COMMUNITY WATER SUPPLY PROGRAMME STATUS REPORT

Volume V: Summary report

July 1977

COMMUNITY WATER SUPPLY PROGRAMME STATUS REPORT

Volume V: Summary report

JACQUES R. BOVIER
PROJECT MANAGER
RURAL WATER SUPPLY
WESTERN DEV. REGION

July 1977

COMMUNITY WATER SUPPLY PROGRAMME STATUS REPORT

VOLUME V: SUMMARY REPORT

Summary of findings documented in individual reports on seventy Community Water Supply Schemes constructed between 1973 and 1976 under the LDD/UNICEF/WHO Community Water Supply Programme in Nepal.

Prepared by:

NEW ERA
Gyaneswar
Kathmandu

For Submission to:

Local Development Department
His Majesty's Government of Nepal
Pulchowk

UNICEF/Nepal
Lazimpat
Kathmandu

July 1977

TABLE OF CONTENTS

TABLES

APPENDICIES

A SUMMARY STATUS REPORT OF COMMUNITY WATER SUPPLY SCHEMES COMPLETED UNDER THE LDD/UNICEF/WHO PROGRAM

I. INTRODUCTION AND OBJECTIVES

The villages of hill Nepal have traditionally been built on hillsides and ridgetops rather than in valleys and along streams. This practice has been followed in order to allow maximum use of fertile valley-bottom cropland and to avoid malarial conditions which have existed in the lowlands until very recently. Living on the hillsides and ridges, however, has often had one major drawback; it has left perhaps the majority of hill Nepalis far from dependable, safe, and convenient sources of water for household use. It is not uncommon in hill villages for several hours to be taken up by the task of fetching a single gagro of water; in some cases, dry season supplies of water become so meagre that whole villages are seasonally abandoned.

The tiny springs, rivulets, wells, kuwas; and irrigation ditches which have generally served as community water sources in the hill areas have not only been inconvenient; in many cases they have posed serious health problems as well. Free-roaming animals, erosion caused by deforestation, and the defication habits of the village people have often caused pollution problems in the water source areas. The multiple uses to which sources are commonly put--washing clothes, cleaning dishes, watering animals, bathing--has added to the pollution problem. Water-borne diseases, as a consequence, have long been a major cause of illness and death, particularly, of course, among the very young. The more scarcity of water has itself had indirect effects on health--people have bathed less often, washed their clothes less frequently, cleaned their dishes and utensils less adequately. And as hill populations have increased, as hill landscapes have progressively deteriorated, the water problems of the villagers have become ever more severe.

With the solution of these problems in mind, the Local Development Department of His Majesty's Government together with the Nepal offices of the United Nations Children's Fund and the World Health Organization embarked in 1971 on an ambitious program to develop piped water supply schemes to hill area villages where water needs were greatest. During the more than five years that have passed since that time, approximately seventy village water supply systems have been completed in communities scattered through twenty-eight districts of the Kingdom in all four development regions. Rapid expansion of the program to more villages and new areas is already underway.

As the number of projects has proliferated, however, concerns have arisen regarding just how successfully the schemes which have been constructed are meeting the needs of the villagers and the objectives of the program. Are the new water sources safe and well-protected? Do the villagers receive water in sufficient quantity year-round? Has the quality of design and construction met standards which may be reasonably applied to hill Nepal? What arrangements have been made locally to maintain the systems and to repair them when they break down? And most important, what does the experience with the program so far indicate with regard to the improvement of future rural community water supply efforts?

In order to answer these and other questions, a status survey of the community water supply program was undertaken in the late winter and spring of 1977. The specific objectives established for the survey were the following:

1. To determine the current operating status of the community drinking water supply systems installed between 1973 and the end of 1976.

2. To assess the continuing adequacy of services being provided by these completed systems in terms of water quality,

quantity, convenience, number of households served, and related measures.

3. To describe local mechanisms for managing and maintaining these systems in comparison with any other that may be specified in the local administration plan.

4. To identify problems 'administrative, technical, financial, etc.) related to the construction of these systems.

5. To identify problems related to the management and maintenance of these systems.

6. To propose remedial action with regard to repair, maintenance, and management problems.

This report summarizes the experiences and insights of six investigators who carried out field research activities aimed at fulfilling the above objectives. Then, drawing upon these findings, the report offers recommendations relating to the more effective implementation of the community water supply program in the future.

METHODOLOGY

The findings summarized in this report are based upon on-site inspections of each of the seventy water systems officially listed as complete at the end of the 1976 calendar year. These inspection visits were made during the late winter and early spring of 1977. During each field visit, a number of different survey activities were carried out:

1. Village Leader Survey. General information about the village served by the CWS scheme and about the project itself was collected from the pradhan pancha, ward members, and/or water committee leaders. Sometimes panchayat records were also

consulted to determine key dates in the history of the project or to secure information regarding the villagers' contribution to its construction.

2. Maintenance Technician Interview. A detailed interview was conducted in each village where a maintenance technicial could be identified--regardless of whether he had been formally appointed or not or whether he was paid or unpaid. This interview dealt with details of the technician's training, compensation, duties, etc., as well as with the general condition of the system itself.

3. Inspection of the System. The researcher, generally accompanied by the technician or by a water committee member, also carried out a direct physical examination of all components of the system--source, intake facilities, pipelines, valves, reservoirs, and taps. A description of the condition of each component and its maintenance needs was recorded on detailed checklists and reporting formats.

4. Water Quality Tests. Without cumbersome apparatus, it is virtually impossible to accurately test the quality of the water supplied by the systems inspected. Rough measures of a system's vulnerability to contamination, however, could be obtained from tests using highly portable "Millipore" tubes. The Millipore tests were carried out generally at three points in each system, (a) the source, (b) the reservoir tank, and (c) one tap. (Details of the Millipore test procedure are provided in the section on water quality below.)

5. Household Interviews. At each project site, from four to six households were randomly visited in order to secure general information regarding the degree to which the system was meeting household water needs, the seriousness of the water problem prior to the construction of the project, and the villagers' ideas about proper maintenance and repair arrangements.

After completing his circuit of field site visits, each researcher organized the data collected from each project on a standardized reporting format (included as appendix E) which then became the central document in an individual site report. A brief prose description of the project and its present condition was then drafted. All such project reports (the standard format plus the project history) were then brought together and bound in a single volume. The four volumes of individual reports (one for each development region) were then distributed in sets to each of the agencies and departments involved in the program.1/ A major intention of this report is to summarize and generalize upon the materials included in these detailed individual reports.

Since one key objective of the project was to generate ideas regarding the improvement of maintenance and repair arrangements, it was also necessary to visit district offices and talk with regionally-posted personnel of the Local Development Department. These interviews were generally loosely structured, their objective being to explore past experience and solicit ideas rather than to collect precise data. A second major purpose of this report is to present ideas and recommendations based in part on these discussions.

Further details of the methodology and data collection procedures employed in this survey are provided in relevant sections of the report below.

III. SURVEY FINDINGS

A. The Distribution of Projects

Seventy projects were officially-listed as complete as of the end of the calendar year 1976. These seventy project sites were

---

1/ A master copy of each individual project report from which reproductions can be made is available at the UNICEF office in Kathmandu.

distributed among twenty-eight of Nepal's seventy-five administrative districts. Projects had been constructed in all four development regions, although none were found in the extreme western zones of the Far Western Development Region (Mahakali and Seti anchals). With the exception of Mustang and Jumla, none of the projects had been constructed in areas officially designated as "mountainous" (although this term should be understood in its peculiarly Nepali context). Table 1 below summarizes the distribution of projects by region and district.

Table 1 : Distribution of LDD/UNICEF CWS Projects Constructed Prior to 1977 by Region and District

Region	District	No.	Region	District	No.
Eastern	Ilam	3	Western	Gorkha	7
	Panchthar	1		Kaski	8
	Taplejung	2		Parbat	4
	Sankhuwasabha	2		Palpa	1
	Dhankuta	1		Baglung	2
	Kotang	1		Myagdi	5
	Okhaldhunga	1		Mustang	5
	Udaypur	1			
			Far Western	Jumla	3
Central	Sindhupalchok	1		Jajarkot	1
	Kabrepalanchok	4		Rolpa	1
	Lalitpur	1		Pyuthan	3
	Kathmandu	2		Sallyan	3
	Nuwakot	2		Surkhet	2
	Rasuwa	1			
	Dhading	2		Total	70

Note: District boundaries have changed since many of these projects were originally constructed. The new district boundaries have been used in all of the above tabulations.

Of the grand total of seventy project, twelve have been constructed in the Eastern Development Region, thirteen in the Central, thirty-two in the Western, and thirteen in the Far Western. Approximate locations of the projects are given on the outline map at the back of this report.

B. Area and Population Served

The areas served by the CWS systems were generally determined by geography and settlement patterns rather than by administrative boundaries. In only one case (Lahachok in Kaski district) did the service area of a project concide more or less precisely with the borders of a single panchayat. More often, only certain settlements or wards within one panchayat were served. In some instances, portions of several panchayats benefited from a single system. The failure of project boundaries to coincide with political/administrative ones obviously has implications for the arrangement of maintenance and repair systems.

The seventy projects varied widely in terms of the numbers of people served.[2/] The largest project (Taruka panchayat in Dhading district) was supplying water to an estimated 621 households or approximately 3,400 persons. The smallest, consisting of a single tap, serves only seven households. The majority of the projects surveyed included fewer than 100 households each. Table 2 below indicates the distribution of projects according to size (measured in terms of households served).

Table 2 : Distribution of LDD/UNICEF CWS Projects According to Number of Households Served

Number of Households	Number of Projects	Percent
Fewer than 100	38	56
Between 101 and 200	16	24

2/ It was not possible to secure highly accurate figures regarding populations served in the field time available to the project. Researchers concluded that "best estimates" could be derived by securing data on the number of households served, a number which could be either counted or estimated with considerable accuracy by village leaders. Population figures were calculated by simply multiplying the number of households by the average household size for that district (as determined by the 1971 National Census). This same procedure was used in making per capita cost determinations as well.

Between 201 and 300	6	9
Between 301 and 400	3	4
More than 400	5	7
Total	70	100

In total, the households served by the seventy projects surveyed numbered 1958 or approximately 51,485 people. Appendix A lists all projects together with the wards and number of households served.

C. Per Capita Costs

Accurate cost figures for projects surveyed were in most cases extremely difficult to secure. Attempts were made to collect this information at central and regional LDD offices as well as in the villages themselves. When it was convenient to visit district offices, figures were sought there as well. "Official" figures provided at different levels sometimes were in conflict with one another, and often it was difficult to determine whether the figures refered to original estimates or represented final calculations. In many more cases, information relating to only one or two of the three participants in project financing (HMG, UNICEF, and the community served) could be located. As a result, figures upon which even minimal levels of confidence could be placed were secured for only 45 percent of the projects.

Using the little information available, however, certain tentative statements can be made regarding per capita costs of the CWS program. It is clear, for instance, that the variation in costs from one project to another is substantial. Costs ranged from a low of Rs. 14/- per capita in Histan (Khibang) of Myagdi district to a high of Rs. 183/- per person in Marpha of Mustang district just two days to the north of Histan. For all projects for which financial data was available, the average per capita cost was Rs. 68.84.

D. Project Histories

Interest on the part of villagers in constructing piped water systems preceded the development of the government's ability to give large-scale assistance in this area. In some of the villages visited, requests for government help in building CWS systems had been first made by the villagers as far back as the Rana period. As a consequence, the lapse of time between the villagers original appeal for government assistance and the actual start of construction has often been extremely long; in more than two-thirds of the cases, the period was in excess of five years. Table 3 below summarizes the experience of these projects in terms of the time taken to process and act upon requests for assistance.

Table 3 : Time Lapse Between Application for Assistance and Start of Construction for CWS Projects Completed under the LDD/UNICEF Program

Time Period	Number of Projects	Percent
Less than 1 year	4	7
1 to 3 years	8	14
3 to 5 years	5	9
5 to 7 years	13	23
7 to 9 years	9	16
More than 9 years	17	31
Totals	56	100

Note: Information was either not available or inappropriate for fourteen projects.

Apart from the limited ability of the government to supply technical and material support to these projects, administrative processes and regulations appear to have been the major cause of delay. For one thing, over the years administrative jurisdictions and procedures have frequently changed. It was only in 1971, for example, that the Local Development Department was created to manage the implementation of village-level construction projects and to give the administration of programs such as CWS some coordination and continuity. The requirement, now changed, that the community receiving assistance raise their own cash and labor contributions to the extent of fifty percent of project costs also constituted a major barrier to prompt project action in cash-poor areas.

Many of the projects whose histories moved more swiftly than the average appear to have benefited by the intervention of influential persons or high officials. Appeals to the King during his visits to remote localities often produced speedy results. Village leaders who could exercise leverage on district and national-level officials and panchayat people were also able to expedite projects for their localities. In fact, project histories reveal that in at least seventeen cases, the regular administrative procedures were foreshortened by "extraordinary" interventions of one sort or another--or simply by-passed altogether.

In some cases, these special interventions had a negative impact on the favored project itself. In one instance, the CWS system appears to have been intended as the "monument" of a local politician, a demonstration of her influence and importance. Unfortunately, the area served by the project was already well-supplied by traditional water sources. Village labor, consequently, was very difficult to mobilize and labor-intensive aspects of construction (such as the burying of pipe) were poorly executed. Community disinterest has similarly led to the rapid disintegration of the system due to lack of maintenance.

In another case, the government itself appears to have selected the CWS site in the interests of broadening development activities in the Far Western Development Region. Since the community selected had no great felt need for the system, support for completing the project could not be generated, and the system remains unfinished--except in the official files.

A further factor in explaining the delays in implementing CWS projects appears to have been the frequent repetition of technical surveys. Only a small minority of the projects were constructed with just a single preliminary survey. (At least three, in fact, were initiated with no prior technical assessment at all.) In seventy-two percent of the cases for which information was available, two, three, and even four surveys took place before actual construction got underway. In many cases there were undoubtedly solid reasons for these resurveys, but from the village point of view they usually only generated confusion and impatience. Table 4 below summarizes the program's experience in this respect.

Table 4 : Number of Surveys Conducted Prior to Initiation of CWS Project Construction

No. of Surveys	Number of Projects	Percent
None	3	5
One	14	23
Two	30	50
Three or more	13	22
Total	60	100

The lengthy time lapse between application and project implementation, the frequent rapetition of technical surveys, and the need, too often, for special intervention to speed the approval process has led to discouragement on the part of many villagers with the "regular channels" for securing help in CWS project construction. As a results, approaches were often made by villagers to the project researchers themselves for assistance in hastening action on new CWS project requests and on appeals for repairs or renovations of existing systems.

By comparision with the years of waiting for administrative processes to grind forward and for surveys to be carried out, the period of actual project construction appears to have been rather brief.[3/] Two-thirds of the projects were completed within a period of six months--with a sizeable fraction of these finished in a considerably shorter period of time. Among those taking longer, the major causes of delay were the familiar ones of design or survey errors, failures in the timely delivery of supplies and materials, shortfalls in budget, the absence of technical help at required times, quarrels over control of water sources between different settlements, and disputes among the villagers themselves regarding the location of taps.

With the exception of a few irregular cases, such as those mentioned earlier, the CWS schemes have for the most part been extremely high on the priority list of village needs. Only seven percent of household survey respondents could think of projects which their villages needed more than the drinking water system; fewer than four percent felt that the project had been anything less than an "absolute necessity" for their village.

E. Current Operating Status

In an attempt to arrive at a single rough estimate of the degree to which the "completed" CWS projects were continuing to meet the objectives of the CWS program, each researcher upon completion of his field surveys rated the projects he had visited according to a simple four-fold scale. The categories used were defined as follows:

1. Incomplete and/or Not Functioning: This category includes projects which, although officially listed as "complete"

3/ We are defining the construction period as starting with the arrival of materials and supplies at the project site. The period between the approval of the project and even the assignment of the technician and the arrival of supplies is often lengthy and tedious--as numerous volunteer technicians will surely testify.

have not in fact ever functioned. It also includes projects which have broken down since completion to the point where they are no longer supplying water to any taps.

2. Functioning with Major Shortcomings. This category includes projects which have serious flaws including water contamination problems, inadequate flow, major incomplete components, or important repair needs. In this category are functioning and supplying water to some or even all taps.

3. Functioning with Minor Shortcomings. This category includes projects which are in essential respects meeting the objectives of the program but which nevertheless require improvement (e.g., better tapstand sanitation, improved watershed protection, modified maintenance arrangements, etc.).4/

4. Operating Close to Optimal Performance Levels. Well-constructed projects supplying ample quantities of good quality water and supported by functioning maintenance systems are placed in this category.

The results of this "success rating" exercise are presented region-by-region in Table 5 below. In total six projects (or nine percent) were found to be incomplete or no longer functioning. Another twenty-nine projects (forty-one percent) were classified as having major shortcomings. Thirty-one projects (forty-four

---

4/ Distinguishing "major" from "minor" shortcomings was, of course, to some extent a subjective process. In general, in borderline cases projects have been assigned to the higher category. This was particularly true with regard to the water quality criterion which, if rigidly applied, would have resulted in most projects being assigned to category two.

percent of the total) were functioning with problems which were more or less minor, and four (six percent) were performing in almost completely satisfactory fashion.

Table 5 : Success Ratings of LDD/UNICEF CWS Projects Completed Prior to 1977

Category	East	Central	West	Far West	Total	Percent
1. Non-Functioning	-	-	4	2	6	(9)
2. Major Flaws	8	2	14	5	29	(41)
3. Minor Flaws	3	9	13	6	31	(44)
4. Near Optimal	1	2	1	-	4	(6)

50%

Appendix B includes a list of all projects and their success ratings together with comments explaining or justifying the evaluation.

F. <u>Water Quantity</u>

From the villagers point of view, the primary reason for constructing a CWS system is to secure water conveniently and in ample quantity. Measurement of the quantity of water being delivered to project area households, therefore, was an important aspect of the survey. Since measurement of actual flow would have involved difficult and time-consuming procedures, the "adequacy" of the flow in each system was determined primarily by the testimony of the villagers themselves collected by means of the household surveys.

Of the sixty-eight completed systems surveyed, villagers at thirty-one sites indicated that their systems suffered from problems related to insufficient water quantity. In the majority of cases, water quantity problems were seasonal in nature, sources usually drying up wholly or partially in the pre-monsoon months of Falgun to Jestha. In at least ten instances, however, supplies were inadequate year-round.

Water shortages in these systems were not in every case due to the inadequacies of the water source itself. In fact, inadequacies in source flow contributed to the problem in only twenty of the thirty-one cases. In other cases, the water quantity problems were caused (or made worse) by shortcomings of the systems themselves--either those of construction (e.g., leaking tanks, inefficient intake arrangements) or those of management (e.g., failure to put reservoir tanks to proper use.) Table 6 below summarizes project findings with respect to the adequacy, in quantitative terms, of the water supplied by these projects.

Table 6 : Performance of LDD/UNICEF CWS Projects Evaluated in Terms of the Quantity of Water Supplied

	Source		System	
Degree of Adequacy	Number	Percent	Number	Percent
Supply Fully Adequate	47	(69)	37	(54)
Supply Inadequate Seasonally	19	(28)	20	(30)
Supply Inadequate Year-Round	2	(3)	11	(16)
Total	68	(100)	68	(100)

G. Water Quality

While villagers may regard convenience as the primary (if not the only) justification for the construction of a piped water system, from the point of the official agencies involved, the improvement of village health standards is an objective of equal or even greater importance. The most direct impact on health, moreover, is presumed to come from the improved quality of the water which a piped system is able to provide.[5/] By tapping sources which are distant from and above settled areas, it is intended that safe (or at least safer) water will be made available to the villages served. Thus a major activity of the on-site surveys was the testing of the water supplied by the piped systems for purity.

The "tests" performed were of two types, a test of bacterial content and a physical/visual test to secure data on turbidity and the presence or absence of strange odors or tastes. The bacterial content test was carried out using "Millipore" samplers, highly portable testing devices which provide rough indications of the degree to which the water sampled is contaminated with bacteria. A follow-up laboratory test to determine whether or not the bacteria present were of pathogenic type could not be performed because of the excessive time which elapsed between the collection of the water sample at a remote field locations and the researcher's return to Kathmandu. The Millipore tests, therefore, do not indicate whether bacteria which may be present in these water supplies are actually harmful to human beings. (In fact, it is possible to consume fecal bacteria with impunity if the individual who passed the fecal material is not at the time carrying transmittable diseases.) What the tests do indicate, however, is whether the source and/or the system are vulnerable to potentially harmful contamination.

It should also be mentioned that though no actual water quality test was performed on water sources previously used by the villagers, it was usually observed that those sources tended to be much nearer to the settlements and lot less protected compared to the water sources tapped by present water systems. Hence, it is very likely that the water villagers were previously drinking might well have been even more contaminated.

5/ The "conventional wisdom" in this case may not be entirely accurate. There is evidence that increasing the quantity of water available to villagers may have an equal or greater impact on the improvement of health. (See "water use" section below.)

Millipore tests were made at three sites for most systems, the source, the reservoir tank, and one randomly selected tapstand. After a seventy-two hour incubation period (using the researcher's body heat for incubation), bacterial counts were made and recorded. Simple calculations were then made to determine coliform counts per 100 milliliters of water. For the purpose of this survey, coliform counts in excess of fifty per 100 milliliters were regarded as intolerably high. This cut-off point is considerably higher than that which could be used to define potable water in developed countries.

In order to form a summary judgement regarding the degree to which the CWS schemes surveyed were meeting the water quality objectives of the program, each system was classified according to coliform counts into one of three categories:

A. Projects were placed in category one if all tests performed at the site gave results which were below the fifty coliform per 100 milliliter level. These projects were regarded as being at least minimally adequate in terms of water quality.

B. A second category was made up of projects drawing water from sources which met "minimally acceptable" quality standards but where contaminants entering the system between the source and the tap lowered the quality of the water below this standard. In these cases, it was assumed that better repair and protection of the system might improve the project's water quality.

C. Projects in which all tests exceeded the fifty-coliform level were placed in a third category. In these cases, the water quality problem appears to begin with the source itself and improvement in water quality may involve major efforts to improve watershed conditions or the utilization of an entirely different and safer source.

As Table 7 (below) indicates, the vast majority (seventy-eight percent) of the projects examined feel into the third category.

Only six projects (less than ten percent) met even the lenient standards set by the survey, and of these none were completely free of evidence of contamination. Source water in only two cases (Mamling in Sankhuwasabha district and Thumkodanda in Kaski) was completely uncontaminated according to the Millipore tests.

Table 7 : Performance of LDB/UNICEF CWS Projects Evaluated in terms of Water Quality (Bacterial Content)

Coliform Counts per 100 Milliliter	East	Central	West	Far West	Total	Percent
A. Below 50	1	-	4	1	6	(9)
B. Source only below 50	4	1	3	-	8	(13)
C. System above 50	5	12	22	11	50	(78)
Total	10	13	29	12	64	(100)

H. Water Use

Maximum benefit can be derived from the construction of a CWS project only if the increased supply of water results in changes in the water use behavior of the population affected. If people do not take advantage of available water to bathe more often, to wash clothes more frequently, to clean dishes more thoroughly, and perhaps to raise small quantities of vegetables in the dry season to enhance family nutrition, then the full potential of the project is not realized.

While within the limits of this survey it was not possible to narrowly quantify changes in water use habits, it is clear that CWS project water is being put to a broad variety of uses. In one area of water use behavior change in which rough quantification was possible, the indications are encouraging. Fully twenty-seven percent of the households included in the household survey indicated that they had started small kitchen gardens using water from the CWS system. In some project areas, the effect of the systems on kitchen garden activity has been almost explosive; a report from one village leader (in Bajredanda in Gorkha district) that approximately forty gardens had been started as a result of the project (in an area of seventy households) was not a typical.

At the same time it was disappointing to note that too frequently run-off water was not being put to productive use. Direct observations by project researchers indicated that in only 33 percent of the projects was run-off water being effectively utilized.

One problem related to water use that had been anticipated turned out not to exist to any really significant extent. This was the matter of free access to water taps by members of caste groups traditionally regarded as "untouchable". In only a few isolated communities in the far west did low-caste householders who were interviewed complain of discrimination in use of the water provided by the system. The vast majority elsewhere indicated that there was no problem in this regard. In more than a few cases, in fact, the maintenance technician himself was a member of a low-caste community.

(2.1) I. Maintenance Problems

From the villagers' point of view a "maintenance problem" is simply any occurrence which reduces or halts the flow of water. These "maintenance problems" (unless they are the result of major damage to the system) are generally attended to by the villagers, although the methods used often involve improvisations that are neither sanitary nor durable. Maintenance as it is more properly understood as including routine procedures carried out to prolong the useful life of the system and to protect the quality (as well as the quantity) of the water supplied is not a concept which has been broadly understood by the villagers--or even, in all too 23.

many cases, by the "maintenance" technicians themselves. Maintenance of this sort is carried out only sporadically in all but a tiny minority of projects; too often it is not carried out at all.

Taking for the moment the villagers' definition of maintenance problems, what are the major reasons why the flow of water in a particular project may be reduced or interrupted? The experience of the survey indicates that most of these problems fall into one or another of four categories.

2.1

1. Poor Design and Construction. Many maintenance problems originate in the inadequacies of original design and construction--poorly selected sources, inadequately buried pipe, improperly constructed tanks, faulty calculation of hydraulic characteristics, insufficient protection of water-sheds, tanks, valves, and taps. These design and construction shortcomings, however, are not in all, or even most, cases the fault of the construction technician. Sometimes the technician is left to implement someone else's design which, though workable, is inadequate. Sometimes the lack of village cooperation, for example, in expending the labor to bury pipe properly is the root cause of the difficulty. Sometimes, work left by the technician for villagers to complete (such as the finishing of tapstands) is not carried out.

   It is also true, however, that the construction technicians (most of them, during this phase of the CWS program, being foreign volunteers) possessed widely varying levels of technical skill and vastly differing abilities to mobilize and guide village participation. In cases where the technicians have been both competent and culturally sensitive, construction has generally been carried out in a manner which has minimized potential maintenance difficulties.

2. Natural Disasters. A distressingly high proportion of the projects inspected have been subject to damage from natural causes, primarily landslides, flooding, and stream erosion. Several projects (e.g., Charkhu in Okhaldunga district, Mulpani in Baglung) have been virtually obliterated by massive land-slide damage. Others are threatened with similar destruction (e.g., Beltar in Udaypur district). And in several cases, villagers assume that the water supply will be cut off each monsoon when seasonal streams rise and break pipelines where they cross their beds (e.g., Baunepati in Sindhupalchok, Ulleri in Parbat).

   Sometimes, the vulnerability of these projects is a product of poor design and construction--pipelines might have been located in safer places or better provisions might have been devised for suspending pipe over erosion-prone areas). Usually, however, the problem stems simply from the wide-spread deterioration of the hill landscapes of Nepal generally.

3. Damage by People. Human beings are a third formidable threat to the proper functioning of water systems. In some cases, the damage they cause is clearly malicious, carried out with the intention of interrupting the flow of water. Reasons generally go back to disputes over use of the water source or the fact that the system has by-passed a particular settlement that, from the point of view of its residents, should have been provided with a tap.

   More often, however, damage caused by people is of a non-malicious sort brought about by thoughtlessness, ignorance, and immaturity. Shepherds and travellers, seeking to quench their thirst, often slash exposed pipe with their khukuris or hansiyas causing reduction or complete cessation of flow. Children have proven to be particularly ingenious threats to the maintenance of water systems. It is probably safe to generalize, for example, that a reservoir tank should never be built near a school; there seems to be little that is capable of reliably separating a group of small boys from a large body of water save distance. The very novelty of devices such as brass taps or regulatory valves add to the maintenance problem; even adults in remote villages find endless fastination in opening and shutting faucets, often breaking them, certainly reducing their effective lifespan.

4. Inadequate Preventive Maintenance. Faulty maintenance in itself a cause of maintenance problems. When tanks are not cleaned, pipes can clog. Valves which are not oiled soon rust and malfunction. Leaks left untended expand. The low level of performance of routine maintenance tasks characteristic of most projects inspected, then, it itself a cause of breakdowns and deterioration of performance. Most of the CWS projects inspected, however, are relatively new--none much over three years old--and the full impact of inadequate preventive maintenance on project lifespan and performance has only begun to be felt.

J. Existing Maintenance Arrangements

The need for making arrangements to deal with the problems of maintaining and repairing the completed CWS systems has not, of course, escaped the notice of those responsible for planning and implementing the CWS program. The backbone of any such maintenance arrangement, it was anticipated, must be a set of of locally-resident maintenance technicians assigned responsibility for carrying out routine maintenance tasks and for dealing with most repair problems that arise.

The usual pattern followed in creating such a local maintenance capability has been for the original construction technician (usually a foreign volunteer, German or American) to transmit basic maintenance and repair skills and instructions to a local worker involved with him in the original construction of the project. The selection of the individual often occurs informally;

sometimes, however, he is formally assigned to the maintenance post by the water committee or the local panchayat. Ideally, once the individual has been thus prepared and designated to carry out the maintenance tasks, provisions are made for compensating him for his work by means of a levy, in cash or kind, from the people benefitting from the water system.

A major facus of the field survey was to determine the degree to which these sorts of maintenance structures had come into existence in the CWS project villages and to what extent they were functioning smoothly. The results of the field survey visits to the seventy CWS projects indicate that maintenance arrangements resembling the anticipated pattern exist in only a minority of the CWS communities. As Table 8 below indicates, almost a third of the projects did not have any maintenance technician at all. Another twenty-nine percent were maintained by local people who were not paid and often had not really been formally selected to carry out maintenance chores. Thirty-nine percent of the projects were organized for maintenance more or less according to the "model".

Table 8 : Maintenance Arrangements for LDD/UNICEF CWS Projects Completed Prior to 1977

Maintenance Arrangement	East	Central	West	Far West	Total	Percent
No Technician	7	4	8	3	22	(32)
Voluntary Technician	1	6	10	3	20	(29)
Paid Technician	4	3	13	7	27	(39)
Total	12	13	31	13	69	(100)

The compensation arrangement under which the maintenance technicians worked varied greatly from village to village. Of the twenty-seven paid technicians, six received payment in kind, the range in the size of payments running from a high of twenty-three *muris* a year (in the large project in Tarukha panchayat of Dhading district) to a low of fifty *pathis* annually in Ghajari Pipal (Malpe) in Sallyan. Cash salary payments were similarly varied. Some technicians were paid on a daily wage basis, being compensated only when they actually worked on the repair or major maintenance of the system (an arrangement that did not encourage the performance of small routine day-to-day maintenance tasks). Most technicians who were paid at all received a regular salary. In one case, this amounted to a more ten rupees a month. The highest salary paid was at Sundarpur (Beltar) in Udaypur district, a troublesome project that required continual maintenance attention; this technician was paid Rs. 150/- per month (Rs. 1800 annually). Table 9 below summarizes pay arrangements for the twenty-seven paid maintenance technicians.

Table 9 : Compensation Arrangements for Maintenance Technicians Assigned to LDD/UNICEF CWS Projects

Salary Arrangement	East	Central	West	Far West	Total	Percent
Daily Wage	1	-	1	-	2	(7)
Rs. 100 to 500 Annually	1	1	7	4	13	(48)
Rs. 500 to 1000 Annually	-	1	2	2	5	(19)
Rs. 1000 and Above	2	1	3	1	7	(26)
Total	4	3	13	7	27	(100)

Note: Payments in kind have been converted into rupees assuming one *pathi* of grain to be worth Rs. 5/-.

In some cases, it was not possible to be precise about the compensation received by the maintenance technicians because contributions toward his salary by the villagers were made on a voluntary basis. In other instances, the technician himself was responsible for collecting his fee on a house-to-house basis from the people served by the project, a procedure which made full payment still more uncertain. Almost twenty-five percent of the villages with paid technicians supported the technician through voluntary, rather than compulsory, collections.

In spite of the generally meagre--and sometimes uncertain--payments made to the maintenance technicians, a high percentage of them have been in continuous service with the project since original construction of the project was completed. This appears to be true of the voluntary technicians as well as those receiving payment. In all but fifteen percent of the cases, the technician serving the project is the same one originally trained during construction and designated when the project came into operation.

Low attrition rates, of course, are partly due to the short period of time that has elapsed since most of the projects were completed. But it is also to some extent explained by the fact that virtually all of the technicians are residents of the villages in which they work and are therefore able to take on the maintenance technician's responsibilities as a supplementary assignment while continuing to carry out their regular farming or business activities.

A further hopeful feature of these maintenance arrangements is that more than eighty-seven percent are (or at least claim to be) literate. The potential presumably exists, therefore, for supplying these workers with written instructions and guidelines for carrying out their duties, a possibility which has not yet been exploited.

The competence and diligence exhibited by the maintenance technicians varied as widely as their compensation arrangements. These qualities were measured during the field survey both indirectly through inspection of the maintenance status of the system and directly through interviews with the technician which allowed the investigator to form a subjective judgement of the man's skills and attitudes.[6/] Other villagers often spontaneously added their comments on the technician's performance.[7/] On the basis of information from these sources, only a handful of the forty-seven technicians performing maintenance on completed CWS projects were judged to be fully competent and in possession of appropriate attitudes for their assignment.

More commonly, investigators found that there were serious gaps in the technician's skills and understanding; the concept of maintenance itself was often only dimly understood. In many cases, it is probably even misleading to apply the term "technician" to the individual entrusted with responsibility for the system. Often his duties extended not far beyond the routine opening and closing of reservoir gate valves once or twice a day. In one village, the sole responsibility of the "technician" was to constantly adjust (or replace) the crude bamboo intake pipe which was repeatedly dislodged by stream bank erosion.

Probably the most important reason why maintenance in most cases was not being carried out effectively was that it was seldom part of a genuine maintenance system. On the one hand, the technician was almost never supervised in any systematic way, although he might be personally responsive to a patron on the water committee or vaguely under the direction of the panchayat. On the other hand, support to the technician, in both logistical and technical terms, was in almost every case totally absent. Although many of the technicians knew where advice and supplies were theoretically available, few could report satisfactory

---

6/ While field investigators were not themselves trained technicians, most quickly developed the ability to distinguish between technicians who had genuine competence and confidence and those who were to a greater or less extent mystified by the responsibilities with which they had been entrusted.

7/ The technicians were also asked to self-evaluate; this proved to be a more or less futile exercise, since few respondents were willing to confess to inadequacies or even request further training.

experiences receiving support from these sources. District panchayat offices visited during the field survey, for example, seldom felt any obligation to assist villagers with CWS repair problems--although most reported having supplied informal help when possible.

The financial resources occasionally required for carrying out major maintenance and repair tasks were also generally not available. Only forty-two percent of the villages surveyed had any arrangement for raising money to support the CWS project, and in the vast majority of cases funds thus raised were fully expended in making salary payments to the technicians. Even during construction, few villages had made any substantial cash contribution to the project, their obligations generally being those which could be met by contributions of labor--the carrying of pipe, the digging of pipeline trench, etc. While villagers interviewed in the household surveys generally indicated their willingness to provide voluntary labor for major repair tasks and cash (or grain) to support a technician, the pattern of contributing cash for the purpose of purchasing supplies and equipment for repair and maintenance work had not been widely established. This was partly due to the general weakness of hill village fund-raising mechanisms, but partly also to the widespread feeling that it was the government's responsibility to supply the cash or the materials required for maintenance just as it had paid skilled workers and contributed pipes and fittings when the project was originally constructed.

From the technician's point of view, the most serious obstacle to the smooth functioning of maintenance and repair activities was the lack of tools. At more than a third of the sites (thirty-five percent) there were virtually no tools available at all. Most of the remaining projects had inventories of tools described by the maintenance technician or the water committee leaders as inadequate--judgements confirmed in most cases through direct inspection by the investigator. Only four projects were judged to possess adequate tools to meet maintenance and repair requirements.

Depletion of expendable supplies was another serious problem in carrying out maintenance which was cited by local technicians and water committee leaders. Replacement of glue was a particular problem for those projects constructed with PVC pipe. Securing valves, fittings, additional lengths of pipe, etc. etc., was also seldom an easy process.

Except in cases where village leaders or former military men had themselves undertaken maintenance responsibilities, many technicians faced a further problem--that of status. Often poor, sometimes low in caste ranking, and seldom with any man-date other than quasi-official designation by the water committee or panchayat, these technicians were seldom able to establish proper water-use regulations or to exercise discipline over those abusing the system. The inability to command respect and to secure cooperation seriously limited their capacity to manage and maintain the systems properly.

IV. RECOMMENDATIONS

The comments and suggestions which follow focus primarily on the problems of maintaining and of upgrading the quality of already-completed CWS systems. Since most of the survey work upon which this report is based took place in the CWS project villages themselves, these recommendations give special attention to maintenance systems at the village level.

1. <u>The maintenance of community water supply systems should continue to be primarily the responsibility of the communities served by the projects</u>. Many local people interviewed in the course of the field survey expressed the opinion that government agencies should take responsibility for CWS project maintenance. This sort of arrangement is neither necessary

nor particularly healthy. Almost forty percent of the villages visited in the course of this survey have already established maintenance systems, of varying degrees of effectiveness, which are staffed by local people and funded by local levies; many other villages have informal or voluntary arrangements that are meeting some, though seldom all, maintenance requirements. There is no need to dismantle these arrangements or to substitute governmental for local finance and direction. On the contrary, these local solutions to the maintenance problem need to be encouraged and supported.

2. The backbone of the local maintenance system should continue to be a locally-resident semi-skilled maintenance technician. The common present pattern of selecting and training (generally on-the-job during construction) a local person in the techniques and procedures of maintenance is basically correct.

3. The individual who is to assume maintenance responsibilities should be identified as early as possible in the construction period. Early selection of the technician will make maximum time available to the construction engineer or overseer to transmit the necessary skills and understandings while the work is proceeding. Selection during, rather than before, the construction period allows those making the selection to assess the candidate's interest in and aptitude for the job. A central role in identifying the future maintenance technician should be reserved to the project overseer who will be in the best position to make objective judgements; at the same time, "official" designation by representatives of the community will also be important to formalize the technician's position and establish his authority.

4. A local arrangement for supervising the maintenance technician should be established. In very few cases did survey investigators encounter local maintenance technicians who were working under proper supervision. Since these are generally part-time

workers, constantly tempted to neglect their CWS maintenance responsibilities in favor of competing obligations, the need for close and regular local supervision is obviously important. Intermittent inspection by a district-level agency is not likely to be sufficient.

5. Local maintenance structures should be organized according to project rather than panchayat lines. Since in only one of the seventy cases studied did the CWS project service area coincide with the borders of a single panchayat, it would be inappropriate to base maintenance arrangements on the institution of the village panchayat. Instead, it may be wiser to establish a CWS committee for each project, the membership of which might include sadasyas of all wards served by the system. The composition of such a committee, however, should not be so rigidly defined as to exclude those who have taken leadership in the original construction of the project even though they may not be themselves sadasyas. This panel would have responsibility for supervising the maintenance technician (or appointing one of its members as supervisor) and for raising local funds for financing maintenance.

   In at least one case in which there were five or six small CWS systems in a single panchayat--only one of them constructed under the LDD/UNICEF program--the creation of a village panchayat-based maintenance capability does seem to be appropriate; as CWS systems proliferate, it seems likely that the appointment of panchayat CWS maintenance personnel may be more and more justifiable.

6. The village to be served by a CWS project should undertake a commitment to establish a maintenance system staffed by a resident technician and supported from local resources before approval of the project is granted. Stress on proper project maintenance should enter into the thinking of village leaders at the earliest possible moment in the sequence of events leading to a completed CWS system.

7. Written maintenance checklists and manuals should be developed for use by local maintenance technicians and their supervisors. Since almost ninety percent of maintenance technicians interviewed were literate, it is reasonable to attempt to upgrade their skills and guide their work through the use of written materials. These should be written, of course, in simple Nepali and field tested before printing. Two items that would be particularly useful would be (a) a maintenance checklist and (b) a "how to do it" manual describing basic repair and maintenance operations.

8. Greater emphasis should be placed on the training role of the construction technician. The job of a CWS overseer is not a narrowly technical one; unless he contributes to the preparation of local manpower to manage and maintain the system, his work in construction phases of the project may have only a short-lived effect. The training of foreign volunteers for CWS work in Nepal should include a major component in which the role of the overseer as educator is carefully examined and ways of filling this role transmitted. Teaching aides, such as the written materials mentioned above, should also be supplied.

9. Additional training and some form of "certification" for the technician should be provided by His Majesty's Government. One way in which to enhance the status and reinforce the authority of the maintenance technician is to provide him with some quasi-governmental status. Since it is unreasonable--and unnecessary--for him to become himself a government employee, the backing of the government should be expressed through special training courses and the granting of certificates testifying to his competence.

Training, of course, is of value in and of itself, especially if it is practical in orientation and rigorous in implementation. Moreover, virtually all technicians interviewed in this survey appear likely to benefit from a course aimed at upgrading their skills. Specifically, then, it is recommended that a series of training courses be organized for all current CWS project maintenance technicians and for new technicians which local water committees or panchayats should be invited to nominate. Each course should be organized for a relatively small group of trainees drawn from natural sub-regional clusters of projects. Courses should be held at field locations, presumably at villages where properly functioning projects are located. The precise duration of each course should be determined by experienced trainers, but ten days to three weeks should be sufficient.

The current practice of providing brief theoretical exposure to CWS maintenance procedures to village panchayat secretaries undertaking training courses at the panchayat training institutes should be discontinued since it has not proven to be of great value.

10. Maintenance tools should be supplied to each project at the conclusion of project construction. Regional LDD offices report that this procedure is already in practice. For various reasons, not all of them clear, it has not been effective, and few of the technicians interviewed presently have adequate inventories of tools in their possession. This may be in part because the technician himself has often not been given custody of the tools. Instead, they are sometimes left in the panchayat ghar or at the home of a water committee member. While it may be appropriate to store extra pipe and expensive replacement parts in a community facility or with a community official, the tools obviously belong with the technician. It may even be appropriate to delay the assignment of tools to a village until a technician is identified and arrangements for his support developed. In the case of completed projects, tool kits might most efficiently be distributed at the conclusion of training courses suggested in recommendation 9 above.

11. Project maintenance funds should be collected by local leaders, not by the technician, and a portion of the collections should be set aside for purchase of needed supplies. The villages should not be totally dependent upon gifts of supplies and equipment from government agencies. They should have some capacity to make direct purchases of fittings and materials in cases where it is more efficient to do so.

12. To more effectively deal with water quality deficiencies, greater emphasis during construction should be placed on watershed and tank protection. The serious water quality deficiencies found in the vast majority of the projects surveyed indicate the need for both concrete measures and educational efforts aimed at protecting the quality of the water both before and after it enters the system. The fencing and reforestation of watershed areas are two obvious measures that have seldom been implemented. The proper roofing and securing of tanks is another essential step. This needs to be supported by a general village educational effort. The "millipore" tubes used by project researchers in testing water quality might themselves become an educational tool; the visible "evidence" of contamination these tubes provided had a great impact on villagers to whom they were shown during the field survey.

13. Experimental use of iodine dispensers to deal with water quality problems should be undertaken. The technology now exists for installing chemical water purification devices based upon iodine in small rural water systems. Field trials of this technology in the Nepal setting should be carried out. Technical details of this approach are provided in Appendix D of this report.

14. Project selection procedures should be refined still further to increase the likelihood that full village cooperation will be given to the project both during and after construction.

Maintenance problems, we have seen, often begin with shortcomings in construction, and these shortcomings in turn frequently go back to lack of village cooperation in mobilizing sufficient labor to bury pipe properly or to effectively complete protective arrangements (fences, roofs locks, etc.). If villages that are well-led and well-motivated are selected, it may be possible to avoid these problems. How such qualities are to be measured in advance, of course, is not easy to say. The past record of community achievement is one measure. Other possible indicators should to consciously sought.

There is some experience to indicate that the setting of CWS system construction priorities within a given district can be effectively entrusted to the district panchayat as a body. Collectively, the panchayat members appear to have a good sense for where water needs are most desparate. Moreover, if the panchayat works as a group in setting these priorities, the special interests of any particular individual or community are balanced and neutralized by competing interests from elsewhere in the district; the priority lists resulting from such deliberations, therefore, can be expected to be fairly close reflections of the actual situations in the districts.

15. An end-of-construction report, perhaps jointly prepared by the water committee chairman and the construction overseer, should be made a routine LDD procedure. Basic information with regard to maintenance arrangements should find its way into LDD regional and central office files and perhaps to those of the Public Works Section Section of the district office as well. Information provided should minimally include (a) the name of the maintenance technician, (b) the name(s) of his supervisor(s) on the local water committee, (c) a list of tools left at the site and the person to whom they have been given, (d) work remaining on the project, if any, and (e) an indication of local plans for compensating the maintenance technician. Standardized reporting forms with clear instructions regarding

the offices to which they are to be sent should replace the present completely unstructured post-construction reporting system.

16. In cases where projects are already known to require major repair or renovation, experienced CWS technicians should be specially dispatched to bring these projects back to proper working order. Such projects have already been identified in the individual project status reports (which have been submitted as companion volumes to this report). Creation of a permanent cadre of "roving" maintenance technicians is not recommended.

17. District-level responsibility for providing technical and material support to the local maintenance technicians should be clearly delineated.[8/] There appears to be a great deal of confusion regarding what responsibilities, if any, the technicians attached to the district offices have with regard to maintenance and repair of CWS projects located in their districts. The situation is further complicated by the continuing post-construction distinction between LDD-implemented CWS projects and those built with district and local resources. There seems to be a clear need for policy to be spelled out regarding what the maintenance obligations of the district office (presumably the public works branch) are and whether or not LDD/UNICEF projects are to be supported in

---

8/ Most of the data collected in the course of this survey came from on-site visits to project villages themselves. Although all LDD regional offices and a number of district offices were also visited, investigators feel less confident in making recommendations regarding the organization of CWS maintenance systems at these levels. The discussion here, therefore, is more tentative and general in nature with few specific action recommendations being offered.

the same manner and through the same mechanisms as district-built ones.[9]

In actual practice, a number of public works unit technicians interviewed during field surveys indicated that they were giving attention to the maintenance and repair needs of projects in their districts--although at they same time they argued that they were not under any obligation to do so. These technicians further agreed that the district office should accept maintenance and repair responsibilities at least to the following extent:

--Provision, storage, and distribution of spare parts, materials, and tools.

--Provision of technical help in cases of major damage to CWS systems.

--Possibly provision of training to local maintenance technicians.

Survey investigators agree that assumption of these limited responsibilities by the district office is in order, especially in those districts where the number of CWS projects has begun to grow. Before these duties can be effectively carried out, however, other concerns expressed by district-based technicians may need to be met; public works unit personnel, for example, repeatedly cited the lack of funds for travel and daily allowances payments as a serious handicap on their ability to perform their jobs in the field.

9/ The District Administration Plan indicates that generally "the tasks of operation and maintenance of the completed projects come within (the) purview" of the district office's public works unit (District Administration Plan, p. 13, English edition). How this general principle is applied in particular cases, however, has not been spelled out to the satisfaction of district-posted technicians.

The question of whether a single CWS repair and maintenance specialist, i.e., a technician exclusively assigned to these tasks, should be appointed at the district level was raised with public works office technicians and others. Respondents generally argued that given the seriously understaffed position of most district technical offices, such specialization could not at this point be justified. As CWS projects multiply, however, and as technical staff become more available, it may be reasonable to consider creation of this sort of specialized position when there are perhaps fifteen or twenty completed projects in a given district. This assumes, of course, that LDD-built and district-implemented projects would be supported by a single district-level maintenance arrangement. Such CWS repair specialists, of course, would not be intended to replace local maintenance technicians; their primary purpose would be to remain "on call" for occasions when major problems develope.

Once lines of responsibility have been worked out between the various agencies and levels of administration, village maintenance technicians and their supervisors must be clearly informed of where they are to go for assistance and what they are entitled to expect when they get there.

Regional LDD offices have not, for the most part, played any signficant maintenance/repair role, according to the testimony of regionally-posted LDD staff.[10/] Given the communications problems and the great distances involved (particularly in regions where LDD offices remain in the tarai), it is probably

10/ Regional personnel indicate that they are discouraged from playing any major role in maintenance by the emphasis placed in planning documents on completing projects rather than repairing those which have broken down. The limited numbers of technicians available, therefore, are generally put to work on new construction which contributes to the achievement of planning targets. If the regional offices are to escape this sort of pressure, it may be necessary to create completely separate repair and maintenance units.

unwise to expect these offices to play important roles in this area in the future--with perhaps the important exceptions of arranging "cluster-level" training of local maintenance personnel and expediting supplies and replacement parts to district-level distribution points.

APPENDIX A

PROJECT NAMES, WARDS AND HOUSEHOLDS SERVED

No.	Project Name*	District	Wards	Households
EASTERN DEVELOPMENT REGION				
1.	Jamuna (Jaubari)	Ilam	--	38
2.	Chisapani	Ilam	2,3,5,6,7	107
3.	Gorke (Manebhanjyang)	Ilam	5	54
4.	Yasok/Ranigaon/Melbote	Panchthar	3,5,6,8/6/4, 8,9	210
5.	Sinam	Taplejung	--	85
6.	Techambu	Taplejung	1,2,3,5,9	87
7.	Kharang	Sankhuwasabha	1	35
8.	Mamling	Sankhuwasabha	2,3,4,5,6,7	418
9.	Dandabazar	Dhankuta	1,2,6,7,8	107
10.	Aiselukharka	Kotang	2,3,4,5	71
11.	Thulachhap (Charkhu)	Okhaldhunga	5,7	72
12.	Sundarpur (Beltar)	Udaypur	8	350
CENTRAL DEVELOPMENT REGION				
13.	Sindhu (Baunepati)	Sindhupalchok	7	37
14.	Sanga (Janagal)	Kabrepalanchok	--	150
15.	Subbagaon (Subba)	Kabrepalanchok	--	100
16.	Pancha Kumari (Birta Deurali)	Kabrepalanchok	1,2	110
17.	Deopur/Naldum Baluwapati	Kabrepalanchok	--	122
18.	Godavari (Kitini)	Lalitpur	--	90
19.	Matatirtha	Kathmandu	5,6,7,8	601

* Project names assigned by this survey are in some cases different from those originally assigned by LDD. This has been done in order to standardize the naming procedure and to take into account changes in panchayat boundaries. In the naming system used here, the first names given are those of the panchayat. Village names have been given in parenthesis when appropriate.

20.	Thankot (Saital)	Kathmandu	--	75
21.	Chogate (Phalante)	Nuwakot	--	33
22.	Ralukadevi (Kharanitar)	Nuwakot	1,2,3,8,9	200
23.	Dhaibung Nilkantha Borle (Jibjibe)	Rasuwa	--	258
24.	Budhasing	Dhading	--	201
25.	Taruka	Dhading	--	621

WESTERN DEVELOPMENT REGION

26.	Palungtar/Ampipal/Harmee	Gorkha	1	70
27.	Phinam	Gorkha	4,5,7	29
28.	Tandrang (Okhale Kubindi)	Gorkha	--	--
29.	Gaikhur	Gorkha	1,2,3,4,5,6	131
30.	Kerabari (Upper Bhirsing)	Gorkha	7,8	58
31.	Kerabari (Lower Bhirsing)	Gorkha	--	48
32.	Palungtar/Ampipal (Badedanda)	Gorkha	3,4,5,7	159
33.	Thumkodanda (Deorali)	Kaski	1,3,4,5	452
34.	Arba Bijay	Kaski	1,2,3,4,5,6	280
35.	Kalika (Thuloswara)	Kaski	3,5,6	78
36.	Kalika (Gairabari)	Kaski	3,6,7,8,9	116
37.	Puranchaur	Kaski	2,6,7,8,9	223
38.	Lahachok	Kaski	All Wards	501
39.	Ramja Tilahar (Thamarjung)	Parbat	1,2,3,4,5	274
40.	Ramja Tilahar (Danabagar)	Parbat	5	7
41.	Deopur (Deurali)	Parbat	1,2,5,6	93
42.	Deopur (Gairathok)	Parbat	3,5,6,7,8,9	326
43.	Dansing (Ulleri)	Parbat	6,7,8,9	82
44.	Dhairing	Parbat	6	60
45.	Somadi	Palpa	6,7,8	157
46.	Mulpani (Harachaur)	Baglung	3	90
47.	Mulpani (Dhikichaur)	Baglung	4	81

48.	Jyamrukot/Arjun	Myagdi	4,5,6,7,8,9	279
49.	Histan (Kibang)	Myagdi	1,2	74
50.	Histan (Gharamdi)	Myagdi	3,4	128
51.	Narchhyang	Myagdi	1,2,3,4,5	176
52.	Bhurung Tatopani	Myagdi	4,5,6	36
53.	Lete	Mustang	4,5	41
54.	Marpha (Chhairo)	Mustang	9	50
55.	Marpha (Marpha)	Mustang	1,2,3	146
56.	Kagbeni (Phalyak)	Mustang	4,5	50
57.	Kagbeni (Dhagarjung)	Mustang	2,3	35

FAR WESTERN DEVELOPMENT REGION

58.	Pipalgaon (Boharagaon)	Jumla	6,7,8,9	20
59.	Haku	Jumla	5,6,7,8	30
60.	Mani (Munigaon)	Jumla	7,8	22
61.	Bhure	Jajarkot	1,6	55
62.	Jangkot	Rolpa	4,5,6,8	110
63.	Phopli	Pyuthan	2,3,4,5	--
64.	Narikot	Pyuthan	3,4,5,6	82
65.	Sapdanda	Pyuthan	2,6,7	62
66.	Charkhuwa Thara (Amchaur)	Sallyan	5	172
67.	Ghajari Pipal (Malpe)	Sallyan	2	50
68.	Bahra Gaon Upplloswara	Sallyan	3,4,5	97
69.	Lekh Pharsa	Surkhet	4,5	200
70.	Gumi	Surkhet	--	--

APPENDIX B

PROJECT SUCCESS RATINGS AND STATUS SUMMARIES

No. Project Name	Rating	Comment
EASTERN DEVELOPMENT REGION		
1. Jamuna (Jaubari)	2-	Only one of five taps was functioning at the time of the inspection visit. The reservoir tank was clogged with debris. No formal maintenance system had been established. Water quality was sub-standard.
2. Chisapani	3	Flow was adequate and all taps were functioning at the time of inspection. Water quality was slightly sub-standard. Tapstands were incomplete and pipe required reburial in places. Maintenance system was functioning with competent, paid technician.
3. Gorke (Manebhanjyang)	3	All but one of seventeen taps were functioning in this recently completed project. No formal maintenance arrangements have been made. Minor "finishing touches" of the project need to be completed.
4. Yasok/Ranigaon/ Melbote	2	Serious pressure problem was causing frequent bursting of pipes in this system. Virtually all tapstands require rebuilding. Maintenance technician's post has not been filled. Water source quality is good, but some deterioration in quality takes place en route.
5. Sinam	3	All but one of fourteen taps were functioning satisfactorily. The development of a proper maintenance system, however, was being prevented by political problems in the community. Water quality, which was good at the source, deteriorated badly en route.
6. Techambu	2	This system was constructed by the local people after political problems led to the abandonment of the original project design and the departure of the technician. As a result, the system suffers from numerous design flaws and sub-standard construction. Project requires rebuilding, not just repair.

7. Kharang	2	Only two of six taps were functioning at the time of the inspection visit. Flow problems require the attention of a well-qualified technician.
8. Mamling	4	This is one of the best systems inspected. Water quality meets standards set by the survey. Quantity is also sufficient and all components are functioning properly. Maintenance system, however, is not well established.
9. Dandabazar	2+	Water supplied by this system is seriously inadequate in terms of both quantity and quality. Quantity problem is in part due to poor management (failure to use the reservoir tank properly). Contamination levels are dangerously high because of inadequate protection of watershed and intake facilities.
10. Aiselukharka	2	Water is unequally supplied at various points in the system, a condition which has caused disputes in the village. The system is poorly constructed throughout. Building of a reservoir tank is required.
11. Thula Chhap ((Charkhu)	2-	Project area is highly vulnerable to landslides which have damaged most of the taps. Contamination levels are extremely high due in part to poor selection of water source. No maintenance system has been set up.
12. Sundarpur (Beltar)	2	Location of the pipeline in and near a river subject to monsoon flooding has meant periodic disruption of water supply due to breakage. Reservoir tank is threatened with destruction from the meandering of the river. Water quality is poor. Substantial redesign and reconstruction of the system is necessary.

CENTRAL DEVELOPMENT REGION

13. Sindu (Baunepati)	2+	Water supplied by this system is highly contaminated and the flow is seasonally inadequate. Pipeline is broken annually where it crosses the bed of a seasonal stream. There is major leakage from the intake tank. A maintenance system exists but it is staffed by under-qualified volunteers.

14. Sanga (Janagal)	4	This project is many ways is a model of what a properly functioning CWS system should be. Construction has been of high standard throughout. A village-supported maintenance system is effectively functioning.
15. Subbagaon (Subba)	3	System is functioning to the general satisfaction of the people served. Contamination, however, is at a high level, and no formal maintenance system has been established. Reservoir tank needs to be protected from contamination by children. Intake works similarly require better protection.
16. Pancha Kumari (Birta Deurali)	2	Source area is badly affected by landslides and flooding which has seriously damaged both intake tanks. Only one tank has been rebuilt; as a result, flow is inadequate. Water quality is seriously sub-standard. No maintenance system has been established. Water, however, is flowing to all taps.
17. Deopur/Naldum Baluwapati	3	This project is functioning in a generally satisfactory way. Water quality, however, falls somewhat short of minimal standards. Excessive pressure causes frequent breakage in pipeline. Reservoir has no gate valve and does not serve any function. No maintenance arrangements have been made.
18. Godavari (Kitini)	3+	The project has been basically well-constructed, but maintenance is not functioning properly. Water quality is somewhat sub-standard.
19. Matatirtha	3	In general terms, the system is functioning adequately, although the supply of water fails to meet local demand during parts of the pre-monsoon period. Maintenance is the responsibility of an unpaid technician.
20. Thankot (Saital)	3	This is a small-scale project which is functioning adequately. Intake tank is badly designed; surface run-off water enters the tank in the rainy season. No maintenance system has been established.

21. Chogate (Phalante)	3	This system is functioning properly. The only serious shortcoming is contamination in the source area which is eroded and badly protected. Surface water is entering the intake system. One tap requires relocation, and a maintenance system should be established.
22. Raluka Devi (Kharanitar)	3	Project was functioning well at the time of inspection except for serious leaks at several points in the pipeline. Water quality, however, was not satisfactory, and a maintenance system had not yet been set up.
23. Dhaibung Nilkantha/ Borle (Jibjibe)	3	Adequate quantities of water are being supplied to all taps in the system, but high levels of contamination were recorded at reservoir and tap test sites. Permanent tapstands had not been constructed and several other "finishing touches" had been left undone. A volunteer-based maintenance system was functioning at less than optimal levels.
24. Budhasing	3	In spite of major construction problems (the project took three years to complete), the system is now functioning satisfactorily. Water quality, however, falls somewhat short of meeting minimal standards. The maintenance technicians are in need of training in virtually all aspects of their jobs.
25. Taruka	4	This is one of the largest systems built under the UNICEF/LDD program and it appears to be one of the most successful also. The components are in excellent condition, and a maintenance system is functioning. Some improvement in protection of the source from contamination, however, is desirable.

WESTERN DEVELOPMENT REGION

26. Palungtar/ Ampipal/Harmee (Bajredanda)	3	People served are reasonably satisfied with the functioning of this system, except for seasonal deficiencies in flow which are made worse through poor management of the reservoir tank. There are also some water quality problems. Two of the systems eight taps are not functioning. The maintenance technician requires greater discipline.

27. Phinam	2	Water supplied by this system is badly contaminated partly because of an unresolved dispute over use of the water source. Three of five taps are not functioning. The poorly buried pipe has been cut on a number of occasions. Because of a broken gate valve, the reservoir too is not being properly used. Maintenance is inadequately performed by an unpaid technician.
28. Tandrang (Lkhale-Kubindi)	1	Although mentioned on the official LDD/UNICEF Project List, this system appears to have been built with district panchayat funds with purchased pipe. Construction was haphazard in the extreme and one of the two mini-systems is not functioning at all.
29. Gaikhur	2	This project consists of two separate systems. It is badly below standard. The supply of water in the large system is insufficient to meet local needs, and the smaller system has virtually ceased to function. Contamination levels are high. Management and maintenance is poorly handled.
30. Kerabari (Upper Bhirsing)	2	One of two systems constructed simultaneously but functioning separately, this project suffers from deficiencies in both quality and quantity. Bad management worsens the problem. Tapstands have never been completed. Maintenance technician is neither skilled nor diligent.
31. Kerabari (Lower Bhirsing)	2	This system suffers from a serious contamination problem. Quantities are also seasonally insufficient to meet village needs. While routine maintenance is being handled well, improved management of the system is needed.
32. Palungtar/ Ampipal (Badedanda)	2-	Only a fraction of the eighteen taps in this system are functioning. Contamination levels are also high. Construction has been careless in several respects. Virtually no maintenance has been done since the system was completed. The root problem is that the villagers did not need or want the project in the first place.

33. Thumkodanda	3	This is a successful system in key respects; water quality is high and it is supplied in ample quantities. Shortcomings, however, include exposed pipeline, several non-functioning taps, and a weak maintenance system.
34. Arba Bijaya	2	This project is substandard in both qualitative and quantitative respects. Contamination is heavy throughout and supplies are so short in the dry season that the system operates for only a few hours each day. Seven of sixteen taps are malfunctioning, and two are completely dry. Pipelines are exposed and vulnerable to landslides.
35. Kalika (Tuleswara)	3-	This is a small and simple system supplying water of good quality to three taps. The quantity, however, is seasonally insufficient for local needs. Maintenance is poor, and no technician has been appointed.
36. Kalika (Gairabari)	2	Water quality in this project is substandard. The project also fails to supply adequate quantities in the dry season. The volunteer maintenance technician is sincere, but badly underqualified. Maintenance and repair needs, such as leaking pipes and inoperative taps, have consequently not been met.
37. Puranchaur	2	Water quality is deficient at all points tested. Seasonally, the project also suffers from water shortages. The system is seriously vulnerable to flooding and landslides which have on at least one occasion completely buried the intake works. A maintenance system is operating.
38. Lahachok	4	In terms of water quality and the effectiveness of maintenance arrangements, this, clearly a superior project.
39. Ramja Tilahar (Thamarjung)	2	This project fails to meet expectations in both quantitative and qualitative terms. Water supplied was not adequate to meet local needs at any time of the year. Although the source water is of good quality, contamination is entering the system en route. Water supply problem is worsened by wastage due to leaks in the intake tank and faulty shut-off valves at the taps.

40. Ramja Tilahar (Danabagar)	1	This system brings water across a major river by means of a suspended pipe. The suspension system has proven to be inadequate, however, and the whole arrangement has collapsed. The primary purpose of the project (which was built by the villagers) appears to have been irrigation rather than domestic use.
41. Deopur (Deorali)	1	All taps in this system were dry at the time of the inspection visit. This is due to inadequate output at the source and the absence of any reservoir arrangements. The pipelines are also exposed in many places; taps have no shut-off valves; and the intake tank has leaked since it was constructed. No maintenance system exists.
42. Deopur (Gairathok)	3	This large system is generally functioning satisfactorily. Quality is somewhat deficient, but quantity is adequate and dependable. Pipeline is vulnerable to landslides and taps and tapstands are not well constructed or in good repair.
43. Dansing (Ulleri)	2	Water quality is below standard. Pipeline passes across serious landslide area and is broken every monsoon. It is repaired each dry season. A volunteer maintenance technician is able to handle most routine problems.
44. Dhairing	3	This is a short and simple system which was functioning adequately at the time of the inspection. Water quality, however, was not particularly good. Maintenance arrangements had not been made, and a number of repair needs had not been attended to.
45. Somadi	3	Although flow is adequate, water quality fails to meet standards. Technical problems which are preventing the simultaneous functioning of all taps should be diagnosed. A reasonably effective maintenance system is in operation.
46. Mulpani (Harachaur)	1	The water source has been completely buried by major landslide; the system is no longer functioning. A new source is needed.

47.	Mulpani (Dikichaur)	2-	This system is barely functioning. Landslide damage in the source area interrupts flow virtually every monsoon. One intake tank is leaking so seriously that it no longer supplies water to its portion of the system. No maintenance system exists.
48.	Jyamrukot/Arjum	3	This system is functioning well and is supplying good quality water in ample amounts. Maintenance is the major remaining proble; the present technician has not attended to numerous relatively minor repair needs.
49.	Histan (Khibang)	3	Although the system is meeting the expectations of the villagers, water quality is not satisfactory. Leakage at the reservoir tank also requires attention.
50.	Histan (Gharamdi)	3	The system is functioning smoothly and is well maintained. Water quality standards, however, are not being met. Beter protection of the pipeline where it crosses a landslide area is also required.
51.	Narchhyang	2	The major shortcoming of this system is the incomplete intake facility. Work was never finished because of a lack of cement. In other respects, the system is performing adequately.
52.	Bhurung Tatopani	2	This project was neither surveyed nor constructed by a qualified technician. As a result several design and construction shortcomings are present. Two of the three taps do not receive adequate water. Components have otherwise been solidly constructed and a maintenance system is functioning.
53.	Late	3+	Except for shortcomings in terms of water quality, this is a well-constructed and smoothly functioning system. The maintenance technician is competent and faithful in the performance of his duties.
54.	Marpha (Chhairo)	2	The original project has been reconstructed to separately serve neighboring communities, a Tibetan refugee camp

		and a Thakali village. Neither system presently functions properly. The large reservoir tank's taps do not operate; water reaches the settlements through highly unsatisfactory ad hoc arrangements.
55. Marpha (Marpha Village)	3	Cold season freezing of the pipes in the source area had caused the system to cease functioning at the time of the visit. This problem can be corrected through deeper burial of the pipes when the ground thaws. When this is done and other construction loose ends completed, this will be a very good system.
56. Kagbeni (Phalyak)	3	Water falls short of meeting quality standards, but in other respects the system is meeting the expectations of the villagers. No maintenance technician has been appointed. The villagers have so far handled maintenance tasks adequately, however.
57. Kagbeni (Dhagarjung)	3	Although there is no maintenance system, this system is functioning adequately. Water quality falls short of standards, however.

FAR WESTERN DEVELOPMENT REGION

58. Pipal (Boharagaon)	3	The major problems of this system include contamination in the source area, seasonal freezing of the pipes and the intake tank, and inadequate maintenance.
59. Haku (Giripandey)	2	The system was poorly designed to begin with. Modifications by the villagers have made the system even less satisfactory. Water is contaminated throughout.
60. Mani (Munigaon)	2	Freezing causes reduction in flow in this system each winter. Floodin the monsoon often submerges the intake tank. Siltation is a serious problem for the project. A maintenance system is functioning.
61. Bhure	3	This system is supplying adequate quantities of water; water quality is

		somewhat sub-standard. Extension of the system to nearby needy villages should be investigated.
62. Jangkot	3+	Problems with water quality are the only shortcomings of this otherwise excellent project.
63. Phopli	1	This project is not functioning. Major components have not been completed reportedly due to shortage of funds. Tanks have no roofs; pipeline is otten not buried; taps have not been constructed.
64. Narikot	2	This project has serious problems with both water quantity and quality. Flow is inadequate during the pre-monsoon period and contamination is at extremely high levels. Maintenance has not been functioning properly, although a new technician has just been appointed. Flow to the various taps is uneven causing quarrels among the villagers.
65. Sapdanda	2	Water quality and quantity problems have made this less than a fully satisfactory project. Contamination is at extremely high levels.
66. Charkhuwa (Amchaur)	3+	This projects suffers only from slight water quality shortcomings and inadequate maintenance arrangements. In other respects, it is of high standard.
67. Ghajari Pipal (Malpe)	3	In most respects, the system is in good condition. One construction task remains--the completion of roofing for the reservoir tank. Maintenance is being carried out properly.
68. Bahra Gaon Upplloswara	3	Project is generally functioning to the satisfaction of the people served. However, it does not meet minimal water quality standards, and a proper maintenance system has not been established.
69. Lekh Pharsa	2	This project has both quality and quantity problems; a badly polluted irrigation ditch is the water source. Pipeline is vulnerable to landslides and many taps are in bad repair. A maintenance system, however, is functioning.

70. Gumi	1	This project was never completed and was not functioning during the time of the inspection visit.

APPENDIX C

PROJECT STATUS REVIEW TABLE

No.	Project Name	District	Water Quality*	Water Quantity**	Maintenance Yes/No	Technician Paid/Unpaid	Success Rating***
1.	Jamuna (Jaubari)	Ilam	C	C	No	--	2-
2.	Chisapani	Ilam	-	A	Yes	Paid	3
3.	Gorke (Manebhanjyang)	Ilam	C	A	No	--	3
4.	Yasok/Ranigaon/Melbote	Panchthar	B	A	No	--	2
5.	Sinam	Taplejung	B	A	No	--	3
6.	Techambu	Taplejung	B	B	Yes	Unpaid	2
7.	Kharang	Sankhuwasabha	B	C	No	--	2
8.	Mamling	Sankhuwasabha	A	A	No	--	4
9.	Dandabazar	Dhankuta	C	B	Yes	Paid	2+
10.	Aiselukharka	Kotang	C	A	Yes	Paid	2
11.	Thula Chhap (Charkhu)	Okhaldhunga	C	A	No	--	2-
12.	Sundarpur (Beltar)	Udaypur	C	B	Yes	Paid	2

* Water quality is rated in three categories. Category A includes projects in which quality standards at all points in the system at which water quality tests were made. Category B includes projects which have water sources of adequate purity but where contamination enters the system at some subsequent point. Category C includes projects in which the source itself is contaminated.

** Water quantity is reated in three categories. Category A includes projects which supply adequate quantities of water at all times. Category B includes projects which have seasonal water quantity problems. Category C includes projects which have year-round quantity deficiencies.

*** Success Rating scales are defined in section III.E. of the text.

CENTRAL DEVELOPMENT REGION							
13.	Sindhu (Baunepati)	Sindhupalchok	C	B	Yes	Unpaid	2+
14.	Sanga (Janagal)	Kabrepalanchok	B	A	Yes	Paid	4
15.	Subbagaon (Subba)	Kabrepalanchok	C	A	Yes	Unpaid	3
16.	Pancha Kumari (Birta Deurali)	Kabrepalanchok	C	B	Yes	Unpaid	2
17.	Deopur/Naldum Baluwapati	Kabrepalancnok	C	A	No	--	3
18.	Godavari (Kitini)	Lalitpur	C	A	Yes	Unpaid	3+
19.	Matatirtha	Kathmandu	-	B	Yes	Unpaid	3
20.	Thankot (Saital)	Kathmandu	-	A	No	--	3
21.	Chogate (Phalante)	Nuwakot	C	A	No	--	3
22.	Raluka Devi (Kharanitar)	Nuwakot	C	A	No	--	3
23.	Dhaibung Nilkantha/ Borle (Jibjibe)	Rasuwa	C	A	Yes	Unpaid	3
24.	Budhasing	Dhading	C	A	Yes	Paid	3
25.	Taruka	Dhading	C	A	Yes	Paid	4
WESTERN DEVELOPMENT REGION							
26.	Palungtar/Ampipal/ Harmee (Bajredanda)	Gorkha	C	B	Yes	Paid	3
27.	Phinam	Gorkha	C	A	Yes	Unpaid	2

28.	Tandrang (Okhale-Kubindi)	Gorkha	-	-	--	--	1
29.	Gaikhur	Gorkha	C	B	Yes	Paid	2
30.	Kerabari (Upper Birsing)	Gorkha	C	B	Yes	Paid	2
31.	Kerabari (Lower Birsing)	Gorkha	C	B	Yes	Paid	2
32.	Palungtar/Ampipal (Badedanda)	Gorkha	C	A	No	--	2-
33.	Thumkodanda (Deorali)	Kaski	A	A	Yes	Paid	3
34.	Arba Bijaya	Kaski	C	C	Yes	Paid	2
35.	Kalika (Tuleswara)	Kaski	A	B	No	--	3-
36.	Kalika (Gairabari)	Kaski	C	B	Yes	Unpaid	2
37.	Puranchaur	Kaski	C	C	Yes	Paid	2
38.	Lahachok	Kaski	A	A	Yes	Paid	4
39.	Ramja Tilahar (Thamarjung)	Parbat	B	C	Yes	Paid	2
40.	Ramja Tilahar (Danabagar)	Parbat	C	A	No	--	1
41.	Deopur (Deorali)	Parbat	C	B	No	--	1
42.	Deopur (Gairathok)	Parbat	C	B	Yes	?	3
43.	Dansing (Ulleri)	Parbat	C	B	Yes	Unpaid	2
44.	Dhairing	Parbat	C	A	No	--	3
45.	Somadi	Palpa	C	A	Yes	Paid	3
46.	Malpani (Harachaur)	Baglung	-	C	No	--	1

47.	Mulpani (Dikichaur)	Baglung	B	C	Yes	Paid	2-
48.	Jyamrukot/Arjum	Myagdi	A	A	Yes	Unpaid	3
49.	Histan (Kibang)	Myagdi	C	A	Yes	Unpaid	3
50.	Histan (Gharamdi)	Myagdi	C	A	Yes	Unpaid	3
51.	Narchhyang	Myagdi	C	A	Yes	Unpaid	2
52.	Bhurung Tatopani	Myagdi	C	B	Yes	Unpaid	2
53.	Lete	Mustang	C	A	Yes	Paid	3+
54.	Marpha (Chhairo)	Mustang	C	A	Yes	Paid	2
55.	Marpha (Marpha)	Mustang	-	B	Yes	Unpaid	3
56.	Kagbeni (Phalyak)	Mustang	C	A	No	--	3
57.	Kagbeni (Dhagarjung)	Mustang	B	A	No	--	3
FAR WESTERN DEVELOPMENT REGION							
58.	Pipal (Boharagaon)	Jumla	C	B	Yes	Unpaid	3
59.	Haku (Giripandey)	Jumla	C	A	Yes	Unpaid	2
60.	Mani (Munigaon)	Jumla	A	B	Yes	Paid	2
61.	Bhure	Jajarkot	C	A	Yes	Paid	3
62.	Jangkot	Rolpa	C	B	Yes	Unpaid	3+
63.	Phopli	Pyuthan	-	-	--	--	1
64.	Narikot	Pyuthan	C	-	Yes	Paid	2

65.	Sapdanda	Pyuthan	C	B	Yes	Paid	2
66.	Charkhuwa (Amchaur)	Sallyan	C	A	Yes	Paid	3+
67.	Ghajari Pipal (Malpe)	Sallyan	C	A	Yes	Paid	3
68.	Bahra Gaon Uppl1oswara	Sallyan	C	B	No	--	3
69.	Lekh Pharsa	Surkhet	C	B	Yes	Paid	2
70.	Gumi	Surkhet	-	-	--	--	1

APPENDIX D

BACKGROUND INFORMATION REGARDING POSSIBLE USE OF IODINE TO PURIFY RURAL COMMUNITY WATER SUPPLIES*

It is possible to consider using iodine dispensers to purify water for communities in remote localities and under relatively primitive conditions where more elaborate procedures are impractical. Iodine has the following characteristics which make it attractive for this purpose:

(1) Iodine is a proven virucide, bactericide, and cysticide; at 0.5 mg/liter concentration, iodine kills all bacteria within two minutes, polio virus within nine minute, and amoebic cysts in approximately thirty minutes at a pH level of 7.5 and a temperature range between 20° and 26° centigrade.

(2) Iodine is effective over a broad range of temperature and water pressure conditions, significantly more effective than chlorine or bromine, common alternatives. The presence of organic material in the water does not affect these qualities as much as it would those of chlorine and bromine.

(3) The low solubility of iodine means that it may be used over a prolonged period of time without maintenance support.

---

* Information presented below is based upon the following report of the Forest Department of the United States Department of Agriculture which has tested iodine dispensers for use in campgrounds and isolated communities in the United States:

Equipment Development and Test Report 7400-1, "Iodine Dispenser Water Supply Disinfection", Brian Cook, Environmental Staff Engineer, U.S. Department of Agriculture, Forest Service, Equipment Development Center, San Dimas, California (January 1976).

(4) At concentrations of 0.5 or 1.0 mg/liter, iodine does not affect the taste of the water noticeably.

(5) In these same concentrations, iodine does not have adverse effects on human populations when used over short periods (three weeks or less). There is a possibility of negative impact on limited numbers of susceptible people (those with pre-existing thyroid problems) when such people are exposed to iodine on a permanent basis. These effects are currently being researched.

(6) Iodine can be stored indefinitely without losing its dis-infectant properties.

An iodine water purification device is manufactured by Iodinamics (a subsidiary of Continental Water Conditioning Corporation, 12400 Darrington Road, P.O. Box 26428, El Paso, Texas 79926). It is marketed under the trade name of "Iodinator" and can be installed in rural water supply systems with no major difficulty. It is presently being used in remote rural communities in the United States. The devices range in size according to the flow capacity of the water systems. A model weighing one pound can treat 241,000 gallons of water at 0.5 mg/liger concentrations; a two hundred pound unit is capable of treating 48 million gallons of water at the same concentration. A middle-sized five-pound unit costs $198 including the initial supply of iodine crystals; the cost rises to $267 for an eight-pound model. Replacement crystals are priced at $11.95 per pound.

There are several problems connected with the use of such iodine dispensers, the most important being the following:

(1) Maintaining a more-or-less constant concentration of the iodine residual is difficult because concentration is affected by flow rate, pressure, temperature, and other variables; periodic adjustments are necessary to take these changes into account.

(2) A contact period of at least twenty minutes is recommended before the water is consumed making it essential that the device be used in conjunction with a reservoir or holding tank of sufficient size.

(3) Obtaining initially the proper level of iodine residual is a trial and error process which can be carried out only by a trained technician.

Promotional Literature distributed by the manufacturer of the "Iodinator" lists the following advantages of iodine over chlorine as a water purifier:

--A chlorinator, as opposed to an iodinator, requires electricity.

--An iodinator has no moving parts, while a chlorinator requires a chemical pump which can become a maintenance problem.

--An iodinator needs to be checked only every two years, and refilling with fresh chemicals is simple; a chlorinator, by contrast, requires constant checking, testing, and refilling.

--The testing of iodine residual is easy and relatively reliable; this is not the case with chlorine.

--Iodine kills amoebic cysts which are resistant to chlorine.

--Iodine is weak chemically and reacts slowly, if at all, with organic material; chlorine, on the other hand, is used up rapidly in such reactions making it considerably less efficient as a germicide.

--Iodine is more stable than chlorine and retains its germicidal potency longer.

--Chlorine is affected by temperature, pH, and sunlight to a greater extent than iodine.

--Iodine in proper concentration is tasteless; chlorine isn't.

The use of iodine dispensers in CWS systems in rural Nepal would probably require some, but perhaps not major, reorientation of the CWS program. More detailed measurement of water use and flow would be required in the design stages of a project. Iodine dispensers could only be used with "closed" systems, not the less expensive "open" ones. Better maintenance to avoid wastage of water would also become ven more important. In addition improved construction and protection of components located below the iodine dispenser would be essential if recontamination of purified water was to be avoided. Nevertheless, given the water quality testing experience of this project, chemical purification may be the only real solution to the pollution problem in rural water systems in Nepal.

* * * * *

APPENDIX E

Project Name: ______________

Reporting Date: ______________

COMMUNITY WATER SUPPLY PROGRAM
PROJECT STATUS REPORT

A. GENERAL INFORMATION

1. Location

a. District Name ______________

b. Panchayat Name ______________

c. Village(s) Served ______________

d. Nearest Roadhead ______________ Distance ______

Nearest Airport ______________ Distance ______

District Headquarters ______________ Distance ______

Regional LDD Office ______________ Distance ______

e. Brief Route Description

2. General Village Information

a. Major Ethnic Groups in Project Area:

(1) ______________ (4) ______________

(2) ______________ (5) ______________

(3) ______________ (6) ______________

b. Settlement Pattern:

c. Major Sources of Villager's Income In Order of Importance:

(1) ______________ (3) ______________

(2) ______________ (4) ______________

d. Major Crops Grown by the Villagers:

(1) ______________ (3) ______________

(2) ______________ (4) ______________

e. Economic Condition of the Village (Relative to Hill Nepal Generally)

3. Names of Responsible Individuals

   a. Pradhan Pancha or Ward Member ______________
   b. Maintenance Technician ______________
   c. Water Committee Chairman ______________
   d. Project Overseer ______________

   Overseer's Agency: ____ LDD ____ GVS ____ Peace Corps

B. GENERAL TECHNICAL DESCRIPTION

1. Project History (Dates)

   a. Village Panchayat Decision to Proceed with Project ________
   b. District Panchayat Approval of Project ________
   c. First Survey Performed ________ Additional Surveys (No.)___
   d. Construction Begun ________
   e. Construction Completed ________
   f. Inspected/Certified by LDD Engineer: ___ Yes ___ No

2. Costs of Construction

   a. HMG Contribution ________
   b. Village Contribution ________
   c. UNICEF Contribution ________
   d. Total Cost ________ e. Original Estimate ________
   f. Source of Information ______________
   g. Per Capita Cost (Present Population) ______________

3. Water Source

   ____ Spring ____ Stream ____ River

4. Number of Households Served: ________

5. Type of System: ________ Open ________ Closed

6. Type of Pipe: ____ HDP ____ PVC
   ____ Combination: Specify ______________

7. Length of the System: ____________

8. Number of Bags of Cement: ________

9. Components

a. Number of Intake Tanks ____
b. Collection Tank ____
c. Gate Valve ____
d. Number of Regulation Valves ____
e. Number of Air Valves ____
f. Number of Washouts on Pipeline ____
g. Number of Reservoir Tanks ____
h. Number of Break Tanks ____
i. Number of Taps ____

10. Water Use

____ a. Drinking
____ b. Cooking
____ c. Washing Dishes
____ d. Bathing
____ e. Drinking (Animals)
____ f. Washing Clothes
____ g. Irrigating (Kitchen Garden)
____ h. Irrigating (Fields)
____ i. Other

C. ASSESSMENT OF PRESENT CONDITION

1. Adequacy of Flow

____ Adequate Supply of Water Year Round
____ Supply Seasonally Inadequate in Months of ____________
____ Supply Inadequate Year Round

Comment:

2. Water Quality Conditions

a. Bacterial Quality Test

Sample Taken From	Presumptive Test Result Pos.	Neg.	No. of Colonies	No. of Coliforms
Source	____	____	____	____
Reservoir	____	____	____	____
Tap No. 1	____	____	____	____

b. Visual/Physical Test

Sample Taken From	Turbidity Sand	Silt	Clay	Color	Taste	Odor
Source	☐	☐	☐	____	____	____
Reservoir	☐	☐	☐	____	____	____
Tap No. 1	☐	☐	☐	____	____	____

c. Comment:

3. <u>Assessment of Watershed Conditions</u>

a. Status Checklist

	Yes	No
(1) Sufficient vegetation in watershed area to prevent erosion	___	___
(2) Watershed area free of signs of animal grazing	___	___
(3) Watershed area free of trails	___	___
(4) Watershed area free of houses	___	___
(5) Watershed area adequately fenced	___	___

b. General Assessment

___ Virtually no danger of contamination from watershed area

___ Some danger of contamination from watershed area

___ Serious danger of contamination from watershed area

c. Comment:

4. <u>Assessment of Intake Works</u>

a. Description of Intake Structures: Components, Materials, etc.

b. Status Checklist

	Yes	No
(1) Intake tanks located at sources	___	___
(2) Sedimentation chamber	___	___
(3) Tanks adequately roofed and sealed to prevent contamination	___	___
(4) Tanks adequately ventilated	___	___
(5) Easy access to tanks for cleaning purposes	___	___
(6) Tanks have functioning washout drains	___	___
(7) Area is free of erosion caused by overflow and washout drains	___	___
(8) Tanks are free of slime or animal life	___	___
(9) Evidence of recent removal of sediments from tanks	___	___
(10) Surrounding area properly graded for drainage	___	___
(11) Tanks free of leaks	___	___
(12) Screens present in sedimentation chamber	___	___
(13) Screens over tank outlet pipes	___	___

c. General Assessment

	Satisfactory	Some Shortcomings	Serious Shortcomings
(1) Design	___	___	___
(2) Construction	___	___	___
(3) Maintenance	___	___	___

d. Comment:

5. <u>Assessment of Reservoir Tank</u>

a. Description of Reservoir Tank:

b. Status Checklist

	Yes	No
(1) Adequately roofed and sealed to prevent contamination	___	___
(2) Adequately ventilated	___	___
(3) Accessible for cleaning purposes	___	___
(4) Evidence of recent removal of slime and sediments	___	___
(5) Has functioning washout drain	___	___
(6) Free of animal life	___	___
(7) Outlets (overflow and washout) arranged to avoid erosion	___	___
(8) Surrounding area properly graded for drainage	___	___
(9) Free of leakage	___	___
(10) Screen over tank outlet pipe	___	___

c. General Assessment

	Satisfactory	Some Shortcomings	Serious Shortcomings
(1) Design	___	___	___
(2) Construction	___	___	___
(3) Maintenance	___	___	___

d. Comment:

6. Assessment of Break Tanks

a. Description of Break Tanks:

b. General Assessment

	Satisfactory	Some Shortcomings	Serious Shortcomings
(1) Design	___	___	___
(2) Construction	___	___	___
(3) Maintenance	___	___	___

7. Assessment of Valves

a. Description of Valves

(1) Cate Valve

(2) Air Release Valves

(3) Washout Valves

(4) Flow Regulation Valves

b. Status Checklist

	Yes	No
(1) Valves enclosed in secure boxes	___	___
(2) Locks provided for all boxes	___	___
(3) Valves oiled and/or painted recently	___	___
(4) Valves functioning as designed	___	___

c. General Assessment

	Satisfactory	Some Shortcomings	Serious Shortcomings
(1) Design	___	___	___
(2) Construction	___	___	___
(3) Maintenance	___	___	___

d. Comment:

8. Assessment of Pipeline

a. General Description of Pipeline:

b. Status Checklist

	Yes	No
(1) Pipeline properly buried throughout its length (except where inappropriate)	___	___
(2) Pipeline free of leaks and cuts	___	___
(3) Ground cover restored over trench line	___	___
(4) Pipeline avoids areas subject to flood, landslide, and erosion	___	___
(5) Flow uninterrupted by pipeline deficiencies	___	___
(6) Exposed pipe free of discoloration (PVC Pipe Only)	___	___

c. If pipeline passes through areas which are vulnerable to landslide, what measures have been taken to protect the pipe from damage?

d. General Assessment

	Satisfactory	Some Shortcomings	Serious Shortcomings
(1) Design	___	___	___
(2) Construction	___	___	___
(3) Maintenance	___	___	___

e. Comment:

9. Assessment of Taps and Tapstands

a. Description of Taps and Tapstands: Number, Type of Construction, Type of Tap (waste-not, brass, polyethelyne, open), etc.

b. Status Checklist

	Yes	No
(1) All taps provide adequate flow and pressure	___	___
(2) All shut-off valves are functioning	___	___

(3) Tapstands constructed of durable material (stone, concrete, brick, treated wood, etc.)	___	___
(4) Tapstands in good repair	___	___
(5) Tapstand areas properly paved	___	___
(6) Tapstand areas properly drained	___	___
(7) Regulatory valves at individual taplines	___	___
(8) Facilities available for washing clothes, bathing, etc.	___	___
(9) Runoff water productively used	___	___

c. General Assessment

	Satisfactory	Some Shortcomings	Serious Shortcomings
(1) Design	___	___	___
(2) Construction	___	___	___
(3) Maintenance	___	___	___

d. Comment:

10. Political Factors

Describe problems of a political nature, either internal to the area served or between the project area and neighboring settlements, which affect the functioning of the system.

D. MAINTENANCE ARRANGEMENTS

1. The Maintenance Technician

a. Name ______________________ Age ________

b. Educational Level ______________________

c. Resident or Non-Resident ______________________

d. Date He Assumed Maintenance Responsibilities ______________

e. Selected by ______________________

f. Nature of Training ______________________

g. Length of Training ______________________________

h. Technician's Supervisor ______________________________

i. Compensation:

(1) Is the technician paid for his work? ___ Yes ___ No

(2) If yes, at what rate is he paid? ______________________

j. Technician's Self-Evaluation of Competence:

(1) Has confidence in his ability to cope with most maintenance problems ___ Yes ___ No

(2) Requires additional training or support in the following areas:

(3) Knows how to secure required tools and materials. ___ Yes ___ No

(4) Knows where to seek help with maintenance problems. ___ Yes ___ No

k. Researcher's Evaluation of Technician's Competence

___ Competent and Knowledgeable
___ Some Shortcomings in Competence and Knowledge
___ Serious Inadequacies in Competence and Knowledge

l. Researcher's Evaluation to Technician's Performance

___ Maintenance Tasks Performed Regularly and Thoroughly
___ Maintenance Tasks Carried Out Irregularly and Inadequately
___ Maintenance Tasks Seldom or Never Carried Out

m. Comment:

2. <u>Village Contribution to Maintenance Program</u>

a. Does the village contribute to the support of the maintenance technician? ___ Yes ___ No If yes, answer the following:

(1) Is the contribution voluntary or compulsory?

___ Voluntary
___ Compulsory

(2) Is the contribution in cash or kind?

___ Cash
___ Kind
___ Both

b. Does the village contribute to the purchase of maintenance supplies and materials? ___ Yes ___ No

c. Has a maintenance team been established in the village? ___ Yes ___ No

d. Describe village arrangements for providing labor for maintenance and repair tasks.

e. Comment:

3. Availability of Tools and Materials

a. General Assessment

___ Technician has sufficient tools and materials
___ Technician has incomplete supply of tools and materials
___ Technician has virtually no basic tools and materials

b. Where are the tools/materials kept? ______________________

c. Inventory of Tools and Materials: For a complete listing of tools and materials available on-site see the accompanying "Tools and Materials" form.

4. General Maintenance Procedures

a. Reporting System: How are problems located?

___ Report of local inhabitants
___ Regular inspection by technician; Frequency __________
___ Other

b. Routine Maintenance Checklist

	Yes	No	Frequency
(1) Is sediment periodically cleared from various tanks in the system?	___	___	_____
(2) Are screens, filters, baffles periodically cleaned?	___	___	_____
(3) Are screens and filters periodically replaced?	___	___	_____
(4) Are air release valves (or air-cocks) periodically regulated?	___	___	_____

(5) Are taps repaired when they break? ___ ___ ___

(6) Are G.I. fittings and tin roofs painted periodically? ___ ___ ___

(7) Are valves periodically oiled? ___ ___ ___

5. Major Maintenance Experiences

Describe circumstances surrounding major damage to the following components of the system and repair or reconstruction work undertaken.

a. Repair or Replacing of Tanks

b. Rerouting or Replacing of Pipe Lines

c. Changing or Rebuilding Tap Sites

6. Causes of Maintenance and Damage Problems (Researcher's Estimate)

___ Design deficiencies

___ Shortcomings in construction

___ Natural disasters (fire, landslide, flood, etc.)

___ Malicious Damage

___ Inadequate Preventive Maintenance

___ Improper Use: Ignorance

___ Improper Use: Negligence

Comment:

E. ACTION RECOMMENDATIONS

1. Training Needs

2. Tools and Materials Needs

3. Repair Needs

4. Dispute Reconciliation Needs

5. Other

Project Name: ______________

Reporting Date: ______________

TOOLS AND MATERIALS

I. PIPES - Please inspect the place where the villagers keep there pipes and quantify their stores of the following:

	H.D.P.	P.V.C.	G.I.
(a) 20 mm (O.D.) [½"]	____	____	____
(b) 32 mm (O.D.) [1"]	____	____	____
(c) 50 mm (O.D.) [1½"]	____	____	____
(d) 63 mm (O.D.) [2"]	____	____	____
(e) 90 mm (O.D.) [3"]	____	____	____
(f) Other (Specify)	____	____	____

II. FITTINGS - Please inspect village's stores of the following and give numbers and sizes of these items:

	H.D.P.	P.V.C.	G.I.
(a) Tees	____	____	____
(b) Reducers	____	____	____
(c) Pipe Ends or Plugs	____	____	____
(d) Flange Sets	____	____	____
(e) Elbows	____	____	____
(f) Sockets	____	____	____
(g) Others	____	____	____

III. ADDITIONAL FITTINGS - Please enumerate stores of the following:

___ (1) Stop Cocks
___ (2) "Waste-Not" Taps
___ (3) Gate Valves
___ (4) Globe Valves
___ (5) Air-Release Valves
___ (6) Corporation Cocks
___ (7) Others

IV. TOOLS - Please enumerate stores of the following:

___ (a) Hacksaw
___ (b) Hacksaw Blades

___ (c) Thermocrayons
___ (d) Heating Plate
___ (e) Woodsaw
___ (f) Screwdriver
___ (g) Adjustable Wrench
___ (h) Pliers
___ (i) Hammer
___ (j) Pipe Wrench (Specify size)
___ (k) Measuring Tape (3M; 30M)
___ (l) Pipe Threader (Specify size of dies)
___ (m) Others

V. MATERIALS - Please describe and enumerate the following:

(a) Screening or Filters ____________________
(b) Plaint (for G.I. Fittings or Roofing) ____________________
(c) Nails (size - Quantity in Kg's) ____________________
(d) Screws (for Air-Release; Other?) ____________________
(e) Glue (for PVC Systems) ____________________
(f) Oil (for Valves) ____________________
(g) Others ____________________

PROJECT NAMES AND DISTRICTS

Project No.	Project Name	District
EASTERN DEVELOPMENT REGION		
1.	Jamuna (Jaubari)	Ilam
2.	Chisapani	Ilam
3.	Gorke (Manebhanjyang)	Ilam
4.	Yasok/Ranigaon/Melbote	Panchthar
5.	Sinam	Taplejung
6.	Techambu	Taplejung
7.	Kharang	Sankhuwasabha
8.	Mamling	Sankhuwasabha
9.	Dandabazar	Dhankuta
10.	Aiselukharka	Kotang
11.	Thulachhap (Charkhu)	Okhaldhunga
12.	Sundarpur (Beltar)	Udaypur
CENTRAL DEVELOPMENT REGION		
13.	Sindhu (Baunepati)	Sindhupalchok
14.	Sanga (Janagal)	Kabrepalanchok
15.	Subbagaon (Subba)	Kabrepalanchok
16.	Pancha Kumari (Birta Deurali)	Kabrepalanchok
17.	Deopur/Naldum Baluwapati	Kabrepalanchok
18.	Godavari (Kitini)	Lalitpur
19.	Matatirtha	Kathmandu
20.	Thankot (Saital)	Kathmandu
21.	Chogate (Phalante)	Nuwakot
22.	Ralukadevi (Kharanitar)	Nuwakot
23.	Dhaibung Nilkantha Borle (Jibjibe)	Rasuwa
24.	Budhasing	Dhading
25.	Taruka	Dhading

WESTERN DEVELOPMENT REGION		
26.	Palungtar/Ampipal/Harmee	Gorkha
27.	Phinam	Gorkha
28.	Tandrang (Okhale Kubindi)	Gorkha
29.	Gaikhur	Gorkha
30.	Kerabari (Upper Bhirsing)	Gorkha
31.	Kerabari (Lower Bhirsing)	Gorkha
32.	Palungtar/Ampipal (Badedanda)	Gorkha
33.	Thumkodanda (Deorali)	Kaski
34.	Arba Bijay	Kaski
35.	Kalika (Thuloswara)	Kaski
36.	Kalika (Gairabari)	Kaski
37.	Puranchaur	Kaski
38.	Lahachok	Kaski
39.	Ramja Tilahar (Thamarjung)	Parbat
40.	Ramja Tilahar (Danabagar)	Parbat
41.	Deopur (Deurali)	Parbat
42.	Deopur (Gairathok)	Parbat
43.	Dansing (Ulleri	Parbat
44.	Dhairing	Parbat
45.	Somadi	Palpa
46.	Mulpani (Harachaur)	Baglung
47.	Mulpani (Dhikichaur)	Baglung
48.	Jyamrukot/Arjum	Myagdi
49.	Histan (Kibang)	Myagdi
50.	Histan (Gharamdi)	Myagdi
51.	Narchhyang	Myagdi
52.	Bhurung Tatopani	Myagdi
53.	Lete	Mustang
54.	Marpha (Chhairo)	Mustang
55.	Marpha (Marpha)	Mustang
56.	Kagbeni (Phalyak)	Mustang
57.	Kagbeni (Dhagarjung)	Mustang

FAR WESTERN DEVELOPMENT REGION		
58.	Pipalgaon (Boharagaon)	Jumla
59.	Haku	Jumla
60.	Mani (Munigaon)	Jumla
61.	Bhure	Jajarkot
62.	Jangkot	Rolpa
63.	Phopli	Pyuthan
64.	Narikot	Pyuthan
65.	Sapdanda	Pyuthan
66.	Charkhuwa Thara (Amchaur)	Sallyan
67.	Ghajari Pipal (Malpe)	Sallyan
68.	Bahra Gaon Uppl1oswara	Sallyan
69.	Lekh Pharsa	Surkhet
70.	Gumi	Surkhet