...gh University of Technology
...t of Civil Engineering

Water and waste engineering for developing countries

7th WEDC Conference

23 – 25 September 1981

water, people and waste in developing countries

PROCEEDINGS

edited by Susan Ball and John Pickford

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OPENING ADDRESS

Dr PETER BOURNE

Co-ordinator, International Drinking Water Supply and Sanitation Decade

Dr BOURNE expressed appreciation to Loughborough University and to John Pickford for organising the Conference. This type of event was vital for the interchange of knowledge which would be essential for the success of the Decade programme.

2. Attention was drawn to a recent Oxfam advertisement seen in Britain, part of a fund-raising effort for the Water Decade. The message was: "Water kills more people than alcohol". Dr BOURNE thought this was an interesting way of getting public attention, and it perhaps reflected on the fact that the general public still had very little appreciation of the significance of water to the health and lack of health of so many people throughout the world. Because water was taken for granted in developed countries, there tended to be little appreciation there of what a barrier it could be to good health.

3. About a year ago there was an earthquake in Italy. In one day 3000 people were killed, and there was great concern all over the world generating massive contributions of aid - a very appropriate response to the tragedy. However, on that same day, 30 000 people - ten times as many - died from water-borne diseases throughout the world, and not only died on that day but on the next day and the next, and every day since then. So this was a tragedy of major proportions, constantly with us, and in many ways a completely invisible tragedy because it was not brought to public attention forcibly, as events such as earthquakes were.

4. It was also pointed out that water was not just a health issue; it was a fundamental theme central to all development. As well as water-borne diseases there was the matter of how far people had to walk to fetch water, and how much better they could utilise the time spent in fetching it. Usually women and children did the water-carrying.

5. Also water could be used for agricultural purposes, cattle, light industry etc which affected the whole quality of life of the people living in the poorer parts of the world.

6. So it was out of growing concern for the lack of attention paid to this vital area that United Nations organisations began to focus on this issue in the late 1970s. It began with the Habitat Conference in 1976 where there was a major push for the creation of some special programme which would focus attention and put priority on the need to deal with the water and sanitation issue as a vital thread through all development.

7. Subsequently the World Water Conference in Mar del Plata in 1977 proposed an International Water Decade, which was accepted by the United Nations General Assembly. The general feeling seemed to be that a situation where more than 50% of the world did not have access to safe drinking water and sanitation could no longer be tolerated by the affluent developed nations. Rather than just deploring the situation it was felt that it was necessary to set a specific time frame within which the situation could be put right.

8. The Decade time frame was set and formally launched by the United Nations General Assembly in November 1980. This was the first time that the General Assembly had given specific recognition of this type to a U.N. programme. There was much trepidation that a party would be given and no-one would come. However, the interest and enthusiasm were so high that people went on speaking until late in the evening. This reflected the high priority put on the issue by many countries.

9. Now, almost a year into the Decade, Dr BOURNE thought it appropriate to look back and assess the progress made. He reflected that the launch of the Decade coincided with the most disastrous financial situation seen in the international development field for many years. Almost all the major donor governments were cutting back their contributions to development. For the first time since the creation of the United Nations its budget this year would be less than that of the previous year, and many programmes would be cut back. It was therefore not a very auspicious time to create a new programme, especially one that was projected by some to cost $300 billion over the next ten years.

10. However, the enthusiasm and activity continued despite financial constraints and maintained the promise created at the launch. There had been committment to the Decade by almost every developing country. Over sixty countries had created national action committees to co-ordinate the planning and implementation. Dr BOURNE told participants that a directory of these committees incorporating lists of the members and

agencies involved was available from New York to anyone who wanted one. Also sixty countries had national action plans in various stages of development, and there had been a major committment in principle if not always financially, by all the international bodies, bi-lateral agencies, regional development banks and the World Bank.

11. Dr BOURNE felt that after one year it was becoming clear that the greatest prospects for the Decade were in Asia. There were several reasons for this. Most Asian countries were at the right stage of their development for water and sanitation to be given a push. Many of them had strong economies so that investment could take place, and also many of them had very good academic institutions with many well-trained people. So there seemed to be the optimum environment for moving ahead there.

12. By contrast, in Latin America, although many of the same benefits existed in terms of government institutions and trained personnel, the situation was not so promising. There was a similar effort to the Water Decade for Latin America set up in the 1960s. Many effective programmes were set up then, especially in the major urban centres. So these cities now had adequate water and sanitation. As a result it was now difficult to convince the governments that this was an area needing priority. They tended to forget the rural areas which were still amongst the poorest in the world. The problem here was one of convincing governments to re-allocate efforts and resources away from the cities.

13. In Africa there was an interesting pattern of progress. In some countries such as Malawi, Nigeria and Kenya there had been good progress. However, in other countries where there was no strong economy and a great need for trained personnel, a real effort would be needed. But the speaker believed that there was potential in Africa for some of the most exciting and dramatic changes in the quality of human life.

14. There was a similar pattern in the Arab States, where there was affluence in the oil-rich countries of the Middle East and these countries tended to develop water and sanitation programmes as they built and expanded their cities and towns. This development was taking place as a natural part of the country's progress, and not as a result of the United Nation's initiative.

15. A particular concern had been to identify specific areas of progress which could be shown to the general public to help build enthusiasm and keep the momentum going. To this end, as part of the Decade programme there would be a special drive to try to eradicate the disease guinea worm. This was not a high-profile disease, but was of major importance in many countries in Africa and Asia. Its most important feature was that it was 100% transmitted by drinking water, so that if the water could be protected the disease would be eradicated.

16. Fifteen countries had been asked to put their highest priority in the Decade on the eradication of this disease. Already the Indian government had made it a major project carrying out a nationwide survey which identified every village where the disease still existed. It was hoped that similar projects would be started in Africa.

17. Of particular significance was that the severe symptoms of guinea worm usually came in the harvesting and planting seasons, so that agricultural production was reduced by 30% in areas where the disease existed. This meant that if the disease could be eradicated the whole standard of life in those areas would be greatly improved.

18. Dr BOURNE continued by outlining the role of the United Nations in the Decade programme:

a) Providing promotion and technical assistance, and maintaining momentum. A group had been set up to co-ordinate public relations efforts in promotion by producing publications, films, posters etc.
b) Consultancy at the country level. The primary focus must be at this level. The countries where most Decade progress had been made were those where the government had become involved and taken initiative and where national media had increased public awareness. Much emphasis had been placed by the media on the huge estimated costs of the Decade, but really these figures were virtually meaningless. Different areas had different needs and there was a great variation in costs. The greatest problem was not the costs themselves, but that the neormity of the overall figure could intiidate people.
c) The United Nations was a small organisation and as such had limited abilities. There was therefore a need for it to reach and influence all the other organisations, including non-governmental voluntary bodies and professional bodies. The latter were not only repositories of technical expertise for consultation, but should also be encouraged to help by promoting the Decade and raising money.
d) Every developing country had unique problems and so the solutions would be unique also. Governments alone could not be expected to generate sufficient interest in projects and so private industry would have to be encouraged to take an important part.

19. Dr BOURNE went on to stress that the

Decade programme was 'people-oriented'. It was not concerned just with technology or health, but with the totality of people's lives. This applied especially to women. The availability of clean water would totally revolutionise the lives of women. Here access was vital. The increased time available to women when they did not have to walk so many miles every day to fetch water could be used to greatly broaden their lives.

20. The successful projects were not necessarily those with the best technology. The people had to be involved in choosing sites and trained for maintenance so that they had a vested interest in the success of a project.

21. An example was given of an area of Burma known as the Dry Zone. There the people used to take their bullock carts and walk miles every day to featch water. Now boreholes were being drilled in 6000 villages. A charge was to be made for the water from the boreholes and some people said that the villagers would not be willing to pay for the water. However it was found that the people were originally paying the water-carriers for their water. The new charges were half the original charges and so the people were happy to pay. The money collected was used to pay for the upkeep of the well and the pump and in some cases there was money left over from this to be invested to provide other amenities such as schools. Another advantage was that excess water was given to cattle so causing the milk yield to go up. This meant that the children's health was better. There was heavy involvement of the local people in these projects right from the start and they had been very successful.

22. Dr BOURNE recognised that even the most idealistic people in the United Nations realised that there could not be 100% coverage in ten years. However he believed that it could be anticipated that the goal would be reached in some countries within that time. Also by establishing the goal, a process was set in motion so that eventually the desired 100% coverage would be reached even if it took a little longer.

23. As an example, in Britain 130 years ago life expectancy was very low, much lower than in the poorest country now. Water supply and sanitation was the single most important factor in bringing about the change there.

24. Development could be seen as trying to speed up history. In the developing world we were trying to make things happen much faster than they would normally. It was not expected that this process would take 130 years in developing countries as it had in Britain and Europe.

25. An example of what could be done was that about fourteen years ago the complete eradication of smallpox was proposed. This was thought to be impossible, but it had now been four years since the last case of smallpox. This was a monumental accomplishment and showed what could be done with perseverence.

7th WEDC Conference: Water people and waste in developing countries: 1981

PEOPLE'S PARTICIPATION IN SLUM UPGRADING

QURATUL AIN — Community Organiser, Baldia Soakpit Project, Karachi, Pakistan.

1. (a) INTRODUCTION:- Pakistan faces similar problems like any developing countries. Karachi being its largest commercial and industrial city, has attracted people from all over the country, resulting in a tremendous increase in its population. The population of Karachi is six million and increases by 5% yearly.

Thus like any other city of a developing country, a large number of squatter settlements have grown up. In Pakistan these settlements are known as "KATCHI ABADIES". About a third of Karachi's population now live in these Katchi Abadies, scattered all around the city. One of the largest Katchi Abadies is Baldia Township.

1. (b). BALDIA TOWNSHIP:- Baldia town is located towards the north of Karachi. The site industrial area which is very close to Baldia, provides employment for many of its people. According to the census of 1971, the population of Baldia was 79,529. But now it is not less than 150,000 covering a total area of 430 hectares, having 24,200 plots.

1. (c) THE PEOPLE AND THEIR EXISTING SANITARY CONDITIONS:- The population is economically and socially hetero-geneous. People from all over the country live in small pockets called "Mahallas" which are extremely homogenous, because people belonging to same villages live within their own country.

Majority of the houses are semi-pucca, that is the walls are made of C.C. blocks with no plaster and a tin or asbestos sheet is used for roofing. About 5% are hutments, and 5% have good quality R.C.C. construction.

Most of the people are unskilled labourers e.g. potters, and apprentice for masons and carpenters. Quite a few are working as loaders at the fish harbour. But a good percentage of trained mechanics and technical people work in the industries near Baldia. Unemployment seems not to be a major problem, although they are low paid workers.

Water is supplied by a network of stand pipes installed by the Karachi Metropolitan Corporation (KMC) pumping station which delivers water for about 5 hours a day. The area is zoned and each zone receives water for about two hours every second day. (For details, refer to the report by John Pickford and Bob Reed on Sanitation for Baldia Township Karachi, WEDC Loughborough University of Technology, Department of Civil Engineering).

The most common latrines are served by the conservancy system, which is not popular with the house owners. About 70% - 80% of the houses in Baldia has bucket latrines. The residents place a gallon oil drum or a battery case in a rectangular channel in which faeces is collected.

Another common practice is that the latrine has a plinth on which defaecation takes place. This plinth slopes towards a hole, in the outside wall through which faeces are removed, and urine and cleaning water runs off to the road-way or open ground outside the plot.

These containers or channels are emptied by self-employed sweepers, who collect the excreta in bigger tins. Then the house owner throws water into the channel, to clean it. The water usually runs through the outside face of the boundary wall, and stays there.

When the containers of the sweeper are full, he takes them to one of the three main disposal points, or dumps the contents into a nearer drain or vacant land. The condition of these latrines get worse when the sweepers do not come for 2 days. Excreta and waste water flow on the streets. Sometimes a small pool of stagnant sullage and excreta are found outside the plot near the latrine.

The occupants of houses without latrines, and also some children from households with latrines defecate in open spaces. (For more details refer to John Pickford and Bob Reeds report on Baldia and its sanitation).

2. (a) BACKGROUND OF THE PROJECT:- According to the KMC report more than 1 in 9 babies born in the slum areas of Karachi die before reaching one year of age. Those who survive suffer from frequent diseases and ill health. The main causes of this high mortality and morbidity rate are unsanitary methods of human waste disposal and a low level of health consciousness. Baldia, which is one of the largest slum concentration of Karachi faces these problems. The government requested in the early 1970's the services of a Dutch Advisory Mission (DAM) to assist in planning a comprehensive scheme for slum improvement. In 1979 the team recommended the construction of

"Long Life" pit latrine, as a relevant solution to reduce child mortality and morbidity rate. UNICEF got interested in the plan as the impact was on children. Since pit latrines are privately constructed and maintained by individual families, they fall outside the scope of government physical improvements. So UNICEF has discussions with government to identify suitable governmental or non-governmental organization that can take this project. Finally the Karachi University's Social Work Department (KUSWD) and Pakistan's Jaycees (PJC) a non-governmental organization were contacted to undertake the project on an experimental basis.

2 (b) AN EXPERIMENT IN CONSTRUCTION OF SOAKPIT LATRINE:- In August 1979, UNICEF began supporting these two organizations. To start with, Jaycees agreed to construct 30 soakpits using UNICEF's funds.

Pakistan Jaycees contacted a local contractor who is also religious leader in Muslim Mujahid Colony (MMC) in Baldia. The pits were constructed by this contractor with technical supervision by the engineers of Jaycees.

Three months later KUSWD had also agreed to construct 30 soakpit latrines. By this time Jaycees had already finished its construction. Having no experience in construction, the professors and students (I was one of them) of KUSWD visited MMC to orient ourselves on the design and procedure of construction. We met the mason who was trained and involved in the construction of the pits. We took a round of the MMC along with the mason and some other active workers, who gathered around us to know what was going on. We observed that MMC was not a very poor area nor the sanitary conditions were that bad. From here the mason took us to his area that is Turk Colony. He extended his full cooperation to us, and requested that the pit latrines be constructed in Turk Colony.

2 (c) TURK COLONY (TC) - The People & Community This community is right in the middle of Baldia Town. It is a compact homogenous community, who call themselves "Turk Sepoy" because their ancestors originally came from Turkey as soldiers of Muslim Army who conquered India.

The area was totally inhabited by Turk Community in 1958, when Baldia was a large place of vacant land, on the outskirts of Karachi. In 1960 after the fire in the city, in which a large number of huts were burned, the government got them settled in the present area. About 250 small houses were allotted to them. The area now covered by this community is 70,000 sq feet, with more than 500 plots, accommodating more than 600 families.

The people of TC came from Veraval near Junagarh State (India) in 1947, at the time of partition of the sub-continent. The community is like one big family because of inter-marriages within their community. One finds every family related to the other. Their language is Gujrati but they can speak Urdu too.

The total population of this colony is about 4000 to 6000 people. The family pattern is joint family system. There is no government school. Illiteracy is high. Eighty percent of the women cannot read or write.

Most of the people are skilled and unskilled labourers e.g. masons, carpenters. Others are shopkeepers, hawkers, paddlers. There are two school teachers, a compounder, and a clerk. The average income is Rs.400 to Rs.1,000 per month (US$ 40 to 100). Few who work in Middle Eastern countries send home a good amount. Women are also involved in income generating activities within or outside their area.

Water is supplied by 6 stand pipes in 8 lanes of the area. These taps receive water every second day for 2 hours. There is extreme shortage of water.

2.(d) SANITATION BEFORE THE SOAKPIT PROJECT:- Sanitation in TC is similar to the conditions existing in other parts of Baldia. A study has shown that the community has 80% bucket latrines. The people lack health consciousness and awareness of child care. But the presence of local soakpit shows that the community had initiated some efforts to solve this problem. These soakpits which they constructed lacked the proper technology. Thus the pits did not function properly, and were of poor quality.

On the whole the community was passive and inactive towards their problems, particularly in sanitation. They had no support from the government or from other authorities. The councillor did not pay any attention to them, because they voted against him in elections. The people lacked confidence and determination. But the basic capabilities are present. They needed knowledge and guidance in organizing themselves and their efforts. The MMC has more or less the same characteristics as TC the only difference is the community of MMC is not homogeneous. The area and population is larger than TC. The sanitary condition is better as most of the houses have local soakpits, because the people are better off than the TC people.

3. PEOPLE PARTICIPATION IN THE CONSTRUCTION OF PIT LATRINES IN TURK COLONY

The pit latrines constructed by PJC were given free to individual families. The local people did not provide any assistance or contribution. The news, therefore, spread that every house will get a free soakpit.

The KUSWD, on the other hand, wanted to develop self reliance in the people. We did not want to cripple and degrade them further by giving charity. It was therefore made clear to the mason and the people of TC that no soakpit will be given free. The people must share in the cost and responsibilities of construction.

This created confusion, mistrust, confrontation, agitation and frustration among the residents of TC because one area got free soakpits while they have to share in the cost. I along with the Professors of SWD had several discussions with the people. After a month of motivation, the mason and 10 other people agreed to do the digging of the pit themselves, for which

materials will be provided by UNICEF, while the local mason will do the masonry work. These 10 people and the mason belonged to a cricket team in their area. They were concerned to clean the place so they can practice on the streets of TC because there is no other place to play.

This group of young community workers started digging their own pits. This provided an opportunity for other community people to observe the new design construction and utility of pit latrines. Within a month 10 pit latrines were completed. The pit W/C was 10 ft. deep by 7 ft. in diameter was dug by the people. Thus saving 30 to 40 US $ per pit. Masonry was done by the mason from the community, and the materials were provided by UNICEF. The total cost of each pit was Rs. 1,200 to 1,500 (US $ 120 to 150).

Within 2½ months, 30 soakpits were completed by this active group of community people. The process forgetting the families involved in digging the pit, and then the construction by this group, gained them confidence and publicity. Their efforts were acknowledged and appreciated by the community and project people. The constant visits by UNICEF and government officials gave them recognition. Seeing this, more people joined them. They are not only a cricket team now but they are looked upon as community workers. Observing this development, we helped them to form an organization and trained more masons and workers. This facilitates the distribution of functions and responsibilities in the construction of soakpit.

The group was organized to assist the project in motivating the people to construct soakpits and also guiding them on their proper use. Moreover, this group helped the community in identifying the poorest, and selecting the place inside the house for digging. While we were able to motivate and organize the people in Turk Colony, there were also technical difficulties in construction such as (1) obtaining cement subsidy permit, (2) use of cheaper materials e.g. PVC pipes, (3) constant deviation from the technical design, (4) variable qualtiy of construction materials and poor quality control, (5) difficulty of fixing the U trap to W.C. bowl, (6) inadequate depth of pit due to sub-soil water and (7) a cheaper design to reduce the cost.

4. EVALUATION OF THE PROJECT:- The project was evaluated after the completion of 120 soakpits in Turk Colony and Muslim Mujahid.

The PJC constructed good quality soakpits in MMC as they had the technological know-how, but they could not organize the people in bringing social awareness and development.

On the other hand, the KUSWD created a social welfare organization through the construction of soakpits. They also followed it up and trained the people on how to use them, and assisted on other activities of social organization and development e.g. education for women and children. The KUSWD had motivated the people of TC but lacked technology so that pits constructed by them were not of good quality.

5. THE BALDIA SOAKPIT PILOT PROJECT:- The University of Karachi SWD has professional expertise in community development and organization to take up the social and motivational aspects of the project. Whilst the PJC has professional expertise in management and technical/construction matters. Thus these two aspects were collaborated and coordinated under Baldia Soakpit Pilot Project.

a) Objectives of the Project

i) To reduce infant and child mortality and morbidity rate due to water related diseases.

ii) To create community wide acceptance of soakpits through improved community organization, and to later develop other social sector improvements benefitting children.

b) The Structure

The project has 2 full time workers, a community organizer from the University of Karachi, Social Work Department and a technical adviser from the Pakistan Jaycees International. The KUSWD and PJC will work in close collaboration. The former will do the motivational, utilization and follow up evaluation of the soakpits while the latter will do the construction of the soakpits, and training of masons, and constantly improving the design to bring down the cost of construction.

6. THE IMPACT OF THE COLLABORATION OF PEOPLE & TECHNOLOGY ON BALDIA SOAKPIT PILOT PROJECT

By March 1981, more than 200 soakpit latrines have been constructed by the project with the leadership provided by the Turk Welfare Society and with assistance from the community organizer and the technical adviser. This time the quality of construction has improved and the technical difficulties overcome with the help from the project engineer.

The project not only brought a positive change in the attitude of the people and the environment but the process had multidimensional achievements, (1) physically, (2) socially, and (3) technically.

- Physical Development:- There is no more bucket latrines in the Turk Colony. Eighty percent of the households have soakpits, either through the project or self made. The streets are free from human excreta. There is a new water pipe line which has increased the water supply. Four more water taps were added. The open drains for waste water from bath and kitchen is under construction. The colony's roads lights have 12 mercury bulbs. The roads are under construction. The colony have a cleaner look. Women now do not throw garbage on roads. They collect it in a place and later burn it, for the sweepers from KMC collect it every third day with supervision from the people of Turk Welfare Society.

- Social and Technical Development:- The best achievement of the whole process is the emergence, creation and development of Turk Colony Welfare Society. It has now 111 members with 33 active workers. The society has also assisted us in preparing the

motivational and publicity materials for sanitation and hygiene. It has recently started a community newspaper, where they express their objectives, achievements and limitations. This paper has served in the motivational, utilization and technical aspects of soakpits.

The organization has also constructed a water storage tank and supplied water to the community when there is a shortage. It has marked houses with soakpits to keep an account of the houses assisted by project. It also undertook a census survey of their area.

I have also trained a group of women who demonstrate and teach women and children on using pit latrines. These women are also given lectures on child care and hygiene by students of Social Work. The society has arranged for a woman to give literacy class to women and children. UNICEF has agreed recently to provide black boards and books to this school.

Through the process of construction and motivation I could reach the women and organize them, around the project for other activities related to education, child care and income-generating.

All the tools and frames for the blocks were bought by the society. Four sets of digging tools were loaned to families who wanted to dig their pits. This accelerated the work. The society people and masons tried for cheaper designs. The mason was involved in designing when Mr. John Pickford visited Baldia as technical expert. He wanted to learn from the technical expert a new design that would not destroy the existing super structure of the latrines. He knew that it costs so much for the residents to first demolish the walls of his present latrines, then dig the pit so that the pan could be fixed directly on the pit, then again reconstruct the walls. Finally, after detailed discussion with the mason and Pickford a design was prepared to satisfy the community people. The mason has already implemented the other design which was recommended by Mr. Pickford.

Presently I have identified 10 women community workers and trained them for the survey work on child mortality and morbidity. Identification and training of mid-wives in the community is also one of the programmes. I also visit houses with soakpits that are constructed by project's assistance and inspect the pan, if the excreta is there I train them of flushing the water so the excreta can go in.

In addition to these activities of the organization there are a number of examples which illustrate the effect of this project on developing peoples participation and confidence.

One example when they invited the Mayor of Karachi and their councillor on completion of the soakpits, they organized a reception, gave a detailed written description of their efforts in developing their area and at the same time expressed their problems of water, street lights, open drains and roads. All these demands were presented to the Mayor, who was impressed by the community's efforts. Later, after constant follow-up they could manage to get what they asked from the authorities. The councillor is also very cooperative now. The garbage collection is regular from KMC and is done under the supervision of the society's worker.

The project and its personnel now enjoy the trust and confidence of the people. The organization, through its active president has helped introduce me to new areas.

A house of 3 rooms has been offered to the project as an office for the community organizer and technical adviser and also as storage for construction materials. The place is managed by the Turk Society on a voluntary basis. They have constructed tables and chairs for the office, for which only materials expenses were given.

The mason trained four more masons in the construction of the soakpits. The Turk Society made blocks themselves under the supervision of technical adviser. These blocks were good in quality and were sold on no profit no loss basis for the soakpits.

Here I would like to relate an example of a change in attitude towards sanitation and hygiene practice. A child had excreted on the street, which is a usual practice in this area. But I saw that 8 or 10 women were quarrelling with the mother of this child. They were telling her that she must train her child to use the latrine. Finally the mother was persuaded to clean the mess right then and there. I was able to set another example of helping the poorest by the poor from within the community. There was a lady with 6 children and a mentally sick husband. Her condition was extremely poor and the bucket latrine was filthy as she could not afford the sweeper daily. Another lady from within the area requested us to construct her a pit. She was quite well-off with 4 sons all earning and her living standard was satisfactory. Her own soakpit was full. She needed a soakpit because she has a large family. They dug their own pit. I motivated them to pay for the materials. I told her that with this money she can help the other poor lady to have a pit latrine. Finally after strong motivation she paid for the digging of the pit for the poor woman with 6 children. Thus, soakpit latrines were constructed for both families.

7. CONCLUSION AND RECOMMENDATION:- Soakpits are not new to the people of Baldia and Turk Colony. They had constructed soakpits by themselves before the project, but they lacked the technology for design and quality of construction. They could afford to construct the soakpits, but still did not know how to maintain and use it properly and effectively. They lacked social training and knowledge of health and sanitation. Thus, Baldia Soakpit Pilot Project provides the opportunity to combine the technical and the social approaches to sanitation. The working mechanism applied was that, first, I as a community organizer would identify the poorest Mahalla with the

filthiest sanitary condition and select those families with large number of children and motivate them to have a soakpit, by sharing in the cost of construction.

Once the Mahalla have been identified according to the above criteria then the technical adviser selects the site and design of the pit, according to the soil condition. He examines the size of the pit when it is dug, and supervises it, when it is constructed. When the soakpit is completed, I train the residents on correct use and maintenance of the pit latrine. My experience in Baldia convinces me that technology and social work must be co-ordinated to have a positive and long lasting result in programs of slum improvements.

Models on people's participation should be demonstrated to the people. The interested communities should be organized, and technical supervision and assistance should be given through community organization. The people of underdeveloped areas are often underestimated of their capabilities and potentialities and considered as a burden on society and authorities. It is the greatest mistake on their part.

My experience proves that people of backward areas only need technical and social guidance to develop and strengthen their capabilities. Through their organized efforts they participate in shaping their society and influence decision makers of their countries. Sponsoring agencies commit a mistake by giving free assistance to the people. This not only creates dependancy in the community, but cripples them for ages. The contributions should be made on teaching and training, demonstration of successful community improvement models that has maximum people participation. Funds and external resources should be used in training the people socially and technically at the grass root level.

The improvement and development of an area should be the impact of community organization.

Session 1

Chairman: Brian Grieveson
Principal Engineering Adviser
Overseas Development Administration

Discussion

Quratul Ain

People's participation in slum upgrading

Mrs AIN explained that her paper was based on personal experience gained on the project from August 1979 on. The most significant factor to arise from her work was that technology and sociology in isolation had limitations and were not as effective as when they were applied together. The impact of the two together was multi-dimensional. It was not just a case of constructing the soak-pits and then leaving the area, or of just organising the people and handing over to the technicians for construction. The Jaycees and the KUSWD worked on the problem together and both had a different approach to it.

2. Soak-pits were not new in the area, but before the project began the construction was of poor quality and drainage was either very bad or non-existant. The people knew the importance of good sanitation and were eager to be involved in projects, but they lacked the technology.

3. Mrs AIN then outlined other ways in which the community had been involved in self-help projects once they were organised. A newspaper had been started which was eventually used as a means of lobbying the government on community matters. A water storage tank had been built. Community schools were started, and here no outside aid was needed. The people found their own teacher from within the community who was trained on the spot. In this way five adult literacy centres and childrens schools had been started. Publicity material had been produced by the University and was distributed all over Baldia to encourage people to become involved in the soak-pit project. Mrs AIN herself had been concerned with training "community girls" who would lecture on health and child care to mothers. These girls also helped with the surveys carried out by the University.

4. Slides were shown which illustrated the poor state of the lanes in the area before the project began. The housing was seen to be of good quality but there was no proper drainage and the lanes were littered with waste. A slide was also shown of the sweeper who was paid by the householders to empty the bucket latrines.

5. Illustrations were then given of the various stages in the project, from the initial meetings with community leaders, who were often mistrustful of the motives of the University people, through training of the mason and digging the pits to the later collection of data by girls trained by the speaker. The schools and adult literacy classes were also shown. The final slides showed in contrast the lanes after completion of the project. They were seen to be clean and dry.

6. Mr GRIEVESON thanked Mrs Ain for her presentation which he said had emphasised once again that it was the people who were most important in a project.

7. Dr MITWALLY confirmed the importance of community involvement. There was a great need for environmental education in developing countries, apart from the obvious need for money.

8. He gave an example from Egypt of a woman who had been provided with a latrine by the authorities. When they returned to check that she was maintaining it properly, they found it clean and tidy but completely unused! When asked why she had not used the latrine the woman replied that she could not use it as it did not belong to her - it belonged to them! If the woman had been involved right from the start in contributing financially to the scheme and then had been taught properly how to use and maintain the latrine this situation would not have arisen.

9. Mr BATTACHARYA said that he was interested to read in her paper that Mrs Ain had succeeded in motivating a richer woman to help pay for the latrine of her poorer neighbour. He thought this a heartening example that showed that fellow-feeling still existed in this materialistic world. It was necessary to encourage this sort of feeling on an international level.

10. From his own experience in Calcutta and from Mrs Ain's experience in Karachi, he felt that the evidence showed that upgrading of slum areas was preferable to bulldozing them.

11. He asked Mrs Ain whether any follow-up investigation of infant mortality and morbidity had been made after the completion of the soak-pit project, and taking into account the other improvements which had followed. He also wanted to know about the standard of the water supply in the area, since this hadn't been mentioned in the paper, and the benefits brought by the new latrines would be greatly reduced if the water supply was not adequate.

12. Mrs AIN replied that statistics on mortality and morbidity were collected before the start of the project, and further investigations would take place two years after the completion of the project. This was

due to take place in 1982.

13. The problems of water supply had not yet been completely solved. However, as a result of the new organisation in the community the water storage tank had been built and the people lobbied the authorities for a new water pipeline which increased the number of standpipes available. Improvements were continuing all the time and it was probably too soon to collect useful data on this aspect.

14. Mr CREE wanted to know how many full-time staff were employed on the project.

15. Mrs AIN replied that she was the only one employed from outside the area and employed full-time. She did not want any more outside staff; all her workers were chosen from the community and paid by the project. She did not even have transport and went everywhere on foot. She was of the opinion that a larger staff working in an office all day presented a barrier to the people. The only time she was in her office was when someone had made an appointment to see her there; otherwise she was to be found out in the community where the people had access to her.

16. Mr HAFNER asked how this type of project could be applied to squatters in urban areas where there would be no social structure or organisation. He also wished to know whether there were political factors involved in the organisation. Were the workers who initially motivated and organised the people sent by political factions, from the city or elsewhere?

17. Mrs AIN felt that people in squatter areas were in fact already well organised to resist the government, and this initial strong organisation had to be taken advantage of right from the start, before it was dispersed, so that improvements could be started.

18. From her experience in Turk Colony, she felt that the people who had initiated the community organisation had had vested interests. They were usually the religious leaders who were already centres of the community and were thus used by the politicians to approach the people.

19. Mr LLOYD asked whether any local agencies or government departments were involved in the passage of funds from UNICEF to the project, and how much disappeared before it reached the beneficiaries.

20. Mrs AIN said that only the University and UNICEF were involved. The money was provided in small amounts when needed, and it came directly to the University. In this way there was no intermediary and the project received exactly what UNICEF sent.

21. Mr RUKOIJO asked what Mrs Ain's hours of work were.

22. Mrs AIN had no specific working hours. She had to be available when the community needed her, which could be at any time. Usually she worked most in the evenings and early mornings when the people were at home.

23. Mr MSIMBE asked whether the government had taken any initiative in the training of people like Mrs Ain who could then be sent to other areas of the country to be involved in similar projects.

24. Mrs AIN replied that in the past there had been no such involvement by the government, but it was felt that they were starting to get involved, probably for the wrong reasons.

25. Mr PRESTON expressed admiration for the work of Mrs Ain, and asked her to what extent she was able or wanted to be involved in the formulation by governments and agencies of the terms of reference for outside consultants. He felt that her experience and that of people like her could make a great contribution in this important matter.

26. Mrs AIN replied that she believed all those involved in a project, including trained people, grass-roots workers and local people should be consulted when such things as consultants' briefs were being decided on. She had examples of the success of dialogue meetings between locals and government officials. The key to the whole issue was the self-respect of the people, which they would work very hard to maintain.

27. Mr GRIEVESON then asked for comments and questions to be directed to Dr Bourne, with reference to his opening address.

28. Mr OBADINA cited examples in Nigeria to highlight the necessity for monitoring of water and sanitation programmes in order to advise governments on implementation. He asked what provision was being made for the monitoring of such projects during the Decade.

29. Dr BOURNE replied that there was much pressure on the UN to improve monitoring of programmes. The biggest difficulty was that they were the servants of all the governments of the world and often individual countries would be eager for monitoring in general, but not so keen when they were the subject of the monitoring. Also the UN could not interfere in the internal politics of countries. So there were problems but they did their best.

30. Mr OTIENO asked whether his co-ordinating committee had considered approaching the governments of developing countries directly for funds, instead of the present system of channelling funds through the United Nations central fund, which was being used for many programmes not just the Decade.

31. Dr BOURNE explained that 50% of his time was spent in trying to encourage bilateral agencies to invest in Water Decade projects. There had been two major meetings of

representatives of all the agencies to outline future projects and encourage their participation in them. There had also been a meeting in Paris related to identifying the needs of the 31 least-developed countries. There water was considered to be a major priority, and the need now was to convince agencies to invest in this sector.

32. Mr WILLIS believed that if the Decade was to be successful, the participation of communities was vital. Governments must learn to set the right climate for this participation and encourage and foster it. They must also learn to limit their interference in projects. Governments all over the world had to learn these lessons, in developed as well as developing countries.

33. Dr BOURNE agreed that it was vital to get governments involved. As Mrs Ain had pointed out, it was not possible to separate community participation from politics, either small-scale local politics or large scale national politics; it was all enmeshed together. What could be done in any area depended entirely on the political situation, and in some areas projects would have support from the government while in other areas the government would be against development of this kind. In this field UNICEF had been particularly successful in getting governments to co-operate in projects.

34. Mr OULTON gave an example from his own experience recently in Ethiopia. There a great problem existed of communication between central government and the individual regions. There had been much criticism of central government by local people, as a result of which the Supreme Planning Council now wanted suggestions for improvements and projects to come from the regions. Obviously more ideas would be put forward than could be paid for, but it was plain to the government that something of this nature had to be set up.

35. Local community committees were being formed which would decide what each area most needed. He was pleased to report that the scheme had been well-received by the central government, and he agreed with other speakers that local people should be given the opportunity to decide for themselves, given proper advice, rather than having unwanted schemes imposed upon them.

36. Mr LLOYD commented that many of the funding agencies were dealing with administrators rather than with people in the field. This meant that when consultants were brought in they were often asked to produce a scheme which the administrators thought was needed but which was inappropriate for the needs of the people.

37. He also wished to comment on a point made by Dr Bourne, that charities, especially in Europe, were making more money available than many of the international funding agencies. In the light of this, would it not be better for governments to let charities have the money for water projects rather than channelling it through the funding agencies?

38. Dr BOURNE said that no specific data was available as to whether charities were giving more money to projects, but it was his opinion that this was likely to be so in most European countries. The Reagon administration in the United States was now formulating policies along the lines of those suggested by Mr Lloyd. The success of this type of policy again depended greatly on political structures involved.

39. Mr BASHAM made the point that often water and sanitation schemes were put into operation without first considering the time factor. Materials were used which would fail after a short period of time, whereas they should be lasting for many years. To use long-lasting materials now would be an investment for the future; otherwise projects would be self-defeating if money was not available later for maintenance.

40. Dr BOURNE felt that there was a dilemma here between the need for quality and long life, and the tendency to want an impressive result quickly. In general, something available immediately, even if not of the best materials, was better than making people wait until more money was available.

41. Mr GRIEVESON thanked participants for an interesting session and summed up by saying that governments alone could not achieve the Decade targets; they needed the help of the people and organisations involved as well. Equally, self-help and voluntary organisations alone would not be successful; they needed the governments. The problem of lack of communication was not peculiar to developing countries, and it had to be improved in order to have any chance of achieving the Decade aims.

7th WEDC Conference: Water people and waste in developing countries: 1981

INCREMENTAL UTILITIES PROVISION AND AFFORDABILITY

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BACKGROUND

With the cessation of hostilities and the re-opening of the Suez Canal the Egyptian Government initiated a policy to reinforce and develop the potential of the Canal Zone.

Clifford Culpin and Partners has been assisting the Egyptian Government implement this policy, as it relates to the Ismailia Governorate and in particular the City of Ismailia, since 1974.

The Ismailia Master Plan Study recommended guidelines for future development in all sectors. An important finding of the Study questioned the efficacy of Government policy with respect to housing provision. The Master Plan advocates a change from one of direct housing provision towards a more flexible system of aid and support for agencies which encourgges greater involvement of the private sector and individuals and is affordable. Work on the Master Plan was followed by a demonstration project which developed in detail the Master Plan recommendations for housing and industry. Since October 1978, the firm has provided a team of technical advisors to assist the Governorate in the establishment of two land development agencies and in implementing the first low-income land sub-division (sites and services) and settlement upgrading project to be initiated in Egypt.

This paper concentrates on the Hai el Salam Project, the first of two projects currently being implemented in Ismailia. Hai el Salam (formerly El Hekr) is an area of uncontrolled, unplanned settlement north of the city. At the time work started on the project the population of the area was in the order of 37,000. Proposals for Hai el Salam cover an area of 226 hectares, within this area approximately 132 hectares were settled. The projected population to the year 2000, on the basis of new development and consolidation of the Project site, is 90,000.

The implementation of the Hai el Salam project began in 1978, with the establishment of a locally staffed Project Agency responsible to its own Board comprising representatives of relevant departments within the Governorate and the City. The Project Agency currently employs 40 staff comprising engineers, surveyors, accountants, senior administrators and ancillary staff members. The majority of the staff are seconded from Governorate or City departments. Although the nature of the work was new to all staff they rapidly developed the necessary skills and an appreciation of the aims of the project through working with the expatriate technical advisors. The staff are progressively taking over responsibility for all day to day decisions affecting development.

The utility provision within the existing unplanned area, the area subject to proposals for upgrading, consisted of a few stand pipes in the southern part of the Project site supplied from an existing water main running east/west along the southern boundary. There was no sewerage network in the Project site, though one existed south of the southern boundary serving an area of public housing. This main was in a poor state of repair and had no spare capacity. The majority of the dwellings in the Project site had either pit latrines or single chamber semi-sealed septic tanks. The City Council ran an emptying service but this was not sufficient to adequately cover the whole area.

The density of the existing settlement was about 280 persons per hectare gross or about 50 households. Density levels varied over the Project site from the more densely populated and consolidated southern area to the northern fringes where single storey mud-brick shelters on large plots predominate.

Neither the physical and geological conditions found in the Project site nor the existing settlement pattern present insuperable problems for the physical upgrading of the existing unplanned area or for the provision of services to new plots on vacant desert land to the north of the Project site.

From social surveys and detailed case studies it was evident that finance would be a major constraint and proposals would require massive subsidy if existing housing policies were followed and subsequently implemented. Based on these findings the Master Plan recommended that policies should encourage the target population to meet their own housing needs by providing them with the right conditions in terms of land tenure, affordable services and other technical assistance.

THEORY

The objectives of the Project included that proposals must be relevant to low-income groups, be affordable and capable of implementation with minimal subsidy. These objectives imposed critical constraints and made the assessment of affordability extremely important. In this respect the Consultants were conscious of the correlation between affordable development and appropriate standards and that these standards are often difficult to achieve because of prevailing political attitudes and aspirations, unrealistically high existing government health standards and building and other statutory regulations.

For the project design it was therefore essential to know how much could be afforded and what could be achieved with the finances available. Socio-economic sample surveys together with in-depth case studies were therefore undertaken and the conclusions drawn from these studies formed the basis of the assumptions used in developing the proposals, including incremental utilities provision. The most critical assumptions are summarised below:

- The proportion of total family income spent on shelter was taken as 20%;
- The proportion of this income allocated to infrastructure differed for upgrading areas and new sub-division areas. For upgrading areas the proportion was 65%, or 13% of total income, for new settlers the proportion was 50% or 10% of total income;
- What could be paid for, from the sum calculated as affordable, was based on amortisation at 7% over 20 years;
- Incomes and inflation would increase at the same rate over time;
- No external subsidy would be available.

The socio-economic surveys also indicated that a household's 'propensity to spend on housing' seemed to be tied to opportunities of building incrementally , perceptions of future security and secondary income, and other factors which have little to do with current income. Nevertheless a calculation of 'ability to pay' for shelter, as a percentage of total income, was applied to the household income distribution of the target population.

It is necessary to make a distinction between existing and new settlers; the former already are occupying a shelter and, if owner-occupiers, are allocating their assumed 20% of income for shelter to only improvements, utility connections to plots and secure land tenure. New settlers however must also pay for or build some form of shelter. In both cases the important question is the amount of income (or that fraction of the assumed 20% devoted to shelter) that will be allocated to infrastructure and plot connections.

Various proposals were examined which took account of existing and preferred plot sizes and uses, the lack of facilities and the desired and minimal levels of infrastructure provision necessary to ensure improved chances of health. These alternatives were costed. Based on the findings, reported on Table 1, an assessment was made of the amounts which might be available for infrastructure.

TABLE 1

HOUSEHOLD ABILITY TO PAY FOR SHELTER UNDER VARYING ASSUMPTIONS (1977 LE) (LE = £0.7 STERLING (1980)).

Annual income ranges: limits & mid-points	% Income for shelter	Monthly (LE)	Annual (LE)	Total available assuming amortisation at 7% over 20 years
150	15	1.9	22.5	238
	20	2.5	30.0	318
	25	3.1	37.5	397
180	15	2.3	27.0	286
	20	3.0	36.0	381
	25	3.8	45.0	476
240	15	3.0	36.0	381
	20	4.0	48.0	508
	25	5.0	60.0	635
300	15	3.8	45.0	476
	20	5.0	60.0	635
	25	6.3	75.0	794
390	15	4.8	57.8	609
	20	6.4	77.0	815
	25	8.0	96.3	1020
480	15	5.9	70.5	747
	20	7.8	94.0	995
	25	9.8	117.5	1244
660	15	8.3	99.0	1049
	20	11.0	132.0	1398
	25	13.8	165.0	1805
840	15	10.4	124.5	1318
	20	13.8	166.0	1758
	25	17.3	207.5	2197

TABLE 2

ASSESSMENT OF CAPITAL AVAILABLE FOR INFRASTRUCTURE. (LE 1977)

Income	Existing settlers	New settlers
20th percentile household	273	210
Medium	400	310
80th percentile household	624	480

This assessment gives a rough indication of the order of magnitude of funds which existing and new settlers might be able to mobilize or be charged for infrastructure. However the issue is not straightforward : first, an infrastructure package includes land under secure tenure, and this represents an 'asset' which should be costed, especially if the future settlers can sell this 'asset' at market rates. Secondly, the use of 20% of income, as the proportion

affordable for shelter is arbitary, and it should be recognised that there is frequently a large, if non-quantifiable, gap between 'ability' and 'willingness' to pay for shelter. Thirdly, there is nothing magical about amortising payments for shelter at 7% for 20 years.

Using the above assessment as a guide to the amount of finance available it was possible to compare the cost of various levels of infrastructure provision assuming a certain distribution of plot sizes. For the existing unplanned area the distribution of plot sizes was known, so it was possible, using existing income levels to postulate what levels of service provision were affordable. For new settlers, in new sub-division areas, plot charges were assumed to vary directly with plot size. Levels of affordability (ability to pay) indicated that not all households could afford similar levels of infrastructure provision. This was not surprising for, as indicated earlier, existing settlers allocate a smaller proportion of their total income to shelter than those settlers in the new sub-division areas (7% and 10% respectively).

Table 3 shows that there was a high proportion of families able to afford payment for Level 1 (infrastructure only in the case of the most basic provision) with freedom to choose plot size.

To enable affordable payments, at the low income levels, covering a higher standard of infrastructure provision (Level III), plot pricing, of plots in the new sub-division area and for new plots in the existing unplanned area, was varied - higher prices being charged for good commercial locations and open market prices being charged for a number of concession plots in key locations. This allowed internal cross-subsidy of the low priced plots, some 60% of the total, thus increasing the level of provision affordable.

It should also be appreciated that in Egypt there is little opportunity for authorities to recover capital development costs except through land charges as there is no equivalent to the British 'rates system' on property and no recovery for the operating costs of water-borne sewage disposal, while water rates are also inadequate. The only directly recoverable cost is, therefore, the connection charge. Central Government directives laid down guidelines for the distribution of costs for sewage disposal and water. In this respect the relevant authorities are responsible for financing the cost of off-site works and the main on-site trunk lines. Plot allottees are expected to pay the cost of the local reticulation network and connection charges.

Table 3 identified broadly the levels of infrastructure provision affordable.

In the Hai el Salam project the amount of income available to be spent on infrastructure was therefore a minimum and as a consequence the level of infrastructure provision selected for the initial phases did not include individual connections for either water or sewerage. It was assumed that the costs of water borne sewerage and of water to each plot would, in the future, be financed, at least partially, by

TABLE 3

LEVELS OF INFRASTRUCTURE AND ABILITY TO PAY FOR TARGET POPULATION FAMILIES IN EXISTING AREAS AND NEW SUB-DIVISION AREAS. (NOTE THAT LAND COSTS ARE INITIALLY ZERO, BEING ORIGINALLY GOVERNMENT LAND).

Level of infrastructure provision	Percentage of target population households affording each level					
	Existing Settlers			New Settlers		
	$83m^2$ plots	$123m^2$ plots	$176m^2$ plots	$72m^2$ plots	$108m^2$ plots	$135m^2$ plots
Level I (administration, pit latrines, stand-pipes, basic local roads)	100	100	100	96	93	87
Level II (level I + electricity and landscaping)	100	100	100	87	81	78
Level III (level II + district and improved local roads)	100	87	69	79	72	66
Level IV (administration, water connections to plot sewerage network and connections + electricity)	48	33	17	41	30	23
Level V (as level IV + improved roads)	38	23	13	35	21	15
Level VI (as level V and trunk water-sewers and paved access roads)	24	14	5	17	11	6
Level VII (level VI + service core)	na	na	na	10	4	1

external subsidies. Further building regulations and planning standards in Egypt, as in many countries, are theoretically high, and metting these standards makes a project unnecessarily expensive. These issues were addressed by preparing detailed proposals for the full provision of urban utilities as a long term goal, which could be reached incrementally over time consistent with the target. This proposal avoided problems of political and social acceptability while ensuring that project costs, and thus compulsory payments, could be kept to a minimum. A further advantage of this approach is that implementation can be effected early with minimal subsidy.

The implications of this strategy were examined. The estimated total costs of full water and sewerage system for the Hai el Salam project are given in Table 4.

TABLE 4

ESTIMATED 1977 COSTS OF FULL WATER AND SEWERAGE PROVISION HAI EL SALAM. (LE 1977)

Infrastructure	Water	Sewerage	Total
Connections	573105	884865	1457970
Reticulation Networks* (local mains)	612234	1109287	1721521
On-site trunk lines	370000*	510000	880000
TOTAL	1555339	2504152	4059491

* excluding system costs of standpipes.

Using the same affordability assumptions referred to earlier the ability of inhabitants to pay a proportion of income towards full infrastructure provision was tested. It was found that 63% of existing households, and 55% of new households could reasonably afford to pay for water and sewerage connections, assuming finance for the full service provision was available. It was also estimated that the Project Agency could, if necessary contribute funds under a sharing arrangement with external funding sources and, subject to the effects of inflation, the future market values of concession plots and the possibility of communal labour contributions, the Project Agency could offer to meet between 30 to 55% of the future costs of the water and sewerage system.

The Consultants were well aware that by planning for staged future provision of water, sewerage (and roads) certain cost elements of initial stages would be written off. These costs were calculated for Hai el Salam to be on a plot basis, and are shown on Table 5.

These extra costs could not be avoided for Phase 1, which includes all existing settlers and 1000 new plots. For subsequent phases the situation is being carefully monitored

TABLE 5

THE COST/PLOT OF 'WRITING OFF' CERTAIN INITIAL DEVELOPMENT COSTS. (LE 1977)

	Existing settler plot	New settler plot
Water-borne sewerage; (the cost of pit latrine is written off)	-	105.0
Piped water; (a small portion of the cost of the standpipe system is written off)	0.9	0.9
Stage 2 roads; (a portion of the cost of Stage 1 road is written off)	14.0	12.0

THE PROPOSALS

The proposed water distribution network consists of a primary ringmain feeding four secondary ringmains each supplying water to approximately 24,000 inhabitants by the year 2000. Detailed proposals were also prepared for the future sewerage system.

In view of the users' ability to pay, the practical limitations imposed by existing major networks and the financial capabilities of the executing authorities, close attention was paid to the implications of staged provision.

The first level, as defined in terms of minimum public health benefits, is the provision of potable water in both new and existing areas by some 75 communal public standpipes on a 150 metre grid, supplied from the south of the Project site by a limited number of connections to the existing network.

The second level of provision is on-plot connections to a single tap and/or shower. The introduction of this level of provision in the initial stages is experimental, as it is constrained by the present difficulty of disposing of waste water and the insufficient capacity of city mains. The final level of provision is the installation of multi-tap metered water connections to each plot, which must be associated with a water borne sewerage system.

Proposals for waste water disposal are also staged. As a minimum level of provision pit latrines, regularly emptied by suction tankers, are proposed, as are septic tanks for public buildings requiring full water provision in advance of the sewerage system. The viability of disposing of sullage from on-plot water connections, without the installation of network drainage facilities, will also be tested experimentally. The final level of provision for waste water disposal is the installation of a full water-borne sewerage system.

It is proposed that a daily collection service for domestic refuse be provided on a house-to-house basis and be subsidised if necessary.

THE REALITY

The Hai el Salam project was started in 1978 and at the time of writing May 1981, some 1,700 new plots had been allocated and 2,000 existing plots rationalised and title to the land sold to the occupants. At the end of the second year 25 standpipes had been provided and currently work has begun on the installation of three 6" lines which, when completed, will allow the Project Agency to provide a full standpipe service throughout the new subdivision areas. The Agency is also advising plot allottees on the design and construction of short-life seepage pit latrines.

In 1980 following the Consultants work on the Demonstration Projects, the Egyptian Government commissioned the Ismailia Water and Wastewater Master Plan Study, funded by USAID. The findings of this report, although subject to final approval by Government, have influenced the implementation of the Agency's utilities programme, particularly as it relates to human waste disposal.

One of the problems posed by this Study was the critical issue of timing and although the Hai el Salam Project area was identified as a priority area for design and development a number of issues affecting the immediate short-term were raised :

- How can the Agency's ongoing and extension programme be integrated, in the immediate short-term, with a completely new system proposed by the USAID programme?

- What are the immediate technical and financial consequences of the USAID programme on the Agency's intermediate solution for waste disposal?

- The USAID study recommends proposals for 'cost recovery' that, in part, contradict current accepted Egyptian practice. If the USAID proposals are adopted will the Agency's programme still be relevant and/or affordable?

Although the Consultants took cognizance of the financial consequences pertaining to an incremental approach, the problem experienced by the Agency, was one of timing and phasing. Further, unless the USAID programme was designed and implemented in full, the Agency's proposals for the Hai el Salam project, could prejudice the city-wide programme as a whole. It was therefore necessary for the Project Agency, in proposing intermediate short-term solutions, to re-examine standards of provision. Short-life pit latrines are a possible solution. The BRE/UK is currently advising the Agency for a pilot pit latrine programme and the cost implications of this programme as it affects individual plot holders, is being carefully monitored.

The USAID proposals for 'cost recovery' are through user charges for both water and sewage disposal. These proposals assume that running costs, the capital servicing and replacement cost and repayment costs must be borne by the user. As stated earlier this is contrary to current policy. If implemented it raises the question of whether plot beneficiaries should be expected to pay twice for a service which is received free by other local public housing tenants.

It raises other questions which also needs resolving. For example, if 'cost recovery' is through user charges it assumes that all potential uses will be connected to the network at the time of installation. This paper has illustrated that very few plot allottees, if any, are able to afford the cost of individual connections and use, although a proportion could reasonable afford to pay for water and sewerage connections, assuming that the cost of the service was borne by others.

The Agency's experience in implementing the Demonstration Project recommendations has therefore not been straight forward, particularly as it relates to human waste disposal. The programme has been affected by the need to examine the cheapest and most effective way of moving from the pour-flush latrine with semi-scaled septic tank or soakaway to a full sewerage system, within a very short time scale. This has meant that the Agency has given priority to minimizing costs.

Several lessons have been learned by the Consultants from the Hai el Salam experience:

- Intermediate solutions require more maintainance and is a factor that is often overlooked;

- Without very tight control and supervision it is impossible to connect a soakaway pit into a main system;

- Careful coordination between the authority and/or their consultants, responsible for planning and developing a new mains system, and the Agency responsible for the initial improvement programme is essential;

- An incremental approach to utilities provision assumes some options are left to the user. This may not be possible if the USAID programme is implemented as it assumes that all potential users will make connections at the time the network is installed;

- The phasing of other related developments and the upgrading of services must take cognizance of likely damage caused by the laying of water and sewer mains;

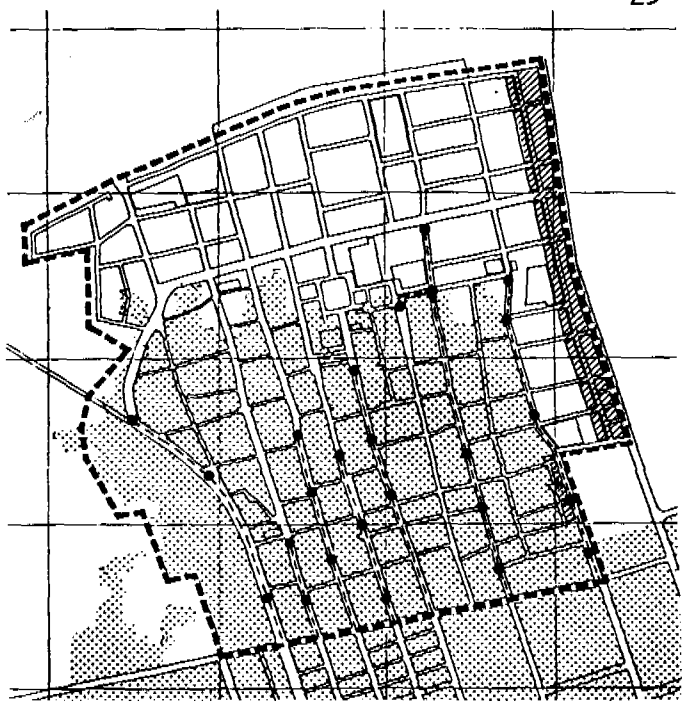
- The 'write off' cost of temporary solutions becomes a very important consideration. Even if the cost incurred is minimal and spread over several years, experience suggests that plot allottees would prefer a more expensive solution if it is seen as a once and for all payment;

- Cognizance of possible changes in official policy and/or attitudes should be allowed for in designing intermediate solutions.

Starting from the premise that development proposals must be affordable the Hai el Salam project is a success. The initial political reservations for the concept have largely been overcome by emphasising the end-product and that

staged provision is a means to an end, and demonstrating that the process is not dissimilar to that adopted by most developed countries at a similar stage of development. The project has also demonstrated that it is possible to implement a major programme, within a very short time of proposals being approved, without massive Government or other subsidy and to give the target population, namely the poor, access to reasonable levels of shelter and services that can be afforded.

The Consultants recognise that incremental and intermediate approaches, while making sense in broad financial terms, do pose problems with respect to local expectations and practices. It is therefore incumbent upon consultants and advisors to be sensitive of prevailing attitudes, customs and constraints and be ready to respond positively and objectively and not be too dogmatic as to what can be achieved.



HAI EL SALAM PROJECT

- Rationalization of existing area. 132ha
- Sub-division of new area. 94ha

- Standpipe provision at end 2nd Year

Project Area
Existing Settlement
New Sub-division Area
Concession Plots
Standpipes

North

0 500m

Scale

7th WEDC Conference: Water people and waste in developing countries: 1981

PLANNING FOR COMMUNITY PARTICIPATION IN WATER SUPPLY AND SANITATION: ACCOUNTING FOR VARIABILITY IN COMMUNITY CHARACTERISTICS

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INTRODUCTION

Planners of community-based sanitation services at both national and local levels are faced with a paucity of meaningful data on the characteristics of the communities for which services are designed. Frequently the data available provide a global view of the problem, but little to describe aspects of potential solutions (Ref. 1). Data on proportions of the population, peri-urban or rural, with or without reasonable access to potable water or adequate sanitation, convey in fact only partially the multiple factors that must be considered in evaluating progress. White (Ref. 1), suggests that other alternative national-level statistics might include estimates of:

1) The proportion of the population in urban squatter settlements invloved in self-help projects of any kind.
2) The proportion of the rural population involved in some form of self-help community development.
3) The extent to which the user is involved in the choice of water supply service level, technology, and management policy.

Estimates of the distribution of these water and sanitation-related factors must depend upon systematic collection of data from at least a representative sample of peri-urban and rural population groups, preferably on an ongoing regional basis. Essential to this task is the development of instruments for the generation of data. The data could be used for national aggregate analysis and subsequent planning for allocation of budget and personnel to water and sanitation programs. Aside from their use in national planning, a primary benefit of such data would be the provision to field workers (assistant sanitarians, public health extension workers, agricultural extension workers) of information that they can use to decide upon the appropriateness of various technical and organizational approaches to water and sanitation improvement.

Needs for data and opportunities for using them exist, therefore, at both the national and local levels; but the means for collecting, processing, and aggregating findings do not exist in most developing countries. The probable result is not only an incomplete and mistaken diagnosis of the problem of water supply and sanitation in its ramifications and dimensions, but also a failure to identify community level resources that could be mobilized in the solution of problems.

Whatever the data collected, by whomever they are collected, to whatever use they are put in the exectution of water supply and sanitation programs, one must take account of a tremendous variability in almost every respect from community to community, even in the same country or region. Variability among rural communities is in fact a cardinal principle of community development work (Ref.2). Because communities vary, differing solutions will be appropriate in each instance.

A key question in community water supply and sanitation work is that of the the degree of readiness or preparedness of a given community to undertake all that is implied by participation in the installation, maintenance, and repair of facilities. Any data collection effort by field workers that is useful in guiding their interventions or for that matter in guiding national-level allocation of resources must address this question. The problem then is to capture in a data collection instrument and interpretative scheme those elements essential to a definition of readiness for participation. Several case examples are helpful in tracing the outlines of what should be included.

VARYING DEGREES OF READINESS FOR COMMUNITY PARTICIPATION: CASE EXAMPLES

Case examples are drawn from the experiences of the author in African countries. Several are derived from the work of the University of Pittsburgh/OCEAC Regional Public Health Training Project in the Cameroon (1972-76). This project emphasized the organization of village health committees as a means of promoting self-help health projects in villages of the Mefou Department of the South Central Cameroon. The operation of the project is described elsewhere (Refs. 3-8). One case example is form the Zaire. Material is drawn from a paper by Cooper (Ref. 9) and, from correspondence with community leaders. Still another case, where the material is derived mainly from correspondence with community leaders is from Ghana.

Levels of readiness are presented as means of analyzing the data available from these cases. The characterization of a given level depends on two estimates:

- The initial demographic, health, socio-cultural economic, and ethno-historical status of each village, to the extent these characteristics are known.

- The type of intital repsonse to any interventions.

As a confirmation of the impression of a degree of readiness, data on the concrete realizations achieved in each village are included. Of course this data is not availabe to field workers approaching communities for the first time, but they do help us to round out the characterization of each case. Communities are categorized at four levels:

1. Little readiness for participation, and none realized, amounting to a profound resistance to organizing efforts.
2. Some readiness for particpation but realization impeded or delayed by serious organizational problems.
3. High level of readiness, but only partially realized.
4. High level of readiness, and largely realized.

Level 1 - Low readiness, low realization

Melen, Cameroon

This village in the South Central Cameroon with a population of about 400 was one of four pilot villages in which the University of Pittsburgh/OCEAC Project initiated its work in early 1972. At first glance one would have supposed a high level of readiness. There was in existence already a protected, although not well-maintained, spring. There were many latrines, although few were of adequate construction. Community leaders were cooperative with the initial survey and organizing efforts and turned out in large numbers at the first several meetings of the village health committee. The survey revealed, however, a strikingly large proportion of the population (22%) holding essentially pessimistic attitudes toward the preventablility of disease in general and low level understanding of the water and excreta-related origins of gastrointestinal infections.

Other indicators of unpreparedness were in retrospect more subtle. For example, the protected spring, it was learned, had been a project of the local Catholic mission. It had been constructed to serve the needs of the mission elementary school. There were no other protected springs and only one latrine. Further, investigation of the social organization revealed a strong dependence upon the church for leadership with a consequent diminution of the influence and authority of traditional leaders. The abby, for example, became chairman of the health committee. Despite four years of Project inputs in the form of health education and community organization virtually nothing was accomplished in terms of water supply and sanitation improvements. The diagnosis of a low level of community readiness which might have resulted from an adequate community assessment at the beginning would thus have been confirmed.

Level 2 - Some readiness, but serious organizational impediments

Nkolnguet, Cameroon

Another South Cameroonian village with a population of about 250 exhibited much the same initial behavior. Community leaders cooperated well with both the survey and the organizing. A village health committee was readily formed. Community leadership was strong in that both the traditional chief and the party representive* were young literate and enthusiastic. There were several skilled persons in the village. Two resident elementary school teachers became active members of the committee. Several influential women were identified.

What was not initially apparent, however, were the deep divisions existing among the clans and subclans making up the population. Like so many Central African populations, the inhabitants of this village traced their origins to hamlets deep in the equatorial forest. During the colonial era, these dispersed populations had been forced to agglomerate in villages along the roads, where tax collection, census-taking, conscription, disease surveillance and forced labor could be facilitated. Not erased, however, were clan and sub-clan identities. At Nkolnguet, in fact, the chief was from one clan and the health committee president from another. At least two other clans were represented. Embedded in these divisions were historical animosities known to most of the villagers.

It was not surprising then when what had been good progress on four protected springs and over 25 latrines for over a year, came to an abrupt halt with the outbreak of open hostility between two of the clans. Because both the chief and the village health committee president were involved, the committee itself was severely damaged.

Despite many positive signs of readiness for participation, therefore, certain factors of a socio-cultural nature served to severely compromise realization of this potential.

Okoa, Cameroon

At first, this village (also one of the original four served by the University of Pittsburgh/OCEAC Project) seemed an unlikely place for a significant degree of participation to occur. Income, education, and manual skills were the next lowest of the four pilot villages (only 6.7% professional, skilled laborers, or businessmen). The proportion of elderly persons was the highest (25% over 50 years). One was struck by the frequency in the initial survey of anemia, splenomegaly, skin diseases, and childlessness. Subjec-

*Union Nationale Camerounaise

tively, an atmosphere of depression and lethargy prevailed.

Despite Project imputs during the first year, very little was realized in improved water supply and sanitation, seemingly bearing out initial impressions. In the second year, however, a young itinerant health worker was assigned to this village as well as to several others in a curcuit. Through patient encouragement, provision of technical information, and working side-by-side with the villagers on spring protection and latrine construction he was able to elicit a participatory response. Three permanent spring boxes were constructed and over twenty households built and used semi-permanent pit latrines.

It became apparent that some communities giving an initial appearance of low readiness to participate should call forth not a delayed, but a more intense intervention. The factor of age in this population proved to portend a favorable rather than an unfavorable prognosis for participation (Ref. 4).

Level 3 - High readiness, but only partially realized

Kpandu-Dafor, Ghana

The village illustrating this degree of readiness is in the Volta Region of Ghana. As a result of the construction of the Akosombo Dam and the subsequent formation of the Volta Lake, the residents of several villages along the eastern bank of the river were cut off from their traditional markets and other sources of goods and services. Particularly acute became the diminished access to medical care. In response to this situation and at the suggestion of an outside consultant, a village health committee was formed early 1978. The effort drew the support of nearly every family head as well as the stool fathers in each of the five villages of the area. One woman donated a house to be used as a clinic; others donated funds from their cocoa and palm wine earnings to equip the clinic and to support the training of two village health workers. Several citizens, originally from the village but residing in Accra, pledged their support. The level of education and/or manual skills among these people was unusually high. Women particpated in large numbers. Plans were laid not only to support primary care services but also a transportation link to the local market town, improved food production, and improved water supply and sanitation.

Despite this high level of readiness and seeming good start, water and sanitation objectives have not as yet been reached. Lack of appropriate technical assistance appears to be a key bottleneck in this failure to reach these objectives, but one cannot overlook the fact that the provision of primary medical care was a first priority.

Djalu, Ziare

A similar situation prevails in this community in the highlands of the central plateau. Readiness for participation in water and sanitation is at a high level. The very existence of the community created as it was out of the confusion of the years 1959-61, attests to a certain level of commitment by every community member. School, churches, and clinics have been built, started, equipped, and maintained. An airstrip exists, and enough rice is produced for export to the rest of the country. Income is relatively high, as is literacy.

Yet, water is still drawn from a nearby river; and in the dry season, from one farther away. Citizens sensitive to the problem have asked for technical assistance. Willingness to share in the cost and the labor seem to pose no difficulty.

Level 4 - High readiness, and largely realized

Ekali I, Cameroon

This case is illustrative of the principle that in community development work one frequently reaps results where another has sowed. Ekali I had been the site of intensive work by Canadian missionaries for nearly four years. This work, aimed at resolving the long-standing estrangement of the older and younger generations that had led to a sizeable out-migration of youth, had contributed to a coalescence of purpose among the inhabitants, a wide degree of participation across age and sex categories, and a vigorous cadre of leaders.

Counting a number of dependent hamlets, Ekali I numbers about 1500 inhabitants, the central hamlet having just over 400. This village gave by far the most positive response to the educational and community organization efforts of the Pittsburgh/OCEAC Project. Not only did the health committee organize easily, but soon took on the intitiative for planning successive local projects: three springboxes in the central hamlet, one each in two of the peripheral hamlets, over sixty households with well-constructed well used latrines, and a functioning village pharmacy for simple drugs and supplies (Ref. 10).

By 1978, two years after the end of the Project, the committee was planning the construction of a water tower with a pump and gravity distribution to a central standpipe. Additional springboxes in peripheral hamlets were also in the plans. Clearly, the health committee had taken on a life of its own and was functioning as a community planning mechanism.

Communities do vary then in their ability to participate in the planning, installation, maintenance and repair of water and sanitation facilities. As the foregoing cases attest even the categories of factors responsible for the variance in each case may be different, It may, nonetheless, be possible to develop a means of both collecting data relative to readiness to participate and to classify and interpret this data in such a way as to guide both technical and organizational

interventions.

TOWARD A SYSTEMATIC AND CONTINUOUS ASSESSMENT OF COMMUNITY READINESS FOR PARTICIPATION IN WATER AND SANITATION PROJECTS.

The purpose of any assessment of this type is two-fold: to provide a basis for a rational allocation of national resources, and to guide field workers in appropriate interventions of both a technical and organizational nature (Ref. 11).

The first can be discussed very briefly. National planners of both urban and rural water and sanitation services need to know how best to distribute the limited financial, material and personnel resources at their disposal, no matter what Ministry in fact houses water supply, or sanitation services or both. Knowledge of the needs of communities, aggregated by region and by district and subdistrict, taking account not only of the need for financing, equipment and technical support, but also for assistance in strengthening their ability to manage water and sanitation facilities, would enable planners to provide for proper training of personnel as well as the purchase of appropriate equipment and material and the development of useful field guides and other instructional material. In a word, areas of the country with the greatest needs could receive priority attention while those whose needs are less could simply be monitored.

At the periphery the use of the information could be more immediate. By means of a simple data collection instrument containing key questions such as those suggested by the case material above, the agent could achieve an impression of community readiness that would enable him to intervene appropriately. The use of some sort of algorithmic decision-making scheme might be appropriate.

In order to avoid some of the pitfalls recounted in the cases the agent would have to be armed with additional questions to pose as the community intervention proceeds. Such questions would relate particularly to ethnohistorical data, details of inter-personal inter-clan relationships, and more detailed descriptions of economic factors, all of which are sensitive issues not readily explored, yet which have a profound influence on the success of participation. In any case, the process must not be perceived as ending with an initial data gathering effort, even if 70% of needed information could be obtained, but rather as an iterative process requiring a continued sensitivity to socio-cultural nuances.

What variables should be included in an instrument developed for use in the initial community assessment? The following would appear as a group to be the minimum to address without limiting the informational value of an instrument to field workers:

Physical Characteristics
- Topography
- Types of soil
- Water table
- Types and locations of water sources
- Meteorologic and climatic variations
- Availability of natural resources

Biologic Characteristics
- Water quality
- Common disease vectors
- Prevalent water and excreta-related diseases

Economic Characterstics
- Assets
- Liabilities
- Economic infrastructure

Demographic Characteristics
- Distributions
- Ethnic composition

Socio-cultural Characteristics
- Beliefs about water and excreta
- Water use
- Excretion patterns
- Local skills
- Existing Local organizations
- Leadership patterns
- Communication patterns
- Decision making patterns

The case material suggests, however, that the most needed information should be mostly of a socio-cultrual nature. Even where technical skills and abundant natural resources exist in a community, such factors as inter-clan dissension or the absence of decisive leadership may interfere significantly with the realizaton of participatory objectives. As a first example, the dependent relationship involving mission and community at Melen, or the Mission-initiated mobilizing activities of Ekali I indicate the need for becoming aware of the types of interventions communities have experienced in the past and especially the kinds of relationships that were established between community and the intervening agency.

As a result of this assessment, a field worker might adopt organizing efforts to promote self reliance, where dependence exists; but where a population is already mobilized, efforts to capitalize on existing self-reliance. Thus at Melen a painstaking step-by-step process of demonstrating what the village could do by itself to improve its water supply and sanitation facilities would have been necessary. At Ekali I or at Djalu, existing self-reliance could be built upon. The implication is for more community organization resources for populations like Melen than for populations like Ekali I and Djalu.

A second set of socio-cultral considerations seem to revolve around the ethnic history of the population in question. A village like Nkolnguet, for instance, where segments of the population have differing historic identities may require the formation of several structures, each corresponding to a segment,

to look after water and sanitation improvements, rather than an unwieldy dissension-prone health committee organized at the level of the entire village. Localities such as Kpandu-Dafor on the other hand, with a well-defined series of mutually dependent chiefs and stool-fathers, can tolerate a committee covering several villages. The essence is to tailor the organizational approach to historical social structures.

Lastly, the case material suggests that the factor of the age of a population, in and of itself, is not necessarily unfavorable to community participation. At Okoa for example, the aged population responded readily to carefully applied organizational efforts, in contrast to previously held impressions of population-wide depression and lethargy. Age in fact correlated rather highly with participation in household based survey carried out in this community (Ref. 4).

CONCLUSION

Community assessment must therefore be both systematic and continuous. Systematic assessment includes an intial screen suggested by the list of characteristics given earlier. A simple assessment tool built around these characteristics should be designed for use by field workers. From applying it these same field workers should be able to design more effective organizational and technical approaches to water and sanitation improvements.

On a continous basis, however, the cases recounted suggest a series of more restricted but more penetrating questions of a socio-cultural nature to be asked in order to avoid pitfalls. These questions pertain to

- the history of self-reliance vs. dependence in the population
- the historic social sturctures of the population
- the age structure of the population

As the cases illustrate, a history of self-reliant behavior bodes a favorable prognosis for participation, whereas a history of dependent relations with intervening agencies indicates a need for carefully planned organizational inputs. Organization of structures for overseeing water and sanitation improvements must be cognizant of the existing organization of the population. Rather than risking the breakup of a village-level health committee in a population with several ethnic subunits, it would be better to organize a committee for each subunit. Lastly, relatively aged populations may have a better rather than a worse participatory outcome under conditions of adequate community organization inputs.

In these ways some account can be taking of the wide variability in community characterisitics in planning for community participation in water and supply and sanitation.

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COMMUNITY REQUIREMENTS IN THE DESIGN OF APPROPRIATE WATER SUPPLY SYSTEMS

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1. Introduction

It is sometimes worth stating the obvious. A community's satisfaction with the development project designed for it is not an optional extra. The happiness of community users depends on designs which meet social needs. Failure to meet these needs may also increase problems of resource development and management in the longer term or in other parts of the economy and society.

Countless surveys show that poorer communities put improved access to potable water high on their list of priorities, second only to, or even above, employment and livelihood. The particular and varied ways in which these needs are linked to other needs and to wider socio-economic and political constraints are of the utmost consequence for the communities themselves. The detail of their requirements is often lost sight of. It can be argued, even, that senior government officers and national politicians should attach little importance to the detailed requirements of small-scale communities: they ought to be concerned with broader policy questions, planning targets and setting standards at sector level. This view implies an artificial distinction between 'planning' and 'implementation' in terms of timing, hierarchy and personnel. This paper starts from a different assumption: it is that consumers and users of water supplies in the poorer countries of the Third World are concerned with the actual outcomes of the allocation of natural and human resources available for water supply rather than with planning intentions however rational.

The UN water decade has attracted considerable attention through its aim to supply 'clean water and adequate sanitation for all by 1990'. The implementation of such a goal suggests a breakdown into planning components: particular targets to identify who needs water; who needs sanitation; in which countries, in which sectors of each country; budgetary implications; natural and human resources available; and a commitment and ability to manage the relationship between specific targets and resources. This approach is eminently rational within its own terms: it sets aims, breaks these aims down into subsidiary targets and relates the achievement of these targets to the availability of finance, landpower and management skills.

It is when one examines, from the grass-roots level, the actual outcomes of this approach that one finds that the formal aspects of a planning rationality have been preserved at the cost of the substance of rationality. Against this, we would also emphasise that an approach which only records a grass-roots perspective and ignores the institutional framework, engineering and financial constraints and opportunities is equally distorted.

There is a third option. It relies on an integrated technical, social, and financial assessment of the process in which water supplies are allocated, both by market and non-market means, and the ways in which these can be realistically improved. The need for this third option of an integrated social and technical planning of water resources is shown in the following paragraphs.

2. Reasonable access can be unreasonable

The UN water decade attempts to ensure reasonable access to potable water supplies for everyone. Many governments will also wish to ensure, for populist reasons, broad equality in access to water holes, particularly in the arid lands of the Middle East and North Africa.

A regular supply of water brings about significant changes in the way of life of the Bedouin (Marx 1978:48). As more permanent settlement and increasing numbers of livestock use the water hole, there is an irreversible impact on the pastures which support the livestock on which the tribesmen are dependent. There are significant impacts on livestock populations, the environmental patrimony, on agricultural strategies and even on the populations themselves since many Bedouin groups have households associated with them in a client capacity. It is these clients who are the people first expelled when water resources are under pressure. The key point here is that unless the overall relationship between environment, agriculture and rural society is taken firmly into account in analysing the way people use their environment, then the result is desertification and population movement.

The inter-relationship of rural water supplies with agriculture and other aspects of the rural society and aconomy is illustrated by

our study of a commercial project in Papua New Guinea. Villagers were so concerned to secure the supposed benefits of a large scale, commercial agricultural project that they were prepared to seriously understate the dangers of contamination to their springs and streams from intensive livestock usage. They were worried that if they created difficulties over water supply that the project would pass them by (Rew 1980). The social response in water planning needs careful analysis.

3. Physical and Social Scarcity

Another aim of the UN water decade is to improve the quality of water supplied. There is obvious sceptism in the Third World about the attempt to supply minimum services - as if these societies were not worth full scale services.

Accordingly, when there are changes to improve the quality of water and its supply, countries usually insist on reticulated systems operating at very high standards relative to the systems they are replacing. The results from installing such a system can be quite dramatic. For example, in Algeria, there are marked differences between those households with access to individual reticulated water connections and those houses with only access to public standpipes. In the case of Algeria, according to 1973 WHO figures, the consumption from standpipes is from less than one-half to only one-sixth of that from private water supplies. (1)

The implications of these figures are apparent. We so often think of scarcity as a feature of the natural resource endowment. Scarcity is thought of as a physical concept. A great deal of economic analysis is built upon Malthusian premises: population pressures, it is thought, build up against limited natural resources with scarcity as a result. The material we have examined suggests that scarcity also should be seen in a social framework: within rather wide physical parameters the experience and maintenance of scarcity is essentially social and institutional. If some individuals and groups have the ability to consume more of a resource while others are forced to consume less because of the way in which it is distributed, then we can speak of a social scarcity. The privileged conditions and quality of supply for some leads to their dramatically increased consumption over others. The limited endowment of natural resources (physical scarcity) is made presing and urgent because of the underlying relations of social scarcity established. Water conservation schemes must take this social process into account and design appropriate institutional, technical and financial controls into the supply system.

4. Water Bureacracies and achievement

Another danger in attempting to meet the target of water for all by 1990 is that over-achievement in trying to reach targets may create its own disasters. The headlines which the UN water decade will create may stimulate certain officials and agencies to press their claims for government finance and resources.

The result may be that aims are set unrealistically high by evangelistic officials. Excessive claims may be made on government resources without sufficient regard for the absorptive capacity of the country. There is another aspect which is worrying. The attempt to over-achieve is likely to lead to highly publicised pilot projects which benefit some to a very high standard as well as showing high standards of engineering. But these pilot projects are likely to make other people relatively deprived and create expectations which cannot be met. Moreover, the publicisation and implementation of these pilot projects will provide a legitimacy for communities trying to achieve the goals of the programme in their own ways. Expectations are high and lacking other means, ad hoc self-help efforts will proliferate.
Our research has shown that a network of illegal water connections then develops as does the uncontrolled exploitation of ground water resources with often serious consequences for the quality of underground water and acquifers (Rew 1978). Lack of social control thus threatens the physical resources themselves and leads to unplanned development. A substantial number of unauthorised connections together with unrealistically high expectations leads to the sabotage of meters and supply lines which then threatens the financial viability of even the controlled pilot part of the programme itself (Rew 1979).

There is a further danger. It is that these kinds of developments create almost irreversible rachet effects in the society. There is no way of making people accept standpipes or other low-cost options when they see the groups which they emulate with regular access to high quality supplies. This effect is reinforced where institutional and social factors mean that there is scope for solving water supply difficulties by independent community action. Because of the social response factor, monitoring and evaluation of water supply projects should assess the distribution of water benefits in the population and the inter-penetration of social, financial and technical factors in design, operation and maintenance.

5. Urban programmes for rural contexts

In planning water supply it is easier to set targets and implement projects for urban populations. Density has something to do with this but only in part. The real differences between urban and rural schemes lie in the way in which home and work are connected in urban settlements and the greater variability in the way in which households are related to the division of labour in rural areas.

Reasonable access to water is a goal for the UN water decade. In order to specify this goal for urban areas one workshop recommended that a minimum target is for a water source within

200 metres of each house. Urban settlement is variable but it is variable within a range: a single minimum standard is therefore feasible. Furthermore, the separation between most household and employment activities is such that the water planner can assess demand for industrial, commercial and public usage almost independently of domestic use. Using aggregated demand and known minimum standards the planner can then proceed on a 'count, cost and carry' basis. He counts demand, costs various ways of satisfying this demand and having decided on a particular technical and financial option then carries it to the population concerned.

This is just not possible in the rural areas. The contextual nature of rural life is incompatible with the idea of universal standards. The range of settlement types is considerable, and the complex inter-relationship of domestic, agricultural and non-agricultural activities means that needs for human consumption, for irrigation and for livestock are all intermingled in different ways within each context. Moreover, the data base for estimating the scale of the problem and the precise nature of interconnections is very often unavailable. The workshop referred to above was unable to recommend anything as specific for rural contexts as it did for urban schemes.

As Donaldson (1976:5) emphasises, water supply in this sector in particular 'is more administrative than technical in nature... all action (technical, administrative and financial) must be coordinated at the central level - without forgetting each project also needs strong local participation'. The attempt to develop and manage coordinated water-supply systems using strong local participation and institutional controls is not an easy one. Certainly, minimum water for all will not be achieved by unaided self-help. National programmes often call for various kinds of self-help and reference is made to supposedly traditional values - for example, to the spirit of bayanihan in the Philippines or to gotong royong in Indonesia. But these self-help values will not thrive without the appropriate institutional, technical and financial support. This would mean placing greater emphasis on technical assistance for officials at intermediate level and a decentralization of the planning process. Certain countries - for example, Botswana, Mexico and Indonesia - try to put the responsibility for detailed allocation of resources as low down the hierarchic scale of administration as possible, leaving to the community the precise choice of how the resources should be used while prescribing the broad limits within which programmes had to remain. This strategy has considerable implications for systems of statistical reporting and accounting and for the balance between recurrent and initial costs.

6. Water supply as a social fact

Water supply, as we have seen, is more than a question of biological quality and engineering delivery. The social response to design determines the actual outcomes and community satisfaction. Aesthetics, social inequalities, conceptions of disease, dependence, labour and employment issues are all involved.

We should be aware of the many 'after-the-event' social impacts of increasing access to water. Improved access to water through improved water supplies has been noted to make life tougher for the women who, within the traditional division of labour, are responsible for carrying water. With secure supplies of water near at hand, women have greater time available and therefore receive less help from other household members than previously. (Elmendorf and Buckles,1980). Improved access may also cut down the time available for women to socialise, to increase control over them and encourage disease through stagnant water.

If supplies are brought close to clusters of households the effect may also be to increase rural inequalities because of the way in which better-off households congregate nearer to the roads. 'To even see the houses of the poor one often has to leave the road' is the comment of one recent study of three villages in the low country of Sri Lanka. Another result may be that within a large scale rural supply programme water may be routed through territories and villages about which people feel considerable scepticism and fear. Any reading of African sociology, for example, shows the enormous fears associated with witchcraft and sorcery. (See for example, the anthropological novel written by Eleanor Bowen and the relationship between choice of settlement and fears of witchcraft). Many riparian rights in rural areas are non-codified but are nonetheless of such a standing that they are equivalent to legal rights. Rural water supply projects which fail to take these rights into account will increase rural tensions.

There are also impacts on employment worth considering. Experience in the southern Philippines shows that municipal water supplies can be used to provide the basic resource for a thriving private sector water supply industry: urban water is tanked into outlying areas. The introduction of piped water supplies into the rural areas should lead to a fall in the price of water for rural consumers since carrying water is expensive. On the other hand such improvements affect levels of employment since rural people will tend to be employed as the drivers and carriers. Dunn reports an interesting case of where donkey drivers, deprived of employment as water carriers by a new scheme, vandalised the new well. The solution was to employ them as guardians of the well to recompense them for the employment they had lost.

The attempt to develop standardised 'community' programmes may well affect the

ability of particular households to solve their own problems and to gain their own optimum solutions. In one Pacific island not noted for its agricultural productivity, the government had funded the provision of community water tanks made with cement and chicken wire. These were delivered to central village locations. The effect was to make it harder to buy the galvanised tanks which they were to replace. Indeed this was one of the aims of the project since there had been many maintenance problems with the galvanised tanks. The effect on rural labour was considerable. People now had to walk to get their water rather than collect it from their own roofs. In a local agricultural economy in which the key constraint on production was the relatively low price-responsiveness of farmers this community improvement created many social costs.

Finally, the 'aesthetic' aspects of water should not be ignored. In one Pacific island we were told that there was a strong preference for rainwater collected from the roofs. This was 'sweet water' compared to the hard water collected from underground sources and piped to consumers. Since people will prefer to use sweet water for drinking purposes then standards for purity should apply to this and be adjusted to local circumstances rather than to the reticulated water system. Elliott (1975) summarises the issue neatly: 'Purity is a relative concept depending on the uses to which water is put, the density of the ambient population, the number of people using the particular water outlet, the drainage available and the health environment... the health hazards associated with a given level of purity may be very different in each environment. Standards are very seldom established locally'.

Conclusion

The UN water decade has laudable aims to help meet an important need acknowledged by poorer people throughout the world. We see the possibility, however, of danger in the way these aims will be translated into action. In the paper we have shown how an over-emphasis on any one aspect of a total system of water service supply can lead to unfortunate results when judged in terms of happiness of the people affected. Our conclusion is that the aims of the UN water decade should be implemented through integrated water resource management projects responsive to the needs of particular regions, countries and communities. If this is not done the result may be an irreversible situation where the implementation of aims may be considerably delayed. Impatient for results, many people will feel, however, that it is important to keep specific recognisable targets before the eyes of engineers, politicians, etc. We have shown that this approach can produce a patchwork of over-achievement and inaction with irreversible rachet effects on people's aspirations. These aspirations prove unrealistic since the aims in the headlines are achieved unevenly. An integrated social, technical and financial appraisal based on regional resources could avoid many of these problems.

Footnotes:

(1) Contemporary figures will be available shortly from Binnie and Partners and W.S. Atkins and Partners combined study of Algiers water supply. Initial print-outs tend to match the range of unit consumption figures for houaw connections given in the 1973 WHO figures.

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Session 2

Chairman: Brian Grieveson
Principal Engineering Adviser
Overseas Development Administration

Discussion

David B Allen, Forbes W Davidson and Alistair C Blunt

Incremental utilities provision and affordability

Mr ALLEN introduced his paper by explaining that his firm was one of three British firms involved in the Suez Canal master plan studies funded by the UNDP, from 1974 to 1976. The study was followed by a demonstration project funded by the ODA/UK from 1977 to 1978, in which his firm developed in detail the housing recommendations. Currently the firm was providing technical advisors to assist in the implementation of the programme.

2. A recommendation of the study was that government should not be involved with the direct provision of housing, but that efforts should be made to encourage community participation, local initiative and self-help self-financing projects.

3. Slides were used to illustrate the area covered in the project and the facilities available there, together with some of the improvements which had been made.

4. He thought it important to end by saying that the project was now self-financing at the levels of service provision which had been provided.

5. Mr RUKOIJO expressed doubts about the income statistics which were given, especially those relating to the squatter settlements. He wanted to know how these figures had been obtained since squatters would be unlikely to want to disclose this information when much of their income was from illegal sources.

6. Mr ALLEN agreed that it was very difficult to find out real incomes even accepting that socio-economic and detailed case studies had been carried out. In undertaking programmes targetted at the lowest income groups it was however important to understand how much could be afforded for housing, including infra-structure provision. However he thought it interesting to note that by the process of formalising tenure of land, people were found to be drawing on family wealth, from whatever source, and investing it in permanent structures. He did not think it would ever be known where this wealth came from.

7. Mr DOWNEY asked for an elaboration on the security of tenure.

8. Mr ALLEN explained that they had tried to formalise an informal process which had already existed. One of the benefits to the programme was that desert land in Egypt was free. In this case executive orders were issued by the Governor of Ismailia whereby all the land in the project area was transferred to the project agency at no cost. Plots of a range of sizes were then sold by a system of deferred freehold at costs which were considered affordable to the target population. After five years, if the holder of the plot wished to sell, he had first to give the project the option to buy back the plot, but it could then be offered on the open market.

9. Dr MITWALLY asked for details of the sponsorship of the study.

10. Mr ALLEN replied that the consultant firm and inception seed capital of £65 000 was provided by the British government. Now, after two years at the level of infrastructure provision provided, the project was self-financing. Except for the initial inception capital there had been no massive subsidies.

11. Mr OTIENO commented that from the slides shown by Mr Allen it appeared that massive structures were going up and the roads seemed to be well-made. He had the impression that the project had been intended for low-income populations and he wondered how feasible it was for these areas.

12. Mr ALLEN replied that two important objectives of the project were that proposals must be:
i) relevant to low-income groups, which formed the majority of the population of Ismailia, and
ii) capable of implementation with minimal subsidy.

During the period of implementation of the proposals the consultants' recommended selection procedure was modified by the Project Agency Board. As a consequence the consultants had been concerned that the lowest income groups were not readily gaining access to the project. However, there were certain safeguards such as variable prices of land, based on plot size, and costs per square metre according to location, which were designed to ensure that there was an opportunity for self-selection according to income. Further, the majority of plots were priced at the lowest price per square metre and easier repayment terms were available to the poorest plot awardees. Based on recent monitoring exercises there was evidence that the target population was participating in the programme.

Raymond B Isely

Planning for community participation in water supply and sanitation: accounting for variability in community characteristics.

Mr GRIEVESON explained that in the absence of the author the paper would be presented by Mr Hafner.

14. Mr HAFNER began by giving some background on the WASH Project. He explained that it was a committment from USAID to the Water Decade, to provide over a forty month period technical resources, information, technical transfer and training capabilities to the seventy AID missions in the developing world. It was made up of a consortium of five organisations, and concentrated on rural and periurban sanitation problems.

15. He explained that Dr Isely had extensive experience in Africa especially in Zaire, Senegal and the Cameroons. He had found that there were problems in obtaining information on community readiness for projects. The planners lacked data and so often made errors in their recommendations.

16. A plan had been proposed by Dr Isely for the collection of data to evaluate the degree of readiness of a community for particular projects.

17. Slides were used to illustrate Dr Isely's work, showing public meetings, basic spring protection and health education classes in the village of Ekali.

18. Mr HERBERT asked whether the assumption was that before implementing any santation improvement schemes a village should be encouraged to rise through these levels of readiness, or was it that only those villages already at a high degree of readiness should be considered for schemes.

19. Mr HAFNER believed it would be the latter. A village would be used which had a high degree of readiness, and then this village with its new scheme would be used as an example to show to the other villages and so encourage them.

Dr A W Rew and F R Delauzan

Community requirements in the design of appropriate water supply systems.

Dr REW began by explaining that his paper was not related to a specific case study, but was a conceptual paper which asked what was meant by community requirements.

21. "Community" was an elusive word. With regard to their requirements it should be remembered that a community was part of a society, and it was the place of the population in this wider society which usually determined the success or failure of a scheme, not parochial community processes.

22. An integrated view and assessment was considered essential for the success of any project.

23. The speaker went on to ask the question "what would be the success or failure of a water supply project - how could we measure it?". He thought it could mean one of two things: either the achievement of particular targets in terms of pipes supplied, connections made and such like; or the achievement of physical targets in relation to the specific social and economic needs of the population concerned. The degree of success could only be established by an evaluation of the actual needs of the population.

24. An example was used to illustrate the danger in any failure to place physical targets in their social context. If good supplies of water were provided for Bedouin populations, this would have an impact on their means of livelihood, in that permanent water holes created pressure on the groups to remain in one place. This began an irreversible process whereby pastures deteriorated through overgrazing. Water supply targets were met but these were not in keeping with the nomadic population's underlying requirements.

25. Emulation could be a factor in the feasibility of a project. It was difficult to persuade a community to accept a standpost system if they could see another community with something better. They were almost certain to want what the other groups had. Thus the community's response to the scheme's design would not be what the engineers or planners would have expected.

26. Dr REW ended by again stressing the point he had made earlier, that local populations could not be seen in isolation from the wider social and political context.

7th WEDC Conference: Water people and waste in developing countries: 1981

HUMAN RESOURCES DEVELOPMENT IN WATER SUPPLY AND SANITATION

Dr JOHN H AUSTIN Environmental Engineer USAID Office of Health
Dr DENNIS WARNER Acting Project Director WASH Project
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INTRODUCTION

Human resources development is the heart of the overall development process. It provides the lifeblood to all other forms of development, whether they be capital works, agriculture, education, monetary reform, or institutional change.

Developing country governments and donor organizations have had a continuing interest in the human resources development and training aspects of water supply and sanitation projects over the years. This was voiced at the Water for Peace Conference in Washington, D.C. in the mid-1960's, at the UN Water Conference at Mar del Plata in 1977, the WHO/ UNICEF "Health for All by the Year 2000" conference in Alma Alta in 1978 and stated strongly at the opening of the International Water Supply and Sanitation Decade at the UN in November 1980. Although individual projects have addressed the problem, efforts on a national, regional, or global scale have been rare. Today, more so than ever before, developing countries ministries and agencies concerned with water and sanitation are recognizing the need for human resource development and training strategies and programs.

WHO estimates that during the Water Decade (1980-90) the world will have about 2.5 billion persons who have inadequate water supply and sanitation. It is generally agreed that 0.5 to 1.5 staff persons are required per 1000 people served depending upon size and type of facility and program. This means that somewhere between 1,350,000 and 3,750,000 people will be required for all aspects of these programs. Futhermore, the required numbers could be increased because of turnover, new technology or other factors. Using an average figure of two million trained persons means that training systems must produce on the average 200,000 newly trained persons per year, 17,000 per month, 4,000 per week or 550 per day.

Although the time required to prepare a competent worker in a variety of simple tasks related to water supply and sanitation may be several weeks, much more lead time may be required to prepare competent personnel for the roles of engineers, accountants, health educators or administrators at the national level. Only a mechanism which can be sustained by the country itself can make it possible to prepare adequate human resources to manage, operate and maintain the water supply and sanitation facilities and programs needed to serve the 2.5 billion rural and urban people of the developing world. Self-sufficiency in human resources development and training must be accomplished at the country, regional and local level to meet Water Decade goals.

A major obstacle to meeting human resources needs is the current fragmentation characteristic of water supply and sanitation programs. For the most part such programs are supported by international banking organizations, bilateral organizations, United Nation groups, and private voluntary organizations. Each organization often specializes in one aspect of water and sanitation systems such as village water supply and sanitation, national infrastructure development, peri-urban technical training in water and sanitation and urban water systems or public health education. As a result fragmentation within a single country or region is more common than it should be. Each developing country, and, in some cases region, should have a comprehensive strategy to achieve long term goals in water supply and sanitation. This paper will focus on a systematic approach to human resources development for water supply and sanitation programs ranging from members of local communities to be served in such programs through mid-level national and regional officials and technicians to government leaders.

THE PLANNING, RESEARCH, EVALUATION AND TRAINING (PRET) MODEL FOR HUMAN RESOURCES DEVELOPMENT

The following assumptions can be made about human resources development for water and sanitation:

- The training and assignment of qualified people can be the major factor in initiating change in the water supply and sanitation sector;
- Water supply and sanitation services must be integrated into rural and peri-urban development;
- The broad-based foundation for water supply and sanitation services consists of a spectrum of personnel trained to perform services in the community and provide support at the regional and national levels; and
- The services provided at the community level must be coordinated with the levels above to ensure adequate two-way communication and continuity.

PRET for Developing Human Resources at the Community Level

Because many water and sanitation projects, especially in rural areas, are dependent upon local

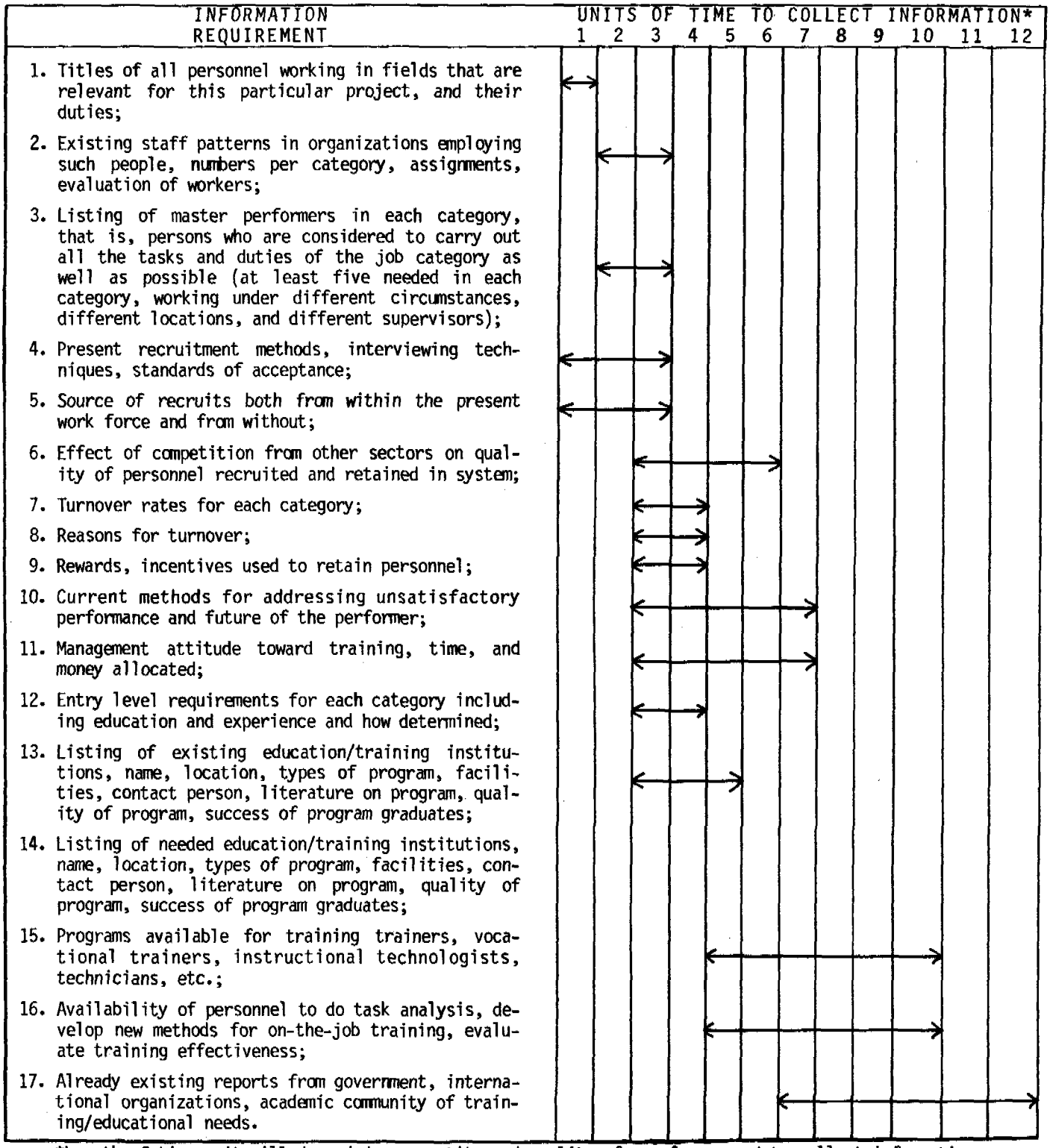
participation and support for their proper use and maintenance, local communities, national organizations and donors must work together to solve the problems of improving water supply and sanitation. Characteristic of such task-oriented planning is a holistic approach to meeting basic needs, with attention first to those problems which are perceived as the most important by the community. This requires the following:

Planning stage:

- Recognition of active community participation as an essential component;
- Flexibility;
- Continuing vertical and horizontal dialogue;
- A multi-sectoral approach; and
- A decentralized organization and mode of operation.

Research and data collection including:

RANKING OF INFORMATION REQUIREMENTS



*Length of time unit will depended on quantity and quality of workforce used to collect information. A unit may be one week or several months.

- Current knowledge, attitudes, and behavior related to water use and excreta disposal in general;
- Attitudes of community members about their present water supply and excreta disposal systems;
- Community member perceptions of their environment and its relationship to their health;
- Their perceived needs and wishes regarding improved water supply and/or sanitation; and
- The incentives and constraints to implementing them as perceived by all community members.

Evaluation methodologies which include:

- Modifying plans to fit users' needs;
- Redesigning when necessary and choosing appropriate technologies;
- Analyzing individual, community, and outside contributions; and
- Designing socially relevant contracts for inside/outside resources through locally organized institutions.

Training programs which include:

- A joint effort of planners and community members in conceiving, planning, developing and implementing new programs;
- Developing appropriate new training techniques;
- Operating the new facilities and/or programs by users;
- Maintaining new installations and/or programs by users; and
- Applying the training effectively within the users perspective.

From this process it will be determined who are the most appropriate people for carrying out specific tasks, who should be trained and how.

PRET for Development Human Resources within the Government Hierarchy

Planning

All too often in the planning and implementation of large schemes human resource development is not provided for until programs are put into operation. Because of the need for long range and comprehensive planning selected individuals must be adequately trained in decision-making and have a commitment to the effective implementation of such programs.

The complexity of the problems of human resource development for a project which will affect a large segment of the population makes it imperative that proposed solutions be examined for direct and indirect effects on other activities. It is equally important to understand the context in which a problem exists. Projects must first be viewed within the limits of government obligations and resources (people time, money), next within the limits set by project objectives and capabilities, and finally within the larger context of future government goals. Over and over again, the questions must be asked, "Why do it this way?" and "Why do it at all?" In order to arrive at satisfactory conclusions in the above process, it is necessary to know who will do what, when, where and how.

In establishing the objective for a plan, the following questions must be kept in mind:

- What is the real problem?
- What are the constraints to solutions?
- What is the current situation and what are the assumptions about the future?
- How has the problem been addressed in the past? Is a new approach warranted?
- Who should participate in the decision-making process?
- How will project activities interrelate with the actions of other government agencies, international organizations, the educational community, the recipient community, and other parts of the same project?
- What are the consequences to be expected from actions taken or not taken?

Research

In addition to the research and information necessary at the planning stage, research is also necessary during implementation, evaluation and training in order to fill gaps in knowledge which are bound to occur in each of these aspects of a program. If any of the information called for in planning is not available (such as present practices and attitudes among recipients of the services, resource constraints, policy of a particular group within government, appropriateness of technologies being considered, etc.) it will be necessary to do research.

Evaluation

Once the required information has been assembled, it must be evaluated and packaged to support the above objectives and the overall objectives of the entire effort. The following questions will have to be answered:

- Is the information relevant to the problem?
- How will the information help resolve the problem or allow the government to meet its responsibilities?
- Is it consistent and/or valid? If the validity is questionable, how can this be resolved?
- Must the information be conditioned by assumptions before it can be applied? If so, are the assumptions reasonable, clearly stated, and generally accepted? Under what conditions might they be invalid?
- Can the information be used in other places and circumstances in the future, thus reducing future costs of information collection?

After the information has been evaluated the following questions and suggestions should be considered:

- When considering the full range of possible actions - from the most ambitious to the do noth-

ing - which options appear most reasonable?

- What criteria are appropriate for determining the feasibility and/or desirability of alternative actions?
- What are the benefits, costs, and risks planned as well as secondary, of each alternative?
- Which of the constraints can be influenced by the attitudes, politics, and other characteristics of management, and can they be overcome through the use of authority and assertiveness?
- If no clear choice emerges what suitable techniques can be employed to clarify and justify a decision?

After having reached a decision, the following checks and balances on the choice can be made:

- Have specific contractual, statutory, regulatory and job-related responsibilities been satisfied?
- Is the choice defensible? Would the same choice be made a year from now, given the same limits of knowledge, resources and circumstances?
- Has the decision making process been documented? Did the process lead to a better decision than would have been reached without it?

Evaluation, particularly with participation of users, during implementation will determine what changes are required to make the program more successful and even whether or not the program should continue. The stages at which a program is evaluated should be synchronized with the stages at which critical decisions are made.

The actual evaluation should include:

- Inputs (i.e., people, facilities, financial resources, and technological resources);
- Processes (i.e., training, administrative support, and technical support);
- Outputs (i.e., facilities installed, personnel trained, organizations advised and programs initiated); and
- Effects (i.e., reduced mortality, reduced morbidity, increased work days/year/person, and acceptance).

Training

Systematic procedures for providing the needed human infrastructure will be required to supply the full range of manpower needs for water supply and sanitation in developing countries as follows:

Manpower Needs Assessment: Determination of the numbers of personnel needed in each job category, the time when each of these persons must be available for their job, the required compentence level, and where they will come from is fundamental to any human resource development and training program.

Development of Job Descriptions and Task Analysis: In order to assure that properly prepared persons are placed in positions and/ or that proper training can be provided for positions where competent personnel are not available, it is necessary to describe the skills and knowledge required for each task and the tasks that are included in each job.

Determining Resources Available: Wherever possible use should be made of existing resources. Existing institutions, organizations, materials, human resources, trainers, etc. should be identified.

Developing Training Delivery Systems: Because two million water supply and sanitation workers over the next decade will require many kinds of training systems options must be considered which range from traditional formal educational systems to innovative self-teaching programs using various media and in relevant languages. Country workshops should be held to train trainers to go back to their areas to carry out the development of systems for training.

Training of Trainers: The actual training of the two million people will be carried out by thousands of trainers at the village, community, provincial and national level in each developing country. Thus, each workshop in such a program must develop trainers who will return to their home area and train others--to train others--to train others. Therefore, all activities, materials and efforts must be so developed that the transfer of information and skills can occur.

Developing Personnel and Training Strategies: In order to maintain a body of trained personnel and prevent large turnover rates and "brain drain" among water and sanitation professionals, personnel must know where they fit into their own system and know of career opportunities and training available to help them move ahead.

CONCLUSION

With this systematic approach it is believed effective implementation of a wide variety of programs can be implemented. Constant evaluation, both formative and summative, will be necessary to assure that the intended beneficiaries indeed benefit.

7th WEDC Conference: Water people and waste in developing countries: 1981

THE INTERDEPENDENCE OF PUBLIC HEALTH ENGINEERING AND A SYSTEM OF LIFELONG EDUCATION

TERRY MURPHY Head of Adult Education Department, CAEES, Ahmadu Bello University, Zaria, Nigeria.

This paper will claim that water and waste engineers and adult educators must be conscious allies. It will reiterate the importance of involving the people in the planning and implementation of projects. It will suggest that the present surge of interest in appropriate technology requires appropriate staff and that this in turn will require the replacement of much of present education by education for less prestigious schemes. Finally, it will survey the role adult education can play.

In northern Nigeria the drive behind mass education is to raise living standards. In adult education we see our first task as that of ensuring that people survive. At greatest risk are the under-fives whose swingeing death rate owes much to adults lack of understanding of the relationship between water, waste and disease. Thus adult educators have to bring about public awareness of the hazards to health of dangerous sanitation practices. On the other hand, it must be stressed that education in public health is of minimal value unless facilities are adequate. A close (symbiotic?) relationship is thus required between adult educator and public health engineer. I would also argue that where adults are exposed to health education, pressure for authority-provided facilities or the development of self-help schemes are likely to follow.

> The developing countries may become the never-to-be-developed countries unless the burden of illness is greatly eased.[1]

This pressure on authorities is much overdue for health expenditure has a low priority* and is heavily skewed towards prestigious urban-based curative services which are making little impression as rural-urban drift intensifies urban congestion.

Yet, typically, 80% of the population are rural dwellers existing in poverty, with its sequelae of chronic, sygernetically related malnutrition and infectious and parasitic diseases. Research at Ahmadu Bello University indicates that the benefits of agricultural extension, including home economics, leading to improved nutrition, is largely negated by preventable debilitating diseases.

Project Planning and Implementation

The concept of "growth with trickle down" is being displaced by "growth from below" where interdisciplinary teams cooperate with the client population in planning and implementation as it is recognised that technocratic solutions to problems are incomplete if they lack participation from the planning stage. Each problem raises its own questions and each has its own solutions. Discovery of these requires involvement of the target group. The participatory approach clarifies the responsibilities and duties of both clientele and support agencies, while engineers and other members of the interdisciplinary teams learn preferences. This multi-source input, in turn, encourages optimal use. In the process the masses become educated in the water, waste and health relationship.

Without this participation, paternalistic provision of projects leads to an "aid mentality". Tanzania provides a warning here where the administration had seen itself as custodians of the Ujamaa villages with the result of, ".... a predominantly illiterate and long-suffering peasantry whose attitudes had crystallized into defeatism and scepticism".[2]

A participatory approach is required, not only for the feedback and cybernation necessary if projects are to serve the interests of the masses, but for the protection of basic biological systems. Involvement of the masses in this way also helps to ensure that the inevitable tensions caused by the interfacing of the traditional with the new will be productive rather than destructive.*

The appropriate technology which should emerge from well-informed discussion is likely to involve low-cost, and therefore non-prestigious, waste-disposal systems, for example, which civil engineers find unpopular with authorities. Participation will develop allies among the people.

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*The Overseas Development Council estimates $1.2 per capita per year in Nigeria. See Social Science and Medicine, Vol 14c June 1980.

*See the example of destructive tensions later in the discussion of Bakolori.

The multi-disciplinary, participatory approach is also necessary to minimise the effects of the inevitable contradictions.

> A frequent consequence of big-dam development is therefore an increase in the incidence of endemic diseases, especially malaria which currently kills over 1 million African children every year.[3]

Fish pools - malaria (seasonal attacks become year round); irrigation - bilharzia; biogas replaces smoky, smelly open fires - more mosquitoes and wood-boring insects in the rafters; on-site waste disposal - physico-chemical and micro-biological pollution of ground water; pit-latrines - bioaccumable pollutants (e.g. nitrate* in wells); boiling water - concentration of nitrate; will supply of potable water encourage bottle-feeding?

Currently there is strong political pressure for more wells and bore-holes in semi-arid northern Nigeria - it is to be hoped that a massive public hygiene campaign accompanies any provision as the wastes of a fast rising population accumulate in the sub-soil and increase pollution risks.

"Barefoot" Public Health Engineers?

As it is increasingly recognised that prestigious technologically sophisticated schemes for public health are unfitted to the realities of the developing world the call comes for technology with simpler to produce, and simpler to operate, systems. Thus, in considering the training of local people there is surely less need to consider an "extensive training programme over a long period of time."[4] Traditional training would "overeducate" as far as the active productive role of the trainee was concerned. "Barefoot" civil engineers, sub-professional public health aides, could carry out numerous operations with minimal specific task training, including simple maintenance, repair and servicing, on-site nitrate testing (especially where chemical fertilizers are being used), monitoring filariasis in soakage pits and record-keeping.

The introduction of this cadre of lower-level sub-professionals would render more flexible the mobilization of scarce skill resources and raise the elasticity of substitution between the highly skilled and less skilled (as the division of labour led to the semi-skilled engineering worker who made such a contribution to the Industrial Revolution). This cadre would also serve as an important link between the masses and the highly trained who are, typically, quickly absorbed and desk-bound by the administration and bureaucracy.

If the semi-professionals were locally recruited, as are the medical aides in China, the participatory process would not be impeded by cultural and linguistic barriers. This would also aid local production of parts as this closeness to the masses would encourage articulation of grass-roots ideas. In itself, this lends commitment to the project as Freire et al have found in retention of literacy when the masses produce their own materials. Indeed, Professor P.D. Dunn includes Paulo Freire's literacy methods in his appropriate technology.[5]

The recognition of the need for local involvement and for education now permeates the literature but the latter seems to be left to rather vague references to "health education". In fact adult education sub-systems provide ready-made structures upon which to build mass participation and enlightenment in public health.

Some Areas Where Adult Education Could Aid Public Health Engineering

First of all, let me lay the myth that adult education is synonymous with literacy teaching. It includes adults engaged from post-literacy to higher degree programmes as well as non-formal education. It includes the education being given to adults in management and trade union courses, vocational training and re-training, agricultural extension, community development and community health activities, workshops and symposia.

In northern Nigeria we embrace the universality of knowledge and reject the encapsulation of knowledges and so adopt a multi-disciplinary approach. Participants in our courses (who are employed as organisers of adult education programmes) are encouraged to see themselves as "animateurs", as change-agents working in multi-agency teams - community development, agricultural extension, community health, etc.

> .... now that it is becoming fashionable to criticise the top-to-bottom, centre-to-periphery, unidirectional planning and plan implementation and replace it with a participatory approach, adult education methodology in itself prepares the masses for participation .... (it) emphasises discussion techniques; rejecting teacher oriented pedagogy, it encourages participant oriented androgogy where the teacher is, at most, primus inter pares. Recognizing that human survival depends on daily success in problem-solving its approach is heuristic. Thus it attempts to restore the balance between education and the real world by reintegrating learning and living.[6]

Adult education is in the persuasion business, concerned with loosening constraints to development (cultural, behavioural, attitude, values and skills). A very considerable body of research findings into adult learning problems and communication techniques in the transmission of new ideas has become absorbed in the methods

*"Nitrate reduces to nitrate by entero-bacteria in the stomach leading to methaemoglobinanaemia and carcinogenisis. Methae moglobinanaemia can act sygernistically with other diseases - diarrhoea and anaemea. Methaemoglobinanaemia can also be transmitted from mother to foetus".

and techniques in adult education. Learning-by-discussion has been shown to be more likely to bring attitude change as participants do not simply retain knowledge, as tends to be a result of pedagogy, but are more likely to believe what they learn.

In opposition to the suggestion in a paper read at the 6th WEDC 1980, health education need not, in fact must not, be the exclusive domain of ministries of health. Much can be done through all of the agencies involved in educating adults. Our participants study, among other sources, the W.H.O. manual for primary health workers, concentrating on the prevention chapters. In the project work they must complete, several are surveying the provision of health facilities in local government areas thus building up a profile of needs and drawing out the roles of adult education in development. The Chemical Engineering and Biological Sciences departments of this university are engaged in a joint project on biogas production. Some of our participants are carrying out the preliminary surveys for this. While making their surveys they are, in the process, spreading to the masses the public health and fertilizer by-products of this form of energy. A spin-off we expect from this is an improvement in environmental awareness and perhaps a change of attitude towards handling human excreta as people become familiar with the use of bio-degraded material for fertilizer. The time may be ripe as the Green Revolution introduced farmers to, now, prohibitively expensive artificial fertilizers.

Attitude change of course is crucial to development. Adult Education could play a crucial role in bringing the attitude change necessary for optimal use of projects. Poor maintenance standards are not due simply to paucity of skills but by attitudes to work and property. The participatory approach brings a proprietary sense to the group and helps change the psychonormative pattern as each member recognizes his importance in success or failure.

The mass public hygiene campaign mentioned above in association with the pressure for wells and bore-holes needs public discussion of what are functional in the current culture of northern Nigeria; whether these remain survival oriented or are in danger of becoming pathological. An informed participatory public can initiate political action towards provision of appropriate technology and press that rhetoric is the prelude to action. As they are in contact with the masses, adult education agencies are valuable links which should be included in interdisciplinary project planning and implementation.

If a "barefoot" cadre is, along with other change agencies, going to take an active role in educating adults, its training should include some methodology on communicating with adults. At the same time, if the participatory approach is adopted in its own training, the self-discipline required for a minimally supervised repair and maintenance system is more likely to be inculcated. If, in turn, the cadre adopts the same techniques in communicating, the masses too will be likely to be more convinced of the need for user discipline. In order to improve on the low rate of acceptance of composting toilets, users must be educated that misuse is not only aesthetically unacceptable but dangerous.

We can "train-the-trainers" in the methods and techniques in the teaching skills appropriate to adults and for communicating with client populations. For example, we ran three workshops for extension workers at the Bakolori scheme the 6th WEDC visited in March 1980. Unfortunately, as I pointed out in my 1977 report, we should have been brought in much earlier as an authoritarian tendency had produced a sorry state of relations with the intended beneficiaries. Since the 6th WEDC visit many farmers died in a serious clash with the authorities. The resettlement village, planned without user participation, nor of the most elementary of sociological principles, I am told is a disaster.

Other areas where adult educators can help include the probability that potential "barefoot" engineers can be identified in adult classes and, of course, help in training these could be given. Another is that research conducted by adult educators into visual perception can warn of errors made in communication exercises using, to the literate, "obvious" illustrations. Adult education has also amassed expertise on the use of the mass media, an important channel of non-formal education for adults.

A system of life-long education, with adults and young learning together helps to ensure that the acculturation necessary in the development process will be gained without loss of enculturation of old and tried ideas, (e.g. of traditional life-support systems). At the same time it will reduce the vulnerability of people previously directly involved in their bio-technical systems, for it must be recognized that for a long time yet these latter are going to be subject to inevitable, all too frequent, breakdown.

Although I have argued above that literacy does not necessarily prevent non-formal education, it does become a necessary minimum for effective implementation of legislation on dangerous substances, especially where agri-business grows around projects.

In the longer run, water engineering and pollution problems require international agreements. The use of the Niger river, for example, requires agreements among Nigeria, Dahomey, Niger, Mali and Guinea. Informed public opinion is a prerequisite for both reaching agreements and implementing them.

However, I must conclude by saying that the problems of civil engineers attempting to move decision-makers away from prestigious but inappropriate projects, ring familiar to the adult educator whose experience is similar. Although, worldwide, lip-service is paid to the necessity of adult education, funds made available to adult education are the last to be considered in expansionist economic periods and the first to be cut in recessions. If its

crucial partnership rôle with public health engineering is recognized, perhaps political action may follow rhetoric.

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VIETNAM'S SANITATION SYSTEM

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The Vietnamese toilet is of interest for several reasons. It is probably the only system which was successfully applied on a national scale in a developing country. This was possible because of its simplicity in use and construction. The system made significant contribution to the environmental care and agriculture in Vietnam by recycling human excreta as fertilizer. Its significance for public health care is also very considerable. The Vietnamese method of excreta disposal is most remarkable since it follows completely different principles of pathogen destruction and mineralisation of organic matter compared to systems used elsewhere.

The great difficulty in public sanitation encountered throughout the Third World certainly justifies some attention for the successful Vietnamese methods, especially since the system is unique in its applicability in flood-prone areas, as well as in places without piped water supply.

The few publications about the Vietnamese Toilet so far available in the west have been limited to short descriptions of the construction and use of the toilet but little information has been available about the actual process performance. In this article we would therefore like to concentrate on these aspects.

Anaerobic composting

The system is characterized by in situ treatment of excreta, separation of urine and faeces, anaerobic composting and family size units.

The Vietnamese toilet is a double-vault system or a discontinuous toilet. There are two tanks one is used as a privy while the other has been closed and is used for composting of the faecal matter.

The Vietnamese Toilet requires that faeces and urine are deposited in different containers. After each use of the toilet some ash or lime is thrown on the fresh excreta to absorb humidity and to eliminate the smell. Toilet pare can be dropped into the vault. The lid is carefully replaced on the opening after each use. When the tank is full the material is levelled off with a stick and all is covered with an extra layer of ash. The opening is then sealed hermetically with mortar and marked with the date to assure a sufficient treatment time. In the Vietnamese Toilet organic matter decomposes in two phases: as long as the toilet is in use there is ample oxygen available. Since the faeces are always covered with ashes the pile remains porous and aerated and the process is aerobic. After the ault is closed the oxygen is rapidly exhausted and the process becomes anaerobic. The Institute of Hygeine and Epidemiology in Hanoi monitored the development regularly and analysed the various processes involved in this type of toilet. Since food tradition and living conditions vary and there are different construction methods in the various regions, the Institute established a number of field stations for such analyses.

The process

The Vietnamese Toilet has been developed as a part of the National Institute of Hygeine and Epidemiology. The Institute started in 1956 to study old and new methods for the collection, transport and treatment of human excreta and its use in agriculture. Data about the qualities and composition of human excreta were collected:

TABLE 1
Human excreta composition

Annual excreta quantities per person: ca 500Kg
Containing: 1.07% N
5.7% Organic matter
1.3% Inorganic matter
0.26% P_2O_5
0.22% K_2O

It was noted that human excreta is rich in organic matter in comparison with excreta of domestic animals. Treatment should therefore not only be useful from the health point of view that is effective in pathogen destruction but also for agricultural reasons: achieving a satisfactory mineralization and conservation of the valuable organic matter. One of the first methods propogated in Vietnam was aerobic composting of human excreta with agricultural waste in windrows on a floor of rammed earth or concrete. The windrows were covered with a thatch and mud layer of ca 20cm Temperatures of 70^0C could thus be reached and the process was completed after three weeks. But all the known disadvantages of windrow composting were experienced: transport and handling of fresh excreta, fly breeding and

very disturbing odours. It was therefore soon decided to try anaerobic composting methods. An interesting development at this stage was the research on the antibiotic effect of carbon-rich material added to the excreta. Household refuse, agricultural waste and leaves were studied. Two types of leaves, Rhizo-hora micronata and Aegiceras were chosen because of their iodine content, while the leaves of the Melia Azadarach were tested because of their antibiotic properties. The results were encouraging and in later developed composting methods these leaves were used. The first experiments with anaerobic composting were executed in pits of 150-200cm depth, where alternating layers of excreta and carbon-rich material were buried under a cover of straw and mud. It was found that after four weeks a satisfactory level of pathogen destruction could be reached. It was also found that a 10% additive of lime or superphosphate would reduce this time to ten days. The positive results of nitrification and pathogen destruction in anaerobic composting encouraged the Institute to attempt composting directly in the toilets in order to avoid the handling of fresh excreta. A multi-disciplinary team in the Institute under Dr Nguyen Dang Duc then set out to develop the Vietnamese Toilet. The first publications about their work appeared in the series Vietnamese Studies. The toilets were first called "Double Septic Tanks". Later the name "Double Septic Bin" was used. In this article we shall simply use the name "Vietnamese Toilet". A major question was whether composting of very small quantities of faeces such as produced by one family would be feasible in view of the problem of odours and of heat loss which retards the composting and changes the character of the process. It took time to solve these problems. An interesting additional requirement was to develop a toilet which would satisfy the peasants' timing for applying fertiliser to the fields. The use of human excreta in agriculture is so general in Vietnam that farmers often proved unwilling to wait for the treatment if it would interrupt the agricultural cycle. The decisive factors for determining the dimensions of the toilet were therefore the minimum composting time possible and the volume of excreta produced during the same time by an average family.

These two factors would assure the peasant the shortest possible cycle to make a safe compost avaialble. The attention of the Institute turned therefore to the choice of suitable carbon-rich material to shorten the cycle. The final product is determined by the composition of the excreta itself and it was noticed that the composting process developed better with a dry rather than a humid mixture. It is essential to avoid flooding of the vault, but it is not easy in a hot climate. Moisture content should either be reduced by adding moisture-absorbing materials or by separating urine from the mixture. This last step proved to be effective. It was also found that fly control would be easier in a dry mixture. Seperate urine treatment was not considered very risky from the health point of view. For the volume of the vault it would mean a reduction by 90%. The seperation of urine from faeces has much effect on the composting process. Firstly great quantities of water are avoided: urine has a moisture of 93-96% (see Gotaas 2). In this way the faeces can be composted without arrangements for drainage or ventilation. The quantities of nitrogen and potassium (as K_2O) are approximately equal in faeces and urine as excreted per person per day. The quantity of calcium (as CaO), phosphorus (as P_2O_5) and carbon in urine are respectively only 50%, 25% and 10% of those discharged in the faeces. It is worthwhile to recover these materials as well.

TABLE 2

Excreta composition (calculated from Gotaas' figures)

Dry weight in grams per person per day

	Faeces	Urine
N	6.75-16.9	7.5-13.3
P (P_2O_5)	4.05-14.58	1.25-3.5
Potassium (as K_2O)	1.35-10.75	1.5-3.15
Carbon	54.00-148.5	5.5-11.9
Calcium (as CaO)	5.40-14.5	2.25-4.2

Urine handling

Urine is seperated from the main treatment tank to simplify the composting process. The large quantities of fluids are handled seperately and the acidity and nitrogen content in the composting pile is reduced significantly Consequently much smaller amounts of carbon-rich material are needed to reach the C/N ratio required for composting. But what are the health aspects of it? The higher temperature now reached in the composting vault promotes the pasteurisation effect of the composting process and makes it therefore more efficient. The urine itself however has to be treated as well. The original method is simply to drain the urine into a water-filled jar outside the toilet building. The one-to-four dilution reduces the smell and the mixture is used to water the garden. In later designs a special receptacle filled with lime and ashes receives all the urine. In this arrangement no flies or odours are detectable even if the receptacle lacks a cover. There are few diseases which are transmitted through urine: bilharzia, typhoid and leptospirosis.*[15] It can therefore be argued that the health risks related to urine are insignificant compared to those caused by faeces. The Vietnamese hold that urine, after absorbtion and retention in lime or ashes can be safely used as fertiliser. There are however no data available to support this claim.

Further experiments were thus based on urine

seperation and on the studies of effects of carbon additives. Since the aim was to develop a toilet with composting in situ it was necessary to know the effects of the additives both during the time the toilet was used and during the composting period. Household refuse, powdered earth, leaves and straw were examined. Although the results were encouraging, a shorter composting time than two months could not be achieved with these and the search for better additives continued. Powdered lime, quick lime and kitchen ashes were found to give good results. These additives would increase the composting temperature, improve fly control and reduce odours in the toilet. The general availability of kitchen ashes to rural households was an important consideration: it would increase the acceptibility of the toilet.

Since only faeces would require a lengthy treatment process the reduction of quantities made a great difference. Dr Nguyen Dang Duc calculates that the annual quantities of faeces per person amount to 48Kg whereas the figure for urine is 438Kg. In other words only 10% of the excreta has to be composted. The treatment of the other 90% is much easier.

In comparison with the 48Kg which have to be treated per person annually by the Vietnamese method it is interesting to note that the annual quantity of waste water per person in North America is 800 times as much: 40 000Kg. The five gallon flush multiplies the treatment enormously.

The Vietnamese emphasise that adding ashes is essential for the process. Gotaas argues, while discussing aerobic composting, that great quantities of ashes should be avoided during the composting to prevent the loss of nitrogen. The Vietnamese on the other hand hold that anaerobic composting in closed containers retains many of the gases which are lost in an open process. Ammonia for example dissolves in the water suspended in the pile and is useful as a fertilizer as NH_4CL, $(NH_4)SO_4$ and $(NH_4)_3PO_4$. Ashes do absorb many of the aromatic gases. The concentrations of NH_3 and SH_2 measured in the vault were only 0.007 mg/l respectively. After three weeks composting no traces of these gases could be found. The effect of ashes and other additives on pathogen destruction was tested in relation to Shigella, Salmonella, Vibro cholera, ascarsis and many other pathogens.

TABLE 3

Additives and pathogen destruction for anaerobic composting - destruction in days

Pathogens	1	2	3	4	5	6	7
E Coli	62	60	35	56	20	0.34	21
Sh Shigae	12	10	10	9	8	0.7	7
S Typhi Vi	24	15	12	12	12	0.4	14
Vibri Chol	9	8	3	7	7	0.24	1

Key to additives:
1 = excreta only
2 = powdered earth
3 = Melia Azadarach
4 = Household refuse
5 = powdered lime
6 = quick lime
7 = kitchen ashes

The effect of the additives is noticable. Kitchen ashes show about the same values as powder lime and are available everywhere in the rural areas. Ashes also have a marked reducing effect on the occurrence of flies. The temperatures in the vault during the aerobic period are a few degrees higher than in the toilet room itself. The humidity is also slightly higher in the vault. After closing the vault hermetically the temperature rises dramatically: in five days from 30^0C to 45^0C peking after twenty days at 52-60^0C and then slowly dropping off after 45 days to the original temperature again. The method used to measure temperatures is to mount water-filled glass tubes through the construction into the pile. During the composting period thermometers are introduced into the tubes to take the temperature of the surrounding material.

The Ministry of Public Works[16] informed us about the test results concerning pathogen survival and gave some details on bacteria and parasites. Salmonella, Salmonella typhi, Para A and B, Shigella, Flexner and Sonnei were absent from the compost. Special attention was given to Escherichia Coli, a very resistent pathogen.

TABLE 4

Survival of E Coli

Total before composting	11 110 000 un.
After one week	1 110 000 un.
After four weeks	100 un.
After 6-7 weeks	traces

Of the common parasites, ascaris was studied carefully because of its high resistance. The effect of the composting process on the survival of intestinal parasites is of great importance since about 70% of the population were reported in 1958 to be carriers of Lumbricoides Ascaris, 35% were carriers of Duodenalis Ankylestema. Samples from the third and fourth composting weeks showed a high occurence of Ankylestema larvae and a 35% reduction of the eggs. The larvae do not survive the seventh and eighth weeks. Of the remaining eggs 50% can no longer develop into larvae. The Vietnamese sources conclude that a total of 85% of the parasite eggs are destroyed after an eight week composting period. The destruction of parasite eggs is closely related to the type of additive used for the composting. If lime, phosphate or kitchen ashes are used 50% of the Ascaris Lumbricoides eggs - the most resistant

parasite - degenerate, while all the larvae are destroyed.

Dr Nguyen Dang Duc informed us that the general application of the Vietnames Toilet must be credited with the sharp reduction in the occurrence of intestinal diseases as demonstrated in the table below.

TABLE 5

Incidence of intestinal diseases

Bacteria and parasites	Incidence(%) 1958	1978
Shigella disentry	12 - 13	1.2 - 1.7
Salmonella	6 - 7	0.1 - 0.6
Coli GEI	4.5 - 12	1.2 - 1.8
Ascaris Lumbricoides	60 - 80	15 - 35
Trichocephalus	40 - 45	10 - 12
Ankylostoma Duodenalis	20 - 25	10 - 15

Mineralisation of organic material can be determined in different ways and is used to indicate the stabilisation of the decayed excreta. The different methods do not give compatible results and there are no general methods to compare mineralisation of composting and water-borne excreta treatments. In the last disposal method Biological Oxygen Demand (BOD) is used to indicate the remaining decay activity. In composting volatile soil tests indicate the same. In Vietnam the mineralisation of the organic material is measured by determining the protein and nitrate content. Measuring biological activity can also be done by determining CO_2 production. We were allowed to take a sample from one of the Vietnamese Toilets, which one week later in Bangkok was analysed by Dr Thanh of the Asian Institute of Technology. A part of the sample was dissolved in water and then the BOD_5 was determined to be 4364 mg/l. The rest of the sample was used in a volatile soil test and the residue content was found to be 10.5%. The Institute of Hygeine reported the following results:

TABLE 6

Proteins and nitrates in the compost

	Proteins gr/100gr	Nitrates gr/100gr
Before composting	1.102	0.011
After 4 hours	0.395	0.210
After 8 hours	0.020	0.446

The nitrification is reportedly most effective during the fourth week of composting and a six week composting period is recommended in view of the agricultural use as a minimum period.

The Institute of Hygeine gives the following chemical processes to describe the composting in the Vietnamese Toilet.

1. Glucose

aerobic: $C_6H_{12}O_6 = C_4H_9OH + 2CO_2 + H_2O$

anaerobic: $C_4H_9OH + H_2O = 3CH_4 + CO_2 + H_2O$

(CH_4/CO_2 ratio = 1:1)

total: $3CH_4 + 3CO_2 + 2H_2O + 8500$ Kcal/Nm_3

2. Protein

aerobic: $CO(NH)_2 + CH_2NH_2COOH = CO_2 + NH_3 + H_2S + H_2O$

$CO(NH_2)_2 + H_2O = CO_2 + NH_3$

anaerobic: $4CH_2NH_2COOH + 2H_2O = CO_2 + 4NH_3 + 3CH_4 + 6375$ Kcal/Nm_3

(CH_4/CO_2 ratio = 3:1)

3. Lipids

aerobic: $C_3H_5CH_3(CH_2)_{16}COOH + 3H_2O = C_3H_5(OH)_3 + 3CH_3(CH_2)_{16}COOH$

anaerobic: $44C_3H_5(OH)_3 + 2H_2O = 7CH_4 + CO_2$

$12CH_3(CH_2)_{16}COOH + 3H_2O = 52\ CH_4 + 20CO_2$

total: $59CH_4 + 25CO_2 + 5970$ Kcal/Nm_3

(CH_4/CO_2 ratio = 2.36:1)

The implementation of the sanitation system

The Ministry of Health of Vietnam is through its Institute for Hygeine and Epidimiology responsible for the implementation of its rural sanitation system. The Institute works through its network of provincial stations and through the health centres of the Ministry of Health in the villages.

The sanitation programme was launched as part of a broader public health programme promoting the establishment of a protected well, a bathroom and improved latrine for each household. The programme has developed into one of the most successful public health efforts anywhere and deserves international attention. The health centres are well organised and work with careful planning methods. The health centre always has a map of the village with each house indicated and numbered. The number corresponds with the number of the health file of the family, which contains medical records as well as the environmental health conditions of the house and plot. The construction and condition of wells, bathrooms and toilets are carefully recorded here. A typical health centre is staffed by an assistant physician (medical assistant), a nurse, a midwife, a pharmacy assistant, two home visitors and two traditional medical practitioners. These health workers live in the village and are responsible for the development of the village public health programme. The plans are drafted at the district level and supervised from there.

The programmes include the construction of sanitary facilities, the cultivation and

processing of medical herbs for drugs, health education, family planning, preventive health care, inclusive vaccination programmes and curative outpatient services.

The district aythorities train the health centre staff and provide them with information and propaganda material such as posters, demonstration models and leaflets. Much of the propaganda work is brought in the form of theatre performances. There are annual competitions between the health centres at the provincial and national level concerning performance and implementation of the public health programme. The health centre organises the population through its Red Cross Society which has a family health worker in each household[17]. It is a very finely developed mobilisation network which highly promotes the contact possibilities with the population. The family health wokers receive regular health information and have some rudimentary health education. They act as family nurse and are trained to enlist more qualified health workers as soon as the problem cannot be safely handled by them. The family health worker sends all the family members to the centre for vaccination, constructs and maintains the well, bathroom and toilet and tends the family medical herb garden and holds the first aid box.

The Vietnamese public health system is based on a successful mobilisation of the population and on a careful definition of the roles which the various actors in the public health delivery system have to play from the national and provincial institutes to the family health worker. The very rapid implementation of the national health programmes tectifies to the effectiveness of the Vietnamese public health system and its remarkable successes can serve as an instructive example to other countries.

The construction

The Vietnamese Toilet is in its present design and construction a low-cost solution. The toilet was developed as a part of the rural health work and the whole effort was therefore geared towards bringing sanitation within reach of the poorest peasants. In the villages there is no problem to site the toilet building, as is the case in the urban and suburban areas. The construction is therefore an independent building.

The construction material varies from place to place according to the local building tradition and the availability of materials. Most common are burned brick constructions with the floors made of concrete. Plastered adobe constructions are used in some areas, whereas even plastered bamboo constructions can be found.

Many areas in Vietnam have a very high ground water table and inundations are there very common. It is in such areas necessary to build the whole toilet construction well above the surrounding ground. The floor of the vaults should be at least 20cm above ground level. The vaults measure 70cm by 70cm with a height of 60-70cm. There are therefore three or four steps leading up to the toilet door. The vaults each have a 25cm by 30cm opening to extract the compost located in the back or front wall. These are closed with bricks and mortar after emptying the vault. The vaults are not ventilated, since ashes deposited on the excreta sufficiently absorb odours. The slab over the two vaults forms the squatting plate and the floor of the toilet and has two openings with foot supports of which one has been sealed and the other has a lid. A urine drain in the slab leads to a tank. In many areas Health Centre workshops prefabricate and distribute latrine slabs.

To summarise, the advantages of the Vietnamese Toilet are simplicity, efficient pathogen destruction, good mineralisation of organic matter, safe use and handling, absence of odours and pollution, low costs, rich yield of fertiliser and applicability in flood-prone areas. The system can still be perfected, especially in its treatment of urine, but by and large all performance criteria for waste disposal systems are satisfied by it. The Vietnamese Toilet can be applied under difficult circumstances where other sanitation systems fail.

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Session 3

Chairman: Bill Moffat
WEDC Group member

Discussion

Dr John H Austin, Dr Dennis Warner and Dr Mary Elmendorf

Human resources development in water supply and sanitation

Mr MOFFAT introduced Mr Hafner who would present the paper in the absence of the authors.

2. Mr HAFNER explained that the authors were part of a nine-person team which went to Sri Lanka in 1980 to develop a national plan for the Water Decade. Their part of the study was to look at the human resources development factor.

3. He then went on to outline the main ideas as set out in the paper.

4. Mr DAVIS pointed out that traditional educational institutions tended to train for occupations but with little practical training. He agreed with Mr Hafner that more practical training in the field was needed and asked what changes could be made in these institutions to extend the resources available.

5. Mr HAFNER thought that there was a move away from institutional training to field work. There was more stimulus now to trainers to go out and train in the field, with as few outside resources as possible.

6. Mr CREE asked whether an element of training in the field was to train only to do the job required, and whether this might help to counteract the tendency for trained people to move to more prosperous areas to work.

7. Mr HAFNER agreed that this was certainly a factor to be considered. The narrower the training given, the less likely it was that workers would then be lost to other areas. This was of particular importance during the Decade since a large number of people would have to be trained in the ten years.

8. Ms VINCENT asked how low were the educational achievements of the people being trained and whether it had been possible to train illiterates.

9. Mr HAFNER replied that in the rural villages the trainees were Peace Corps volunteers and their counterparts. Most of these could read and write. He had no experience of training illiterates; in all the training in which he had been involved, the lowest level was with students who had not gone on to secondary school. He pointed out that the training of illiterates was extremely difficult, since it posed problems with such things as basic mathematical skills for example measuring.

10. Mr HERBERT commented that the sort of limited training which had been proposed presupposed that it was possible to define the jobs for which training was to be given. It was very obvious from papers presented so far that this was not possible. Situations would arise for which the worker was not adequately trained and so would not be competent to deal with.

11. Mr HAFNER felt that there was a need for on-going in-service commitment to training. He gave an example of an area in which he had worked where the public health inspectors had been working for ten years and had been given only a single one-week course in all that time. There was also a need for increased training in basic organisational skills, so that people were able to make decisions and implement plans.

Terry Murphy

The interdependence of public health engineering and a system of lifelong education.

Mr MURPHY began by saying that most of what he had intended to say had already been said by other speakers, and he had been surprised and pleased to find that civil engineers were on the same wavelength as himself.

13. When he first went out to Nigeria he had found that from 1962 on the standard of adult education had deteriorated until it had become simply a case of teaching reading and writing. Illiteracy was a great problem in Nigeria. At Ahmadhu Bello University-a recent survey of employees had shown that 1500 of them could not read or write, and this was the largest University in black Africa. This was a scandalous state of affairs.

14. In considering what could be done about the problem he had concluded that the adult education being provided was too narrow. In an attempt to broaden it he began with the very high death rate of children in the country. This he believed, was caused because adults did not connect water and waste with disease. As a follow-on from this health education classes should be started. This would lead to pressure from the people for more and better facilities, which would be appropriate because the local communities were involved.

15. Health expenditure had a very low priority in Nigeria and was concentrated in the urban areas, so that it was important to motivate the people in rural areas to try to

improve conditions. There was therefore a shift from mere literacy teaching to take in community development and health courses.

16. He placed emphasis on what other speakers had said, that there should be less importance placed on degree programmes and education for high level jobs. Much more sub-professional training was needed. In this way it was possible to avoid the problems brought about when people were too highly educated and trained to be available for the simple tasks.

17. He ended by saying that by getting the people involved he thought that civil engineers and adult educators could be allies in the future.

18. Mr OBADINA thought that Mr Murphy's view of Nigeria was not balanced. He had given only a very poor impression of the country by his concentration on a certain area. In fact there were cities and towns in Nigeria which compared favourably with any city in the world.

19. Dr BASU wanted to know whether there was data available to prove that the introduction of biogas plants led to the spread of malaria.

20. Mr MURPHY was convinced that when a biogas plant was introduced so that smoky fires no longer kept down the insect population, then there would be a subsequent increase in the incidence of malaria. He had used this as an example to help show that contradictions do occur when all sides of a problem were not fully explored.

Dr Krisno Nimpuno

Vietnam's sanitation system.

Dr NIMPUNO began by explaining that his paper was the result of visits and co-operation with the Ministry of Health in Vietnam. He had included much technical data in the paper because so little was known about the system in the West. There had been no other publication with technical details on the subject.

22. The sanitation programme had a good record of pathogen destruction, recycling the human waste to produce excellent compost. The toilets were pleasant to use, having no smells, and were cheap to build. But the most interesting fact to note was that in North Vietnam there was now over 95% coverage in rural areas with this system.

23. Slides were used to illustrate parts of the programme which was built up by the Institute of Hygiene in Hanoi and instituted by the local health centres. In these health centres an integrated health programme was based on self-reliance. An example of this was that 80% of the drugs were produced in rural areas. Herbs were grown at the health centres and also in the small gardens of each household. The herbs were collected, dried and processed into drugs locally.

24. Also illustrated was a brick kiln, which most villages had. The majority of houses in the villages were built of brick and the standard of rural housing was far higher than in Hanoi or any other large town. Also found in the villages were kindergartens and if possible some protected water for swimming pools.

25. The three major elements of the national health programme were shown: a protected well, a bathroom and the Vietnamese toilet.

26. Organisation was very important in the health centres with extensive records of households together with medical records. Adult education was fundamental to the whole scheme. Demonstration models were used to help the people understand how the toilets worked. Teams of actors gave performances in which local names and incidents were related to health education in order to help teach the people. Local health centres had workshops where slabs and other components were made.

27. Most important had been the setting up of village Red Cross Societies. Each household had a member of the Society who was trained in basic health care and was given a first aid box. These people kept checks on vaccinations, sent people when necessary to the health centre for treatment and looked after the household well, bathroom and toilet. In this way responsibility was brought down to the level of the people, and also the central Institute of Hygiene was kept up-to-date on the working of the system by regular reports.

28. The design and construction of the toilet was shown as a double-vault built above ground level, so the system was especially good for areas prone to flooding. The first box was used until full and then sealed up for composting while the second box was filling. After some time the first box was opened and the material removed and used as fertiliser. A normal human produced around one kilogramme of excreta every day, but only 20% of this was faeces the other 80% being urine. Of the fifty diseases transmitted in excreta only three were transmitted by urine, so it was considered reasonably safe to channel urine away from the vaults. This greatly reduced the volume of material to be stored. The urine was collected separatley and sprinkled on the garden.

29. Dr NIMPUNO summarised by saying that this was an example of a very successful rural programme which involved the whole community in a simple low-cost solution.

30. Mr JACKSON commented that the system seemed to be very similar to the one which was commonly in use in the buildings in North Yemen, many of which were centuries old. He

asked whether there would be an application of the system in urban areas.

31. Dr NIMPUNO replied that the system could only be introduced into periurban areas. This had nothing to do with the qualities of the system but was a direct result of bureaucratic intervention. Rural health was in the hands of a different Ministry from that in charge of urban areas and there was little or no contact between them. However, attempts were being made to try to change the situation.

32. Dr BOURNE thought that the system seemed to be similar to the Chinese double-vault system. He also commented that in many places in the world the need for water was very clear and it was easy to motivate the people in water programmes. However it was not the same with sanitation. It was usual to provide the two services in sequence, water first and then later trying for sanitation. He asked how this was tackled in Vietnam: was the water provided first or was sanitation included in the same programme?

33. Dr NIMPUNO said that there were many composting systems used in China, but to his knowledge they were not the same as that used in Vietnam.

34. The programme was called the "three steps in one" programme, to include the well, bathroom and toilet as an integrated system. In Vietnam the key to the problem of motivation toward sanitation was the agricultural use of nightsoil. The toilet had a short cycle producing compost every two to three months at the times when it was needed on the land. So the motivation for this type of sanitation system to be developed along with the water supply was high.

35. Mr PRESTON asked about the method of hand and anal cleansing used. He also wanted to know what happened to sullage and other household waste, and how the compost was removed and used.

36. Dr NIMPUNO replied that leaves and sometimes paper were used for cleansing. In some systems in India where urine was not separated water was used, and this was important in Moslem areas. Greywater was usually infiltrated, but in Vietnam this was still a poorly developed part of rural sanitation. Some soak-pits had been dug but they were small and the high groundwater level meant that they did not work well. The compost was shovelled out. It had the appearance of soil and was odourless.

37. Mr OBADINA asked whether perhaps old people and some others may be unhappy about climbing the steps to the toilet.

38. Dr NIMPUNO felt that education was important in this matter. The people were aware of the flood situation and the dangers of blackwater flooding the streets. They accepted that the toilets had to be built in this way above ground level. Also because of the separation of urine the boxes were only small and so the flight of steps was shallow.

39. Mr GRIEVESON knew of double-vault systems in use in Egypt and Botswana. He wondered whether they were the same as the Vietnamese toilet.

40. Dr NIMPUNO explained that there were many double-vault systems in use in different places but they were not the same as that used in Vietnam. The separation of urine and the use of anaerobic decomposition made the Vietnamese toilet unique. Most pathogens were killed by the high temperatures which could be reached, up to 72^0C in some cases.

41. Mr HERBERT asked whether the society was already organised and receptive to the programme, or whther this was something which grew with the development of the programme. He also wished to know how long it had taken to achieve the 95% coverage.

42. Dr NIMPUNO said that the revolution and organisation of society had come first. The system had taken between eight and ten years to perfect and a further eight years after that to implement and bring to 95% coverage. Since 1974 attempts had been made to bring the system to South Vietnam and there had been moderate success there already.

7th WEDC Conference: Water people and waste in developing countries: 1981

WHAT ROLE FOR THE CONSULTING ENGINEER

DAVID O LLOYD Managing Director, Halcrow-Balfour Ltd.

SUMMARY

This paper discusses the fundamental changes that have, and are taking place, in the role and uses of environmental and public health consulting engineers to help provide services for the benefit of recipient communities. Reference is made to the shortcomings of some of the present procedures, and comments are presented on the changes which could lead to overall benefits to users.

INTRODUCTION

The requirements for the provision of adequate water and waste services throughout the world remain undiminished and undiminishing. The aspirations of people for the acquisition of these benefits rightly ever increases, all too often beyond the capability of local, regional or central government financial and technical resources; the capacity of international agencies; or the willingness of donor countries.

Detailed dissertation on the existing situation in the world is inappropriate in this paper but Table I indicates the overall magnitude of 60% of the 2,300 million people living in the developing world being without any adequate or safe drinking water and rather more with no sanitation at all. The investment needed for the correction of this situation was originally quoted at about £60,000 million. This is approximately 120 years of capital expenditure at the current UK rate or 70% of the replacement value of the present UK assets of similar services.

CONSULTING ENGINEERING

It is perhaps a reflection on the profession that many people have no clear idea of what Chartered Engineers do, and even less what Consulting Engineers are. The British Association's definition of a Consulting Engineer is

"A person possessing the necessary qualifications to practise in one or more of the various branches of engineering who devotes himself to advising the public on engineering matters or to the designing and supervising the construction of engineering works, and for such purposes occupies and employs his own office and staff, and is not directly or indirectly concerned or interested in commercial or manufacturing interests such as would tend to influence his exercise of independent professional judgement in the matters upon which he advises."

The field of engineering is so wide that consulting engineers are bound to specialise to a greater or lesser degree.

Consultancies exist in almost every professional discipline; from economics to engineering; chemistry to combustion; and management to marketing; to name but a few. They are generally active in two broad fields of service. They can provide authoritative and unbiased advice based on their knowledge and experience purely in an advisory capacity. In addition, they can act as design, executing and supervising agencies for specific projects.

In the former role they are probably acting in the 'purest' possible professional way, and the roles of consultants, as we know them today grew from these specialist beginnings. In the latter role, the consultant acts within prescribed and specified limits, and it could be construed that they merely operate as an extension of the existing establishment of the clients administration. The edges between these two distinct functions, tend to become blurred, and most commissions contain an element of each role.

THE ROLE OF THE CONSULTING ENGINEER

Conventional

The conventional role of the Consulting Engineer normally results in the provision of a series of defined steps linked to the "Project Cycle" as used by many funding agencies. (See Appendix). These include (i) Pre-feasibility study, (ii) Feasibility Study, (iii) Design, (iv) Tender Document Preparation, (v) Supervision of Construction. Although rare project examples exist of a different consultant being retained for each stage, normally at least 2 firms will share the project work and commonly 3. This situation may have arisen because more consulting engineers are available, but a more likely reason is that the increasing involve-

ment of more countries with international funding agencies has led to greater pressure to "spread the work around".

Is such division of consulting engineering project involvement efficient in man power and financial resources? It can be argued that the use of different firms produces better designs but on close examination this argument regularly fails. Almost inevitably a multiplicity of firms, results in design services being duplicated; overheads increased; and mobilisation payments being incurred more than once. Each firm, at each stage, will wish to reassure themselves that the overall project concept and design is correct (indeed their terms of reference will probably require them to do so) all at additional cost to the client.

The current pattern of the "Project Cycle" can also lead to inflexibility to the clients disadvantage. A project may take many years to come to the fruition of detailed design and construction supervision, by which time the Feasibility Report can be out of date. Anticipated development may not have happened, or even be planned any longer, but the provision of infrastructure services has already been embodied in miles of bureaucratic reports at all administrative levels of government and funding agency. A consulting engineer would be failing in his duty if he did not propose changes, but would probably make administrative enemies (to his disadvantage) even though the final project would benefit more needy people.

Current practices could result in Consulting Engineers becoming mere design agents on many projects to the detriment of both themselves and their clients. A return towards greater mutual client/Agency/Consulting Engineer trust; Wider involvement at all project stages; and less division of services between separate firms would reduce many project overall execution times and costs.

Less Conventional

The more traditional role of the consulting engineer as referred to previously has widened in recent years by providing services to clients in differing ways. The relationship between Client and Consulting Engineer must be clearly understood, however many other parties may be involved in any "package", so that the personal and professional integrity of the latter is preserved for the benefit of all.

Recent examples of less conventional roles for consulting engineers include:-

(a) A pilot study including the inspection, cleaning, renovation and recommendation of remedial measures for the sewerage system of a large Indian City under World Bank finance.
The Client, a Metropolitan Development Authority engaged an Indian Contractor together with the services of a British Consulting Engineer, who in turn employed a British Water Authority and a British specialist contractor as sub-consultants/contractors.

(b) The design of water supply schemes; the procurement and transportation of materials; the direct employment of local labour and plant for construction; the supervision of plant installation; and project commissioning in a West African State.
The project financiers (UK Overseas Development Administration) approved a "turn-key operation" by the Consulting Engineers because the low level of commercial and development activity within the country made the employment of civil engineering contracting companies entirely uneconomic.

(c) The secondment of individual engineering staff at all levels to recipient Government Departments overseas with the retention of individual pension rights and limited financial recognition of the support afforded them by head office.

(d) The assessment, study and site trial in a number of less developed countries of solar powered low head pumping installations, under direct World Bank financing.

(e) The establishment of joint formal legal entities by groups of consulting engineers and/or other consultants to offer clients and funding agencies one "contractor" in contrast with the rather loose, ill defined consortium, joint ventures etc of the past which could give rise to feelings of impermanence and lack of resources. A recent water resources project in a Middle Eastern country encompassed engineers, systems analysts, chemists, agriculturalists, economists, hydrologists and hydrogeologists all engaged within the confines of one consulting engineering company.

Fees

Good advice demands fair reward. Remuneration for consulting engineering services can be based on many formulas, including; lump sum, percentage, man month rates, etc. Whatever method of payment is adopted due allowance must be made by Clients for the hidden assets that lie behind the directly visible staff employed on the project work. The full experience available within any larger firm and that readily available to most smaller organisations has to be paid for, as do overheads etc. If margins are cut too much in project fee negotiations on a continuous basis, standards of service and design will inevitably fall.

CONCLUSION

This paper is by conference organisation direction - short. The outline ideas expressed can be developed during discussion. Suffice it to say that there is a continuing need for consulting engineers who can provide professional skills, realising that their mission is to serve the worlds needs and not to remake it in their own mold. It is to be hoped that they can continue their work in an atmosphere of increasing mutual trust and decreasing bureaucracy.

TABLE I

Numbers of people in the developing world (excluding China) without clean water and sanitation in 1980 (Comprehensive Report on the Decade for the UN General Assembly)

Population (million)		Without reasonable access to clean water		Without adequate disposal facilities	
Urban	703	177	(25%)	331	(47%)
Rural	1612	1143	(71%)	1399	(87%)
Total	2315	1320	(57%)	1730	(75%)

APPENDIX

Abstract from "The World Bank Project Cycle" by Warren C. Baun, Finance and Development, December 1978.

"Bank lending has become increasingly development-oriented in terms of borrowing countries, development strategy, sectors of lending, and project design.

In terms of countries, lending has been directed increasingly toward the poor and less developed countries in Asia, Africa, and Latin America.

In terms of development strategy, the so-called trickle-down theory, which assumed that the benefits of growth would eventually reach the masses of the poor, has been replaced by a more balanced approach, combining accelerated growth with a direct attack on poverty through programs to raise the productivity and living standards of the rural and urban poor.

In terms of sectors, the emphasis has shifted from basic infrastructure (roads, railways, power) and industry to a more comprehensive program aimed at growth, provision of basic services, and better income distribution. While infrastructure continues to be important, lending for agriculture and rural development, urban sites and services, water supply and sanitation, education, population, and nutrition has been introduced or expanded greatly.

In terms of project design, greater attention is given in all sectors, both new and traditional, to income distribution and employment, impact on the environment, development of local resources and institutions, training of local personnel, and overcoming social and cultural constraints".

THE PROJECT CYCLE

1. IDENTIFICATION

Selection by Bank and borrowers of suitable projects that support national and sectoral development strategies and are feasible according to Bank standards. These projects are then incorporated into the lending program of the Bank for a particular country.

2. PREPARATION

Borrowing country or agency examines technical, institutional, economic and financial aspects of proposed project. Bank provides guidance, and makes financial assistance available for preparation, or helps borrower obtain assistance from other sources (one to two years).

3. APPRAISAL

Bank staff review comprehensively and systematically all aspects of the project. This may take three to five weeks in the field and covers four major aspects: technical, institutional, economic, and financial. An appraisal report is prepared on the return of Bank staff to headquarters and is reviewed extensively. This report serves as the basis for negotiations with the borrower.

4. NEGOTIATIONS

This stage involves discussions with the borrower on the measures needed to ensure success for the project. The agreements reached are embodied in loan documents. The project is then presented to the Executive Directors of the Bank for approval. After approval the loan agreement is signed.

5. IMPLEMENTATION AND SUPERVISION

The borrower is responsible for implementation of the project that has been agreed with the Bank. The Bank is responsible for supervising that implementation, through progress reports from the borrowers and periodic field visits. An annual review of Bank supervision experience on all projects underway serves to continually improve policies and procedures. Procurement of goods and works for the project must follow official Bank guidelines for efficiency and economy.

6. EVALUATION

This is the last stage. It follows the final disbursement of Bank funds for the project. An independent department of the Bank, the Operations Evaluation Department, reviews the completion report of the Bank's Projects staff, and prepares its own audit of the project often by reviewing materials at headquarters, though field trips are made where needed. This ex post evaluation provides lessons of experience which are built into subsequent identification, preparation or appraisal work.

7th WEDC Conference: Water people and waste in developing countries: 1981

URBAN SANITATION AND PLANNING IN KHARTOUM AND OMDURMAN

Jack R Preston — Partner, Watson Hawksley
Richard P Cree — Senior Engineer, Watson Hawksley

1. INTRODUCTION

1.1 The Project

In 1980 sewerage studies were commissioned by the Sudanese Ministry of Public Works to initiate improvements in sanitation for the cities of Khartoum and Omdurman. The assignment contained the familiar elements of master planning, preliminary engineering and feasibility studies and required consideration of low-cost sanitation alternatives to sewerage.

First phase sewerage implementation designs were also to be prepared in the 12 month study period to support applications for funds.

Some conclusions reached by the project and the factors which led to these conclusions are summarised for reference when objectives are being established for similar commissions.

2. BACKGROUND

2.1 Location

Khartoum and Omdurman are two towns in the three town capital conurbation of Sudan at the confluence of the White and Blue Nile river, 1200 km from the delta (Fig.1).

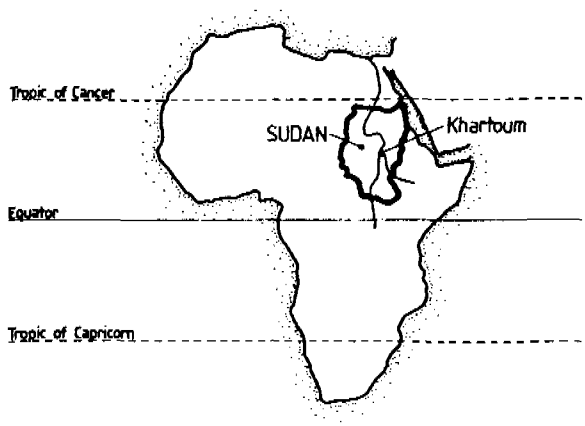

Figure 1. Project location

Sudan has an area of close to a million square miles and a population of 20 million. The capital is isolated and communication with the outside world relies on air transport and on a 1200 km road and 800 km railway line to the Red Sea at Port Sudan.

2.2 Economy and development

The country is poor: its natural mineral resources are thought to be considerable but are virtually unexploited. Its agroeconomy is based on cotton in which production has flagged and on sugar, the potential of which is only just being realised.

The harsh climate, the economic situation and the enormous problems of infrastructure, particularly communication, present unusual and severe difficulties which beset aspirations to improve and develop.

In these circumstances, the allocation of resources to plan and provide sanitation ranks low on the list of urgent needs in the country. But the population of the capital is a million persons and rising fast, despite awareness of the need to limit, and efforts to prevent, rural to urban migration.

2.3 Physical development

Khartoum has developed as a rectangular grid on the flat alluvial plain between the White and Blue Nile rivers. It extends over an area of about 10km square.

Omdurman's street pattern is much more irregular, affected by the relatively pronounced topographical features based on four main wadis. The town is founded on varying thicknesses of consolidated alluvial cover over sandstone and basalt, which outcrops at the surface to the south and east.

Figure 2 shows the two towns in relation to the third, called Khartoum North. The centre of Khartoum is a mixture of low rise and moderately high government and commercial buildings but the bulk of development is of simple single-storey compound houses to the south, with higher class residential development closer to the centre and also to the east which is rapidly developing.

Omdurman is similar in its development pattern. The commercial area is centred on the Suq where the streets are characteristically narrow and congested. The old town has many irregular winding streets but newer areas are set out on a grid pattern, similar to the newer towns of Khartoum.

An area about 5km square at the centre of Khartoum was provided with modern sanitary sewers and sewage treatment twenty years ago, and the industrial quarter of North Khartoum more recently. No more than 100 000 persons

are served by these means. Some of the balance have septic tanks, but most have pit latrines of varying standards or nothing.

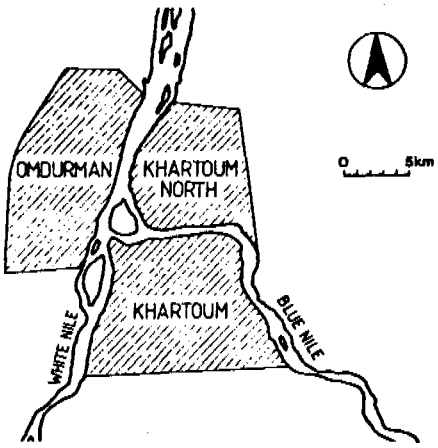

Figure 2. The three towns.

2.4 Population

Demographic statistics are dated, incomplete and varying in reliability. The main sources of information are in a development master plan dated 1975, a water supply master plan produced in 1979, a partial population census carried out in 1972, and relatively sparse contemporary planning and economic data. Figure 3 shows predicted population curves for Khartoum, from three sources.

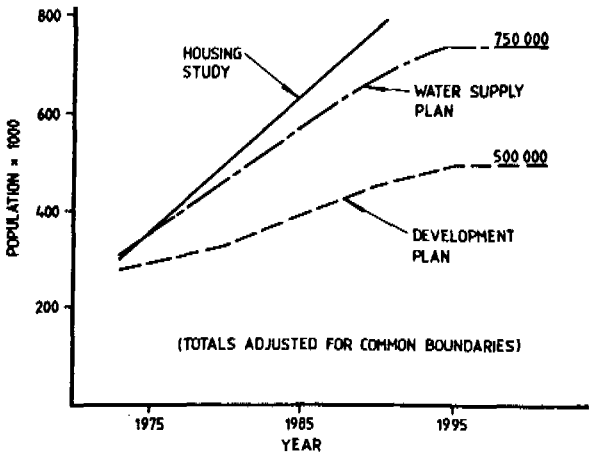

Figure 3. Conflicting population data for Khartoum.

Considered comparison of these sources concluded that the existing populations are 450 000 in Khartoum and 430 000 in Omdurman, rising to 790 000 and 780 000 respectively by the end of the century.

3. PLANNING CRITERIA

3.1 The client's requirements

The principal responsibility of the client government department was the design and construction of conventional sewerage systems and he expected the consultant to plan and design conventional sewerage and to propose means of resolving the problems of the existing system. In Khartoum the Planning Authorities are actively trying to encourage prestige development and required extensions to the sewerage system to contribute to this end.

3.2 The consumer's needs and wants

It became clear that the most urgent problems were in the existing Khartoum sewerage system, which frequently overflowed into the streets; in liquid waste disposal from commercial and industrial areas in Omdurman; and in the absence of sanitation in the unplanned, largely squatter areas. Diarrhoeal diseases are already a major health problem and the risk of transmission in public places is high.

Present indications are that the proportion of the population with no satisfactory sanitation will increase. The relative attractions of urban living have caused a large rise in the squatter population. The authorities fear that the provision of services will encourage even higher numbers, creating a further drain on resources. General policy therefore is not to provide such services to squatters, but this is an expedience rather than a solution.

At the other end of the scale, although the national economic position is poor, there is substantial private activity, and considerable pressure from the more affluent for water and sewerage services to be extended. There is adequate water in the Nile to meet the former demand and the latter is partly a consequence of increasing usage linked with the high cost of building the deep soakaways necessary for the effective disposal of septic tank effluent.

3.3 Availability of capital funds

The consultants were told that capital funds should not be a problem and yet great difficulty was being experienced in finding funds for urgent water supply extension proposals, recently formulated. The dilemma is evident.

3.4 Public health administration, education and control

The Ministry of Health and the Municipalities have well established administrative systems, but many of the professional and artisan members of the community have taken better paid employment abroad and despite the efforts of the hard working remainder, the level of achievement clearly suffers. This poses a planning constraint which is difficult to accomodate realistically. Development projects rarely concentrate on programmes of education, training and control, for these are complicated by the interaction of many more social factors than are Capital Works construction programmes.

3.5 Selection of technical solutions

The most appropriate sanitation solution is that which is technically satisfactory at a purchase and maintenance cost the consumer is willing to pay.

The importance of lower cost solutions is becoming increasingly recognised and reported but long-term experience of successful, planned and engineered schemes is limited in comparison to experience of conventional sewerage. Social factors and education assume overriding significance. The problem of implementation and funding of the construction in such schemes is administratively complicated as the construction takes place entirely on the private property of individual householders.

The planning team have to select and design a reliable, long term system which will accomodate increasing flows of water as living standards rise. The design must be safe in all soils (a serious problem in Khartoum) and accomodate variations of construction methods or quality. Low cost systems require local trials and development and organisational changes before large scale implementation can be successful, which necessitates a longer term design commitment than a brief, close ended, planning and design project.

The critical questions which then arise are on the appropriate limiting capacities of each aspect of the system, the measures to be taken for each section of the community and how the scheme should ultimately be paid for. There are many ways in which country-wide tax payers effectively subsidise amenities for residents of the capital. These issues are highly complex and their resolution needs adequate data and a clear policy on resource allocation.

4. CHOICES

4.1 Conventional sewers

For both cities, sewers, pumps and pipelines offer the most reliable long term solution for large flows of liquid wastes from the commercial and industrial areas. The most interesting technical problem was set by the twenty year old sewerage system, constructed with asbestos cement pipes. A combination of favourable circumstances has minimised sulphide attack but it was decided that, as these may not last indefinately, non-corrodible pipes should be used in vulnerable areas of future construction.

The greatest planning problems arose from the considerable lack of consistent, comprehensive planning data or policies. Best estimates had to be made. The final proposals for the sequence of sewerage of residential areas was a sensitive issue. Social and political aspects had to be balanced with technically based factors.

4.2 Treatment and disposal

Anti-pollution laws prohibit the discharge of effluent into the river Nile. There is however a strong requirement for the irrigation of eucalyptus trees for amenity and timber production.

For Khartoum it was confirmed that stabilisation ponds, such as those being constructed by the client, will provide the most appropriate form of additional treatment facilities where required, but that the existing resource of sound treatment works structures would be best used by refurbishment of the mechanical plant.

For Omdurman, ponds were designed to treat the bulk of the sewage, but special facilities are needed for oil mill wastes which are to be excluded from the public sewers and treatment works.

4.3 Operation

It became evident that problems with immobilisation of existing plant are not so much attributable to a lack of skills of mechanical and electrical fitters but to a severe shortage of parts and materials.

Designs and documents for new sewerage work aim to reduce maintenance requirements. For example, higher sewer velocities, submersible pumps and backup and by-pass facilities should reduce surcharging and blockages. Circuits and controls are kept simple and clear. The problems of organisation and resources are however not so amenable to "solution by specification".

4.4 Organisations

Responsibility for the existing system is split between Municipal and Health authorities, Khartoum North sewerage is operated separately. In contrast, power and water services are administered by a public corporation responsible for revenue collection as well as for providing a service for all three towns. The study concluded that some of the operational problems would be relieved by the formation of a single sewerage operation authority and ultimately by a public corporation responsible for both water and sewerage services. The design and construction of new sewerage works would however remain as an indepedant service. Detailed proposals were submitted for manning levels and tasks, such as those of maintenance terms, so that future operation and maintenance esponsibilities would be clearer and easier to control.

4.5 Non-sewered options

The first study reports (Master Plans) showed that conventional sewerage is unlikely to reach large areas of the residential development in the foreseeable future (Fig.4).

Non-sewered alternatives were briefly examined showing the suitability of continued development of pit latrines and septic tanks. It was recognised that the intended sequence of planning reports were inadequate and so an additional report: 'Sanitation for Non-Sewered Areas', was produced.

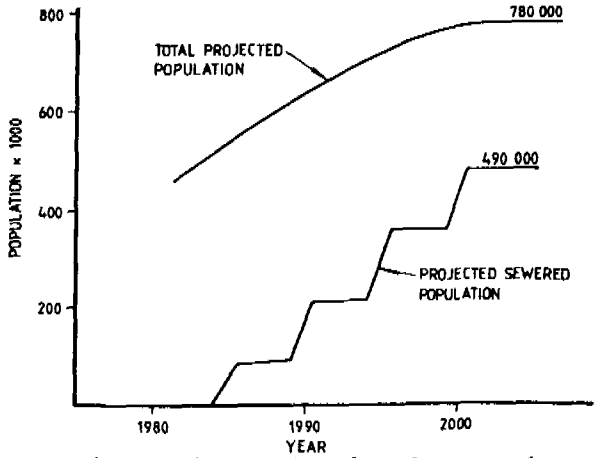

Figure 4. Projected total and sewered populations: Omdurman.

This report reviewed sanitation requirements including the need to improve septic tanks and soakaway design and their economic construction. The possible advantages of communal septic tanks were noted.

The report showed the need to provide economic safe pit latrines in the local social context, where for example men and women require seperated facilities. For implementation, it was considered necessary to strengthen and build on the established expereince of the public health officers; making changes gradually rather than immediately imposing new, locally untried, design and construction details.

A long-term programme of public education, advice and inspection was therefore proposed and costed in detail.

This programme would be preceded by a three year implementation project carrying out trials and training. After the first two years of the full-scale programme progress would be reviewed.

A preliminary draft was discussed in Khartoum with Public Health Education officers and local representatives of WHO and UNDP.

While every effort would be made to use Sudanese staff (at a salary level greater than government levels but far less than of expatriates) some imported expertise would be required. The initial three year implementation project is costed at LS 814 000 at 1980 prices. (The cost of minor sewerage for 28 hectares of a high class housing area with 144 plots.) (£1 = LS 1.9)

It was hoped that the long-term programme would serve up to 60 000 households at a running cost of some LS 2 per household. The programme would not pay for latrine construction, householders would still have to provide their own. However the implementation project would confirm designs for appropriate latrine substructures in affordable price ranges. Local builders and suppliers would be trained in the improved techniques and designs.

4.6 Project feasibility

The question of project feasibility is liable to highly contentious and 'political' interpretation. It embraces the questions of can, will and should a project be commissioned and paid for, and by whom?

The planning team can only state a limited number of possible actions and their likely financial implications for the nation, the sanitation authority or the consumer: others have to take the appropriate decisions.

In Khartoum there are a large number of consumers using a sewerage system for no effective charge and so there is, in theory, a large reservoir of potential useful revenue.

If all consumers including government offices commerce and industry pay a charge based on about 3% of household income; if this revenue can be collected and properly used; if aid agencies could be found to fund the project on low interest terms; and if the projected costs in local and foreign exchange prove accurate; then the master plan convential sewerage proposals for the two towns are probably feasible. Value judgements on the desirability of this are left to others.

5. CONCLUSIONS

5.1 Alternative priorities

The final emphasis of the project was on conventional sewerage; with low-cost techniques, stressing public health education as a supplement. An alternative approach to stress low-cost solutions with only essential conventional sewerage would have to have been decided before the Terms of Reference were prepared. Such a decision could still have been implemented by consultant engineers.

The resulting priorities would probably have been more difficult to satisfy and would have needed close co-operation between many different authorities. A longer study period might also have been required.

5.2 Role of the consulting engineer

At present while there is considerable emphasis on lower cost sanitation systems, the main body of established knowledge and experience of large scale sanitation is of conventional systems. This applies to engineers in both private and public sectors. Sanitation planning will increasingly demand

a multi-disciplinary approach. The future will show whether "engineers" have the training and ability to lead such projects. Firms of "consultant engineers" should have the necessary experience of using wide ranging expertise outside the resources of a single urban (or sometimes national) authority. Their experience of different problems and solutions should lead to a more efficient use of resources. By recognising the critical factors which in practice influence the results of planning projects suitable directions can be taken in commissioning new planning and design projects. The most valuable work will arise from long-term co-operation between international expertise and local knowledge, and not from short-term studies.

SIMPLIFIED DATA RESUME

POPULATION PROJECTIONS

	1973	1990	2000
KHARTOUM (Principal Area)	300 000	707 000	790 000
OMDURMAN	280 000	630 000	780 000
KHARTOUM (Southern Area)			535 000
			2 105 000
ADDITIONAL ILLEGAL POPULATION MAY BE EXPECTED			(400 000?)

AREAS

KHARTOUM (Principal)	110 km^2
OMDURMAN	105 km^2

POPULATION DENSITIES

RANGE (Gross)	55 PERSONS/HA TO 160 PERSONS/HA

PERSONS PER HOUSEHOLD

1973 (Census)	6.2
2000 (Estimate)	8.2

ESTIMATED INCOME DISTRIBUTION

% OF POPULATION	2	7	30	50	75
EARNING LESS THAN: LS PER YEAR	300	600	1200	1800	3000

PROJECTED CHARGING BASIS

2.5% TO 3.5% INCOME

SEWAGE FLOWS: RESIDENTIAL AREAS

DOMESTIC	125 LITRES/HD/DAY
ALLOWANCE FOR LOCAL INSTITUTIONS	15 " " "
ALLOWANCE FOR FUTURE INCREASE	10%
TOTAL	154 L/H/D

MASTER PLAN TO YEAR 2001

	CAPITAL WORKS COSTS LS X 10^6	POPULATION
KHARTOUM AND CENTRAL OMDURMAN	240	610 000
KHARTOUM AND FULL OMDURMAN	400	1 200 000

SANITATION PROJECT AND PROGRAMME

OBJECTIVES: RESEARCH; TECHNICAL IMPROVEMENT; EDUCATION; SUPPORT

	DURATION	COST
IMPLEMENTATION PROJECT	3 YEARS	LS 814 000
PROGRAMME	INDEFINITE	LS 135 000 PER YEAR
REVIEW	3 MONTHS	LS 60 000

STUDY TEAM

11 STAFF IN KHARTOUM FOR 8.5 MONTHS + LOCAL SUPPORT + VISITS + UK WORK

7th WEDC Conference: Water people and waste in developing countries: 1981

LOCAL INFLUENCES AND THEIR EFFECT ON THE CONCEPT AND DESIGN OF SANITATION PROJECTS

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J F Jackson — Associate, Howard Humphreys and Partners

INTRODUCTION

This paper considers the provision of improved sanitation facilities to major urban population centres in developing countries and endeavours to demonstrate the significant effect that local circumstances and influences have upon the concept and design of the projects entrusted to consulting engineers.

The first stage in any sanitation project comprises a review of the existing sanitation arrangements, technical controlling factors, demographic data, cost and availability of water, institutional arrangements, public health status and cultural/ethnic aspects. This review would be followed by an appraisal of development and economic planning within the project planning period and a clarification of the client's brief and the project's particular objectives. The concept and design of the sanitation scheme will be developed from this basic groundwork but it must be noted that the depth and scale of this work will be limited by the programme and monetary constraints imposed by the client.

Different technical, institutional, economic and cultural constraints are encountered in each major urban centre and there can be no single sanitation system or scheme which is suited for universal application.

In formulating the appropriate sanitation programme for a particular urban area, the consulting engineer may be severely constrained by local influences and the success of his project will depend upon his response to them.

This paper examines two projects in different locations and shows how the local circumstances and influences were reflected in the formulation of the particular project.

Case Study A demonstrates the role of the consultant where the circumstances, aspirations and resources of the population allow the consultant to pursue a conventional sewerage scheme through the traditional course of project report, detail design and preparation of contract documents.

Case Study B demonstrates the consultant's role when his task is to meet the objectives of the Drinking Water and Sanitation Decade which are to provide as many people as possible with an adequate and hygienic form of sanitation within the limiting constraints imposed by local resources and the availability of funds.

CASE A: SANA'A SEWERAGE AND SEWAGE TREATMENT PROJECT, YEMEN ARAB REPUBLIC

Project Area

The Yemen Arab Republic is a Muslim country which lies at the south west corner of the Arabian peninsula. Sana'a, the capital of the Yemen Arab Republic is an ancient city situated in the central mountainous region of the Yemen at an altitude of some 2250m.

The city has expanded greatly over recent years. The ancient part of the city has been described as "a living archaeology" and features multi-storey buildings built in stone and brick, and with narrow streets mostly unpaved.

Recent development features multi-storey offices and commercial buildings built with modern techniques, and residential areas where the buildings are either single or multi-storey. The architecture of the recent development has been blended with the ancient buildings, and there is a complete absence of squatter or shanty style dwelling places.

The population is currently estimated at about 200 000 and is expected to rise to about 500 000 by the end of the century.

Existing water supply

The traditional source of water for the people of Sana'a was from shallow hand-dug wells situated within the curtilage of properties. From about 1965 onwards, some wells to serve localised communities were constructed to a depth of about 150m using cable tool rigs. The supply from these wells was distributed by a limited pipework system or by tankers. The water consumption per head of population from the traditional source was put at about 20 litres.

The first stage of a new water supply project was inaugurated in 1978. This scheme featured the development of well fields to the north of Sana'a and included transmission, head works, distribution and house connections. The second stage is currently under construction.

Existing waste disposal

At the present time the city of Sana'a has no public sewerage system. Within the confines of the Old City, where in the past the water consumption per head has been low, the old buildings incorporate a form of internal latrine consisting of a chamber at street level, above which there are squatting areas. Urine and other waste waters are channelled to the outside wall of the building, and then to the street. Modern buildings, outside the Old City area usually enjoy a more plentiful supply of water and deep cesspool or septic tank sanitation.

Health conditions

In the absence of statistical documentation the only evaluation available in 1976, when proposals for sanitary improvements were formulated, was of a qualitative kind without an economic justification. Quoting from a report by Dr Lantini, who was a member of the Italian Medical Mission to Sana'a, the most commonly occurring diseases were:

(1) Parasitic, including amoebic dysentry, ascariasis etc.
(2) Dysentry, in all its forms and in all seasons was extremely frequent, and the consumption of antibiotics to combat it was enormous.
(3) Viral hepatitis was common in the expatriate community. Milder forms affecting the local community were probably not brought to the attention of a doctor.
(4) Trachoma affected between 60 - 70% of the school population.

The report concluded that the high incidence of diseases was attributable to the insanitary conditions prevailing.

Circumstances in Yemen Arab Republic

Though still a relatively poor country in economic terms, the Yemen Arab Republic has been able to attract much of the funding necessary to finance the development and social improvements to which her people aspired.

Public health projects, such as the Water Supply and Sewerage of Sana'a, were high in the order of priorities, and in 1973 a government body known as the National Water and Sewerage Authority was set up to administer the implementation of such projects.

A Preliminary Engineering and Feasibility Study, under the sponsorship of the World Health Organisation, was commissioned in 1974 and submitted in 1975. This report, prepared by Italconsult, had as its principal objectives the study, definition and planning of works required to effect a change from the rudimentary and inadequate sanitary methods with attendant health hazhards, to a modern system for collection, treatment and disposal to meet the socio-economic demands of a rapidly growing population.

The report concluded with the recommendation for a comprehensive water-borne sewerage sysyem and treatment.

These recommendations were adopted and various tariff studies have been carried out with the intention that the project should be self-supporting with revenue generated by the metered sale of water.

Procedure for implementation - consultants' role

The appointment of Howard Humphries and Sons as consulting engineers to the National Water and Sewerage Authority for the Sna'a Sewerage Project, was made in May 1976 following selection from proposals submitted in competition with other consulting engineers.

Funding for the project study and design stage of the project was provided partly from internal resources and partly from a credit from the International Development Association.

The duties of the consultant under the Terms of Reference of the Consultancy Agreement may be summarised as:

The preparation of a Project Report incorporating the following main features:

(i) A review of the Preliminary Engineering and Feasibility Study drawn up by Italconsult under the sponsorship of WHO.
(ii) Projected water demands and determination of expected per capita sewage flows, peak flows and pollution loads.
(iii) Definition of drainage areas, location of area pumping stations and the sewage treatment works.
(iv) Selection of sewage treatment methods and disposal of the final effluent and sludge.
(v) Preparation of outline designs and cost estimates.
(vi) Investigation of local stormwater flooding and proposals for remedial action.
(vii) Investigation of intermediate arrangements for the improvement of sanitary facilities in the areas of Sana'a not served by the initial stages of the sewerage project.

The preparation of detail designs and tender documents in accordance with the scope of works agreed by the Authority from the recommendations made in the Project Report.

Contract Works - Stage 1

The implementation of the construction stage

of the sanitation element of the project was conceived under three separate contracts.

Contract 1 - Supply of materials

Contract 2 - Civil engineering works

Contract 3 - Mechanical and electrical works

Contract 1 provided for the manufacture and delivery of the major offshore materials of construction such as manhole covers, pipes and steel reinforcement in advance of construction, thus taking advantage of available funding, and the avoidance of cost increases due to escalation.

Contract 2 provided for the construction of the civil engineering works associated with the sewerage system and treatment works.

Contract 3 provided for the procurement, delivery and installation of all the various items of works machinery and equipment under a single contract.

Tenders for all three contracts were invited from selected Contractors.

The funding of the capital cost of Stage 1 of the Sana'a Sewerage Project is provided jointly by the International Development Association and the Saudi Fund for Development with a contribution from internal sources.

The Stage 1 works will cater for some 50% of the present population where priority has been given to sewering the densely populated areas of the Old City. A further 50% of the present population , representing recent development, will be served under the Stage 2 works as soon as administratively convenient.

The project envisages a third stage in the development of the sewerage scheme as the City continues to expand. Pending the extensions of the sewerage system, drainage will be effected by septic tanks.

CASE B: DAR ES SALAAM

General background

Tanzania is a poor country, the gross domestic product (GDP) in 1977 being approximately Shs.1500 per capita (Shs.19 = £Stg 1). Between 1967 1nd 1977 it grew at an average rate of 4.5% per annum in real terms, however since the country's population increased by about 3.7% annually during the same period, real per capita growth in GDP increased by less than 1% a year.

Agriculture is still the dominant economic activity in Tanzania, accounting for almost 40% of GDP in 1977. However the gradual decline in its relative importance has been counteracted in recent years more by a growing significance in public administration and services rather than by growth in the direct productive sectors of the economy.

The city of Dar es Salaam is of relatively recent origin, having been founded in 1862. It is the commercial centre, largest city and main sea port of Tanzania. The relatively modern city centre has several multi-storey buildings and is surrounded by suburbs of traditional permanent housing. The rapid expansion of the city over the past two decades has been largely due to migration into the city from the rural areas of Tanzania and has resulted in the establishment of extensive squatter housing zones in the periurban areas.

The existing urban area and suburbs of Dar es Salaam are mostly situated on a gently seaward sloping plain dissected by old incised and filled valleys. The surface layer is of poorly graded sand and overlies materials of variable permeability creating a complex hydrological situation. The annual average rainfall in the area is 1100mm of which 50% occurs in the March-May period of the S E monsoon.

Population

Tanzania is a multi-tribal country and in the coastal region the population are understood to be Muslims. Within the regional boundary of Dar es Salaam the total population is currently in the order of 930 000 of which over 80% are African and the majority of the remainder are Asian. Some 10% of the total population resides in the rural areas on the fringe of the city. Population growth in Dar es Salaam has been at an average rate of 8.5% over the past 15 years which is over twice the national average rate for the period. The trend towards urbanisation in Tanzania is, however, still less intense than in many other African countries, and continued pressures on urban areas, and in Dar es Salaam in particular are expected to continue. The Sewerage and Sanitation Master Plan by Howard Humphreys and Partners prepared for Dar es Salaam was divided into four stages as follows:

Stage I	1980 to 1984 inclusive
Stage II	1985 to 1989 inclusive
Stage III	1990 to 1999 inclusive
Stage IV	2000 to 2010

The projected population distribution in conjunction with these planning stages are shown in Table 1. (see over).

Water supply and consumption

A major influence in the selection of appropriate sanitation facilities is the availability, use and cost of potable water. In Dar es Salaam there is an adequate quantity of water available from river resources and it is not foreseen in the project planning period that groundwater resources within the city boundary would need to be drawn upon. There is also a relatively good reticulation system and the majority of the population has ready access to a potable water supply point

TABLE 1 Urban population projections (thousands)

	1979		1984 Stage 1		1989 Stage II		1999 Stage III		2010 Stage IV	
	Pop	%	Pop	%	Pop	%	Pop	%	Pop	%
Existing Residential	794	93	888	75	958	62	1005	43	1028	30
- Planned	(316)	(37)	(371)	(31)	(412)	(27)	(440)	(19)	(453)	(13)
- Unplanned (squatter)	(478)	(56)	(517)	(44)	(546)	(35)	(565)	(24)	(575)	(17)
New Residential	-	-	208	18	461	30	1187	50	2180	64
Institutional	55	7	87	7	127	8	177	7	212	6
TOTAL	849	100	1183	100	1546	100	2369	100	3420	100

which for the lowest level of service comprises a standpipe serving a group of dwellings.

Four different levels of consumption for residential areas were determined in the Sewerage and Sanitation Master Plan Study for existing and future development areas and are set out in Table 2.

TABLE 2 Per capita domestic water consumption (litres/day)

Water Demand \ Stage	1979	St.I	St. II	St.III	St. IV
High	240	245	250	260	270
Medium	120	125	130	140	150
Low	60	65	70	80	90
Very Low	30	30	30	30	30

The above water consumption levels were applied to each existing or proposed development area of the city on the basis of the general residential character and income pattern of the area.

Existing sanitation

More than 80% of the population of Dar es Salaam is currently served by on-site sanitation systems. Pit latrines are the type most commonly employed and considerable design improvements can be made to provide a more hygienic, efficient and economic unit. The majority of latrines are of the standard type but mound latrines have been constructed in some of the areas where high water tables are experienced.

The small proportion of the population served by foul sewerage systems (approximately 12%) comprises the city centre where flows are discharged via a sea outfall. There are also a number of outlying areas where flows are conveyed to waste stabilisation ponds for treatment. The city centre system was constructed some 25 years ago but all other systems are of much more recent origin. Almost without exception the systems are in a poor state of repair and require urgent rehabilitation.

Less than 5% of the population of Dar es Salaam was found to have no sanitation facilities at all.

Public health aspects

A major benefit sought from any proposed sewerage and sanitation scheme is a reduction of disease levels in the community. There are three main groups of diseases which can be affected by improved sanitation: faecal-oral infections, mosquito borne diseases and schistosomiasis.

Faecal-oral diseases such as diarrhoeal diseases, infectious hepeatitis and most of the intestinal parasitic worm infections, notably roundworm (Ascaris) and hookworm are all experienced in Dar es Salaam. These are the classic diseases of the poorer and more crowded sections of a community and particularly of children in all hot countries. The chain of transmission starts with poor excreta disposal, and is compounded by poor personal and environmental hygiene and crowded living conditions.

The two mosquito-borne diseases of major importance in Dar es Salaam are malaria and filariasis. The vector of filariasis in Dar es Salaam is Culex quinquefasciatus which prefers breeding in polluted waters, especially when these are enclosed. Wet pit latrines, septic tanks and stormwater drains are particularly important sites as are poor sullage disposal practices.

Schistosomiasis, though a major problem within Tanzania, is predominantly a disease of rural

areas and as such does not greatly affect Dar es Salaam.

The scale of the problem of sanitation related diseases in Dar es Salaam is indicated by infant and child mortality (15% of children die before they are 1). Life expectancy at birth is less than 45 years. It was found that water-borne and water-related diseases in the study area affected up to a quarter of the population at least annually and that despite treatment the incidence of these diseases was increasing. There is always the danger of typhoid and cholera outbreaks as evidenced by the 1978 cholera epidemic.

Sanitation system selection

Criteria based on water consumption and population density were established in order to determine those areas of the city where foul sewerage was a practical system to instal. However, financial limitations and economic projections indicated that for the majority of the population the only feasible form of improved sanitation in the planning period would be a pit latrine of improved design. In order to determine the appropriate type and form that improved latrines should take a household survey was executed, based on ten representative areas of the city which were selected with the help of government public health officials. By this means sociological preferences could be determined and scope for construction improvements identified bearing in mind local construction techniques. A great deal of thought was given to the format of the questionnaire used in the survey. It was so arranged that householders merely had to answer yes or no or give a number or a date. In this way a large amount of information could be recorded in a relatively short time. The object of the questions was to provide information on the type of housing, method of excreta disposal, details of usage, emptying services, age of latrine, type of construction, personal preferences and dislikes.

It is important that local help be recruited for the execution of such a household survey and such help should be trained for the job. Teams should comprise personnel with public health and sociological experience. In Dar es Salaam we were fortunate to be assisted in the preparation of the questionnaire and the execution of the household survey by the Low Cost Sanitation Unit of the Ministry of Lands, Housing and Urban Development.

The survey results were analysed and produced some interesting and useful findings. The major local preferences and therefore influences on design were found to be:

(i) Each property to have its own latrine.

(ii) Latrine facilities to incorporate seperate units for male and female use.

(iii) Latrine superstructure to be large enough to permit washing or showering therein.

(iv) Water to be used for anal cleansing.

These factors and other minor ones derived from the analyses of the survey results were taken into account in the formulation of the designs of improved pit latrines.

Since the water supply in Dar es Salaam is from an external location it proved feasible to adopt a design of pit latrine from which the liquid contents could be permitted to leach into the surrounding soil with no detriment to the water supply and therefore to the public health of the community.

A key factor which influences the selection and design of a sanitation system is the ability of the local community to afford and maintain a selected system. In Dar es Salaam it was clear that great difficulty was being experienced in adequately maintaining the existing foul sewerage system, although this was partly due to past administrative problems and this clearly had to be taken into account in formulating any new proposals. In selecting the appropriate combination of sanitation systems great emphasis was therefore placed upon the need for extensive strengthening of the existing institutional structure and the engineering proposals were of the most straightforward form in order to both simplify maintenance procedures and to minimise costs.

In addition to working within the above mentioned constraints dictated by local influences it is necessary to consider the effects of future social changes as well as government policies such as those related to housing. The selected scheme must be flexible in order to allow for the upgrading of the sanitation project from its initially conceived form. Future economic developments are difficult to predict accurately and it is important in terms of optimising design and economising on initial construction costs that the design data adopted is reliable. This task could be assisted by the application of risk analysis as discussed in the paper of Lumbers and Harris (Ref 1).

Project implementation strategy

In Dar es Salaam the occurrence of diseases which improved sewerage and sanitation can be expected to reduce are the faecal-oral diseases and filariasis. In both cases health improvements will be small unless the improved environmental sanitation reaches all sections of the community. Three major tasks were recommended for implementation as the first stage of the phased Master Plan programme in order to obtain the maximum improvement to public health, namely:

- rehabilitation of existing sewerage systems and sewage treatment works.

- development of manpower and institutional capabilities to support present and future activities (including education) in the sector.

- installation of new sanitation systems.

For maximum impact these tasks had to be directed at works which would produce results in the shortest time and to the area of the city with the greatest health hazards.

Specific activities considered necessary in association with these tasks ranked in priority are as follows:

A - implementation of community health education campaigns.
  - rehabilitation of the pit latrine emptying service, and expansion to meet demand.
  - rehabilitation of existing sewerage systems and sewage treatment works.

B - installation of improved pit latrines in houses without any excreta disposal facility, or with poorly constructed traditional pit latrines.
  - installation of improved pit latrines in squatter upgrading areas.
  - installation of improved pit latrines in areas of high water table.

C - installation of improved sullage disposal systems in those areas served by pit latrines.

D - campaigns/assistance to promote the connection of houses with suitable water supplies to existing sewers.

E - installation of foul sewerage in areas already developed where problems exist with other forms of sanitation because of adverse ground conditions and where adequate flows can be attained to ensure self cleansing sewer operation.

F - expansion of existing foul sewer systems and pre-development installation of new systems to serve appropriate sections of new development areas.

Proposals are currently in hand to implement tasks A-E and the role of the consulting engineer is being finalised.

CONCLUSION

Each major urban centre in the world imposes its own highly individual constraints on the consulting engineer designing a sanitation project to meet its future planned needs. In addition to technical and monetary constraints, major influences on the selection of the appropriate scheme are made by the local factors attributed to the social and cultural background of the people.

Water borne sewerage remains a practical and economically viable solution to some particular circumstances but for the poorer and the majority of countries low-cost sanitation systems such as pit latrines offer a considerably cheaper but at the same time effective alternative to improving public health for the benefit of the majority of the people.

In the latter circumstances the role of the consulting engineer will undergo change. The circumstances of such schemes require the involvement of institutional support and project management staff accompanied by specialist advice from sociologists and health educationalists.

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Session 4

Chairman: Bill Moffat
WEDC Group member

Discussion

David O Lloyd

What role for the consulting engineer?

Mr LLOYD introduced his paper by saying that his prime aim was to promote some discussion on the role of the consulting engineer. This role was changing or wideningwithin a field that was so wide that specialisation was bound to occur.

2. Consulting engineers were generally active in two fields: giving advice based on their own experience; and the design, execution and supervision of projects. Most commissions tended to contain an element of each.

3. Seven years ago UK consulting engineers were responsible for overseas projects totalling £5000 million in value. Last year the figure was £39 000 million and the fees earned were £425 million. The public health sector accounted for between one fifth and one sixth of these totals.

4. Two issues arose from the definition of the consulting engineers' role as set out in the paper. The first related to the tendency for division of consultants' involvement between a number of firms on any single project and whether this was efficient in terms of manpower and financial resources. He did not think so. He believed that the multiplicity of firms involved led to duplication of design services and mobilisation payments, and an increase in overheads.

5. The second question was whether feasibility studies were always necessary. An example was given of a feasibility study undertaken for two towns in a central African state, which had been substantially destroyed. The study had gone ahead and would no doubt be produced as a glossy document. But the real need in those towns was for a few experienced engineers, mechanics and a plane-load of spares. Then the water and sanitation problems would be put right.

6. The solution was partly a need for a return to greater trust between the funding agents, clients and advisers/consultants.

7. The less conventional roles and projects were outlined as set out in the paper, and some pit-falls were pointed out.

8. With regard to the funding of projects, the speaker was puzzled as to why certain practices took place. He cited the example of a project which was internationally funded. The money was loaned to the federal government concerned at 1% interest. The federal government then loaned the money to the provincial government at 10%, and finally they loaned the money to the executing agency at 16%. On top of this customs duty was levied on all the plant brought into the country. The people who suffered from all these increases in costs were the low-income consumers who could least afford it.

9. A further example was given of the situation in another country where funds for consulting engineering services were taxed, so the consultants were in fact paid 68% more than the agreed fee so that the tax could be levied.

10. Mr LLOYD ended by saying that he believed that consulting engineers in general did realise that their role was to serve the needs of the world and not to remake it in their own mould.

11. Ms VINCENT agreed with the speaker's criticisms of feasibility and pre-feasibility studies. However they were not unnecessary and neither should they be reduced. Another problem was the frequent involvement of people who were not familiar with the country or area. In this case feasibility studies were useful in that they gave the consultants the opportunity to get to know the problems.

12. Mr LLOYD believed that consulting engineers who did not have knowledge of the area involved in a project should not be employed on it. The whole object of using advisers was that they could bring a wide experience not otherwise available to the project, so there was no point in using someone not familiar with the area. This would be a waste of money. Unfortunately the choice of people was often based on the lowest quoted price. Also he wondered whether feasibility studies were not often used by politicians as delaying tactics.

13. Mr DOWNEY wondered whether there should perhaps be a change of emphasis, when something went wrong with a project, away from blaming the consulting engineer involved, as so often happened.

14. Mr LLOYD agreed that he would like to see this change of emphasis. Often it was a string of circumstances which led to the failure of a project. This meant that greater trust was needed with more communication between parties involved. The present tendency was for compartmentalising of tasks in a project, a spin-off from the legalistic world in which we found ourselves. He would like to see the edges become more blurred and better mutual trust arise.

15. Mr BUKY pointed out that the World Bank had been working on a Project Preparation Handbook in which it was hoped to set out a uniform system of requirements and standards for the use of all the agencies involved in projects of this sort. He commented on the points raised by Mr Lloyd on the various interest rates charged on loans to countries. It was the policy of the World Bank and most other major funding banks that money was lent at concessionary rates to the country as a whole and not to individual executing agencies. These agencies had to be sufficiently financially viable to be able to borrow from their governments at the current commercial rate. The only hope for reaching the Decade targets was to recover the costs from the consumers. He also pointed out that none of the major funding banks employed consultants. The countries concerned did their own selection. The World Bank might reserve the right to review the qualifications of consultants proposed and if not satisfied as to their competence might withdraw the funds, but ultimately countries were responsible for their own choice of consultants.

16. Mr SSENTAMU was concerned that possibly consultants would not wish to be involved with small projects which could not afford to pay as much as a larger more prestigious project, and so it might be difficult to get experienced people to advise for these small projects.

17. Mr LLOYD said that no project would be overlooked, provided that the service could be given at a reasonable cost, and the firm had the experience and expertise required by the project.

Jack R Preston and Richard P Cree

Urban sanitation and planning in Khartoum and Omdurman.

Mr PRESTON began by showing a series of slides to illustrate the great contrasts in Khartoum between the rich and poor areas of the city. The main streets were seen to be in poor condition, dirty and pot-holed. Power supplies were unreliable with long cuts common, especially after the rainy season. Shortages of basic foodstuffs occurred frequently and and luxury goods were almost non-existant.

19. For a long time it had been the custom in the area for the people to provide their own sanitation according to their means.

20. Mr CREE described slides showing the septic tanks used in better-off areas. In some cases several houses would share a central very deep soak pit. Soak pits were up to 30m deep.

21. In the poorer areas pit latrines were dug by outside contractors, and these pits could also be very deep.

22. Mr PRESTON showed that sullage collection was basic and risky. Even in the better-off areas standards were poor, and the incidence of diarrhoea was high.

23. The established custom of self-help had led to many of the local professionals leaving the area to make their fortunes elsewhere, only to return later to establish better positions for themselves at home. This was evident in the expensive and lavish private development going on in the new suburbs. Pressure had come from these people for the extension of the sewerage system, rather than the provision of basic improvements to give sanitation to all. This led to the setting up of the project described in the paper.

24. Mr CREE showed slides of the new stabilisation ponds being constructed for Khartoum. These ponds were less than 1.4km^2 in area.

25. Mr PRESTON said that ideas of alternative sanitation had been injected into the terms of reference for the project, probably influenced by bodies such as WHO, however these carried little weight since those who could afford to pay wanted improvement for themeselves. Public funds for low-revenue projects were severely limited.

26. The consultant in this sort of situation was faced with a dilemma. The only solution to the problem was to try to put into good order that which existed, and to provide simple immediate benefit to the maximum number of households. Plans could be made for more costly improvements for construction when general prosperity rose.

27. These decisions had to be backed by financial initiative and this could only come from the consultant's client, or from specific requirements in the terms of the funding agents.

28. Professor MITWALLY asked whether there was any evacuation of the septic tank soakaway pits.

29. Mr CREE did not have any records of this but the pits were so deep that decomposition took place in them, extending their life considerably. However with increasing population and greater use of the septic tanks it would become necessary to give more thought and consideration to the improved use of septic tanks with smaller soakaways.

30. Mr PRESTON added that in fact the pits did not have to be as deep as they were for technical reasons. It was simply the established custom to dig them down to 'flowing water', and it might not be possible to convince people not to do this.

31. Dr NIMPUNO added that ten years ago he

knew that it had been a bye-law in Khartoum that pits must penetrate groundwater. He did not know if this bye-law still existed.

32. Mr CREE established that this did not still exist as a bye-law. The minimum depth required was 8m, but the usual advice given was to dig into the water table. This was a very strong local custom and the people preferred to dig down this far because they knew that there was a greater rate of decomposition under the water. Groundwater flowed from the Nile, and did not return to it until a considerable distance downstream. So the amount of pollutant entering the water table compared with the massive amount of water flowing through it was small.

33. Mr PRESTON pointed out that they had felt that although the cost of digging such deep pits was fairly high, it did give the householder many years without problems. Pits might last forty years or more so he did not have the problem of digging another in his small compound within a few years.

34. Mr HUTTON pointed out that there was a great fear amongst groundwater experts that direct flushing of excreta into groundwater should be avoided. After all someone further downstream might have a deep well and be pumping this polluted water out. This must be considered.

35. Mr CREE said that the authorities did take microbial samples, and sometimes closed boreholes where pollution was found to occur. However he agreed that not enough care was taken in some cases.

36. Dr NIMPUNO belived that not far outside Khartoum people were using wells for drinking water and so must have been taking polluted water. This pollution was not only bacterial but also contained nitrates.

37. Mr PRESTON answered that the majority of people in Khartoum had access to piped water, either through individual supplies or through public standposts. Most groundwater was taken from the main boreholes and it had already been said that these were controlled.

38. Mr CREE said the reports tried to make it clear to the authorities that more controls were necessary, and had suggested using shallower pits. But the present system worked well and was easily enforced and controlled. It would be difficult to change to a system which might not be so easily controlled. The consultants were aware of the problems of the system but it was necessary to see them in the correct context.

39. Dr BASU wondered whether the large stabilisation ponds seen under construction in the slides would be conventional ponds or whether aquatic weeds would be used to speed up the process. He gave the example of the water hyacinth which grew very successfully in such conditions.

40. Mr PRESTON explained that the consultants had not built new ponds but had adapted existing ones by altering the inlets and rearranging the ponds into primary, secondary and maturation modes. There had been no consideration of the water hyacinth. It was difficult to carry out experiments on these techniques as the only large amount of wastewater available for testing was in the north of the city and was to oily to be suitable.

41. Dr BASU thought that the technique should be given consideration in this case, as it could be very cost-effective. With a conventional pond it was not usual to get more than 70% stabilisation within three weeks, but when water hyacinth were used the rate was raised to 80% in one week.

42. Mr HUTTON asked what was the average cost of connection to the sewerage system. He also asked whether there were any plans to re-design the intake structures to work more efficiently as the load on the ponds increased.

43. Mr PRESTON said that the emphasis had been on rehabilitation of the existing system together with staging to take the minimum of sewage at first, for financial reasons. With regard to the cost of connection, it was difficult to estimate this, but was probably between £3000 and £5000 (Sudanese) per household, which was very high compared with about £1000 (Sudanese) for alternative sanitation.

44. Mr HUTTON wondered who would be expected to pay these huge costs.

45. Mr PRESTON again pointed out that the money was available, as was apparent in the new housing developments. The people wanted the sewerage system and were prepared to pay for it.

R B Harris and J F Jackson

Local influences and their effect on the concept and design of sanitation projects.

Mr JACKSON explained that he would deal with his work which had been concentrated in the city of Sana'a, a very old and economically poor area which attracted funding from its rich neighbours and elsewhere. His colleague would talk about Dar-es-Salaam, also very poor but not in such a fortunate position.

47. He described the geographical, social and political position of Sana'a. In 1974-75 a feasibility study was carried out, sponsored by WHO, to look at the existing water supply and waste disposal facilities and to suggest

improvements. The result of the study was the proposal for a completely new water supply for the city. Previously the water had been obtained from hand-dug wells and consumption was very low.

48. The waste disposal system was an interesting one. It was a system known as 'long drop latrines', which had developed as a result of the high density of population living in tall, multi-storey buildings. This system had worked well except where piped water supplies had been introduced causing a problem of overflow of wastewater into the streets. This overflow, together with seepage from overloaded septic tanks had caused pollution of the well water. What was needed was a completely new sewerage system with sewage treatment, and this was considered affordable.

49. Slides were used to illustrate the area and its problems.

50. Mr HARRIS described the contrasting situation in Dar-es-Salaam, a comparatively recent city which from the 1960s had suffered very rapid expansion due to influx of people from the rural areas. About 50% of the current population were squatters and the whole city was very poor.

51. The city centre had a separate foul sewerage system connected to a sea outfall. Twelve outlying areas were similarly sewered and drained to waste stabilization ponds. However, some 80% of the systems were currently inoperative and needing rehabilitation.

52. There was a good water source for the city piped from rivers outside. The reticulation served the majority of the population, the lowest level of service being a shared standpost. Never-the-less there was a high level of water-borne disease and infant mortality was also high.

53. Slides were again used to illustrate.

54. Mr BHATTACHARYA asked whether there was any blockage of the chutes in the 'long drop' system due to the small amount of water used.

55. Mr JACKSON replied that there were no problems of this sort. The size of the chute prevented any blockage. Solids simply dropped straight down the chute and no water was necessary to wash it down as in a normal flush toilet.

56. Mr RUNYERA wished to know who paid the collector to come and empty the chamber, since the multi-storey buildings seemed to hold several families in separate apartments.

57. Mr JACKSON pointed out that in fact it was usual for all the occupants of a building to be from one family, so there was no problem.

58. Dr NIMPUNO thought that what was really needed in this area was not a new sewerage system but a greywater system.

59. Mr JACKSON said that with the high consumption of water and density of population prevailing he considered that a proper system was necessary to deal with this. The final decision was probably a political one, reflecting the aspirations of the community. It was decided that a new sewerage system was required.

60. Ms ELLINGTON asked whether any effort had been made to encourage community participation in the squatter areas, or whether all services were brought in from outside.

61. Mr HARRIS answered that this had been encouraged and now there was community and political party involvement. A local team of professionals was being set up to assess the local needs and to motivate the people.

7th WEDC Conference: Water people and waste in developing countries: 1981

TREATABILITY OF RICE STARCH WASTEWATER

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INTRODUCTION

Production of starch in Egypt starts from low grade rice as a basic raw material. A major rice starch processing plant is located in Alexandria and is considered one of the major polluting industries at Moharrem Bey Industrial Complex (MBIC). This complex discharges all its wastes into the massively polluted Lake Mariut at the entrance to the city.

The wastewater generated at this plant originates mainly from two manufacturing processes, namely, the steeping process in which clean broken rice seeds are macerated in caustic soda solution for dissolution of proteinaceous matter, and the primary concentration process involving centrifugation of the milk of starch. The plant discharges 800 cu meter/day of concentrated organic waste(1).

Although biological treatment has been successfully applied to potato starch wastes(2) and corn starch wastes(3), Brebion *et al.*(4) noted markedly detrimental effect of potato starch wastes on a municipal (trickling filter) treatment plant. This contradiction in results could be attributed to the different loading conditions used by various investigators. Chemical coagulation of potato processing wastes using iron and calcium salts has been found effective in reducing the pollutional content of this waste(5). Protein recovery from potato starch wastes by multi-stage evaporation was emphasized by Stabile *et al.*(6), who recommended the use of recovered protein as animal feed.

This study was conducted in order to evaluate the potential for acidification, biological treatment and filtration of rice starch wastewater to reduce its pollutional content and recover reusable constituents for animal feed.

MATERIALS AND METHODS

Treatability experiments were conducted at room temperature (18-22°C) using a multiple treatment system consisting of two pH adjustment-sedimentation units, an activated sludge unit, and two filtration columns. The system was operated at different treatment conditions and its performance was evaluated based on solids and organic removal. The parameters measured daily included pH electric conductivity, solids, turbidity, biochemical oxygen demand, chemical oxygen demand, and sludge volume index. Some other parameters were determined occasionally such as sulfates, nitrates, phosphates and dissolved oxygen.

The experimental program comprised three series of experiments as shown in Figure 1. Basically, each series of experiments involved four consecutive treatment stages, namely: acidification to pH3 and sedimentation; pH adjustment to 6.5-7 with sedimentation; activated sludge treatment; and filtration. This scheme was typically followed in series I, but in series II different doses (1, 2, 5 mg/l) of a non-ionic polymer (Herclues 824.3) were added in the first treatment step, whereas in series III different doses (50, 100, 150 mg/l) of powdered activated carbon were added in the activated sludge aeration tank.

The experimental units used for pH adjustment and sedimentation consisted of two polyethylene tanks of 200 liters each. In the first tank, the wastewater was poured and acid (10% H_2SO_4 solution) was added to adjust the pH at 3, stirred for one minute at 120 r.p.m. to achieve rapid mixing and for 10 minutes at 20 r.p.m. to promote flocculation. The tank contents were left to settle quiescently for one hour after which the supernatant was discharged to the second tank whereas the precipitated starch was withdrawn at the bottom of the tank. To allow for further precipitation of starch and to render the supernatant suitable for biological treatment, the pH of the supernatant from the first tank was adjusted in the second tank at 6.5-7 while stirring as followed in the first tank.

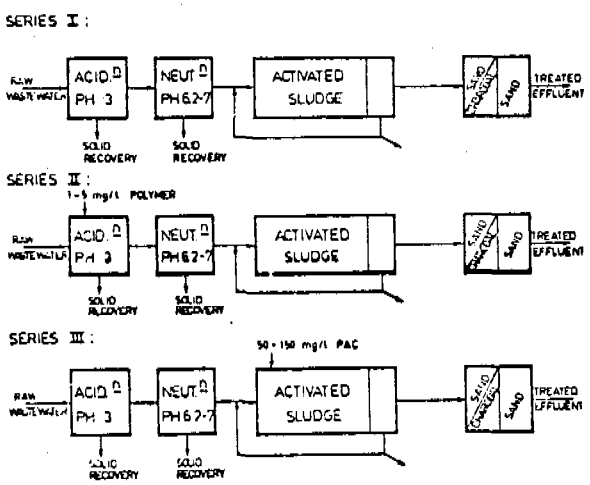

Fig.(1): SCHEMATIC OF EXPERIMENTAL MULTIPLE TREATMENT SYSTEM

The activated sludge unit consisted of a plexiglass rectangular tank of 120 cm length, 25 cm width, and 30 cm liquid depth. This unit was divided into an aeration compartment of 72 liters volume and a clarification compartment of 14.4 liters at the effluent end of the unit. The two compartments were separated by a sliding baffle adjusted to leave a slot opening at the bottom for the back flow of the settled return sludge. Intentional wasting of excess sludge was made to attain MLSS of 2000-3000 mg/l in the aeration compartment. The air flow rate was controlled to maintain 3-4 mg/l of dissolved oxygen in the aeration compartment.

Two filtration columns made of plexiglass were connected in series and used for final polishing of the activated sludge process effluent. The first column was packed with dual media of charcoal (1.1 mm particle size) and sand (0.45 mm particle size). The second column was filled with sand only (0.45 mm particle size). Each column had a total median depth of one meter.

Chemical and physical analyses were performed according to the Standard Methods for the Examination of Water and Wastewater(7).

RESULTS AND DISCUSSION

1. Wastewater Characteristics

Table 1 summarizes the average characteristics of the raw wastewater. In general, these characteristics varied slightly during the phases of study and daily variations were moderate. The raw waste is highly organic with a considerably high percentage of solids (about 82 percent) in the volatile form. The COD/BOD ratio of the raw waste averages 1.3 indicating that the waste is fairly biodegradable. This ratio was reduced during treatment especially after acification which shows that the majority of the organics in the colloidal form were removed.

The raw wastewater was relatively low in phosphate (1.8 mg/l of PO_4) and nitrate (2.3 mg/l of NO_3) content. These nutrient deficiencies of the waste were compensated for by the addition of phosphoric acid and ammonia solution prior to activated sludge treatment to attain the BOD:N:P ratio of 100:5:1 required for successful treatment.

2. Process Performance

Acidification to a pH value of 3 proved to be effective in solids and organic removals (Table 2). This particular pH value was adopted based on the results of a previous study(1) which showed best removals at pH3. The results summarized in Table 2 also indicate that subsequent adjustment of the pH of the acidified waste to 6.5-7 achieved further removals of solids and organics.

Considering the nature of colloids (quasi-hydrophobic-hydrophilic) present in the starch waste, it is postulated that acidification resulted in lowering the zeta potential and, to a certain extent, enhanced coagulation of the colloid. Presumably, the magnitude of the zeta potential of the hydrophobic colloid was reduced so that repulsive forces between particles are less than the Vander Waals attractive force. Thus coalescence of colloidal particles would occur and coagulation could be accomplished. This caused the destruction of dispersed colloids in the wastewater and led to their settling and reduction of suspended solids and organics in the suspended form.

Table 1
Raw Wastewater Characteristics
(Average Values during Experiments)

Series of Experiments	pH	Electric Conductivity Umhos/cm	T.S mg/L	S.S mg/L	V.S mg/L	BOD mg/L	COD mg/L	Turbidity NTU
I	6.5	1670	6421	4320	5265	3177	4220	1000
II	6.7	1600	7586	4927	6317	3406	4387	1261
III	6.3	1775	6394	4674	5587	4093	5246	1327

Table 2
Summary of Results of Acidification and pH Adjustment

	T.S	S.S	V.S	BOD	COD	Turbidity NTU
Acidification to pH 3:						
Treated Effluent Quality, mg/L	3853	881	2143	1153	1223	137
Overall Percentage Reduction, %	40.0	79.3	39.3	63.7	71.0	25.3
pH Adjustment to 6.5-7 :						
Treated Effluent Quality, mg/L	3596	678	1595	949	928	70
Overall Percentage Reduction, %	44.0	84.3	69.7	73.3	79.0	93.0

The additional reduction of these parameters through the readjustment of pH to 6.5-7 was probably dependent upon the isoelectric point of the hydrophilic colloids (e.g. proteins) at which minimum solubility occurs being in the range of pH 4.0 to 6.5 for the majority.

Addition of different doses of the monionic polyelectrolyte after acidification (series II experiments) improved the percentage removal of solids and organics (Figure 2) but a polymer dose of 1 mg/l gave the best results. However, addition of a higher dose of the polyelectrolyte than the indicated optimum (1 mg/l) did not bring better coagulation, this is probably due to restabilization or deflocculation of the colloid when excess polymer doses are used(1). In general, the high polymer cost does not justify the slight improvement in solids and organic removals achieved by polymer addition after acidification. Moreover, addition of polymer or other coagulants may alter the nature of the precipitate to be recovered as an animal feed.

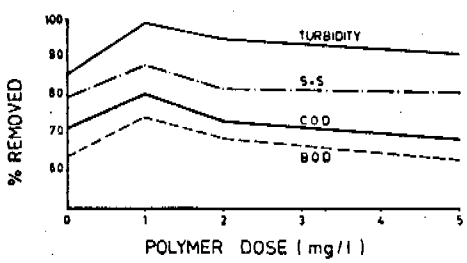

Fig.(2): EFFECT OF POLYMER ADDITION ON ACIDIFIED WASTE CHARACTERISTICS

The performance of the activated sludge process was evaluated at different hydraulic detention times in the range of 8 to 15 hours which correspond to organic loadings in the range of 0.18 to 1.2 kg BOD_5/kg MLSS-day. The results

obtained (Table 3) indicated that a significant portion of the organic constituents in the wastewater were removed during biological treatment. Approximately 96 percent of the BOD and 95 percent of the BOD were removed during the best operating periods.

Table 3

Effect of Biological and Filtration Treatments on Starch Wastewater

Operating Parameters:				
kg BOD/kg MLSS-day	0.18	0.6	0.9	1.2
Hydraulic detention time, hours	15	12	10	8
SVI, ml/g	66	90	120	175
Percentage removal of the successive treatments				
1. Activated sludge system				
BOD	96.0	93.0	83.0	70.3
COD	95.1	91.2	82.0	68.5
2. Multi-media filter				
S.S	46.0	49.0	50.0	52.0
BOD	35.0	36.0	35.0	37.0
COD	40.0	42.0	38.0	43.0
3. Sand filter				
S.S	31.0	33.0	34.0	36.0
BOD	12.0	13.0	13.0	17.0
COD	18.0	19.0	20.0	22.0

The BOD results fitted fairly well (Figure 3) the kinetic model suggested by Eckenfelder(8) which relates the removal rate of BOD to the effluent BOD concentration as follows:

$$\frac{So - Se}{X_a t} = KSe$$

Where: So = influent BOD concentration, mg/l
Se = effluent BOD concentration, mg/l
Xa = mixed liquor volatile suspended solids concentration (MLVSS) mg/l
t = hydraulic detention time, days
k = BOD removal rate coefficient, L/mg/day.

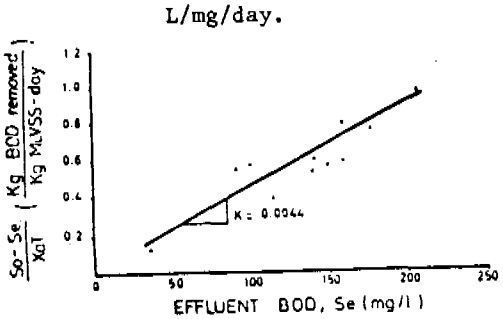

Fig.(3): BOD REMOVAL KINETICS

The BOD removal rate coefficient (k) obtained is 0.004 at a temperature of about 20°C ± 2°C. This coefficient is comparable to values reported for sewage(11) indicating that the waste was fairly biodegradable.

The BOD removal percentages were plotted against the parameter $X_a t$, as shown in Figure 4. Detention time (t) was corrected by MLVSS in the aeration tank during different experimentations. Figure 4 clearly indicates that higher organic removals were obtained at longer detention times.

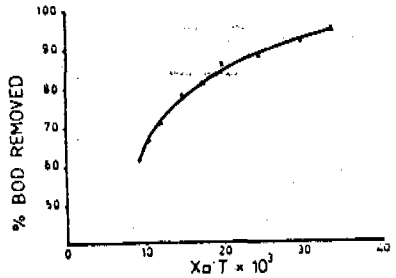

Fig.(4): BOD REMOVAL CHARACTERISTICS

Acidification, in addition to its effect on starch precipitation, could have resulted in partial solubilization by hydrolysis of the colloid remaining in the acidified effluent fed to the activated sludge process. The hydraulized substrate was presumably more readily uptaken by the process microorganisms.

Figure 5 shows the effect of organic loading (F/M ratio) on BOD removal efficiency and on sludge settleability as indicated by SVI. Lower organic loadings resulted in higher BOD removals and better settling characteristics in the range of loadings studied. As expected, the higher loaded systems bulked and developed dispersed organisms that did not settle well. As the loadings were increased higher than 0.6 kg BOD/kg MLSS-day the system performance deteriorated drastically. This corresponded to hydraulic detention times of less than 12 hours in this study.

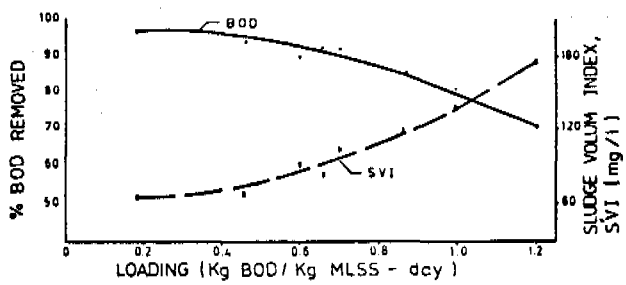

Fig.(5): PARAMETER RESPONSE TO ORGANIC LOADING

In a trial to improve the activated sludge system performance operated at a high organic loading of 1.2 kg BOD:kg MLSS-day, PAC was added to the aeration tank at doses of 50, 100 and 150 mg/l. Addition of PAC improved the system performance considerably as shown in Figure 6. The organic removal efficiency was increased with the increase in PAC dose in the studied range. Also, the sludge recovered its good settleability. Figure 6 shows that percentage COD removals were higher than dose for BOD removals, indicating better removal of non-biodegradable organic matter after PAC addition.

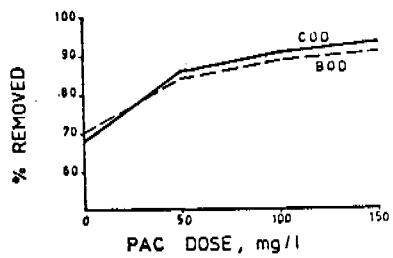

Fig.(6): EFFECT OF POWDERED ACTIVATED CARBON ON ORGANIC REMOVAL IN THE ACTIVATED SLUDGE PROCESS

The use of filtration for polishing of the activated sludege process effluent proved to be effective (Table 3). The first dual-media filter column adsorbed and retained most of the remaining organics and solids escaping the activated sludge process through adsorption/filtration. The second sand filter retained further suspended solids escaping the first filter. Up to 100 percent reductions in turbidity were achieved after filtration. However, in field applications, the problem of filter back-washing must be considered.

3. By-Product Recovery

One of the objectives of this research was to recover a saleable by-product from the starch wastewater to be used as an animal feed. The solids precipitated by acidification and pH adjustment can be further dried and processed for a cheap animal feed. Experiments conducted in this study showed that about 70 grams of dry solids were recovered per liter of acidified waste. This means that the rice starch processing plant under study would produce about 56 tons of dry solids daily.

CONCLUSIONS

Based on the results of this study the following conclusions can be made:

1. Acidification of the rice starch waste to pH3 effectively reduced the solids and organic content of the waste. Further adjustment of the pH to near neutralization achieved additional solids and organic removals and rendered the waste suitable for activated sludge treatment. Overall removals of SS, BOD and COD were 87%, 78% and 80% respectively.

2. The rice starch waste is amenable to activated sludge treatment. However loadings higher than 0.6 kg BOD_s/kg MLSS-day resulted in drastic reductions in process performance and led to sludge bulking. Up to 96 percent of the BOD and 95 percent of the COD were removed at optimum loading conditions of 0.2 kg BOD_s kg MLSS-day.

3. Reasonable activated sludge system performance attained at higher organic loadings when PAC doses in the range of 50-150 mg/l were added to the aeration tank.

4. Double stage filtration, using charcoal sand and sand filters, proved to be an effective polishing treatment for the activated sludge process effluent. Total removals of 98 percent each of SS, BOD and COD can be achieved through this multiple treatment system.

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MEMBRANE TECHNIQUES IN EFFLUENT DISPOSAL ALONG WITH WATER/CHEMICALS RECLAMATION

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INTRODUCTION

Although three-fourths of the Global surface is filled with water, 99% of the water is nor accessable for direct human consumption, 97% being confined to seas, another 2% being fixed-up as ice-caps in the polar regions. With much of this available water, which constitutes hardly 1% of the total Global water, being impaired due to unrestricted disposal of domestic and industrial effluents, water supply is fast becoming one of the costliest resources to sustain the industrial growth in most of the developed and underdeveloped countries of the world.

The most single deficiency in conventional waste treatment systems, based on biological or chemical conversions, is the inability of these systems to reclaim water for reutilization.

Moreover, none of these conventional waste treatment systems are addressed to the removal of inorganic solutes which contribute to the degradation of the surface or groundwater, and may inhibit the use of the water.

Against this background of grave industrial pollution, coupled with acute scarcity of water, extensive exploratory research, and engineering studies have been undertaken during the last two decades, on the development, and application of membrane technology-Electrodialysis (ED), and Reverse Osmosis (RO) - for the reclamation of water and useful chemicals, along with pollution abatement from industrial effluents in Pulp & Paper (Ref.1 - 6), Dairy (Ref 7.), Electroplating (Ref 8), Food processing industries (Ref 7.), and saline water (Ref. 9). RO and Ultrafiltration techniques as a cost effective device have been suggested by different researchers as a tertiary aid in conventional waste treatment systems for the elimination of toxic and bio-refractory pollutants from the secondary effluents along with water receovery for recycling (Ref.10).

A large quantity of wash effluents (around 25 m^3/hr per spinning machine) are generated during spinning process which remain a big pollution hazard surrounding Rayon industries. Conventional waste treatment process (based on lime preparation) requires high capital investment, with high operating costs due to non-recovery of sodium and zinc sulfates from the spinning wash effluents.

Techno-economic feasibility of $Na_2SO_4/ZnSO_4$ concentration and recovery from admixture in dilute solutions by RO technique has been suggested by several researchers recently (Ref.11, 12).

An attempt has been made in this work to demonstrate the applicability of RO technique in treatment of Rayon industrial effluents, major objectives being to evaluate the techno-economic feasibility of pollution abatement, along with water/chemicals reclamation for recycling, from spinning process wash effluents.

EXPERIMENTAL PLANNING

Spinning wash effluent was obtained from a Rayon manufacturing plant at Kalyan near Bombay for experimental work with the following analysis:

pH	-	1.50
TDS	-	30,000 mg/l
SS	-	1000 "
Na_2SO_4	-	15,500 mg/l
$ZnSO_4$	-	250 "
H_2SO_4	-	3250 "

Initial experiments were carried out in test RO loop with an effective area membrane surface of 41 cm^2 supported on porous stainless steel (Fig.1) for the evaluation of membrane performance, with respect to feed pH, solute concentration, and flow velocity on permeate flux rate, solute rejection, concentration ratio, and permeate recovery at different pressures ranging from 25 to 60 kg/cm^2.

Further experiments were carried out on a tubular RO set-up (active membrane surface area of 2450 cm^2) at the DEED Lab of the Bhava Atomic Research Centre (BARC), Bombay, with three different types of membranes,
i) Cellulose

Diacetate(CDA) from BARC , ii) CDA from CSMCRI, Bhavnagar, India, and iii) Thin film composite aromatic polyamide (PA-300) from UCP, USA.

Based on experimental data obtained with test RO loops(flat and tubular), a spiral wound RO module (capacity= I.50 lit permeate/min) was designed, fabricated(in collaboration with Permionics, Baroda, India), and standardized at the Chemical Engineering Department, IIT, Bombay.

Experimental flow-sheet diagram(connecting both the test loop and the spiral wound modules) is depicted in Fig.2.

As shown in Fig.2, pressure was regulated by a spring loaded SS back pressure regulating valve installed in the concentrate stream. Flow was controlled by adjusting the needle valves BVI and BV2. The system, at start-up, was slowly pressurized, and depressurized at shutdown, by operating the needle valves BV2 on the by-pass line. The concentrate and the permeate were recycled back into the I00 litre capacity HDPE feed tank, during experimental run.

A triplex plunger Pump (PT 8I/60 manufactured by the Speck of W.Germany) having rated capacity of I5 lit/min at discharge pressure of I20 kg/cm^2 was used. A conductivity meter , calibrated against the range of compositions expected, was used to measure the stream concentrations in terms of TDS.

Conceptual design features of the spiral wound RO module is depicted in Fig.3, and the details presented as follows :

Size of the module	- 8.30 cm ϕ X 60 cm length
Active membrane area	- 2.80 m^2
No. of membrane leaves	- 2

Dimensions of membrane leaves

= 55 cm width X I50 cm length.

Module is housed in I0 cm diameter 40 schedule seamless M.S pipe of 60 cm length.

Membrane components:

Membrane	- CDA
Mem. support sheet	- woven polyester cloth
Permeate channel	- melamine formaldehyde impregnated polyester.
Concentrate channel	- 200 mesh HDPE net I.I2 cm thick.
Module wrap	- PVC tape
Product(permeate) tube	- PVC I.25cm tube diameter.

RESULTS AND DISCUSSIONS

Fig.4 represents flux decline results with untreated effluents (without pH adjustment) using CSMCRI membrane, which indicates pronounced flux decline due to fouling effects. Permeate flux and solute rejection % is found to be higher when feed pH is increased above 3.

Therefore, further investigations were carried out with pH adjustment to 4.80 followed by cartridge filtration whereby all suspended solids more than 5 μ could be removed from the feed. Feed pH could not be kept above 4.80 because of Zinc precipitation.

Experimental results depicted in Fig.5 indicates, that, permeate flux rate is above 0.60 m^3/m^2/d (I5 gfd) and solute rejections (Na_2SO_4 and $ZnSO_4$) are higher than 97 % over the pressure range 40 - 60 kg/cm^2, PA-300 membrane providing best performance.

Zinc rejection is found to be above 99% with less than 4ppm appearing in the permeate at 60 kg/cm^2.

As presented in Fig.6, permeate flux rate, and solute rejections are adversely affected at higher level of permeate recovery.

When RO module is operated at above 60 kg/cm^2 pressure under minimum permeate recovery conditions, permeate quality is found to be below 200 ppm(with Zn^{++}content less than 4 ppm (Fig.7), which could be recycled back to the spinning process washing.

Na_2SO_4 concentration in the concentrate could be reached to the level of I6% under optimal conditions of RO treatment, and therefore complete recycling of permeate and concentrate streams appears to be technically feasible, according to the flow sheets presented in Fig. 8a, and 8b.

Reclamation of salts (Na_2SO_4 and $ZnSO_4$) and reusable water from spinning process wash effluents, along with abatement of pollution problems by RO technology,is expected to give considerable amount of socio-economic benefit to Rayon industries.

Further Work is in progress to evaluate long range membrane performance data at elevated temperatures in a spiral wound I5 lit/min RO plant (pilot unit), to confirm the operational data presented in this Work.

ACKNOWLEDGEMENT

One of the authors(SM) offers his grateful thanks to the authorities of IIT-B for giving him PG Scholarship for M.Tech Dissertation, a part of which is presented in this Work.

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INSTALLATION AND OPERATION OF A NIGERIAN ANAEROBIC DIGESTER BASED ON CROP WASTES.

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DR K ADESOGAN Dept. of Chemistry, University of Ibadan, Nigeria.

INTRODUCTION

The generation of inflammable gases from organic substances by the 'works of nature' has been observed for centuries and many famous names have shown interest in these gases including Volta, Davy and Pasteur. These gases have been known by many names from the strange Will-o-wisp' lights sometimes seen over marshland to the more down to earth name of sewer gas often used in the water industry. What ever it is called (I prefer Biogas) the gas which is generated by the anaerobic fermentation of organic material is a mixture,with carbon dioxide and methane as its major components. Table 1 shows the typical analyses of such a gas and the properties of its components.

It has long been the hope of scientists and engineers to harness this natural degradation system to produce a useful fuel while conserving any valuable fertilizer components that exist in the original material. It has only been during periods of crisis that the western world has utilised these systems and during the second world war many 'digesters' were built throughout Europe. With the cheap and readily available fuel of the late 50's and the 60's the interest in small scale energy production units went into a decline.

Table 1. Composition and Properties of Biogas.

Property	CH_4	CO_2	H_2S	Typical biogas
% by volume in typical biogas	54-80	20-45	0.1	100
Energy value (kcal/litre)	9.0	-	-	5.4
Explosive range (% by vol.with air)	5-15	-	4.46	6-12
Density (g/litre) 0°C 760mm	0.72	1.98	1.54	1.22
Specific gravity (relative to air)	0.55	1.5	1.2	0.93
Critical temp. (°C)	-82.5	+31.1	+100.4	
Critical press. (Atm.)	45.8	73.0	88.9	
Odour	None	None	Rotten egg.	

Anaerobic Digesters however, carried on their development along two major routes. Firstly as a pollution control route for sewage and indutrial wastes. Secondly as a means of material and fuel conservation for small village and town units in developing countries. More recently the higher prices being charged for fuel has revived the interest for digesters on European farms and a bewildering range of digester designs are presently available for a farmer's selection.

BASICS OF METHANE FERMENTATION

The generation of methane from organic matter is achieved by the use of naturally occurring (fairly ubiquiteously too) micro-organisms. These create one of natures alternative routes to conventional aerobic decay.

Where insufficient air is available to breakdown natures wastes a whole series of anaerobes (bacteria which exist without oxygen) step in. If the temperature is sufficient this degradation can be carried as far as the production of methane.

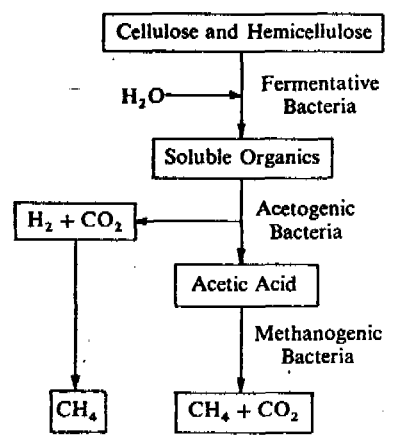


FIG. 1. Anaerobic fermentation of organic solids.

The process is not a simple one and is made up of many differing groups of organisms but can be most simply shown as a three stage process. (see Fig.1). Firstly the cellulose and hemicellulose is broken down to smaller more soluble organics by fermentative bacteria. Next acetogenic bacteria set to work producing acetic acid, other fatty acids plus hydrogen and carbon dioxide. Finally the methanogenic bacteria take both fatty acids and the carbon dioxide/hydrogen mixture and produce methane and carbon dioxide.

Each of these stages is equally important and all the groups of bacteria have to have their needs satisfied otherwise instabilities set in. On the whole each stage satisfies the other so that the only parameters which have to be controlled are temperature and feed rate.

FACTORS AFFECTING METHANE PRODUCTION

In real life many factors affect the production of methane by anaerobic digestion.

However usually only a few of the parameters need to be controlled or monitored. The complete breakdown of material anaerobically takes from 10 to 20 days at a temperature of 30°C therefore the flow rate through the digester is an important factor which has to be controlled.

The other factor which has to be controlled is temperature. In normal (mesophillic operation) conditions this means that the temperature has to be maintained between 30 and 40°C. To optimise the gas production it is best that the temperature be controlled to within 1°C at any selected temperature in the above range. Fig. 2 shows the effect of both temperature and retention time upon the gas yields from a digester. In this case the results are for sewage but similar curves are exhibited on most raw materials.

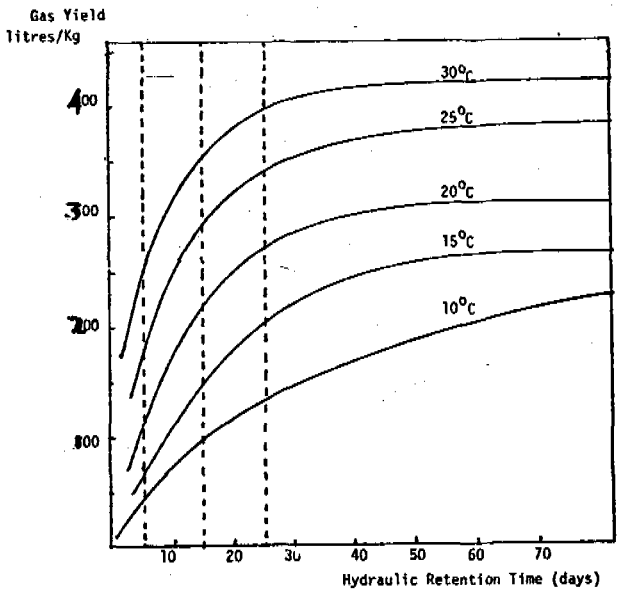


Fig.2. Gas Yields Versus Retention Time.

One parameter which usually cannot be controlled is the raw material. Table 2 shows the typical composition, gas yield and calorific value of biogas produced from the batch digestion of a range of different materials. As can be seen the gas yields can vary quite immensely as can the percentage methane. Some of the plant leaves giving the best results, both in quantity and quality of gas produced.

FERTILIZER VALUE OF THE RESIDUES

Biogas has one major advantage over other forms of fuel production from waste, it does not eliminate nitrogen. All the nitrogen in the original material remains there. Table 3 shows the typical effect of digestion upon a piggery waste.

As can be seen almost 50% of the solids are converted into biogas. Almost 80% of the fatty acids which are to some extent responsible for the bad odours of many wastes are also removed.

Table 2. Gas Yields from Various Substrates.

Organic matter digested	Specific production (litres/kg organic)	% CH in digester gas	Calorific value (MJ/m³)
Dairy cattle waste	315	80·2	28·8
Cattle waste	342	75·5	27·0
Pig waste	415	80·8	28·9
Wheat straw	367	78·5	28·1
Wheat straw 3cm	383	80·2	28·8
Wheat straw 0·2mm	423	81·3	29·1
Clover	445	77·7	27·9
Grass	557	84·0	30·2
Turnip leaves	496	84·0	30·1
Sugar beet leaves	501	84·8	30·3
Potato stems	606	74·7	26·7
Maize stems	514	83·1	29·8

Reference: Rheinhold and Noak.[1]

The Oxygen Demand of the waste whether measured by chemical or biological means is significantly reduced while the nitrogen level does not change. Therefore most suitable organic wastes may be converted into a useful less odorous and less polluting irrigation/fertilizing slurry by anaerobic digestion.

Table 3. Characteristics of Input and Output of Digester.

	Ten-day detention		
	Input	Output	% Reduction
Total Solids (%)	4	2·2	45·0
VFA (ppm)	5226	1113	78·7
NH_3N (ppm)	2122	2171	Nil
BOD (ppm)	21055	5333	74·7
COD (ppm)	72480	41938	42·2
Gas/kg TS added		0·300 m³	

Table 4. Composition of Input and Output of Digester.

	Input (% DM)	Output (% DM)
Ash	14·0	15·4
Protein N (Protein)	3·2 (20·0)	4·1 (25·6)
NH_3N (NH_3)	2·1 (2·6)	2·7 (3·3)
Fat	13·7	9·4
NDF	45·2	41·3
P_2O_5	3·6	6·0
K_2O	1·1	1·4
ADF	23·6	25·6
Lignin	8·1	11·8

NDF = Neutral detergent fibre. Cellulose, hemi-cellulose and lignin.
ADF = Acid detergent fibre. Cellulose, lignin.

Table 4 shows that there is an increase also in protein content of the solids in the digester effluent. This is being closely investigated around the world as a possible source of animal feed.

Anaerobic digestion has one other 'grace'. The temperature and length of time required to produce methane also reduces the population of many pathogens. See Table 5.

DIGESTER TYPES.

As mentioned earlier there are a staggering variety of digester designs available around the world. It will be useful if I describe three types of digesters which are more numerous than most.

Table 5. Survival of Pathogenic Bacteria during Anaerobic Digestion.

Bacteria	Digestion No.days	Removal %	Remarks.
Endamoeba hystolytica	12	<100	Greatly reduced populations at 20°C.
Salmonella typhosa	20	92	85% reduction in 6 days retention.
Tubercle bacilli	35	85	Digestion cannot be relied upon for complete destruction.
Escherichia coli	49	<100	Greatly reduced populations at 37°C about the same reduction in 14 days at 22°C.

(a) The 'High Rate' Digester:- This is the digester which is most accepted in Western Europe and U.S.A. To be classified as 'High Rate' it requires to be a heated and stirred reactor. Many different designs are available, Figure 2 shows but one. These type of digesters have been built at many thousands of sewage works as secondary sludge treatment units. They are also becoming increasingly popular with large farmers.

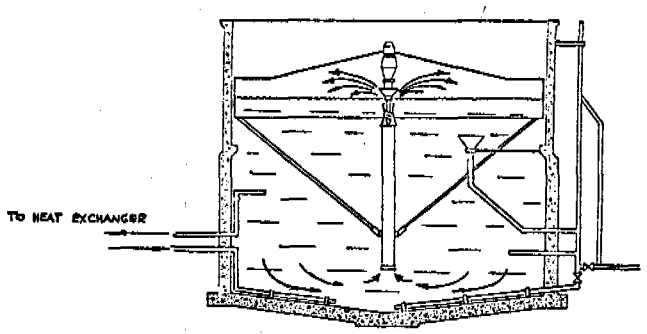
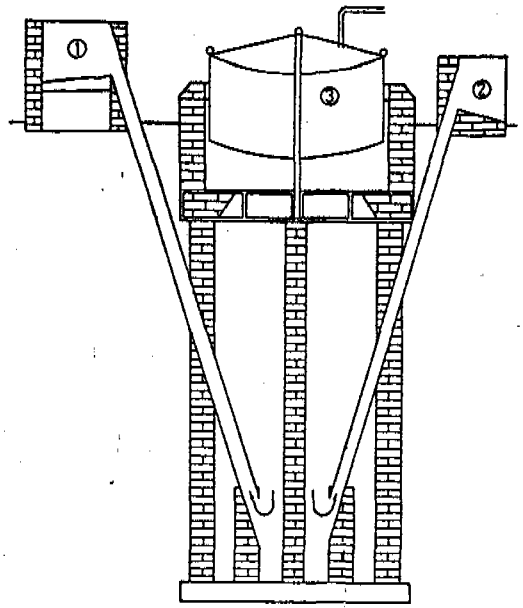


Fig. 2. The 'High Rate' Digester.

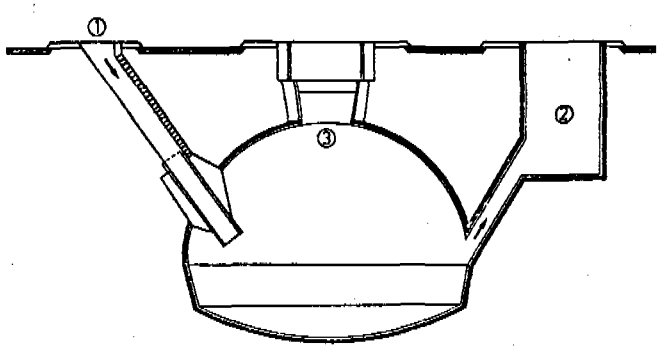
(b) The Gobar Gas Digester:- This type of digester has been designed specifically with rural India in mind (see Fig.3). It is a displacement type digester where cattle waste is added at one side and the effluent overflows at the other. In most of these type of digesters there is an integral gas holder built on top of the digester. Their sizes range from 4m³ to 140m³ and are usually constructed from brick with a metal gas holder. Most are fed with a mixture of cattle dung and night soil. Presently over 70,000 of these plants are reported to be in operation most being backed by government aid, though the plan is seen as a political failure mainly due to the amount of capital required per digester.

Fig. 3. The Gobar Gas Digester.



(c) The Chinese Digester:- These are operated on a semi-continuous basis being fed once a day. The digesters are usually constructed from concrete and bricks. The suspended solids tend to accumulate in the main body of the digester and have to be dug out two or three times per year. It is claimed that there are seven million of these digesters in operation of sizes varying from 6 to 8m³ (see Fig. 4).

Fig. 4. The Chinese Digester.



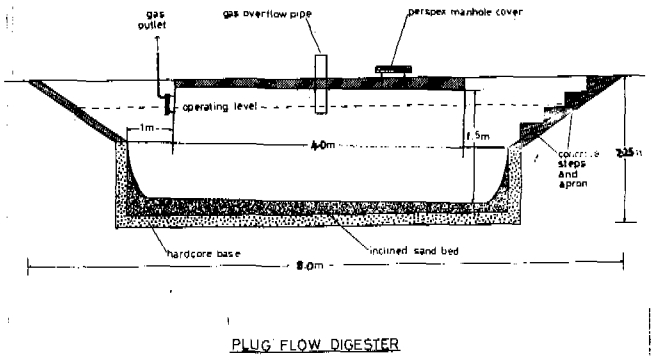
THE DESIGN OF A DIGESTER SUITABLE FOR NIGERIA.

The University of Ibadan decided to build up a University Consultancy Group and one area that this group found to be of particular interest was anaerobic digestion, especially for the production of electricity in rural areas.

The organic feedstocks to be investigated are based upon crop wastes and will be supplemented by night soil and/or animal wastes. In that way local wastes can be converted into fuel and fertilizer while minimizing water losses and assisting with sanitation problems.

The type of feedstock envisaged is likely to be suitable for a digester designed for high solids, i.e. above 10% by weight, therefore the mixing has been minimised. The local high ambient temperature also minimizes the amount of heating required. The daily temperature variation however suggests that insulation could be important. The digester decided upon therefore a horizontal 'plug flow' type of digester as shown in Fig. 4 made of a fibre glass sewer pipe (in this instance but could be made of any local material.)

Fig. 5. The Plug Flow Digester



PLUG FLOW DIGESTER

Mixing and heating will be carried out by means of a mild steel pipework within the digester which can be rotated by chain and pulley whilst hot water is pumped through it. The digester will be installed in the ground so giving natural insulation from daily temperature changes.

The gas will be piped from the digester to a fibreglass gas holder and then through a gas scrubber to remove the CO_2 and on to a small electrical generator.

Three $3m^3$ digesters have been shipped to Ibadan from Cardiff at the time of going to print, and are due to be installed and commissioned during the month of July.

The digesters will work in parallel on different wastes and will hopefully demonstrate the suitability of this type of digester for power generation. The final figure, Fig. 6, gives an artist's impression of the proposed research facility with storage clamps on the right for digester feed solids and fertilizer sludge bays on the far right of the three digesters.

These three digesters when in optimum operation should be able to produce 10 to $20m^3$ of gas per day, i.e. 250 to 500 HJ of energy per day. If converted to electricity at a conversion rate of 30% this will give 2 to 4 Kwh for 1 - 2 hours every day plus 150 to 300 HJ of hot water per day.

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Ref. 2. Stafford, Wheatley and Hughes.
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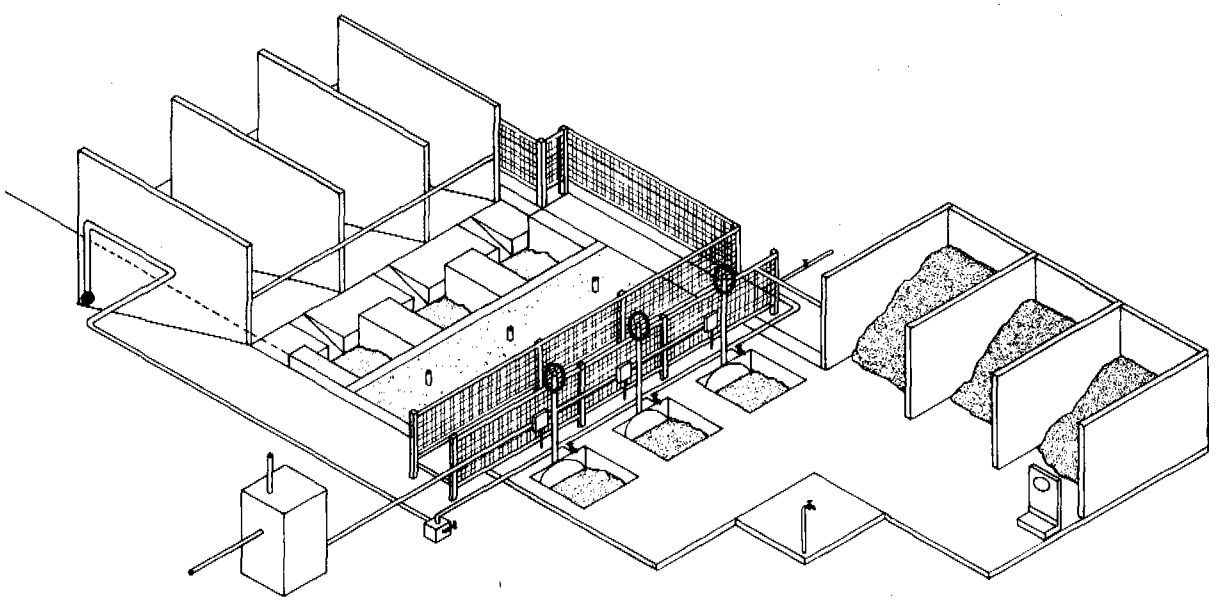
Fig. 6. Arists's Impression of the Anaerobic Digestion Research Facility at Ibadan.



Session 5A

Chairman: Ken Ellis
WEDC Group member

Discussion

Dr Ahmed Hamza, Dr Fathy Hamoda and Dr Samia Saad

Treatability of rice starch wastewater

Dr HAMZA outlined the acute industrial waste problem in Egypt. One million cubic metres of effluent was being discharged to the Mediterranean sea and other waters every year, with 67 000 tonnes BOD annual discharge.

2. Slides were shown to illustrate the Abu Kier Bay area and the appalling conditions produced by the industrial waste discharge. In most cases there was no pre-treatment of material before discharge. Many plants had a common sewerage system which discharged into the lake.

3. The law required a maximum BOD concentration of 80 mg/l, and maximum COD of 60 mg/l. This had never been enforced and was constantly violated due to lack of manpower, finance, monitoring etc.

4. A paradox existed in that the government owned and operated the plants, but the monitoring agents operated through the government and the law could only be enforced by the government. The plants relied on industrial subsidies from the government to keep running, and produced only marginal profits.

5. The problem was one of public awareness. The feeling seemed to be that as there was plenty of water available there was no immediate danger. More obvious problems were considered more important.

6. Now the University had been given a grant to survey the plants and to suggest appropriate re-cycling systems. Examples were given of three different schemes for starch wastewater treatment as outlined in the paper. Good results were being obtained in the studies.

7. Dr BASU asked how such a large amount of rice-straw waste could be discharged to the Mediterranean.

8. Dr HAMZA replied that there was no recovery in this case. There was now co-operation with the german government to try to find a solution to the recycling of caustic soda.

9. Dr BASU knew of the german package for a soda recycling plant which had been given to Algeria. The Alexandria plant was an old plant and he wondered why they did not have a similar package.

10. Dr HAMZA explained that Algeria could afford this type of solution but Egypt had to find a more realistic and practical solution.

11. Mr OTIENO could not understand why it was not possible for reasonable discussion to be proposed with the government to try to combat the problem.

12. Dr HAMZA said that they were trying hard to persuade people of the dangers. Industry was already convinced but foreign aid and government help was essential before anything could be done.

13. Dr SAAD, a co-author of the paper, said that a great effort had been made to convince the members of government committees, but they did not have a realistic view of the situation and seemed to have too many other things to think about.

14. Mr OBADINA commented that without the grant the University people could not have carried out their experimental work. He wondered why they did not set up a University consultancy service. This would make them independant of outside funding.

15. Dr HAMZA replied that they had tried this but all foreign aid had strings attached. Foreign aid was essential for projects to be set up and agencies tended to want their own consultants to be used. It was probable that costs incurred by the University would be recovered if the experimental plant was eventually installed.

Dr S Basu and Sumit Moulik

Membrane techniques in effluent disposal.

Dr BASU explained that the membrane technique described in the paper meant that pollution control could be integrated with a recycling method so making it very cost-effective. In developing countries pollution was often not considered to be major problem, but in his opinion it should be.

17. An outline of the basic technique was given illustrated with slides. Dr BASU pointed out that the technique had great potential, not only for industrial wastewater treatment but also on a smaller scale for simple desalination of drinking water in rural areas.

18. Mr PHAROAH asked how long the membranes could be expected to last.

19. Dr BASU said that in the prototype RO module the cellulose acetate membrane life was evaluated to be around one year. However new non-cellulose membranes were under

development which could last up to three years under more drastic conditions.

20. Mr OTIENO wondered whether the technique was really suitable for rural use.

21. Dr BASU was sure that the hand-operated model described would certainly be useful in rural areas for the treatment of brackish water.

22. Mr OBADINA asked whether the technique was adaptable for large amounts of water.

23. Dr BASU gave an example of one desalination project where up to 100 million gallons of water could be treated every day.

Barry I Wheatley, S E Etheridge and Dr K Adesogan

Installation and operation of a Nigerian anaerobic digester based on crop wastes.

Mr WHEATLEY began by giving a description of the process of anaerobic digestion as took place in the digesters described in the paper.

25. He said that the method had several advantages when used for waste disposal. He listed these as being: reduction of bulk, reduction of putrescibles to an innocuous form, BOD reduction, no loss of nutrients, significant pathogen destruction, production of gas and finally simplicity. The materials needed were simple and could often be found locally.

26. A study had been made to try to find a suitable type of digester for use on a small scale in rural areas. A simple digester had then been constructed from fibreglass based on a large diameter sewer pipe, with paddles to help disperse scum.

27. Slides were shown to illustrate the installation of the digester on a test site in Nigeria. Three digesters were used in the tests to experiment on different mixes of waste material. As a demonstration the gas produced was used to generate electricity.

28. Mr RUNYERA asked whether the method could be used for the disposal of nightsoil.

29. Mr WHEATLEY explained that this had been one of the major aims of the project - to produce a rural digester to take agricultural wastes and nightsoil. Pathogen destruction was good so there was no reason why it could not be used for this purpose.

30. Dr BASU asked about the costs of the system.

31. Mr WHEATLEY explained that the demonstration model built of fibreglass was expensive. It had cost between £800 and £1500. But he was not advocating the use of a specially-made unit like that one. The idea was to design a digester that could be made from local materials.

32. Mr OBADINA asked how failures of the digester were dealt with.

33. Mr WHEATLEY pointed out that failure of a small tank such as the one he had worked on was usually due to the material input. Monitoring was necessary to keep a check on whether the mix was producing the wrong results. One great problem with digesters was the build-up of scum, but this would be partly alleviated by the use of paddles.

34. Mr OBADINA said that he knew there was a digester in use at the nearby hospital in the area where the demonstration model was installed. He wondered why no mention of this had been made.

35. Mr WHEATLEY said that he was not aware of that digester until he arrived in the area. He had not been able to see it but he believed it to be a conventional one designed for use with sewage. Their concern had been to produce a digester of novel design which would be suitable to take green material as well.

7th WEDC Conference: Water people and waste in developing countries: 1981

ORGANISATION DEVELOPMENT

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Introduction

In order to complete a task which is beyond the capabilities or resources of a single individual it is necessary to develop some kind of organisation. The supply of water to, or collection and disposal of waste from communities are the sort of tasks requiring organisations. When these tasks are defined in more detail, for example the quantity and quality of water to be supplied to a community within defined boundaries, they are termed the definitive objectives of the organisation. Water supply and waste disposal organisations have a second objective which is to survive and this is sometimes not adequately considered. If an organisation is set up to design and/or to construct specific works only, then the survival objective will not be relevant. In order to achieve its objectives the organisation carries out activities with resources which it either acquires or already possesses. The resources may be divided into three categories: physical, time, human. The physical resources required will differ considerably depending on the organisation objective. The possible utilisation of time will also vary. The human resource is consistently the raw material of organisation structures and is probably the most variable and difficult resource to use. In addition to people within the organisation there are people outside who will be affected by and who may influence the organisation's activities.

Organisation structures

Various organisational structures can be illustrated diagrammatically, the simplest form being an authoritarian structure whereby one individual makes decisions on the utilisation of resources, and possibly also on objectives. Diagram 1 illustrates a simplified form of authoritarian structure. The manager may be answerable to shareholders or similar interested parties but executive control and power is wielded by the manager.

When the scale of operations grows so that effective control by an individual becomes impossible the organisational structure must be changed so that the organisation and the manager can survive. A manager should have foreseen that a change would be necessary, and should have considered the available options. In this way any changes will be planned and therefore likely to be successful and suitable to the circumstances. Haphazard changes or improvisations are less effective than planned changes. One option available may be to extend the authoritarian system by appointing a manager to develop his own authoritarian network in individual functions or services. This would result in a number of almost separate units reporting to the general manager who would no longer exercise the same detailed control of the functions as previously. This is shown in diagram 2. Further growth involves the preparation of a great deal of very varied information for use by the managers. This can often be done most effectively by special supporting staff, thus leading to a third possible structure as shown in diagram 3. Another alternative would be to develop very specialized seperate groups as shown in diagram 4, which could be used by contractors or consultants working on water supply or waste disposal projects. A development of this structure would use a project control section. This section would be responsible for projects, which may involve specialists from several other sections. On completion of the projects the specialists would either move to other project teams or return to specialized work within their own section.

People in organisations

Organisation structures can only exist and operate if there are people able and willing to fill the different roles within the organisation. A role not shown on any of the previous simple diagrams is that of policy making. The policy makers or governing body are not concerned with the day to day operations of the organisation. The General Manager is responsible for ensuring that daily operations are in accordance with the policy adopted by the governing body. There may be cases where people undertake two roles, for example the General Manager may be a member of the governing body and at the same time has executive responsibilities. Other examples of dual roles may occur; the manager of a water testing laboratory may also advise a waterworks manager on water treatment. Care is needed to ensure that there is no misunderstanding about the role in which

actions are taken. Every individual in an organisation has their own view of what their role is, or should be, within the organisation. These views will be affected by an individual's abilities, personal objectives and attitudes to colleagues. Consequently the actual organisational development may not be as neat and simple as an organisation diagram implies. All managers have certain powers associated with their position; these may be enhanced or diminished because of personal character, expert knowledge, control of a resource or control of information; factors which may be possessed by non-managers, thus giving some power to influence actions which would not normally be associated with their role. In addition to people in the governing body and managerial positions there will be those directly concerned with production and others concerned with supplying services to the production and managerial groups. In water supply and waste disposal organisations this means quite a wide range of abilities are required from professionally qualified to unskilled manual workers.

People outside the organisation

Groups outside an organisation who may exert some influence on development and activities include politicians, customers, suppliers of services or resources, government departments and Trade Unions. In the case of water supply and waste disposal organisations which are generally government sponsored, the politicians can probably influence the resources available. Customers will often exert pressure on political representatives or may affect the acquisition of resources by withholding payments. Suppliers may affect procedures because of the quantity or quality of their product or because of their commercial practices. Government departments' activities may increase the need for water supply or waste disposal or make the acquisition of foreign resources difficult. Trade Unions can affect procedures, staffing levels and remuneration levels. As the individual members of these external groups develop and change, the interrelationship between the groupsalso will change and may result in organisational changes.

Constraints on organisational development

Water supply or waste disposal organisations cannot develop if there is a reduced demand for their services due to large scale emigration or other causes. Alternatively development is difficult when there is a shortage of people with adequate training and education to fill all the roles in the organisation. This sort of problem may be solved by redistribution of tasks or in the setting up of training facilities. The latter course may generate new problems in obtaining resources and people for training programmes. Other constraints may be due to geographical and climatic factors, for example there are physical limitations on the development of island or desert communities. Communication and provision of resources may be restricted by snows, floods, forests or mountains. Wherever such constraints occur special provisions and possibly training will be necessary for the continued effective operation of an organisation. Communications are an important aspect of any organisation; the successful completion of any activity is dependant on communications. Potential communication difficulties may arise from differences in education, use of technical words, use of slang words, dialect, language or lack of understanding of the means of communication. Communication of information on the availability, quality and location of resources is as important as communication on activities. Communication deficiencies could therefore affect the obtaining of resources.

Finance is necessary for obtaining resources such as power, equipment or people. Therefore any restriction on the availability of finance could prevent or defer obtaining the necessary resources for achievement of objectives. Development of an organisation requires finance in order to acquire the additional physical and human resources essential to growth.

Co-ordination with other authorities concerned with water use or waste generation may impose a constraint on organisation development, particularly when there is legislation defining government departments to be consulted.

Example of a rural water supply authority

The formation of a rural water supply authority or a waste disposal organisation can mean developing a completely new organisation where none previously existed. The following details derived from a rural water supply authority development illustrate the application of some of the points discussed previously. The full development planned to be completed in twenty five years would consist of about 3200 new works of various sizes. About 7% of the new works would involve an extension of 50% or more to existing municipal waterworks. The new authority should design and construct the new works as well as operate them after construction. The legislation setting up the authority required that it be an autonomous body and also required co-operation and co-ordination with various concerned government departments at two levels. The provision of water supplies to a large number of rural communities being the purpose of the new authority, it was considered most suitable that the management of these numerous

waterworks would be the executive backbone of the organisation. The large number of works meant several management levels would be required and this afforded an opportunity of ensuring the required co-operation with government departments. An expansion of the structure shown in diagram 3 was evolved for the ultimate 25 year development programme. The resulting diagram of the executive chain and corresponding government levels is shown in diagram 5.

A maximum span of management of six is obtained with this arrangement. In addition to the executive chain there would be a need for staff to deal with operating data, performance monitoring, quality testing as well as accounts budgetary control, wages and administration necessary at each level to Area Manager. Planning of new works and monitoring the progress of a 25 year Master Plan was included in the staff work at the Chief Executive's office and at each Regional Director's office. The staff work at individual works would usually be handled by one clerk. In addition to staff various services would be required. A Director of Technical Services would control workshops, transport, supply and stores, and building maintenance. Due to the large programme of works to be undertaken a project construction department would be necessary and a seperate training department also would be required. These were also regarded as services to the executive and staff. The total staff required for the ultimate organisation would be approximately 39 700 and the population to be supplied would be just under eight and three quarter millions. The government had decided on the construction period of 25 years but any change in the construction rate would affect the organisation development. The construction programme was split into five five year plans. The organisation development was split into three phases, first the Feasibility Phase, second construction phase build-up, and thirdly construction phase run-down.

During the Feasibility Phase conducted by the embryo staff at the Chief Executive and Regional Director's offices the work consisted of planning projects and training. The assistance of expatriate consulting engineers was obtained in order to prepare design standard manuals which would facilitate future design work. Mobile laboratories were also used to take samples and examine the quality of sources. Some officers transferred from government departments where they had obtained relevant experience but many technical officials had little previous experience. Consequently the initiation of good training facilities will be very important; in some categories it has been possible to arrange with existing outside institutions to provide training. One problem, which is common to many countries is that on completion of training some people will leave the organisation for better paid work elsewhere. The training facilities need to allow for this sort of wastage.

During the construction build-up phase the organisation's own workforce would not build up to the level necessary to complete the full construction programme. The excess load would be undertaken by contractors. During the first construction phase the experience in construction will help to determine whether more use should be made of contractors for future construction. When the construction rate is reduced in the second construction phase there will probably be a need to switch some staff from design and construction to operation work. The development of workshops, stores, laboratories and vehicle fleets will be finalised in the second phase.

The periods of change when construction rate is increasing, when commissioning work is at its peak and when construction rate is declining are periods when there is a tendency to incur unnecessary labour costs. Care will be needed in forecasting the staff needs during these periods of change. Good judgement will be required in deceiding when it is necessary to create a District Office or an Area Office.

The professional, scientific and managerial staff would be recruited from urban areas but the majority of manual workers, whether skilled or not, are to be recruited from the rural communities. In these communities almost half of the population over the age of twenty are illiterate and this may impose constraints on the operating procedures and require special training facilities. In some areas the local education authorities are able to assist in helping to teach employees to read and write. The provision of incentives may be necessary to encourage employees to learn to read and write.

Having decided the numbers and categories of staff needed an investigation was made to ascertain whether the numbers were likely to be available to the organisation. The professional categories such as engineers, chemists, geologists and bacteriologists appeared to be being trained in adequate numbers. There appeared to be a potential shortage of accountants during the early years of the organisation but the educational institutions were preparing to increase the numbers of accountancy students. Technical sub-professional categories such as surveyors, laboratory technicians and draughtsmen are not likely to be produced in adequate numbers for some years and shortage of these categories could cause acute problems.

No difficulty is envisaged in recruiting suitable people for administrative posts. Training in the organisation's procedures would be necessary. Technical and administrative supervisors could also be a problem area; it may be possible to attract

competent supervisors from other organisations or, more likely, the training of apparently suitable people will be undertaken by the organisation. There may be difficulty in assessing craftsmen until examples of their work have been seen because of a lack of standard for most craftsmen in the country. There will be no problems in recruiting semi-skilled workers who would undergo training in the organisation. There may be difficulty in providing the training. There will be a shortage of managers, both operational and constructional, but management training facilities exist.

The early years of the organisation have followed the predicted development reasonably well. Modifications and adjustments will occur at every stage but having an overall view of what is eventually required will enable the effect of changes to be assessed more easily. The actions and interactions of people in the organisation help to determine the way in which the organisation develops. Organisations sometimes seem to have a life of their own, but like growing children, their development is influenced by the people associated with them.

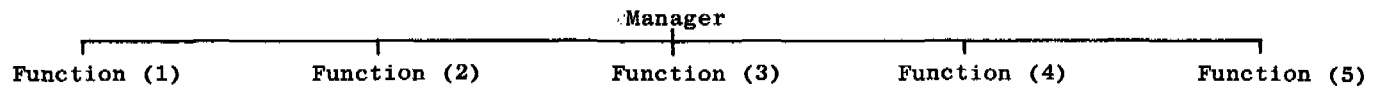

DIAGRAM 1

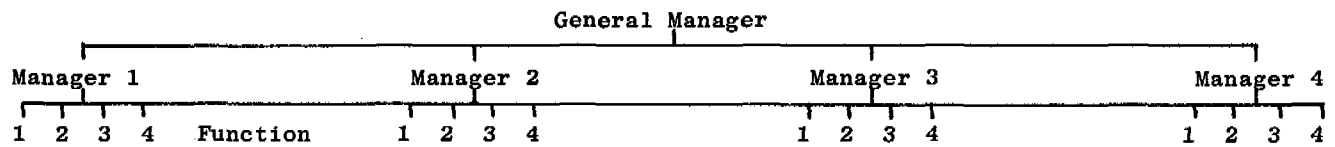

DIAGRAM 2

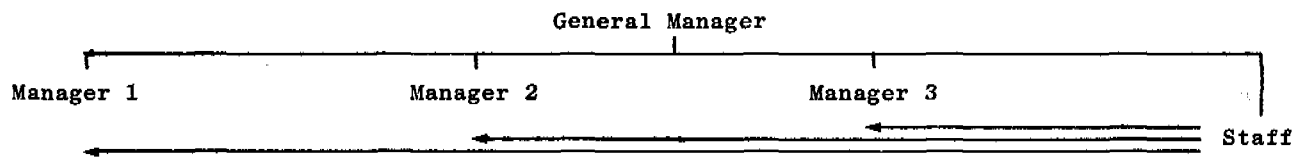

DIAGRAM 3

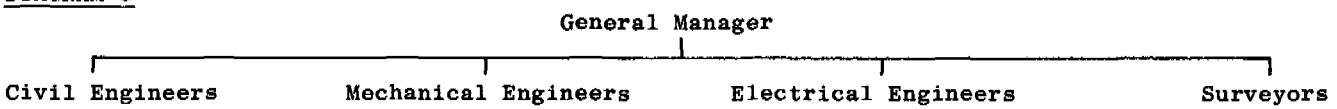

DIAGRAM 4

Government level	No of Govt Offices	Water Authority	No of Water Offices
Minister	1	Council and Chief Executive	1
		Regional Director	3
Province	16	District Manager	16
Provincial Sub-Division	96	Area Manager	96
Sub-Area	277		
		Works Manager	550

DIAGRAM 5

7th WEDC Conference: Water people and waste in developing countries: 1981

"THE PREHISTORY OF PUBLIC HEALTH - WATER AND WASTE IN THE ANCIENT NEAR EAST"

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Introduction

Techniques of water management and the problems of providing and maintaining sources of clean water for both households and communities have a long history in the Near East. Without the evolution of patterns of behaviour which helped to preserve public health, the widespread sedentarisation which preceded and accompanied the establishment of early farming communities would have been impossible (refs. 1 and 7). The existence of settlements lasting several centuries shows that some of the problems of public health could be met and controlled within tolerable limits, even though there is also evidence from both early villages and early urban centres that originally high standards of hygiene could deteriorate with time, leading to the abandonment of sites or acceptance of lower standards of public health.

Components of traditional domestic water use can be traced back to Neolithic farming villages of 9-10,000 years ago, while fully developed town planning including sophisticated systems of water engineering designed to support urban communities began to appear by 5,000 years ago. However, the difference between village and urban water systems is largely a matter of the scale on which water was diverted, obtained and stored and the size of the labour force which could be mobilised, as the hydrological techniques varied surprisingly little.

Archaeological evidence of public health and patterns of waste disposal and water use can provide case studies of the ability, or even inability, of human communities to provide and maintain water resources over a period of several centuries, as well as illustrating the range of adaptations to local hydrological conditions which is possible using a simple traditional repertoire of skills and tools.

Public health in the early villages of the Near East

Features of traditional water use in the Near East which were developed in the Neolithic villages of c. 10,000-7,000 years ago include digging canals or wells to supply water to settlements and using ceramic containers for domestic water storage.

While canals would have increased crop yields, the economic benefits of irrigation would have been partly offset by the increased incidence of schistosomiasis which is endemic to irrigation projects. Although the earliest direct evidence of schistosomiasis at present comes from Egypt c.1250-1000 BC (ref. 2), it is probable that schistosomiasis has been endemic in human populations exploiting marshy environments from the Pleistocene onwards.

Establishing permanent settlements in the immediate vicinity of permanent water sources would have enabled early sedentary communities to exploit the relatively rich food resources of well-watered environments, but would also have exposed the inhabitants to a greater incidence of water-related diseases. Without careful attention to domestic hygiene and ensuring a good supply of unpolluted drinking water, there could have been a relatively high incidence of gastroenteritis contributing to mortality, especially during summer months when water would be in critically short supply and of poor quality (ref. 3: 103-10). Forms of skeletal pathology attributed to chronic gastroenteritis and malaria have been diagnosed in both adults and infants among early Neolithic farmers of the eastern Mediterranean and western Asia settled near marshes and permanent sources of water (refs. 4 and 5). Although the skeletal sample is probably too small to be of significance, a lower frequency of skeletal pathology was noted in prehistoric groups inhabiting dry environments away from springs and permanent sources of water (ref. 4: 762).

Water-washed diseases, particularly diarrhoeas, are one of the major human health hazards (ref. 6: 12-13). Indirect evidence of a significant part of the household water budget being devoted to domestic hygiene is found in the scrupulously clean plaster floors which are found in early Neolithic houses of the 8th-7th millennia BC at sites such as Jericho and Çatal Hüyük. Rubbish from meals and household activities was swept and washed off the plaster surfaces of these floors, which extended part way up to the base of the walls, facilitating waste water runoff, and frequent cleaning with water could lead to the leaching of the underside of these floor plasters (ref. 7: 335). Such carefully plastered floors are often lacking in later Neolithic households from the second half of the sixth millennium BC on, and were generally replaced by mud floors, although some culturally conservative sites, such as Byblos,

founded in the middle of the 6th millennium BC, continued to plaster house floors. Elsewhere in the Near East at this time there is much greater likelihood of finding domestic refuse caked on mud floors, suggesting that standards of domestic hygiene may have deteriorated, with an accompanying increase in water-washed diseases.

However, the suggestion that standards of domestic hygiene in later Neolithic villages may have deteriorated needs to be qualified, as an important innovation in sites from the 6th millennium BC on is the existence of permanent wells, which enable individual families and separate residential quarters to have access to their own private water supply and avoid depending on surface water sources which are more liable to pollution. Such wells which could provide water in quantity for both drinking and washing are a feature of late 6th millennium BC settlements in Mesopotamia, and contemporary sites in the Levant are often located in areas with easily tapped sources of permanent groundwater where wells were probably also a feature of village subsistence.

Provided the well head is protected from pollution, and sewage is not discharged into the groundwater in the vicinity of the well, high quality water could have been obtained from such wells, and it is possible that trial and error led to the development of ad hoc public health standards. In normally permeable soil, such as the clay of an occupation mound, wells which tap groundwater deeper than 12 m should be free of bacterial pollution (ref. 8: 336). The need for wells to exceed this depth may have been recognised in the late 6th millennium BC at Tepe Gawra and Arpachiyah in northern Iraq where wells 15 m deep have been found.

Another Neolithic innovation of lasting significance for public health was the use of ceramic containers which could hold water beginning around the second half of the 7th millennium BC. In addition to holding drinking water, domestic water jars could also be used to keep an alkaline solution of ashes from the hearth which could be used to wash dishes and laundry, following traditional Near Eastern village customs. However, open containers in households also provided a new breeding ground for the Aedes aegypti mosquito, which carries filariasis and yellow and dengue fevers. In the Mediterranean, this mosquito is totally dependent on the man-made environment provided by storage jars and discarded containers (ref. 9: 295), and was probably one of the unintentionally domesticated species produced by the Neolithic revolution.

One answer to the problem of avoiding water-related diseases was to avoid settling at permanent water sources and instead to rely on journeys to springs to obtain drinking water. At the early Neolithic site of Beidha in southern Jordan, for example, the nearest spring is 5 km away, but water for laundry and stock-watering could have been obtained from seasonal pools and shallow wells in nearby valley floors.

Another option was to avoid sedentarisation, and some groups probably chose to remain mobile, either as hunter-gatherers or livestock herders. After 6000 in Palestine and Syria there is a temporary break in sedentary occupation on many sites which may reflect a widespread reversion to nomadism. Although the boundary between settled and nomadic life has often fluctuated as a result of social and economic choices as well as in response to micro-environmental changes, one factor in the persistence of nomadism in the past which should be taken into account is the existence of groups aware of their lack of resistance to the various water-related diseases endemic to settled populations. A parallel may be drawn with recent Arabian nomads who avoided contact with towns and farms because of the fevers they experienced when camping too near densely populated well-watered areas (ref. 10: 477). Where standards of village hygiene have deteriorated in the past it may be suggested that the option of nomadic life would have proved attractive.

Nomadism enabled encampments of variable but generally modest size to exploit widely dispersed seasonal surface and groundwater catchments where the relatively brief association between humans and water sources would inhibit the transmission of water-related diseases dependent on a permanent reservoir of human carriers such as a village or town could provide. In addition to avoiding some pathogens associated with settled life, poor hygiene and permanently polluted water, nomadic groups were able to exploit efficiently small and quickly exhausted water sources which would otherwise be uneconomical to use.

The sophistication with which these scattered water resources were exploited can be seen in the number of words used to describe wells and groundwater catchments among the early 20th century AD Rwala bedouin of N. Arabia, who distinguished between fourteen different kinds of well and six types of groundwater (ref. 10: 676-84).

Early urban water systems

In the period beginning around 3500 BC, water engineering skills for supplying urban centres with water were developed in the Near East. Systems of diversion dams, canals and reservoirs were constructed to provide water for irrigated fields near settlements and provide intramural water supplies to supplement surface water sources in and near settlements.

One of the best preserved of these early town water systems is found at Byblos (ref. 11), where a centralised water system lasted for almost a millennium, evidence of effective continuity in integrated town planning and public health. Shortly before 3000 BC during the phase of urban development which transformed Byblos from a fishing village into a major Mediterranean trading port, the marshy area near the spring was dug out to create a small reservoir of water, simultaneously providing an improved supply of water and eliminating the marsh which would have been a favourable environment for mosquitos and other carriers of water-related diseases. During the following millennium of urban prosperity at Byblos, the area round the spring was kept free

from burials and domestic construction, and a clear space of c. 30 m diameter around the spring was retained down to c. 2150 BC.

This area was the focus of the town plan, at the intersection of two major streets, with public buildings constructed on the periphery of the clear space around the spring. As the level of the town rose c.2750-2500 BC, the sides of the spring pool were reinforced with retaining walls and a flight of stairs was constructed to give access to the spring. At the same time a reservoir with a capacity of c. 2500-3000 m^3 was put in north of the spring to provide a source of water for laundry, stockwatering and swimming and to keep the spring free of the pollution associated with these activities.

Byblos provides an example of long-term use of water sources created or modified by water engineers which can be maintained and used without special skills once the water system is set up. Similar successful long-term water planning can be identified in the re-use of earlier water systems in a number of first millennium BC Palestinian towns, in the well-built Iron Age and Roman water systems which are still in use today at Jerusalem, Homs, Bosra and elsewhere, in the qanats of the mid-first millennium BC and later, and in the canal systems in the alluvial plains of S. Mesopotamia.

In the case of Mesopotamia, a number of early second millennium BC texts enable us to reconstruct the activities of early water engineers as seen by their contemporaries. Even though the credit for the work usually went to the monarchs who sponsored it, the scale of these works is impressive. In order to provide fresh water for Larsa, Sin-iddinam (1849-1843 BC) dug out a new course for the Tigris (ref. 12: 191-2) and Rim-Sin of Larsa (1822-1763 BC) dug a large canal and reservoir to divert the spring flood of the Tigris and Euphrates with the dual function of irrigation and supplying fresh water to the cities of lower Mesopotamia (ref. 12: 205-6). Some concern for public health may be inferred from the claim by one late 19th century BC ruler of Uruk to have repaired the city rampart which had slumped into the canal by the city and to have faced the canal with burnt brick "so that the water in its ditches would be noisy", ie. fast-flowing and not stagnant and thereby reducing the infestation of the canal by the snail hosts of schistosomiasis (ref. 12: 233).

One of the best documented water systems in the Near East during the early 2nd millennium BC is that at Mari, where part of the correspondence of Kibri-Dagan, the official in charge of building the canal which was at the basis of the city's prosperity, has been preserved (ref. 13: nos. 1-9). This canal was some 100 km long, and brought water from a diversion dam built on the Khabur 20 km upstream from its confluence with the Euphrates. In an inscription commemorating the building of the canal, the king of Mari states: "I opened canals, I did away with the digging of wells in my country .... in scorched lands, in an arid place where no king before me had ever built a city, I .... built a city" named after himself, "Yahdun-lin City" (ref. 12: 244-5).

The obsolescence - or banning? - of wells and their replacement by canals is interesting, and may reflect the differing water exploitation priorities of town planners and rural farmers, as some of the bottom lands used for pasture by shepherds were likely to have been brought under cultivation and lost to them together with the wells located in the bottom land, creating a potential source of conflict, and requiring the resettlement of shepherds with new sources of water and patterns of water use, perhaps in the newly-established urban centre built by Yahdun-lin.

A conflict between nomads and townsmen over water resources and access to stored water is believed to have been one factor implicated in the breakdown of the best-preserved early town water system, that of Jawa, a late 4th millennium BC site in the basalt desert of northern Jordan which provides a unique, if short-lived example of urban water engineering (ref. 14). A system of deflection dams, canals and reservoirs was built to supply a population estimated to be 3000-5000 with water for their fields, flocks and households. As both groundwater and springs are lacking in the region today, if the same conditions prevailed in antiquity, a precondition of human occupation was having the engineering ability to harvest the runoff from episodic and unpredictable winter storms to provide enough water for the coming year.

To design and construct Jawa's water system needed a knowledge of local hydrology, geology and soils to determine the best materials, location and design for the components of the system. Even today specialised engineering skills of a high order would be required (ref. 15: 166).

Although Jawa's water system needed to operate at only 3% efficiency to harvest and store an estimated 50-60,000 m^3 of runoff from the 2 x 10^6 m^3/yr available from adjacent catchments, it failed wihin a few generations of its construction. After a phase when squatters' housing encroached on public land and huts were built next to reservoirs and sluice gates, with the town authorities either unwilling or unable to prevent the spontaneous expansion of the settlement, and an abortive attempt to rebuild the water system without expanding its storage capacity, the site was abandoned (ref. 14: 201-14).

However, the tradition of water engineering represented by Jawa continued, and reservoirs linked to the town plan, although on a smaller scale than at Jawa, are features of the urban landscape in a number of third millennium BC towns of the Levant apart from Byblos, notably Ai and Arad. Arad was laid out inside a small catchment basin whose runoff was channelled by radially oriented streets to a central reservoir which could have stored approximately 2000 m^3 (ref. 16). At Ai runoff from inside the town was diverted to a corner of the fortifications which surround the site and stored in a 3 m deep pool with a storage capacity of about 1800 m^3 which was paved with stone slabs and sealed with naturally water-sorted clay found locally (ref. 17).

Although significant as adaptations of

water engineering principles to local conditions which have been studied by archaeologists in co-operation with water engineers, the importance of these third millennium BC reservoirs should not be exaggerated, as their storage capacity is less than half the capacity of open-air cisterns used in modern villages in Syria and Lebanon to store water for stockwatering and washing (ref. 7). Except in times of siege, most ancient sites would have obtained drinking water from springs or wells within a few kilometres of the site and could have used intramural runoff for laundry and animals.

As emergency stores of drinking water, these reservoirs suffered from grave defects. If precautions were taken to ensure that the water stored in these reservoirs did not receive fresh inputs of human waste, any pathogens brought in with the original storm runoff from inside the town would either be diluted, destroyed by ultraviolet radiation or die after reaching the end of their natural life-cycles without finding a fresh carrier. However, these reservoirs would have inevitably become populated with algae, producing unpalatable drinking water.

Whatever the intentions of the water engineers who designed and installed them, such open reservoirs were hazardous civil defence measures which would be vulnerable to pollution. Even if at the time of their construction awareness of the sort of hygienic behaviour needed to prevent faecal-oral disease transmission was present (Elmendorf, this conference), the odds are good that eventually a conflict or emergency would arise when these reservoirs which had been allowed to become polluted through their convenience for laundry and stockwatering were used to supply drinking water to the town as a whole, with potentially serious risks to public health. A serious epidemic of disease could eventually lead to the site being abandoned and avoided, as most of these early urban sites eventually were.

Conclusion

What relevance does evidence of water use and waste disposal in the past have in planning for the future? One concrete suggestion is that in an arid area such as the Near East, having separate sources of water for drinking and other uses, combined with public health education aimed at individual households, is a formula which has worked well in the past, where both rural and urban water use and water engineering have a much longer history than is often realised. Models derived from and taught in water-rich areas are more likely to be inappropriate in the long run, even if already in operation (Metwally, this conference).

The efficiency of small-scale water exploitation techniques in contributing to the long-term survival of rural communities, and the dangers of poorly maintained, poorly understood, or poorly applied water systems can be observed in action archaeologically. Perhaps study of past techniques of water use in a given area could be of some use in formulating cost-efficient and lasting public health improvements appropriate to their geographical and cultural setting.

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7th WEDC Conference: Water people and waste in developing countries: 1981

TREATMENT NEEDED FOR GROUND WATER IN SOME MIDDLE EAST COUNTRIES (CASE STUDY)

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ABSTRACT:

Water treatment plants of the traditional type are generally built to remove turbidity from raw water. Turbidity in excess of the acceptable limits is found in surface sources as rivers and resevoirs. Ground water turbidity has been found always within the acceptable limits; accordingly, no clarification treatment is needed. Some cities have built their treatment plants with its surface water treatment units to receive groundwater of very low turbidity. When it becomes exposed to the atmosphere, algae breeding takes place due to the presence of high material content, low turbidity, and exposure to light. Consequently, algae troubles as taste, odour, and filter clogging take place too. All such troubles and others relevant to the presence of algae could have been completely avoided if the raw water from the ground source bypassed the treatment plant and joined directly the clear water resevoir for disinfection, if needed, and then distribution directly. No technical reason is known to build a surface water treatment plant for a groundwater source. This is confirmed by results shown in table (1), and (2) for Geita spring water which is considered the main source of supply for the city of Beirut. As a result of a survey carried out in Lebanon where groundwater is introduced to clarification units, it can be stated safely that no need for clarification since the groundwater turbidity has been always found within the international acceptable limits.

1. INTRODUCTION:

In this part of the world, water treatment for municipal purposes is carried out to remove turbidity in the vast majority of treatment plants. Surface water is the only water that has turbidity in excess of the acceptable limits. Treatment plants in Egypt, Syria, and Iraq are provided with surface water from rivers and permanent sources. Such plants have been capable of reducing the turbidity of raw water to the acceptable levels. The relevant turbidity ranges from few units in draught time to few hundreds during flood season. The turbidity is mostly inorganic and its removal, which is the main function of many regional treatment plants, is carried out through chemical precipitation processes and sand filter operations.

Algae might contribute to the presence of turbidity especially draught time and when the turbidity level permits considerable sun light penetration as the case in Egypt after construction of the high dam. Therein, it has been reported to have a considerable ratio of organic turbidity as a result of algal abundance.

11. ASSOCIATED TROUBLES:

Algae flourish in waters of low turbidity and high mineral contents when it is exposed to light. Groundwater environment, accordingly, when it becomes exposed to the sunlight for a considerable period encourages the breed of algae which might thrive to the extent of having an algal overpopulation case with the consequent die off. This will be due to the lack of sufficient feed from the limited mineral contents of groundwater. Extensive algal growth in water supplies can result in serious deterioration of the quality of water particularly if it is to be used for domestic or industrial purposes. However, the presence of algae in water, whether alive or dead, causes tastes, odour, and filter troubles. Additionally, the ability to combine inorganic elements into organic compounds makes algae important as primary producers in aquatic food chain. Many of the blue-green algae possess the ability to fix free nitrogen which allows them to grow independant of sources of combined nitrogen.

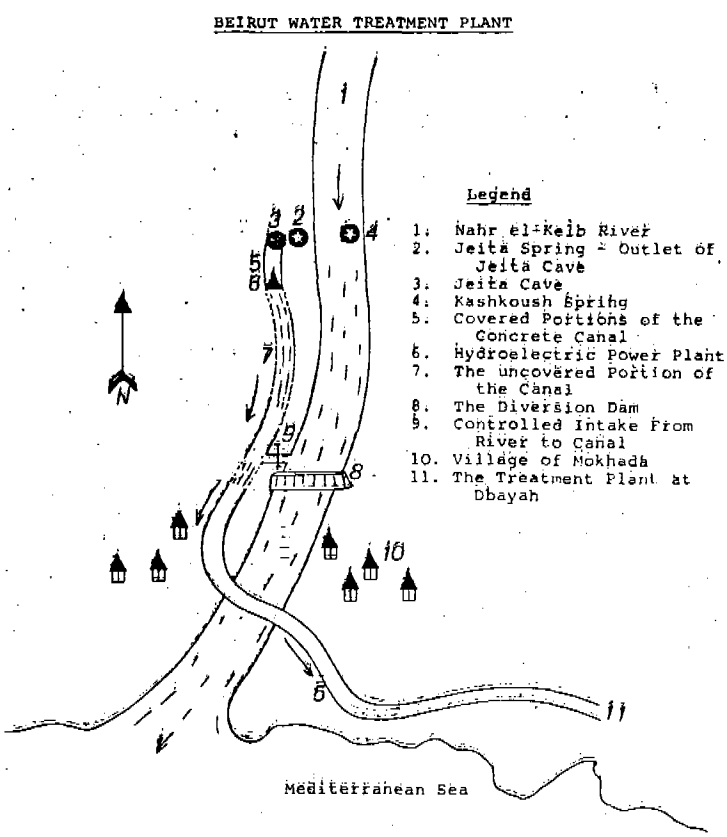
In water treatment plants algae are best known for their ability to produce odour and taste problems, and because they clog sand filters. In addition, algae often contribute large quantities of organic material to the water, and cause pH, alkalinity, colour, and turbidity changes. During the daylight hourse algae continuously remove CO_2 from the water for photosynthesis. The CO_2 removal may be high enough to alter the amount of bicarbonates in the water causing the precipitation of carbonates and a reduction in water hardness. Another possible effect of algal photosynthesis is an increase in dissolved oxygen which increases the corrosive activity of water.

Such algal problems are mostly associated with surface water supplies. Groundwater supplies if exposed to the direct atmosphere for a considerable time will be a very suitable environment for algae breeding with the consequent algal troubles. To avoid such troubles, groundwater supplies

Table 1. Chemical and Physical Analysis of Water Samples collected at the Entrance to the Beirut Water Treatment Plant by Seasonal and Annual Mean Values and Yearly Standard Deviations*

Parameters	Seasonal Mean				Yearly		
	Winter	Spring	Summer	Fall	Number of Samples	Mean	SD
Conductivity (micromhos/cm) at 25°C	326	333	359	407	25	344.2	61.45
pH	8.09	8.16	7.79	7.93	24	8.06	0.288
Temperature, °C	15.0	16.3	17.4	16.5	21	16.31	1.05
Turbidity, JTU	2.2	0.71	1.75	1.47	24	1.57	1.13
Total Hardness, as $CaCO_3$	211	187	233	257	24	219.5	42.7
Calcium Hardness, as $CaCO_3$	176	146	173	175	24	168.2	39.7
Magnesium Hardness, as $CaCO_3$	35	41	60	82	24	51.3	29.8
Total Alkalinity, $CaCO_3$	195	194	168	279	24	206	46.08
Hydroxide Alkalinity, as $CaCO_3$	0	0	0	0	25	0	-
Carbonate Alkalinity, as $CaCO_3$	0	0	0	0	25	0	-
Bicarbonate Alkalinity, as $CaCO_3$	195	194	168	279	24	206	46.08
Ammonia N, as N	-	0.48	0.38	-	5	0.42	0.18
Nitrite N, as NO_2	0	0.004	0	-	4	0.00	-
Nitrate N, as NO_3	0.93	1.03	0.84	1.75	21	1.106	0.428
Phosphates, as ortho	0.23	0.25	0.27	0.23	21	0.247	0.05
Sulfates, as SO_4	10.70	8.0	8.3	21.5	25	12.2	6.3
Total dissolved solid	219	207	237	320	11	236.27	45.8
Calcium, Ca	63.5	-	67.7	63.5	4	65.6	20.12
Chloride, as Cl	11.7	15.42	25.00	17.5	14	16.96	8.89
Iron, as Fe	0.055	0.015	0.048	-	7	0.041	0.015
Magnesium, as Mg	9.35	-	21.43	-	4	15.39	6.99
Potassium, as X	1.1	0.81	0.76	-	12	0.87	0.26
Sodium, as Na	-	-	1.08	-	2	1.08	-
Dissolved Oxygen	9.85	9.92	10.75	-	9	10.17	0.4
Fluorides	0.68	0.081	0.107	-	9	0.033	0.019

* All values are in mg/l unless otherwise indicated



Sketch Showing Locations of Jeita Spring, the Concrete Water Canal, Kashkoush Spring, and Nahr el-Kelb River

Table 2: Chemical and Physical Analysis of Raw and Treated Water Samples from Beirut Water Treatment Plant, 1979/80*

Parameters	RAW		TREATED **	
	No. of Samples	Mean Value mg/l	No. of Samples	Mean Value mg/l
Conductivity (micormhos/cm)	25	344.2	14	337.5
pH	24	8.06	15	8.14
Turbidity, JTU	24	1.57	8	1.31
Total Hardness, as $CaCO_3$	24	219.5	15	229.2
Calcium Hardness, as $CaCO_3$	24	168.2	15	164.5
Magnesium Hardness, as $CaCO_3$	24	51.29	15	57.3
Total Alkalinity, as $CaCO_3$	24	206	15	226.5
Hydroxide Alkalinity, as $CaCO_3$	24	0	15	0
Carbonate Alkalinity, as $CaCO_3$	24	0	15	0
Bicarbonate Alkalinity, as $CaCO_3$	24	206	15	226.5
Nitrate N, as NO_3	21	1.106	9	1.001
Phospates, as ortho.	20	0.249	9	0.21
Sulfates, as SO_4	25	12.22	15	12.91
Chloride, as Cl	14	16.96	4	13.13
Potassium, as K^+	12	0.87	4	1.11

* All results are in mg/l unless otherwise indicated
** Filtered water, before Chlorination.

Table 3. Monthly mean of Total Algal Units Per ml of Water by Sampling Site, and Daily Mean Value of Hours of Sunshine, 1979/80(a).

Period	Sampling Site: At Entry To Plant	Effluent of the Coagulation-Sedimentation Basins	Rapid Sand Filters
A - Months with daily mean between 8.00 to 11.40 hours of sunshine			
April	31,925 (2)	28,810	35,430
May	47,320 (3)	70,992	66,475
June	23,640 (2)	29,340	23,043
July	26,200 (2)	27,800	30,685
August	125,080 (2)	84,000	53,240
September	127,060 (2)	64,620	50,226
October	137,305 (3)	156,147	136,773
Mean	74,076 (16)	65,958 (16)	56,555 (16)
B - Months with daily mean between 3.38 to 7.9 hours of sunshine			
November	51,500 (2)	58,420	45,572
December	29,984 (2)	27,740	26,567
January	23,980 (2)	31,128	28,835
February	47,640 (2)	39,573	19,875
March	29,400 (3)	18,650	21,306
Mean	36,501 (11)	35,102 (11)	28,431 (11)

(a) Number within brackets represents the number of Samples

should be piped from the ground source in closed pipes or conduits to storage tanks where disinfection, if needed, takes place, and then to the distribution system. Ground water supplies in the regional plants do not need any treatment except disinfection as a safeguard measure.

All groundwater plants in Egypt invest such gifts of nature and provide water supplies without any treatment. However, in Egypt chlorination should be applied as a safe guard against any probable contamination and as a control measure of summer diseases. In new expansion unit where iron and manganise may cause troubles, special units for their removal are recommended preferably of the closed type to avoid any surface contamination or exposure to the atmosphere with the relevant troubles.

III. SURVEY AND PROBLEM

In a survey on water treatment plants in Lebanon where surface water sources are not reliable, it was found that some cities are supplied with groundwater sources after passing through surface water treatment plants although such sources are not in need of any traditional treatment. These cities have built and operated their plants with surface treatment units while the raw water comes from ground sources. The exposure of groundwater with its negligible bacterial and turbidity load to the atmosphere in open channels from the source to the plant where it stays for additional several hours as detention periods in treatment units provides all favourable factors for algal growth with its sequant plant troubles. This is the case in considerable number of treatment plants where surface treatment units are introduced for some reasons which are not technical, and which are not known obviously.

The needed treatment for the groundwater from all these plants is chlorination only without any extra clarification since the trubidity recorded has always been within the international acceptable limits. Examples of some treatment plants using surface treatment units for groundwater sources in the region are those of Beirut, Syda, and Tripoli cities in Lebanon where the sources came from the springs. Jeita Cave and Kashkoush Spring near Beirut, Ras El-Nabe Spring near Syda, and Kadisha Spring near Tripoli are the soueces of groundwater which are directed to surface treatment clarification units without any technical reason. This is an extravagant way of spending money and effort which ought to be avoided by transferring the raw water in closed conuits to be chlorinated and distributed into the distribution system without passing into the present treatment plants. The presently constructed treatment plants should be demolished or altered to surface water treatment if surface water is available and needed.

IV. RESULTS

To illustrate such a survey numerically, Beirut water treatment plant is selected for presentation. Table (1) shows the chemical and physical analyses of water samples collected at the entrance to the Beirut Water Treatment Plant by seasonal and annual mean values and yearly standard deviations.

It is to be noted here that at the mouth of Jeita Cave "The source", the spring water is diverted into a concrete canal which conducts the water to the treatment plant. The canal is closed for one kilometer from the mouth of the cave. Then it is uncovered for three kilometers after which it is covered again for about 10 kilometers. The open portion of the canal runs through a narrow valley of cultivated land exposed to sunlight and to contamination from surface runoff water.

Table 2 shows the chemical and physical analyses of raw and treated water samples from Beirut water treatment plant. The difference between the raw and treated samples as regards the relevant parameters as turbidity for example is by all means insignificant especially when we notice that the turbidity of the raw water is much lesser than the maximum international limits.

Table 3 shows the monthly mean of total algal units per millimeter of water sampling site and daily mean value of hours of sunshine. The numbers of algal units shown are self explanitory and they need no comment more than that they would have been absent completely if the diverting canal was covered and the treatment plant was not built.

V. RECOMMENDATIONS:

In conclusion, the only needed treatment for groundwater in the region is disinfection mostly by chlorination. This is carried out as a factor of safety against any probable contamination. No need for clarification since the groundwater turbidity has been always within the international acceptable limits.

Session 5B

Chairman: Dr Andrew Cotton
WEDC Group member

Discussion

R Franklin
Organisation development.

Mr FRANKLIN expressed the need for a proper organisation for the design, construction or operation of a water supply or waste disposal scheme. It was a means of utilising resources to achieve an objective.

2. He used the diagrams from his paper to illustrate his ideas on the structure of organisations. However in practice things rarely worked out as in the diagrams because of the different people and their characteristics that were involved either inside or outside the organisation.

3. For example within an organisation people had different powers and often had a different perception of their role than others did. Outside the organisation politicians, trades unions, customers, suppliers, governments, international agencies and charities all exert influences.

4. The factors outlined in the paper were taken into consideration when a project was proposed for a master plan for rural water supply in Iraq. This was started by a consideration of the requirements of the ideal organisation which should exist after the twenty five years of the project. In this way the method of development of the organisation could be decided. The development began as anticipated, but then there was a complete change of personnel which had held back development.

5. Mr WILLIS felt that this paper was of the utmost importance, not only in developing countries but for every country in the world. He thought that organisation was a neglected, misunderstood area. The problem was that everyone in power seemeed to assume that they were competent to design organisations, although often unaware of organisational requirements. There was a great need for this awareness and for the use of the skills involved.

6. When creating an organisation it was almost essential to get an outside view from someone free from involvement, with skill in organisational design, who could avoid the fossilisation of internal, preconceived ideas.

7. Mr CREE suggested that managerial skills needed as much training as technical skills, and asked what training of this nature was being provided.

8. Mr FRANKLIN replied that when starting from scratch in forming the organisation referred to in the paper, the jobs grew with the organisation. Training was given as needed but mostly skills were learned through experience. No formal training was given except by definition of the tasks required. In this way people learned to work out their own solutions through experience and sometimes by mistakes.

9. Mr BUKY pointed out that the World Bank tended to have as its primary objective the provision of institutions rather than actual facilities in the water and waste sector, and that in fact this was the field in which they had been least successful. He felt that they might be using the wrong people. For instance the use of management consultants may not be right. It would be better to have more water industry personnel brought in.

10. Charts and diagrams with boxes for different levels of organisation were of no significance if the actual manpower did not exist - they might also be totally unsuitable for the social and cultural requirements of a community. In his opinion the whole idea lacked practical application. What was needed was more assistance from the water industries. There had been some effort in this direction in the United States and the UK but so far this had been pitifully small.

11. Mr FRANKLIN agreed with this. His first recruits had been from the Ministry of Municipalities and they had some experience of working in the water industry. Young graduates were then brought in to work under them to get experience. Originally a management training scheme had been set up to give geologists, chemists and engineers a broad management training. However as soon as they had been trained, these people left to take better positions elsewhere and the scheme had to start all over again. This sort of situation often arose in developing countries where rapid promotion could be gained outside the original field of training.

12. Mr GRIEVESON agreed with Mr Buky. Management training was a very difficult field. The ability to effectively manage was a natural skill which could not be entirely imparted through teaching. The training could be used to help expand a natural ability but could not in itself create leaders.

13. He believed that institution building was one of the most important issues in the developing world at the present time. His organisation, the ODA, had two of its most successful schemes in the water field. For these schemes, people had been seconded from water organisations in this country to bring management experience to people in developing

countries. It was hoped to start similar management schemes in other areas and in parallel with them to introduce programmes in public hygeine education.

14. Mr FRANKLIN felt that the education of consumers was very important, especially in the area of health and hygeine.

15. Mr SAYLES had great sympathy with the views expressed on this subject. He felt that it was very easy for organisations to forget that they were dealing with people. Consultants might find it convenient to draw charts with boxes, but the people were not there. It was necessary to find them, train them and keep them. For this, autonomy in institutions was important, otherwise people were shunted around to work in inappropriate areas of which they had no experience.

16. Mr FRANKLIN agreed and gave an example from the project in Iraq. There they had found that the people who were expected to help collect and collate water records were in fact mostly illiterate. So it was necessary to start by encouraging these people to at least learn to read.

17. Mrs AIN gave an example of human organisation in water distribution. In Pakistan the only human organisation was the Mosque. The mullah managed water distribution in his area to between 2000 and 5000 people. A local committee had organised and dug a well actually in the mosque. There were also lectures given on hygiene after prayers.

18. Mr BUKY endorsed this point. He said that the mosques represented the formalised use of water through required ablutions and so it was necessary for them to organise its supply and use. He wanted to know whether this water provided by the mosques was also available for drinking.

19. Mrs AIN replied that if the water was sweet then it was made available for this purpose; otherwise the government supplied drinking water in tankers.

Dr Robert Miller

The prehistory of public health: water and waste in the ancient Near East.

Dr MILLER explained that the paper was confined to the Near East because that was the area in which he had lived and worked for some time. The same approach could be applied to any area of the world. There were interesting case studies of water use over long periods, and this provided the opportunity for collaboration between historians, anthropologists and water engineers in educating students about the use and misuse of water.

21. In the Near East the first villages grew up between 9000 and 10 000 years ago. This indicated a change from the former nomadic existence to a settled way of life. From this came the need for the development of patterns of water use and waste disposal in order to preserve the health of the settled groups.

22. Early agricultural villages were found to have used all the basic components of water use with the exception of the cistern. The use of irrigation canals enhanced the opportunities for development of schistosomiasis, and this was not just a problem of the Near East. It was known that similar development had occurred in Indonesia.

23. He believed that the development of schistosomiasis went back into early palaeolithic times but the earliest direct evidence for the disease was found during the dissection of mummies in 1910. These mummies dated from 1200 to 1000 BC. In Iraq in the 1950s snail shells of a carrier of schistosomiasis were found in mud bricks from 6000 years ago.

24. There was some evidence of gastro-enteritis and malaria from skeletal remains from 7000 to 9000 years ago.

25. In the early villages it seemed that there had been great efforts to keep the floors of living areas free from waste etc, since there was a lack of the usual materials of use to archaeologists. It was not until between one and two thousand years later that food remains and artefacts were found in quantities in the hut rubble. The conclusion drawn from this was that there had been a deterioration in general hygiene standards in the villages. This coincided with the almost total abandonment of Palestinian Neolithic sites. A possible explanation for this was that increasing mortality from water-related diseases had encouraged the people to leave the permanent sites and take up a nomadic existence again.

26. Shallow pits had been used for a long time to provide water for both humans and animals, but the digging of permanent wells developed around 7000 years ago in Iraq. The depth of these wells, up to 15m in some cases, may have been due to a recognition that the filtering effect so achieved was desirable from a health point of view.

27. The examples from the paper of failed and successful water systems in urban areas were then examined.

28. Mr BHATTACHARYA had found the paper very interesting and he thought that we had much to learn from the prehistorical studies. Egyptian wall inscriptions and Indian Sanskrit writings indicated that ancient peoples related water and disease. Some inscriptions were found which suggested that water should

be boiled before drinking. Also the Romans had well-developed systems for water treatment. They may not have been built on our present scientific principles but these people had some expertise.

29. Mr SAYLES asked whether the speaker had come across any evidence of early water laws, and the conflicts in water use which must have occurred.

30. Dr MILLER explained that this was a very specialised field, especially where investigations in early written languages were concerned. He had not come across any actual evidence of municipal legislation. He thought it was more a case of the people knowing what worked in practice.

31. Professor MITWALLY was interested in Dr Miller's account of the discovery of schistosomiasis in Egyptian mummies. A characteristic of the disease was the passing of blood in the urine, and it was known that in early Egypt, if someone was known to be passing blood he was not allowed to urinate or defecate into water. It had to be done in a dry place and in the direct sun where it would soon dry out. This showed an appreciation of the connection between the disease and water.

32. Mr BUKY had an example of current abandonment of land through recognition of water-borne disease. Land in the Upper Volta had been abandoned because of the high incidence of river blindness.

33. He also asked whether Dr Miller had any evidence of a correlation between increase in wealth and increase in water use. He was thinking particularly of the Roman Empire at its height when water use was known to be high. It was known that use of more than 100 lpd had no additional health benefits and so was purely convenience use.

34. Dr MILLER had no direct evidence of this but he felt that it was an interesting and valid point. He thought that prestige certainly played a role in the amount of water used and this applied in Rome.

Dr Hassan Mitwally and Dr Jack I Ibrahim

Treatment needed for groundwater in some Middle East countries.

Professor MITWALLY explained that parts of the paper were taken from a doctorate thesis by the co-author, Dr Ibrahim. The study had arisen from recognition of the problem of algal growth in water treatment plants in both Beirut and Alexandria. It was a problem of how to deal with the decision-makers in an area. Letting them know what was meant by public health, environmental engineering and environmental sanitation.

36. The survey of treatment plants in Lebanon was outlined, as was the diagrammatic map of the Beirut treatment plant as found in the paper.

37. Ms ELLINGTON asked whether the river water which joined the spring water had been treated, and also how the water was transported from the Kashkoush spring to the canal.

38. Professor MITWALLY explained that no treatment of any kind was given and this helped to save money. He pointed out on the map of Beirut the position of the pipeline which carried the water from the spring to the canal.

39. Mr BHATTACHARYA wondered why the plants were built in the first place. He thought it was a glaring example of good water being turned to bad.

40. Professor MITWALLY said that the plants had been built in the 1940s so he did not know why they had been built. There was a concern to save money by combining the spring water with the surface water.

41. Dr COTTON commented that money could be saved by simply closing down the treatment plants. Then there would be no maintenance or operation costs.

42. Ms ELLINGTON asked whether any surface water was going into the treatment plant.

43. Professor MITWALLY said that only spring water was now directed through the treatment plant.

7th WEDC Conference: Water people and waste in developing countries: 1981

IRRIGATION IN AFRICA AND ASIA - POLITICS AND PROBLEMS

CHRIS EDWARDS
LINDEN VINCENT
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1. Objectives of this paper: to provoke discussion at the 1981 WEDC Conference among irrigation engineers and planners about the need to consider the social structure as well as the natural environment when planning irrigation schemes. The points raised in this brief paper arise from the experience of:

> Chris Edwards, economist; and Linden Vincent, hydrologist, both at the School of Development Studies, University of East Anglia, Norwich, England, and from the writings of other people on irrigation - full reference to which are given at the end of the paper.

2. Irrigation - what is it? Irrigation is defined here as the application of water to land for cultivation using manual or mechanical means. There are many different methods of irrigation, some of which are illustrated in figure 1; there is a range of technologies, with the class structure in a particular society as well as the physical environment determining the technology used. The large-scale schemes, such as gravity canals or deep tube-wells, are invariably controlled or at least sponsored by central or local state agencies, while the smaller scale schemes are more commonly associated with private capital. The annual capital costs per hectare range between US$ 10 and US$ 40. It should be noted that these are rough estimates, based on 1978 prices and exclude interest charges. Clearly the range of capital cost per hectare is quite small, but these capital costs per hectare are calculated on the basis of the potential or maximum command areas specified in figure 1; the actual areas irrigated are often considerably less, particularly for the large-scale schemes.

3. The scope of, and need for irrigation

In the four countries in which we have experience, the utilisation of irrigation potential varies considerably - ranging from over 60% in India to less than 2% in Zambia as shown in Table 1 below.

In Bangladesh, the population density is one of the highest for any country in the world; land is relatively scarce and labour plentiful. Irrigation is indispensible for increasing agricultural output (See ref.1). It is required both for reducing the risk attached to high-yielding varieties and for multiple cropping; see figure 2. Here, particularly, there is a conflict between fragmented land-holdings and a relatively indivisable technology - we come back to this central point in section 4 below.

Dryland India also confronts a severe land constraint. Water resources are regionally variable, but often poor - see fig 2 - with limited groundwater availability and restricted potential for small storage schemes because of the volume and pattern of rainfall. As in Bangladesh there are strong class distinctions in access to capital for irrigation equipment.

In Tunisia, sophisticated technology is required whether it be for the large communal schemes in the north and centre, or oases, and irrigation schemes have been associated with resettlement. In general, compared with Bangladesh and India there is less pressure on the land, and irrigation is not an indigenous activity, having been 'superimposed' to alter or extend traditional rainfed cropping, and is associated with bring farmers into the market economy.

In the latest Zambian Five Year Plan, two prominent objectives are to increase agricultural output and to promote self-reliance. Irrigation is inferior on both counts compared to more intensive rainfed agriculture through, for example, the use of oxen. Land is not as serious a constraint in Zambia as labour, and there is a progression by farmers through oxen and tractor ownership for rainfed farming before labour and capital is released for irrigation (see ref.2).

4. Politics and problems in irrigation

In the mid 1970's, the Agricultural Administration Unit of the Overseas Development Institute began a programme of

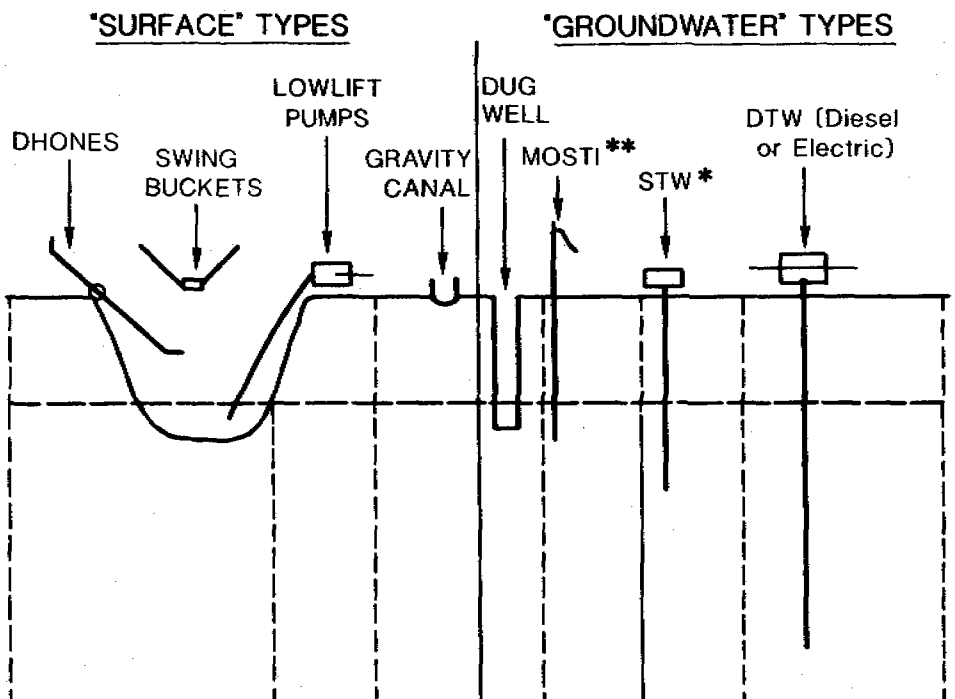
Notes

[1][2] - Based on data from:
1. Bangladesh
2. Zambia

[3] Annualised capital costs exclude interest charges

* Shallow tubewell

** Manually operated shallow tubewell for irrigation



Potential command area (hectares)	0.1-0.4	24-40	100 or more	0.1	0.2-0.8	6-8	24-32
Capital cost per hectare ($US, 1978 prices)	30-50 [1]	150 [1]	1000-3000 [2]	60 [1][2]	200 [1]	200 [1]	180 [1]
Annualised capital costs per hectare (") [3]	10-15 [1]	20 [1]	40 + [2]	20 [1][2]	30 [1]	30 [1]	25 [1]
Pumping height (metres)	0-1.5	0-9	-	-	0-3	0-4.5	10 or more
Generally financed by State (S) or private (P) capital	P	P/S	S	P	P/S	S	S

Fig. 1 Irrigation Methods

Table 1

	Bangladesh	India	Tunisia	Zambia
Total population (1980-mns)	90	630	6	6
Total cultivable area (mn has)	9	152	9	32
People per cultivable hectare	10	4	<1	<1
Irrigated area				
- actual (mn has)	1	58	0.14	0.02
- potential (mn has)	8+	93	?	1-10
- % actual factor to potential	12	62	?	2 or less

comparative research on the organisation and management of irrigation schemes (ref.3). The motivation for this study was provided by the failure of many large irrigation projects, with much of the poor performance being blamed on weak management. In some areas (eg. Taiwan) the schemes seem to have been successful but it is claimed by some of them that there are historical reasons peculiar to Taiwan accounting for this success (ref.4). In other areas (eg. on the Mwea and Gezira schemes in Kenya and Sudan respectively), a highly 'integrated management' structure seems to have been successful (in terms of increasing agricultural output) in the early stages of the schemes, but seems to have suffered from institutional stagnation (see refs.5 and 6).

But why is the strong and detailed management provided by, for example, the irrigation associations in Taiwan necessary? We argue that 'strong management' is an attempt to resolve a contradiction which arises in the context of irrigation, and which is particularly evident in, for example, Bangladesh. This is the contradiction between a fragmented landholding structure and a relatively indivisible irrigation technology. The average landholding in Bangladesh is very small (see Table 2 below) with even moderately rich farmers in Bangladesh having too little land in one holding to make the purchase of a hand-pump economically viable without the sale of water to neighbouring farmers. This sale is often difficult to effect because of the nature of the commodity. Thus the risk associated with the purchase of even small-scale irrigation equipment is high; the provision of credit by the government may eliminate this risk, but because of the political power of rich farmers, the loans are invariably not repaid, thus reducing the incentive to sell water. The problem of equipment underutilisation then emerges.

Table 2 - median landholdings (hectares per farming household)

Bangladesh	less than 1
Dryland India	3
Tunisia	more than 5
Zambia	2

The contradiction and the equipment underutilisation may be resolved by the consolidation of landholdings under private ownership. This seems to be happening particularly rapidly in those areas of Bangladesh in which state credit has been most extensively given for irrigation and other investment in agriculture (see ref.7). But then this "capitalist" consolidation has created growing landlessness. The landlessness may be avoided without recreating a fragmented landholding structure through the establishment of production cooperatives as in the communes of China (see ref.8), but this requires a political framework not obtaining in the countries of South Asia.

Consolidation, whether 'capitalist' or 'collective', is one way of resolving the contradiction between fragmentation of landholdings and an indivisible technology. Another way is to make the technology divisible. The latter route was discussed in an article by Ed Clay which discussed innovations in the Kosi region of Bihar in India (ref.9). Clay pointed out that "the two most important innovations were the development of lower cost wells culminating in the bamboo borings, made largely of local materials, and the emergence of a market in the services of pumpsets" (see p. 77, ref.9). The latter also seems to have been occuring in Bangladesh with farmers buying the services of pumpsets for use on their own land rather than buying the water pumped from the land of a neighbouring farmer (see ref.10).

These - the consolidation of landholdings or the fragmentation of technology - are alternatives to a 'strong integrated' management system. They are, of course, not

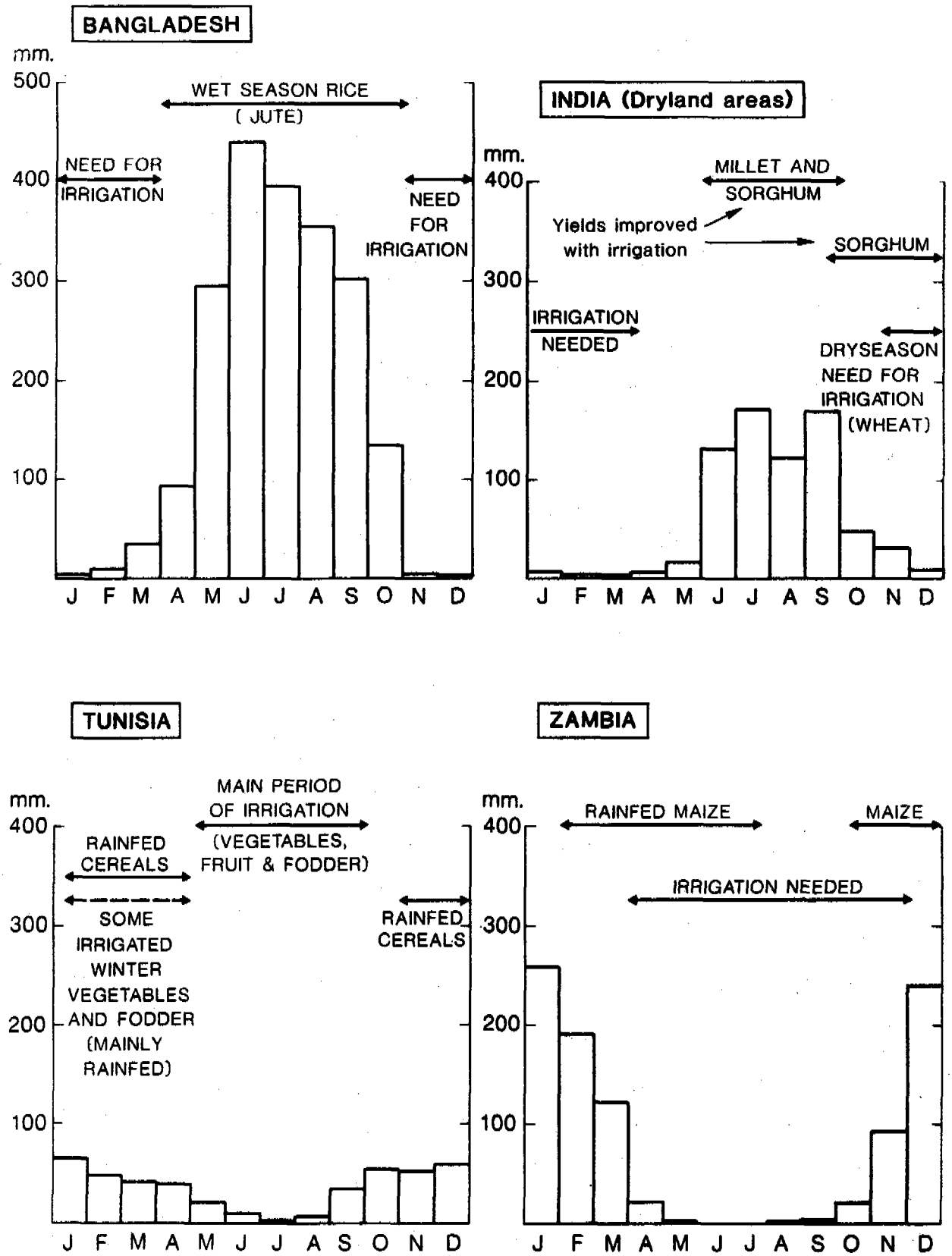


Fig. 2 Crop Calendar and Irrigation Needs in Four Countries

mutually exclusive alternatives but we emphasise them to illustrate the importance, for irrigation planners, of considering the political structure of a society.

5. Five important points

We wish to emphasise five points which arise from our experience of irrigation:

(i) without specific political commitment, the smaller farmers do not have equal access to irrigation;

(ii) the promotion of irrigation and other agricultural "improvements" by the governments of those countries in which we have worked, has encouraged the growth of capitalism in agriculture along with landlessness and inequality (see ref.11): but...

(iii) land reform, if limited to redistribution of land ownership through re-fragmentation, may hold back long-run development and accumulation in agriculture, even though it reduces landlessness and inequality in the short-run;

(iv) the cost-benefit analysis of irrigation schemes is often a spurious paper exercise with highly unrealistic assumptions commonly made about irrigation command areas given the social structure. In these circumstances, detailed technical planning is useless or even counter-productive (see ref. 12).

(v) if a scheme fails, the temptation of blaming the failure on an "irrational peasantry" should be avoided. A number of studies suggest that such a simplistic conclusion is invariably unwarranted (see refs.12 and 13).

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Session 6

Chairman: Adrian Coad
WEDC Group member

Discussion

Dr C B Edwards and Linden Vincent

Irrigation in Africa and Asia: politics and problems.

Ms VINCENT explained that she was from the School of Development Studies of the University of East Anglia, which was primarily academic in nature, but also had an arrangement with the University by which it was able to take on overseas work.

2. The paper was based on experiences gained in irrigation in four countries: Bangladesh, India, Tunisia and Zambia. Slides were shown to illustrate the contrasts between these countries in terms of population size and density, rainfall and cropping patterns. An important point was that in areas of high population density land for agricultural use was scarce but labour was plentiful. In contrast where population density was low, land was available for agriculture but but labour for operating irrigation schemes was scarce.

3. Before reviewing or changing an irrigation system it was necessary to know three things. These were: why was irrigation being used - for instance was it helping to provide a stable or marketable crop; were there alternatives available; and what was the irrigation providing and at what levels of net profit.

4. Slides were shown to illustrate aspects and methods of irrigation found in the four countries. These included deep and shallow tube wells, hand jetting of tube wells, low lift pumps, hand dug wells, simple lifting devices and irrigation furrows.

5. Mr CREE wanted to know how free the social planning of an irrigation scheme could be, taking into account limited supplies of water. Even where groundwater was available for irriagtion it would often be necessary to bring in fresh water from outside to counteract the build-up of salinity by leaching. Finally he pointed out that an irrigation project was an easily-seen development project often introduced as a political measure to show that improvements were being made. It was often important for the people to be able to see such visible improvements.

6. Ms VINCENT felt that there were financial and political arguments with regard to the freedom of planning. It was highly important that many people should benefit. To produce a very efficient system, good management was needed and this could be expensive, so it might be better at that stage to have slightly less efficiency. Where finance was limited staggering and phasing of schemes often helped.

7. She had no experience of working in an area where lack of leaching caused salinity problems. Where she had worked rainfall was high at certain seasons and this had the effect of flushing out the build-up of salts.

8. Mr GRIEVESON thought that the provision of irrigation raised the same sort of problems as that of drinking water and sanitation. It was a question of winning hearts and minds. Good management was essential. There were many small-holder irrigation schemes in the world where as much as 60% of the water applied was wasted through ignorance or poorly operated systems. He asked whether the figures given in the paper included all sorts of irrigation, for instance flood irrigation.

9. Ms VINCENT replied that supplementary and flood irrigation were not included.

10. Mr MURPHY commented that they were finding from studies at Ahmadhu Bello University that disease was oftn negating the effects of better irrigation amongst farm workers. They had found that instead of the irrigation being used to provide food for the farmers and their families it was producing breakfast cereals and sugar for the rich countries of the world.

7th WEDC Conference: Water people and waste in developing countries: 1981

MIGRATION AND SQUATTING AND THE IMPLICATION THIS HAS ON WATER SUPPLY AND SANITATION

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Introduction

Much has been written about migration but little has been said on how it affects the sanitation and water supply of the region to which the migrant is bound. Migration as defined in this paper is population movement from one place to another, either temporarily or permanently. Although there are several patterns of migration all of which have different effects on water and sanitation, in this paper the emphasis is on urbanization and the influx to Dar es Salaam for presumed opportunities, rather than migration in the general sense which is rarely encountered in Tanzania.

Urbanization in Tanzania has been very conspicuous and has attracted much attention, especially from planners. Although most of the present urban centre developed during the Colonial period as a result of externally oriented economic development, much urbanization occurred after Independence in December 1961. The indiginous population accepted urbanization as a way of life and this could be reflected in the rural to urban migration. In Dar es Salaam in the recorded population growth of the last few years, migrants represent 79% of the population. It has been observed that most major towns grew at an avergae of 8-10% pa over the period 1957-67. The annual growth rate for Dar es Salaam rose from 7% in 1957 to 11% in 1967. The 1978 census put the population at 830 398 compared to 272 875 in 1967, which is an annual growth rate of over 15%. Such a rapid increase in urban population means at least doubling it in less than ten years. Urban population in Tanzania is 2.8 million, constituting 13% of the total population of 17.5 million.

The inevitable consequence of this high rate of urbanization is senn in the pressure exerted on land, housing, employment and other social and technical infrastructure. Implicitly, urbanization is associated with problems of low income which cretaes a category of people who cannot afford to develop land in planned areas. Available services and utilities are unable to cope with urban growth and financial constraints on the government contribute to the problem. This partly explains the existence of large squatter or slum areas which are inadequately serviced. Government housing and loans favour people in formal employment, whereas migrants are usually jobless, self-employed or doing low paid jobs. When the city expands these people are engulfed as squatters and the government demolish their poor structures or accept and upgrade their settlements.

The slumming and squatting problems are invariably associated with poor and inadequate sewage disposal and sanitation systems, poor refuse collection and diseases associated with sewage and water.

The case-study findings presented in this paper are based on Mabibo, Buguruni and Keko Toroli squatter areas, with the emphasis on Buguruni.

Rural to urban migration and government policies towards associated problems

Both 'pull' and 'push' from the place of origin suggest to the rural residents that things might be better in the urban areas. Factors constituting the 'push' include:

1. Lack of employment opportunities for the large numbers of untrained people in rural areas.
2. Low productivity and low incomes in the agricultural sector due to traditional farming methods, vagaries of weather and pests, resulting in low prices for agricultural products.
3. Over population in some areas such as Kilimanjaro and Bukoba where the land tenure system has resulted in fragmentation of land through multiple inheritance. Young people who cannot inherit land from family and are not willing to find other vacant land migrate to urban areas in search of jobs.
4. Government investment in major regional towns in preference to rural areas. Over 80% of industries in Tanzania are found in urban areas, Dar es Salaam having more than 25% and employing 61% of all urban labour in manufacturing industries. The absence of effective planning and co-ordination among responsible authorities has contributed to continued unregulated urban growth.
5. Immediately after Independence the education curriculum was changed to increase primary and secondary education. At least 10% of urban and rural youth received seven years of primary Colonial education so as to be able to assist in clerical teaching and

administrative work. Education after Independence, education was aimed at preparing young people to live in rural areas and to be self-reliant. However this was not successful. Employment in the non-agricultural sector continues to be the ambition of people even after completing primary, middle and higher education. Research in Dar es Salaam shows that increasing numbers of youths engage in banditry.

6. At the family level, social disruption caused by modern development is seen. The present high living standard is out of reach of many low-income, unskilled and unsuccessful farmers. Family breakdowns are common. Male divorcees migrate and engage in such jobs as banditry and pick-pocketing. Females engage in sedentary jobs such as plaiting women's hair, selling bread and prostitution.

Consequences of migration

After looking into the 'push' and 'pull' factors we have now to look into the positive and negative aspects of migration. The negative aspects are mainly problems caused by the increase in population. The effects of this are social, economic, health and technical.

1. Housing is a problem in all urban centres in Tanzania. Due to financial constraints, the government has failed to house its increasing urban population. Individuals, especially low income earners, are unable to construct their own houses and provision of government housing favours people with formal employment. Thus the unemployed and those in the informal sector usually seek accomodation in privately owned housing or they construct houses in unsurveyed areas. Every town or city is bounded by a legally recognised boundary. Many low income earners dodge plot payments imposed by the government by crossing the urban boundary and settling 'free of charge'. As population increases these areas become congested and disorganised. Pressure falls on related government authorities to try to accomodate these areas in plans for provision of water, dispensaries, electricity, roads, schools and markets, but this is difficult to achieve.

2. Slumming and squatting have always produced hygiene problems. Disorganised, congested housing with no proper roads have made it difficult to construct storm water drains or service the areas with refuse trucks. Often the groundwater table is too high for the use of pit latrines, although these are the most common form of sanitation system. With inadequate emptying services the latrines are flooded and create serious public health problems.

3. Hospitals, schools and other social facilities are overcrowded, so that the limited facilities become obsolete too quickly.

4. Water for Dar es Salaam is the responsibility of the Ministry of Water, Energy and Minerals and the Dar es Salaam Water Corporation. The Public Health Department within the City Council has the duty of checking water quality by taking samples for bacteriological and chemical analysis, and advising the Water Corporation. Demand for water in the city has increased very rapidly in recent years and has outstripped both supply and distribution facilities.

5. Sanitation. Only six towns in Tanzania have some form of sewerage system which is limited to 10% of the population of those towns. Septic tank soakaway systems service a further 10% of the population in the low and medium density areas. The other 80% depend on either pit latrines or nothing at all. Those with no latrines use neighbours facilities or public toilets which are often in a disastrous condition, out of order or overflowing due to misuse. At present out of 77 units in Dar es Salaam only 11 are functioning. In squatter areas conditions are worse. Inadequate structures are built due to lack of finance. Pits fill quickly through over-use and inadequate emptying services, and the high groundwater table means they are often flooded. Malaria, cholera, hookworm, Bilharzia, Filariasis and other excreta-related diseases are common.

6. Increased urbanization brings technical problems, especially in the field of town planning. Master Plans for towns, Bye-laws etc become inadequate in a short space of time even if the technical and economic means are available. Traffic and transport problems abound due to narrow roads and increased numbers of vehicles.

7. Government efforts to solve the problem have included the slum clearance and compensation programme of 1964, aimed at ejecting people from squatter areas and discouraging more people from coming to town, forceful repatriation of loiterers and unemployed migrants, and the 1975 Repatriation Program.

8. Migration involves movement of people from less developed areas to developed areas. Hence more development takes place in urban towns and so the migration process becomes continuous.

Government efforts to contain migration problems

1. Repatriation. This concentrated on street beggars, loiterers and those engaged in selling on the streets. Disabled beggars were taken to Rehabilitation Centres. The Forceful Repatriation method was in line with the goals of the Arusha Declaration of 1967 which stated that everyone should be self-reliant by being an industrial worker or a peasant. By the end of 1967 the policy was seen to be inadequate because it attacked the migration problem from

the receiving area rather than from the source area, only dealing with those who were rounded up and not prohibiting further migration. It was also expensive. Identity Cards were then tried, but people managed to forge them.

2. Slum clearance and reconstruction. Before Independence provision of good housing was largely based on race and income, with residential zoning for high, medium and low income dwellers. Characteristically, in high income areas, density is low and the areas are well planned on good land and with good quality services, as opposed to low income areas with high density, poorly or unplanned, with few or no services and thus poor conditions. After Independence the government aimed to eradicate insanitary conditions by providing modern standard housing and basic infrastructure. Rural people were expected to be self-reliant, providing their own modern housing. Institutions were created to cater for housing needs and to provide loans

In 1964 national slum clearance aimed at the abolition of the worst housing and the redevelopment of modern housing. In 1969 the programme was stopped because it had proved too expensive. Construction of houses was slow and behind target, and at family level income was reduced due to disruption. Also the compensation scheme brought an unexpected problem in that the compensation money attracted more people. Poor units were erected overnight in anticipation of compensation. It became necessary for the government to pass a bye-law to stop compensation in cases of illegal construction on private plots. The abolition of the town council in 1972 resulted in further deterioration of the urban environment with no enforcement of urban laws.

In 1972 the government adopted the site and service squatter upgrading scheme focussed at providing infrastructural services at a minimally technically viable level. It was envisaged that this would act as an incentive for people to improve the quality of their environment by building their own houses on newly serviced areas or improving existing houses with loans. Poor houses were no longer bulldozed.

3. Redistribution of investments and basic community infrastructure. Rural development policy through Ujamaa villages was expected to absorb the present unemployed and unskilled and school leavers. To date we find that 90% of our people live in 8210 villages throughout Tanzania. This figure is below target but nonetheless acceptible. In general redistribution of investment has been unsuccessful.

Water and sanitation

Various water projects in association with UNICEF and DANIDA have been undertaken. There have been improvements to water supply stations, increase of public standpipes etc. Water at public kiosks is provided free. In 1976 86% of households used tap water as their main source of supply. Unpiped water is contaminated and the public is cautioned and advised to boil this water. Various water and sanitation campaigns have been carried out through radio, newspapers, adult education classes and meetings etc, aimed at improving public health, respect and dignity and increasing productivity. In spite of this sanitation systems in old towns are inadequate. Sewerage systems are old, and out of eighteen pumping stations serving Dar es Salaam centre only two are in operation and those are giving problems. The results have been discharge of sewers and foul sewerage overflows to drainage ditches and streams.

The government has set up a sewerage and drainage division in the Ministry of Lands, Housing and Urban Development, with the task of formulating sanitation policies and rehabilitating the existing sewerage system. Assisted by the World Bank the country has adopted both sewerage and low-cost sanitation systems, according to local conditions and financial constraints. Compost pit latrines and ventilated improved pit latrines (VIPs) are being tested.

In the Water and Sanitation Decade the government will provide loans for upgrading of latrines in squatter areas or construction of new ones, mainly VIPs. Studies are currently being undertaken by foreign firms in the major towns aimed at rehabilitation of existing sewerage and drainage systems.

Case studies of Buguruni, Keko Toroli and Mabibo

In 1974 Dar es Salaam was converted into a Region by itself with three Districts: Ilala, Kinondoni and Temeke. Buguruni is located in Ilala District. The area is densely populated with disorganised housing highly congested. Keko Toroli and Mabibo are situated on either side of Buguruni. All the areas have similar socio-economic conditions.

Economic factors

All three areas are squatter areas situated near Industries Government and privately owned. Except for the major tarmac roads crossing the areas there are no proper roads, being served by meandering tracks. There is limited social infrastructure, with only one Dispensary at the District centre to serve almost all the people in the District. Water points are few and the taps are far apart. Buguruni has only 52 public taps serving a population of 32 672. There are no surface water drainage systems.

Housing and people

The majority of houses are poor, Swahili type

houses which are cheaper to build than a modern house of equivalent size. Despite poor conditions rents are usually high and frequently raised. To many house owners housing is seen as a source of income rather than a social amenity. Tenants complaining about intolerable conditions are threatened with eviction. Because housing is a problem for both employed and unemployed people accept insanitary conditions because there is no alternative. Most people are low-income earners self-employed in petty businesses or casual work who often cannot afford to pay their monthly water charges and so have the water cut off.

Sanitation and water

For the household survey done in Buguruni, 688 houses were visited and completed the questionnaire, showing that 98% used pit latrines and 1% had no proper sanitation. In Keko all fourteen houses visited had pit latrines. In Mabibo of 123 houses visited, 97% had pit latrines, and three houses had flush toilets.

In a number of cases the pit latrine superstructure is also used for showering. There is no problem with sharing of sanitation facilities between families in the same house, although the same cannot be said for next-door neighbours.

Among complaints were the inefficiency of the city refuse trucks, shortage of space for a new pit and scarcity of materials for building permanent latrines. Low income is senn as a contributory factor to the present poor latrine structures. The units lack privacy and have no ventilation pipes or covers to prevent smells and insect breeding. Drums, tyres and blocks are used to line the pit, and are easily affected by water causing sagging and collapse. Overcrowding causes the pits to fill up rapidly and high ground water causes overflowing of excreta. These problems are more pronounced in Mabibo.

Another feature brought out by the survey is the practice of manual pit latrine and soak pit emptying. The method involves the digging of a new pit adjacent to the full one. A hole is then broken through the adjoining wall, releasing the contents to the new pit. The faeces is removed by scooping with buckets. The government is trying to improve conditions by introducing a high capacity vacuum truck to do the job, and also by increasing the numbers of cesspit emptiers.

People are generally not aware of the connection between insanitary conditions and disease and mostly believe that foul water from shallow wells is safe for washing. Garbage disposal is done in open pits, dustbins and on vacant land, so garbage tends to be blown and spread around. City Councils are inadequately equiped to deal with the problems, having only 21 refuse trucks and few street sweepers and refuse collectors.

Waste water is disposed of in soak pits, pit latrines and open drains near houses.

Recommendations

Over-concentration of economic activites in Dar es Salaam and other major towns partly contributes to the poor sanitary conditions. Government funds are directly channelled to those productive activities and thus proper sanitation, safe water and cleaning activities are given less attention. The government should put priority on primary health care and implement equalization of socio-economic development in rural and urban towns so as to reduce the burden brought about by migration.

Practical implementation of preventive health programmes in urban and rural areas as a whole is essential and should be enforced by law. This will alleviate many of the insanitary conditions. Better preparation of refuse for collection is one of the prime needs of the residential areas. Improvements may be brought about by a media campaign, through radio and self-help groups. If this does not work it may be necessary to use a law and impose fines.

To make the Decade successful we should train more women in water-related professions. Health education in primary schools should be strengthened. It is women and children who suffer most from poor facilities and disease. It is these people who must walk long distances or queue at taps for water. It is therefore these people who could prevent environmental contamination and plan for adequate options in safe water and sanitation if they were equipped with adequate knowledge and tools.

Conclusion

There should be effective control of the environment for better living. Endeavours made by related Ministries of the Government of Tanzania to ensure better conditions are greatly appreciated. Efforts are however hampered by lack of proper expertise and resources, thus reflecting the general level of development in the country.

Session 7

Chairman: Jo Buky
World Bank

Discussion

Hildegarda M Vanlankveld

Migration and squatting and the implication this has on water supply and sanitation.

Ms VANLANKVELD explained that her paper was based on social surveys which she had carried out. She was also involved in the provision of health education in areas of special need.

2. Tanzania was described as a developing country which relied mainly on agriculture for employment. Industrialisation was limited. The country suffered from most of the problems usually encountered in developing countries.

3. From the 1960s the country had suffered a rapid growth of its towns and cities due to a large influx of migrants from rural areas. The causes and consequences of this were dealt with in the paper. Migration took place in search of employment and a generally improved standard of opportunities, and there had been a lack of proper planning and implementation to deal with the problems arising.

4. She explained the causes of migration and the problems it brought in housing, education, employment and of course water and sanitation. The government had tried to contain the problem by limiting influx and by moving people back to rural areas, but this had been shown to be inadequate so another method had been tried by issuing identity cards. However, forging then became common.

5. Further efforts by the government included slum clearance programmes and the building of more modern housing. But this too had brought problems. Now squatter upgrading schemes were being tried. Piped water supplies were part of these schemes.

6. The government recognised the need for great improvements in connection with the Water Decade and were making efforts to raise funds, sponsor studies and increase facilities for appropriate training.

7. Mr HARRIS said that Ms Vanlankveld had participated in the household survey carried out at the start of his firm's study, to try to determine what would be the most appropriate and useful improvements to the existing pit latrine system. Following this initial work the government had built a demonstration project and installed over one hundred pit latrines. He wondered whether there had yet been any feedback from the demonstration project.

8. Ms VANLANKVELD replied that about 110 pit latrines had been built in various parts of the city. Most of these units were now in use. A problem that had been highlighted was that people wanted two units, one for bathing and the other for defecation. Only single units had been provided so that bathing had to take place in the same unit as defecation. Another small problem had been one of size and design. The units had been found to be rather too narrow to be comfortable.

9. Mr OTIENO asked why only three low-cost sanitation systems had been tried and whether she was convinced that they had chosen the cheapest options.

10. Ms VANLANKVELD said that their surveys had shown that 80% of the people used pit latrines. They had tried to demonstrate composting latrines and the ROEC but the people wanted pit latrines. There were also problems of space in that there was often no room for a garden, and thus no need for compost. Experiments would take place in other areas with low-cost options of other types. The VIP latrine was certainly the cheapest option to install and operate.

11. Dr NIMPUNO asked whether there had been any cases of pit collapse due to use of the pit for bathing as well as defecation.

12. Ms VANLANKVELD replied that there had been no problems of this kind because there was allowance made in the pit for soakage, so there was no build-up of liquids. There had been experiements on insect breeding in the pits and it was found that 80% of the flies etc escaped through the vent pipe and 20% through the hole. If the surrounding area was kept clean and dry, flies would not find so many places to breed and the incidence of excreta-related disease would be reduced.

13. Mr OBADINA asked whether the VIPs were provided in public places or private houses.

14. Ms VANLANKVELD replied that both had been tried and monitored. A check had to be made on whther the public latrines would be kept clean, and whether private ones were properly maintained. Some had been provided in primary schools to help with health education.

15. Mr OBADINA felt that attendants should be provided to keep the public latrines clean. He also thought that provided each household realised that the latrine belonged to them they would look after it properly.

16. Ms VINCENT wished to know how much work of this nature was being done in other towns in Tanzania, and how finance would be provided for further work.

17. Ms VANLANKVELD said that her department was responsible for all the towns in Tanzania. Rural areas were the responsibility of the Ministry of Health, who with the help of UNICEF were carrying out several projects.

18. Mr WILLIS commented on the mention in the paper of conflicts between ministries and other bureaucratic problems. He wondered whether part of the problem was lack of proper organisation.

19. Ms VANLANKVELD agreed that this was a problem. It came down to weak organisational structure and poor planning.

20. Mr BUKY thanked the speaker and wished her luck with the implementation of such a massive programme.

General discussion

Water, women and waste

Mr PICKFORD introduced a general discussion session by saying how the Conference had heard much about women and their place. Mrs Ain and Ms Vanlankveld proved that there were women in developing countries who were articulate and often better able than many men to express themselves and enthuse people with the need for water and sanitation.

22. The Conference had heard of the need for more women public health engineers, although there were a few. He said that the 1981-82 WEDC MSc Course was expecting to have four women students.

23. Much had been heard of the suffering of women in getting water. There were hundreds of pictures available of women carrying water. The great need was to involve these women. Many of the speakers had described projects for water and sanitation in developing countries, but they had concentrated on a description of the technology. They had not said how they would involve the women and it was accepted that this was a difficult task.

24. He felt that the involvement of the ordinary women who carried the water was crucial to the success of the international water programme and he invited participants to enter into general discussion on how to go about getting this involvement.

25. Ms ELLINGTON felt that it was basically a problem of education. In many developing countries women were not allowed even primary education. She believed that this was the key: that once they had the opportunities for education, they would become more involved with the running of their countries.

26. Mr BUKY pointed out that some of the world's most powerful leaders were women and that teachers were often women.

27. Ms CHARD thought that it was difficult to get people involved when most of their day was spent in fetching water. Time was a factor in the problem. However, complaining was the first stage in getting involved. Once these women had realised their problem and begun to complain then the battle was half won. They had to be shown that there could be more to life than just fetching water.

28. Mr BUKY said that this was true in many places. But he was concerned that in Ghana and parts of Nigeria, commerce was in the hands of some very capable and forceful women, but there were none in the field of water and sanitation.

29. Dr BOURNE felt that the introduction of technology in water could often be destructive to the role of women. Although they did all the work they were at least in control of the situation. Once simple technology was introduced, such as handpumps, the men tended to take over and made the decisions and did the constructional work. The women no longer had control of the situation.

30. The potential of women to do other things when the burden of water-fetching had been taken away had also been mentioned. It was felt that women would then be free to take part in education and economic activities. However he knew of a study of this which had shown that in fact the women tended to use their new-found free time for resting. So there was a health benefit, but not necessarily any other benefit to them.

31. He felt that it was misleading to look at what some women did in one sector and then generalise for other sectors in other parts of the world. In many developing countries the class distinctions were strong, and in the upper classes of these countries there was little distinction between men's and women's roles. Here the women could become very powerful. But at the very bottom of the socio-cultural scale the women were in a very inferior position and had no opportunity for such powerful role-playing.

32. He stressed that it was important to avoid a sort of cultural imperialism in our view of the developing world. Equality was a new idea even in developed countries, and it was wrong to immediately try to impose these ideas on countries where it would simply be regarded as a fad. The process would be a slow one and required complete change in all sectors, not just the water sector.

33. Finally he agreed that education was crucial. Literacy for young girls was more important than anything else.

34. Mr BUKY said that developing countries were being expected to produce women to help

develop and implement the Decade targets. However some previous papers had mentioned that 50-60 years ago Europe was not much further ahead than many developing countries were now. He wanted to know whether in the course of development, european women had stepped forward and taken roles in planning etc.

35. Ms ELLINGTON said that this was just the point being made. At that time european women were not being educated. It was not until basic education was provided for them that they were in a position to become involved.

36. Mr JACKSON believed that, given time, women would emerge in all fields. He felt that the worst cases of the suffering women were in the poorest of the developing countries. He gave the example of Libya, which he first visited in 1960 when it was still poor. The women and girls carried water then and the girls were married off very early into a life of child-rearing. When he returned in 1978 after the development of the oil industry when Libya had become a rich nation, the situation was very different. The girls were being educated and becoming emancipated.

37. The key was economics. It was the same in this country. Women needed to work to help support their families.

38. Mrs AIN said that in Pakistan in the rural agricultural communities, the women worked in the fields alongside the men. They participated in all economic activities. Because it contributed to the family income they were allowed to go out to work.

39. She told how, when the education classes were first set up in Karachi, the organisers could not go directly to the women. It was the men who had to be persuaded because they were the decision-makers. She went to the men and asked if she could set up sewing and knitting classes for the women so that they could earn extra money. Of course the men agreed and contributed money to help buy the machines and provide a trained sewing teacher. After the sewing classes started, the organisers began to teach reading and writing as well. When the news of this got out many men objected, but they did not want to stop the scheme because their money was involved and much time and effort had been put in. So they agreed that the literacy classes should continue alongside the sewing. This was an example of a very successful scheme achieved through the provision of several benefits to the community.

40. Mr RUKOIJO belived that training and education still did not make women equal.

41. Mrs AIN said that equality was completely inappropriate for these women. It was an idea which did not occur to them. Education must begin on the day a girl was born, in what she saw other women doing around her. In Pakistan a girl was considered to be a burden. What did anyone expect from girls who were brought up in this way? It did not matter how highly trained they became. They might become doctors, but they were still basically very weak people who were subject to the wishes of their families, were married off as soon as possible and were then subject to their husbands and the husbands' families.

42. Mr PICKFORD asked whether in that case all the efforts being made by the UN and the World Bank and other organisations were being wasted because of this lack of education for women. Was the whole thing impossible?

43. Ms ELLINGTON pointed out that women were held back by men. The men in charge had to give opportunities to women. The idea of having to approach women through their men, as described by Mrs Ain, was a humiliating state of affairs.

44. Mr JACKSON thought that there would always be some women who would prefer to stay at home, just as there would always be men who did not want responsibity. He believed that opportunities did exist for women to be like the women present at the conference if that was what they wanted.

45. Ms CHARD said that it had taken a long time to get equality in developed countries, and care should be taken that our views were not forced onto people in developing countries. There was a given social structure in these countries which must not be destroyed.

46. She also believed that it did not matter whether change was initiated by men or by women, provided that change happened. There must be people who at a certain stage would put pressure on authorities.

47. Mr MURPHY gave an example of training courses for farmers which he had once visited in Kenya. In that country all the farmers were women but he had found that the people on the courses were all men. In Northern Nigeria where he had worked, the last course he had organised had 20% women participants, and those women had dominated the course. They were married women whose husbands had sent them to the course. So he believed that things were changing slowly. He also pointed out that education should be working the other way too, in providing courses for men in traditional womens subjects such as sewing. In this way the barriers could be broken down.

48. Mr MSIMBE said that different countries had different views of women and their roles. For instance in Muslim countries women were not supposed to be seen at all, so how could they be approached. How could they participate? Many villages still retained taboos regarding women.

49. Mr BUKY said that this was the point being made by the women participants, that change had to be made.

50. Mrs AIN thought that the education of men was also important. Where men were also illiterate and uneducated this worsened the position of their women.

51. Mr BUKY pointed out that the socialist and communist countries were reputed to have total equality of the sexes. Recently however, at a womens' congress in Moscow, the leaders had expressed the view that they had gone too far in this, that it was time to get off the tractors and put down the shovels and go back to the home.

52. Mr KIDD said that emancipation was a function of development. The most highly developed country in the world, the USA, had very dominant women, but in Islamic countries women were still second-class citizens. It was a matter of education - of men as well as women. Women had the same potential as men; they simply needed the opportunity to develop it.

53. Mr BUKY closed the conference by saying how much he had enjoyed the sessions. He expressed thanks to Mr John Pickford for organising the event.