Community Water Supply and Sanitation Programme
Helvetas Pokhara

Final Report
on
Drinking Water Quality Surveillance Programme
1992/93

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1. INTRODUCTION

This is the final report of the Drinking Water Quality Surveillance Programme (DWQSP) which was carried out in some of the rural water supply projects of Community Water Supply and Sanitation Programme (CWSSP/HELVETAS, Pokhara) in the Western Development Region of Nepal. The surveillance programme started since August 1992 and was complete in September/October of 1993.

1.1 Background Information

Since 1978, bacteriological water testing has been carried out in a sporadic way in the CWSSP. The CWSSP considers water schemes requiring some kind of water treatment, except plain sedimentation, as not feasible. Henceforth water tests are used to assess the quality of new proposed sources for water supplies and if the conditions permit to choose the one with the best water quality.

1.2 The Concept of DWQSP

The basic principles underlying the DWQSP is to ascertain that the quality of water supplies do comply with accepted drinking water quality standards and that any deterioration and/or problems within the water supply system is identified so that corrective measures can be quickly taken to restore the quality of water. To fulfil this task requires a sound knowledge of water-related diseases, the principles of Drinking Water Quality Surveillance, proper planning, good technical support and institutional arrangement, sufficient trained manpower, good information processing and dispatch system, and some key elements which spell out the details in methodologies in carrying out monitoring, sanitary surveys, remedial action-plan, community involvement, etc. An effective surveillance programme depends on the existence of national regulatory standards of water quality and code of practices. These, in turn, depend on appropriate national legislation and the establishment of a competent surveillance unit or agency within the government.

1.3 Objective of DWQSP in CWSSP/HELVETAS

From July 1992 onwards, the laboratory in the CWSSP was inducted into a unit itself. To stimulate the monitoring work, a DWQSP was developed to be executed for a period of one year. The primary objective of DWQSP in CWSSP is to monitor, on a routine and regular basis, the water quality in number of existing water supply projects within the period of one year and to assess and evaluate the results of water quality. The other objective is to develop a statistical record of the test-results which later on should be used as a guiding tool in improving the quality of water in those water supply projects where there is the occurrence of a major health risk due to water-related diseases.

The CWSSP, however, at the present situation can not meet all the requirements of a fully established Drinking Water Quality Surveillance Agency because of its own limitations. The study was

initiated on a very rough idea and lacks in experience. This study on DWQSP should be regarded as a pilot work and therefore there is a need for further improvements.

1.4 Area Coverage

Initially, there was an idea to cover more projects for DWQSP. But later on, even after visiting once or twice, few water supply schemes were dropped out because of various reasons and limitations. Finally, the number of projects were reduced only to 8 (eight). The following CWSS constructed water supply projects were selected and visited for the study.

Table 1: List of projects visited for DWQSP in 1992/93

District	Name of Project	Name of VDC	Year of constr.	Type of project
Kaski	Bharat Pokhári	Bharat Pokhari	1991/92	New
Tanahun	Kotre-Juwadi	Dulegaunda	1989/90	Training
	Eklekhet-Majuwa	Dulegaunda	1990/91	Training
	Tarkudanda Bhangara	Dulegaunda	1992/93	Repair
	Makanpur	Dulegaunda	1992/93	Training
Parbat	Khurkot Subedithar	Khurkot	1989-1992	Rehab.
	Khurkot Lampata	Khurkot	1987-1990	Rehab.
	Pakuwa Mandanda	Pakuwa	1991-1993	New

1.5 Sampling Location

In this study, the water quality was analysed/monitored only at the sources of water supply projects. Majority of the schemes consisted of stream sources. A brief description of the surveyed water sources is given below.

Table 2: Name and general description of water sources

Name of Project	Name of Water Source	Nature of Water source
Bharat-Pokhari	Tinghare Mul	This is a spring source and lies inside a dense forest. The intake area is not protected. During monsoon season there is a high risk of water pollution.
Kotre-Juwadi	Bhutte-Chhahara	This is a stream source. The dam/intake is somehow o.k. but there is a need of frequent visit to be made by the VMW to the source. High risk of water pollution because the source area is not protected well. Moreover, the nearby area is used for farming.
Eklekhet-Majuwa	Bhirpani	A stream source. It is located far away from the village and lies deep inside the jungle. Unprotected source. Although it is normally inaccessible by man and other animals, it presents a high risk of pollution during monsoon.
Tarkudanda-Bhangara	Bhirpani	As described above for Bhirpani water source.
Makanpur	Bhirpani	As described above for Bhirpani water source.
Khurkot-Subedithar	Jukepani Mul	This is a spring source which is located on the bank of a stream. High risk of pollution. Before the intake chambers were nicely built and the source was protected. But in the last rains the whole structure of dam/intake was washed away in the flood and as such the source did not existed at all. Some immediate corrective measures should be taken to reinstall the spring source and prevent water from pollution.
Khurkot-Lampata	Halhaleko-Phedi	A stream source. The source is situated up in the hills. The catchment area is not protected and there is a high risk of water pollution.
Pakuwa-Mandanda (system I)	Mathe-Khola	As described above for Khurkot Lampata stream source.

Name of Project	Name of Water Source	Nature of Water source
Pakuwa-Mandanda (system II)	Maruwa Mul	This is a spring source. In fact there are two other small spring sources near to it. Water from all these three springs is collected into Maruwa Mul and then supplied to the village. The intake is constructed just in the middle of rice fields and is unprotected. It exhibits a very high risk of water contamination- both chemically and bacteriologically.
Pakuwa-Mandanda (system III)	Bivadeko-Khola	A stream source. This is located at the lower end of a village and is inside the valley. The dam/intake is unprotected and very much exposed to high risk of water pollution.
Pakuwa-Mandanda (system IV)	Bivadeko-Khola	As described above for system III water source.

2. SURVEILLANCE METHODOLOGY

The planning for monitoring the quality of water was developed in such a way that within the duration of the DWQSP, at least four surveys could be carried out in each of the selected water supply projects. These surveys were carried out in varying climatic conditions so that a general overview of the water quality throughout the year could be obtained.

Two different kind of methodologies were considered to assess the water quality- 1) The bacteriological quality and 2) Physico-chemical quality.

2.1 Bacteriological Indicators

In this analysis, the method followed was Membrane Filtration (MF) Method. The examination included determination of fecal-coliform bacteria, presence of which indicate the fecal contamination of water which in turn, implies the potential presence of pathogenic organisms. Ideally, drinking water should not contain any micro-organisms known to be pathogenic.

The equipments and field test kits used for bacteriological analysis were those supplied by Millipore Corporation, U.S.A. All the tests were carried out directly in the field using the portable field test kits.

2.2 Physico-Chemical Indicators

The analysis for physico-chemical quality of water was carried out using portable instruments and field test kits supplied by HACH Company, U.S.A. The following parameters were selected in this study.

Table 3: List of physico-chemical parameters used in DWQSP

Parameter	Method used
Total Hardness (as $CaCO_3$)	HACH Digital titration
Calcium Hardness (as $CaCO_3$)	HACH Digital titration
Magnesium Hardness (as $CaCO_3$)	HACH Digital titration
Nitrate (NO_3^-)	HACH Color Disc
Nitrite (NO_2^-)	HACH Color Disc
Iron	HACH Color Disc
P^H	HACH Color Disc
Temperature	-

3. THE WHO GUIDELINES

Before evaluating the results of DWQSP, it is necessary to have a general idea on the WHO (World Health Organization) guidelines on water quality. After all, there has to be certain standards for measurement so that the test-results could be interpreted. On one hand it is nice that WHO has given the guidelines on water quality. However, on the other hand experiences in several small community water supplies have shown that these guidelines, especially those set for bacteriological quality, are found too stringent to be adapted for water supplies of developing countries. The following table shows guideline values given by WHO on water quality. The parameter shown are only those tested in the CWSSP.

Table 4: WHO guidelines on water quality

Parameter	Unit	WHO Guideline Value	Remarks / Effects On Beneficial Uses
A) Bacteriological:			
Fecal-coliform organism	number/ 100 mL	0	Indications of fecal pollution of water.
Total coliform organism	number/ 100 mL	3 *)	Indication fo bacterial pollution of water.

Parameter	Unit	WHO Guideline Value	Remarks / Effects On Beneficial Uses
B) Physico-chemical:			
Total Hardness (as $CaCO_3$)	mg/L	500	Hard water lead to formation of scales in the pipes and boilers, results in excessive soap consumption.
Calcium Hardness (as $CaCO_3$)	mg/L	200	Higher concentration lead to formation of scale deposits in pipes and boilers.
Magnesium Hardness (as $CaCO_3$)	mg/L	-	At higher concentration Magnesium salts have laxative effect, increase hardness of water.
Nitrate (NO_3^-)	mg/L	44.3	Toxic if present in excessive amount, cause death of infants by cyanosis.
Nitrite (NO_2^-)	mg/L	-	Higher values indicate groundwater pollution by sewage.
Iron	mg/L	0.3	Higher values lead to corrosion of iron pipes and form deposits in the pipes, stains laundry and plumbing fixture, taste complaints, increase maintenance costs of the system.
pH	-	6.5-8.5	Elevated or less pH values lead either to corrosion problems or inefficiency of chlorine disinfection processes.
Temperature	^oC	-	Cool water is palatable but it inactivates the water treatment process Higher water temperature on the other hand, enhances the growth of undesirable micro-organisms.

*) Only in occasional sample but not in consecutive samples.

4. EVALUATION OF SURVEILLANCE RESULTS

A detailed description of the surveillance results is given in the attached annexes. (Please refer to Annex I for bacteriological test results and Annex II for the physico-chemical test results).

4.1 Bacteriological Quality

As pointed out earlier, the WHO guidelines for bacteriological quality of water are considered too stringent to be applied for small rural water supplies as this would lead to the condemnation of vast majority of the existing water supplies in low-income communities. The CWSSP, which is dealing with installation of gravity-fed rural water supply schemes, is not out from it. Therefore, a more flexible classification system as proposed by R. Feachem et al is used in this study.

Proposed Bacterial Grading Scheme:

Although there were two kinds of microbiological examinations made in this study, i.e. the total coliform test and fecal-coliform test, the CWSSP preferred to analyse the results against the density of thermotolerant fecal-coliform bacteria (E.coli). It is because that fecal-coliforms are a sub group of the total coliforms and have the same properties as that of total coliforms except they tolerate and grow at the higher temperature of 44 - 44.5 ^{o}C. Moreover, the identification of fecal-coliform bacteria provides a definite evidence of fecal contamination of water.

Table 5: Proposed bacterial grading system

Grade	Number of fecal-coliforms (E.coli/100 mL)	Risk / Recommended operation
A	0-10	No risk. Supply untreated.
B	10-100	Low risk. Treat if possible, if not supply untreated.
C	100-1000	Gross pollution; high risk. Water should be treated, if not supply untreated or abandon the source depending on various other factors.
D	> 1000	Gross pollution; very high risk. Water must be treated or otherwise the source should be abandoned depending on various other factors.

From among the total of 43 tests carried out in DWQSP, 42 tests were made for total coliform examination and 28 tests were carried out for the examination of fecal-coliforms. On the basis of above proposed grading scheme, the bacteriological quality (fecal-coliform density) of the 28 tests can be summarized as follows:

Table 6: Bacteriological grading of surveillance results

Grade	No. of tests	(%)	Risk / Action priority
A	6	21.43	No risk; no action priority
B	18	64.28	Low risk; low action priority
C	4	14.29	High risk; higher priority action
D	0	0	Very high risk; highest priority action required.
TOTAL	28	100.00	

4.2 Physico-Chemical Quality

From the results obtained, it can be summarized that water quality of all the eight water supply projects selected under DWQSP is within the WHO permissible limits. Water quality of all the sources do not show any considerable variations in physico-chemical composition. Generally, all the visited sources could be regarded as fairly good in terms of physico-chemical characteristics.

5. CONCLUSION

5.1 Bacteriological Quality

From the above table, it could be explained that majority of the water sources fall under grade B of bacteriological grading scheme. This means that most of the water supplies contain fecal-coliform bacteria in the range of 10-100 organisms per 100 mL of water. The table also reflects that about 21% of the surveyed samples contained less than 10 fecal-coliform bacteria per 100 mL water (Grade A) indicating that these water schemes are supplying fairly good and clean water. Similarly, it can also be explained that few water supplies (about 14%) are having poor water quality indicating that pollution has occurred at their sources (Grade C).

Though it is observed that some water sources are of poor water quality (Grade C), but if the quality of individual sources are assessed, the results lie very near to the lower end of this grade. This implies that in general, all the water sources surveyed under DWQSP are supplying average quality of water.

But as according to the general condition and nature of the water sources described earlier, all the sources are liable to high risk of pollution. This indicate that most of the water sources should have been very poor in terms of quality of water. Nevertheless, there are several other factors which give rise to grading of the water schemes in these various categories. They are as- number of tests carried out in one particular season, sampling location, type of source, sanitary conditions, etc.

If a comparison is made for all the eight water supply projects, three projects contain worst quality of water. They are- 1) Bharat Pokhari 2) Kotre-Juwadi 3) Pakuwa Mandanda (system II). The surveillance results exhibit that pollution by fecal-coliform organisms is found very high during monsoon season and is low in the dry period. The risk of fecal contamination is found severe in those water supplies which contained stream source. The spring source, in general, are found less prone to fecal contamination.

5.2 Physico-Chemical Quality

As stated earlier, generally all the visited sources could be regarded as fairly good in terms of physico-chemical characteristics. However, some notable variations were also observed in chemical compositions. For example, in June 1993 the total hardness of water for the source of Pakuwa Mandanda (system II) was recorded as 82 mg/L as $CaCO_3$ whereas in October 1993, it showed only 2 mg/L as $CaCO_3$. Similarly, the pH-value for the same source changed drastically from 7.6 in September 1992 to 6.7 in October 1993. The cause for this is unknown but one reason could be that as the source is situated in the middle of the rice lands, the change in the use of various fertilizers at different seasons must have led to these changes. The nitrogen composition, in general, found to be higher during monsoon season and remained high until October. This was noted to be low in dry season. This could also be understood by the fact that during rainy season, when most of agricultural practices are carried out, the concentration of nitrogenous compounds and other fertilizers become more abundant on the soil surface.

6. RECOMMENDATIONS

In view of the past, most of the water supply systems are built without previous findings of the quality of the proposed water source. Therefore before going to construct any water supply system, it would be ideological to consider the following aspects:

- Bacteriological and physico-chemical analysis of the existing water sources should be carried out before the commencement of any construction work.
- If possible, always select the best spring source.
- The source catchment area must be well protected against intrusion of any other foreign things to safeguard the quality of water. This could be done by doing plantation of fast growing trees but not the fruit trees at and around the source area.
- After the water supply scheme is built, each and every structure of the system must be protected.
- Good and proper education on Operation and Maintenance (O & M), health and sanitation, water using patterns, etc. should be given to the communities.
- A thorough sanitary inspection, along with the bacteriological analysis, should be carried out for the water supply schemes where there is a danger of water pollution.

7. FOLLOW-UP PROGRAMME

One of the objectives of this DWQSP is to take remedial actions in the water sources which expose a serious health threat to the consumers. In this DWQSP, three water supply schemes are found to be problematic and hence a follow-up programme shall be launched in the next stage in these projects.

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Water Quality Analysis, CWSSP/HELVETAS, Pokhara: BACTERIOLOGICAL TEST - RESULTS

Test No.	Name of Project	Name of V.D.C./ District	Sample Site	Name of Water Source	Type of Source	SAMPLING Date	SAMPLING Time	ANALYSIS Date	ANALYSIS Time	Sample Volume (mL)	BACTERIAL COUNT / 100 mL Total Count	Total Coliform	Fecal Coliform
1	Bharat Pokhari	Bharat Pokhari/ Kaski	Source	Tinghare Mul	Spring	25-08-92	18.00	26-08-92	15.00	100		80	
2	Kotre - Juwadi	Dulegaunda/ Tanahu	Source	Bhutte-Chhahara	Stream	27-08-92	15.00	28-08-92	17.00	100		85	
3	Eklekhet-Majuwa	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	28-08-92	10.00	29-08-92	17.00	100		68	
4	Tarkudanda-Bhangara	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	28-08-92	11.50	29-08-92	17.00	100		62	
5	Makanpur	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	28-08-92	15.30	29-08-92	17.00	100		52	
6	Durlung Deurali	Durlung/ Parbat	Source	Panchase Muhaan	Spring	09-09-92	14.45	10-09-92	15.00	100	302	200	
7	Durlung Deurali	Durlung/ Parbat	Source	Chinar Mul	Spring	09-09-92	16.15	10-09-92	15.00	100	270	170	
8	Khurkot Lampata	Khurkot/ Parbat	Source	Halhaleko Phedi	Stream	09-09-92	18.00	10-09-92	15.00	100	462	396	
9	Khurkot Subedithar	Khurkot/ Parbat	Source	Jukepani Mul	Spring	10-09-92	9.30	11-09-92	7.30	100	TNTC	192	
10	Pakuwa Mandanda (system II)	Pakuwa/ Parbat	Source	Maruwa Mul	Spring	11-09-92	12.00	12-09-92	18.00	100	TNTC	450	
11	Pakuwa Mandanda (system I)	Pakuwa/ Parbat	Source	Mathe Khola	Stream	11-09-92	14.00	12-09-92	18.00	100	TNTC	364	
12	Pakuwa Mandanda (system III)	Pakuwa/ Parbat	Source	Bivadeko Khola	Stream	11-09-92	15.30	12-09-92	18.00	100	TNTC	412	
13	Bharat Pokhari	Bharat Pokhari/ Kaski	Source	Tinghare Mul	Spring	23-09-92	16.15	24-09-92	17.30	100	321	151	
14	Kotre - Juwadi	Dulegaunda/ Tanahu	Source	Bhutte-Chhahara	Stream	24-09-92	16.30	25-09-92	18.00	100	TNTC	940	
15	Eklekhet-Majuwa	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	25-09-92	9.45	26-09-92	16.30	100	TNTC	142	
16	Tarkudanda-Bhangara	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	25-09-92	11.30	26-09-92	16.30	100	TDTC	418	
17	Makanpur	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	25-09-92	15.30	26-09-92	16.30	100	202	127	

Water Quality Analysis, CWSSP/HELVETAS, Pokhara: BACTERIOLOGICAL TEST - RESULTS

Test No.	Name of Project	Name of V.D.C./ District	Sample Site	Name of Water Source	Type of Source	SAMPLING Date	SAMPLING Time	ANALYSIS Date	ANALYSIS Time	Sample Volume (mL)	BACTERIAL COUNT / 100 mL Total Count	Total Coliform	Fecal Coliform
18	Bhakunde (Old project)	Bhakunde/ Baglung	Source	Saure Muhaan	Stream	24-11-92	16.30	25-11-92	17.30	100		0	Test failed
19	Bhakunde (New project)	Bhakunde/ Baglung	Source	Dharapani Mul	Spring	25-11-92	9.00	26-11-92	16.00	100		111	Test failed
20	Bhakunde (New project)	Bhakunde/ Baglung	Source	Rakse Mul + Khalleko Mul	Spring	25-11-92	10.15	26-11-92	16.00	100		96	Test failed
21	Bhakunde (Old project)	Bhakunde/ Baglung	Source	Rakse Muhaan	Stream	25-11-92	11.15	26-11-92	16.00	100		126	Test failed
22	Bhakunde (Old project)	Bhakunde/ Baglung	Source	Inara Mul	Spring	25-11-92	14.15	26-11-92	16.00	100		36	Test failed
23	Bhakunde (Old project)	Bhakunde/ Baglung	Source	Patle Mul	Spring	25-11-92	15.50	26-11-92	16.00	100		46	Test failed
24	Bhakunde (Control source)	Bhakunde/ Baglung	Source	Pairekholako Pandhero	Spring	25-11-92	17.00	26-11-92	16.00	100		TDTC	Test failed
25	Khurkot Lampata	Khurkot/ Parbat	Source	Halhaleko Phedi	Stream	27-02-93	13.00	28-02-93	14.45	100	-	10	0
26	Khurkot Subedithar	Khurkot/ Parbat	Source	Jukepani Mul	Spring	27-02-93	16.30	28-02-93	14.45	100	-	80	2
27	Pakuwa Mandanda (system I)	Pakuwa/ Parbat	Source	Mathe Khola	Stream	01-03-93	14.00	02-03-93	17.00	100	-	11	0
28	Pakuwa Mandanda (system II)	Pakuwa/ Parbat	Source	Maruwa Mul	Spring	01-03-93	14.30	02-03-93	17.00	100	-	65	2
29	Pakuwa Mandanda (system III)	Pakuwa/ Parbat	Source	Bivadeko Khola	Stream	01-03-93	12.45	02-03-93	17.00	100	-	25	0
30	Pakuwa Mandanda (system IV)	Pakuwa/ Parbat	Source	Biyadeko Khola	Stream	01-03-93	12.00	02-03-93	17.00	100	-	35	0
31	Bharat Pokhari	Bharat Pokhari/ Kaski	Source	Tinghare Mul	Spring	11-05-93	13.00	12-05-93	17.30	100		232	152
32	Kotre - Juwadi	Dulegaunda/ Tanahu	Source	Bhutte-Chhahara	Stream	11-05-93	17.15	12-05-93	17.30	100		280	190
33	Eklekhet-Majuwa	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	12-05-93	9.15	13-05-93	12.30	100		120	70
34	Tarkudanda-Bhangara	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	12-05-93	10.30	13-05-93	12.30	100		110	50

Water Quality Analysis. CWSSP/HELVETAS. Pokhara: BACTERIOLOGICAL TEST - RESULTS

Test No.	Name of Project	Name of V.D.C./ District	Sample Site	Name of Water Source	Type of Source	SAMPLING Date	SAMPLING Time	ANALYSIS Date	ANALYSIS Time	Sample Volume (mL)	BACTERIAL COUNT / 100 mL Total Count	Total Coliform	Fecal Coliform
35	Makanpur	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	12-05-93	13.30	13-05-93	12.30	100		80	40
36	Khurkot Lampata	Khurkot/ Parbat	Source	Halhaleko Phedi	Stream	17-06-93	9.30	18-06-93	17.00	100	-	280	52
37	Khurkot Subedithar	Khurkot/ Parbat	Source	Jukepani Mul	Spring	16-06-93	17.15	17-06-93	17.00	100	-	210	40
38	Pakuwa Mandanda (system I)	Pakuwa/ Parbat	Source	Mathe Khola	Stream	18-06-93	12.15	19-06-93	15.00	100	-	95	30
39	Pakuwa Mandanda (system II)	Pakuwa/ Parbat	Source	Maruwa Mul	Spring	18-06-93	10.30	19-06-93	15.00	100	-	254	112
40	Pakuwa Mandanda (system III)	Pakuwa/ Parbat	Source	Biyadeko Khola	Stream	18-06-93	13.30	19-06-93	15.00	100	-	150	89
41	Pakuwa Mandanda (system IV)	Pakuwa/ Parbat	Source	Biyadeko Khola	Stream	18-06-93	14.45	19-06-93	15.00	100	-	120	39
42	Bharat Pokhari	Bharat Pokhari/ Kaski	Source	Tinghare Mul	Spring	15-09-93	14.30	16-09-93	18.00	100	-	422	170
43	Kotre - Juwadi	Dulegaunda/ Tanahu	Source	Bhutte- Chhahara	Stream	16-09-93	9.00	17-09-93	9.00	100	-	96	38
44	Eklekhet-Majuwa	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	16-09-93	13.00	17-09-93	13.00	100	-	258	68
45	Tarkudanda-Bhangara	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	16-09-93	14.45	17-09-93	13.00	100	-	204	60
46	Makanpur	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	16-09-93	17.00	17-09-93	13.00	100	-	132	28
47	Khurkot Lampata	Khurkot/ Parbat	Source	Halhaleko Phedi	Stream	02-10-93	15.15	03-10-93	18.00	100	-	102	15
48	Khurkot Subedithar	Khurkot/ Parbat	Source	Jukepani Mul	Spring	02-10-93	12.15	03-10-93	18.00	100	-	146	26
49	Pakuwa Mandanda (system I)	Pakuwa/ Parbat	Source	Mathe Khola	Stream	03-10-93	12.30	04-10-93	16.00	100	-	112	40
50	Pakuwa Mandanda (system II)	Pakuwa/ Parbat	Source	Maruwa Mul	Spring	03-10-93	15.45	04-10-93	16.00	100	-	176	52
51	Pakuwa Mandanda (system III)	Pakuwa/ Parbat	Source	Biyadeko Khola	Stream	03-10-93	13.30	04-10-93	16.00	100	-	204	74

Water Quality Analysis, CWSSP/HELVETAS, Pokhara: BACTERIOLOGICAL TEST - RESULTS

Test No.	Name of Project	Name of V.D.C./ District	Sample Site	Name of Water Source	Type of Source	SAMPLING Date	SAMPLING Time	ANALYSIS Date	ANALYSIS Time	Sample Volume (mL)	BACTERIAL COUNT / 100 mL Total Count	Total Coliform	Fecal Coliform
52	Pakuwa Mandanda (system IV)	Pakuwa/ Parbat	Source	Biyadeko Khola	Stream	03-10-93	14.15	04-10-93	16.00	100	-	94	30

Note: TNTC = Too Numerous To Count TDTC = Too Dirty To Count

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Water Quality Analysis, CWSSP/HELVETAS, Pokhara: PHYSICO-CHEMICAL TEST - RESULTS

Test No.	Name of Project	Name of V.D.C./ District	Sample Site	Name of Water Source	Type of Source	ANALYSIS Date	Time	HARDNESS as CaCO3 mg/L Total	Ca	Mg	pH	T o C	NO3 mg/L	NO2 mg/L	Iron mg/L
1	Bharat Pokhari	Bharat Pokhari/ Kaski	Source	Tinghare Mul	Spring	25-08-92	17.00	12.1	4.4	7.7	6.7	24.0	17.6	0.07	0.04
2	Kotre - Juwadi	Dulegaunda/ Tanahu	Source	Bhutte-Chhahara	Stream	27-08-92	13.30	9.3	4.3	5.0	7.2	25.5	17.6	0.07	0.04
3	Eklekhet-Majuwa	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	28-08-92	9.15	9.5	4.7	4.8	7.2	21.0	17.6	0.03	0.08
4	Tarkudanda-Bhangara	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	28-08-92	11.00	8.9	4.0	4.9	7.2	21.0	17.6	0.03	0.04
5	Makanpur	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	28-08-92	14.45	7.9	3.6	4.3	7.0	20.0	13.2	0.03	0.04
6	Durlung Deurali	Durlung/ Parbat	Source	Panchase Muhaan	Spring	09-09-92	14.00	4.1	2.5	1.6	6.6	19.0	22.0	0.03	0.06
7	Durlung Deurali	Durlung/ Parbat	Source	Chinar Mul	Spring	09-09-92	15.45	3.4	1.9	1.5	7.0	18.0	17.6	0.09	0.06
8	Khurkot Lampata	Khurkot/ Parbat	Source	Halhaleko Phedi	Stream	09-09-92	17.30	4.5	2.0	2.5	7.1	20.0	17.6	0.07	0.06
9	Khurkot Subedithar	Khurkot/ Parbat	Source	Jukepani Mul	Spring	10-09-92	8.30	11.5	7.0	4.5	7.1	22.0	17.6	0.07	0.04
10	Pakuwa Mandanda (system II)	Pakuwa/ Parbat	Source	Maruwa Mul	Spring	11-09-92	11.15	32.2	17.0	15.2	7.6	27.0	17.6	0.07	0.10
11	Pakuwa Mandanda (system I)	Pakuwa/ Parbat	Source	Mathe Khola	Stream	11-09-92	13.15	10.2	6.2	4.0	7.3	21.5	17.6	0.07	0.06
12	Pakuwa Mandanda (system III)	Pakuwa/ Parbat	Source	Biyadeko Khola	Stream	11-09-92	14.45	14.5	9.5	5.0	7.3	23.0	17.6	0.03	0.08
13	Bharat Pokhari	Bharat Pokhari/ Kaski	Source	Tinghare Mul	Spring	23-09-92	15.30	12.9	4.2	8.7	6.6	24.0	17.6	0.03	0.04
14	Kotre - Juwadi	Dulegaunda/ Tanahu	Source	Bhutte-Chhahara	Stream	24-09-92	15.30	10.7	4.5	6.2	7.1	25.5	17.6	0.07	0.06
15	Eklekhet-Majuwa	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	25-09-92	9.00	14.9	6.5	8.4	7.3	20.0	17.6	0.07	0.06
16	Tarkudanda-Bhangara	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	25-09-92	10.45	14.9	6.0	8.9	7.1	20.0	13.2	0.03	0.08
17	Makanpur	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	25-09-92	14.45	9.0	2.0	7.0	6.8	19.5	17.6	0.03	0.06

Water Quality Analysis, CWSSP/HELVETAS, Pokhara: PHYSICO-CHEMICAL TEST - RESULTS

Test No.	Name of Project	Name of V.D.C./ District	Sample Site	Name of Water Source	Type of Source	ANALYSIS		HARDNESS as CaCO3 mg/L			pH	T o C	NO3 mg/L	NO2 mg/L	Iron mg/L
						Date	Time	Total	Ca	Mg					
18	Bhakunde (Old project)	Bhakunde/ Baglung	Source	Saure Muhaan	Stream	24-11-92	16.00	< 1.0	-	-	6.8	8.0	17.6	0.03	0.06
19	Bhakunde (New project)	Bhakunde/ Baglung	Source	Dharapani Mul	Spring	25-11-92	8.30	8.0	2.0	6.0	7.0	15.0	17.6	0.07	0.04
20	Bhakunde (New project)	Bhakunde/ Baglung	Source	Rakse Mul + Khalleko Mul	Spring	25-11-92	9.45	< 1.0	-	-	7.0	12.0	17.6	0.03	0.08
21	Bhakunde (Old project)	Bhakunde/ Baglung	Source	Rakse Muhaan	Stream	25-11-92	10.40	2.0	< 1.0	-	7.0	12.0	17.6	0.07	0.10
22	Bhakunde (Old project)	Bhakunde/ Baglung	Source	Inara Mul	Spring	25-11-92	13.30	1.0	-	-	6.9	17.0	17.6	0.07	0.06
23	Bhakunde (Old project)	Bhakunde/ Baglung	Source	Patle Mul	Spring	25-11-92	15.15	2.0	-	-	6.6	16.0	17.6	0.07	0.06
24	Bhakunde (Control source)	Bhakunde/ Baglung	Source	Pairekholako Pandhero	Spring	25-11-92	16.30	1.0	-	-	6.3	15.0	17.6	0.07	0.06
25	Khurkot Lampata	Khurkot/ Parbat	Source	Halhaleko Phedi	Stream	27-02-93	12.10	4.8	2.5	2.3	6.7	16.0	17.6	0.07	0.06
26	Khurkot Subedithar	Khurkot/ Parbat	Source	Jukepani Mul	Spring	27-02-93	15.30	13.6	6.0	7.6	6.9	19.5	17.6	0.03	0.04
27	Pakuwa Mandanda (system I)	Pakuwa/ Parbat	Source	Mathe Khola	Stream	01-03-93	13.15	16.4	8.2	8.2	7.3	12.0	17.6	0.03	0.02
28	Pakuwa Mandanda (system II)	Pakuwa/ Parbat	Source	Maruwa Mul	Spring	01-03-93	14.45	38.0	36.0	2.0	6.9	19.0	22.0	0.10	0.06
29	Pakuwa Mandanda (system III)	Pakuwa/ Parbat	Source	Biyadeko Khola	Stream	01-03-93	12.15	13.0	11.0	2.0	7.3	13.0	13.2	0.03	0.04
30	Pakuwa Mandanda (system IV)	Pakuwa/ Parbat	Source	Biyadeko Khola	Stream	01-03-93	11.30	47.8	27.0	20.8	7.6	13.0	13.2	0.03	0.02
31	Bharat Pokhari	Bharat Pokhari/ Kaski	Source	Tinghare Mul	Spring	11-05-93	12.30	12.5	3.3	9.2	7.1	23.5	22.0	0.03	0.03
32	Kotre - Juwadi	Dulegaunda/ Tanahu	Source	Bhutte-Chhahara	Stream	11-05-93	16.30	16.7	8.0	8.7	7.3	22.0	17.6	0.07	0.06
33	Eklekhet-Majuwa	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	12-05-93	8.30	17.5	8.0	9.5	7.4	18.0	13.2	0.03	0.06
34	Tarkudanda-Bhangara	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	12-05-93	9.50	17.5	8.0	9.5	7.1	18.0	13.2	0.03	0.06

Water Quality Analysis. CWSSP/HELVETAS. Pokhara: PHYSICO-CHEMICAL TEST - RESULTS

Test No.	Name of Project	Name of V.D.C./ District	Sample Site	Name of Water Source	Type of Source	ANALYSIS Date	Time	HARDNESS as CaCO3 mg/L Total	Ca	Mg	pH	T o C	NO3 mg/L	NO2 mg/L	Iron mg/L
35	Makanpur	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	12-05-93	12.45	15.5	6.8	8.7	7.1	18.0	13.2	0.03	0.06
36	Khurkot Lampata	Khurkot/ Parbat	Source	Halhaleko Phedi	Stream	17-06-93	8.45	5.3	-	-	7.0	19.0	17.6	0.07	0.04
37	Khurkot Subedithar	Khurkot/ Parbat	Source	Jukepani Mul	Spring	16-06-93	16.30	17.6	-	-	7.0	21.0	17.6	0.09	0.06
38	Pakuwa Mandanda (system I)	Pakuwa/ Parbat	Source	Mathe Khola	Stream	18-06-93	11.45	13.2	-	-	7.2	21.0	17.6	0.03	0.04
39	Pakuwa Mandanda (system II)	Pakuwa/ Parbat	Source	Maruwa Mul	Spring	18-06-93	10.00	82.0	-	-	6.9	22.0	22.0	0.03	0.10
40	Pakuwa Mandanda (system III)	Pakuwa/ Parbat	Source	Biyadeko Khola	Stream	18-06-93	13.00	17.0	-	-	7.2	23.0	13.2	0.07	0.12
41	Pakuwa Mandanda (system IV)	Pakuwa/ Parbat	Source	Biyadeko Khola	Stream	18-06-93	13.45	16.5	-	-	7.3	21.0	22.0	0.07	0.08
42	Bharat Pokhari	Bharat Pokhari/ Kaski	Source	Tinghare Mul	Spring	15-09-93	13.45	11.6	-	-	6.2	23.0	26.4	0.03	0.02
43	Kotre - Juwadi	Dulegaunda/ Tanahu	Source	Bhutte- Chhahara	Stream	16-09-93	8.00	9.0	-	-	7.0	22.5	22.0	0.03	0.08
44	Eklekhet-Majuwa	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	16-09-93	12.30	14.2	-	-	6.8	20.0	22.0	0.03	0.02
45	Tarkudanda-Bhangara	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	16-09-93	14.00	10.5	-	-	6.8	20.0	22.0	0.03	0.08
46	Makanpur	Dulegaunda/ Tanahu	Source	Bhirpani (Thulokhola)	Stream	16-09-93	16.30	8.4	-	-	6.7	20.0	22.0	0.03	0.08
47	Khurkot Lampata	Khurkot/ Parbat	Source	Halhaleko Phedi	Stream	02-10-93	14.30	3.9	-	-	7.1	20.0	26.4	0.03	0.02
48	Khurkot Subedithar	Khurkot/ Parbat	Source	Jukepani Mul	Spring	02-10-93	11.30	9.6	-	-	7.2	23.0	26.4	0.07	0.02
49	Pakuwa Mandanda (system I)	Pakuwa/ Parbat	Source	Mathe Khola	Stream	03-10-93	11.45	11.2	-	-	7.1	20.0	26.4	0.07	0.06
50	Pakuwa Mandanda (system II)	Pakuwa/ Parbat	Source	Maruwa Mul	Spring	03-10-93	15.30	2.0	-	-	6.7	24.0	26.4	0.10	0.06
51	Pakuwa Mandanda (system III)	Pakuwa/ Parbat	Source	Biyadeko Khola	Stream	03-10-93	13.15	13.7	-	-	7.3	21.5	26.4	0.07	0.08

Water Quality Analysis. CWSSP/HELVETAS. Pokhara: PHYSICO-CHEMICAL TEST - RESULTS

Test No.	Name of Project	Name of V.D.C./ District	Sample Site	Name of Water Source	Type of Source	ANALYSIS		HARDNESS as CaCO3 mg/L			pH	T o C	NO3 mg/L	NO2 mg/L	Iron mg/L
						Date	Time	Total	Ca	Mg					
52	Pakuwa Mandanda (system IV)	Pakuwa/ Parbat	Source	Biyadeko Khola	Stream	03-10-93	13.45	11.0	-	-	7.3	22.5	22.0	0.07	0.06

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