



Economic and Social Council

Distr.
LIMITED

202.6
82MA

E/ICEF/L.1442
12 March 1982

ORIGINAL: ENGLISH

UNITED NATIONS CHILDREN'S FUND
Executive Board
1982 session

**MAINTENANCE OF COMMUNITY WATER SUPPLY
AND ENVIRONMENTAL SANITATION FACILITIES**

LIBRARY KD 4441
International Reference Centre
for Community Water Supply

CONTENTS

	<u>Paragraphs</u>
Foreword	1 - 2
Introduction	3 - 10
Problems affecting maintenance	11 - 29
Technical problems	14
Environmental problems	15 - 19
People problems	20 - 24
Administrative problems	25 - 27
Funding problems	28 - 29
Positive experience from UNICEF-assisted programmes	30 - 36
Solving maintenance problems	37 - 50
Technical solutions	37 - 38
Environmental solutions	39
Some solutions to people problems	40 - 44
Administrative solutions	45 - 48
Solutions to the funding problems	49 - 50
Conclusion: needs and potential for further development maintenance	51

7992C

82-06008

LIBRARY, INTERNATIONAL REFERENCE
CENTRE FOR COMMUNITY WATER SUPPLY
AND ENVIRONMENTAL SANITATION
P.O. Box 435500, 2100 AD The Hague
Tel. (070) 814911 ext. 141/142

RN: 24441 3138
LC: 202.6 82MA

202.6-82 MA-3138

Foreword

1. In addendum 3 of the 1981 general progress report of the Executive Director, the Executive Director indicated that "maintenance of water supply systems continues to be a concern to Governments and UNICEF. Maintenance plays an important role in a community's health, as a water supply can only bring convenience and health benefits while it is working, and any benefit from it is unnecessarily limited if it frequently breaks down" (E/ICEF/681(Part II)/Add.3, paragraph 36).
2. During the Board discussion, concern was expressed about the maintenance and operation of drinking water and environmental sanitation installations in some project areas. The Board "believed that UNICEF should considerably strengthen its co-operation in programme planning and promotion of governmental services and community participation in the maintenance and operation of such installations. It was requested that the Executive Director report to the Board at its 1982 session on the status of maintenance of these installations" (E/ICEF/685, paragraph 135). The present report responds to this request.

Introduction

3. It should be borne in mind in the following that operation and maintenance of water supply and sanitation facilities normally is the responsibility of the communities and their individual citizens, with support by the Governments in appropriate cases. UNICEF's role, jointly with that of the other United Nations bodies under the auspices of the International Drinking Water Supply and Sanitation Decade, 1981-1990 (IDWSSD), is to promote government policies and to assist in developing adequate maintenance and repair systems as well as appropriate operational practices.
4. UNICEF is involved in drinking water supply and sanitation programmes in almost 100 countries. Systems have been constructed and put into use in the most marginal rural and peri-urban areas. The objectives are to improve the health and well-being of children and women, and by implication, the entire communities. The estimated total of UNICEF expenditure on water and sanitation programmes for 1981 amounts to \$45 million.
5. Along with other external agencies and Governments, UNICEF began to deal with water supply and sanitation problems on a large scale in the mid-1960's. Many large programmes originated from emergencies such as the drought in Bihar and Orissa in India (1965-1967), the great drought in the Sahelian region (1972-1974) or situations of human conflict such as the Sudan which ended in 1972. Immediate action in these cases concentrated on the survival of the local inhabitants. In some cases, this meant introducing sophisticated technologies such as rapid water well-drilling to provide the necessary water sources at a sufficient rate.

6. Most of the emergency situations were resolved and a new phase of rehabilitation and assistance to Governments ensued in order to build up a structure and capacity for long-range improvements of these essential community services. With the lack of experience among all participating organizations and the technological means being very ill-adapted to conditions of developing countries, the first thrust was very much on development of technologies.

7. Emergency situations mostly created a top-down approach. This could result, for instance, in government crews entering villages with a high-speed drill rig, sinking a borehole within a few days, installing a hand-pump and then leaving the villagers to cope with it as best they could. The results in many of these cases were almost disastrous. In one case, in a major village water programme, 80 per cent of the hand-pumps were reported out of order after two years of operation.

8. This high rate of failure initially experienced caused major concern both within UNICEF and other organizations. Consequently, increasing attention was paid to the operation and maintenance of installations as a crucial element of any programme. The following analysis covers the more specific aspects of maintenance as seen against the whole host of factors determining programme impact.

9. These factors include the beneficiary populations themselves, their environment, physiography (topography, climate, water sources, etc.) and organic aspects (disease patterns, pathogens, vectors, food, biological environment), the ecology, the socio-cultural setting, administrative structure and policies as well as human resources. They include the technical systems involved (high versus low-cost technology, water supply systems with hand-pumps, power pumps and gravity flow). To these are added the different types of excreta disposal and disposal of other wastes.

10. This report gives a brief overview of the problems encountered, some positive experiences from UNICEF-assisted programmes, some possible solutions attempted and a brief list of conclusions.

Problems affecting maintenance

11. There are several individual types of problems, described below in some detail, but they have to be seen jointly. They concern technical approaches, problems of environment, administration, funding and primarily, people. The variety of problems is tremendous. Sometimes they are quite unexpected at the beginning of a programme. The present description is based on a combination of previous experiences and a series of specific reports from countries which were received during the last months of 1981 and the beginning of 1982. These reports clearly indicate that a major cause of failure has been the lack of preventive maintenance due to a shortage of skilled technical personnel and,

/...

Ref
100 3 11 11 11 11 11 11

at the same time, a lack of motivation and ability of the communities to take care of this fundamental task. Thus, corrective maintenance, even though it plays also an important role, remains a consequence of the failure of prevention. Therefore two areas need to be addressed: the building up at community level of a human structure capable of taking care of preventive maintenance simultaneously with a technical and administrative structure which could be in charge of corrective maintenance. It is clear that the two structures should be mutually supportive.

12. Central to the UNICEF-assisted hand-pump rejuvenation and maintenance programme in India is the "three-tier maintenance system for hand-pumps". This system was introduced in 1975 and is now being extended all over the country: hand-pump "caretakers" from each village are trained not only in simple hand-pump maintenance, but also in health education and, in certain cases, other elements of improvements with appropriate technology. This constitutes the first tier. The second tier consists of roving mechanics, paid by the district authorities, who backstop the caretakers and report major breakdowns which need the attention of the third tier, mobile maintenance teams on the district or state level. The system is coupled with community motivation and decision-making processes.

13. In Guatemala, UNICEF is sponsoring the training for supervisors, inspectors, technicians, masons and caretakers. The programme evolved from the lack of practical know-how of some personnel working in rural water supply activities. At the same time, however, the project was designed to reduce maintenance to a minimum since no mechanical equipment is used in construction of the majority of water systems, which are spring and gravity systems. The improvement of technical skills on one side and the reduction of maintenance problems on the other have reinforced each other and the programme is effective.

Technical problems

14. Such problems concern the selection, design and quality of the equipment and materials supplied for use and their relationship to cost and human behaviour. There are also the maintenance problems of equipment and materials used for the construction of the facilities (e.g., drill rigs, vehicles, etc.). The lack of standardization can have consequences for the availability of spare parts. In several countries, pumps of many different manufacturers require a great quantity of spare parts.

Environmental problems

15. Among the environmental problems encountered in many programmes are those affecting certain geological or geographical regions through poor water quality due to high salinity or contents of fluorine, iron or manganese. These may severely hamper the access to groundwater in many areas or the acceptability by the water users (taste, discolouration). Similarly, there is the phenomenon of increasing salinity by overuse of groundwaters in coastal areas or near other sources of salt pollution. In Sudan, hardness of water caused chemical action with leather gaskets, corrosion of steel rods and rising mains, and erosion of hand-pump tubewells platforms.

/...

16. In Banqladesh, because of the corrosive ground water in some parts of the country and unfavourable ground formations, some of the tubewells have become choked-up and need replacement or resinking. In Kenya and Ethiopia siltation problems in surface reservoirs involved using subsurface dams.

17. Another problem is that of a general lowering of the water table through increased needs of an enlarged population with more water sources being opened up through intensive water well drilling. For example, in the Coimbatore region of southern India, deep-well power pumps of major consumers, such as industries or larger farm estates, can literally suck the water away from shallower tubewells with hand-pumps used in villages. Likewise, the overdrawing of groundwater in the region of Sana'a in Yemen, due to population increase, irrigation and limited industrialization, has dried out many wells. These problems are partly the result of natural causes such as the lack of sufficient recharge or adverse hydrological/hydrogeological conditions, partly influenced by the lack of water resources management backed up by the necessary legislation.

18. Other equally difficult environmental problems include catastrophic flooding or erosion around water and sanitation installations, e.g., when appropriate afforestation measures were not taken in upstream catchment areas, or diverting channels were not constructed. UNICEF-assisted projects in Nepal are now subject to particular measures through specific guide-lines for maintenance, complete instructions for the completion of projects including a handbook on gravity-flow water systems. This is followed up at the field level through adequate support communication with village water maintenance committees and village maintenance workers. In Guatemala, 76 per cent of the communities in the UNICEF-assisted projects were provided with safe water by gravity systems. Here, protection of springs and watershed treatment was undertaken, as well as other preventive measures such as upstream diversion ditches to avoid erosion and assure permanent water discharge.

19. Yet other problems, sometimes unexpected, can be caused by wildlife, e.g., baboons thrashing the glass panes of the solar distillation plant recently set up in a coastal village in Somalia, hyenas chewing plastic pipes or elephants uprooting pipe joints or knocking down hand-pumps in other parts of East Africa.

People problems

20. This is the most basic and most difficult set of problems to tackle. Technical problems can be overcome, subject to research and development within a short period. With environmental problems, nature can be contained. Administrative and funding problems can be tackled through suitable promotion of policies and fund-raising. But to promote proper use of water and sanitation installations involves an understanding of the basic causes of diseases and poverty and complicated long-term processes of education and motivation.

21. People problems can also be purely numerical. Many countries report that, even with full understanding and community participation, problems remain because there are too few taps or too few hand-pumps to serve all the people. Often, the number of users exceeds the generally accepted maximal number of 250 persons per hand-pump or about 100 per public standpost (tap). When many people are required to use the same water point, the result is a greater wear and tear on the equipment and unhygienic surroundings. Moreover, overcrowding tends to dilute people's sense of ownership and responsibility for the water point and makes organization of maintenance and clean-up more difficult.

22. Other problems with people are the distances to the water points. Experience shows that if people are more than 200 metres from a pump (or a tap) with good water, gradually lower amounts of water will be taken home. At larger distances, the use of uncontrolled water sources can increase, resulting in negative consequences for hygiene and health. These problems can be overcome with appropriate project design and development, but are also a function of how many water points can be installed given a mostly limited funding level.

23. Damage to installations is mostly unintentional but nevertheless severe. Vandalism for its own sake is much less frequent than the unintentional damage which may be caused by playful children putting stones into pump orifices, or mountain shepherds slashing into a free-lying section of plastic pipe to slake the thirst of their herd.

24. Entrenched social attitudes, beliefs and traditions can underlie a lack of maintenance. They can make people go back to their traditional contaminated water sources or not use properly built latrines. The absence of traditional taste in safe tubewells or the taste and colouring of iron-laden but otherwise safe waters can make a whole population desist from using a new safe water source. This often results in neglect of the installations, in spite of the good physical and chemical quality of the water. This was the initial reaction of the Navenchauc community in the highlands of Chiapas, Mexico, which, two years later, became one of the leading communities in community participation activities with a high degree of acceptance of the new safe water sources and the concept of sanitary excreta disposal.

Administrative problems

25. Again, as in other sectors of development, there is a host of problems. They include lack of motivation in terms of policies and priorities at high government levels; problems of administrative structure; too great attention to city problems while rural areas are neglected; and low inducements to planning and supervisory national staff to go out to the most needy areas.

26. The lack of supervision of maintenance due to the lack of trained government personnel and village-level maintenance personnel is rampant. This is one of the major concerns of Governments and for the planning and promotional activities of the IDWSSD. UNICEF's part in this is to support training people for operation and maintenance at intermediate and community levels.

27. Another administrative problem strongly related to maintenance is supply and logistics (equipment, materials, spare parts, fuel, chemicals and transport). Long distances, bad or no roads, lack of communication facilities and absence of vehicles can also hamper maintenance.

Funding problems

28. Activities to support maintenance of water and sanitation systems at country and global level require adequate government and community funding. The general trend so far has been to allocate financial resources to the construction of new schemes rather than to commit funds to the support of maintenance and repair of older installations.

29. At present and on average in the developing countries, 20 per cent of capital investment costs come from external contributions, 40 per cent from government budgets and 40 per cent from the communities, the latter contributing in cash, labour or kind. These figures seem to indicate also that funding for maintenance could be available at the local level. In some countries, communities are willing to support the operating and maintenance costs. This is the case in the Republic of Korea and in Mexico. In other countries, communities are not yet motivated to meet such costs. This poses a problem, although it seems that even the poorest community manages somehow to buy water, even when it is available only from water vendors at prices 10 to 20 times those charged by communal systems. There are examples of water of doubtful quality being sold at over \$10 per cubic metre.

Positive experience from UNICEF-assisted programmes

30. Despite the above problems, the experience gained by UNICEF at field level over several years of co-operation in this field can be encouraging. This section highlights activities which allowed us to deal with the problem of maintenance in a optimum way.

31. As a global figure, about 80 per cent of water systems constructed are currently in operation. In Bangladesh, in the programme assisted by UNICEF and WHO during 1973-1980, the number of constructed tubewells with hand-pumps was 393,263, of which 341,109 (87 per cent) were in operation in 1980. Of the 13 per cent of tubewells which were choked up, 40 per cent would have to be replaced or resunk; the remainder could be restored to working order through adequate replacement of spare parts or minor adjustments.

32. In Indonesia, government field reports indicate the following figures, as percentages in operation, of systems constructed from 1979 to 1981: shallow well (suction) hand-pumps, 73 per cent; deep well (lift) pumps, 76 per cent; piped systems (23 gravity, 4 with pumping equipment), 91 per cent; and rainwater collectors (18 m³ and 9 m³ capacity), 84 per cent. Most systems which are out of order (an average of 19 per cent) are reported to be repairable.

33. In Mali, 85 per cent of the new wells are in operation. In the Philippines in 1980, of a total of 22,572 wells with hand-pumps, 73 per cent were operational. In the Bahr el Ghazal Project in the Sudan, 69 per cent of the 420 hand-pumps are working.

34. The Tirunelveli project in India provides positive results on the effectiveness of the so-called "three-tier maintenance system", mainly due to participation at the village level through the village hand-pump caretaker. Prior to the caretaker programme, the average number of non-operative hand-pumps was often as high as 60 to 70 per cent; this average fell dramatically to 10 per cent and less soon after the caretakers started work.

35. Environmental sanitation also has its maintenance problems involving materials and design. Even more so, the use and maintenance, e.g., of latrines, is subject to attitudes and habits. In one country in South East Asia, the acceptance of latrines with plastic water-seal pans was poor and the community initially reverted to traditional patterns, defecating in the open around the villages. Whenever sufficient health education and motivation were provided, and wherever people contributed at least some of the funds or with materials and labour, this problem could be overcome. Great difficulties remain, however, with communal latrines used in schools, health centres or marketplaces which often fall rapidly into misuse and utter neglect.

36. Intense health education, especially in schools, as well as more attention to suitable design measures (e.g., smaller holes for children, fly traps, ventilation pipes - painted black and placed on the sunny side, etc.) and access to liberal amounts of water for cleaning can result in better use and upkeep. In northern India, voluntary organizations have provided communal latrine and bath (shower) facilities for a small fee. This fee provides the user with a piece of soap and pays for the services of latrine cum-bathroom attendants to keep the place clean. These neatly maintained facilities are gaining great popularity in otherwise underserved communities. A few years ago, in a basic health project in the south of Haiti, sanitary units were installed with showers, wash-sinks and standposts, which were well accepted by the communities.

Solving maintenance problems

Technical solutions

37. Solutions to technical problems caused by adverse weather and hydrogeological conditions are a matter of proper installation of well screens, gravel pack filters, spring catchments or latrines. This can go a long way to prevent silting up of tubewells, for instance. A very recent development in this respect, partly originating from UNICEF, is the design of low-cost, pre-packed gravel filter screens which can easily be produced in developing countries.

38. The development of simple sturdy hand-pumps, such as the India Mark II Hand-pump and the New Number 6 Bangladesh Hand-pump, together with a certain standardization at the national level, have gone a long way to simplify maintenance and make it less expensive. In this context, there is active UNICEF participation in two global UNDP projects executed by the World Bank. One is for testing and further improvement of hand-pumps, the other for low-cost sanitation techniques. These two major projects have reached a stage where the initial research and studies, including extensive laboratory tests, are now being supplemented by large-scale field testing and demonstration projects around the world. Some project areas were chosen with direct UNICEF involvement, others with the active co-operation from a number of bilateral organizations. The urban communities development project in Rio de Janeiro, Brazil, sponsored by UNICEF in the favelas, is one such demonstration area.

Environmental solutions

39. One field of environmental concern where action should be possible is water resources control and management. Much greater knowledge, government authority and supervision are needed in many parts of the world. As to support from the United Nations system, this is primarily the mandate of the United Nations Secretariat, UNESCO and the World Meteorological Organization (WMO). UNICEF is involved locally in a few countries with support to this element, when it is directly connected with ongoing water supply programmes (Benin, Burma and Pakistan). In Burma, a special hydrogeological team and project staff were appointed to make a survey and to effect the relevant follow-up. Other simple protective environmental measures include the building of fences around hafirs (rainwater catchment dams), isolated hand-pumps, and dam walls to keep out cattle and wild animals.

Some solutions to people problems

40. Particularly during the last two years, UNICEF considerably increased its motivational activities connected with water and sanitation as part of the health delivery system. These are directed towards planners and implementers at different government levels, in co-operation with other agencies, such as WHO, UNDP and the World Bank, as well as with NGOs. This also aims at combining water and sanitation activities with primary health care, nutrition, family food production and integrated community development. It takes time to achieve the desired integration, since government services in general function sectorally.

41. Considerable progress, however, is being made, as in the Baluchistan Integrated Area Development scheme, in western Pakistan. Multidisciplinary mobile teams work with village volunteers to simultaneously tackle health care, education, immunization and the digging of latrines. Another example is the integrated project in Chiapas, Mexico, where the various government services at field level worked closely together, with youth and women's organizations playing an important role in developing water and sanitation projects and assuring maintenance at community level. In rural remote areas of Guatemala, community initiative, organization, implementation and maintenance are focusing on water supply with excellent results, stimulating other community-based activities, such as the construction of health posts,

/...

school repair, volunteer health work and participation of rural school teachers in social activities for women and youth. In Kenya, a UNICEF/NGO water for health project represents a "model" example of women's participation, which extends into energy conservancy, village technology, and training of local co-ordinators.

42. Vandalism and unintentional destruction can be counteracted by education and by changes in design, such as providing sharply angular spouts for pumps to prevent children inserting stones or sticks into the pump. Latrine designs have been changed following similar experiences, including modification of the chutes from water seal latrines so as to allow the water poured from cans to flush properly.

43. Responsibility for repairs of hand-pumps and other common facilities often is not clearly spelled out and therefore maintenance is neglected.

44. In such and other cases of unclear responsibilities or reliance on higher authorities, community involvement is the best solution. Experiences from UNICEF-assisted projects in Thailand show this clearly: (a) social preparation in the villages has enhanced community participation and co-operation in project activities; (b) the training of village caretakers has ensured longer working life for UNICEF-assisted water systems; (c) the involvement of village development committees in siting the deep wells and the use of village health volunteers and village health communicators to promote the use of clean water has improved the end-use by the villagers; (d) social preparation activities have made the villagers feel that the deep wells are "owned" by them and they are, therefore, willing to maintain and repair their pumps on a self-help basis; and (e) funds for water resource development and maintenance can now be raised within the communities themselves through local committees.

Administrative solutions

45. The motivation of a good number of Governments to strengthen their own structures and increase budgets has been given considerable impetus by the promotional work of the United Nations agencies and UNICEF under the IDWSSD auspices. In Bolivia, the UNICEF-assisted water and sanitation projects are directed by the local development commissions instead of a central government department. This allowed the establishment of repair and maintenance systems through the local administrative boards and village committees, which also collect tariffs to meet maintenance and, in some cases, repair costs. In Morocco, a new water and sanitation project promoted by UNICEF with funding from the Arab Fund for Economic and Social Development (AFESD), will involve the setting up of provincial and village maintenance teams.

46. Under the auspices of the IDWSSD, a number of Governments have held, or will be holding, national conferences. Among countries which have already held such conferences, resulting in resolutions for intensified national planning and streamlining of government administration, are Burma, Pakistan and Thailand. Maintenance and the various socio-economic concerns in this context are foremost on the agenda. The same aspects are also stressed in information and project support communications work carried out with UNICEF support.

47. At the global level, the promotion of policies to reinforce structures for operation and maintenance of water and sanitation installations is being undertaken through various channels and through different organizations in the United Nations system.

48. Much remains to be done on the many different aspects of supply and logistics, particularly in strengthening government capacities and know-how and overcoming certain administrative constraints in many countries. This particular field is subject to special attention in the global planning of inputs from the United Nations system through the Steering Committee for the IDWSSD.

Solutions to the funding problems

49. This complex matter is closely linked with the administrative approaches, especially on the community level. It is also closely linked with supply and logistics, especially the availability of spare parts and - where water treatment is carried out - of chemicals. As mentioned above, most or all of the operation and maintenance costs will have to be, or are borne, by the communities themselves. Depending on government policies, the concept of levying a water fee or a water tax, established on a household or per capita basis, is being accepted and introduced in some countries. The capacity of communities to fund the operation and maintenance of their own water supply can be improved, particularly when the water supplied from the community system is less expensive than that from water vendors.

50. For initiating proper maintenance and repairs, a supply of basic tools and spare parts must be made available. Therefore, such items are a significant component in UNICEF-assisted projects. UNICEF's provision of appropriate and inexpensive tools include the "universal spanner" developed in Bangladesh and the special tool set for installation and repair of the Mark II Hand-pump in India.

Conclusion: needs and potential for further development maintenance

51. A number of factors need to be strengthened in the planning and programming of future water and sanitation activities. Most of these concern the entire scope of the water and sanitation programmes and projects, but also have a direct bearing on the possibilities for improvement of maintenance, including:

(a) Encouragement of government policies which support the continuity of projects;

(b) Systematic establishment of background knowledge of socio-cultural attitudes and patterns;

(c) Analyses of the prevalent disease patterns in individual project areas. From these follow suitable adaptations of the technical designs for lessening the impact of diseases on the populations, their health and their well-being;

(d) Mandatory inclusion in the programmes of health education and community motivation supported by project support communications;

(e) Further development of systems and specific technical designs, local energy resources, materials and means of production, both of capital items and of spare parts and tools;

(f) Intensified training and development of human resources at all levels for preventive and corrective maintenance. Special attention should be paid to encourage the participation of women in all phases of the planning, installation, operation and maintenance. This implies educational and training activities specifically directed towards the women in the communities;

(g) Exchange of experiences and information on the organization of maintenance, particularly at the community level;

(h) Encouragement and guidance for funding by the community itself of operation and maintenance and for the overall replacement of worn-out equipment and material after a number of years; and

(i) Monitoring, supervision and product evaluation of the condition of water and sanitation installations in all project areas, as a direct tool for keeping up efficient and proper use by the inhabitants and a continuous impact on their health and well-being, particularly that of their children.
