall control is exercised by the Govt. of India through the Ministry of works and Housing.

At the level of State Government, this programme in rural areas is planned and implemented by Rural Development Department whereas in urban areas it is planned and implemented by the Urban Development Department through various agencies of the State Govt., including the local Self Govt. of the State. The provision of potable water supply facilities in urban and rural population is an important aspect which has been considered in the successive five years plans of India. So far about 1% to 2% of plan allocations were earmarked for this programme. However, in the 6th five year plan, this allocation has been increased to about 4% of the total planned provisions. It has been estimated that at the beginning of 6th five year plan i.e., April 1980 about 30% of the population in rural areas had access to a reasonably safe drinking water supply. This is considered to be much on lower side compared to the corresponding levels of services in the other developing nations. The 6th Five year plan, therefore aims at stepping up the programme in this sector. Simultaneously, a decade programme (1981-90) has also been drawn in order to provide 100% water supply services in the urban and rural areas of India.

The review taken at the beginning of the sixth five year plan revealed that out of 35778 revenue villages in Maharashtra covering a rural population of 41 millions, 17112 villages covering about a population of 14 millions were still required to be provided with safe drinking water supply.

GENERAL STATISTICS OF THE STATE

Location:
The state of Maharashtra forms a major part of peninsular India with the coast in its Western Side. It lies between 16.4 and 22.1 degrees North latitude and 72.6 and 80.0 degrees East longitude.

Area :
The Maharashtra State is the 3rd largest State in India with an area of 0.308 million sq.kms.

Population:
The populatinn of the State is 62 millions as per 1981 census with about 65% population from rural area.

Geology:
About 80% of the area of State is covered by Deccan Trap. The other hard rock constituting schiest, gneisses, quartzites, granites are exposed in Eastern, Southern and Western parts of the State Covering the areas of Nagpur, Bhandara, Chandrapur, Yewatmal, Nanded, Ratnagiri and Kolhapur districts. The rocks belonging to cuddapah series occur on large scale in Yewatmal, Chandrapur & Kolhapur district.

They mostly include lime stones, shales and quartzitic sandstone. The coal bearing Gondwana formations occur in Nagpur,Chandrapur, and Yawatmal districts only. Alluvial belt of Recent to sub-recent origin occur in Amaravati, Akola, Buldhana, Jalgaon and Dhule districts along Tapi and Purna rivers.

Climate:
The climate of the Maharashtra State is Tropical. The maximum temperature is 38°C and the minimum temperature is 29°C .

Rainfall :
There is considerable variation in the rainfall among the different parts of the state. Heavy rains pour over the Ghats and the Coastal districts of Thane, Raigad and Ratnagiri. At certain places in the Ghats, it is more than 3000 mm. The major part of the state, however, lies in the rain shadow of the Ghats, with the rainfall average around 700 mm. and in some area even less than 500 mm. The rainfall of the state ranges from 500 mm to 3000 mm.

The annual revenue and capital budget of the state is around Indian Rupees 35774 millions (100 Indian Rupees=5.952 sterling pounds as on 26th August 1985).

An abstract of the General Statistics is given below :

i)	Area of the state	3,08,000 sq.km.
ii)	Population as per 1981 census	62 millions
iii)	Urban Population	21 millions
iv)	Rural Population	41 millions
v)	Average Density	164 person/sq.km.
vi)	Rate of growth of population	2.4% per annum
vii)	No.of corporations	9 Nos.
viii)	No.of Municipal councils.	217 Nos.
ix)	No.of Districts	30 Nos.
x)	No.of towns	289 Nos.
xi)	No.of Revenue villages(inhabited)	35,778 Nos.
xii)	No.of Zilla Parishads	29 Nos.
xiii)	No.of Panchayat samitis	296 Nos.
xiv)	No.of Gram Panchayats	24,016 Nos.

ORGANISASTIONS DEALING WITH RURAL WATER SUPPLY PROGRAMME

Maharashtra Water Supply and Sewarage Board:

The Board is a Panel of 11 members to include the Chairman, the member Secretary,4 secretaries of the Departments as ex-officio members, 3 elected Presidents of the local bodies and 2 nominated technical members. On the executive side, it has 3 Chief Engineers, 13 Superintending Engineers, 50 executive Engineers and about 200 Deputy Engineers for implementation of the programme of rural and urban water supply in the state. Administratively the Board is under the Urban Development Department of the State. The annual turnover of the board is about Rs.1500/-. millions.

Ground Water Surveys and Development Agency:

The Agency consists of Directorate at the headquarter level under the control of Director who is the Geologist, under him there are 4 regional officers headed by Regional Deputy Deputy Directors who are Geologists. At each of the 29 district, there is a district Geologist and the supporting staff to undertake the works of hydrogeological survey, drilling of bore wells, procurement installation of hand pump & power pumps.

Zilla Parishads :

The Zilla Parishad is three tier administration with the Zilla Parishad at District level Panchayat Samiti at Block level and Panchayat at village level. The members of these organisations are partly elected and partly nominated by Govt. The Supervisory control of these organisations is with the Rural Development Department at the State Level. The Board mainly looks after the piped water supply programme costing above 3 lakhs while the G.S.D.A. looks after programme of bore wells with hand pumps and power pumps. The Zilla Parishad and the village Panchayats undertake the programme of the dug well and the piped water supply schemes of smaller magtitude below Rs.3 lakhs.

SELECTION OF PROBLEM VILLAGES :

The criteria for deciding problem villages.

i) The villages having source at a dist. more than 0.6 km. as per Government of Maharashtra norms.

ii) The villages having source at a dist. more than 1.6 Km. as per Govt.of India's norms.

iii) Villages endemic to cholera, where drinking water sources are infested with guinea worm and where sources have excessive chemicals.

PROCEDURE FOR IMPLEMENTATION OF PROGRAMME"

The rural Water Supply Programme :

It is tackled in three ways viz. Dug well, Bore well with hand pump and Power Pump and piped water supply. The Inter Desciplinary Committee consisting of the Collector and the Chief Executive Officer of the Zilla Parishad assisted by the Executive Engineer, Environmental engineering organisation and the District Geologist, established at each district decides the nature of the scheme for each of the problem villages and prepare the list of least cost solution for these villages. After this is done the District Planning & Development Council finalises the programme of the District within the allocations made available to it.

MEASURES ADOPTED FOR SOLVING THE PROBLEM OF DRINKING WATER.

Simple Measures:

Water supplied through Bore wells/Tube wells or piped water supply schemes.

Preparation of Project :

For the preparation of working plan for the sixth plan period, it was assumed that the villages having population of 2000 and above as per 1971 census would need piped water supply schemes and below that bore wells (at (at the rate of 1 bore well for 250 souls) may suffice. However, there can not be water tight compartment and the feasibility of the programme is also required to be examined.

To study Water resources for bore well:

General water Survey and Development Agency carried out the work of ground water assessment for the entire state of Maharashtra under the International development assessment programme for Maharashtra Credit Project. For this purpose, the entire area of the State is divided into 1467 water sheds. Each water shed had the area of about 200 to 300 sq.kms. The parameter for ground for water recharging were considered on the basis of field observations of acquier conducting of acquier conducting geological hydraulic surveys and observations of water table fluctuation. Accordingly bores are drilled & hand pumps are installed on successful bores & power pumps are installed on bores yielding more than 12000 litres/hour.

To study water resources for piped water supply the water sources such as percolation tanks, Irrigation tanks, rivers in the area are observed. The source should be perennial and having adequate yeield. The water is tested chemically and bacteriologically to assess its potability in both the above cases. The drinking water standards prescribed by world Health Organisation are adopted while preparing the project report.

BACTERIOLOGICAL STANDARDS :

Water in the distribution system shall satisfy all the three criteria indicated below ;

1) E.coli count in 100 ml. of any sample should be zero.
2) Coli form organisms not more than 10 per 100 ml. shall be present in any sample.
3) Coliform organisms should not be detectable in 100 ml. of any two consecutive samples or more than 50% of the samples collected for the year.

TABLE No.5

DRINKING WATER STANDARDS FOR PHYSICAL AND CHEMICAL QUALITY OF WATER

Sr. No. constituents	Recommended by W.H.O. Max.accept. able concentration	Max.allowable limit.
A) PHYSICAL		
1.Colour(Hazen units)	5	50
2.Turbidity(units)	5	25
3.Odour and Taste	Unobjectionable	
B) CHEMICAL		
4. pH	7 to 8.5	Less than 6.5 or greater than 9.2
5.Total Solids(mg/L)	500	1500
6.Total Hardness as $CaCO_3$(Mg./L.)	100	500
7.Calcium(Mg/L)	75	200
8.Magnesium(Mg/L.)	30	150
9.Iron (Mg/L)	0.1	1.0
10.Manganese(Mg/L.)	0.05	0.5
11.Copper(Mg/L)	0.05	1.5
12.Zinc(Mg/L)	5.0	15.0
13.Chloride(Mg/L)	200	600
14.Sulphate(Mg/L)	200	400
15.Phenolic compound (Mg/L.)	0.001	0.002
16.Fluoride(Mg/L)	-	1.5
17.Nitrate(Mg/L)	-	45

Sr. Constituents	Recommended by W.H.O. Max.acceptable concentration	Max.allowable limit.
TOXIC		
18. Arsenic (mg/L)	-	0.5
19. Cadmium (Mg/L)	-	0.01
20. Cyanide (Mg/L)	-	0.05
21.Lead(Mg/L)	-	0.10
22Marcuri(Mg/L)	-	0.001
23.Selenium(mg/L)	-	0.01

* International Standards for Drinking water - WHO 1971.

The rate of water supply at 40 litres per capita per day is adopted for framing rural schemes and 25% losses on gross supply are assumed.

Cost estimation of the project

a) For bore well programme with hand pump Rs.95/- per capita (1 bore for 250 souls)
b) For bore well programme with power pump Rs.135/- per capita (1bore for 1000 souls)
c) for piped water supply programme Rs.300/- per capita in plain area.
Rs.400/-per capita in hilly area.

The above per capita cost have been assumed at March 1984 rates and an escalation, at 10% per year compound is to be added for preparing programme for completion of the scheme.

FINANCIAL PATTERN :

100% of financial assistance is given by the Govt. of Maharashtra for executing the dug well, bore well piped water supply programmes in Tribal areas and Dug well and bore well programmes in chronic scarcity and flood affected areas and 95% of financial assistance is made avavailable for Dug well and bore well programmes and piped Water supply scheme in other areas.

The difference is to be made good by way popular contribution.

The Government of India also assists for piped water supply schemes and bore well programme under the centrally sponsored Accelerated Rural Water Supply programme which is in operation in the state since 1977-78.

PLAN OF OPERATION FOR SIXTH PLAN PERIOD 1980-85.

Programmewise Indentification of villages:

At the commencement of the sixth five year plan 1980-85 out of 35778 inhabited villages in the state, it was estimated that about 17112 problem village still required to be provided with safe and adequate drinking water supply as on 1st April 1980 of these, 12935 villages satisfied the Government of India norm whereas 4177 villages satisfied the state Government norm of difficult villages.

Govt. had decided to solve the problem of drinking water supply of these villages at an estimated cost of Rs.3350/- million (including Rs.200 million towards popular contribution) during sixth plan period by adopting the following measures.

Programme of villages to be covered on 1.4.1980.

Measures	G.O.I. Norms	GOM Norms	Total
1)Piped water supply	3070	1289	4359
2)Bore well programme	9865	-	9865
3)Dug well programme	-	2888	2888
Total	12935	4177	17112

Problem villages covered during VIth Five year plan

I) Government of India's Norm(12935 villages)

Year	P.W.S.	BORE WELL F.C.	BORE WELL P.C.	Dug	Total
1980-81	209	908	1557	-	2674
1981-82	398	1232	962	340	2932
1982-83	495	788	1007	23	2313
1983-84	411	669	897	-	1977
1984-85	1016	385	471	248	2120
TOTAL	2529	3982	4894	611	12016

II)Govt.of Maharashtra's Norm(4177 villages)

1980-81	102	377	694	10	1183
1981-82	89	305	322	31	747
1982-83	77	189	254	4	524
1983-84	95	427	238	28	788
1984-85	311	136	149	29	625
TOTAL	674	1434	1657	102	3867

Note-P.W.S.: Piped water supply, F.C.Fully covered P.C.-Partially covered.

Out of 17112 problem villages as per above tables, 15883 villages have been covered under piped water supply Bore well and Dug well programme.

d) MAINTENANCE OF THE RURAL DRINKING WATER SUPPLY SCHEMES.

It is the legal responsibility of the local body concerned as per three tier system/.

Maintenance of Dug well :

The construction of the dug well is undertken by the Zilla Parishad from the Government grant and they are maintained by Zila Parishad

Maintenance of bore wells

On completion by Graund Water Surveys and Development Agency, the borewells are handed over to the concerned local bodies for operation and maintenance.

In order to ensure the proper maintenance and repairs to the hand pumps fitted on bore wells, Government introduced three tier maintenance system from March 1978. The salient features of the system are :

a) At village level a responsible person in the village will function as caretaker of the hand pumps. He will report promptly to the Block officer, if the hand pump goes out of order.

b) At Taluka level, one mechanic is to be appointed for maintenance of every 100 pumps in the taluka. The mechanic is required to inspect the hand pump periodically and to effect minor repairs as soon as the report about pump going out of order is received from any village or in turn will send report to the district officer i.e. Deputy Engineer, G.S.D.A./Executive Engineer Z.P.

c) At district level a pump repairer's team with a mobile van equipped with necessary tools and comprising one mechanical Supervior, a mechanic and a helper would be set up for doing major repairs for every 5000 hand pumps in the district

d) The appointment of the required technical staff are to be made by the Zilla Parishads and the expenditure is to be met from their own resources. The Zilla Parishads are also required to incur expenditure initially from their own resources on maintenance and repairs of the hand pumps. The village Panchayat has to pay Rs.400/- pump/annum to Zilla Parishads for bearing expenses on mechanic.

i) Cost/pump to be paid to Zilla Parishad. Rs. 400/-

Population served/Pump 250 souls

ii)Honourarium to caretaker Rs. 240/-

Hence maintenance cost per capita per annum $\frac{640}{250}$ 2.6

assuming 6 souls per house i.e.2.6x6=15.6
Say Rs.16/- per house.

e) Maintenance of power pumps :

Govt. has also introduced a system of maintaining power pumps. As in the case of three tier system of maintenance & repairs to hand pumps a responsible person in the village will function as a care taker of the power pump fitted on bore well. Village Panchayat will take general care of power pump. As and when pump goes out of order, the Sarpanch or Gram Sevak should promptly send report to the Zilla Parishad Office about it. So that the electrician will immediately visit that village for repairing. For maintenance of power pumps one electrician is appointed at Zilla Parishad office for every 50 power pumps installed in the district and is provided with necessary tools, spare parts, accessories etc.

The village panchayat will receive depreciation charges from the tax collected for water. The village panchayat will appoint operator cum caretaker for proper and smooth functioning of the pumps. It is assumed that normally when a power pump is installed on the bore well, population equivalent of 4 stand posts (1000 souls) would at least be served assuming available discharge of bore well.

In order to meet the expenses for running power pump installation the village panchayat will have to collect tax from beneficiaries as given below.

i) Charges for Zilla Parishad Service.	Rs.500/-
ii) Power charges (Assuming 3 B.H.P.)	Rs.500/-
iii) Service rendered by pump operator cum caretaker	Rs.6000/-
iv) Depreciation of power pumps	Rs.400/-
Total	Rs.7400/-.

Population served 1000 souls.

Therefore maintenance cost per capita Rs.7.40

Assuming 6 souls/house tax per capita Rs.45/-

f) Maintenance of piped water supply schemes:

It is the policy of the Government of Maharashtra that after implementation, water supply schemes in individual villages are handed over to Panchayats and combined and regional schemes are handed over to the Zila Parishads for operation and maintenance.

g) Tarriff:

In order to make these schemes self-supporting the local bodies are expected to levy adequate water rate and taxes as proposed below and according to provision of bylaws.

A Table indicating the taxes to be recovered from beneficiaries:

Sr. No.	Type of supply	No.of villages	Population	No. of houses	Rate of tax.	Total tax to	Remarks.
1	2	3	4	5	6	7	8
1.	Hand pumps with bore well				Rs.16/- per house per year		
2.	Power pumps with bore well				Rs.45/- per house per year		
3.	Piped water supply with surface source				Rs.60/- per house per year		
Total							

CONCLUSION

If the problem of drinking water in rural area is tackled by appropriate measures systematically with sufficient funds and staff the goal of supplying potable water to all villages by 1990. 1990.

REFERENCES

1. Annual Plan 1980-81 Govt.of Maharashtra Planning Department, July 1980.

2. Water Analysis report, Ground Water Surveys and Development Agency, Maharashtra, 1982.

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

Simon Watt

Tailor-made or off the peg?

Background to Planning.

Project Planning Methodologies coordinate the wide range of disciplines and control the long series of tasks involved in the planning process.

Pre-investment planning develops projects through from their inception to completion to give schemes that are (one hopes) technically sound, economic,financially viable, socially acceptable,- and institutionally possible.

Planning is an empirical science rooted in a 'practice' that grows like topsy with the institutions doing the planning.Planning methodologies make this 'practice'more systematic and controllable.

Established planning 'practice' can cause difficulties when the sector programme is suddenly accelerated in scale or scope.

The rapid increase in Water Decade expenditures has caused difficulties in many water and sanitation departments,particularly in the small-urban(4-15,000 people) and rural(measured in 100's) subsectors.

Does the cost of pre-investment planning matter when we consider the lifetime cost of a project?This paper,using experience from the Philippines and Indonesia, suggests that it does.The planning should not only be efficient in resouce use,but planners should be wary of ascribing needs to the users that they will be unwilling to pay for once the investment is sunk in the ground.

Large urban, small urban, and rural subsectors-a comparison.

Water and sanitation departments before the Decade concentrated their efforts on the large urban sub-sector using comprehensive Methodology Manuals for the pre-investment planning.

Urban areas,as centres of economic activity and and civil administration,contain a large proportion of high income earners who can afford an economic rate.The large number of people served and their housing density give substantial economies of scale, reducing unit costs.

Large urban schemes are 'technique-intensive' to plan and use teams of skilled designers.They are built by skilled contractors and then delivered to the users.Operation and maintenance is normally in the hands of professionals as part of a municipal authority.

In contrast, rural schemes are 'people intensive'.They use simple and standard components -the risks of expensive design errors being minimal.Income levels are low, the population is dispersed, so unit costs must be held down by lowering service levels.

They are built either by semi-skilled artisans, by the users themselves ,or by a combination of the two.Operation and maintenance is generally the responsibility of the users.

Between large urban and rural schemes lie the small urban projects-the subject of this paper -that cater for small,low density populations with low average income and few skills in the community.These are often too large for off the peg rural designs, yet too small to justify the tailor made systems of large urban schemes.

They are a special case requiring a hybrid planning methodology that incorporates the experience and techniques of both the rural and urban planning subsectors.

The pre-investment planning activities needed for the subsectors are compared in Fig 1.

Small-Urban Planning: the Philippines and Indonesia.

The Philippines -LWUA.

Small-urban water supply schemes in the Philippines are handled by the Local Water Utilities Administration(LWUA) and the Rural Waterworks Development Corporation(RWDC).

LWUA is a lending agency that also carries out the pre-investment planning, assists in construction and management advice, and provides low cost loans.LWUA works through locally elected Water Districts(WDs) that are ultimately responsible for the schemes.

LWUA have found that the cost of pre-investment planning is inversely proportional to project size:

Popln. (av)	Study Cost	Study cost / Construction
192,000	$110,000	4%
92,700	$85,000	8%
73,200	$83,000	16%
42,400	$81,000	38%

These studies included a Master Plan,and a single phase feasibilty study with 5-8 years design horizon.

But small-urban schemes, even with pared down planning steps had pre-investment costs between 20-50% of estimated construction costs;in one case the study cost exceeded the estimated cost of the construction.

These excessive costs occured because whatever the scheme size the 'planning practice'demanded the same engineering staff time; the smallest schemes with little data in fact demanded longer study time than the largest schemes and in many instances were shown to be unviable after months of work.

This has prompted LWUA to revise their planning methodology,design standards,- and seek flexibility through the use of micro-computers.

The Philippines -RWDC.

RWDC has the task of providing the rural villages with improved water supplies through point sources and stand-posts.They provide technical assistance in design and construction, grants and low interest loans to a village level WD.

RWDC's approach is simple, field orientated and aimed at mass implementation to meet stiff targets.Designs and drawings are standardised for low capacity systems that are intended to meet basic needs. Pre-investment planning costs are less than 10% of construction costs.

RWDC is finding, however,that their standardised approach is too inflexible for the larger schemes in their programme.

Indonesia: IKK

To meet the targets of the Water Decade programme the Indonesian government set up the 'Ibukota Kecamatan (IKK) programme to provide 1700 small towns(populations 5-15,000) with a basic water supply by 1990.

This fast implementation is to be met using standardised designs which have low service levels and are cheap.Planning is therefore simplified by designs and costs being taken off the peg.

These designs come in a range of standard sized packages.Service levels are fixed at 50:50 house connections:public faucets.Flow is restricted to 600 l/hh/d for households and 6000 l/pf/d for the standposts.IKK pays for investment costs but the users are expected to pay for operation and maintenance.

Studies have shown that the users are not satisfied with the IKK service levels and in many instances regard the new schemes as only marginally better than their existing supplies.Between 70-95% of households are able to pay for house connections, although the design allows only 50% connections.

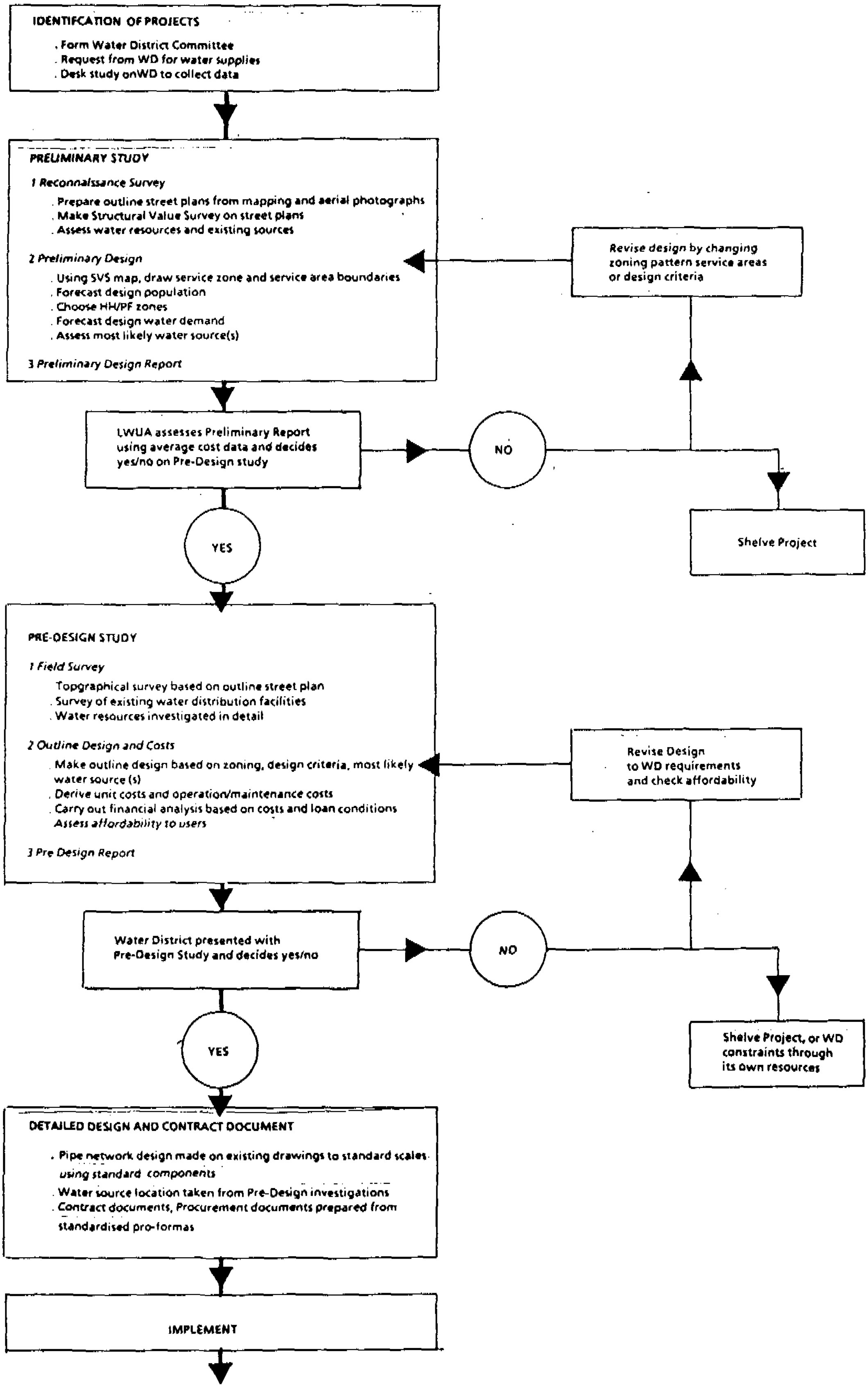
The IKK is now considering ways to make the planning process more flexible to meet actual site conditions and the wishes of the users.

LWUA's Approach to more flexible design.

Use of micro- computers.

In 1981 LWUA ,with the assistance of UNDP, began a research programme to integrate micro-computors in the planning process to make more efficient use of staff,reduce design costs, and investigate more alternatives.

Fig 2 Decision Flow Chart, for Revised Small-Urban Planning Methodologies



Research was carried out costing the effect of lowering design standards and service levels. Minimum pipe sizes were reduced,fire flows deleted,residual pressures reduced, and service levels lowered.Reducing design standards only lowered capital costs by 20%; but reducing service levels as well lowered costs by 30-40%.

Modifying design in this way reduced water rates by 47% in one of the towns studied, making an initially unviable project financially viable.

In practice,of course, design standards are seldom maintained.Systems are mostly operated on a fill and draw basis and design flows are seldom reached.

LWUA's objective was to limit pre-investment planning costs to 13% of construction costs.The schemes had to be financially viable and acceptable to both LWUA and the users.

Revised planning procedures were tried out on six projects as a guinea pig using the methodology shown in Fig 2.

Each of these steps advanced the planning to a higher level and allowed LWUA's decision makers to intervene if the schemes proved likely to be unviable.The procedure also presented the WD's with a feasible scheme to consider and be modified to their rquirements without wasted design work.

This approach built the experience of senior engineers into the start of the planning process in the Preliminary Study.It makes a compromise between a comprehensive study that reduces risks of errors and the limited study of the standard package approach.

The computer network package allowed the systems to be modelled to trade off service level reduction against user preference for fully piped systems.

Data collected during the studies showed that the income profiles of the towns varied widely and a pre-determined service level mix would have been inappropriate.

Financially viable,mixed service level designs caused problems when presented to the WDs who were unwilling to consider standposts at all because of the difficulties of collecting revenue.

Some Conclusions.

The planning experiences in both the Philippines and Indonesia in small-urban water supply systems suggests that 'appropriate' planning methodologies are as necessary as 'appropriate' water supply technology.

Pre-investment planning for these systems must be flexible,use experienced judgement for early decisions instead of extensive and expensive documentation,and be responsive to user preferences.

Small-urban projects present the planner with the problem of designing a system that is cheap enough to be financially viable yet have a service level that reaches the 'critical mass' of the higher income groups willingness to pay.

Experience in both countries shows that the higher income groups have already made considerable investments in their water supplies which they are unwilling to abandon if the new supplies are not superior in service level.Projects that meet basic needs only through stand pipes will not acceptable to them.

Most authorities are required to plan for the needs of all users, including the poor.Schemes that prove financially unviable can either be subsidised or shelved.

If they are subsidised then service levels acceptable to high income groups are a direct subsidy to them paid out of state taxes or from cross subsidies from wealthier schemes.If the projects are left to the private design of the high income groups then these will inevitably appropriate existing water sources denying access to the poor.

Flexible design and the staged upgrading of service level may produce schemes that are equitable and financially viable.Many small-urban schemes, however,will inevitably require subsidies.

In this case the task of the planning team is to minimise subsidy levels whilst maximising service levels.Planners should remember that they can approach small-urban planning from both the top and the bottom.For the smaller systems below the critical economic mass the rural approach of upgrading point sources is a usefull one to consider.

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

A K Dutt

Water Decade and Calcutta water supply

1.0 INTRODUCTION

"Clean water and adequate sanitation for all by the 1990" was the target set, in the year 1980, by the United Nations. The time span allotted for achievement of the target was the Decade-1981 to 1990. Today, in the year 1985 we are in the middle of the time span. Where are we now? How far is the Decade target relevant to old urban areas like the great city of Calcutta? What are the problems? What are the solutions? These questions with reference to the water supply of Calcutta have been discussed here along with general issues on urban water supply systems.

2.0 DECADE OBJECTIVE

A basic minimum level of water and sanitation for all the people of the World - particularly for those who did not have any such access was the main object of the water Decade. The HABITAT symposium declared - "clean water should be provided to all people in all settlements by a specific date, say 1990".

For fulfilment of the target, nations were requested to fix their service standard according to their suitability. It was declared that government should adopt programme with realistic standard for quality and quantity to provide water for rural and urban areas by 1990 if possible. We hear, in connection with the Decade, some flexible standards as expressed through - "reasonable access to safe water"; or "appropriate technology" or "adequate sanitation" etc. The reasonable access for example have been defined to that when the water points, in urban areas, are available within 200 meters from the house, for rural areas the reasonable access was defined as - "housewives do not have to spend a disproportionate part of the day in carrying water for the family". The word "disproportionate " is non-specific too and there are conflicting opinions regarding the reasonable distance.

We can, perhaps, sum up the Decade target as - to supply drinking water and provide sanitation to all the people of the World in a way which is technologically, socially and economically feasible and which will bring welfare in health and economy of the people by reducing diseases and hardships. The water shall be safe for various uses and shall be of such quantity as would satisfy the minimum needs for a healthy life. The flexibility in quantity and quality is a practical proposal.

3.0 CALCUTTA BACKGROUND

3.1 Consumer composition

City of Calcutta, having a population of about four million, is one of the world's important urban concentrations. Several sections of people live in the city of Calcutta. In addition to the residents of the city several thousands of persons are regularly coming to the city for economic gain. They spend about eight to ten hours a day in the city enjoying city facilities. The residents of the city can be broadly divided as - street dwellers, squatters or slum-dwellers, low income families in semi-pucca or pucca housing, middle income families huddled in rented houses, higher middle income families in individual houses or rented apartments, higher income families and rich in good, comfortable living space or in multi-storied flats in good locality.

3.2 Water demands

The per capita water requirement of the consumers depends upon several factors like educational standard, economic status, housing and shelter facilities, standard of living, nature of plumbing fixtures, number of taps, distance of the water source from the residence, season, age, culture, social customs, cost of water, regularity of supply and other factors. The different groups of people of Calcutta have widely varying economic conditions, cultural backgrounds, educational status, housing facilities and water supply appliances. As such they have different real water demand. If we can supply this real water demand, to the concerned groups of people, then the objective is adequately fulfilled. The quality of water obviously should not be injurious to health.

Several U.N.organisations including the World Bank and the W.H.O. time to time tried to assess this percapita demand for the third world urban and rural population. For urban areas percapita water demand stated to very from a bare minimum of 3 gallons per day to 40-50 gallons per day depending on consumers character and type.

Dr. Gilbert White after study of third world urban water demand had assessed the demand as -

City dwellers depending on public stand posts	- 2 to 11 gallons per day.
City dwellers with single house hold taps	- 3 to 20 gallons per day.
City dwellers with several taps	- 8 to 60 gallons per day.

A World Bank report said that "Health benifits of safe water are attainable at service levels of 30 to 40 litres (7 to 9 gallons)percapita per day on site,this will provide for protection against the range of water related disease and adequate for the personal hygiene which(with health education) will lead to less diarrhoel diseases,skin and eye infections and fewer parasites on the skin. For the later access to water is more important than the microbiological or chemical quartity".

Allocating a real water demand rate,depending on the variable factors as stated earlier,to the different groups of people,the probable real domestic water demand for Calcutta(old limits)works out to about 109 mgd. If we add to the real demand an allowance for industrial and commercial use and leakage of about 35% of the total supply then a demand of 180 mgd will mature.

3.3 Available water supply

The several water sources which are meeting water demands of the city in various forms are -

Treated surface water from Pulta Water Works.
Treated surface water from Garden Reach Water Works.
Surface water through unfiltered water system.
Public deep tubewells and hand tubewells.
Private deep tubewells and hand tubewells.
Private small intakes.
Other sources-wells,tanks,ponds etc.

The water of River Hooghly is also used for bathing purposes. The unfiltered water is generally used by the street dwellers for bathing or washing purpose.

A conservative assessment of the combined total capacity of all the sources indicate that more than 200 mgd of water can be made available for Calcutta.

3.4 Overall situation

Apparently City's capacity to produce water,looks sufficient. Moreover, due to several water supply improvement programmes extension of pipe lines,sinking of hand tubewells and construction of street stand posts water points are available within 250 ft. The growth of Calcutta and its continued attraction indicate that the city water supply is not too troublesome.

The actual position of water supply, however,is not so bright. There are reports of water shortage, low pressure,drytaps,breakdown and chockage of tubewells regularly. In some areas the water qualities are doubtful and there are occassional out breaks of water borne diseases. What has gone wrong then? It is essential that in the mid decade we examine the situation critically.

4.0 DEFICIENCIES

4.1 General

Obviously the hydraulic efficiency of the complicated network is inadequate. The pipes are old,there are also defects in the pumping system;pipe leaks;chockages;intermittent supply hours;etc- these however are not totally unexpected of a century old distribution system. Over and above these profuse quantities of water get wasted through open stand posts or by individual consumer. The quality of water cannot be maintained high due to the leaks,low pressure and intermittent supply.

4.2 Human factors

Before going further into the deficiencies,some human factors are highlighted. Safe water supply alone or even safe water and sanitation do not guarantee protection against water borne diseases. Lack of health education lack of personal hygiene, hygienic habits of mother,play an important role in spread of diseases, The water may be pure but the collecting and storing containers may be dirty. It is said that "clean water for all" by itself will not bring health but there cannot be health without it".

In slums or group housing system for lower income groups the ladies and house wives will not come out to the roadside water taps or tubewells for washing themselves or for proper bathing- they would prefer alternative sources like tanks,ponds etc in the vicinity where the water is doubtful. Their water uses sometimes are limited to the amount they are able to collect and haul from the road side water points. A single tap within a house/hut where several rented families stay does not encourage hygienic water usage to the required level.

The slum dwellers or the urban poor are to be treated as a very important users of the water supply system and if proper sanitation and water supply are not provided then these points become a threat to city life for transmitting disease. The hardships of urban poor,if they do not get water are more severe than those of rural poor as the urban areas are too concentrated and too environmentally polluted.

4.3 Wastage and misuse

Some of the fortunate higher and middle income groups who are advantageously located in relation to the water supply system as a whole,draw profuse quantities of water. They use a part of it,misuse another portion and waste the remaining. They draw water more than that is required. They store water in cisterns only to empty it next morning,so that fresh water can again be stored. They never close the taps. Why should they?Water is practically free. The amount of corporation tax is fixed and whether they draw 20 gallons per day or 150 gallons per day,the amount of tax remain the same. Their physical location is so advantageous that the system is able to deliver any amount of water. As a result,other consumers particularly the lower income group consumers on the fringe do not get the required quantity of water. During summer peak hours when demands are high,the distribution system is unable to deliver required water at desired quantity due to the skewed pattern of withdrawal. Leakage and wastage through street stand posts add to the scarcity. The ground water sources which are shallow tend to yield less water and if there be any breakdown the position becomes very difficult.

4.4 Leaks

The pipe line system being very old continuous vibrations due to the wheel loads had resulted many leaks in the system,there are some corrossions also. The leaks from old mains and wastage through stand posts account for about 35% of supply. According to an estimate about 40 mgd water can be saved by reducing leakage. When the water pressure is low these leaks may be entry points of contaminated water as the supply hours are intermittent.

4.5 Ground water tappings

Uncontrolled tappings of ground water resources by the rich owners of multistoried building and industrial and commercial establishments is another problem. The previlaged class is getting water to their full oversatisfaction by abstracting directly the underground water through high rate pumps without paying the economic price of ground water. These withdrawals are preventing in summer,other relatively backward consumers or public body to pump water to fulfill their needs. Every gallon of ground water has an opportunity cost- this is not being paid by the rich. Since the demand of ground water is high during summer and marginal value in use is high; the high rate abstractors of ground water should pay the marginal value of others and not just a nominal tax. The authorities should be aware of "tragedy of commons".

5. BETTERMENT APPROACH

Improvement of the hydraulic efficiencies through interconnections replacement of old pipes and addition of new components like pumps, reservoirs and pipe lines have been taken up. It is to be pondered whether to create more treatment plants, boosters etc without correcting old systems. It is necessary to strengthen the pipes,plug the leaks and then add new sources. Prevention of wastage and misuse can only be tackled by social pressures from the citizen as metering in large scale may be unsuitable.

A strong consumer motivation is required. Since the city residents are approachable by media - Radio, Cinema and Newspapers,they should be motivated with health education. If a consciousness can be grown within them regarding the necessity of proper water use,hygienic habits etc they will utilise the facilities properly. Indiscriminate ground water tapping can be controlled by taking penal measures.

6.0 CONSUMER PARTICIPATION

Consumer participation in planning and system monitoring is very important contacts with mass should be established local people in groups are to be invited to lodge their greivences,to offer their suggestions and to analyse the present situation. Unless the deficiencies of existing system are correctly diagonised no efficient improvement programme can be chalked. The local people can show - where there is defective subsoil or poor cushion, where the pressure is low,where the pipes are frequently leaking,where the street taps only waste water, where the pressure is high,where there is long queu for water etc. Some of the local residents may suggest perfect technical reasons,for such malfunction and even technical solutions through sheer experience.

7.0 EVALUATION - MONITORING

Evaluation,monitoring and feed back are essential. If it be possible to identify facts of failure,breakdowns,misuse and then analyse the reasons;evaluate the alternative solutions and then review the whole situation then it may be possible to improve planning. This "Critique" portion require extensive survey for which groups of investigators,consisting of social workers,surveyors, engineers,planners,statistician etc should be formed. Formats for reporting regularly the break down history, technical survey of source and distribution system,water use and collection survey etc should be developed for proper records.

8.0 THE RURAL CONTRAST

In rural areas some brisk activities on water and sanitation development are taking place recently. Piped water supply and sanitary latrines are being introduced to villages,even where the real demand for such facilities are absent. Most of the rural population were accustomed socially, psychologically and even bacteriologically to conventional system and they do not like new systems. Some national and international agencies however are over interested to get involved,in the decade,with rural water supply.

9.0 THE URBAN SCENE

The urban water supply augmentation and maintenance are less glamorous but more fruitful. Persons who are accustomed with use of tap water or water closets and who do not have any other alternative feel immensely benifitted when the defective pumps,pipe lines tubewells or chocked latrine are corrected. Not only these works are devoid of publicity but technologically these works are very difficult to execute in old busy cities like Calcutta. The underground space below roads and streets are too congested with utilities. Sufficient room are not available for laying or repairing water and sewer lines. The roads are always busy with heavy traffic and complete road closure is not possible during execution. Working in the available narrow space keeping the traffic and pedestrial flow uninterrupted are extremely difficult and hazardous. Moreover during such work the water supply of city cannot be stopped for obvious reasons.

Thus the augmentation,maintenance and operation of the old system are always a challenge to all and particularly to the engineering profession.

10.0 CONCLUSION

In very old cities the water supply position may deteriorate fast unless preventive maintenance works are taken up simultaneous with augmentation works. In the past,during the sixties and the seventies some international agencies took part in preparation of master plans for water supply and in funding water supply projects for Calcutta. Many of these plans did not stress on the upkeepment of existing facilities. Nevertheless,continuous system monitoring, development of proper operation and maintenance activities,consumer participation in planning and appropriate engineering practice,if taken up during remaining part of the decade,will no doubt bring the water supply position to a satisfactory state fulfilling the decade objective.

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

E K Y Dovlo

Ghana: mid-Decade review

Ghana Water and Sewerage Corporation (GWSC)

The GWSC is responsible for the development, operation and maintenance of water supply and sewerage systems for domestic and industrial purposes throughout the country. It is a national autonomous organisation created by an Act of Parliament in 1965. The Corporation is administered from its Head Office in Accra and ten Regional Offices. It is decentralised to the district level.

WATER SUPPLY SUB-SECTOR

Pre-1980 Situation

In 1980 the water supply coverage was 93% for the urban population and close to 30% for the rural population. During the last two decades, in a bid to promote rapid national development after independence in 1957, the government created the Ghana Water and Sewerage Corporation and launched a crash programme for rapid urban water supply expansion and accelerated rural water development. Thus from a low figure of 35 water supply systems in 1957, 1980 saw 194 pipe-borne water supply systems, comprising 3 high capacity (10-40 mgd) systems, 13 medium capacity (1-10 mgd) systems and 178 small capacity (40,000 - 1,000,000 gpd) systems. In addition, 2,500 shallow boreholes fitted with handpumps were provided under a Canadian Government Aid Programme in Upper East and West Regions of Ghana. Due to inadequate operating revenues as a result of uneconomic tariff charged, the pumping equipment and treatment plant in the systems were poorly maintained for lack of funds to procure replacement parts. This situation, coupled with the old age of some of the plant and equipment, has brought most of the systems to a state of disrepair.

Action Plan for the Decade

In response to the challenges posed by the UN Declaration "Clean Water and Adequate Sanitation for all by the year 1990", the Government of Ghana set out to initiate various planning processes to ensure the achievement of the goals of the Decade. A rapid assessment of the current and projected sector development was made in 1978. A National Action Committee was set up in 1980 under the chairmanship of the Ministry of Finance and Economic Planning. Its membership included representatives from Ghana Water and Sewerage Corporation, Ministry of Health, the Ministry of Rural Development and Co-operatives, the Water Resources Research Institute, the Environmental Protection Council, and the University of Science and Technology. As a result of its work, a National Action Plan was drawn up and accepted by Government in 1982.

The Decade Plan called for the following activities:

1. Rehabilitation of existing pipe-borne water supply systems, the plant and equipment of most of which had over-run their useful lives.

2. Capacity expansion of water supply systems in five regional capitals where the demands had exceeded the plant capacities.

3. Provision of shallow boreholes fitted with handpumps for communities of population between 500 and 2,000.

4. Providing hand-dug wells through community participation for communities of population below 500.

5. Training of managerial, operational and maintenance personnel and community-based group facilitators.

6. Institution building through the re-organization of the GWSC.

Progress made During the First Half of the Decade

The major activities during the decade focussed on stabilization of the existing pipe-borne water supply systems and development of rural water supply by the drilling of 3000 boreholes fitted with handpumps in six regions of Southern Ghana.

Some of the major projects undertaken during 1980-1985 were:

1. Rehabilitation of the Kpeng-Tema-Accra Transmission Pipeline feeding the capital city and Tema with World Bank assistance.

2. Rehabilitation of 17 existing pipe-borne water supply systems in the Northern and Upper Regions with the assistance of the Canadian Government.

3. Rehabilitation of 24 existing pipe-borne water supply systems in the Eastern Region with the support of the Federal Republic of Germany (FRG).

4. Rehabilitation of 17 existing pipe-borne water supply systems in the Volta and Central Regions with the support of UNDP.

5. Expansion of Cape Coast and Sekendi/Takeradi water supply systems with assistance of the FRG.

6. Expansion of Ho Urban Water Supply with the provision of a new treatment plant entirely funded by the Government.

7. Drilling of 3000 boreholes fitted with handpumps in six regions of Southern Ghana with the assistance of FRG.

8. Rehabilitation of 250 handpumps on boreholes in four regions and other small scale drilling programmes by UNICEF and Church groups in the country.

The foreign aid for the above projects averaged about $8-9 million per year with a local currency component of about $300-400 million per year ($1.0 = C70 Cedis)

During the period, various seminars and workshops were organised. One successful and significant event was National Workshop on Hand-dug Well Construction organised to launch a National Hand-dug Well Programme.

As a result of these activities, the water supply coverage for the urban population was maintained at 93% with the rural coverage increasing from 29.8 to 39.3%, resulting in an increase of 8.3% in total water supply coverage. The comparative coverage table is given below:

(ii)(a) 70% of the people residing in rural communities of population between 500 and 5000 have access to pipe-borne water supply and shallow boreholes fitted with handpumps.

(ii)(b) Only 15% of the people in rural communities of population below 500 have potable water. The people in this population group constitute 30% of the country's population and contribute significantly to the national wealth.

Another significant event which occurred was the restructuring of the organisation and management of the GWSC, the major sector institution, with the assistance of the World Bank. The reorganization process is still going on and it is hoped that an effective delivery system will be fashioned to take us through a successful decade.

SANITATION SUB-SECTOR

Pre-1980 Situation

As at 1980 there were three urban water-borne sewerage systems in existence - two in the fairly new townships of Tema and Akosombe and the third in the national capital, Accra. The latter is particularly under-utilized and covers only a limited area of the older part of the city. There were also some 33 water-borne institutional sewerage systems throughout the country, most of them reportedly non-functional.

Excreta disposal systems generally used in the urban towns are septic tanks, aqua privies, pan latrines and pit latrines. There are private as well as public systems. Records are not readily available for the total coverage situation but Table 3 shows indicative figures for six regional capitals, Tema and Accra.

Table 1 Population served with safe drinking water

	1980		1985		Target 1990	
	Pop	Coverage	Pop	Coverage	Pop	Coverage
(a) Urban population served through house connections and standtaps	3,088,000	93.0%	3,679,000	93.0%	4,621,000	100%
(b) Rural population served through public standtaps and shallow boreholes with handpumps	2,439,000	29.8%	3,314,000	39.3%	7,481,000	78%
(c) Total	5,527,000	48.1%	6,993,000	56.4%	12,102,000	85%

A breakdown of the above figures show the following:-
(i) 93% of the people in the urban communities have access to pipe-borne water supply.

Solid waste disposal poses serious problems in most urban areas. In the city of Accra, for example, where the bulk of the refuse is

TABLE 2

DATA ON EXISTING EXCRETA DISPOSAL FACILITIES IN SEVEN URBAN TOWNS (BASED ON 1970 ESTIMATES)

	1970 Population	No. of Houses 1970	% with Private W.C.	% with Pan Latrines in Houses	% Using Public Facility or Other means(1)	Source of Information
Accra	564,194	35,835	30	44	26	Consultant's Report, 1982
Tema	60,767	10,021	100	-	-	- do -
Kumasi	260,286	11,755	40	50	10	Consultant's Report, 1970
Sekondi/ Takoradi	91,874	4,469	20	27	53	House to House Survey, 1977
Cape Coast	51,653	3,037	20	40	40	Consultant's Report, 1976
Koforidua	46,235	2,332	12	58	30	House to House Survey, 1977
Sunyani	23,780	1,114	35	30	37	- do -
Ho	24,199	1,871	19	70	11	From District Council Office

Note(1): About 60% of the population shown in this column estimated to use public facilities, whilst 40% resort to derelict areas.

normally transported to sanitary landfill areas, the refuse heaps up in the collection centres due to frequent breakdown of haulage vehicles.

Data on rural sanitation is scanty, given the very uncertain institutional support for this area. However estimates for 1980 put it at about 10-15% of the rural populations with adequate disposal facilities in the form of pan and pit latrines.

Coordination for both urban and rural sanitation was very poor due to the unavailability of central coordinating and supervisory mechanism. The night-soil collection system had virtually broken down. Difficulty in recruiting conservancy labourers became a reality adding to the general problems of maintenance and operation of equipment and transport vehicles that have bedevilled the local councils for some years.

The Challenge of the Decade

Given the very disturbing picture above, the tasks for the Decade were outlined as follows:

1. Improvement of public toilet facilities in the low income and urban fringe areas by the construction of improved latrines, and rehabilitation of those in existence.

2. Improvement of sanitary services by the provision of vacuum trucks, transport vehicles and other needed spare parts for the rehabilitation of existing fleet. This is to ensure efficient excreta disposal and effective refuse management.

3. Provision of improved pit latrines in all rural villages not served by the district councils.

4. Reorganization of the institutional support system within both the Rural Development and Local Government Ministries for effective delivery and management of sanitary services.

It was very clear at the beginning of the decade that waterless systems for excreta disposal will be practised for many years to come. This argument is strongly supported by the low average figure of 5-20 gallons per capita per day of water available for consumption in most of the urban centres.

Progress made During the First-Half of the Decade

Against the background of concerns expressed by various studies and national discussions around the issue of sanitation, the need for a coordinated action in the sub-sector was picked up by the Government. This culminated in a national workshop in 1982 attended by officials from all Ministries and Agencies involved with the sub-sector.

Even though the very far-reaching resolutions of this workshop were not carried out structurally, it marked a turning point in sanitation delivery in the country. The improved waterless pit latrine , named the Kumasi

Ventilated Indirect Pit (KVIP) latrine, developed through the research efforts of the University of Science and Technology in Ghana was accepted for adoption countrywide.

Massive training and promotional programmes were mounted through the Rural Development Ministry and to-date about 100 communal KVIP latrines have been commissioned with quite a substantial number at various stages of construction. Its acceptability is phenomenal given its effective odour and fly control characteristics. It also has the advantage of allowing the conversion of pan latrines into pit latrines.

Under the guidance of the Government's Primary Health Care Programme launched in 1983, the rehabilitation of existing public latrines in the urban areas and pit latrines in the rural areas is in progress. Even in the capital, Accra, another dimension of community management of public latrines has been introduced and this is being encouraged snd replicated in other urban towns.

In the northern parts of the country, the Mozambique slab-type latrines have also been tested with some measure of success but had to be discontinued due to poor institutional support.

The comparative figures for the first-half of the decade are given below. These depict a stabilization situation given the fact that there was very little expansion vis-a-vis population increase.

PERSPECTIVE FOR THE SECOND-HALF OF THE DECADE

The Challenge

How then do we in the next five years provide safe drinking water to the remaining 4.3 million people, i.e. the 43.6% of the population with 70% of them in the population group below 500 and at the same time stabilize the present modest coverage? How do we provide the complement for excreta disposal given the poor performance recorded in this sub-sector? These are questions, very fundamental questions, that have plagued the offices of planners and policy makers in Ghana.

The economy is yet to come out of the doldrums after a decade of stagnation. The effects of drought and environmental destruction have left their trails on the economy. Thus any attempt to accelerate the process of meeting the glorious objectives of the decade should reflect a philosophy of realism. The plight of our rural people is still deplorable but the attempts to put things right should not put undue stress on the economic recovery programme currently being pursued by the government. Social justice should therefore seek a compromise with reality.

The Approach

For Ghana then, the approach for the next half of the decade will be taken on three fronts namely technology, organization and mobilization, and improved resource planning. The following strategies will be adopted:

Table 3 Population served with excreta disposal facilities

	1980		1985		Target 1990	
	Pop	Coverage	Pop	Coverage	Pop	Coverage
(a) Urban population served with adequate disposal facilities	1,940,00	58.4%	2,304,000	58.2%	3,235,000	70.0%
(b) Rural population served with acceptable disposal systems	1,227,000	15.0%	1,363,000	16.2%	2,882,000	30.0%
(c) Total	3,167,000	27.5%	3,667,000	29.6%	6,117,000	43.0%

The figures speak for themselves. There is still much to be done compared to water supply and thus the second-half of the decade should see more strides being made in this sub-sector. The low target coverage for the decade represents a realistic forecast given the rat inadequate institutional support for the sub-sector.

(1) Increased innovation through the choice of least-cost appropriate technologies with corresponding low operational and maintenance cost and effort, coupled with the stabilization and effective preventive maintenance of the existing systems.

(2) Institution building for improved

coordination of the delivery mechanisms, particularly in the sanitation sub-sector.

(3) Increased community involvement at all the stages of the programmes.

(4) Improved operation and maintenance practices supported by adequate tariff levels.

Options and Proposals

It is estimated that in Ghana today, the average costof water supply projects using various options is as follows:

(i) Hand-dug well of average depth of 35 feet with community participation - US $2 per capita and US $3 if provided with a handpump

(ii) Shallow boreholes fitted with handpump - US $35 per capita.

(iii) Pipe-borne water from mechanized boreholes - US $100 per capita.

(iv) Pipe-borne water using conventional treatment plant to process surface water - US $150 per capita.

There might be other implications other than cost, but within the limited experience that we have gained in the recent past with shallow boreholes and hand-dug wells, social reality demands the choice of such least-cost technologies. The two large scale shallow borehole programmes by CIDA in Northern and KfW in Southern Ghana (2500 and 3000 boreholes respectively), the water utilization project employing hand-dug well technology in the Upper regions, the Ghana Government/UNDP project in Volta and Central regions, and other numerous people-centred projects, have clearly demonstrated what could be done with community participation and appropriate technology.

Thus a programme of 4000 shallow boreholes fitted with hand pumps utilising for a start the newly commissioned four Indian Drilling Rigs, and the National Hand-dug Well programme that will involve the sinking of 10,000 hand-dug wells throughout the country, particularly in small rural communities with a focus on community involvement and a complementary health education programme, are being vigorously pursued. In addition to the above development programmes to increase the water supply coverage, the decade proposals will include rehabilitation of the existing pipe-borne water supply systems and completion of on-going development projects. These programmes are estimated at US $41 million as local cost and US $30 million as off-shore cost. It is estimated the above programmes will increase the water supply coverage by about 28.6%, bringing the total coverage by the end of the Decade to 85%.

A parallel programme of sanitation and community and health education will also be given momentum through the construction of VIP latrines country-wide with a fixation towards increased use of locally available construction materials. UNICEF and UNDP have already mounted pilot programmes in various parts of the country.

For the above task, a vigorous institutional arrangement will be needed. An attempt will be made to build a strong, self-supporting water and sanitation sector, through appropriate policy support at coordination, adjustment policies and effective harnessing of both local and external assistance. This restructuring of the delivery systems will ensure structural support lines from the Rural Development, Local Government and Health Ministries. There will be a thrust to institutionalize the rural water supply and sanitation extension services that reflect full community participation. For this reason the following notions will be given urgent attention in 1986:

(a) The revitalizing of the National Action Committee on the Decade to facilitate improved coordination. An attempt will be made to bring all the scattered sector development programmes into a national framework.

(b) A rural water and sanitation study to define concretely the institutional framework for accelerated and self-supporting growth.

(c) Water conservation campaigns involving leakage detection and improved utilization of water.

Conclusion

The Government of Ghana attaches great importance to the provision of good drinking water and basic sanitation. In pursuance of this objective, the sector institutions are being reorganised and strengthened. With the government's policy of decentralisation, self-reliance and mobilisation of local resources, there is active community participation in development. This is a key in future development as it will reduce the financial burden on the central government budget. Finally with the continued support of both bilateral and multilateral donors, we hope to achieve the goals we have set for the Decade.

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

E E Mahawi

Health through sanitation and water, Tanzania

1. INTRODUCTION

Swedish (SIDA) assistance to water supply in Tanzania which include provision of funds, supply of equipment and material, provision of technical assistance etc begun already in 1965. Up to 1975 the programme was national, covering piped water supply projects in all regions.

From 1976 Swedish assistance was gradually shifted towards the three regions bordering Lake Victoria, starting with a comprehensive water master plan delivered 1978.

The high fuel prices during the seventies and to-date made it evident the piped water supply based on diesel powered pumps could simply not be afforded due to high running cost, especially operation and maintenance costs. The 1981 survey showed that less than 50% of the existing schemes supplied water.

Another shortcoming during this time was that community participation was not considered important or not deliberately included in planning of the schemes. The implementers of the rural water supply programmes has been SIDA and the Regional water engineers on sectoral basis. Thus the beneficiaries did not identify themselves as part of the programme. Generally, planning for rural development projects rests exclusively with various functional departments, which means that project designs are restricted to a sectoral or even sub-sectoral planning background. Programmes and projects are mainly planned by Government elites with or without the assistance of donor agencies and in general suffer from a relatively low degree of village's participation in project identification, planning and implementation. This results in a limited identification with projects to be implemented and consequently in low motivation on the villagers side to contribute.

With these shortcomings SIDA in 1983 come up with new principles on water strategies again concentrated in lake regions. These new principles were based in intersectoral approach to coordinating health education, sanitation and water supply at the village level on community participation basis. Thus the integrated approach to coordinating health education, sanitation and water supply at the village level on community participation basis. Thus the integrated approach, health through sanitation and water, HESAWA, was developed in February 1984. Field implementation began in July 1985. The overriding objective of the programme is to improve the rural areas through improved health education, sanitation and water supply and to create better prospects for social development and economic growth.

2. EXECUTING AGENCIES

Three departments have been identified as the key executive department for the programme at regional and district village levels, Water department, Health department (Primary Health Care Section) and Community Development department.

The implementation of the programme involves the regional, district and villages organisation established or to be established. The other parties involved are of course Swedish (SIDA) as donor and Prime Minister's Office as the agreement partner with SIDA at national level. For smooth running of the programme, roles and responsibilities for each party or department have been defined as follows:

A. Sida Roles

(a) Financing the programme

(b) Procurement on consultancy services for Technical Assistance

(c) Implementation of Swedish aid policy

(d) Negotiations

(e) Monitoring and evaluation

B. Prime Minister's Office (PMO) Roles

(a) Ensure sufficient and continuous provision of local staff required by relevant executing agencies of the programme and appoint duly qualified Tanzanian counterparts to work together with expatriate personnel.

(b) Facilitate an effective integration of activities under the HESAWA programme by providing policy guidelines and promote cooperation between the authorities concerned.

(c) Support to Regions/District/Villages and facilitate communication between the Technical Ministries concerned

(d) Negotiation and approval of projects

C. Regional and District Councils Roles

(a) Provide local resources required such as staff, officers accommodation, fuel transport and funds

(b) To compile and present plans and budgets

(c) Mobilise and control resources and manpower

(d) Follow up and monitoring

D. Village Councils and Assemblies Roles

(a) Identify needs and forward to relevant authorities

(b) Accepting or rejecting to participate in the Programme

(c) Selecting villagers for training as village Health Workers

(d) Compensating (in cash or kind) these village workers

(e) Deciding on location of new water points and improvement of old ones (in cooperation with MAJI)

(f) Contributing labour for construction purposes and pay

(g) Contributing cash/labour for operation and maintenance which is a main village responsibility

(h) Continuously improve environmental sanitation and upkeep of water supply

E. Department Roles

(i) Water Department (MAJI)

Provide expertise for all activities necessary within HESAWA (Maji) at Regional and District level

Organize procurement and distribution of material and equipment

Training and development of technical staff

Advise, design and execute technical activities i.e. survey, construction of shallow wells, gravity piped supplies and rehabilitation of existing schemes

To make comprehensive studies for the possibility of water schemes for livestock

Advise and design permanent structure for operation and maintenance and decentralisation to District and Village level

(ii) Community Development Department (Maendeleo)

To make research on data and information available on village

Clarification of HESAWA Programme to villages

Assist villages in defining priorities for water

Promote female participation in HESAWA

Promote productive use of water where appropriate

Assist villages to mobilize and promote self-help work labour

Construction of demonstration Ventilated Improved Pit Latrines

Assist CCM, AYA and MAJI staff in using participatory methods

To make surveys and improve traditional water sources

Assist villages in selection of HESAWA village committees and well caretakers

(iii) Health Department (AFYA)

Assist villages in selection of village Health Workers

Carry out training of VHWs at health centres and dispensary level

Participate, promote, coordinate and act as spokesman of health education activities in HESAWA

Decision making and implementation responsibilities have been decentralized to District and villages. This means planning, budgeting implementation and operation and maintenance responsibility. Need identification starts at village level and goes through the District to the Region. Integrated plan of action is prepared by the Regional promotion team, the District action team and the villagers themselves who have identified and forwarded their needs.

3. WOMEN PARTICIPATION

Generally speaking it can be said that at the beginning of 1985 - half-way through the water decade - very little attention has been given to women involvement in spite of increasing calls for the same at international level.

There has been a lack of a conscious objective on the part of the donor agencies and national government ministries to reach and involve women water projects, since women are not considered special targets. There have been no concrete strategies developed to facilitate their involvement. The involvement of women in planning decision making and operation and maintenance is of major importance in their potential effect upon acceptance and correct use of the new facility.

Failure of water supply projects can be attributed in many cases to lack of contact with women concerning the suitability and acceptability of the location and sources of water. Most women are back at their traditional sources even after the villages have received improved water supplies. If more attention were given to health aspects of water supply, as HESAWA has done hygiene and general environmental hygiene, women would appear to be the most obvious targets for information and motivation.

The main strategy employed by HESAWA to stimulate increased involvement of the women in the improvement of their water supplies has been:

(i) Establishment of the village HESAWA Committee (VHC) whereby 50% of the members are women

(ii) Appointment of pump attendants, one man and one woman

(iii) Appointment of well caretakers, one man and one woman

(iv) Training programmes have been initiated for the elected/appointed pump attendants and well caretakers to be contacted as near as possible to the village concerned so as to allow women to attend

(v) Establishment of women's groups for productive activities such as small scale irrigation schemes and other income generating projects. Health education and environmental sanitation lessons are also discussed in these groups.

(vi) The appointment of female field staff which has ensured that village women feel more at ease in public discussions

(vii) Selection and training of village health workers, 50% of whom are to be women.

4. IMPLEMENTATION/CONCLUSION

As it was said before the HESAWA, principles are based in intersectoral approach to coordinating health education and water supply at village level on community partidpation basis. That means to improve the rural areas through improved health education, sanitation and water supply. The overall responsibility of need identification, planning, budgeting and especially implementation will rest with the District authorities and Village communities. HESAWA started in July 1985 when Maendeleo and Afya were included in the budget. Thus it is still on the start-up area which is confined to two districts on selected villages.

In these six months the promotion activities have been very successful and the village community have well accepted the programme together with the responsibilities and they have participated fully in the shallow well construction. The consultancy services (HIFAB International) have been playing a very important role in giving technical advice to the executing agencies.

It seems intersectoral approach has been reached through a written integrated action plan, for this financial year has not been compiled and the HESAWA Regional Office has not been established yet. During this period we experienced the problem of obtaining construction materials and inadequate supply of fuel for programme activities.

Session 3b

Chairman: P Hilton
Co-Chairman: Mrs Lena Chakraborty

Discussion

A M Thabit

Training of Tanzanian engineers in India

1. Mr THABIT described the urgent need for trained engineers in Tanzania and pointed out the ILO recommendations that an engineer or scientist could support 5 technicians who could in turn supervise 25 to 30 craftsmen. Through the crash training programme of undergraduates in India, each of Tanzania's twenty regions now had three to four engineers supervising and implementing water projects.

2. Mr WAN asked how many of the trained engineers are women? Have there been any changes in the trend?

3. Mr THABIT answered that there were no women engineers trained throughout this programme of training in India. This is because women in Tanzania did not like to join engineering, but recently they have started to cultivate an interest in geology, electrical engineering and similar fields.

4. Dr COTTON enquired whether the author was satisfied that the number of competent technicians will in practice be available to satisfy the "ILO Pyramid"?

5. Mr THABIT replied that he was satisfied with the ILO Pyramid in that the technicians were available. When the programme of training engineers started, immediately our Water Resources Institute was expanded by increasing the intake from 60-120 students per year. Likewise training of craftsmen at lower level was started, the latter being conducted on what is termed as "On the Job Training" which puts emphasis on the operation and maintenance of rural water supply. Recent survey showed that we have approximately 240 Engineers/ Scientists; 5000 Technicians; 9500 Craftsmen/ Skilled labourer.

6. Mr BHATTACHARYA asked is there any Faculty-development programme for Technical Institutes in Tanzania? Is there any mechanism for monitoring Training Programmes?

7. Mr THABIT replied that the Ministry had established its own institute known as the Water Resources Institute for the purpose of training technicians who would speed up the programme of providing water to the people. There are also other institutions which train technicians. These, as I mentioned, are Dar es Alaam Technical College, Arusha Technical College and the TANESCO Technical Institute at Kidatu. There is a strong monitoring programme for our trained manpower both for engineers and technicians. It is constantly carried out either by visits to Regions and where impossible to visit, by correspondence.

8. Mr DUTT commented that the author was describing the training of engineers in India and technicians and craftsmen in Tanzania. How was the interaction between those trained in India and the others in Tanzania?

9. Mr THABIT answered that the engineers trained in India and technicians trained locally have had very good interaction on the job, because each one has been trained to a level of being an engineer or technician, and since both of them have an important objective of providing clean water to the people, therefore their duties are automatically separated. The engineer will plan, design and check construction while the technicians will carry out construction on the site with the assistance of craftsmen and other skilled personnel.

10. Dr Mwamba noticed that there have been some dropouts. Have they gone back to Tanzania? Would it not be much cheaper for training to now be taken over by Tanzanian Universities instead of continuing the programme with India?

11. Mr THABIT agreed that there had been some drop-outs. All these students were sent back to Tanzania as soon as they were found to be unable to follow the studies. As explained in the paper, this crash training programme of engineers in India has now come up to the end. The last group of students at BIT, Ranchi and BMS, Bangalore will complete their studies in June 1986. The Ministry has now to rely on graduate engineers from our local University of Dar es Salaam.

12. Dr COAD wondered whether the students sent to India were required to sign an agreement to work for Government after their return? If so, would you give details and comment on the success of the arrangement.

13. Mr THABIT said that the Government insists that any person attending training exceeding nine months must be bonded. On courses exceeding nine months students are bonded for three years. Any course exceeding that period the bond is five years. Therefore all students who were sent to India were bonded for five years. (That is they had to sign an agreement). The arrangement has been quite successful. I can safely say that 80% has been achieved.

Z Ahmed, N D W Lloyd and Md Sariatullah

Local Government training in Bangladesh

14. Mr LLOYD explained the needs for local government training and emphasised that such courses had to be practical 'hands-on' and job-orientated. The formal two-week intensive courses were so designed to give maximum impact and to impart a real sense of achievement.

15. Mr ROY asked what are your strategies for continued evolutionary changes:-
a) for institutions which were established long ago (Government)
b) for social and religious institutions
c) for other NGO institutions?

16. Mr LLOYD replied that there was a suitably long time scale with a desire for excellence and a willingness to change, including personnel changes. There were no plans for working with social, religious and non-governmental organisations.

17. Mr ISHENGOMA commented that in Tanzania we have found it preferable to have centralization on technical training as well as technical centralization of professionals - even though development activities are decentralized in the respective districts. This is important for ensuring the quality of our technical personnel, as well as planning and deciding naturally on their motivation, upgrading and promotion. What is your opinion on this with the experience in Bangladesh in Local Government.

18. Mr LLOYD answered that his organisation was dealing with short term (less than 2 weeks) training on a large scale (see paper). Only decentralisation allows the numbers to be trained in the short time available when staff are not tied up in project preparation and implementation seasons. We try to maintain the quality by involving the Training Unit in preparation of the course as well as running it, by making them personally committed to their success and by monitoring from HQ. We expect that as training becomes institutionalised, the department will come to trust the assessment of trainee's performance on courses, and these will then be used in the process of promotion.

19. Mr MULLER noted that LGEB is the local body for rural water supply and sanitation project implementation. How do you cooperate with UNICEF and its caretaker programme? Are there any women involved in the training programme, and if so how are they being accepted by the students and how by the instructors?

20. Mr LLOYD replied that cooperation with UNICEF provided one resource person to TOT course, there are frequent phone calls and exchanges of information. There are no women amongst the government trainees; where we have women trainees they are usually entirely women (not because of discrimination but because all trainees are women!). We use women as trainers mainly for matters relating specifically to women; these are at present only found in courses specific to the donor-aided project (not part of the national programme) and we use Women Assistant Field Officers from the Technical Assistance Team. We have had no problems when women have been acting as trainers.

21. Dr COTTON commented that the experience of WEDC staff in professional and sub-professional training concurs very much with that of the author. In particularly the "DOING" aspects of on the job training and "problem solving" are critical. This also has advantages in convincing engineers to appreciate the value of "low cost" solutions. For example in a recent workshop with the NHDA of Sri Lanka the engineers were initially unconcerned about WEDC proposals for 'site and services provision'. The workshop actually prepared a design and COSTED out the possibilities. This achieved the most important aspect which was CONVINCING the engineers of 'low cost' solutions, as well as providing the technical training. Dr COTTON emphasised that training manuals should be BRIEF and not thick volumes such as the WASH projects and that Workshops need to be as short as possible.

22. Mr LLOYD agreed that the best way to charge beliefs and attitudes is for the trainee to discover the answers himself. Course materials should usually be in the mother tongue and use the maximum of illustrations, minimum of words. It is important that participants should feel that they have participated in all aspects but this takes time.

23. Mr BHATTACHARYA asked what are the method adopted for construction works - training interaction in case of training for trainers? How is the training programme identified with field conditions and monitored?

24. Mr LLOYD replied that the TOT course teaches construction techniques in the same way as the field courses, i.e. by doing it - costing concrete slab, compacting earth embankment, building brick wall etc - see the paper. The Upazila Engineers as trainers are monitored by the District Training Officer. The field courses and DTOs are visited at least once in two months by someone from HQ. As shown in the paper, the training courses are kept relevant to field conditions by:
- using DTOs to prepare courses
- using UEs as trainers
- having continuing feedback from field.

25. Mr TALBOT requested any Indian Engineer

present to advise the conference whether a training system similar to that described by the author is in operation in India?

26. Mr MUNSWELI, the UNICEF representative, stated that similar training has been started in several states of India.

A K Bhunia

Training needs for the Decade programme

27. Mr BHUNIA introduced his paper. The Institute of Local Government and Urban Studies was the logical organisation to provide the necessary training to complete the Decade programme.

28. Mr LLOYD commented that it would be helpful to have some measure of the quantity of work done by the staff (value, number of schemes, number of contracts). He then asked how were the extra numbers of staff estimated, are staff numbers a constraint on implementation, and how does this structure compare with the ILO pyramid?

29. Mr BHUNIA replied that in terms of money value each division handles about Rs 20 million per year. The Divisional Engineer has about 8-15 years experience as a graduate engineer with three to five graduate engineers with 1-8 years experience under him. Staff numbers were a constraint. There is also a dearth of technical manpower, particularly graduate engineers and diploma holder engineers for an intensive programme like this. The staff structure compares well with the ILO pyramid in the top

30. Mr GUIN asked what is the basis for assessing requirements of professionals/technicians? Town planners and architects have not been considered. Is there a reason for this? Have you included Public Health/Environmental engineers?

31. Mr BHUNIA answered that the basis of calculation of manpower is Rs 20 million/division/ year. Theinvolvement of Town Planners/Architects at the implementation stage of Water Supply and Sanitation is remote to my mind. They were involved in the policy planning level. The technical personnel viz the Engineering Degree holders are practising Public Health/Environmental engineers.

32. Mr KHENGOMA commented that India has immense manpower potential. In the West Bengal state it is shocking to see that there is a huge deficiency of professional personnel to carry out the Decade activities. What is your opinion that alongside the training programme personnel recruitment could be done even if it involves recruiting personnel from other states?

33. Mr BHUNIA agreed that India has huge manpower resources but still there is a dearth of technical manpower in all the States for implementing such a massive development programme in such a short time.

34. Mr MANSOOR wondered whether for health education and community participation in Rural water supply, do you think you can possibly implement an Awareness Building Campaign through State Institutes mentioned in your paper or through the technicians or do you have alternative suggestions/proposals?

35. Mr BHUNIA answered that an Awareness Building Campaign will require involvement of multidisciplinary personnel viz Health Educators, Community Organisers clubbed with technical personnel.

36. Mr DUTT noted that the author had highlighted serious shortages in the number of trainers which is causing shortage of trained personnel to pursue the Decade programme. What is coming in the way, money or strong will?

37. Mr BHUNIA believed that intensiveness of technical manpower requirement was not anticipated at the beginning of the Decade programme. It is only by strong will we can overcome the present situation.

P N Gholap

Village water supply in Maharashtra State

38. Mr GHOLAP described the village water supply requirements of Maharashtra State and the organisation and programmes which have evolved to meet those needs.

39. Mr GUIN asked the author to define 'Maharashtra Norms' and 'Government of India Norms'. He also asked about the present system of maintenance of Rural water supply in Maharashtra State.

40. Mr GHOLAP replied that the village having a source at a distance of more than 0.6 Km is defined as an identified village as per Maharashtra Norms. The village having a source at a distance of more than 1.6 Km is defined as an identified village as per Government of India Norms.

41. The borewells with hand pumps and power pumps are maintained by Zilla Parishad as per

three-tier maintenance systems. One caretaker is at village level and one mechanic for every 100 hand pumps is at Taluka level and one electrician for 50 power pumps is employed at district level. At district level there is a pump repair team with supervisor, mechanic, electrician and helpers etc for 500 pumps. An individual village scheme is maintained by village Punchuyat and a combined and regional scheme is maintained by Zilla Parishad.

42. Mr MAJUMDER asked about the operational and maintenance costs per capita per year for piped water supply system and the water supply system in Maharastra for the selected villages. Who finances this O & M cost?

43. Mr GHOLAP answered that the cost of operation and maintenance of borewell with hand pump works out to about Rs 16 per house per year assuming 6 souls per house. Cost of O & M of borewell with power pump works out to Rs 45/house/year assuming 6 souls per house, i.e. for hand pump Rs 2.67/capita/year and for power pump Rs 7.5/capita/year. Cost of O & M for piped water supply works out to Rs 10/capita/year assuming rate of supply as 40 litres per capita per day on standpost basis. Zilla Parishad initially finances the O & M and recovers the cost from village Punchuyats.

S Watt

Tailor-made or off the peg

44. Mr WATT discussed the particular needs of designing medium sized water schemes which require considerable pre-investment studies and design time. However with examples from the Phillipines and Indonesia he pointed out that it can be difficult to justify the preparation costs as a percentage of the overall project cost.

45. Mr LLOYD enquired whether high tech norms were suitable for such schemes.

46. Mr WATT believed that engineers were not receptive to the study conclusions that appropriate planning techniques were required as well as appropriate designs. In the Phillipines private development of schemes was now taking place.

47. Mr MAJUMDER asked about the use of shared projects.

48. Mr WATT answered that the idea of clubbing together works in Indonesia but that subsidies might benefit high income groups.

A K Dutt

Water Decade and Calcutta water supply

49. Mr DUTT described the mid-decade position of Calcutta water supply with a demand of 175 mgd and problems with the malfunctioning of the distribution system. This system was not hydraulically efficient but a computer study was not able to accurately simulate the 1100 km of pipeline. NEERI had estimated that leakage and wastage was approximately 30%. Organisations such as WHO believed that metering was appropriate but the author disagreed because of the size of the city, operational problems and for socio-cultural reasons.

50. Mr SMOUT noted that the author described bulk metering as a check on wastage. The bulk metering of zones has been used elsewhere as part of a leakage detection programme, followed by detailed investigation within problem zones. Monitoring can be computerised if desired and linked to simulated networks. Is bulk metering of zones to be used for leakage control in the Calcutta programme and how is this to be done?

51. Mr DUTT replied that for leakage detection purposes bulk meters were used by NEERI, during the night when the house consumption is practically nil and the question of wastages by consumers does not arise. The leak detection and control is in progress by CMDA. But for the wastage control it was proposed to have bulk metering for sub-districts during daytime - peak hours also. If the consumption is too high compared to the population or other features then further investigation and social intervention are required. Please note that we have intermittent supply.

52. Mr CHAKRABARTI asked the author whether he felt that the tubewell water that is being injected into the grid is not damaging or rather shortening their life by way of corrosion.

53. Mr DUTT answered that tube well water is slightly more corrosive than surface water and it causes chokes. But if we consider cost-effectiveness of total water supply - tube well water cannot be totally discarded, at least for Calcutta.

54. Mr GHOLUP noted that there are some defects in individual metering, but how can revenue be collected without metering so that recovery will be as expected.

55. Mr DUTT said that individual metering may be the best way to recover costs, but if the metering costs are too high for the magnitude, congestion and administrative reasons it would

be better to meter a portion of consumers (I-C-I) and use a social pressure on wastage by others. In any case there should not be any questions regarding slum metering in Calcutta - nearly 42% of populations in Calcutta are slum dwellers.

56. Mr ROY enquired whether the intense application of "preventive maintenance" in the urban water distribution system in a city like Calcutta will reduce the ultimate operation and maintenance cost of whole water supply system?

57. Mr DUTT agreed. Moreover low cost technologies were to be adopted and health education for proper usage and to reduce wastage was also required.

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

J M Kalbermatten, A K Roy, K J Nath

Training network for the Decade

INTRODUCTION :

The number of people presently without adequate water supply and sanitation in the developing countries, amounts to more than a billion and a half to which natural growth will add another three quarters of a billion, so that by 1990, close to two and a half billion people would have to be provided with facilities for safe water supply and excreta disposal. The staggering amount of money required for achieving the Decade's objectives not withstanding, the efforts required to train sufficient manpower to design and constructnecessary facilities and to operate and maintain them is no less challenging than generating the financial resources required.

MAN POWER REQUIREMENT FOR THE DECADE:

It is difficult to decide just how many staff members will have to be added during the Decade to provide a sufficient number of managers, engineers, technicians, operators and other staff. An approximate estimate could, however, be made on basis of the number of people to be served, the level of service contemplated and the staffing pattern of the existing service facilities in our country. Well managed sector enterprises in developed countries employ from 0.5 to 1.5 staff members per 1000 people served, depending on the size of the enterprise, the type of facility and technology used; the density of population etc. For our country, this figure would be some what higher, considering that we are likely to opt for more labour intensive technology. As per the targets set by Govt. of India, another one and a half billion people would have to be provided with the facilities of potable water supply and sanitation, during the decade, which means that our manpower requirement for the Decade would be around 200,000 to 2,50,000.

On the basis of the existing staffing patterns of various organisations, working in the field of P.H.Engg, for every 100 staffs, the distribution of various professionals and technicians could be as given below.

TABLE - I

Distribution of Professionals in P.H.Engg. Works.

1) Engineers(Degree)	15
2) Jr. Engineers(Diploma) ...	27.5
3) Administrators/Economists/ Soc.Scientists/Financial ..	2.3
4) Sanitary Chemists/Biologists/Geologists	0.3
5) Technicians (Draughtsmen, plant operators,Mechanics/ Electricians/Fitters/ Plumbers/Drivers/Lab Technicians etc)	54.7
Total	100.0

(Prepared according to data collected by C.P.H.E.E.O from various state Govts.)

TABLE - II

Manpower requirement of the Decade

Category of staff	Total requirement for the Decade
1. Engineers(Degree)	34,500
2. Jr. Engineers	63,250
3. Administrators/Economists/Social Scientists/ Acctts./Health Educators etc.	5,260
4. Sanitary Chem./Biologists/Geologists etc.	1,100
5. Technicians(Draughtsman, Plant operators,Mechanics, fitters plumbers etc.)	1,26,000
Total	2,30,000

Requirement of manpower for the Decade thus worked out compares reasonably well, with the figures that C.P.H.E.E.O., has recently collected from various state governments, regarding their manpower requirement during the decade;

TRAINING PROGRAMMES :

It is quite obvious, that any long term modifications or augmentations at this moment in the regular degree, & diploma courses will not have any bearing on the training needs in the seventh plan period. Hence the manpower planning for the decade should have two basic approaches :

(i) Short term planning for the 7th plan period.

(ii) Long term planning for post 7th plan period.

THE INTERNATIONAL NETWORK

Objectives

The training Network for Water and Waste Management was established by the World Bank, the United Nations Development P rogramme, and other multilateral and bilateral agencies to support the Human Resources Development objectives of the International Drinking Water Supply and Sanitation Decade. The Network's principal objective is to train sector staff and other specialists to more effectively plan, implement, and maintain water supply,sanitation and waste disposal/rouse programms and projects serving low income beneficiaries. For this purpose the World Bank has developed extensive training materials for instructors and trainees which in addition to providing information on technologies, emphasize community participation and hygiene education as essential components of water supply and sanitation programs. Additional training side will be developed by this Network as required.

Organisation.

The Network will be composed of some 15 "Participating Institutions" in developing countries. They will be selected from those which have well established teaching and research programs which can be adopted and expanded to cover Network topics. Participating institutions will receive financial support for Network activities from bilateral, multilateral and national agencies. Financial resources include funds for obtaining technical assistance from "Associated Institutions" which are training institutions located in developed countries with demonstrated expertise in training or research in developing countries and in Network topics. The identification of the need for such assistance and the choice of associated institutions is the responsibility of the participating institution.

Coordination.

The World Bank, with the support of the United Nations Development Programme, has established, within its Urban Development Department, a "Network Coordinating Unit". The purpose of this unit is to promote the Network, to identify resources for its expansion and improvement, to coordinate its activities and to provide, at the request of network institutions, technical assistance. Amongst the latter activities are :

- Information exchange among network institutions, including the organisation of international workshops and conferences (funds for the participation of network institution staff are included in the respective budgets).

- Participation in selected Network activities at the request of institutions, such as decision-makers,seminars etc.

- Provision of technical assistance at request of institutions, in specific topics, such as institutional development, finance, etc.

- Identification,respectively preparation, of additional needed training materials, particularly the addition of materials to teach operation and maintenance.

The coordinating unit will make special efforts to promote "Technical Cooperation among Developing Countries" through joint or complementary activities of participating institutions.

OBJECTIVES IN INDIA.

The objectives of the Network activities in India are to assist the Government to achieve its targets for the International Drinking Water Supply and Sanitation Decade. The Networks effort will concentrate on increasing the sector's capacity to apply low cost water supply and sanitation technologies in a socio-culturally acceptable manner, at costs affordable to the low income beneficiaries, and with their participation in the planning and implementation of projects and with the provision of related personal hygiene and environmental health measures. The Network will assist in human resource and institutional development.

Human Resource Development:

a) Engineering Students at Undergraduate and Graduate Levels in civil, engineering, sanitary/ environmental engineering and public health would learn to develop and design programs and projects incorporating various technologies appropriate and affordable to specific user groups, to communicate with those user groups, alone or together with behavioural scientists and health workers, to determine user preference and motivate them to participate in project development, implementation and maintenance, and to modify personal hygiene habits.

b) Polytechnical Institute Students (Diploma and Certificate Courses) would learn to design and construct various low cost technologies, work with public health workers in promoting the use of these technologies and supervise the execution of low cost technology projects. Instructors of selected Industrial Training Institutes would receive instruction in construction techniques of specific low cost water supply and sanitation facilities.

c) Practising Engineers in public sector agencies and consulting Firms would become cognizant of the various low cost technology alternatives, the need for user hygiene education,community participation in technology choice and implementation and the requirement that technologies need to reflect socip-cultural user preference. Practising engineers would receive training in design and implementation in accordance with their experience and responsibilities.

d) Voluntary workers with NGDs, who are often deeply involved in user participation, would increase their understanding and knowledge of the appropriate technology for low-cost systems.

Institutional Development

a) Network Participating Institutions will acquire the capability to assess and develop training programs, to orient instructors of engineering schools, polytechnical institutes and agency in house training courses and train practising engineers and students in low cost technologies and related community participation and public health topics. They will be capable of providing training support in special subjects, monitor progress and promote the use of low cost technologies and related activities. They will, in addition, develop the capacity to advise on low cost water supply and sanitation project development. To accomplish this functio, "Participating institutions" would be provided with the financial and technical support to establish a Unit for Low Cost Water Supply and Sanitation staffed by a multi-disciplinary team capable to perform the task described in the work-program.

b) Engineering Colleges and Polytechinical Institutions will acquire the capability to teach the some subjects to their students. As the program expands one or two "key institutions" in the States participating in this effort will receive both technical support from the network participating institutions and financial assistance from finance development agencies to serve as State focal point for dissmination and orientation activities in the State.

c) Sector Agencies and Consultant Firms would acquire the capability to develop and implement low cost appropriate technology projects and train their staff to do so.

NETWORK INSTITUTION IN INDIA :

The two participating institutions selected in India are the All India Institute of Hygiene and Public Health in Calcutta and Anna University in Madras, Each will establish a Project Unit to undertake the work program described in this document. The All India Institute will work in Assam, Bihar, Gujarat, Himachal Pradesh, Rajasthan, Uttar Pradesh and West Bengal. Anna University will work in Andhra Pradesh, Karnataka, Kerala and Tamil Nadu. "Key institutions" will be selected from colleges and polytechnical institutes in each state. The key institutions will become the principal promotional link through which the Centres will work to reach institutions in the States once the size of the program in a State makes such a decentralisation necessary for effective operation. Public sector agencies will be provided with assistance in the formulation and implementation of their own continuing education programs. The Network activities in India would be guided by a Co-ordinating Council set up under the Ministry of Urban Development, under the Chairmanship of the Adviser, C.P.H.E.E.O,. The Indian Network Programme is proposed to be financed by the O.D.A.(U.K).

12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

T K Basu

Mid-Decade status in West Bengal

1.BASIC DATA

The State of West Bengal has been divided into two Parts so far as activities in the Water-Supply and Sanitation Sector are concerned. One part consists of the Calcutta Metropolitan District and the other part is comprised of the remaining area of the State. According to 1981 Census, there are 75 Municipal Towns (M), 100 Non-Municipal Urban Units (NM) and 35 Urban Outgrowths (OG) within the Non-CMD part of the State.

According to 1971 Census Report, there were 38074 numbers of inhabited villages in the State.

2.INTRODUCTION

The State Government has broadly approved the Programme for the International Drinking Water Supply and Sanitation Decade commencing on and from 1st April 1981. Service coverage at the begining of the Decade is 40.30%, 16.24% and 7.42% for Urban Water Supply, Rural Water Supply and Urban Sanitation respectively. There was insignificant service coverage in the Rural Sanitation Sector.

3.PHYSICAL TARGET AND FUND REQUIREMENT

Physical Targets envisaged during Phase I (upto 31.3.85) and Phase II (upto 31.3.1991) in terms of Target population and estimated fund requirement therefor at 1980 Prive Level in the different Subsectors are indicated in Table 1.

4.PHYSICAL AND FINANCIAL PROGRESS ACHIEVED DURING PHASE I (1981-85)

Urban Water Supply

New Water Supply Schemes in 6 Municipal Towns and 12 Non-Municipal Towns and Augmentation Extension Schemes in 6 other Municipal Towns have been commissioned/completed. 0.06 crore persons have been benefitted through these schemes. Substantial progress have also been achieved in respect of execution of New Water Supply Schemes in 19 Municipal Towns and a part of one Municipal Town, 48 Non-Municipal Towns and Urban Outgrowths, and also Augmentation-Extension Schemes in 13 Municipal Towns.

Total expenditure for the Urban Water Supply Sector during Phase I of the Decade Programme was Rs.23.27 Crore of which Rs.7.87 Crore were available from the Life Insurance Corporation of India as Loan Assistance for seven New Schemes and four Augmentation-Extension Schemes.

Urban Sanitation

Efforts were made to utilise the fund available during the first four years of the Decade towards providing low cost sanitation facilities in the Municipal towns in Non-CMD part of the State. Planning and Monitoring of these Schemes are entrusted with the Municipal Engineering Directorate of the LG & UD Department while execution is done through the concerned local bodies. During the Phase I of the Decade Programme 35742 number of latrines were

Table - 1 : Physical Target and Fund Requirement

Target Population-crore
Fund - Rs. crore

	Phase I (1981-85)		Phase II (1985-90)	
	Target Pop.	Fund	Target Pop.	Fund
Urban Water Supply	0.13	28.35	0.42	67.42
Rural Water Supply	1.78	67.54	2.41	416.89
Urban Sanitation	0.11	4.90	0.21	101.74
Rural Sanitation	-	-	1.21	60.61

constructed spread over all the 75 Municipal Towns with a total expenditure of Rs. 4.25 crore.

The execution of the Sewerage Scheme for Mirik Tourist Project (within Mirik Notified Area) and also conversion of dry latrines in Ranaghat Municipality were entrusted to the Public Health Engineering Directorate. Both these schemes are in progress. The expenditure during the first four years of the Decade for the conversion programme in Ranaghat Municipality was Rs. 0.05 crore. The expenditure for the Sewerage Scheme of Mirik Tourist Project was Rs.0.09 crore during the Phase I of Decade.

Rural Water Supply

At the beginning of the VI Plan there were 25243 numbers of uncovered problem villages. During 1980-81, 873 Problem Villages were fully covered (54 by piped water supply and remaining by spot source) and 1206 Problem Villages were covered partially with creation of one spot source in each village. During the Phase I of the Decade, 3782 Problem villages were fully covered (297 by piped water supply and remaining by spot source) and 9767 Problem Villages were partially covered with creation of one spot source in each village. Thus at the end of the 1st Phase of the Decade Programme, there are 9615 Problem Villages remaining uncovered and 10973 problem villages partially uncovered.

Out of 12831 other villages 436 have been provided by piped water supply upto the end of Phase I of the Decade Programme.

A population of about 1.6 crore could be covered during the 1st Phase of the Decade Programme. Substantial progress could be made in respect of 293 ongoing Rural Piped Water Supply Schemes aiming at covering 1924 villages (1358 Problem Villages) during 1st Phase of the Decade Programme. A total expenditure of Rs.77.80 crore was made during the period.

Rural Sanitation

Inspite of financial limitations, some fund was made available. This has been utilised for construction of low Cost Pour Flush Twin Pit latrines in the rural areas. It has been possible to benefit about 22000 persons by completing construction of 4238 numbers of latrines during the Phase I of the Decade with an expenditure of Rs. 0.40 crore.

Support Programmes

i) Manpower Development and Training- During the Phase I of the Decade Programme, the Refresher Courses arranged by CPHEEO, Govt of India were utilised for manpower development and training. Institute of Local Govt and Urban Studies (ILGUS) had arranged various Training Courses for technical and managerial persons engaged by the Local Bodies.

ii) Community participation and Health Education - In West Bengal, Panchayat Bodies in the Rural Areas and the Local Bodies in the Municipal Towns are very actively engaged in the Sector Development. Management Studies and Tariff Studies could not be initiated during Phase I of the Decade.

5. HUMAN RESOURCES DEVELOPMENT

An overall augmentation to the extent of 22% has been achieved in the organisation of the two major Sector organisations of Public Health Engineering Directorate and Municipal Engineering Directorate.

6. MOBILISATION OF RESOURCES AND ANTICIPATED PHYSICAL COVERAGE DURING PHASE II (1985-91)

Annual Plan 1985-86

i) In the Urban Water Supply Sector a total fund of around Rs. 12.72 crore may be available. It is expected that ongoing New Schemes in 18 Towns and Augmentation Schemes in 7 Towns would be commissioned/completed to benefit about 0.10 crore persons.

ii) In the Urban Sanitation Sector around Rs. 0.15 crore would be available. The target is to cover 12,000 persons.

iii) In the Rural Water Supply Sector around Rs.9.25 crore would be available. The target is to cover 1168 problem villages to benefit a total of 0.12 crore persons.

iv) In Rural Sanitation Sector, about 6000 persons would be covered during 1985-86 by Low Cost Sanitation facilities with the fund of Rs. 0.12 crore to be available from the State Budget and assistance from the UNICEF in the Sub-Sector during 1985-86.

VIIth Plan (1985-90) :

i) Estimated requirement of fund during the VIIth Plan as recommended by the Working Group of Planning Commission in Urban Water Supply Sector is Rs. 291.06 crore from different sources. The target is to provide Piped Water Supply facility to all the 75 municipal towns in Non-CMD part of the State and a population of about 0.24 crore would be benefitted during the VIIth Plan.

ii) In Urban Sanitation Sector, the Working Group of Planning Commission has recommended an outlay of Rs. 4.00 crore for Sewerage and Sewage Treatment facilities in the Class I Towns and an additional outlay of Rs. 4.00 crore for Low Cost Sanitation in other Urban areas in Non-CMD part of the State. Thus, a total outlay of Rs.8.00 crore has been recommended in the Urban Sanitation Sector. The target is to cover a population of 0.04 crore.

iii) In Rural Water Supply Sector, the Working Group has recommended an outlay of Rs.82.50 crore under Minimum Needs Programme by the VIIth Plan out of a total requirement of Rs.195.23 crore. The target during VIIth Plan is to provide drinking water supply facilities to a rural population of 1.60 crore and to cover all the Problem villages remaining uncovered at the end of the Phase I of the Decade.

iv) In Rural Sanitation Sector, the Working Group has recommended an outlay of Rs.4.00 crore during the VIIth Plan to provide Low Cost Sanitation facilities to about 0.02 crore persons.

Expected physical coverage and requirement of fund during 1990-91

The requirement of fund during the Decade was estimated to be Rs 747 crore for Non-CMD part of the State at 1980 price level. Considering price escalation during the Decade, the completion cost of the decade programme is likely to be enhanced by 50% in Water Supply and Urban Sanitation Sector. In Rural Sanitation Sector, the Unit cost was taken as Rs 50/- per capita. The completion cost of the rural sanitation programme during the decade may be four times of the initial estimate. As it stands now, during the last year of the Decade, in the Rural Water Supply Sector 24% of Target population has to be covered and an expenditure of Rs 453.62 crore has to be met. In the Urban Water Supply, Urban Sanitation and Rural Sanitation, similar figures would be 44%, 82%, 98% of Target population and Rs 18.33 crore, 147.56 crore and Rs 238.04 crore respectively.

The likely short fall in the Decade targets would depend on the availability of fund and manpower within the Decade. As there is no firm indication of the amount of fund which would be available within the decade, it is too early at this stage to make an assessment of the shortfall in the decade targets.

Plan of action

The main hurdle in fulfilling the objectives of the Decade Programme has been inadequate resources. Institutional finances are available for Urban Water Supply Sector to a certain extent. Similar arrangement for Institutional finances may also be made for financing rural water supply programmes. International and Bilateral Assistances also may be obtained for implementation of Rural Water Supply Programme.

The Sector Organisations are to be adequately strengthened to meet the demand of the Decade Programme.

7. CONSTRAINTS

During the Phase I of the Decade Programme, the following constraints were experienced,

1. Inadequate resources.
2. Insufficient manpower at different levels in the Sector Organisations.
3. Procedural delay in Land acquisition.
4. Socio-economic status of people to support self-financing Schemes.

During Phase II of the Decade Programme, it may not be possible to remove all the constraints. National policies are to be formulated for removal of the constraints of inadequate resources.

8. OPERATION AND MAINTENANCE

Rural Piped Water Supply Scheme are operated and maintained by the P.H. Engineering Dte with funds available from the State Govt. Mobile Maintenance Teams for major repairs of India Mark II Hand Pumps fitted in Rigbored tubewells are placed with the P.H. Engineering Dte.

Maintenance of Schemes with ordinary and deepwell Hand Pumps of the handbored tubewells and minor repairs of the India Mark II hand pumps of the rigbored tubewells are done by the Panchayat Samitis with fund provided by the State Govt. Provision of fund for operation and maintenance of Rural Water Supply Schemes is made in the State Budget.

Municipal Water Supply Schemes are to be operated and maintained by the Municipalities after completion. In many cases, however, water supply schemes are being operated and maintained by the P.H. Engineering Dte as the Municipalities were not in a position to take over the schemes after completion for operation and maintenance.

Help of the Voluntary Organisations may be taken for motivating the rural people to make proper use of the sanitation facilities created under Low Cost Sanitation Programme.

9. HEALTH EDUCATION & COMMUNITY PARTICIPATION

Health Education is given by the Directorate of Health Services in Health & F.W. Department. People have become conscious about the necessity of safe drinking water. It is, however, very necessary to create an awareness amongst all the rural people about the importance of sanitary disposal of human excreta.

In the rural sanitation programme, people are participating in construction of the Superstructure of the latrines within their premises.

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

A M D Allen

Effective contracts for appropriate technology

INTRODUCTION

1. This Paper seeks some reasons why too many projects founder on contractual rocks. Engineering is essentially a practical profession, yet, too often it becomes a sideshow for the legal profession to demonstrate their wares. Why?

CONCEPTUAL THOUGHTS

Contractor's view

2. It is a useful starting point to examine what might be the principal conceptual thoughts between the two main parties to any project. Looking first at the situation from the contractor's point of view - he's the one doing the work, he might want to know:

i) how is he going to get paid,
ii) what does the job involve doing,
iii) who is going to keep an eye on him, and
iv) what powers is that fellow going to have,
v) what does he do if things go wrong,
vi) what 'get-out' clauses are there?

Client's view

3. From the client's point of view - he's the one footing the bill, his list might look like this:

a) what powers does he have over the contractor,
b) how closely has he got to watch matters,
c) who is responsible if things go wrong,
d) how does he control his payments,
e) what guarantees does he have that the finished job will be what he wanted,
f) what 'loop-holes' are there?

4. These lists have, provocatively, been set out in what could be their relative order of importance! Of course, most people will have recognised that these lists are incorporated into our standard Conditions of Contract. So, of course, is much else as well. It is my task in these few words to persuade you to a view I have now held for some time that really we have made our contracts far too cumbersome and long winded.

FUNDAMENTAL QUESTIONS

5. It is time that two very fundamental questions were re-examined and answered.

1) What exactly are we trying to get across in the formal statements of our contracts?
2) Is the way in which it is being expressed the best and clearest for that particular point?

6. In the context of what I now have to say it must be remembered that we are here to discuss the implementation of the Water Decade. Translated down to practical levels that will mean a very much greater number of small projects than larger capital works. However, whilst my comments are obviously directed at the smaller projects it is also worth asking oneself if there might be lessons to be learnt for larger projects as well.

TYPICAL PROBLEMS

7. Before I turn to the questions I posed I shall first put before you two of the more common areas of dispute. These are merely intended to be taken as examples, but they indicate the types of problems which underlie these two questions.

Payments

8. The first of these disputant areas concerns payments. Clause 60 in both the FIDIC and ICE (Refs.1 and 2) documents dismiss it to Part II - that part composed by the Employer. Yet, contract payments are fundamental to the unhindered progress of a contract. Consider for a moment, even on a small project a contractor may have to carry up to three months financing before he receives his first payments. If that is delayed, and if it is a small project, then the contractor may even have finished before receiving his first progress payments.

Risk profession

9. In addition to being a practical profession it must be recognised that engineering is a risk profession. There can be very few engineering projects where any responsible engineer would pronounce them to be risk free. Yet, as an industry we tend to be dominated by administrators and auditors, to whom risk is anathema. But, regularity of cash flow is life-blood to the contractor who is doing the work, and if that regularity is to be maintained it sometimes involves risk on the employers part.

10. It must be understood though that the Employer will have to have some accountabil-

ity for money spent. But in setting out the Contract it should be possible for the Employer to allow for this and set down realistic time periods for the various stages from when a Contractor puts in his account to receiving his payment.

Import licences

11. The situation may be even more complicated if any question arises of import licences and foreign exchange. Specialist goods are often immediately unavailable in many developing countries. In such circumstances the employing authority should have greater cognizance and be better prepared to assist - especially when those authorities are often governmental or quasi-government organisations.

Re-think

12. There is a need to re-think and re-state the whole philosophy underlying contract payments.

Site supervision

13. The other disputant area concerns site supervision. There are two grey areas here. First, as a general observation, in most developing countries projects are carried out at great distances from the offices where they were designed. Telephone services may have to depend on radiocall, or on the operating hours of a manual exchange. Consequently, the site staff are left to get on with things far more than might be the case in a country such as England, for example.

Contractor's agent

14. So far as the contractor is concerned that is alright. Under the contract, and under his administrative set-up, his site representative is his agent. That is clearly and unambiguously understood by all parties.

Delegated duties

15. However, and here we have our first grey area, the employer is represented first by the Engineer, who may or may not be the same person who designed the project. Then, subordinate to the Engineer is the Engineer's Representative, more commonly called the Resident Engineer. Now, what is so often overlooked is that the R.E.'s powers are severely limited, unless the Engineer delegates other duties, in writing to the contractor. Even then there are some duties which even the Engineer cannot delegate - see, for example Cl.40 (FIDIC), Suspension of Work.

Assumed powers

16. Yet, there are many reported instances where R.E.'s have assumed responsibilities not delegated to them and the contractor has accepted that as status quo. The problems then arise of course when a contractor thinks he has a justifiable claim based on some action or omission of the R.E.

The Engineer

17. The other grey area arises over the use of the word 'Engineer'. In Kenya, for example, it is a summary offence under the Engineer's Registration Act to use the title 'Engineer' unless one has the proper qualifications to go with it. However, it is the practice with some Ministries in Kenya for the 'Engineer' to be vested in the Permanent Secretary, who is not usually a qualified engineer. Difficulties have arisen from this when an Engineer's Decision is required.

Re-think

18. As the titles Engineer and Engineer's Representative seem to attract suspicion and misunderstanding there has to be a re-think on their titles and functions.

A solution

19. One solution might be to re-title these positions. For example, the Engineer could become the Senior Technical Officer, and the Engineer's Representative could be titled the Superintending Officer. These titles are, I submit, less ambiguous. Together with these new titles I also believe the respective duties should be re-written and that more autonomy could be given to the Superintending Officer.

THE AIMS OF CONTRACT CONDITIONS

20. Returning now to the first fundamental question any standard legal textbook will give you the legal definitions of Condition and Warranty. (Ref.3). A moment's reflection based on those will reveal that what we call Conditions of Contract in fact contain clauses which do not deserve to be distinguished as Conditions.

Simple statements

21. Again, I will presume on your abilities to determine from the textbooks what constitutes a valid contract. How then do, or rather should, the Conditions of Contract fit in. I believe that brought back to basics they should be simple statements of the contractual obligations of the parties towards each other.

Objections

22. At this statement I can hear lawyers leaping to their feet to shout: "Objection, we must have certainty". Quite right, we must, but at what cost? In any case if that is the lawyers' plea, why are there so many books explaining the terminology in the documents? (Refs.4 to 7). It is interesting to note that two prominent such gentlemen prominently disagree on a lot of issues!

Simplicity

23. Simplicity should not reduce certainty. It is a belief of mine that too often the printed word veils in obscurity a mysticism founded on ambiguity.

Something wrong

24. There must be something seriously wrong when the deputy managing director of a major international contracting firm is quoted as saying:

> "... the conventional FIDIC form of contract can engender confrontation between the Engineer and the Contractor, even when the project is straightforward". (Ref.8).

Solution defined

25. I say again I believe the Conditions of Contract should be simple statements of the basic contractual obligations, which I believe should include:

1) Defining who the parties are, and their respective obligations.
2) How payment is made, by whom it is checked, and how long it will take.
3) What happens when things go wrong.
4) How to resolve disputes.

CLARITY OF PRESENTATION

Fog Index

26. The second of my basic questions concerned clarity of presentation. May I introduce you to the 'Fog Index'.

Defined

27. The ICE publishes an excellent little booklet (Ref.9) in which the 'Fog Index' is defined thus:

"The Fog Index was devised by Robert Gunning as a means of measuring the comprehensibility of written work. Test your essays to establish their rating in the following way.

(a) Choose, at random, a number of consecutive sentences containing in total approximately 100 words.
(b) Note the number of sentences contained by the 100 words and calculate the average number of words per sentence (NWPS).
(c) Using the same 100 words, count the number of words which contain three or more syllables, ignoring proper nouns and words which are three syllables long because of -ed or -es (TSW).
(d) Add NWPS to TSW and calculate 40% of this total. The answer is the Fog Index (FI) for that piece of writing.

The lower the FI the more readable is the work. You should aim for a FI of 12 or less. If the FI is greater than 12, either shorten your sentences or use simpler words or do both. This should prevent the fog closing in".

FI scores

28. Using that definition an examination was made of four clauses from one of the standard documents. They are four which are commonly quoted in disputes. The best scored an FI of 17, the worst 55, and the average was 28.

An example

29. Having committed myself to this cause I must give an example of how I believe these solutions could be worked out. In the FIDIC Conditions Clause 2(2) scores an FI of 21 for the first paragraph alone. It could be re-worded thus:

"2 (2) The Superintending Officer shall report to and be responsible to the Senior Technical Officer. The Superintending Officer shall normally be on the site and his duties shall include:-

a) To watch and supervise the Works.
b) To test and examine materials brought to the site in connection with the Works.
c) To test and examine workmanship employed in connection with the Works.
d) To check setting out and site measurements made by the Contractor.
e) To inspect alleged site difficulties reported to him by the Contractor, and make agreed records.
f) To authorise any variations in the Works for which he shall have written authority from the Senior Technical Officer.
g) To receive the Contractor's interim accounts, check them, agree corrections with the Contractor, and despatch them to the Senior Technical Officer for audit and certification.
h) To keep a continual check on progress of the Works and check the causes of apparent lateness.
i) To carry out other duties as the Senior Technical Officer may delegate to him in writing".

For the record, this re-wording scores an FI of 11.

DISPUTE RESOLUTION

30. "Let wars yield to peace,
laurels to paeans". (Cicero).

It cannot be denied that the most successful contracts are those where everyone works in complete harmony. Yet, it would be stupid to deny that this ideal state always exists. The frailty of human beings is such that disputes are bound to happen. It is a true saying that the Engineer who has never made a mistake has never done anything.

31. If we therefore accept the inevitability of disputes what can be done to minimise them and their effects? I believe that the very name 'Arbitration' sometimes strikes fear into the hearts of some people. It should not. After all, the Arbitrator will usually be a fellow professional and the proceedings should be conducted confidentially.

32. Why not then take a fresh look at the Arbitrator? Why not work out a new role for him under the contract? Why not nominate your Arbitrator when drawing up the contract, so that he is known to both parties, and his appointment already exists? Why not use him whenever any potentially contentious situation arises? He can make his decisions in the form of Interim Awards and publish his Final Award at completion of the contract. By using your Arbitrator more fully and involving him earlier, totally implacable disputes should be reduced, and minor disputes resolved whilst the facts and material evidence are still fresh. It could also be that if the Arbitrator is moved up from Long Stop to Short Stop then the parties might try to do some fielding themselves, and find they can get on together after all!

CONCLUSION

Literary work or literate?

33. Whilst I do not pretend that contract documents should be literary works of art, they should be capable of being understood by the ordinary person who will have to use them. A lot of money has been spent in the last two decades on the world literacy programmes. At the Persepolis Symposium in 1975 (Ref.10) it was stated then:

"The very process of learning to read and write has been made an opportunity for acquiring information that can immediately be used to improve living standards, ... mastery of the environment ...".

Professional obligation

34. As engineers, it is a duty arising from our professional obligations that we should be assisting our fellow men. We do not necessarily fail, but we do not make things easier by using documents which are even attracting criticism from within the countries of their origin. (Ref.11).

35. Is it too late to take a completely fresh look at what we are trying to achieve?

REFERENCES

1. FIDIC. Conditions of Contract (International) For Works of Civil Engineering Construction. 3rd Edition. March 1977.

2. INSTITUTION OF CIVIL ENGINEERS (ICE). Conditions of Contract For Overseas Work Mainly Of Civil Engineering Construction. 1st Edition. August 1956.

3. UFF John. Construction Law. Concise College Texts. Sweet & Maxwell. London 1981. (a book)

4. WALLACE I.N. Duncan. Hudson's Building and Engineering Contracts. 10th Edition. Sweet & Maxwell. London 1970 (Supplement 1979). (a book)

5. ABRAHAMSON Max W. Engineering Law and the I.C.E. Contracts. 4th Edition. Applied Science Publishers. London 1979. (a book)

6. WALLACE I.N. Duncan. The International Civil Engineering Contract. Sweet & Maxwell. London 1974 (Supplement 1980). (a book)

7. WOOD R.D. Building & Civil Engineering Claims. 2nd Edition. The Estates Gazette Ltd. London 1978.

8. STEVENSON James. New Civil Engineer.

9. MADGE B., BARR B., BEVAN A., DAVIES M. The I.C.E. Essays. Thomas Telford Ltd. London 1981. (a book)

10. UNESCO SECRETARIAT. A Turning Point For Literacy. Proceedings of the International Symposium for Literacy, Persepolis, Iran, 3 to 8 September 1975. Pergamon Press. Oxford 1976. (At page 21, from a Paper delivered at the Symposium).

11. JACKSON Rupert. Are Standard Forms of Contract a Good or Bad Thing? Construction Industry Law Letter. London, February 1985. (from a periodical)

12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

D C Sims

Simple operational techniques for waterworks

INTRODUCTION

The Water Decade statistics which are quoted to show what fraction of the world has access to a supply of safe water include all existing waterworks supplies. The figures refer to population served. It is assumed that the quality of water served is satisfactory. This may be so, if the operation of the waterworks is satisfactory. If, however, the treatment plant is not run correctly then an unsatisfactory standard of water will be produced and this will be reflected in the health standards of the community served. The operation of works must therefore be given very careful attention if the full benefit to the people is to be realised.

In this paper the author attempts to discuss some aspects of how water treatment plants can be simply operated, based on experience of some years plant operation in U.K. and observations of operational works in Africa, Asia, the Caribbean and U.S.A.

GENERAL

Good operation of treatment plant depends mainly on good observation of the different parts of the process. This requires patience and training as conditions change relatively slowly. Good observation will detect subtle changes early, so that corrective action can be taken before the situation develops into a more serious incident. For example, if a channel is seen to be accumulating silt it can be cleared before the situation has become so bad that the carrying capacity of the channel is affected. However this presupposes that the observation has been made, recorded, reported, and acted upon, and can only happen if there is a system of proceedure. The basic proceedure is the same in principle for all operations.

TOOLS

No operations can be undertaken without tools. These are few and simple for operators, in contrast to the craftsman's need for many and special tools. Each group of operators should be jointly responsible for their tools on the works. These are usually left at the location where they are needed, as often they are needed quickly and are only used at that location. For example, rakes at the intake coarse screens. There should be a special place for tools such as a rack or shelf on a convenient wall. They should not be locked away from the place where they need to be used frequently.

Work Schedules or Log Books

Water Treatment Plant operators work on shift systems in order to obtain 24 hour manning. The shifts are often 8 hours continuous work. This work period has to be of a disciplined nature. The supervising staff must ensure that every operator has a schedule of work layed out for him to cover during his shift period. This can be done by a routine plant "walk", which will include visiting and observing each part of the process at set periods of time. It is usual for this period to be one hour. In order to ensure that the operator achieves his schedule a reporting system is necessary. The format for this schedule can vary according to the layout of the works. It will follow the pattern and sequence of the plant walk. It will require the operator to observe the functioning of the individual items making up the process, and to record the operating condition of each. For example a pump observation would include the running volts, and amps readings, the operating pressures and flow, and comments on the general running conditions, such as hot bearings, leaking glands, and noisy or noise damage in motors.

When these work schedules, sometimes referred to as log books, are completed, it is most important that the supervisor should take an active interest in the results. Operators soon become disillusioned if this is not done regularly and effectively.

Work Instructions

The work schedule must be accompanied by instructions to the operator on what he is expected to do and achieve at each section of the plant walk. Examples of these will be given through the individual parts of the plant described.

SOURCE

The operators observations of the source of water, before treatment, is of great importance. In a river this may be the gradual increase in turbidity over some hours, the sudden appearance of oil pollution on the surface, or floating bodies of dead fish or animals. In all these cases corrective action must be taken, perhaps by the operator himself, or by reference to the supervisor. A much longer term observation may be the siltation or changing course of the river channel. If this is detected,early action can be taken to remove silt, assist in formation of new channels, or excavation of alternative channels to ensure that water arrives at the works from the source. The consequence of delay in taking action early may be the complete closure of the water source.

INTAKES

Siltation is a common difficulty and this is often difficult to observe in the early stages. Operators must be trained to watch out, and supervisors encouraged to take action early, before a major incident developes.

SCREENS

Coarse screens are usually kept clear by the operator raking them. He may need assistance at times of heavy floating debris in the river such as trees, hay bales, sugar cane, and vegetation, to say nothing of dead animals. It is necessary to remove debris from the site after removal from the screens. This can be done by burning, carting away, or sometimes returning to the river below the intake. Fine screens are always very difficult to clean and sometimes an impossible situation involves the screens being removed and taken out of use. Simple strong rakes for operators use are essential for the task and should be stored conveniently near to the screens.

RAW WATER PUMPS

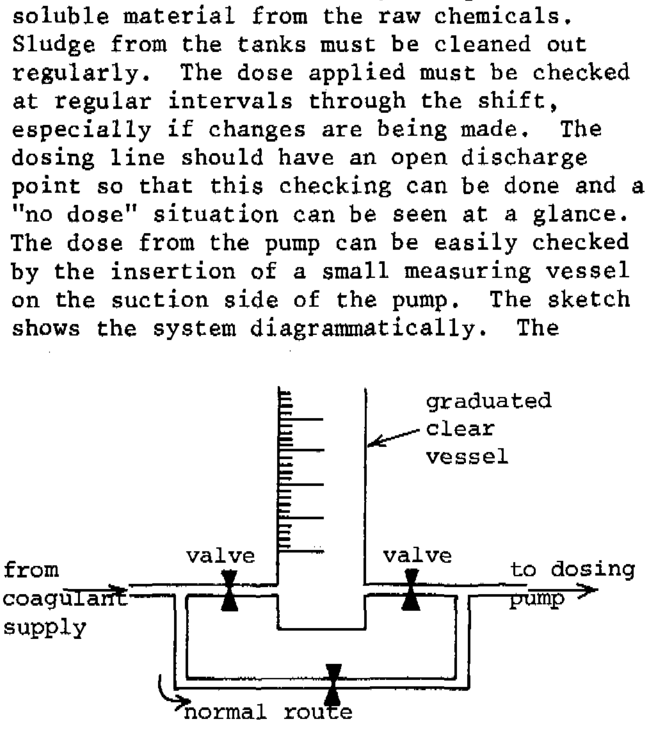
The main operation here is starting and stopping. The operators need to observe the starting of each unit to see if the routine is normal. Any abnormality, including a difference in noise should be noted. The switchgear must also be observed as often arcing on the contacts can be heard or seen long before major replacement is required. The cleanliness of the switchgear can be observed, but it will be a skilled electrician's job to carry out the cleaning task. The non-return valves need to be observed in order to ascertain that they close effectively. The temperature of bearings (by touch), the sealing glands, and running sound also need the operator's attention. Major breakdowns can often be avoided by the skill of the operators in noticing quite small changes in running sounds made by plant with which they are very familiar. They become very skilled at observing changes if they are encouraged by the supervisory staff.

AERATION

There is a small work content in the operation of aerators. Perhaps the main observation to be made is to decide when they become unnecessary and should be by-passed. Weirs, channels, plates, and cascades have to be kept clean of growths by brushing frequently.

CHEMICAL DOSING

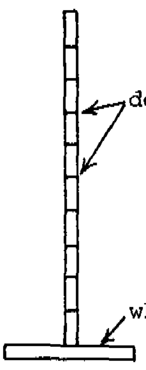
When no resident Chemist is employed the operator has to make the decision on the chemical doses to be applied. This dose may need to be changed during times when the supervisor is not present to carry out the necessary testing and calculations. Therefore the testing and calculations must be made available to be applied in a practical way. The normal jar test for establishing the coagulant dose should be carried out regularly by the operators. The results can be translated into the dosing pump setting by a carefully prepared table. The solution strength also needs to be established by use of an hydrometer. This is easier if a saturated solution is always used, but this may not be possible for smaller doses and flows. Making up these solutions must be carefully carried out in a separate container or tank from the dosing container. If this is not done the dosing container becomes fouled by sludge and in-soluble material from the raw chemicals. Sludge from the tanks must be cleaned out regularly. The dose applied must be checked at regular intervals through the shift, especially if changes are being made. The dosing line should have an open discharge point so that this checking can be done and a "no dose" situation can be seen at a glance. The dose from the pump can be easily checked by the insertion of a small measuring vessel on the suction side of the pump. The sketch shows the system diagrammatically. The



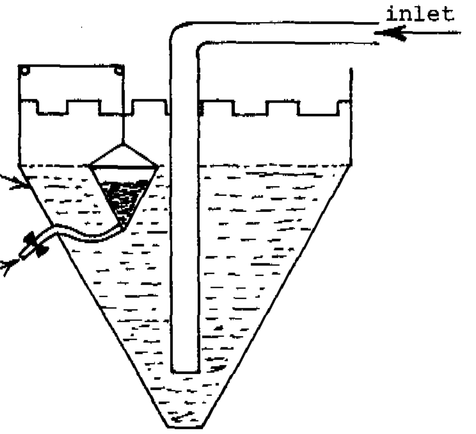
vessel is filled and level noted, then the dosing pump is made to draw from the vessel for a set period of time. The chemical lines must be flushed at intervals with clean water to prevent a build-up or blockage. Care must be taken that the coagulant mixes well with the incoming water, best achieved in a turbulent area such as a weir. Gravity dosing systems with constant head apparatus are simple to operate and easy to check.

SEDIMENTATION

Observation of the flocculation system is a pre-requisite to the sedimentation stage. Often the operator can suggest ways in which flocculators can be improved - sometimes these observations are the first stage in a modification of the installation. The operation of sedimentation tanks is an art. The combination of various water conditions, floc conditions, sludge blanket controls, sludge controls, velocities, and many other variables is a real challenge to the operator. This art is made impossible if the tank design is not correct for the water under treatment. Observation of the tank inlet and outlet are vital. Heavy blanket, wild floc, boiling, overturn, short circuiting, are all terms used by operators to describe the process they are trying to control. The measurement of the depth to the top of the blanket in sime tanks is important. This is done with a simple pole plate instrument.



The pole is dropped vertically into the tank until the plate disappears into the top of the blanket. The depth of water above the blanket can be read off the graduations on the pole. Blanket control is done by use of the sludge controls towards the top of the tank. These controls are connected to hoppers, and cones set at the blanket surface level in the tank. Sludge migration into these hoppers/ cones is a delicate observation and indicator to the operator. Heavy sludge draw-off is carried out from the base of the tank and care must be taken in the operation of these large valves. This should never be done when there is danger of discharging all the blanket material present in the tank. The observation of wild floc at the discharge weir of a tank is a good indicator of the correctness of dose applied. Horizontal flow tanks must be emptied and cleaned at regular intervals and after periods of high turbidity water. High pressure hosepipes are useful but squeegees are still necessary on flat floors. Sometimes a half-clean of a tank is possible between major cleans. Hopper bottomed vertical flow tanks can be improved by the introduction of blanket control cones as illustrated. These cones are positioned near the centre of the tanks and the sludge is drawn from the surface of the blanket.



Solids contact sedimentation tanks are controlled by various positions of the sludge draw-off. The blanket should be formed in a similar way to the vertical flow tank.

<u>Filters</u> (Rapid gravity)

Here the operator has many observations to make, many actions to take, and most hard work to do. The main work is concentrated in the washing proceedure. This is one of the most important operations in any works. It involves disturbing the sand bed in order to loosen the accumulated dirt and mud and then washing this mud out of, and away from, the filter. It is vital that each washing completes the removal of mud or a very gradual accumulation will occur. This starts with small balls of mud on the surface which penetrate the bed as they get larger and heavier until they cannot be removed by air scouring action and have to be dug out of the bed by the operator himself. The main observation to be made is when the filter is running, to observe the quality of the water at the outlet. Many filter outlet chambers are coloured white or white tiled to help this observation with a metre or so of water to look through. If the quality deteriorates then the filter needs to be washed. The loss of lead through the filter is also an important observation. Loss of lead gauges are notoriously inaccurate and frequently do not record at all. The loss of lead can be observed increasing as the level of water in the filter rises. This will occur even when the outlet controller is working, but is more marked when it is not. Outlet controllers have bad habits of not working and getting set in one position. Providing this position is not closed, the filter will continue to operate but at a variable rate.

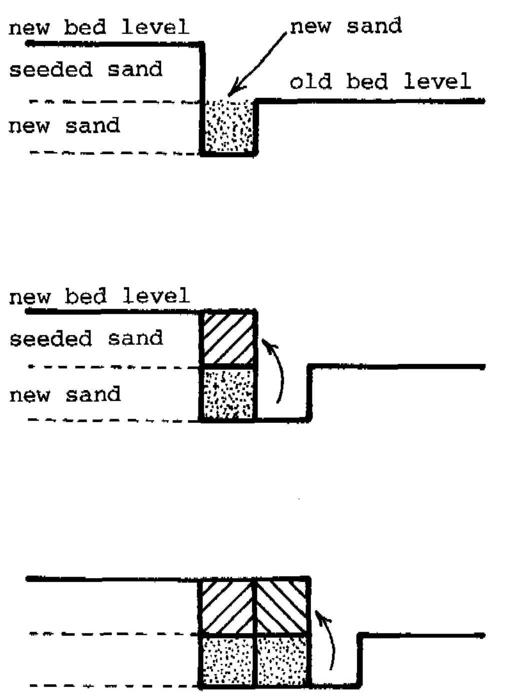
By a combination of these two observations the time for washing is established. More often, however, filters are washed "on time". This means that washing takes place after a set period of use. Often this is 24 hours, or 48 hours, which will mean each filter is washed at a set time every day, every other day, or even longer. This method may mean that filters are washed more frequently than really necessary, but it ensures that a regular pattern of operation is established and better filter cleaning and performance is the end result.

The valve operation for the washing sequence should be written down for reference, but is usually well known by the operators. The time for each operation should be set by the Supervisor, but with some latitude left for operators judgement. This means that if the operator judges that the washing operation has not quite removed the mud, he can prolong the wash. Similarly if he observes the mud on the surface has not been disturbed sufficiently by the air scour, he can extend this time. There should be maximum limits set for both scour and wash. The time of each operation should be carefully recorded.

If for some reason the air scour fails completely, as in the case of breakdown of blowers or compressors, then manual disturbance of the mud may be necessary. The operator walks on the surface and disturbs it with a fork or rake before the washwater is turned on. Some filters are operated in this way with no air scour sequence. There seems to be a reluctance of operators to get into rapid gravity filters. Perhaps this is because a ladder is needed, or because it is an unpleasant muddy job. The method of cleaning filters when they have become badly contaminated so that the air scour will not disturb the sand bed is to manually dig and try to wash out the mud. Sometimes this can be achieved but often the only method is to completely remove the sand and mud, wash it manually, and return it to the bed. The malfunctioning of the underdrain system and nozzles can only be detected by keen observation, and repaired by removal of the whole depth of sand and coarse media. Many filters can be rehabilitated by this method of manual disturbance and constant washing providing the underdrain system is sound. Filter defects can only be detected initially by keen observation of the operators during the washing sequence. The opportunity to pass these observations to the supervisors must be afforded to the operators and their observations should always be treated with great respect, they may be the key to something which is causing a detioration of the filters.

SLOW SAND FILTERS

To operate slow sand filters efficiently is a skilled job. It is important to filter slowly after cleaning to allow a new filter mat "Schmutzdecke" to form. The rate of filtering and the quality at outlets has to be observed diligently. Beds must never be allowed to dry out. At the end of the run the cleaning of the top sand should leave the sand surface level and clean. When new sand is added it should always be seeded by placing existing sand from the bed on top. This is done by trenching across the bed as illustrated.



Care must be taken, when sanding and cleaning, to avoid compacting the sand surface. Barrows must always be run on timber planks. Excessive walking on the surface must be avoided by using walking planks. The finished surface of a bed must be level and of constant thickness throughout.

PRESSURE FILTERS

Observation of the wash water outlet will indicate when the filter is clean after washing. Observation of the filtrate is rarely possible when the filter is running and washing is carried out on a time basis. Times for air scour and/or agitation should be carefully monitored. Inspection of the sand by emptying the filter and opening the access holes should be carried out at regular intervals. The air scour should be observed with the sand just covered with water to ensure that even distribution is achieved.

DISINFECTION

When chlorine gas is used the drums or cylinders must be stored in a cool, well-ventilated place. The chlorinator should be at a higher ambient temperature than the cylinder and the temperature gradient of the gas feed line should never be reversed since this can cause the chlorine to condense. The feed line should be as short as possible. Cylinders should be secured as a cylinder falling and a pipe fracture can cause a dangerous leak. It is necessary to make joints carefully with the correct washers. These are of lead fabricated with a fibre reinforcing. All empty cylinders should be chalk marked MT. Operators need careful training on the proceedure to bring a cylinder into use. Instructions should be issued in writing such as:

"The proceedure to bring a cylinder into use is:

1. Remove the protecting dome, by unscrewing.
2. Ease gland nut on spindle head to 'finger tightness' taking care that the valve spindle does not turn.
3. Remove cover nut on side of spindle.
4. Attach union connection using washer supplied by manufacturer.
5. Open valve slightly using appropriate spanner (No.4.)
6. Test gland and all pipe connections for leaks using the ammonia bottle. (By holding the open ammonia bottle UNDER all joints. Any leakage will become apparant by the appearance of dense white fumes.)
7. In the event of leakage, tighten gland nut GENTLY.
8. If all satisfactory, 3 complete turns will fully open the valve, do not attempt to open further."

Gas masks are kept near the chlorine installation, (not locked up in the supervisor's cupboard) and operators should wear them for at least five minutes once every three months. This familiarity is necessary in case of emergency and it also indicates when a mask has reached the end of its useful life. Masks are often seen hanging behind doors very dusty and quite useless if required. Operators should understand why icing of cylinders occurs when the draw-off of gas is excessive. When bleaching powder is used it should be mixed in a mixing tank, allowed to settle, and the clear liquid then transferred to the dosing tank. The sludge should be regularly removed from the mixing tank. If powder is mixed in the dosing tank this sludge will clog any taps, pipe or dosing mechanism. Simple dosing apparatus is required. A tap at the bottom of the dosing tank is not satisfactory as the dose will vary with the level in the tank. A constant head device is necessary and can be easily constructed with cheap materials. The point of application should be visible so that it can be checked at a glance if dosing has ceased.

RECORDS

Each shift operator will record the state of operation of the plant during his tour of duty. This record can be in various ways but is usually in a log book. A selection of parameters, observations, and readings are called for at set intervals, often one hourly. It is easier if these are in order of his plant walk. The supervisor will inspect this record at least daily. The local Engineer will always look at it when he visits the works and action will be taken based on the operators remarks and observations.

CONCLUSION

The operators job can be best summed up in a few words.

Objective Observations
Delicate Dosing
Careful Control
Continuous Cleaning
Dedicated Disinfection
Wonderful Water.

Plenary Session 2

Chairman: Professor J A Pickford
Co-Chairman: Professor K J Nath

Discussion

A K Roy and others

Training network for the Decade

1. Mr ROY introduced the objectives of the training Network for water and waste management sponsored by the World Bank and UNDP. The Network's effort will concentrate on increasing the sector's capacity to apply low cost water supply and sanitation technologies in a socioculturally acceptable manner at costs affordable to the low income beneficiaries. The Network centres in India which will assist with human resource and institutional development are the All India Institute of Hygiene and Public Health and Anna University.

2. Dr Bhattacharya asked what were the criteria of selection of the two training institutes in India and what was the selection procedure?

3. Mr ROY replied that AIIPH is the best institute in India which has been dealing with low cost technology for water and sanitation for the last 50 years. There is no Institute in India which covers all aspects of this programme, sanitary engineering, health, health education and community participation required in this field. Anna University has conducted courses of the World Bank on water and waste disposal and has established an international reputation.

4. Mr LLOYD asked how has the projected requirement of the decade been related to the work load. Rural water and sanitation projects often require more engineer's time per unit cost (because they are small and widely spread and cheap). Has this been taken account of in the estimates of manpower required? Has O & M manpower requirement been included. With such large increases in manpower, organisations will need to change in structure, not just in numbers; what is being done to plan and implement such structural changes?

5. Mr ROY replied that this is only a training module, to indicate how the training should be conducted, who should be trained, how they should be trained etc. Hence it was not necessary to assess the requirement of work load. Manpower requirement has not been considered. But what type of training is needed for different categories of personnel who will be involved(whether in a rural or an urban programme) has been provided in the module? In the various courses and workshops the training will be given to trainers who in their turn will go on imparting training to more and more people. Low cost technology should not require a very high cost technical (engineering) manpower. Experience will show what structural changes will be needed. Similarly even the training programme may require change after gaining experience.

T K Basu

Mid-Decade status in West Bengal

6. Mr BASU presented his paper. The main hurdle in fulfilling the objectives of the Decade programme had been inadequate resources. The sector organisations were to be adequately strengthened to meet the demand of the Decade.

7. There followed a general discussion about certain aspects of appropriate technology. Mr PATEL made the comment that the past experience of rural water supply via borewells and handpumps has not been wholly satisfactory due to possible health hazards and manual drawing of water, hence what is the scope to assess, develop, approve and implement alternative water systems which can ensure water from the tap from deeper sources free from subsoil contamination and pollutants as also through a tap which can ensure controlled flow. This aspect of rural water supply needs to be reviewed seriously for modification and improvements of the limitations of conventional ground water development.

8. Ms RADITLOANENG in discussing the double compost latrine in Botswana said that it has more disadvantages than successes. Due to hard materials that are often found in the pit, emptying is really a problem. There are some taboos related to the use of the pit contents as fertilizers, hence it is more costly to empty the pits than if the households were to do it manually. This entails too much expenditure. Due to high water table compost pit contents do not really decompose, hence the latrines are in most cases unhygienic and very smelly because the inside is always wet, unlike the VIP.

9. The Chairman asked Mr QUANG QUYNH to comment on the use of composting latrines in Vietnam. Mr QUYNH said that the major problem in his country was that the demand for fertilizer for multiple cropping was so great that often the excreta was used before it was well composted. This led to almost 90% of the population having ascaris. They were trying to shorten the duration of composting and an

experimental programme was under way to this end.

A M D Allen

Contracts for appropriate technology

10. Mr ALLEN made a strong plea for contracts to be written in simple terms which were easily understood by the ordinary people who will have to use them. Simplicity should not however reduce certainty, documents should not be ambiguous.

11. Mr DHAR asked what in your opinion is the way of avoiding arbitration where the works have to be delayed by the Engineer in charge for want of unforeseen shortage of money and materials which particularly happens in many underdeveloped or developing countries.

12. Mr DHAR also commented that in our state of West Bengal, some awards from the Learned Arbitrators have been received which are "non speaking" and which cannot be challenged in the court. What, in your opinion, is the way to guard against this.

13. Mr ALLEN replied that arbitrations will never be totally stopped where the parties are determined enough. However, he believed they can be reduced by adopting more of a risk sharing attitude. This would particularly apply where the employer is a Government or Parastatal organisation and some element is under the control of the employer, such as fuel or cement, etc. Awards cannot be challenged on findings of fact. Depending upon your Arbitration Act, it may be possible to challenge an Award on findings of law. Where the Arbitration Act does not enforce "Speaking Awards" an Arbitrator cannot be forced to include reasons with his Award.

14. Mr PURNELL-EDWARDS asked within the context of Mr Allen's Action Plan, has he any comment on the proposal of Risk Sharing amelioration for such contract forms as Target Cost. This contract form has been used successfully in East Africa recently.

15. Mr ALLEN referred the questioner to his answer to Mr Dhar.

16. Mr HUGMAN commented that many of the points made by Mr ALLEN are probably equally applicable to consultancy agreements. Would you comment on such agreements.

17. The problems of language are even more serious in non-English speaking countries where international contracts are often still written in both English and the local language. Translations are made difficult by non-standard terms not found in dictionaries.

18. Mr ALLEN believed that Consultancy Agreements also should be re-written, especially for two situations:

a) where the consultant does not also carry responsibility as the engineer.
b) where aid funds are involved.

19. Mr ALLEN agreed with the second point made, and it underlied his suggestion that language should be made simpler. It was possible to exclude non-standard terms, or to exclude legalistic technical terms which he appreciated must be very difficult to translate into some local languages.

D C Sims

Operational techniques

20. Mr SIMS stressed that the quality of water coming out of a works depends on the operator. A multitude of small jobs were required to make up a successful operation. This meant observing what was going on, doing things when needed, using tools made by and for the operators, having working instructions and log books, but above all getting on and 'doing things'.

21. Dr COAD asked whether in view of the need to rake sand filter beds that have become clogged with mud that is not removed by washing, would you recommend a return to the circular filters with rotating rakes, like those that were in use at the beginning of this century?

22. Mr SIMS agreed that everything should be done to improve the cleaning of filters. This can be done manually by getting into the filter bed and raking the surface. It can be done mechanically as suggested by Dr COAD but this system is rarely installed at works constructed today.

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

H M G van Damme

People's water and sanitation Decade

Mr van Damme, in making his valedictory address, stressed that in seeking to attain the objectives of the International Drinking Water Supply and Sanitation Decade we must not confuse targets with goals.

There were three particular areas where balance in our approach was required without polarisation or over-emphasis on any one aspect of development. The first was with regard to cooperation between the Government, the communities and the special role of women. The second was between the competing needs of water supply, environmental sanitation and hygiene education. The third area where balance was required was in the competing demands for facilities to be constructed, the requirement for effective maintenance as well as the need for the facilities to be properly used.

This balance had to grow out of a 'bottom up' approach with the balance and initiative coming from the people who were going to benefit from the improved water supply and sanitation.

However there were also aspects of the programme which had to come from the 'top down'. Training was absolutely vital for progress to be made through the rest of the Decade - 'We need more trained people'. Information had to be shared around the world, between districts and regions, between countries and even between continents to ensure that the best ideas were being used by all who could benefit from them.

Money was required. It was recognised that more money must come from the consumers but there was still a need for funding to come from external sources. Standardisation was needed to avoid confusion and difficulties both with regard to hardware as well as with regard to sociological methods and survey techniques.

Institutional aspects could never be neglected. The requirements of management, organisational structures, delegation and decentralisation must be considered and made effective if progress was to be made. Privatisation was becoming fashionable and may be useful in certain situations. Finally, rehabilitation was going to be a vital component of all programmes. Attention would have to be given from the highest level in order to ensure that priority was given to appropriate rehabilitation ahead of replacement works.

In conclusion, Mr van Damme reminded the conference that technology had to be seen in the context of people, it must be a servant of the people rather than a director. We must not see people simply as a means to get our technology functioning. The needs of the Decade remained great but if we kept our eyes on the ultimate target we would succeed.

WEDC 12th Conference: Water and sanitation at mid-Decade: Calcutta 1986

Conference Visit to Palta Water Works, Calcutta

On Wednesday 8 January 1986 conference delegates were warmly welcomed by the Manager and staff of Palta Water Works for an extensive site visit.

Historical background - In the nineteenth century, Calcutta, which then was the capital of British India, was known as the second city of the British Empire. Naturally, no efforts were spared to give the city a good water works. With the strenuous efforts of the British hydrologist, Dr McNamara, who carried out elaborate tests on river Hooghly and selected the present site at Palta, about 27 Km to the north of the then Governor's House at Esplanade, Calcutta and the late W Clarke, the Secretary to the Corporation, who designed the first water works, Palta Water Works with an initial water production capacity of 6 million gallons (Imp) per day, started functioning from 1870.

Subsequent developments - As the demand for potable water supply went on increasing in Calcutta, successive schemes were executed to increase the water production capacity of Palta Water Works through the Decade and the present capacity has reached the figure 160 million gallons (Imperial) per day. Famous British engineers were involved in such developments of Palta Water Works. To name a few, Sir Bradford Leslie in the 1870's, W B McCabe in the 1910's, J R Coats in the 1920's and Dr B N Dey in the 1930's, come to mind.

The present facilities - Palta Water Works at present is a conglomerate of two separate and complete water works. The first one is known as the Old Water Works and the second one as the New Water Works. The production capacity of the Old water works is 100 million gallons per day, while that of the New water works is 60 million gallons per day. Of course the two water works, for the sake of operational facility, are inter-connected at various stages of production. In the Old water works, water is drawn from the river Hooghly through suction pipes suspended from a jetty, with the help of electrical motor driven centrifugal pumps, then clarified in clariflocculator plant, then detained in large settled water detention basins and then subjected to slow sand filtration and rapid gravity sand filtration. Finally filtered water is chlorinated and then pumped through large diameter pipes to the Booster Pumping Station at Tallah (situated

(situated in the Northern part of Calcutta) over a distance of about 20 Km.

In the New water works raw water is drawn from the river Hooghly through suction pipes suspended from a jetty, with the help of electrically driven motor pump sets, then treated in a compact water treatment plant having a capacity of 60 MGD, where raw water is clarified and subjected to rapid gravity sand filtration and then chlorinated. Finally filtered water is pumped by high pressure pumping station to Tallah Pumping Station through large diameter trunk mains.

Some technical data of the facilities of the Palta Water Works:-

i) Total land area of the water works; 480 acres.

ii) Raw water centrifugal pumps at Old Water Works; three nos each of 2 MGH capacity at 52 ft head driven by 650 hp, 375 rpm, 6 kv slipring induction motors of Mather & Platt of England make.

iii) Raw water centrifugal pumps at New Water Works; three nos each of 1.75 MGH capacity at 54 ft head driven by 630 hp, 375 rpm, 6 kv slipring induction motors.

iv) Suction pipes:

(a) Old Water Works; three nos 54 inch diameter each of riveted steel construction, One no C.I. of 36 inch diamater

(b) New Water Works; two nos 60 inch diameter each of welded steel construction.

v) High pressure filtered water pumping station:

(a) Old Water Works; three nos centrifugal pumps each of 1.75 MGH capacity at a head of 120 ft by water gauge driven by 1500 hp, 600 rpm, 6 kv , squirrel cage induction motors of Mather & Platt, England make. One no three stage (in parallel) centrifugal pump of 2 MGH capacity at a head of 120 ft by water gauge, driven by 1630 hp, 1000 rpm, 6 kv, synchronous motor of West German make.

(b) New Water Works; three nos centrifugal pumps each of 1.5 MGH capacity at a head of 120 ft by water gauge of Mather & Platt of England make, two of which are driven by 1150 bhp and one no driven by 1300 bhp 600 rpm 6 kv squirrel cage induction motors.

vi) Clariflocculators:

(a) Old Water Works; six nos each of 180 ft diameter with a capacity of 16.66 million gallons per day.

(b) New Water Works; six nos 140 ft diameter each with a capacity of 10 million gallons per day.
vii) Settled water storage capacity:
(a) Old Water Works ; 350 million gallons
(b) New Water Works ; Nil
viii)Filtration facilities:
(a) Old Water Works; RG Sand Filter, capacity 82 MGD.
Note:- There are 93 units of slow sand filter beds each having an average filter capacity of 1.1 MGD. One unit of bed has a size of 200 ft by 100 ft.
(b) New Water Works; RG sand filtration capacity, 64 MGD. There are 32 nos beds each of 2 MGD capacity.
ix) Chlorination facility:
(a) Old Water Works; three nos chlorinators each of 40 lb per hour capacity.
(b) New Water Works; three nos chlorinators each of 40 lb per hour capacity.
x) Trunk water mains to Tallah; one no 42 inch diameter CI running by gravity.
One no 60 inch diameter riveted steel construction operating under pressure. One no 48 inch diameter CI operating under pressure.
One no 72 inch diameter welded steel construction, cathodically protected, operating under pressure.
Each of the above four pipelines is of 72000 ft length.

Administrative set-up: Palta Water Works employs 928 persons of which 727 nos are in labour category and 201 nos are in supervision category. Administrative set-up of Palta Water Works is divided into 20 different sections looked after by four assistant engineers (civil) four assistant engineers (mechanical) two assistant engineers (electrical) and one assistant superintendent. The set-up is headed by an executive engineer. Dy.Ch.Engineer (Generation), who is in overall supervisory control of Palta Water Works and the Booster pumping stations in the city proper is resident at Palta Water Works.

Total budgetary expense on all accounts for Palta Water Works during 1985-86 Rs 80 million.

Chemical coagulant used; mainly basic alum.

Data collected from C.I.F.R.I.

Physico-chemical parameters of the estuarine water around Nawabganj during 1985 (Jan to July 1985)

Air temp	=	25.4 - 34.2°C
Water temp	=	24.3 - 32.0°C
pH	=	8.0 - 8.5
D.O.(ppm)	=	5.4 - 8.6
Turbidity (ppm)	=	85 - 155
Total solids (ppm)	=	180 - 2660
Total alkalinity (ppm)	=	77 - 115
Chloride (ppm)	=	8 - 16
Salinity (ppt)	=	0.014 - 0.028
Sp cond (uS/cm)	=	350 - 599
Total hardness(ppm)	=	80 - 120
Nitrate (ppm)	=	Tr - 0.06
Phosphate (ppm)	=	Tr - 0.12