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Ten Years of Experience

Community Water Supply and Sanitation Programme Pokhara, Western Development Region, Nepal

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Ten Years of Experience

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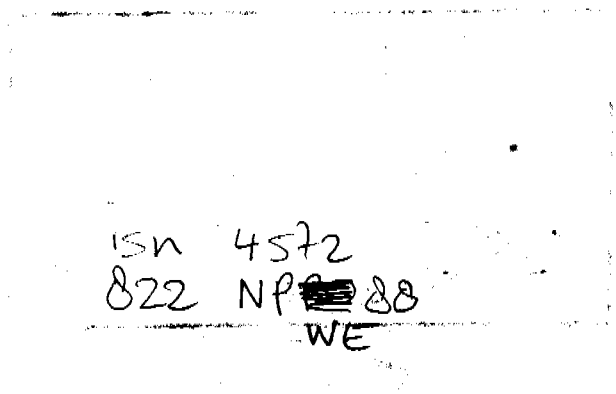
TEN YEARS OF EXPERIENCE

COMMUNITY WATER SUPPLY AND SANITATION PROGRAMME, POKHARA, WESTERN DEVELOPMENT REGION, NEPAL

Marieke Boot and Han Heijnen



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Abstract

The developments and achievements over a ten-year period of the Community Water Supply and Sanitation Programme, Pokhara, in hill areas of the Western Development Region of Nepal are documented. The programme concerns gravity fed water supply schemes with public tapstands, and school and household latrines. It is a joint effort of four parties: rural communities, the Nepali Government, and donor organizations UNICEF and SATA/Helvetas.

Programme developments are traced from initial focus on standardization of design and procedures with due attention to manpower training and recruitment. Over the ten-year period the emphasis has changed increasingly to promotion of sanitation and maintenance with due attention to rehabilitation of completed schemes. More recently personal and environmental health have been promoted as a means to increase the benefits of new water supplies. Experience in this community based, low-cost programme shows how the committed effort of all parties has made steady and sustained progress in building and extending the programme.

Keywords: Nepal; case studies; gravity supply; public standposts; latrines; programmes; manpower development; maintenance; community participation; health education; training; rural areas; design.

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List of Abbreviations

BSLD	=	Basic Services for Local Development
CWSS	=	Community Water Supply and Sanitation
GNP	=	Gross National Product
HDP	=	High Density Polyethylene
HMG	=	His Majesty's Government
ITDG	=	Intermediate Technology Development Group
KTM	=	Kathmandu
lcd	=	litre/capita/day
LDD	=	Local Development Department
LDO	=	Local Development Officer
MPLD	=	Ministry of Panchayat and Local Development
NGO	=	Non-Governmental Organization
PCRW	=	Production Credit for Rural Women Project
PDTC	=	Panchayat Development Training Centre
RD	=	Regional Directorate
SATA	=	Swiss Association for Technical Assistance, the former English title for the Swiss non-governmental organization Helvetas
SFDP	=	Small Farmers Development Programme
UNICEF	=	United Nations Children Fund
VMSC	=	Village Maintenance and Sanitation Committee
VMSW	=	Village Maintenance and Sanitation Worker
VMW	=	Village Maintenance Worker

Currency equivalent:

1976: US$ 1.00 = Nepali Rs 12.54
1982: US$ 1.00 = Nepali Rs 13.10
1986: US$ 1.00 = Nepali Rs 20.00

Preface

At the request of UNICEF, Nepal, and the Swiss Association for Technical Assistance, Helvetas, ten years experience in the Community Water Supply and Sanitation Programme, Pokhara, in the Western Development Region of Nepal has been recorded. This task was undertaken by Marieke Boot, Research Officer of IRC and Han Heijnen, the Programme Manager in Nepal from 1982 to 1986. We have prepared this case study in the conviction that sharing this experience will encourage others to view their own projects in a wider time frame. Through this study we hope also to demonstrate that sustainable achievements in community based water supply projects are possible with committed effort and enthusiastic support of all those concerned.

Preparation and publication of this document have been made possible with financial assistance from UNICEF/Nepal and Helvetas, Switzerland.
Numerous people contributed to this account. Much information was communicated in informal discussions with officials from the Ministry of Panchayat and Local Development, UNICEF and Helvetas, the Director and staff of the Regional Office in Pokhara, project staff in Pokhara and Chaurjahari, women development workers of the Production Credit for Rural Women Project, and villagers both men and women, water committee members and village maintenance workers. The numerous reports and documents consulted in preparing this case study are presented in the List of References. A number of drawings prepared for educational purposes by Durga Baral and his colleagues have been included.

Valuable contributions were made to the report of programme activities by a number of people in their review of the manuscript. In particular we would like to mention Markus Engler, Helvetas/Pokhara; Andres Wiederkehr, Helvetas/Zurich; Larry Robertson, UNICEF/Nepal; Colin Glennie, UNICEF/Bangladesh and Martin Strauss, IRCWD/Dübendorff.

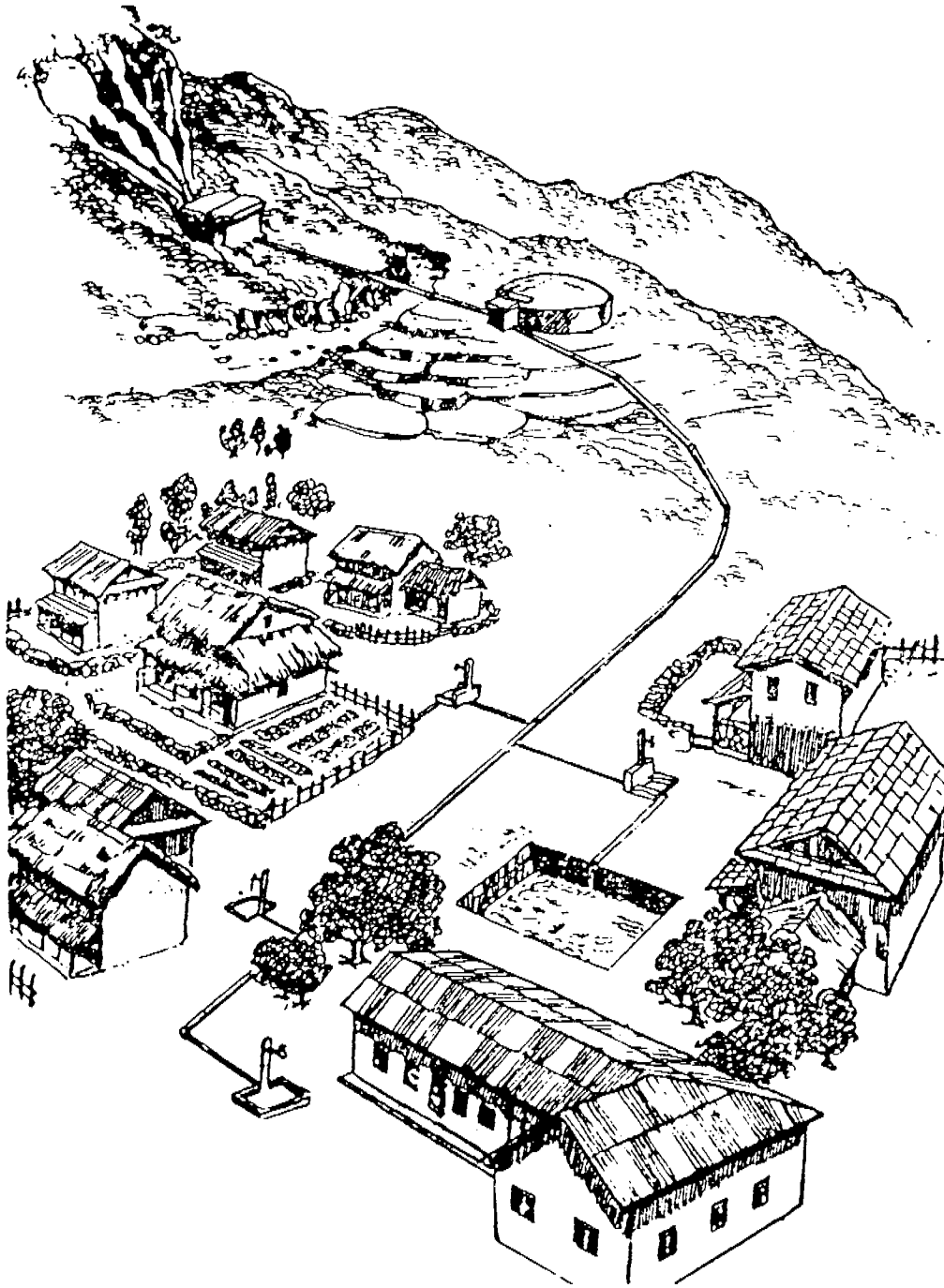
1. Introduction

Water supply and sanitation programmes do not prosper overnight. Time is needed for manpower training and institution building, development of design standards and implementation procedures, establishment of optimum targets and integration of related activities to maximize potential benefits of water supply and sanitation. The progress and achievements over a ten-year period of the Community Water Supply and Sanitation Programme, Pokhara, in Nepal demonstrates this.

The small Kingdom of Nepal is wedged between the tropical lowlands of the Indian Plain in the south and the Himalayan mountains in the north. More than half of the 17.6 million population live in the hill lands between these two extremes. Adverse physical conditions make communication difficult and slow and most villages are only accessible on foot. Traditionally rural communities have depended on unprotected springs and streams for their water supply. The targets set for the International Drinking Water Supply and Sanitation Decade (1981-1990) were improved water supplies for 67% and sanitation facilities for 13% of rural communities. These targets have been adjusted recently. The current plan is to provide basic needs to all Nepalese by the year 2000, including safe water for everyone. In 1980 responsibility for rural water supply was transferred from the Local Development Department (LDD) to the Ministry of Panchayat and Local Development (MPLD). In December 1987, all water supply and sanitation programmes and activities were placed under the new Ministry of Housing and Physical Planning (see Appendix).

The Community Water Supply and Sanitation (CWSS) Programme, Pokhara, covers the hill areas of the Western Development Region of Nepal. The programme concerns gravity fed water supply schemes with public tapstands and school and household latrines. Four parties are working together in the programme: rural communities, the Nepali government, and the donor organizations UNICEF and Helvetas. Until recently foreign volunteers have contributed greatly to overcoming the shortage of qualified manpower.

It has been decided to document the experience gained in this community-based, low-cost programme and to show how the committed efforts of all parties has made steady, sustainable progress in building and extending the programme. Looking back over the ten years of the programme, it is now possible to place developments and activities in context. For example, at the time, the first training course for technicians was evaluated as being disappointing. Yet viewed in the ten-year time frame, this was certainly a positive step in establishing relevant training courses to ensure manpower development for continued programme advancement.



Gravity piped water supply schemes with spring catchment, ferrocement tank reservoir, public tapstands, and waste water use for cattle pond or vegetable garden are being constructed under the CWSS Programme

The CWSS Programme, Pokhara, is part of the national programme carried out jointly by His Majesty's Government (HMG) and UNICEF with additional donor funds. The developments described are not necessarily unique to the Western Development Region. The same are taking place, although at differing rates, in the other four Development Regions of the country. The CWSS Programme, Pokhara, has been taken as an example because it was the first to start, thus taking the lead in trying out new approaches and procedures. Where possible alternatives developed in other regions have also been included.

Programme development has greatly benefited from cross-fertilization of ideas and experience between the Development Regions. A commendable flow-on from the programme is the development of national guidelines and procedures and a nation-wide programme for community piped supplies and sanitation.

The programme started in 1976 as a follow-up of the regular HMG/UNICEF water supply programme which has been running since 1971. During the first years efforts were concentrated on improving construction including standardization of designs and procedures. Much attention was given to recruitment and training of manpower. Gradually more time has been devoted to promotion of sanitation and maintenance, with rehabilitation of completed schemes becoming an important issue. The physical achievements

Table 1: Number of completed water supply schemes under UNICEF assisted Community Water Supply and Sanitation Project

	No. of schemes	Total population served	Total cost (US$ '000)
Western Development Region			
Before 1976	32	60 000	576
After 1976 (Noted A)	214	220 000	3 971
Eastern Development Region			
Before 1976	12	9 800	196
After 1976 (Noted B)	136	120 400	2 416
Mid & Far Western Development Regions			
Before 1976	13	6 600	132
After 1979 (Noted CDE)	141	130 200	2 826
Central Development Region			
Before 1976	13	15 600	312
After 1982 (Noted G)	36	41 600	575
Total	597	604 200	11 004

of the programeme are summarized in Table 1. Recently, a further shift has been made to the promotion of personal and environmental health to increase the benefits of the new water supplies.

A very important feature of the programme has been the increasing appreciation of the value of community participation for the success of water supply and sanitation activities. From the start, the initiative for a water supply scheme had to come from the community through their elected village panchayat and district panchayat. Right from the beginning communities were invited to form user committees. However, it was only slowly understood that programme success depended on a partnership of programme staff and communities in every aspect, from initial request to operation and maintenance. To this end, the programme has placed emphasis on communication and the active involvement of both men and women.

An overview of the districts in the five regions where the programme is being executed is given in Figure 1.

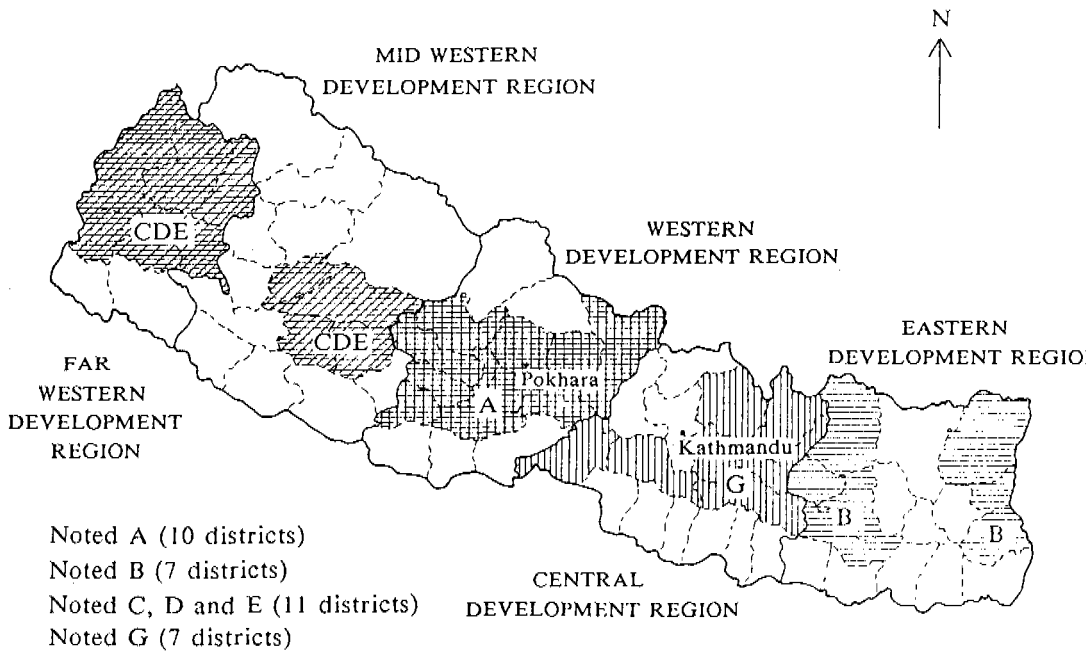


Figure 1: Districts in five regions of Nepal where the CWSS Programme is being implemented

PART I
Developments and Achievements

2. *Origin of the CWSS Programme, Pokhara*

2.1 History

In 1971 His Majesty's Government (HMG) and UNICEF embarked upon an ambitious programme to develop piped water supply schemes in hill area villages where the need for water for domestic purposes was greatest. The overall objective was to improve the health status of the population in general and young children in particular. The programme covered all Development Regions. Because of the shortage of Nepali engineers most village schemes were implemented under the guidance and supervision of foreign volunteers. Voluntary labour was provided by the villagers. By the end of 1976, 70 schemes were registered as being complete.

According to an undated UNICEF report, the programme met with many problems. One of the main difficulties was a lack of trained manpower, especially masons and pipefitters. The foreign volunteers, on whom the programme depended, did not have the necessary experience and were not involved in the programme long enough to gain that experience. Technical design and construction of schemes were generally poor, and little provision was made for preventive maintenance and repair. Delays in transporting materials hindered implementation and even led to some schemes never being completed. Other problems were related to arbitrary selection of villages. For example, some schemes were not requested by the villagers themselves, but by town dwellers on behalf of their home villages. This invariably led to difficulties in generating community support for implementation.

Thus HMG/UNICEF decided on a new programme, the Community Water Supply and Sanitation Programme, and defined more specific objectives for implementation. One objective was to provide safe drinking water for selected communities in accordance with agreed criteria (UNICEF, 1975, p.5). The criteria were:

- A request for a drinking water scheme must be lodged with Local Development Department (LDD) by a village panchayat through the district panchayat.
- The need for drinking water must be genuine.
- The water scheme must be simple, with per capita cost not exceeding NRs 100 Rupees (1975 prices).
- Community participation in transporting pipes, provision of local materials, construction, and regular maintenance must be guaranteed in writing by the village panchayat.

- Villages with primary schools and health posts will be given preference, provided taps and drainage are included in the scheme for each school and/or health post.
- Schemes will be allocated on a first-come, first-served basis, with priority to areas with other UNICEF supported development activities (UNICEF, 1975, Annex D) .

Other specific objectives were set out for training of all levels of technical staff and also of villagers in the maintenance. Several experiments were planned, including development and implementation of standard designs, introduction of cement substitutes to counter the problem of high cost of this material and organization of village-based operation and maintenance.

In support of improved project design and implementation, UNICEF published a reference book entitled "Standards and procedures for the design of watersupply systems in rural areas of Nepal and Bhutan" (Johnson, 1976). Compiled by a Peace Corps Volunteer, this book covers village survey and feasibility study, design period, population and water demands, construction of schemes from intake to public tap, water quality control, and use of windmills and hydraulic rams.

To overcome the acute shortage of trained manpower, expatriate engineers would be employed to assist with programme development. Retired soldiers living in the village panchayat areas were expected to assist with implementation. Their basic technical training in the army was assumed to be sufficient to enable them to build the schemes. As many of these ex-servicemen were living in the Western and Eastern Development Regions, HMG/UNICEF decided to initiate "noted" projects in these regions to increase the rate of implementation. A "noted" project is a UNICEF assisted project, using additional donor funds to supplement the regular UNICEF budget.

For the "noted B" project in the Eastern Development Region, UNICEF received a special contribution from the Netherlands Government. For the "noted A" project in the Western Development Region, the Swiss Government provided UNICEF with a budget of US$ 511 000. In addition, SATA/Helvetas made two engineers available to support the project. The project's name would be Community Water Supply and Sanitation Programme, Pokhara (CWSS Programme, Pokhara). The project was to be implemented on the same terms and conditions as the regular HMG/UNICEF programme for 1976-1980.

Noted C, D and E projects started in the Mid and Far Western Regions (then one Region) in January 1979 with a contribution from the Fuji Network and the Netherlands National Committee for UNICEF. It was not until 1983 that the Noted G project started in the Central Region with funding from EEC.

2.2 CWSS Programme, Pokhara

The CWSS Programme, Pokhara was to start in July 1976 and would include six districts: Gorkha, Tanahu, Lamjung, Kaski, Parbat and Syangja. These districts were selected because they are fairly accessible from the road linking Kathmandu, Pokhara and Tansen; are located close to each other and to Pokhara; and have experience in water supply construction under the regular HMG/UNICEF programme. With the assistance of the British and Indian army depots in Pokhara, a Government survey revealed almost 200 ex-servicemen who claimed to have knowledge of water supply construction and pipe fitting. The programme would cover 100 schemes, supplying water to about 65 000 people. Each system would be on average 4.5 km in length. Programme duration would be between two and two and a half years.

As in other Development Regions, the CWSS Programme, Pokhara, would be the responsibility of the Regional Office of the Ministry of Panchayat and Local Development (MPLD), at that time called the Local Development Department (LDD). Programme staff would include field engineers, overseers, technicians and foremen, and two expatriate engineers.

The tasks of programme staff were to be as follows: Technicians and foremen were responsible for day-to-day guidance and assistance of construction at project sites. They would be based in the project villages for the entire construction period. Overseers, in charge of three to five projects, would visit the sites regularly to guide and advise technicians and villagers on technical and organizational matters and administrative procedures. Under the guidance of field engineers, overseers participated in project surveying, design and costing. With one field engineer assigned to each regional zone, the programme would have three field engineers in the Region. They had overall responsibility for all projects in their Zone including surveying, design and costing, general supervision and follow-up on specific problems reported by technicians and overseers.

Volunteers would compensate for the initial shortage of field engineers and overseers. Meanwhile, the HMG/UNICEF regular programme started a course for overseers at the Institute of Engineering of the Tribhuvan University in 1973. This three-year course comprises one-year theoretical training, one-year practical work as trainee overseer, and a further year of theoretical training.

Inputs to the programme would be as follows:

- HMG through MPLD covers salary costs for overseers and field engineers and supplies the cost of porterage, skilled labour and locally available tools and fittings.
- Communities contribute through their local management, voluntary labour and the provision of local construction materials.
- UNICEF, through Swiss Government funds, supplies materials such as HDP pipes, cement, fittings, tools and vehicles. In addition it subsidizes the

training of manpower and the salaries and allowances of the Water Supply and Sanitation Technicians (As from 1987 this last cost item has been taken over by HMG/MPLD).

- Helvetas, a Swiss non-governmental organization working in Nepal at that time under the name of Swiss Association for Technical Assistance (SATA) provides technical and managerial assistance.

Women and Children fetching water from distant sources in the hill areas.

2.3 Programme area

Land and people

The CWSS Programme, Pokhara, covers the hill area of the Western Development Region, a north-south strip of Nepal, with Pokhara at its centre. The region is 29 398 km^2 in area and had a total population of 3.1 million in 1981. It comprises three administrative zones and 16 districts.

In the hill area, villages are small and scattered, with no more than 10% being directly accessible by motorable roads. The remaining villages can only be reached on foot, a journey which may vary from several hours to five days.

Most villages comprise a number of small clusters of 3 to 30 houses and a number of dispersed dwellings. This settlement pattern is largely determined by the topography and by family and caste divisions. Some villages or even

larger areas are inhabited by one caste only, other villages are composed of two or more castes. A family group tends to live in a cluster of households. The majority of households comprise five to eight members.

Houses are built of mud masonry, and sometimes of quarry stone or burned bricks, with roofs of thatch or galvanized iron sheets. In houses of two storeys, the ground floor is used for kitchen and grain storage and the first floor for sleeping and also storage.

Economic activities

In the hill areas, subsistence farming is the main economic activity. Landholdings are usually small with small farmers and share croppers cultivating the land. Both men and women are active in agriculture. During the monsoon, the main agricultural season, all arable land is cultivated. Only a small proportion of the fields are irrigated, which allows for more than one crop per year.

Most households have one or more head of cattle, a cow or water buffalo for milk and manure, or an ox mainly for draught power. Poultry and goats are raised for home consumption, and sometimes for cash income.

During the off season, porterage provides an important additional income. Mainly men work as porters but sometimes also whole families. A number of young men join the Gurkha regiments of the British or Indian armies which gives them a salary and a pension on retirement. Most of these soldiers have some command of the English language. Women on the other hand have little opportunity to earn a cash income. However, they derive some cash return from activities such as preparing and selling alcoholic beverages (rakshi), and cleaning, spinning and weaving of wool.

Education and literacy

Although no area-specific information is available about the level of education and literacy, two case studies from the Western Development Region confirm the national picture of a literacy rate of about 35% (New Era, 1984, Loon et al., 1985). Female literacy and school enrolment are extremely low, mainly because families depend heavily on them to work both at home and in the fields. A study on the status of women in Nepal revealed that girls between the ages of 5 and 9 years work 3.4 hours per day and boys 2.3 hours, while girls between the ages of 10 and 14 years work 7.3 hours, and boys 4.8 hours per day. There is also little incentive to send girls to school because after marriage they live in their husband's household and thus their natal family does not reap the benefit of their education (Acharya et al., 1980).

Participation in the public sphere

Men are more mobile and have greater access to education and cash income than women. Although no information is available for the Western Development Region, the study on the status of women in Nepal shows that being primarily involved in the household economy, women depend largely on

Filling water vessels from unprotected springs and streams in the hill areas

men to mediate with the outside world. This is reflected in their low level of involvement in the formal political and government structures (Acharya et al., 1980, p. 193 and 307). Women do not exercise their voting rights to the same extent as men, and there are few women candidates for the village assemblies and the Rasthriya Panchayat. The implication for the CWSS Programme is that there is a barrier to their participation in decision making for programme development and implementation.

Water supply

Piped water supply is an extremely high priority for village communities (personal communication; New Era, 1977; New Era, 1984). Their primary reason for constructing a local scheme is to secure a convenient and ample water supply.

Existing water sources are often unclean, and are either springs or streams high in the hills or rivers deep in the valleys. Water shortage is especially serious during the three months preceding the monsoon, when women and girls have to walk long distances to collect minimum quantities. Water is usually carried in a baked clay, metal or copper vessel, known as a gagri, which may contain 15 to 20 litres. It often takes 15 minutes to an hour to collect one gagri of water, depending on the area and season. In most cases this is a strenuous activity which involves descending and climbing a hill.

Water is usually collected in the early morning and late afternoon. The gagri is sometimes cleaned before being filled and sometimes only rinsed. Estimates of water use are difficult to obtain as bathing and laundry is done at the source, except for small babies who are bathed at home. No reliable information is available on the frequency of these activities. One study (Loon et al., 1985) indicates that for drinking, food preparation, dish washing and cleaning an average of nine litres per person per day is used. Thus, with an average of 5 to 8 members per household, a minimum of 3 to 5 gagris of water has to be collected each day. In addition water needs to be collected for watering cattle and garden and making alcoholic beverages. Water is usually stored inside the house, near the door, in the same gagris as it is collected. Some households cover their gagris.

Sanitation

There is no tradition of using latrines and few households have such a facility. Undefined spots such as the river bank, a dry stream, open field, or bushes are used for defaecation. Sometimes special places are frequented, such as between several rocks or on the side of a steep slope. Often some water is carried from home or fetched from the river for cleansing after defaecation. Where latrines are found and used, they tend to be dirty with bits of excreta around the squatting hole, which is mostly without a pit cover and surrounded by flies. Young children invariably defaecate near the house, even when there is a latrine (New Era, 1984; Loon et al., 1985).

Most people seem to be little aware of the relationship between human excreta and disease, and of the relationship between bathing and clothes washing on the incidence of skin disease. Preventive health care is therefore assumed to be a slow and difficult process.

Health

Although few reliable statistics are available, reports from health posts and various surveys indicate a high prevalence of diarrhoea diseases, worm infestations and skin and eye diseases (Brussee, 1985). Next to water-related diseases, respiratory ailments and eye problems are two major causes of morbidity. Lack of iodine in the diet leads to widespread incidence of goitre and cretinism. Although preventive measures are increasingly being undertaken by HMG, the incidence of diseases caused by iodine deficiency remains high especially in the more remote hill areas.

Malnutrition is a serious health problem. In Kaski District, the nutritional status of 52 398 children was assessed by measuring the mid-upper arm circumference with the colour-coded tapes provided by HMG/UNICEF.

Hygiene education picture designed to show the disadvantages of open field defaecation which is common practice in rural areas

According to this measurement, 11% of the children were seriously malnourished, and 33% mildly malnourished. The health impact study carried out in Kaski District by the CWSS Programme, Pokhara, confirmed these findings (see Chapter 10).

Fuel

Firewood is the main fuel for cooking and other household purposes such as preparing kholey (livestock food) and local alcoholic beverages. During winter it is also used for heating. Cooking is done on a stove of one or two holes, or on an iron tripod, which requires more firewood because of the heat loss from the sides.

A study in Nawalparasi District estimated the average household consumption of firewood to be 4953 kg per year, or 3 to 4 bhari per week (one bhari being a backload of approximately 25 kg). A bhari of firewood may take one to four hours to collect, depending on the area (New Era, 1984).

Deforestation can lead to the deterioration of springs and streams and even to them running dry. The present forest depletion in Nepal has not only increased the time needed to collect firewood but also to fetch water. Long hours devoted to these activities means that women may not be able to give adequate attention to the children, particularly to breast-feeding as often as may be necessary. Thus in order to safeguard water supply sources, programmes must fight deforestation.

3. *Emphasis on Technical Quality and Quantity, 1976 - 1980*

The CWSS Programme, Pokhara, started in August 1976. It was a forceful start, as can be concluded from the first progress report, dated 31 October 1976. During the first three months, visits were made to several projects completed under the regular HMG/UNICEF programme. At the same time manuals were developed for the training of ex-servicemen and the first training course was held. To ensure good water quality and durable construction, a new design was made for spring catchment and storage tank. The first four village survey reports were completed , and the Pokhara store used for the regular HMG/UNICEF programme was reorganized.

This explosion of activity was followed by further expansion and improvement of water supply activities. Emphasis was put on providing safe water supplies of durable building construction.

3.1 Training of ex-servicemen

As discussed in Chapter 2, water supply schemes were to be implemented by ex-servicemen and other skilled villagers living in the project area. This became such a central feature of the programme that it was even stated in many reports that the programme objective was "to implement gravity flow drinking water supply schemes by using retired army servicemen and other skilled villagers" (Progress Reports).

During the first month of the programme five manuals were prepared for training ex-servicemen as project foremen. These manuals dealt with:

- hydrology and the water cycle
- stone masonry construction
- cement and concrete
- pipes and fittings
- rural water supply construction.

Social aspects and administrative procedures were also covered, as the project was to be implemented by villagers with government support. The Panchayat Development Training Centre (PDTC) dealt with these two subjects.

The first course was conducted from 31 August to 28 September 1976 with 29 participants from all six districts. Unfortunately, there were a number of problems. Participants were selected in such a hurry that not all of them had the technical background needed and the course content proved to be too

sophisticated. Further, there was no suitable location for practical training close to Pokhara. At the end of the course only five participants were considered to be skilled enough to be employed as foremen.

In retrospect, the start might have been too enthusiastic. In the Eastern Development Region more time was taken to prepare the course and to select the trainees. Of the 15 participants, the results of eight were excellent and for the others quite satisfactory.

The meagre results obtained in the Western Development Region led to reflection on the participants' profile and general course set up. In the future, only masons, plumbers or those with at least basic construction and design knowledge would be accepted. Participants would be selected by the project staff only. Although it was not easy to hold to these criteria, selection of participants gradually improved.

The curriculum was also adapted. The course was divided into two parts as it was recognized that neither a very short and simple, nor a sophisticated programme would prepare the ex-servicemen adequately for their task.

The first part was a one-month course for programme foremen based on the five training manuals. Two hours each morning were devoted to social service, panchayat administration, village economy, hygiene and first aid. Practical work included pipe jointing and fittings assembly. This section of the course concluded with a short field visit.

Participants with the best results were selected for the follow-up course for water supply technicians. Those with average results were employed directly as foremen under the supervision of a water supply technician. The remaining participants undertook a caretakers course in order to be able to take charge of maintenance in their respective villages.

The water supply technician course concentrated on drawing and reading of technical designs. Mathematics and conversion from imperial to metric units were also included. The two-month course included one -month practical training at a project site to improve construction skills. Those successfully completing this course were given responsibility for the construction of a water supply scheme.

3.2 Manpower development and organization

Shortage of manpower especially during the first year meant that rate of construction was lower than anticipated. Initial experience demonstrated that the expectations for the use of ex-servicemen as main project implementors had to be scaled down. As no overseers were assigned to the project until February 1977, implementation depended heavily on expatriate volunteers.

Experience with volunteers was generally good and their efforts were very much appreciated by the project communities. However, working through

volunteers also had limitations. Most did not have experience in water supply and sanitation, and some were not qualified for the job, having only a little theoretical training in the principles of water supply. Especially during their first year, often they did not have sufficient command of the language to communicate with the villagers. Where there was no strong community leadership and no high motivation for a new water supply, the lack of communication could provoke serious problems.

Despite the difficult start, the manpower situation improved considerably during the first four years as shown in Table 2. This table does not include foremen. In total, 159 were trained in five courses, but it is not clear how many were actually employed. For example, of the 40 course participants in June 1977, only five were employed as foremen and five as masons. The others remained "under consideration".

Table 2: Number of staff in the CWSS Programme, Pokhara, in the period 1977 - 1980

	1977	1978	1979	1980
Water supply technicians	1	6	19	33
Qualified overseers	7	6	10	16
Trainee overseers	7	11	9	0
Volunteers	4	8	10	8
Nepali engineers	2	2	1	1
SATA engineers	2	2	3	3

The number of water supply technicians increased dramatically during the four years. They all completed the one-month and two-months courses. Although programme implementation largely depended on their abilities, their position within the programme was very uncertain. Generally they worked on three-month contracts at a salary of NRs 450 per month (1980). Only in 1980, four very experienced water supply technicians were offered contracts for nine months per year from LDD. For the other three months of the year work could not continue because of the monsoon and also it was felt that technicians needed to return home to work their fields. Salaries and a field allowance were fixed at NRs 600 per month and paid by UNICEF.

The number of overseers increased steadily. Initially they worked under the close guidance of SATA engineers and as counterparts to the foreign volunteers, who welcomed them as they facilitated communication thus making the task easier. However, some overseers had misinterpreted their job and were more interested in an office career than working in rural areas. They also found it difficult to work in the villages as often they did not command the respect of foremen, water supply technicians and villagers, largely because of their youth and lack of experience. As time passed, they were able to take increasing responsibility for supervision of water supply technicians and foremen as well as for survey and design.

The assignment of engineers was a point of continued concern because of shortage of qualified people and the greater attraction of large construction works such as irrigation projects. Although HMG had created posts for four engineers in the LDD Pokhara office, only two and later even only one, were filled. This shortage was particularly serious because the engineers were also responsible for other LDD activities, such as construction of minor irrigation schemes, suspension bridges, and roads.

To make up for the shortage of engineers, a third expatriate SATA engineer was appointed to the project. The position of the SATA engineers in LDD structure was rather unclear. On the one hand, they had overall responsibility for programme development and implementation, but on the other hand they were not integrated in the structure of LDD Regional Office. "We feel alone" sighed the Programme Manager in January 1977 (Progress Report no.2). The feeling would go, but the integration would remain a subject for discussion (See Chapter 4).

3.3 Standardization of construction

From the beginning, the CWSS Programme, Pokhara emphasized good water quality and durability of construction. A field visit was made by the programme team to review a number of schemes completed under the earlier regular HMG/UNICEF programme and many were found to be wanting on both counts. Furthermore, building structures varied considerably. Guidelines and standardized plans were urgently needed (Bovier, 1978, p.1).

The observations of the programme team were confirmed by an evaluation of the current operating status of community water supply systems installed between 1973 and the end of 1976 under HMG/UNICEF agreement. The evaluation indicated that: "Many maintenance problems originate in the inadequacies of original design and construction: poorly selected sources, inadequately buried pipes, improperly constructed tanks, faulty calculation of hydraulic characteristics, insufficient protection of water-sheds, tanks, valves and taps" (New Era, 1977, p.20).

Within nine months of the start of the programme, the following had been standardized:

- survey system
- survey book recording
- survey calculation
- longitudinal profile
- water supply design criteria
- quantities calculation for structures
- price estimates
- presentation file of completed design.

In addition, standardized designs and estimates were made for spring catchment, valve chambers, break-pressure tank, storage tank and tapstands.

The storage tank design was based on the Project Manager's experience in Cameroon and aimed at long life. "It is necessary to have the tank in good stone masonry with a design that keeps it free from pollution, not easily broken by the villagers and under control for hydraulic manipulation" (Bovier, 1978, p.8). The solution was found in a stone arch masonry slab, replacing the current wood and steel corrugated sheet for a cover, which was liable to damage and pollution (see Figure 2).

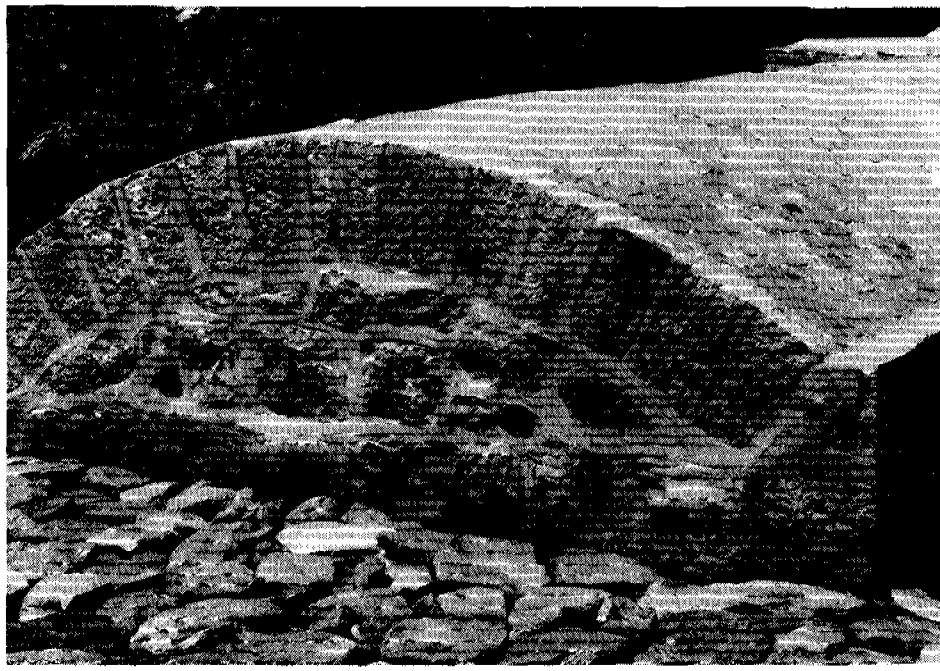


Figure 2: Stone arch water storage tank

Although this stone arch storage tank certainly contributed to the durability of the system, it had some serious drawbacks. A tank required many stones and much cement, together with considerable labour input to construct. Tanks often leaked because of poor quality stone and construction technique. This type of tank therefore was abandoned in the early 1980s (see Chapter 5).

3.4 Project selection and implementation

In accordance with the agreed criteria, a request for a drinking water scheme should be lodged with LDD by the village panchayat, through the district panchayat (see Chapter 2). Despite this agreement, a number of projects were directly requested through a political channel or individual leaders. These projects were usually less successful , as implementation was frequently delayed because of disputes about source and tap locations or other internal conflicts, or by a lack of community motivation for voluntary labour. In January 1980, 10 out of 44 projects under construction suffered from these problems.

The difficulties encountered contributed greatly to appreciation of the value of community participation. At the beginning of the programme, community participation was primarily understood as providing free, voluntary labour, and it was assumed that villagers would co-operate automatically. Although village water committees were established to satisfy programme requirements, working through these committees was thought to slow down implementation. However, experience has demonstrated increasingly that the success of a water supply scheme very much depended on a real partnership between programme staff and community. This change in thinking was evident in all Development Regions, and cumulated in a national conference in Japha, 1980. This meeting was instrumental in formulating policy and procedures to involve the community in all aspects of a water supply project (see Chapter 7).

Evaluating four years experience of the CWSS Programme, Pokhara, the Programme Manager concluded that problems in project selection and implementation would have emerged earlier if preliminary surveys had been conducted with more care (Progress Report no.13, 1980).

By mid-1980, some 168 preliminary surveys had been completed and reports made. The example in Figure 3 shows that these surveys still provided only very limited data. Of the total, 57 (34%) project schemes were designated as not being feasible for reasons such as lack of suitable source, maintenance only being required, community disputes and lack of motivation.

From the start, the construction rate was much slower than expected. Only one scheme was completed in the 1976-1977 and eight schemes in 1977-1978. "The target was unrealistic. The estimated number of schemes which can be constructed under this "noted" project is 65 and not 100 as previously planned. The target date for completion is June 1980 and not 1979" (UNICEF Progress Report, 1977-1978, p.4). Nevertheless, programme staff, donor organizations and HMG remained optimistic. The second project phase, covering the period 1979-1981, aimed to complete 120 systems: 35 in 1979, 40 in 1980, and 45 in 1981. At the same time it was decided to extend the programme to all hilly districts.

1 - Introduction

The villages of Ghalel (Ward 5 + 6) and Kali Mati (Ward 5) are located in Kaksi District, a six-hour walk north-west of Pokhara. The village of Ghalel is comprised of 130 houses, with approximately 1000 inhabitants. There is a primary school with 60 students. The village of Kali Mati is a dispersed settlement with 26 houses scattered over six small groups at long distances.

2 - Water Situation

For the village of Ghalel there is a spring named Purano Pandero which was measured 1.3 liters per second on the end of March 1979. Presently, the villagers have already a pipe-line made of low density polyethylene pipe in very bad condition, hanging around trees and broken in many places. They have three temporary tapstands, no intake and no tank (storage) build. Nothing of it can be used for a new project.

For the village of Kali Mati, there is a spring located ten minutes walk from the center group of houses.

3 - Water Supply Feasibility

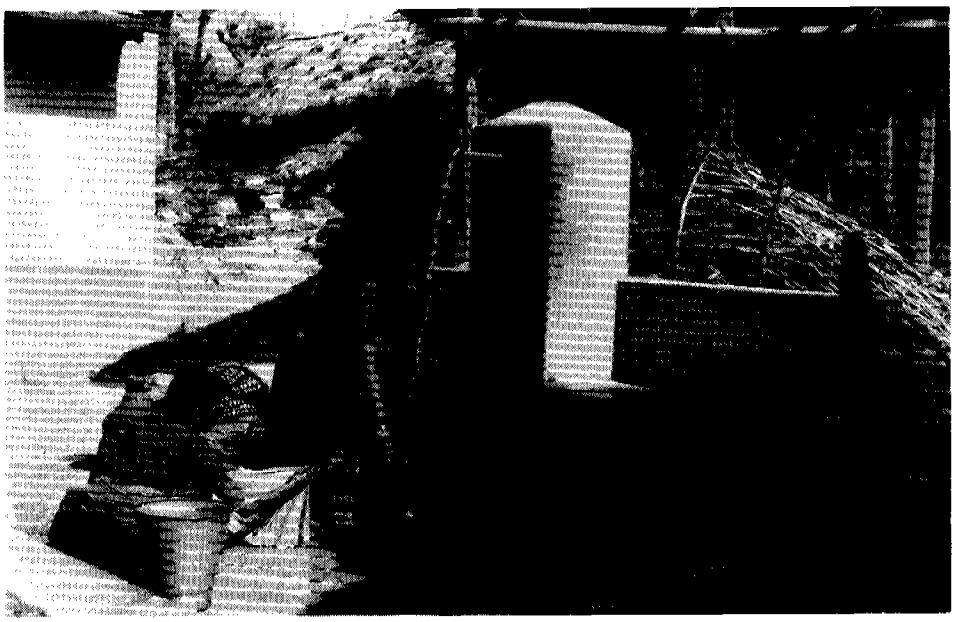
The project of Kali Mati is not feasible because of the scattered position of the houses, the small number of inhabitants according to the total length of the system and the cost of it. Also, it is more likely a private project giving a tapstand for each two to three houses.

The project Ghalel village is feasible and will consist of the following:
-1 spring catchment;
-1 storage tank;
-8 tapstands for the village;
-1 tapstand for the school.

A special protection is needed for the spring catchment because the spring is located inside a small stream which will carry a lot of water during the monsoon.

Figure 3: Example of preliminary survey report prepared between 1976 and 1980

Although construction rate improved with time, neither the original target of 100 nor the adapted target of 65 completed schemes have been met. In 1978-1979, 18 schemes were completed and the same number again in 1979-1980, bringing the total to 45 schemes completed between June 1976 and June 1980.



New tapstand constructed as part of a new water supply scheme

4. *Towards Realistic Targets: 1980 - 1983*

During the first programme period, a firm foundation was established with adequate training capacity, standardized designs and procedures, and trained field staff. The second programme period, July 1980 to June 1983, is characterized by three major developments:

- acceptance of a more realistic implementation rate;
- gradual inclusion of sanitation, maintenance and rehabilitation as main areas of concern;
- more attention to institutional aspects and programme organization.

4.1 Rate of implementation

Early in 1981 it became very clear that the original targets were not achievable. The Programme Manager put forward the following reasons for the more moderate rate of implementation than expected.

The average time required to implement a project is 6 - 12 months. Because of the monsoon and peak agricultural periods, construction is only possible in seven to eight months of the year. Therefore very often two construction seasons are needed to complete a scheme. As the Regional Office has a set capacity for project handling, this limits the number of schemes which can be completed within a given period of time. A number of physical factors at the site may make project implementation difficult, for example, shortage of suitable stone and sand, difficult terrain, monsoon damage, and shortcomings in the logistic of supply and transport of materials. A variety of socio-economic and socio-political conditions may hamper progress in setting water supply schemes including:

- lack of interest because the project does not originate from a genuinely felt need of the majority of the community;
- lack of co-operation between community groups;
- shortage of skilled craftsmen and of voluntary labourers;
- dwindling of community motivation especially in large projects implemented over more than one season;
- shortcomings in project preparation and handling, for example water disputes and delayed payments to skilled craftsmen;
- difficulties in communication between villagers and office staff;
- disruptions for matters of national interest and importance, such as referendum or elections.

A further reason is that even though the office now has considerably more staff than previously, the number of systems completed does not increase linearly with each staff member, because "non-productive" co-ordinating and management tasks increase with the number of staff (Strauss, 1981, p.1 - 2).

Other factors slowing down the implementation rate were the gradual inclusion of sanitation, maintenance and rehabilitation which required allocation of time, manpower and budget. Institutional support, not yet fully developed, hampered the efficiency of the programme.

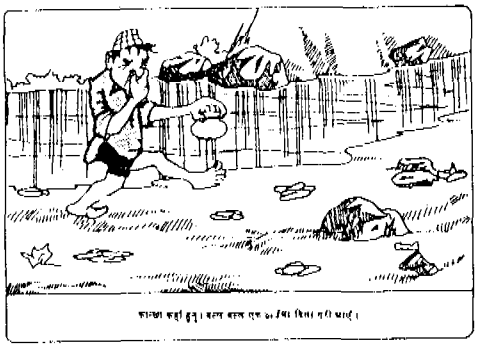
These conditions and factors all set a limit to the number of projects under construction in one financial year. Therefore, it was decided to have no more than 45 schemes simultaneously under construction, that is an implementation rate of 20 schemes per year. More than this number was considered to be counter-productive (Strauss, 1981, p.2 - 3). As stated in the Annual Report, 1980-1981: "Demanding a limit to quantitative growth at this stage, contrasts without any doubt the demands and projections set for the end of the UN Water Supply and Sanitation Decade. However, trying to implement the number of projects postulated by the Decade, will leave behind pipes laid on the ground and running dry instead of well constructed schemes giving long lasting benefit to the villagers!"

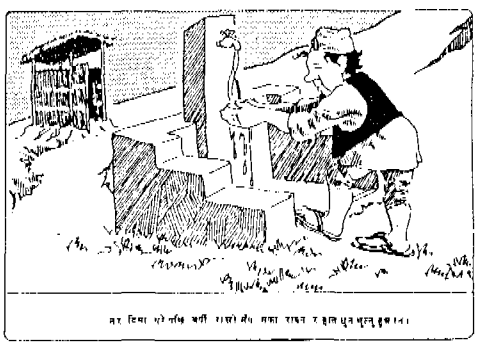
4.2 Maintenance, repair and rehabilitation

From the start of the CWSS Programme, maintenance was considered to be a village responsibility. Thus, HMG was very reluctant to make maintenance management a programme activity. However, when it became clear that numerous schemes had deteriorated beyond village capacity of repair, and more and more requests for rehabilitation were being received, the Ministry in 1980 agreed that:

- regional directorates could formulate proposals for maintenance management. This decision was in line with the recommendations of the national conference on the Rural Water Supply Programme held at Jhapa in September 1980 (See also Chapter 8).
- a budget of NRs 150 000 be set aside by Pokhara Regional Directorate for maintenance and rehabilitation work during the 1980-81 construction season.

A two-men team from the Pokhara Regional Directorate carried out a survey of 45 schemes, of which 18 had been constructed under the regular programme before 1976 , and 27 schemes under Noted A. They found 54% of schemes to be defective or non-functioning (Schramm et al., 1981) and recommended that due attention be paid to maintenance and rehabilitation. The study is discussed in detail in Chapter 9.





Improved sanitation calls for changes in personal habits and practices

At that time, the difference between maintenance and rehabilitation projects was defined as follows. Maintenance is a minor activity carried out by a technician from the Regional Directorate with skilled labour and porterage services provided by the village. As this work requires less than NRs 15 000 and one month work, approval can be given directly by the Regional Director. Rehabilitation on the other hand, means major overhaul and reconstruction, often costing as much as a new project. Therefore, after a detailed survey, Ministry approval is required as is the case for a new scheme. Gradually a further distinction was made between maintenance and repair. Maintenance is carried out by the Village Maintenance Worker and concerns preventive care to ensure that the system continues to function, whereas repair is required when the system has actually broken down and need outside assistance in terms of material and expertise.

During the 1981-1982 construction season, 24 formal requests for project rehabilitation were received. Four such projects were started, and maintenance assistance was provided to five schemes. A national seminar on maintenance and sanitation held in October 1982 provided further momentum for maintenance, and a maintenance policy for rural water supply systems was set out (see Chapter 9).

4.3 Sanitation

Sanitation was only included in the CWSS Programme, Pokhara, in 1980. The start was modest because: "Improved sanitation calls for people to change their habits. Such changes may occur in very small steps only, and will require a time period in the order of at least one to two generations rather than 5-10 years!" (Annual Report, 1981). As it was assumed that a massive latrine construction campaign would end in failure, emphasis was placed on sanitation education as well as preparing suitable latrine designs and construction methods. In 1980-1981 a good start was made with a number of activities including:

- reparation of the "Sanitation Handbook" for field staff;
- inclusion of sanitation education in training courses and seminars for all programme staff and village maintenance workers with experience in latrine construction;
- construction of latrines by several water supply technicians for their own use in project villages;
- preparation if designs for family latrines, and in co-operation with UNICEF Kathmandu, for school and health-post latrines;
- design and cost estimate for latrines and bathing facilities for the community training centre at Pokhara (Annual Report, 1981, p.4-5).

This approach was developed further in the second year. Several technicians and overseers had succeeded in motivating villagers to construct latrines, for both individual households and schools. Three school pit latrines schemes were constructed and requests for a further ten were received. Ways of constructing improved household pit latrines from local material were studied.

In close co-operation with Regional Directorate staff, UNICEF introduced a "school sanitation curriculum" and "teachers' sanitation guide" to overseers and technicians during a four-day workshop. The aim was to qualify field staff to guide teachers in project villages to introduce sanitation education (Annual Report, 1982, p.11).

At the end of the third year (1983), the project manager concluded: "Sanitation is gradually being recognized as an essential part of the CWSS Programme. Yet, it is the hard reality that this component is still very, very new to Nepalese thinking. And because of this is not yet receiving the priority it deserves". This conclusion may not be surprising. People have been relieving themselves in the bushes for centuries. Even for the technicians and overseers who are expected to motivate villagers and teachers, improved sanitation was a very new topic.

The sanitation component gradually developed in the following direction:

- Latrines for school, teachers and health posts are now incorporated as standard in the cost estimate for each new water supply scheme.
- The technician motivates communities to improve environmental hygiene during both project preparation and implementation with the aid of a UNICEF sanitation kit. He explains the health benefits of clean water and a clean environment. These talks are given at school, near the health-post, and in the village itself.
- Through his teaching he tries to motivate the headmaster or the officer-in-charge of the health post to make an official request for a latrine unit. This is necessary as they are only constructed when there is a felt need.
- As a rule, a technician builds a latrine for his own use near his quarters and assists interested villagers to build their own.

4.4 Decentralization

In May 1980 the Ministry of Panchayat and Local Development (MPLD) was formed from the Local Development Department. At the same time, a decentralization process was set in motion. The post of Panchayat Development Officer, which is in effect executive secretary of the District Panchayat, was upgraded and renamed Local Development Officer, directly responsible to the Ministry as well as the Regional Directorate (Figure 4).

Decentralization was reinforced by the Decentralization Act, involving all levels in all ministries. This process aimed to facilitate communication between HMG and local communities; to involve local communities actively

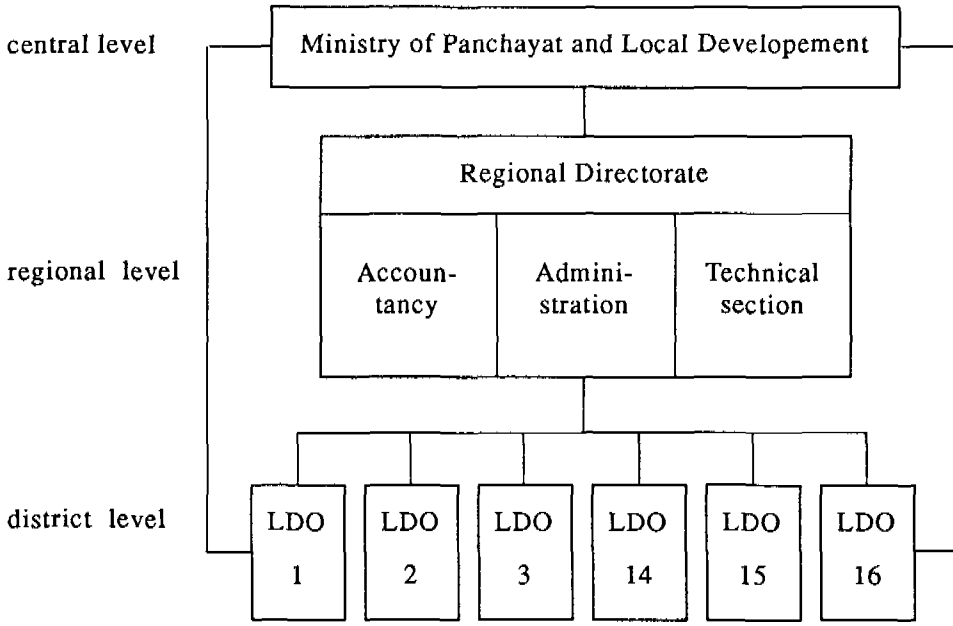


Figure 4: Decentralized organizational structure (Annual Report, 1981, p.13)

in development efforts; and to mobilize local resources. As adverse physical conditions make communication difficult and slow, it is difficult to decide development priorities at ministry level. Decentralization of decision making would reduce this problem and would facilitate local involvement in development.

For the CWSS Programme, decentralization meant a transition of manpower and funds from regional to district level. Monitoring, supervision, logistic support and training would remain the responsibility of the Regional Directorate. No change would occur at village level as the programme set up was already decentralized. A request for a village water supply was made by the community itself and forwarded to the district panchayat through the village panchayat. Planning, implementation and maintenance of water supply schemes had also been decentralized from the beginning.

While recognizing and appreciating the aim of decentralization, the programme was concerned about the transition of manpower and funds in the short-term. It was feared that achievements made would be lost as district panchayat offices were not prepared to take over programme implementation at such a short notice. Their administration, communication and infrastructure

were not as yet sufficiently developed to allow for decentralized programme implementation.

Transfer instructions issued to staff early in 1981 led to much uncertainty and delay in construction work. After deliberation, decentralization was postponed until the following year and after further negotiations in 1982, again postponed for a period up to ten years. Development funds would be transferred partly to district level. Previously, district authorities had paid for labour and porterage with funds transferred from the Regional Directorate. Now, these funds, 70% of the total budget, were directly allocated to the district. The remainder continued to be allocated to the Regional Directorate to pay for local material, vehicle operation and maintenance, salaries and travel expenses of field staff.

4.5 Programme organization

Within the framework of the newly established MPLD and the decentralization policy, the structure of the Regional Directorate was also reformulated (Figure 5).

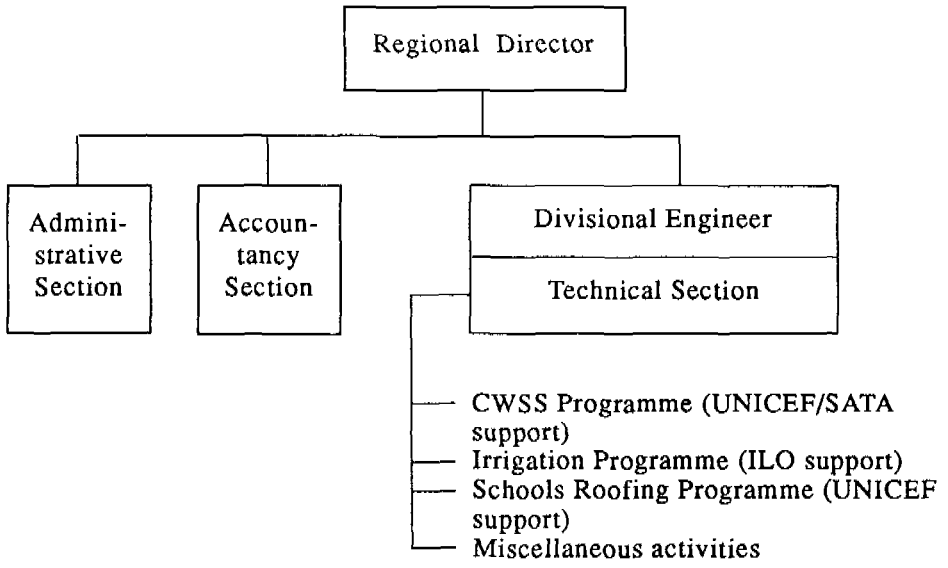


Figure 5: Organizational structure of Regional Directorate (Annual Report, 1981, p.15).

The position of programme staff was still not clear in the new organizational set up. As a result, they felt rather left out. It also created uncertainty as they were expected to take responsibilities without knowing their position in the government structure (Annual Report, 1981, p. 6-7).

A "Special Programme", launched in the 1980-1981 construction season also created a degree of uncertainty. Pipes, cement and other materials were provided to villagers on a district quota basis for self-help implementation at the discretion of the members of parliament. At the same time as the CWSS programme budget was cut by more than one-third to NRs 2.8 million, the Special Programme received NRs 5 million. MPLD office staff and to a lesser extent project staff were expected to carry out the Special Programme tasks, thus reducing their time for the CWSS Programme. The long-term effects of these self-help projects were doubtful as no proper project procedures were established.

4.6 Manpower training

Training continued to be an important programme activity. Training for water supply technicians was further developed into three stages: a basic training for foremen, followed by one year's practical work under the guidance of an experienced technician; an upgrading course with again one practical year; and a final foreman course to qualify trainees as water supply technicians.

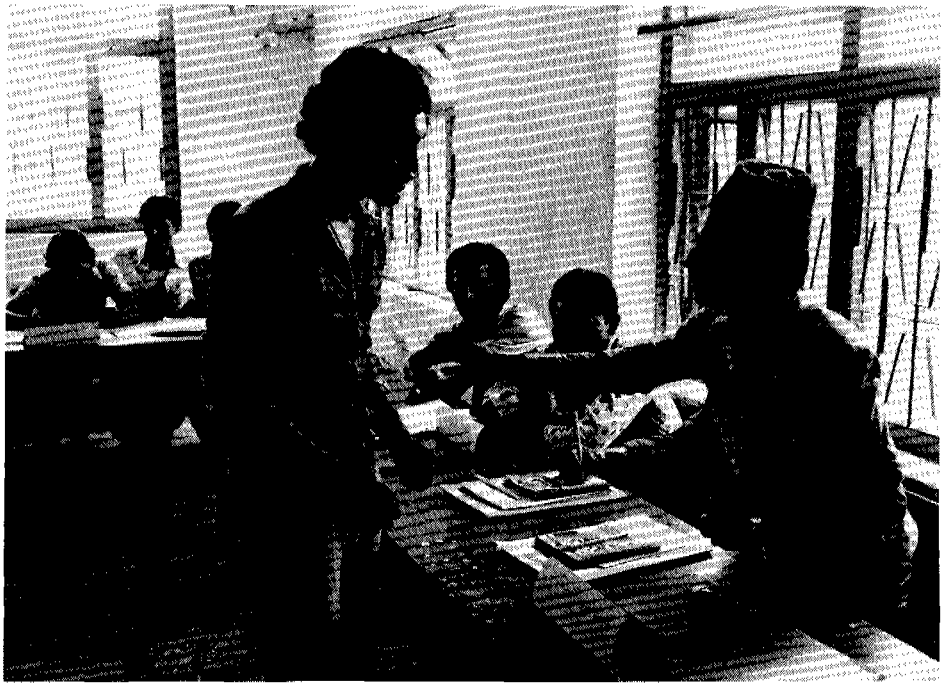
Training of village maintenance workers became a regular part of the programme. A national seminar for overseers and engineers was organized in November 1980 to discuss project implementation procedures and administration (LDD/UNICEF, 1980). Following the maintenance survey (see Section 4.2) a refresher course in masonry work was organized for technicians with two or more years of experience. The course held in July 1981 aimed:

- to share experience on village level project implementation;
- to develop awareness and skills on how to approach, communicate and liaise with villagers;
- to refresh and augment basic knowledge (Annual Report, 1982, p.12).

Participants and instructors were very satisfied with the course, especially the communication training given by two experts, one from UNICEF/Kathmandu, and the other from the Panchayat Development Training Centre/Pokhara. Therefore, a second refresher course was organized in the rainy season of 1982, also directed at improving communication skills and increasing knowledge and skills in masonry and cement work. Several latrines were constructed and a stock of ferrocement latrine slabs made.

All courses were conducted in the excellent facilities of the Panchayat Development Training Centre. Technical instructors from the Centre were given the opportunity to acquire field experience within the CWSS Programme

during the 1982-83 construction season to strengthen their capability to implement the regular training courses. Until such time, programme overseers and engineers would continue to organize and implement the various courses.



Role playing during a communication training session

5. *Improving the Household Environment: 1983 - 1986*

By mid-1983 the technical aspects of the CWSS programme were well established. Regular training courses were being conducted and the shortage of manpower had largely been overcome. More time and attention was now being given to promoting the health benefits of water supply and sanitation to be obtained by improving the household environment. This need was reinforced by two studies (Loon et al., 1985 and Leuenberger, 1983). The first, a health impact study, showed that health improvements could not be derived solely from new water supply and sanitation facilities. The second, a water quality study, indicated that although water quality of the new schemes was generally better than that of unimproved sources, water is easily recontaminated before use (see Chapter 10).

During the project period, 1983-1986, sanitation improvements, hygiene education and maintenance management became increasingly central activities. Costs and work-load were reduced greatly when stone arch masonry tanks were replaced by ferrocement tanks. Community participation and communication were strengthened further with the setting up of the communication unit. Other new developments during this project period were the introduction of the smokeless oven programme and increased co-operation with other development projects.

5.1 The slow birth of phase three

Although a first draft of a proposal for a three-year extension was prepared in June 1981, it was 1983 before official agreement was reached by HMG, UNICEF and SATA/Helvetas. The number of new schemes was the main stumbling block. The initial proposal was for 100 new and rehabilitation water supply schemes, 100 small repair projects, and 2500 latrines for households, schools and health posts, with a UNICEF/SATA contribution of US$ 2 548 600. Agreement was reached on 70 new and rehabilitation schemes, 100 small repair projects and 1000 latrines for schools and health posts, with a UNICEF/SATA contribution of US$ 2 150 000.

This reduced number for phase three allow for important conclusions. Firstly, the target cut down of both new and rehabilitation projects shows a general appreciation of the need to set realistic targets, allowing for quality of construction (see Section 4.1). Secondly, by reducing the overall targets the rehabilitation and small repair projects were not threatened, thus signifying acceptance of shared responsibility for upkeep of the systems by communities

and government (see Section 4.2). Thirdly, the emphasis on latrine construction for schools and health posts is continued, with second priority for household latrines (see Section 4.3).

In the third phase increased emphasis was put on social aspects, sanitation and sanitation education, maintenance and project environment. The overall objective "to reduce the incidence of water and sanitation related diseases" was now followed by a second objective, "to reduce the burden of water collection". This is recognition of a heavy daily burden of women and children. In the UNICEF funding proposal the following statement was made:

"Due to serious environmental degradation, water sources are becoming scarce and villagers have to walk further and further each year to draw water. The provision of a water tap within easy reach of each household will substantially reduce the burden of water collection saving as much as one or two hours daily, and releasing this time for more productive activities. Children, particularly girls, will be needed less for households duties and parents will be more willing to send them to school" (UNICEF, 1981, p.5).

Also, for the first time mention is made of the importance of water quantity: "The increased quantity of water made available nearby will also have an effect on personal hygiene and will reduce the many water-washed diseases prevalent among children in Nepal" (UNICEF, 1981, p.5). Another feature of the new programme phase was increased integration of the CWSS Programme with other rural development projects.

The objectives and activities for phase three are in line with the Water Supply and Sanitation Master Plan of Operation of HMG/UNICEF, for the period of mid-1982 to mid-1986, and thus reflect a general trend to widen the scope to a more integrated and balanced approach.

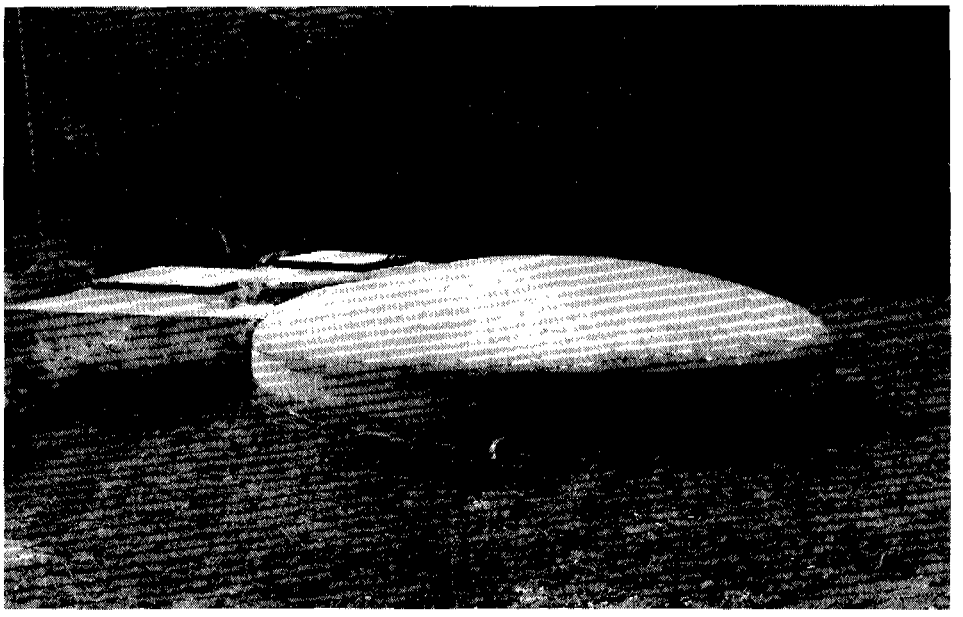
5.2 Ferrocement as alternative to stone masonry

Until mid-1983, most reservoirs in the CWSS Programme were constructed in stone masonry with an arched roof. As already discussed, this type of tank from Cameroon was introduced to Nepal as being sturdy, and of low maintenance. That these expectations were met, may be concluded from a comparative study on reservoir tank construction, which stated: "This is a solid construction. It is like a bunker. The attached operation room is a step in the direction of advanced water system building, especially maintenance. This tank assures maximum sedimentation of undesirable material in the water" (Dubbeldam, 1979a, p.11).

Notwithstanding these advantages, the stone arch tank had some serious drawbacks. Considerable quantities of stone, cement, and sand are required which are costly to transport. The arch frames needed in construction also have to be transported manually to and from the site. Further, it has been

difficult to produce watertight constructions mainly because of the quality of the stone and the fact that local craftsmen are more familiar with mud masonry than with stone masonry.

This experience and the increasing use of ferrocement tanks in Indonesia and Thailand led to consideration of a more suitable storage tank for the hill areas of Nepal. The first ferrocement tank was built in the Western Development Region in 1979. This experiment and other prototypes showed that ferrocement would be a viable option. This tank design requires less cement which is a scarce commodity in Nepal, is cheaper and quicker to build, and is leakproof. Use of this construction material thus has advantages for all parties concerned. HMG pays less because labour, material and transport costs are lower. As less stone, sand and gravel are required, the village contribution is less. For UNICEF contribution of cement is also less. Cost comparison of an arch stone masonry tank and a ferrocement tank is given in Table 3. The design for the new ferrocement tank was finalized in 1983 and a decision made to change to this type of tank in the CWSS Programme, Pokhara (see Chapter 8).



Ferrocement water storage tank

Table 3: Estimated cost comparison (NRs) of arch stone masonry and ferrocement storage tank*

	Arch stone storage tank (22 m^3)	Ferrocement storage tank (20 m^3)
HMG Contribution		
Materials (steel rod, plastic, nails, lime, binding wire)	1 226	2 154
Skilled labour	5 500	2 250
Semi-skilled labour	2 340	1 080
Transport to village	2 355	765
Transport by vehicle	1 920	1 140
GI pipe and fittings	1 011	687
Tools	844	716
Contingencies (10%)	1 519	879
Total	16 715	9 671
Village contribution		
Materials (stone, sand, gravel)	10 600	2 800
Unskilled labour	360	360
Transport to village	4 585	1 500
Total	15 545	4 660
UNICEF contribution		
HDP pipe	60	105
HDP fittings and valves	450	265
Portland cement (NRs 76 /bag)	11 704	3 420
Other materials (toolbox, tools to joint HDP pipe, chicken wire mesh, plain wire)	1 836	2 910
Total	14 050	6 700
Grand total	46 310	21 031

Source: Dubbeldam, 1979b

* This is based on the assumption that the project village is a two-day walk for porters from the nearest roadhead 50 km from Pokhara Regional Office. The cost of one bag of Portland cement (50 kg) is NRs 76.

5.3 A shift to special training courses

In 1983, it was concluded that: "Courses during the last few years were quite effective in training technicians in the technical and social knowledge and skills needed for the implementation of CWSS projects". Therefore, it was decided to focus on special courses for the group of about 45 technicians who had completed the three regular courses (Annual Report, 1983, p.12).

The first of these was a four-week course on ferrocement, organized by a Nepali engineer and four overseers in July 1983. Together the 19 participants constructed two 10 m^3 reservoir tanks. A second course organized along the same line trained another group of technicians in ferrocement construction. As a result all new reservoir tanks could be built according to the new ferrocement design from the 1983-1984 construction season.

Special courses were also organized on bamboo-cement technology to train technicians in the use of bamboo-cement as a relatively cheap and durable option for household and school reservoir tanks. Experiments are continuing to determine the suitability of this material.

In 1984 a refresher course in sanitation was organized for technicians at the Institute of Medicine. Some 40 course participants discussed public health and personal hygiene under the guidance of two senior lecturers from the Institute. Implementation of sanitation measures was discussed by the engineers.

The three courses for foremen organized in co-operation with the Panchayat Development Training Centre continued as before. Also, the village maintenance workers course remained a regular part of the programme, although the course organization was adapted somewhat. The venue was changed from the Panchayat Development Training Centre to a project site in need of maintenance. One advantage of this arrangement was practical on-the-job training; another was that a maintenance project was carried out as part of the training.

There are three main developments in the training component of the programme. Expatriate inputs in all training courses became less and less. Nepali engineers, overseers and technicians have acquired the knowledge and skills to initiate, organize and run training courses in support of the programme.

Co-operation with the Panchayat Development Training Centre has become increasingly fruitful. Initially, the CWSS Programme developed its own courses with limited input from PDTC because the Centre's capacity was insufficiently developed for this type of training. Also, as the programme was considered to be a UNICEF rather than a HMG programme, the Centre did not include these courses in its annual plan of operations, thus creating planning and budgeting problems. However, the situation has improved considerably in the last few years with new teachers and a foreign volunteer increasing the

Village maintenance workers training

Centre's capacity. Since 1984, the three foremen courses have been organized by the Centre, with only two CWSS technicians to assist as required. In 1985 the Centre prepared its own training manuals on various aspects of the CWSS Programme.

The success of the training component is also clear from requests for co-operation from other agencies, such as Tinao Watershed Project, Integrated Hill Development Project and United Mission to Nepal. As a result, overseers and technicians from CWSS Programme, Pokhara, provided training services to these agencies and a number of their foremen have been trained in the Pokhara course.

5.4 Communication support

Over the years, it had become very clear that effective communication between technical staff and community is essential for programme implementation. This has come to the fore in various ways:

- It proved to be important to discuss the need for water and possible conflicting interests or source disputes before the start of a project. If these problems were neglected serious delays in implementation could occur.

- Discussion between programme staff and villagers is necessary to prevent misunderstandings about respective contributions and responsibilities in project implementation, operation and maintenance.
- During implementation, technicians need their communication skills to keep motivation high and to solve any problem arising. These skills are especially important when a scheme takes more than one season to complete, thus requiring substantial community contributions over a long period of time.
- Special communication skills are needed for sanitation motivation and education, because these improvements are slow to achieve and require villagers to change their household environment and habits.
- The cultural division of roles and tasks between men and women hamper active participation of women in project planning, decision making and sanitation education. Recognizing the crucial role of women in water supply and sanitation, the programme staff have sought alternative solutions to this problem.

Technician motivating villagers to continue trench digging

A special communication unit was set up in 1983. The first task of the unit was to support communication and sanitation training in the various course programmes. The second task was to support promotion of community participation during and after project implementation. SATA/Helvetas employed a sociologist with a teaching background as head of the unit. He

was the first non-technical person in the team and Helvetas Head Office, Switzerland, welcomed him as follows:

"We are glad to know that the SATA team in Pokhara has now also included a person with a socio-cultural background. We hope that with your help the programme will be able to put new light on the question of maintenance of rural water supplies and on the question of a sanitation programme by the rural population. Maybe we have looked at these questions of the CWSS Programme a bit one-sided from the viewpoint of a technical planner and implementor in the past" (letter by Andres Wiederkehr, 15 July 1983).

The other two members of the unit are a technician with experience in sanitation education, and since 1985, a woman development worker. Together they have developed a number of activities. An information collection sheet was prepared to assist technical staff in priority setting of villages for project implementation (see Chapter 7). Communication training was developed to include social and cultural aspects for technical staff and to improve skills in village motivation and education. To improve contact between village and staff, a co-ordination workshop was developed for both parties in which

Women's group meeting

agency tasks and procedures and village responsibilities are discussed and clarified to ensure harmony during implementation. The introductory talks given by the director, chief accountant and store keeper were effective in eliminating some administrative misunderstandings. Audio-visual materials, such as flipcharts, slide shows and films, were designed and ordered. The materials are used in short village communication programmes to raise motivation and support for programme activities. Participation of women was further stimulated by promoting the selection of female water committee members and by organizing special women's group meetings.

5.5 The wider context

In recent years there has been increased emphasis not only on social aspects and communication, but also on the wider context of water supply, sanitation and health. One aspect is the introduction of smokeless stoves called chulos. Another is increased co-operation with more general development programmes in the region. The most important are the Small Farmers Development Programme (SFDP), the Production Credit for Rural Women Project (PCRW) and the Basic Services for Local Development Programme (BSLD).

Smokeless chulos are baked clay cooking stoves which make more economic use of firewood. The main reason for their introduction is forest conservation which helps preserve water sources and reduce the risk of landslides, thus enhancing continuous functioning of schemes. These stoves have a number of other advantages. The more economic use of firewood reduces the heavy burden for women of its collection. Further, these stoves help to combat widespread respiratory diseases and eye inflammation as smoke is conducted through a chimney. They are much safer for children and will reduce the high incidence of burns. The smokeless chulo programme is seen as contributing significantly to improvement of the household environment.

The smokeless chulo programme covers manpower development, motivation and implementation. Potters are trained to produce a high quality chulo. Demonstration chulos are installed in all project villages to show the benefits of this type of stove. The communication unit has prepared a slide show about them and ordered a film on deforestation. In addition the UNICEF booklet, "Smokeless Chulo" was reprinted in 2000 copies for distribution. All water supply and sanitation technicians are trained in the promotion and in practical aspects of chulo installation.

A recent internal evaluation showed that a smokeless chulo consumes only 50% of the firewood needed for cooking on a traditional stove, but the time required is longer. Therefore the present type of smokeless chulo is less suitable for households of more than seven people and for the preparation of

animal food and local beverages. The advantages of no smoke in the kitchen for eyes, breathing and clothes are appreciated although sometimes smoke is felt to be needed to dry the corn and to preserve timber used in the house construction. To encourage potters to produce these stoves, training and adequate guarantees for marketing them were included in the start-up phase of the programme.

Increased co-operation with other development programmes is the second important feature of the wider context. These programmes all aim at agricultural development and improving living conditions in rural areas. The CWSS Programme supports these programmes by providing water supply and sanitation facilities in villages in which development activities are concentrated.

Co-operation with the Production Credit for Rural Women (PCRW) project has been especially fruitful. PCRW seeks to raise the living standard of low income families by increasing the efficiency and productivity of women's current work and enhancing their status by creating new opportunities (UNICEF undated/b, p.5). To meet this objective, the PCRW project has concentrated on income generation opportunities and credit facilities for women. But at the same time it is realized that their participation in project activities is only possible if they are freed from some of their present duties. Obviously, installation of water supply facilities near the houses is instrumental to this and thus co-operation was sought with the CWSS Programme. This is also beneficial to the CWSS Programme because it facilitates the involvement of women in the planning and management of water supply schemes. The importance of co-operation for the PCRW Project may be clear from the following:

"Water projects often play a big part in PCRW's acceptance locally. In Hungi, for example, the field team started with a fruit tree planting project. This is now well-established but the field team feels that the construction of two tapstands was really the turning point in terms of the villager's attitude to PCRW, because this met a crucial felt need. Subsequently, having won their confidence, it has been easier to introduce new ideas for projects, such as rabbit breeding, which is now arousing a good deal of interest. Similarly in Walling, construction of a water system serving four wards gave powerful support to community participation and voluntary labour in a wide variety of activities such as building a school and improving paths (UNICEF, 1985).

5.6 Development of phase four

Although the funding proposal for the subsequent fourth phase (1987-1990) was prepared in mid-1986, lengthy consultations between HMG and the funding agencies, SATA/Helvetas and UNICEF, and transfer of the programme

to a new ministry delayed signing of the agreement until after 1987. In line with ongoing developments and experience in the CWSS Programme, Pokhara, three new overall objectives were added: participation of women in project preparation, implementation and management; increased emphasis on development of maintenance and repair capabilities at village and district level; and decentralization support through strengthened district level government institutions.

The latter objective is particularly important as it is a prerequisite for effective decentralization of project planning and implementation. One of the urgent matters to be tackled is fund handling, as 75% of the cash budget for each project directly goes to the district. Another identified need is to familiarize district officials with the CWSS Programme and to discuss procedures and problems. Two workshops have already been organized to serve this purpose.

To enhance women's participation, the duties of the women development officer were further specified to include "developing a strategy within the present government infrastructure to promote the involvement of women in the water supply projects and in health/hygiene and sanitation activities; co-ordinating inputs from other agencies, government and non-government, which have women-related activities; and organizing and conducting training for women" (UNICEF, 1987a).

For the first year, a pilot approach to women's participation has been set up and is being tested in four project villages. Following three initial field visits of the women's development officer, each village selected two women as members of the water supply committee. These women participated in a one-week training course in communication and hygiene education. Although the emphasis is on awareness building, more visible activities which can also be used to monitor and evaluate the success of this pilot programme include cleanliness around the tap site; proper use of private latrines; kitchen gardens; two women active in the water supply committee and good maintenance standards of the water supply system (Gurung et al., 1987).

A new development in this programme phase is that HMG has agreed to take over payment of salaries and travel and daily field allowances of the water and sanitation technicians. In return, UNICEF has agreed to pay for the locally available materials. This new situation may be considered as a major step in the process of institution building. However, it also creates new risks. For career promotion office performance might become more important than performance in the field. Payment of salaries and allowances may be subject to delays and cuts due to limited government finances. These risks require careful consideration, because the technicians are the backbone of the programme.

6. *Overview of Achievements*

Between 1971 and 1976 some 70 rural water supply schemes were completed by the regular HMG/UNICEF programme, of which 32 were in the Western Development Region. In view of the absence of road connections, difficulties in construction material supply, lack of manpower and experience with gravity piped supplies, this may be considered to be quite an achievement. Unfortunately, the quality of construction left much to be desired and many schemes quickly fell into disrepair.

The CWSS Programme introduced a new concept to improve the quality of construction and to increase the rate of implementation. Adequate funds, trained manpower and logistic and technical support were the three pillars of the programme. A quantitative indication of the programme achievements in the Western Development Region in the past ten years is presented below.

6.1 Manpower training

The critical manpower situation at the start of the programme made training the first priority. At the national level, UNICEF assisted the Institute of Engineering of the Tribhuvan University, Kathmandu, to organize a three-year course for technical overseers. Over the years several hundred have been trained. Although many graduates have opted for more prestigious office work, those who joined the programme have been well motivated for the demanding work in the remote rural areas. Their knowledge and inputs have contributed greatly to programme expansion and their increasing ability to take on design of water supply schemes has relieved the work-load of the few engineers available and overcome the need for foreign volunteers. The development of standardized plans for the various elements of a gravity supply scheme and standardized forms for cost estimates have also contributed to this achievement.

The capabilities of the overseers were further strengthened by participation in the national seminars and workshops on water supply, sanitation and maintenance held in Jhapa, Kathmandu and Pokhara between 1980 and 1982.

At the regional level, development of a phased training course for water supply and sanitation technicians is the main asset. The course alternates formal training during the rainy season with on-the-job training during the construction season for a period of two years. The course curriculum was developed in co-operation with the Technical Section of the Panchayat Development Training Centre. Over the years the training course has been adapted to programme developments. More attention is now being paid to communication skills, health education, sanitation and construction of

ferrocement tanks. Technicians, trained previously, have been able to make up these subjects in short upgrading courses. The numbers trained between June 1976 and June 1987 are presented in Table 4.

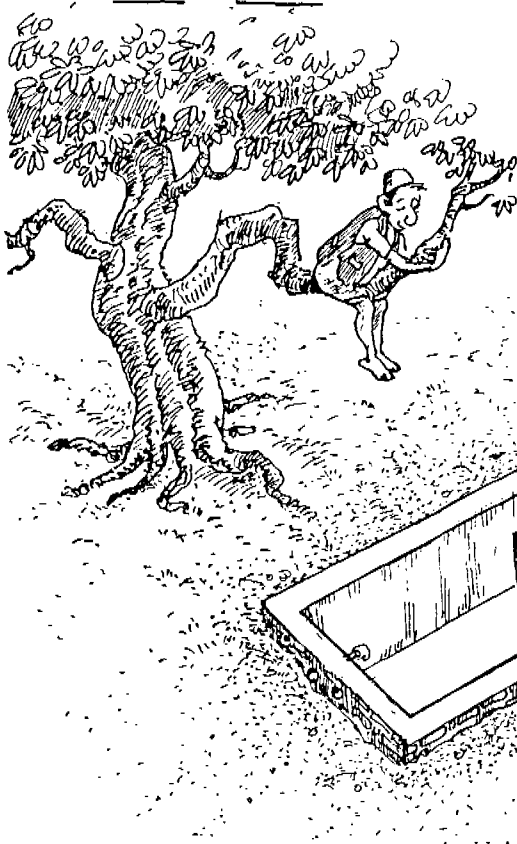
In addition, special training courses and workshops were developed, not only for technicians, but also for other target groups. Further details on these courses are given in Section 5.3.

Table 4: Number of participants in training courses and workshops organized by the CWSS Programme, 1976-1987

Technician courses	
Regular courses	146
Refresher course	45
Ferrocement tank construction course	102
Bamboo cement tank construction course	51
Smokeless stove installation course	55
Health education and sanitation course	90
Health education and sanitation course for sanitation technicians	8
Village maintenance workers course	282
Smokeless stove production course for potters	39
Communication and hygiene education course for women community workers	20
Co-ordination workshop for village representatives and programme staff	162
Agencies co-ordination workshop	44

For these courses, various manuals and other training materials have been developed covering technical, social and health topics. Five basic manuals for the design and construction of water supply systems were prepared. The manuals have been updated subsequently to integrate new programme experience. The latest editions have been produced in Nepali. The original reference book "Standards and procedures for the design of water supply systems in rural areas of Nepal and Bhutan" written in 1976 has been improved by experience of programme staff. It is the basis for "gravity water supply manual" by Thomas Jordan , and published by the Intermediate Technology Development Group (ITDG). Other manuals published by the programme include a sanitation handbook; design guidelines for water supply systems; an instruction booklet on the installation and use of smokeless chulos; a manual on maintenance and repair; a handbook on the construction of ferrocement and bamboo-cement tanks; and numerous educational and

PLAN - प्लान



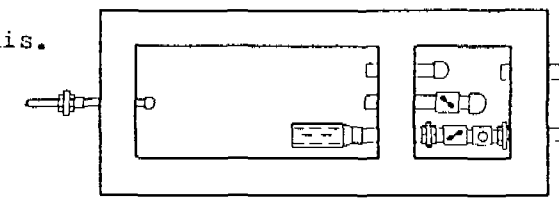
If you were up in a tree

and looked straight down at this uncovered storage tank,

यदि तपाईं रूखमा चढेर यो नछोपेको स्टोरेज टैंकीलाई सोझो हेर्नुभयो भने,

It would look like this.

त्यो यस्तो देखिन्छ ।



This view is called plan.

यो दृश्यलाई प्लान भनिन्छ ।

Explanation of how to read design drawings prepared for training course in CWSS Programme

promotional materials for use in workshops and village gatherings. Except for the first three publications, all these materials were written directly in easy to read Nepali.

6.2 New water supply schemes

Between 1972 and 1987, 246 water supply schemes were completed serving about 280 000 people in the Western Development Region, with 32 schemes already constructed before the start of the programme in 1976. The increase in coverage since 1972 is shown in Figure 6. The figures given take into account annual reduction in coverage of 10% for projects built before mid-1976 and 4% projects built after mid-1976. The average population increase is taken as 2.6% per year. Compensation is made for maintenance and rehabilitation projects.

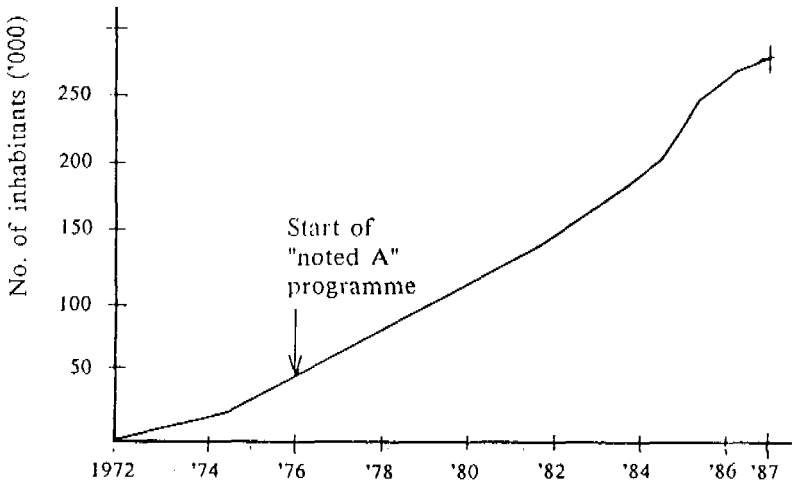


Figure 6: Number of inhabitants of Western Development Region served by the CWSS Programme 1972-1987

Inputs in the construction of water supply schemes are shared by the community, HMG/MPLD and UNICEF/HELVETAS as follows:

- Community
  - co-ordination of village work
  - excavation of pipelines trenches
  - collection of stones, gravel and sand and transport to work site
- HMG/MPLD
  - planning and technical execution
  - porterage and other transport

- skilled labour
- locally available tools and fittings

- UNICEF/HELVETAS
  - programme co-ordination, training, village preparation and engineering support
  - construction materials such as cement, pipes and fittings.

With time the community contribution has increased while that of HMG has declined (see Table 5).

Table 5: Proportion (%) of contribution to new water supply schemes

Year	HMG/MPLD (%)	Community (%)	UNICEF (%)
1981/82	27	18	55
1982/83	26	21	53
1983/84	23	25	52
1984/85	23	23	54
1985/86	23	32*	45
1986/87	20	32*	48

* Use of real values instead of nominal values as used in previous years partly explains the considerable rise in community contribution

The growing importance of the village contribution is mainly due to the increase in average length of schemes and number of tapstands (see Table 6). As trench digging for the pipeline and transporting materials for the tapstands is the community's responsibility, the burden of the increased size of the schemes is largely shouldered by them. However, they are also the ultimate beneficiaries because a larger scheme means greater convenience for users as water points are brought closer to clusters of houses.

Table 6: Average characteristics of new water supply schemes constructed between 1977 and 1987

Year	Population	Length of system	No. of Taps	Cost per head (NRs)	No. of users per tap
1977/78	--	2.0	3.7	--	--
1980/81	--	5.1	8.0	--	--
1982/83	1340	6.5	11.5	358	116
1983/84	1490	7.9	14.8	363	101
1984/85	1500	9.9	17.3	410	87
1985/86	1448	10.7	16.7	438*	87
1986/87	1400	9.8	17.8	477*	79

* Prices based on currency value before 1986 devaluation, and on nominal amounts as was common practice up until 1985.

6.3 Construction and overhead costs

The average cost per head given in Table 6 does not include programme overheads. These costs for 1986/87 are given in Table 7 and are approximately 19% of the total annual cost. When the salaries and allowances for technicians are included in the construction budget, this percentage falls to just 12%.

Table 7: Estimated expenditure in CWSS Programme, Pokhara in 1986/87

	Proportion of total cost (%)	Cost (NRs)
Overhead		
Salaries, allowances, travel expenditures of programme staff, engineers and overseers	6	1 400 000
Salaries, allowances, travel expenditures of project technicians	7	1 600 000
Investments	3	700 000
Operational Expenditures	3	815 000
Construction costs		
Cash/HMG/UNICEF	55	13 070 000
Community contribution	26	6 140 000
Total		23 725 000

In evaluating the costs of the CWSS Programme, it has to be recognized that a lot of money is fed into the local economy by providing employment opportunities. Some 120 personnel are directly engaged by the programme in the Western Development Region. In addition, NRs 2.3 million was spent on skilled and semi-skilled labour and porterage, that is 9.6% of the total estimated expenditure.

6.4 Maintenance and rehabilitation

Maintenance, repair and rehabilitation have become a major concern of the programme in the past few years. In 1981 a thorough study was made of a limited number of projects to determine maintenance and rehabilitation requirements. The study revealed an urgent need for rehabilitation projects, especially of schemes constructed before 1976. Details of this study are presented in Section 9.2.

Since this survey, 17 schemes have been rehabilitated. Also, more attention has been given to maintenance and repair, and between 1983 and 1987 more than 81 schemes have had maintenance and minor repairs done.

A mail-survey carried out in 1985/86 to assess the status of completed water supply schemes as perceived by the communities indicates that the

programme is moving in the right direction by training sufficient numbers of village maintenance workers and by giving increased attention to maintenance and repair of completed projects as well as constructing new schemes (see Section 9.4). The next programme phase continues to emphasize the importance of maintenance and upkeep of existing schemes by restricting the number of new projects in favour of work on rehabilitation projects, and setting up of a maintenance management system at both the programme and village level. This also means that responsibility for maintenance is shared by the Nepali administration, and that provisions are incorporated in the Decentralization Law as well as staff and funds being allocated for the purpose.

6.5 Sanitation

Compared with the achievements in water supply, the results in sanitation have been modest. One reason for this is that sanitation has only been included in the programme since 1980. Another is that it is not really a perceived need of most rural people. Sanitation promotion has only changed that picture marginally.

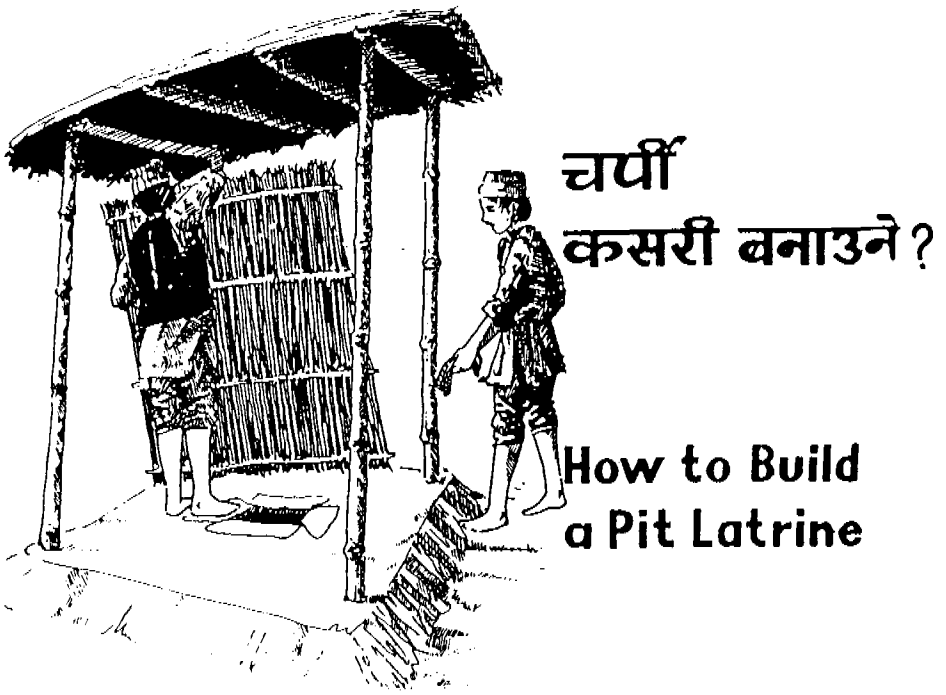
In 1981 the MPLD set up a "sanitation cell" to support activities within the national programme. The cell has prepared standard designs for household and school latrines, but its main purpose is to remind the relevant authorities in Kathmandu of the importance of sanitation improvements. Unfortunately, the cell has never been strong enough to provide support to the CWSS Programme.

The national programme concentrates on the construction of school latrines. HMG and UNICEF together prepared a set of health education flip charts for use in schools. Because of a variety of logistical problems these flip charts were never available in large numbers in the rural schools. Usually it is left to the water supply and sanitation technician to provide some health education in schools provided with latrines as part of the project activities.

In 1986 another attempt was made at the national level to include health education in the school curriculum. A new flip chart was made (many of the illustrations in this book have been taken from that flip chart) and seminars for teachers were held. This time, health education is hopefully being introduced more successfully as a subject in schools.

Whereas the construction of institutional latrines has been quite satisfactory, construction of household latrines has not met with much enthusiasm. In each project village one or more latrines have been built by the programme technician or with his assistance. The exact number of these simple latrines has not been recorded. In addition, in the last five years some 375 household latrines have been constructed under the programme, which are mostly VIP latrines, although a number of twin-pit poor-flush latrines were

built in Pokhara. By 1986-1987 some 250 latrine units each serving 100 people had been built in schools and health posts. Meanwhile sanitation promotion has gained new momentum through the women's participation programme.



Cover of public health booklet on building a pit latrine with local material

6.6 Smokeless chulos

Introduction of smokeless wood stoves (chulos) is a relatively new programme activity. Use of this stove is expected to contribute considerably to the conservation of forests and thus to the protection of water sources. The smokeless chulo will also help to reduce the prevalence of respiratory and eye diseases and the incidence of burns.

This part of the programme focuses on training of local potters and on the sale and installation of smokeless chulos. To date some 39 potters have been trained to make chulos in various locations in the Western Development Region. As an incentive the programme has guaranteed to purchase a certain number of stoves from each potter's co-operative. Over 2000 stoves have been produced and some 1200 installed in project villages.

Cooking with a smokeless chulo.

PART II
Procedures and Experience

7. *Project Implementation Procedures*

At the start of the Water Supply and Sanitation Programme, Pokhara, in 1976 the first concerns were manpower development and standardization of technical design. Various types of problems were encountered which made the programme team reflect on implementation procedures. One problem was the selection of villages. It was observed that when a water supply scheme was not considered to be an urgent need by the villagers, implementation was more likely to be hindered by conflicts, delays and lack of maintenance. Implementation was also sometimes hampered by communication difficulties between villagers and programme staff. This was often a twofold problem. On the one hand, lack of experience with government programmes made it difficult for the villagers to appreciate programme procedures and limitations. On the other hand, the long walking distance between project village and programme office often led to poor communication.

Over the years implementation procedures have developed and improved, thus contributing to quicker and better results. More attention is now being paid to village preparation and participation. Although this may seem to delay construction, in fact it pays dividends in terms of implementation rate and care for the system after completion.

Improvements in implementation procedures have also been made in other Development Regions. In 1980 the first national conference on the rural water supply programme was held in Jhapa. This resulted in revised and unified procedures for the implementation of individual schemes with special emphasis on engaging and maintaining community participation. Since then, procedures have been further improved.

Sanitation education and latrine construction were included in the programme in 1980. This component is still in a developmental phase. Much experience has been gained and much is still to be improved, both promotion of construction and stimulation of proper use. In September 1981, a national seminar was held on environmental sanitation. This increased awareness of the need for sanitation, especially by decision makers in the relevant ministries. A follow-up to the Jhapa conference was organized in November 1982 to propose plans and policies for a sanitation programme. Although procedures and tasks of villagers and programme staff were not defined in the same detail as has been done for water supply schemes, valuable information and ideas were assembled. Maintenance issues were also covered in the 1982 conference and these are discussed in Chapter 9.

Generally implementation of the water supply schemes and sanitation facilities follows the seasons and agricultural calendar. During the farming season, construction activities slow down because most villagers are occupied cultivating their land. In the rainy season, when many villages are

inaccessible, implementation is also almost impossible. Therefore during these months emphasis is on staff training and preparation of designs and cost estimates. The sequence of activities shown in Figure 7 reflects the desirable situation. In reality, the time frame may be put under pressure for various reasons, such as staff constraints, delayed availability of funds and material, political influence and delayed submission of initial requests for new water supply schemes by the district assembly. The latter especially is a common problem, creating a bottleneck for the feasibility studies. Therefore, it is preferred that initial requests are made and feasibility studies undertaken one year in advance. An additional advantage of extending activities over two years is that the feasibility studies can be done just before the monsoon when the yield of the proposed water source is lowest.

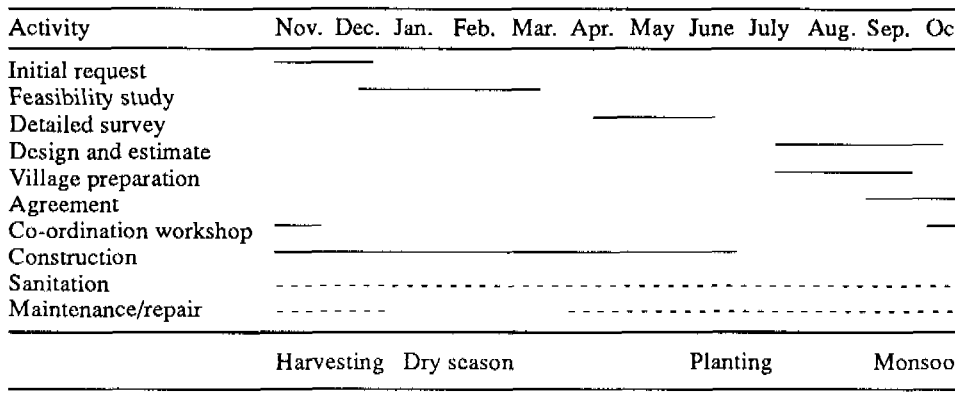


Figure 7: Annual sequence of CWSS programme activities

7.1 Initial request

Each year, the village panchayat has to prepare a development plan based on the needs and interests of the villagers in the nine wards. This plan is then forwarded to the district panchayat. A request for a village water supply scheme is often one of the proposed activities. Priority ranking for new schemes is established by the district assembly. Those schemes considered to be of highest priority are passed on to the Regional Office of the MPLD in Pokhara. This process has to be completed before the end of November/December to allow for timely preparation for the following construction season.

7.2 Feasibility survey

Between January and March the field engineer and overseers of the Regional Office carry out a feasibility survey of all villages on the priority list. This work is done in addition to their co-ordinating and supervisory tasks for schemes under construction. The feasibility study covers both technical and social aspects, such as:

- investigation of the proposed water source(s): type, flow/yield, altitude, water quality, use and ownership of the source, possible source disputes;
- assessment of the present water supply situation and the need for a new water supply scheme: water quality and quantity, walking distance, altitude; investigation of the potential area and population to be served: number of households, dwelling pattern, ethnic groups, presence of health post, post office, school(s), shopping centre;
- short description of the water supply scheme required: spring catchment, break pressure tank(s), storage tank, length of pipelines, nature of the terrain to be covered, number of tapstands, number of households per tapstand;
- tentative assessment of the villagers' interest in a new water supply scheme, their readiness to participate in project implementation, any community aspects which may influence project implementation;
- tentative assessment of the present sanitation situation and possible interest to work on improvements;
- investigation of reafforestation and erosion control activities;
- indication of how many hours the villagers will have to walk to collect sand and stones and how many hours the porters will have to walk from the roadhead to the village.

The feasibility survey is not merely a technical investigation. Time is taken to initiate a process of sustained community participation. To this end, informal discussions are held with ward representatives and other community members. A village meeting is organized to explain and discuss the proposed project. Although all villagers are invited to the meeting, often only the men participate. At present ways are being sought to increase the active involvement of women from the very start of project activities.

The survey results in an overall ranking of the proposed project: feasible; not yet feasible because of unsettled problems; or not feasible technically and/or socially. Based on this ranking, the programme team revises the priority list for the district panchayat who will select the schemes to be implemented in the following construction period. The total number of schemes per district will depend on the manpower and budget available.

7.3 Detailed survey

Once a village has been selected, a survey team consisting of an engineer and/or one or more overseers will carry out a detailed technical survey of the site for design purposes. During their stay in the village they will use every opportunity for informal discussions about present water supply and sanitation problems, possible improvements and expected inputs from the community. This process aims to enhance community support for the forthcoming construction activities and proper use and maintenance of the completed facilities. It also aims to stimulate interest in sanitation and health related aspects of the project. Where necessary, the survey team will assist the community to solve any technical or social problem. If not successful the problem is reported to the Regional Office and either the priority list is rearranged or som one from the Communication Unit is sent to help with the problem (see Section 5.4). These detailed surveys have to be completed before the end of June, when the rainy season starts.

Informal problem solving aided by the Communication Unit

7.4 Design and estimates

During the monsoon rains in July and August, project designs, bills of quantities and cost estimates are prepared. Construction features are standardized as much as possible.

The spring intake generally consists of a covered collection box built to reduce the chance of surface pollution. Depending on the topography, the water may be piped to a small intake tank and from there to a ferrocement reservoir tank just above the village. Some systems do not require a reservoir tank. The pipelines are designed as a pressure system and because of the generally step gradients, break-pressure tanks are frequently necessary.

Tapstands consist of a galvanized steel standpipe supported on a stone masonry back wall. The floor is made of concrete or stone slabs with cement mortar. Surplus water is drained via a channel or pipe to a cattle watering pond, vegetable garden or cultivated field. Taps are either brass bib-cocks or self-closing. All taps are public; there are no private connections.

The design standard is 45 litres of water per day per person. This is expected to be sufficient for personal and domestic water use, including cattle watering. Pipelines are designed for a 20-year period; but the number of taps is based on actual population. Average flow per tap is 0.225 l/s. One tap is provided for 10 to 20 households, although often the ratio is lower, especially if the nearest standpipe is more than 200 metres away. Exceptions to these rules may be made in consultation with the villagers, for example when water is scarce or houses are isolated.

After the design has been completed, a detailed estimate of manpower, material and cost requirements is drawn up for each village water supply scheme.

7.5 Village preparation

A recent development in implementation procedure is the inclusion of a one-week visit to each of the selected villages by two Water Supply and Sanitation Technicians (WSSTs). This visit is made after official approval has been granted by the Ministry of Panchayat and Local Development for inclusion of the project in the following year's work plan. The objective of the visit is to explain and discuss the forthcoming project activities with all villagers and to help sort out any problem which may affect construction, use and maintenance of the water supply system.

One aspect often needing attention is the sensitive question of location of the tapstands. People are inclined to reconsider proposed locations when they feel that the new water supply will become a reality. Another issue requiring time for clarification is the expected village contributions to construction.

During their stay the WSSTs will invite the villagers to form a water committee. The main tasks of this committee are:

- regular consultation with villagers and programme staff;
- clarification of the reasons for the proposed location of tapstands by the programme team, and in case of strong opposition by the community, to liaise with the programme team;
- organization and time registration of community labour inputs;
- organization of porterage of material from the roadhead to the village;
- settlement of disputes and liaison with the programme team when greater problems arise.

Since the Decentralization Law, the water committee consists of the ward head as chairman and seven selected members. When more than one ward is covered by the new water supply scheme, one of the ward heads is appointed chairman and nine members are selected.

Sanitation education continues to be a difficult task

A water committee is formed at a general meeting of all villagers. Participation of women in the selection and functioning of the committee has been a matter of concern. Women do not often attend general meetings and have no experience in participating in public bodies. The programme team is becoming more sensitive to this problem and is looking for realistic approaches to increase women's involvement with support from the Women Development Officer (see Section 5.6).

The WSSTs are supposed to take advantage of their stay in the village to discuss sanitation and health related matters and to motivate the community to improve their personal and environmental health. As the WSSTs are more trained and experienced in technical subjects, these non-technical aspects may easily suffer from a lack of attention (see also Section 7.9).

The Communication Unit has prepared a checklist for the WSSTs for all aspects needing further understanding, approval and/or arrangement. The checklist includes a number of factual questions to enable the programme team to plan activities for the construction season, such as present number and location of latrines, availability of skilled and unskilled labour, names of trusted community leaders, and peak months in agricultural work.

7.6 Agreement

Before construction work begins a formal agreement is signed by the water committee, the village panchayat, and the district panchayat secretariat and the MPLD, Western Regional Directorate. This agreement sets out the structures to be built, the material required and the obligations of the parties concerned.

Essential information about the villages to be included in the new construction season is summarized on an information board which is displayed on the wall in the Regional Office.

7.7 Co-ordination workshop

A recent development is the organization of a co-ordination workshop just before the start of the construction season. Participants are the chairmen and members of the water committees and the programme team, including the director, accountant, engineers, overseers and WSSTs. The workshop is conducted because it is acknowledged that progress with construction depends on co-operation between the parties involved. In the past, misunderstandings have not been uncommon. For example, the water committee chairman often experienced difficulties in finding the right person at the Regional Office to discuss progress and problems, to collect construction materials or to get reimbursement for payments to the skilled labourers. The fact that it often takes several days to walk to and from the Regional Office indicates the

magnitude of such a problem. Subjects considered during the co-ordination workshop are:

- government policy on water supply and sanitation
- principal features of the CWSS Programme
- office staff: people, tasks and responsibilities
- office procedures
- maintenance management of completed water supply systems and selection of a village maintenance worker
- sanitation and hygiene education
- smokeless chulos.

The workshop emphasizes communication through group discussion and sometimes role playing. Slide shows, films and posters are used to introduce various subjects and to explain the basic features and procedures of the programme.

7.8 Construction

The construction period runs from November/December to May/June. Each water supply scheme is assigned one or two WSSTs, depending on the volume of work. His first task is to help organize collection and transport of material such as HDP pipes and fittings, valves, galvanized iron pipes and fittings, cement and tools. These are transported by truck to the nearest roadhead and then by porter to the project site. Porters are organized by the village and paid by the MPLD Pokhara. Porterage is a strenuous task, requiring the carrying of loads up to 50 kg through mountainous terrain for a period ranging from several hours to several days. Local construction materials such as river sand, stones, bamboo and wood, are collected and carried to the project site by voluntary village labour.

Apart from supplying local materials, the villagers dig trenches for the pipelines and excavate intake and tank sites. The WSST helps the water committee to organize these labour inputs. As a rule, every household has to contribute an equal number of working days, usually 25 man-days per month. Men and women 15 years of age or older only are accepted. Depending on family size and composition, occasionally persons one or two years younger are accepted. The secretary of the water committee keeps a record of the number of work days provided by each household. If a household fails to meet its obligations, the water committee will pay a visit to discuss a possible solution. Mostly, social control mechanisms help to solve the problem, and for example, two members of a household may provide labour inputs to catch up arrears. Otherwise, the household is fined NRs 20 for each day of non-labour contribution. Other regulations may be applied. For example, in one village seven of the 147 households did not want to be involved in construction of a

new water supply. In consultation with all relevant parties, the water committee decided to exempt these households on the understanding that they would not use the new supply unless they first paid NRs 2000.

Organization of labour inputs is quite demanding, with sometimes more than 100 people digging a trench a one time. The WSST is responsible for supervising the work, supporting the water committee in keeping the people motivated, and solving problems. In one village the WSST had to point out to a group that they had started to dig a trench in the wrong direction. This was

Trench digging by voluntary community labour

towards their own houses as they very much wanted a tapstand nearby. The WSST needed all his communication skills to settle the problem without endangering communal interests and the timely process of work.

In co-operation with the water committee, the WSST is responsible for finding local artisans for construction of the intake, reservoir tank, break-pressure tanks, valve boxes and tapstands. These builders are paid from the project allocation on a daily basis.

During the construction season the village will be visited regularly by the overseer responsible for the area. His main task is to guide and consult with the WSSTs and the water committees on technical and organizational matters and administrative procedures. He will also assist in supplying materials from the Regional Office to the village. If village co-operation is hindered by some dispute, the overseer or the WSST may call upon the Communication Unit to assist in sorting out the problem. Should changes in the technical design be required, the field engineer will be consulted.

Walking distance permitting, the field engineer visits the project site once a month. When the scheme is ready, he has to visit the project site to check the quality of construction and to write a completion report. Only then is the new scheme handed over to the village who is responsible for operation and maintenance.

7.9 Sanitation

When the WSST settles into the village at the start of the construction season, one of his first tasks is to build a pit latrine entirely from local material. This latrine is not only for demonstration purposes but also for his own personal convenience.

Just as during village preparation (see Section 7.5), the WSSTs are expected to conduct hygiene education meetings and informal discussions throughout the construction period. To this end, they are supplied with basic promotional material such as a flipchart. When a household shows interest, the WSST assists them in building a latrine. Experiments are underway to provide interested households with half a bag of cement and some reinforcement bars to construct concrete squatting slabs. The aim is to improve sanitary conditions of the latrine including ease of cleaning, and to reduce the need to fell trees for timber. However, the price of cement and portering costs are high.

Provision is made in the design and estimates (see Section 7.4) for construction of public latrines in schools and health post in the project area. But latrines are only constructed when a formal request is received from the headmaster or officer-in-charge of a health post. These latrines are simple ventilated improved pit (VIP) latrines with a concrete squatting slab. Teachers

Construction of a latrine using locally available materials; picture taken from health education flipchart

and health workers are encouraged to pay extra attention to hygiene education during and after latrine construction.

Procedures developed for the promotion of sanitation improvements are not the same in all Development Regions. For example, in the Mid-Western Region, the construction of household latrines is a precondition for the provision of a water supply scheme.

Sanitation motivation seems to be most successful in areas where the WSSTs are given constant encouragement and support by their overseers and engineers. However, promotion of sanitation improvements is still a difficult task for many technicians, notwithstanding their training in health and latrine construction. One of the problems is lack of communication skills to address these subjects. In the near future, it is expected that new approaches will be developed to increase coverage and proper use of latrines.

7.10 Operation and maintenance

Operation and maintenance of a completed water supply scheme is primarily a community responsibility. During the construction period, one or more village maintenance workers (VMW) will be selected by the water committee. They will work on the construction as unskilled or semi-skilled labourers for a daily wage. At the same time, they will be trained on-the-job by the WSST to carry out minor repairs and protection works. Usually, the VMW is a farmer, just like the other villagers. There are no female VMWs, but in a number of cases, women take care of the tapstand and the direct environment.

Upon completion of the scheme, the water committee is transformed into a maintenance committee to facilitate and guide the tasks of the VMW. Usually, the committee keeps the set of tools provided by the programme to be used by the VMW for upkeep and minor repairs. When required, the committee organizes the village to provide additional money and labour for repair work. Village contributions to compensate for the services of the VMW are also co-ordinated by the committee. These contributions may be either in cash or in

Village maintenance workers are often paid in kind

kind and made yearly or monthly. Not all villages succeed in raising enough funds to keep the VMW motivated. Sometimes a solution is found by freeing him from community labour.

In the first year of operation of a water supply scheme, the VMW is invited to attend a one-month training course. This course is organized once a year for some 40 VMWs from all over the region. It is designed to refresh their knowledge, to evaluate their first months of independent work, and to teach additional skills such as latrine construction and the installation of smokeless chulos.

For more complicated and expensive repairs, the maintenance committee will request assistance from the Regional Office. Programme-supported repair work is often undertaken at the end of the dry season when people are highly motivated to provide community inputs. During this period most alternative water sources will have dried up. The procedures for maintenance support from district and regional level as developed by the various development regions are further discussed in Chapter 9.

8. *Technical Aspects and Standardization of Technical Design*

From the beginning of the Community Water Supply and Sanitation Programme, Pokhara, the need for standardized technical designs and procedures was recognized. Standardization would not only contribute to quality of construction, it would also facilitate the process of construction and reinforce the confidence of programme staff. Standardization further allows for the training courses to be tailored to the requirements of the technical tasks. Therefore, much effort was devoted to preparing a set of standard construction plans for each structure. These plans were based on those developed in the SATA/Helvetas assisted community development programme in Cameroon and later adapted to Nepal. The material quantities required were also fixed. To support technical execution of the field activities various administrative forms were developed.

8.1 Profile of a water supply system

Only gravity water supply schemes have been constructed by the programme. Water from springs or small streams high in the hills is collected in an intake works and then flows under gravity a distance of 3 to 5 km to a reservoir on a hillock or higher point above the village. Tanks are commonly circular and constructed in ferrocement of standard capacities of 2.5, 5, 10 or 20 m^3. Water is distributed from the tank to an average of 17 public tapstands through a pipeline system about 5 km in length. Depending on requirement, air-release valves at high points, washouts at low points and break-pressure tanks to create pressure zones with acceptable maximum pressures, are included in the design (see Figure 8).

8.2 Source

Where possible, preference is given to a spring as source because usually the water is of better quality. However, often the source cannot be easily pinpointed because it is mostly a seepage area. Water from a seepage area is drained by a trench catchment, containing a perforated pipe. This allows water from the water bearing soil to seep into the pipe through the perforations. Alternatively, a dry-wall channel is built, that is a channel constructed without cement. This functions in the same way as the perforated pipe and for many situations in Nepal, may be better because it can be constructed from local

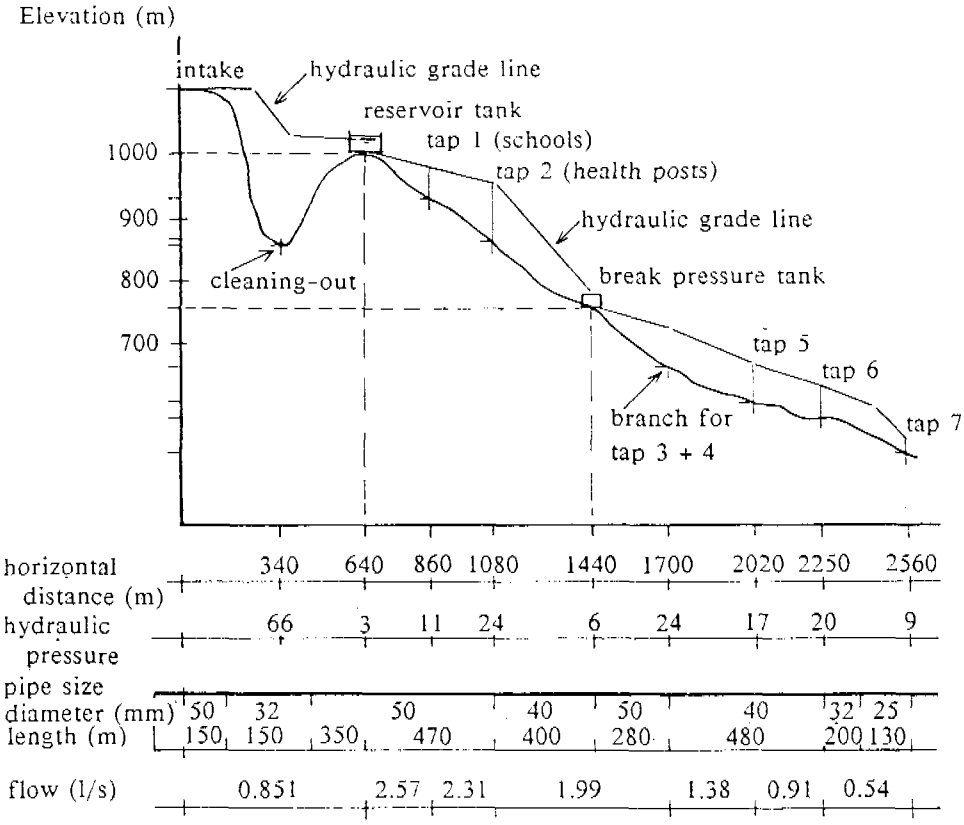


Figure 8: Longtitudinal profile of a water supply scheme constructed in the CWSS Programme

materials without having to bring in special pipes. Trench catchments are also used for small sources, but whereas trench catchments in seepage areas may drain water up to 30 metres per branch, trench catchments of small springs are usually only a few metres. Catchment installations using a dry-wall channel and using perforated pipe are shown in Figure 9.

In areas where small streams and rivulets have to be used as source, a catchment installation is built usually consisting of a dam across the stream, a spillway at the dam and a collection chamber. This collection chamber must be carefully sited so that it is not swept away in flash floods during the monsoon.

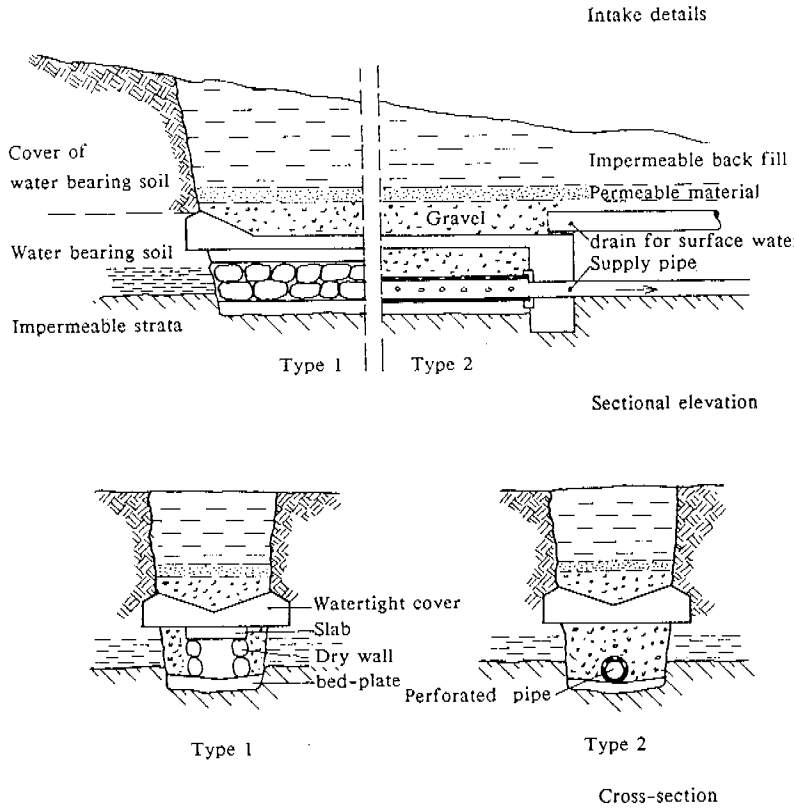


Figure 9: Cross-section of catchment intake for community water supply scheme

For the same reason, the reservoir formed by the dam across the stream needs to be filled with boulders up to dam level.

8.3 Storage tank

In 1983 ferrocement storage tanks were introduced (see Figure 10). Ferrocement consists of a sand-cement mortar heavily reinforced with rods and chicken wire (reinforcement percentage by weight 0.9-1.1%). The reinforcement consists of a network of vertical and horizontal rods of small diameter (4-5 mm), spaced at a distance ranging from 50 to 120 mm. A layer of chicken wire (mesh size 20 mm) is placed on both sides of this network, which is then embedded in mortar made of one part cement and two parts sand. The sand should be well graded and contain no silt. Coarse sand is preferable because shrinkage is less, although it reduces workability of the mortar. If fresh cement is not available then the cement should be sieved before use.

Ferrocement is particularly suitable for curved structures, such as circular tanks, because bending moments do not occur and a small degree of deformation is acceptable. The main advantages of this type of material are low cost, simplicity of construction, and durability.

Either an inside or outside mould is used to construct a ferrocement reservoir. In Nepal a temporary inside mould is made of HDP pipe which is used later in the water distribution system. A construction schedule for a ferrocement tank using internal shuttering is given in Figure 11. Careful curing is necessary, especially in warm, dry weather, to ensure satisfactory adherence of the successive layers.

Although new to many places, construction of ferrocement tanks can easily be mastered. Furthermore, these tanks can be constructed quicker and cheaper than tanks of many other materials. A team of one supervisor, two experienced masons/pipe fitters, and 5-10 semi-skilled labourers, can build two 4 m diameter tanks within four weeks. Thus, ferrocement work can be carried out efficiently by a small team of artisans, provided they are adequately trained and care is taken to cure the ferrocement structure properly.

More than 70 ferrocement tanks have already been constructed in the Western Development Region and none was reported to be leaking in a review carried out early in 1985. This is quite remarkable because the review included a 10 m^3 tank dug out of a landslide, and a combined tank of 2 x 20 m^3 which lost its support when a large amount of the soil beneath it "disappeared" leaving a hole below the tank foundation. However, both tanks continue to function. At least as many ferrocement structures have been built in other Development Regions where the UNICEF supported CWSS Programme is being implemented.

Experiments with bamboo-cement construction techniques have resulted in the development of inexpensive household and school tanks. With minimum outside assistance, these tanks can be built by a group of determined villagers. In this sense this technology contributes directly to affordable rural infrastructure. In the last three years some 20 tanks ranging in size between 1 and 5 m^3 have been built. Further evaluation is required to assess the quality of these tanks. Construction costs based on data for 1985 are given in Table 8.

Table 8: Comparison of construction costs (NRs) of bamboo-cement and ferrocement reservoir tanks*

	Bamboo-cement (4.5 m^3)	Ferrocement (5 m^3)	Ferrocement (10 m^3)
CWSS Programme	4 500	13 500	19 000
Community	1 200	1 300	2 100
Total	5 700	14 800	21 100

Source: Müller, 1985

* Porterage costs for cement, rods and chicken wire not included. (1985 prices).

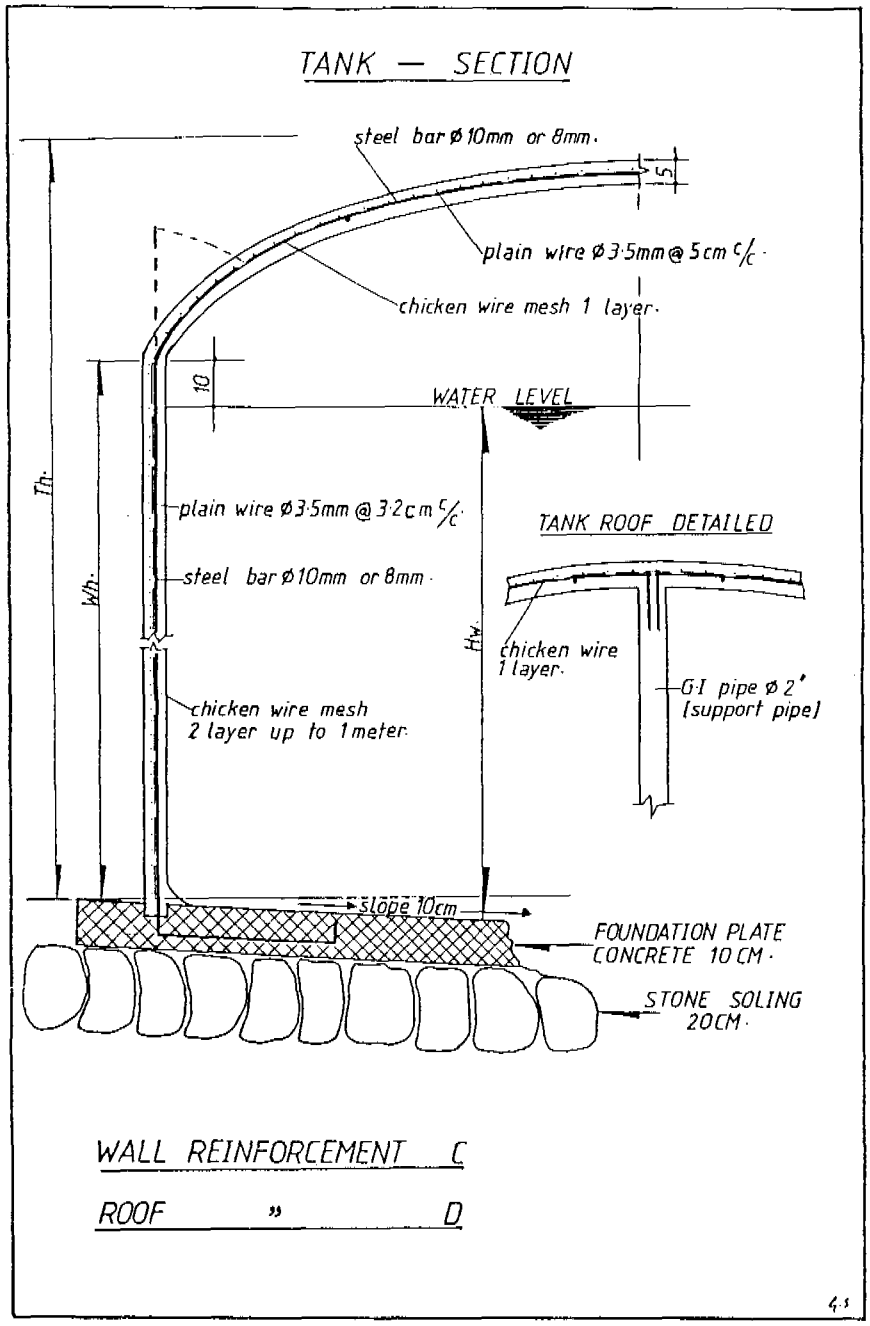
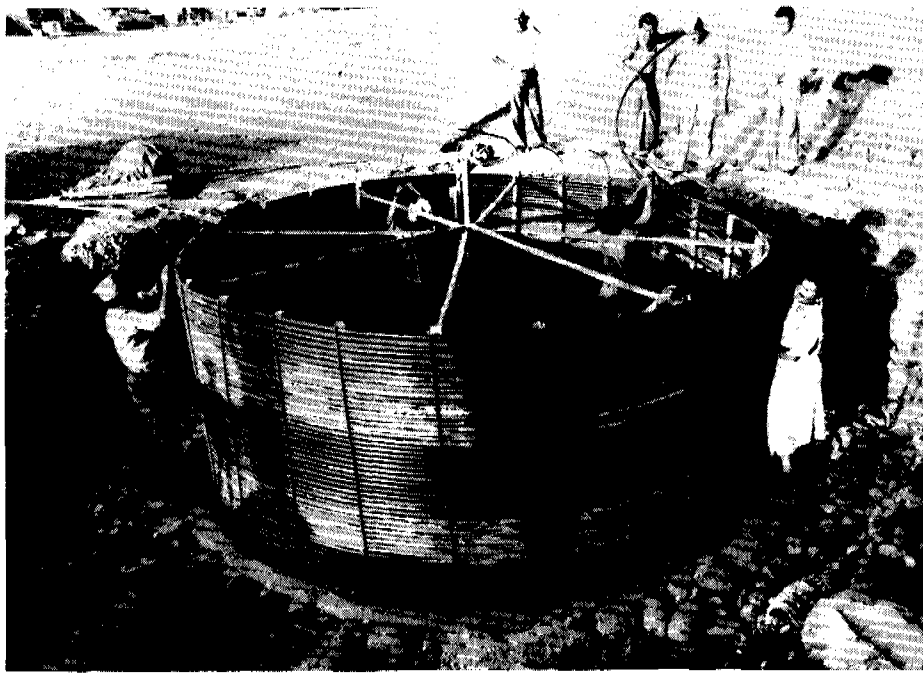


Figure 10: Cross-section of standard design of ferrocement water storage tank



Construction of a ferrocement water storage tank

8.4 Developments in hydraulic design

One of the major issues addressed in the last few years was the hydraulic design of the water supply systems. An extensive guideline for the hydraulic design of gravity water schemes followed by interactive supervision of the field engineers and overseers has led to considerable improvement. The design process starts with the detailed survey in the project area using an abneylevel or a theodolite. From the survey data, the distances between the survey points and their elevation are derived and plotted to obtain a profile. Using the hydraulic design guideline, a flow diagram is made for the scheme based on the design population, number and siting of taps, and storage required.

The programme uses high density polyethylene (HDP) pipes of two quality classes, 6 kPa and 10 kPa, for 60 m and 100 m pressure respectively. This means that pressure zones within the schemes cannot exceed these limits. Galvanized iron pipes are used in rocky areas and to cross gulleys. Common pipe diameters are 20, 25, 32, 40, 50, 63 mm, and in some cases 16 and 90 mm HDP is also used.

For many years the hydraulic design of a water supply scheme was prepared manually. This had as a severe disadvantage that only one or at best

1st Day: ..... Installations: Washout, overflow, inlet, supply
Reinforcement: Foundation steel bar
Foundation: Concrete 1:2 1/2:4 Topping wet/wet

2nd Day: ..... Reinforcement: Wall steel bar
Wall-formwork: P.E. pipe diam. 32 mm
Cover fresh topping to avoid damages

3rd Day: ..... Wall-formwork: P.E. pipe diam. 32 mm
Reinforcement: Chicken wire, plain wire diam. 3.5 mm
spacing 1"

4th Day: ..... Plastering:
1. coat 1:3 outside wall (1-2 cm) surface rough
2. coat 1:3 outside wall (1-2 cm); surface floated
Apply 2. coat after 1. coat has set.
Water cement ratio 0.45-0.50

5th Day: ..... Hardening time for plastering outside wall

6th and 7th Day: Cover the wall with suitable material and cure at least three times daily

8th Day: ..... Remove P.E. pipe
Plastering:
1. coat 1:4 inside wall (1-2 cm) surface floated
2. coat: cement paste (1-2 mm) apply up to 5-10 cm above proposed water level.

9th Day: ..... Reinforcement: Roof steel bar
Manhole wood formwork (45 cm x 60 cm)
Plain wire diam 3.5 mm / chicken mesh
Roof-formwork: Hardboard

10th Day: ..... Plastering:
1. coat 1:3 outside roof (3-4 cm) surface floated

After 7-14 days remove roof-formwork and apply 2. coat 1:3 inside dome (roof) 2-3 cm.

Figure 11: Example schedule for the construction of ferrocement water storage tank

two possible pipeline configurations were tried. In 1984 the programme provided each engineer and overseer with a programmable calculator (Casio FX-602 P). Use of calculators has reduced considerably the chance of pipe oversizing in the design work and has led to more economic design.

The lower cost of ferrocement tanks allows for more liberal application of reservoirs. Especially storage tanks of 5 and 10 m^3 capacity have been used recently to provide storage at critical points in the system. Improved methods of calculation combined with clever application of storage tanks have increased considerably the reliability of supply at very little extra cost.

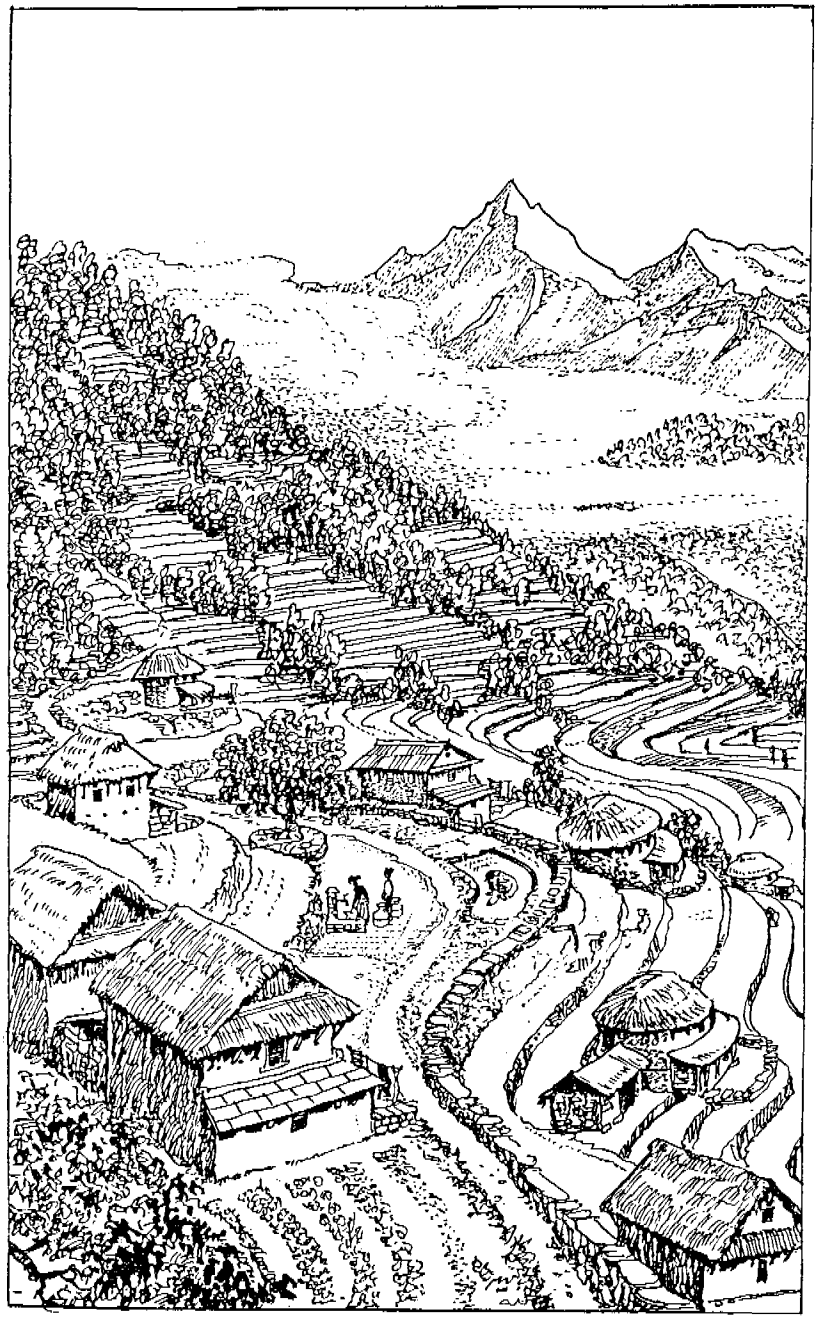
In the past many water supply schemes were designed for open flow. This did not create supply problems because projects were smaller and sources adequate. Now that projects have increased in size there are few sources left which allow for open flow. Yet an open flow system is an attractive option because it is very reliable, and if water is taken from a spring it is the safest possible. However, an open flow system requires attention to the safe disposal of large quantities of wastewater. In the Western Development Region open flow water supply schemes are still designed where larger schemes can be divided into a number of smaller systems and water availability is more than 115 litres per head per day. In the other Development Regions open flow schemes are more common.

8.5 Tapstands

The tapstand design used in the Western Development Region has not been changed in the past ten years. It is a spacious place, often with wing walls with a step of about 50 cm. Women can set down their basket (dhoko) used to carry the gagri on the step and then lift everything easily onto their head band. The faucet is 120 cm above the floor of the tapstand so that adults can easily bathe themselves. Glennie (1985) describes the Western Region tapstand design as follows: "I consider this tapstand design the best one in use. It has a large platform area, uses flagstones for the floor, the central pillar is of cement masonry, the rest is mud stone masonry with cement plaster. The drain is through a large sump under the tap, with a grid of reinforcing bar, and through HDP pipe under the floor".

A tapstand usually serve 10-20 houses in a cluster often all of one caste. In consultation with the consumers, tapstands are sited in the centre or at the lower end of a cluster of houses. Possible re-use of water for a pokhari (water buffalo pond), vegetable gardens or to prepare rice seedlings is a major factor in deciding where to place the tapstand.

The design pressure at the fauce is 15 m (see Table 9). The great differences in elevation make it very difficult at times to reduce the pressures sufficiently at the tap. If the pressure remains too high, the women cannot fill their waterpots easily because of the excessive water spraying. Also, faucets



Suitable location for community tapstand

washers wear out quickly thus leading to considerable waste of water. To maintain reasonable pressure at the tap, break-pressure tanks and storage reservoirs are used. But sometimes it is necessary to resort to small diameter piping (16 mm) or orifices to reduce the pressure.

In addition to reasonable pressure level, good quality faucets need to be installed. Sturdy, brass bib-cocks supplied with washers usually function better than self-closing faucets which are more likely to be abused by consumers. Furthermore, self-closing taps can damage piping and fittings because of the water hammer effect which at times raises the pressure above the allowed rating. In tests done in 1985, pressures surges due to water hammer were recorded of up to 140 m.

Table 9: Main design criteria for water supply schemes

	Village	Bazaar* village
Design water supply	45 lcd	60 lcd
Design period	20 years	20 years
Annual population growth	1.5 %	2.5%
20-year growth factor	1.35	1.64
Leakage	10 %	10 %
Peak factor (peak hour demand/ average day demand) **	3.75	3.0
Maximum no. of users per tap	100	100
Maximum distance to tap	200 m	200 m
Design tap pressure	10-15 m	10-15m
Maximum tap pressure	60 m	60 m
Flow range at tap	0.1-0.25 l/s	0.1-0.25 l/s

Source: Design Guidelines, 1987
* Bazaar is a trading post comprising a group of shops, often at crossroads and attracting more people than actually live in the village.
** For open systems, the peak flow factor is assumed to be 2.5 only.

8.6 Upgrading designs and procedures

Standard designs have been reviewed and amended at regular intervals throughout the years. Each structure is reviewed on the basis of the following considerations in order of importance:

- reliability
- ease of maintenance at little cost
- quality of construction
- cost.

A number of design refinements have been introduced. For example, gate valves at the cleaning out of every intake structure, break-pressure tank, and

interruption chamber have been abandoned in favour of end caps only. These valves have always been weak points in the system, possibly because of their quality but also because of being tampered with by villagers. By replacing all non-essential valves with a more reliable solution, water supply schemes have become less prone to maintenance and repair problems.

An example of the capacity of the programme to incorporate staff ideas is the new design for the break pressure tank. A senior WSST suggested relocating the gate valve from the outlet line in the operation chamber to the inlet side just before the ball valve. This eliminated the need for an operation chamber because the tank itself can function as this. Further, the gate valve can be adjusted, although a bit crudely, to reduce the flow if the ball valve which automatically regulates the flow is out of order. This change in design cut costs considerably while at the same time increasing the reliability of the hydraulic system.

In addition, there has also been continuous review and fine tuning of programme forms and procedures. Better information combined with reduction in paperwork were the main concerns. The use of an "Additional Estimate Form" on which in one page the reasons and the detailed cost of extra project work as well as the necessary technical and administrative approvals are given, is an example in point. Nowadays the "original" file which is kept by the technical office of the programme contains the following information:

- preliminary survey report
- survey calculation sheets
- calculation of peak flow for each tap
- hydraulic calculation sheets
- sketch and quantity estimate of additional structures for spring or stream catchment
- map-like sketch of the supply area indicating easily recognizable points (temple, bridge, peepal tree)
- blueprint of final design with profile, hydraulic grade line and flow diagram of system (indicating flows only)
- approved estimate
- relevant correspondence.

Relevant information is also sent to the various sections of the MPLD in Kathmandu and to the District Local Development Officers concerned. The water committee receives a copy of the file when the project agreement between village and programme is signed.

9. *Maintenance Management*

Whereas clear project implementation procedures have been established over the years, much less experience has been gained with successful maintenance management. The first years of the programme were much more directed to increase and improve the implementation of new schemes than to maintaining completed ones. This is the more understandable as maintenance was agreed to be a village responsibility. As more information became available on systems functioning below expectation, clear procedures for maintenance management were required.

9.1 Operational status of schemes in early 1977

In 1977, a first survey was carried out to determine the operating status of all completed schemes up until December 1976, under the previous HMG/UNICEF Programme and to identify the most urgent problems effecting continued operation.

Of the total 70 schemes, 9% were not functioning at all, 41% had major faults and the remaining 50% had either minor faults (44%) or were functioning without problems (6%). In addition, just over 50% of schemes were said by users to give an adequate supply throughout the year, 30% were seasonally inadequate and 16% were inadequate throughout the year. Less than 10% produced water of acceptable bacteriological standard (less than 50 coliform per 100 ml).

The survey indicated that the major reasons for inadequate functioning fall into one or more of the following categories:

- poor design and construction, such as poorly selected sources, inadequately buried pipes, improperly constructed tanks;
- natural disasters, primarily landslides, flooding and stream erosion;
- damage done by playing children or thoughtless adults, sometimes by a dispute about the use of the water source or because a settlement was by-passed by a scheme;
- inadequate preventive maintenance, such as neglect to clean tanks leading to clogging of pipes, neglect to oil valves causing corrosion and malfunctioning, and untended leaks (New Era, 1977).

9.2 Operational status of schemes in 1981

The Jhapa conference in 1980 (see Chapter 7) to establish detailed implementation procedures for water supply projects did not allow time to prepare maintenance guidelines. However, the conference recommended that each Development Region prepare a proposal for maintenance procedures to be discussed in a follow-up conference in 1982. As a basis for their proposal, the Western and Central Development Regions decided to carry out a detailed investigation of completed schemes.

In the Western Development Region, this investigation included 45 water supply schemes; 18 constructed before 1977 under the previous HMG/UNICEF programme, and 27 implemented according to the new standards of the CWSS Programme. Of the 45 schemes, only 8% did not need repair, whereas more than 50% had major flaws or were not functioning. An important finding was that 82% of schemes constructed under the regular programme needed major repair or rehabilitation, while only 35% of schemes completed under the CWSS Programme required these repairs. The conclusion may be justified that a well designed and executed standard is a major tool in preventive maintenance. Better trained technical manpower also contributed to improved quality of works, although to a lesser extent as shortcomings in construction still occurred, indicating the need for further training.

An interesting finding was made about maintenance arrangements at village level. Of the 45 schemes, 18 had a voluntary VMW and 11 a paid VMW, often in kind but sometimes in cash. However, performance did not seem related to payment. Community spirit and responsibility were more influential factors. As it cannot be expected that maintenance requiring more than little cash and unskilled labour be carried out by the village alone, the investigators recommended a clear maintenance structure indicating responsibilities and procedures at all levels. The Village Maintenance Worker Training Course was considered to be a major achievement but would fail to have full benefits if not supported by a back-up structure (Schramm and Gurung, 1981).

In the Central Development Region, 31 water supply schemes were reviewed. More than 70% had major problems hampering proper functioning, lack of standardization being identified as the main reason for this state of affairs. Only 30% of schemes had an assigned VMW. The proposed policy for a maintenance and repair system put much emphasis on the village level, with district and regional level responsibilities being limited to technical supervision, and material and financial support beyond the capacity of the local community (Ommen, 1982).

9.3 Maintenance policy

At the follow-up conference held in Pokhara, October 1982, a maintenance policy for rural water supply schemes was developed and approved. This policy, which defined specific functions and responsibilities at all levels, is in line with the national decentralization policy. Responsibilities were allocated as follows:

- Village level
  - routine inspection, maintenance and operation of the system
  - maintenance and repair of tapstands from and including the stop-cock
  - provision of local materials and voluntary labour for all maintenance and repair.
- District level
  - technical, material and financial support for all repairs from stop-cocks to the source requested by the village maintenance and sanitation committee through the village panchayat.
- Regional level
  - major repairs and rehabilitation of systems estimated to cost more than NRs 25 000 requested by the district panchayat. On the technical judgement or at the discretion of the Regional Directorate, this figure may be raised or lowered in exceptional cases.
- Ministry level
  - supervision and support for the overall implementation of the maintenance programme.
- Responsibilities at village level were to be co-ordinated by a village maintenance and sanitation committee composed of:
  - one representative from each tapstand user group
  - the chairman of the ward served by the water system
  - one representative from school and health post
  - at least two female committee members.

A village maintenance agreement between the CWSS Programme and the Village Maintenance and Sanitation Committee as developed by the conference is shown as example in Figure 12.

It was deemed necessary to have a maintenance and sanitation unit in each District Technical Office, comprising at least one overseer and two technicians. This unit is responsible for regular inspection and support to the village workers and village maintenance and sanitation committee. The unit is also responsible for promotion and supervision of sanitation improvements as indicated in the job description given for maintenance technicians in Figure 13.

MINISTRY OF PANCHAYAT AND LOCAL DEVELOPMENT
VILLAGE MAINTENANCE AGREEMENT

Name of system: Ward No:
Village Panchayat: District:

We, the undersigned members of the Village Maintenance and Sanitation Committee, as representatives of the people served by our Water Supply System, agree to assume the following responsibilities:

Operating and maintaining and protecting the water supply system.

Appointing and supervising the Village Maintenance and Sanitation Worker (VMSW), who should have been nominated and trained during the construction phase. In case no VMSW has been previously selected, the committee shall select a suitable villager.

Ensuring that tools and spare parts left on site after construction are stored and used properly by VMSW and that replacements are obtained from the District Technical Office.

Arranging for appropriate remuneration, either in cash or kind, for the VMSW. The VMSW's remuneration should be based on the number of tapstands, length of the system and the ability of the village to pay.

Organizing provision of local materials and un-skilled voluntary labour.

Resolving social disputes and preventing vandalism and misuse.

Ensuring environmental protection of the source.

Educating community in their responsibility for proper system use and maintenance.

Maintaining a project file and keeping record of repair work and minutes of meetings.

Requesting support for major maintenance through the District Panchayat.

Each tapstand user group's representative of the VMSC shall be responsible for ensuring:
maintenance of tapstand and the surrounding area
collection of money, materials and voluntary labour for tapstand repairs.

Encouraging proper use and maintenance of latrines in schools, panchayat buildings, health posts and other institutes, if any.

Signed ..... Date .....

Figure 12: Example of a Village Maintenance Agreement

MINISTRY OF PANCHAYAT AND LOCAL DEVELOPMENT
JOB DESCRIPTION FOR MAINTENANCE AND SANITATION TECHNICIAN

The Water Supply Maintenance and Sanitation Technician will have the following duties and responsibilities:

1. Re-activate or organize a responsible Village Maintenance and Sanitation Committee (VMSC)
   1.1 He will see that the Village Maintenance Agreement is signed.
2. Conduct public meetings and explain the concept of maintenance and sanitation.
3. Explain the duties and responsibilities of the VMSC to the individual members and to the villagers.
4. Assist the VMSC in the selection of a Village Maintenance and Sanitation Worker (VMSW).
5. See that a contract for the employment of the VMSW is signed.
6. See that an appropriate system is established in the village to ensure regular remuneration for the VMSW.
7. Explain to the VMSW his duties and responsibilities.
8. Demonstrate to the VMSW proper inspection and maintenance procedures as per maintenance checklist.
9. Inspect the water system and latrines thoroughly with the VMSW and complete the inspection form accordingly.
10. Demonstrate to the VMSW the proper maintenance of the water system and sanitation facilities.
11. Identify any large scale maintenance works requiring voluntary labour and formulate a plan for their execution together with the VMSC and the VMSW.
12. Instruct the VMSW in making any minor repairs that can be completed with materials on hand.
13. Train the VMSC members in the proper maintenance of the system's components and sanitation facilities in the member's ward or area.
14. Assist the VMSC in preparing any request to the District Panchayat/Field Office/Regional Directorate for needed spare parts, tools or materials.
15. Submit to the Maintenance Co-ordinator reports on the status of the system and any major repair work required.
16. In consultation with the Maintenance Co-ordinator, prepare a travel plan to visit each assigned project on a regular basis.
17. Serve as a liaison between the village and the Field Office/Regional Directorate.
18. Assist in resolving any problems faced by the VMSC or the VMSW.

Figure 13: Example of job description for Maintenance and Sanitation Technician

9.4 Recent developments

Increasing recognition is being given to maintenance management, and rehabilitation has become an accepted part of the programme. Nevertheless, much remains to be done. Experience with the maintenance and sanitation units has been mixed. For example, in the Western Development Region, the system has been abandoned as overseers and technicians felt that they derived little prestige from carrying out these tasks. Maintenance support is now concentrated in the months outside the construction period when there is time for short visits to completed schemes. The initial results have been encouraging.

In the Mid-Western Development Region on the other hand, the maintenance and sanitation unit is functioning. There is no problem with work prestige, as overseers and technicians involved in maintenance have higher positions and salaries than those in charge of construction. However, maintenance technicians are still primarily directed to repair and rehabilitation, whereas they are expected to set up maintenance committees, supervise and motivate VMWs, and support communities to become more self-reliant to carry out their maintenance. Development of maintenance management will require renewed attention in the years to come to maximize the benefits of the completed schemes.

Maintenance management is an essential part of the CWSS Programme

In the Western Development Region frequent requests and need for minor repair support from the maintenance and sanitation committees to the programme has revived interest in a regional maintenance and sanitation unit, and eventually also at district level. As a first step a mail survey was organized in 1986 to find out more about maintenance requirements as perceived by the consumers. A copy of a handbook on maintenance and repair of gravity water supply schemes, newly published in Nepali, was distributed with the questionnaire. The returns from this survey were quite encouraging, as shown in Table 10.

Table 10: Results of maintenance mail survey, 1986

	No.	Percentage
Questionnaires distributed	231	100
Responses	96	41
Projects not needing repair	50	52
Projects with trained village maintenance worker	53	55
Projects with untrained village maintenance worker	38	40
Projects with maintenance committee	93	97
Village maintenance workers to be trained	43	45

Further assessment of the status of projects based on the mail survey as well as the personal knowledge of programme staff showed that 73% (175 schemes) are functioning well, about 12% (29 schemes) need some repair, and a further 15% (36 schemes) need major repairs or even to be rehabilitated. A follow-up survey is planned in which all completed schemes will be visited to get a further picture of maintenance requirements as a basis to set up a new maintenance unit.

10. Support Studies

The overall objective of the CWSS Programme, Pokhara, is to improve the health status of the rural population in general and young children in particular. Water supply schemes are considered to be instrumental in improving health because safe and sufficient quantities of water help reduce water and sanitation related diseases, especially diarrhoeas, worm infestation, eye and skin diseases. Several studies have been carried out to evaluate the overall objective of the programme, including water quality, social impact and health impact studies. These studies have helped to give better insight into factors influencing the programme success, and thus provide a basis for programme development and improvement. A water quantity study was also carried out to supply data on design criteria.

10.1 Water quality study I

The first water quality survey was started in 1978 to define programme success in supplying safe water for human consumption throughout the year (Bovier, 1978 and 1979). A millipore portable test kit was used for bacteriological water testing. Total coliform and faecal coliform were measured in four project schemes. Water was tested only at the source in two schemes and at the spring catchment, storage tank, tap and in a private house in the other two schemes. From each spot, 15 to 20 samples were taken over a period of nine months.

The tests can only be seen as indicative because of the simple equipment used. The total coliform was often too numerous to count and faecal coliform ranged between 0 and 48 per 100 ml. The study concluded that none of the systems met the WHO International Standard.

Two trends become clear from the study. Firstly, water contamination is greater after heavy rains. Secondly, water stored at home tends to be more contaminated than at the spring catchment. The report recommends putting more emphasis on motivation, education and sanitation to increase the potential benefits of the improved water supplies. It states "a system could be well built but, if there is no proper education and sanitation of the people, these systems will not solve the problems of diseases and mortality" (p.6). Another recommendation concerns the need to study the chemical quality of improved water supplies (Bovier, 1978 and 1979).

10.2 Water quality study II

A second water quality study was carried out by Leuenberger (1983) to determine both the bacteriological and chemical quality of water supplied by the CWSS Programme. In total 13 schemes were covered, but tests were taken from September to October only. The limited number of tests allowed only tentative interpretation. The analyses showed that the chemical water quality met WHO standards. The criteria given in Table 11 were used to assess bacteriological water quality. These criteria are partly based on Feachem (1978) who recommends that water supply containing more than 10 E.coli per 100 ml be treated. According to these criteria, the water quality was satisfactory in all 13 schemes from spring catchment to tap. The study also indicated a trend of water contamination through transport and storage. Levels of faecal coliform contamination were acceptable at the tap but rose to unacceptably high levels in storage containers. Levels of 80 faecal coli/100 ml were recorded. The quality of water in tea shops proved to be doubtful (Leuenberger, 1983), except in one case, where it was discovered that water for drinking was always boiled.

Table 11: Criteria for bacteriological water quality

	E. coli/100 ml	
Good	0 - 20	supply untreated
Acceptable	10 - 100	treat if possible
Doubtful	100 - 1000	treatment strongly recommended
Bad	> 1000	abandon the source

10.3 Social impact study

A first attempt to quantify the impact of improved water supplies in Nepal was made in September 1984 by a foreign volunteer in co-operation with two maintenance and sanitation technicians. This "experimental social impact study" in the Surkhet and Dailekh districts in the Mid-Western Development Region aimed to obtain insight into the impact of the CWSS Programme on health and living standards (Hofferbert, 1984). As time was too limited to compare the situation before and after programme implementation, villages with and without an improved water supply were studied.

Six panchayats with and three without improved water supply systems were selected in each district. Criteria were that the water system be as old as possible with at least two taps in working order throughout the system's existence. The three control panchayats had to have a recognized water need but for technical or financial reasons would not be receiving an improved system.

In each of the 18 selected panchayats, 10 to 12 households were randomly selected and interviewed using a questionnaire. If possible, the person most responsible for water collection was interviewed.

Field-work took two weeks. Some problems were encountered in collecting data on sensitive subjects, such as personal hygiene, and occasionally responses were biased because of the interview situation. Nevertheless the data collected provided some important information.

The new water supply schemes meant considerable time savings of 1.5 to 2 hours per household per day. The average round trip of almost 40 minutes per gagri was now reduced to some 5 to 10 minutes. In the control villages, responsibility for water collection was shared by daughters, wives and mothers (37, 30 and 33% respectively) whereas in the programme villages this burden was more on the daughters (67%) than the wives (21%) and mothers(12%). Perhaps the duty of daughters to collect water increases as the distance to collection point decreases. Time savings were mainly absorbed in farming and domestic work. Some women claimed more free time (13%) or time for education (9%).

The study did not reveal an increase in the amount of water collected resulting from shorter walking distance to the new tapstands. However, it was suggested that both adults and children visited the tapstand more frequently for washing and bathing. About 28% of respondents indicated that occasional use was made of tap water for small-scale irrigation. The usual crop is onions, which can be peeled, rather than potatoes or radishes which is claimed are contaminated by the dirty drain water from the tapstands.

Major benefits of improved supplies were reported to be convenience (35%) and cleanliness of the water (27%). Improved health was only perceived as a benefit by 3% of respondents.

Children between the ages of one and two years were consistently cited as being most prone to diarrhoeal diseases. The practice of withholding water from infants until their first birthday may be one reason for this finding.

The study also indicated that not the water system but the water source is responsible for a health impact. Infant morbidity and mortality rates were lower in households using spring water, whether or not from an improved supply, than in households using other sources.

Although the study was meant to provide information to improve programme effectiveness, recommendations are more directed to future research activities. The study supports simple and flexible studies at various programme levels which would provide information for future policy decisions.

10.4 Health impact study

In 1985 a study was carried out to evaluate the health impact of an improved water supply scheme implemented by the CWSS Programme, Pokhara (Leentjens, et al., 1986). Conducted by medical students from the Erasmus University, Rotterdam, The Netherlands, the study tested the hypothesis that the health impact of an improved water supply would not be significant because of other, perhaps more important, determinants. The study included water quality analysis to determine the level of faecal contamination; health determinants in children under six years of age, such as diarrhoea and ascaris prevalence, nutritional status and skin and eye diseases; and assessment of the health impact of an improved water supply.

The study area was in Kaski district, a half-day walk north of Pokhara. A village with a five-year old improved piped supply was compared with two control villages where people used unimproved sources, such as small streams and sometimes the main river directly. The villages were matched for geographic and demographic aspects such as socio-economic status, caste and literacy. The intervention village had 178 households with 129 children under six years of age; the control population consisted of 156 households with 145 children under six years of age.

Faecal coli was used as indicator of the bacteriological quality of the water. Water samples were taken from 10 tapstands and 15 unimproved sources every two to four weeks, except between June and August because of lack of trained manpower and inaccessibility of the area during the monsoon. Millipore membrane filtration method for field tests was used for water testing. In the field, samples were placed in a holding medium to allow for up to 72 hours delay in return to Pokhara, but most were transported within 36 hours. In the laboratory, the samples were transferred to a petri dish containing the standard nutrient medium and incubated. According to the criteria adopted (see Table 13), water from the improved system was of almost consistently high quality. Some 88 to 98% of samples contained less than 10 E.coli per 100 ml. In the control area, only 10 to 30% of the samples were in this category. In general, water from unimproved sources was ten to a hundredfold more contaminated than water from improved sources. Occasionally water was tested from a gagri in a household, and in most cases was of lesser quality than water from the tap or source from which it was drawn.

Each household with a child under six years of age was visited at two-weekly intervals to investigate the incidence (new case) and prevalence (presence at that time) of diarrhoeal diseases. Although some households lost interest in answering the same questions again and again, others gave more accurate answers with time. Throughout the year, diarrhoea prevalence showed a similar pattern in the intervention and control villages, with a peak prevalence in April and May, at the end of the dry season. However, the mean

incidence of diarrhoea was somewhat lower in the intervention population (4.0 episodes per child over the year) than in the control population (4.5 episodes per child over the year), (statistical significance $p<0.05$). The mean duration of a diarrhoea episode was nine days, with each child suffering from the disease on average 32 days over the year. The incidence of diarrhoea was related to a number of possible factors, the most important being difference in water quality. But no significant correlation was found, indicating that high quality tap water alone is not sufficient to affect the incidence of diarrhoea. However, the study did not indicate the possible influence of water contamination during transport, storage and handling. Socio-economic circumstances were also not found to have a significant effect on diarrhoea incidence. Only age with 0 and 1 year old children being most affected ($p <0.01$), and nutritional status ($p <0.05$) were shown to be related to incidence of diarrhoea.

The nutritional status of all children in the sample was assessed four times, at three monthly intervals, by measuring the mid-upper arm circumference. Nutritional status was best in December with 17% of children mildly malnourished and 3% severely malnourished. In May their nutritional status deteriorated to 27% being mildly malnourished and 10% severely malnourished. Thus, the study showed that at the end of the dry season when food is scarce, the nutritional status of children declines and gradually increases after the monsoon when crops are harvested. The study also revealed a relationship between nutritional status and prevalence of diarrhoea. Overall, prevalence was 2.4 times higher in mildly and severely malnourished children than in well nourished children. Also, the duration of an attack increased when nutritional status was lowest.

As an indicator of the level of community sanitation, the children's stools were examined for the presence of ascaris infestations (roundworm) using the Kato method, in January 1985. A high prevalence of ascaris was found especially in the older age groups. Over 85% of five-year olds were found to suffer from ascaris, with 5% heavily and 20% mildly infected. No correlation was found between ascaris and either latrine accessibility or nutritional status.

The effect of increased availability of water at a shorter walking distance was assessed as the amount of water used. Whereas 5 to 10 minutes were needed for a roundtrip to a tap and 15 to 30 minutes to an unimproved source, this seemed to have little effect on the amount of water collected. The average was about nine litres per person per day in both villages. However, more water may be used at the tap site itself.

The study confirms the hypothesis that an improved water supply at a shorter walking distance is not in itself sufficient to improve the health status of children. The researchers emphasize the need to pay more attention to water use practices through integrated hygiene education in order to maximize the benefits of a water supply.

Sufficient quantity of water for hand washing is as important as safe quality of water

10.5 Water quantity study

In 1984 a water quantity study was carried out in all Development Regions to provide data for design criteria. The following was investigated:

- amount of water collected and used at a tapstand per capita per day, including water for drinking, personal hygiene, clothes washing, cattle watering and also waste;
- daily pattern of tap use to calculate the required reservoir capacity.

As there were likely to be large differences between projects in geographically different regions in Nepal, a number of villages in each district region were selected. In the Western Development Region, two project villages each were selected in the remote hill region, the remote middle hills and the bazaar villages along a road in the middle hills. Teams of two WSSTs were sent to the respective villages after one-day training session with the sociologist attached to the programme. Each tapstand was observed for two days from a convenient distance, that is a nearby house or tea-shop.

Project: Lukumswara, Tap. no. 6
District: Kaski
Population served: 150 (25 houses)
Total collection and use per day including wastage: 6858 Litres
Total water wasted per day: 215 Litres
Amount of water per person per day including wastage: 46 Lcd
Date survey: 26th May, 1984
Tap type and flow: Brass tap with flow of 0.2 lps.
Situation: Rural hills at altitude of 1200 m.

Time	Collection in litres	Collection as % of the total
4 - 5 AM	294.9	4.3
5 - 6 "	404.6	5.9
6 - 7 "	521.2	7.6
7 - 8 "	349.8	5.1
8 - 9 "	658.4	9.6
9 - 10 "	713.2	10.4
10 - 11 "	493.8	7.2
11 - 12 "	294.9	4.3
12 - 1 PM	418.3	6.1
1 - 2 "	370.3	5.4
2 - 3 "	637.8	9.3
3 - 4 "	397.8	5.8
4 - 5 "	267.5	3.9
5 - 6 "	534.9	7.8
6 - 7 "	288.0	4.2
7 - 8 "	212.6	3.1

Example of water collection sheet

Although no definite conclusions can be drawn from this small survey, consumption varied considerably even though water was abundantly available throughout the day:

- remote hills 20 - 30 litres per head per day
- middle hills 35 - 45 litres per head per day
- bazaar village 60 - 70 litres per head per day.

These figures seem to indicate that the national design criterion of 45 lcd is slightly too high in remote hill villages, but is somewhat inadequate in market centres. Outsiders using the tapstands push water consumption up to around 60 litres per head per day in bazaar villages. The new design criteria, as decided upon in 1987 reflect the different water needs for hill villages and bazaar villages (Design guidelines, 1987). The tap use pattern emerging from the survey differs significantly from that used to calculate the required reservoir capacity which was based on data collected in June 1976. Drawing water now starts earlier in the day and extends well into the evening, and is thus spread more evenly throughout the day. Even so, significant changes are not indicated in the calculation of the reservoir capacity required.

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Appendix I: Country Profile

Geography and climate

The small country of Nepal is wedged between the Indian Plain in the south and Tibetan Plateau in the north. Only 140 797 km2 in area, Nepal has the greatest variation in altitude of any country in the world. The Terai in the south is almost at sea level, while the Himalayan mountains in the north contain the world's highest peak, Mount Everest. More than half of the people of Nepal live on the hilly midlands between these two extremes.

Climate conditions vary with altitude from hot and tropical on the southern plains to extremely cold in the high mountains. Located between 26° and 30° north latitude, Nepal also experiences seasonal variations in temperature. The rainy season extends from June to October, and there are occasional showers throughout the remainder of the year. Total annual rainfall varies between 1000 and 6000 mm per annum depending on the part of the country.

People and religion

The present population of approximately 17.6 million people is an increase of 6.5 million since 1971. Almost eight million are under 15 years of age. A caste system defines status and influence according to birth. There is a multitude of ethnic and tribal groups, some having their own language. The 1981 census lists 18 major languages. Approximately 42% of the population do not speak Nepali, especially those living in remote areas.

Hinduism is by far the most important religion in Nepal, with almost 85% of the population being followers of this faith. Approximately 5% of the people are Buddhist and 1 to 2% Muslim.

Economy

The economy is based largely on agriculture, with about 91% of the population depending on this sector for their livelihood. The main crops are passy, maize, millet, wheat, potato, jute, sugar-cane and oil seed. Approximately 20% of the country is cultivated, and with the increasing population, agriculture is expanding into more marginal areas. Population pressure is also aggravating problems of soil exhaustion, thus leading to a decline in production. Agriculture accounts for almost two-thirds of the gross domestic product. In addition there are some cottage industries.

Women make a considerable contribution to the economy, both to agriculture and cottage industries. A study on their status found that rural women work on average 10.8 hours per day and men 7.5 hours per day (Acharya et al., 1980). Women were estimated to contribute 50% of the household income, while men contribute 44%, and children between 10 to 14 years of age, 6%.

About 43% of the population is estimated to live below the poverty line, assessed by the Government to be NRs 10 667 (about US$ 500) per family per year (UNICEF, 1987). A World Bank Development Report (1985) gives the per capita GNP for 1983 as US$ 170, thus equating Nepal with Mali, the third lowest on a global ranking. No improvement is to be expected in the near future as economic development has barely kept pace with the rapid population growth of 2.7 per annum in the period 1971-1984.

Education

Estimates for 1986 suggest that 35% of the population is literate, that is 52% of men and 18% of women. Primary school enrolment has risen considerably in the last few years, but the drop-out rate is also high, with the proportion of girls attending school still being extremely low. Another constraint is the lack of trained teachers. Although there are currently 75 000 teachers, twice the number as in 1976, more than 65% are untrained.

Health

Communicable diseases together with poor nutrition are the main reasons for the high mortality rate in children. According to the most recent estimates (1984), infant mortality is 113 per 1000 live births, whereas in the group under five years of age the rate is 165 per 1000. Life expectancy at birth is 54 and 51 years for men and women respectively (1987). The lower life expectance for women is attributed mainly to child bearing and their heavy work load (UNICEF, 1987).

Approximately 50% of all children suffer from mild to severe malnutrition. The incidence of water-related diseases is high, especially diarrhoeal diseases, worm infestations, skin and eye diseases, goitre and cretinism. Respiratory infections are also very common. Health services are still modest with approximately 818 health posts unevenly distributed throughout the country.

Water supply and sanitation

In the hills and in some areas of the Terai, water collection is often a very time consuming and laborious domestic task for women and children. In the hills, water is usually drawn from unprotected springs and streams. Targets for improved water supply set at the beginning of the International Drinking Water Supply and Sanitation Decade (IDWSSD) have been adjusted recently. The current plan is to increase coverage of rural areas from an estimated 6.6% in 1980 to 44% in 1990; and in the urban sector to increase coverage to 85% by 1990. In the most recent directives from HMG, a programme to provide basic needs to all Nepalese by the year 2000 includes safe drinking water for everyone.

Open field defaecation is a general practice in all rural areas. A survey in 1986 estimated that only 5% of rural and 47% of urban households have access to sanitation facilities (UNICEF, 1987b). The Decade target is 13.4%

coverage of households by 1990 and some 18 000 schools, at an estimated total cost of US$ 240 million.

Deforestation

The growing need for food and fuelwood has led to rapid environmental degradation, including deforestation, soil erosion, land slides and floods as a result of watershed destruction. Forest recession and drying up of perennial water sources force women and children to fetch water and to collect firewood from even greater distances.

Communication and transportation

The rural population lives in some 28 000 scattered settlements mostly accessible only on foot from the nearest road or air strip. Such a journey may vary from a few hours to several days. During the monsoon months, large areas are cut off completely, because of the treacherous state of foot tracks and the impossible conditions for air services. There is one radio station broadcasting in Nepali and English. Few people have a transistor radio, there being only 180 000 in use throughout the country in 1981. Television has been introduced only recently, with three hours transmission per day to an estimated 40 000 viewers in the Kathmandu valley (UNICEF, 1987b).

Administrative structure

The administrative structure in Nepal is based on a system of more than 4000 village and town panchayats. A village panchayat covers several villages and clusters of houses, generally covering 3000 - 5000 people in the hills, and 10 000 - 12 000 people in the Terai. Each village is divided into nine wards, each electing five members to the village assembly. One of the five members is selected as ward chairman to be their representative on the village panchayat, the executive body of the village assembly. The village panchayat comprises 11 members: the nine ward chairmen, a pradhan panch (chairman) and a upa-pradhan panch (vice-chairman). The latter two are elected by all those elegible to vote in the panchayat.

The district assemblies comprise all pradhan panches and upa-pradhan panches within a district. The district panchayat, the executive body of the district assembly, is elected by the town and village assembly on the basis of indirect balloting. There are 75 district panchayats.

The Rastriya Panchayat, or national legislative, has 140 members, 112 of whom are elected for a five-year term from the 75 districts on the basis of adult franchise. The other members are nominated by His Majesty, the King. At present eight of the 140 members are women of whom three are elected and five nominated.

To facilitate and coordinate development inputs, the country is divided in five Development Regions, each being subdivided in two or three Development Zones. There are in total 14 zones.

Government agencies for water supply and sanitation

Up until December 1987, responsibility for water supply and sanitation was shared by three government agencies:

- Water Supply and Sewerage Cooperation (WSSC) of the Ministry of Water and Power was responsible for providing facilities in major towns.
- Within the same ministry, the Department of Water Supply and Sewerage (DWSS) provided facilities for district urban centres and all compact rural communities of more than 1500 inhabitants.
- The local Development Department was responsible for rural communities of less than 1500 inhabitants. In 1980 this department was integrated into the Ministry of Panchayat and Local Development (MPLD). The Ministry's responsibility for water supply and sanitation was shared with the communities themselves, and the village and district panchayats.

In December 1987 HMG brought together all water supply and sanitation programmes and activities under the new Ministry of Housing and Physical Planning.

Calendar

The official Nepali year begins in mid-April. The period, April 1986 to April 1987, is the year 2043 in Nepal.

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