社会開発調査部報告書

JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)

FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

MINISTRY OF WATER RESOURCES

No. 11

THE STUDY ON ELEVEN CENTERS WATER SUPPLY AND SANITATION IN FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

APPENDIXES DEJEN

(Volume III-XI)

FEBRUARY, 1996

SANYU CONSULTANTS INC.

KYOWA ENGINEERING CONSULTANTS CO., LTD.

GOVERNMENT OF JAPAN
JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)
FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
MINISTRY OF WATER RESOURCES

THE STUDY
ON
ELEVEN CENTERS WATER SUPPLY AND SANITATION
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APPENDIXES
DEJEN

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PREFACE

This is the Appendixes for Dejen presenting the results of the Study on Eleven Centers Water Supply and Sanitation (the Study) carried out in accordance with the Scope of Work agreed upon between the Government of Federal Democratic Republic of Ethiopia (GOE) through the Water Supply and Sewerage Agency (WSSA) of the Ministry of Natural Resources Development and Environmental Protection (MNRDEP), which was recently reorganized Water Supply and Sewerage Service Department (WSSD) under Ministry of Water Resources (MWR), on the one part and the Government of Japan (GOJ) through the Japan International Cooperation Agency (JICA) on the other part dated April 8, 1994.

The major objectives of this Study are 1) to conduct a feasibility study on the water supply system in order to improve living condition of the population in the Study area by enhancing the level of the water supply services in terms of water quantity, water quality and its accessibility, 2) to formulate a plan for sanitary education and the diffusion of sanitary facilities in order to raise peoples' awareness on hygiene and improve environmental sanitation, which will be able to prevent the contamination of water source(s) and to secure safe water supply, and 3) to transfer technologies to the Ethiopian counterpart personnel in order to strengthen the managerial aspects of water supply services.

The Study had been conducted over a two (2) Japanese fiscal year-period from 1994/95 to 1995/96 and divided into two (2) phases. The Phase I study was conducted between December 1994 and March 1995, and Phase II was conducted between May 1995 and February 1996, for a total study period of 15 months during which three (3) times of visit to Ethiopia were made.

The survey items and major activities are meteo-hydrological survey, geo-electric prospecting (GEP) survey, water quality, water use condition, sanitary and health condition and people's awareness, social background, socio-economy, initial environmental examination (IEE), environmental impact assessment (EIA), sanitary education practice, and existing pump investigation.

The Study Team extends heartiest thanks to WSSD especially those assigned counterparts for their close cooperation and hard work in both office and the field, and the officers of related agencies of Japan.

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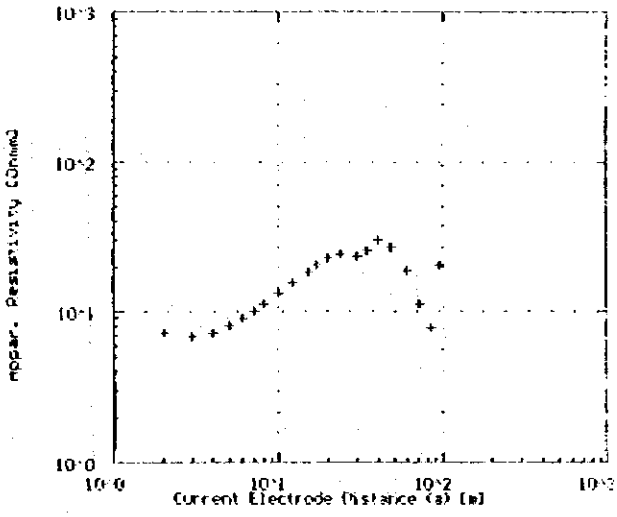
Appendix - 1

Resistivity Interpretation of VEP

Figure 1 Geoelectrical Survey, Wenner Array

VES St. No.1 -DEJEN



Point (No.)	MN/2 (m)	a (m)	Res (ohm)
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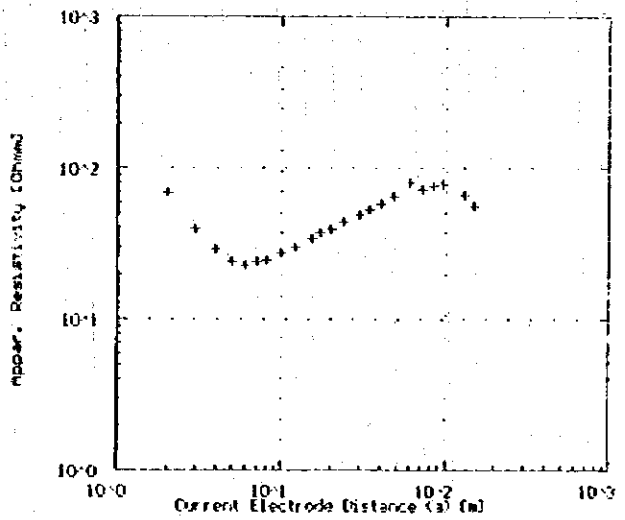
3	3.00	1.[illegible]	
4	4.00	[illegible]	
5	5.00	8.910	
6	6.00	9.910	
7	7.00	9.920	
8	8.00	11.050	
9	10.00	12.250	
10	12.00	15.370	
11	15.00	18.320	
12	17.00	20.200	
13	20.00	22.930	
14	24.00	25.270	
15	30.00	23.550	
16	36.00	25.570	
17	40.00	26.020	
18	45.00	27.120	
19	50.00	18.060	
20	72.00	11.200	
21	84.00	7.810	
22	95.00	20.500	
23	110.00	0.850	

Specific Resistivity(Ω-m)	12.2	6.1	328	50	3.93

VES St. No.2 -DEJEN



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1	1.00	101.110	
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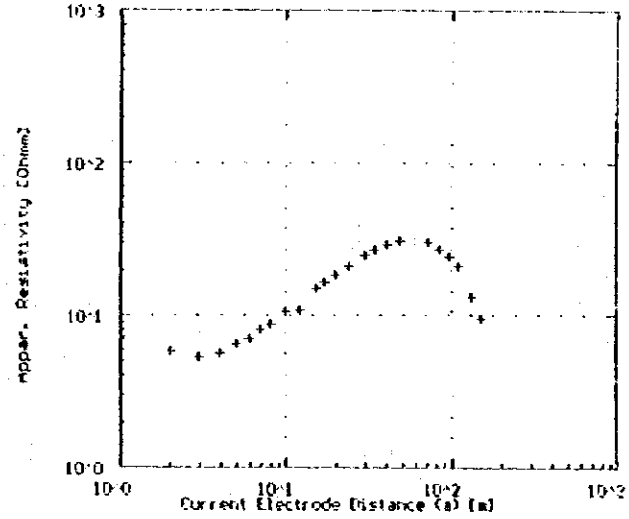
3	3.00	35.100	
4	4.00	29.350	
5	5.00	26.100	
6	6.00	23.570	
7	7.00	26.100	
8	8.00	26.070	
9	10.00	27.630	
10	12.00	30.560	
11	15.00	32.010	
12	17.00	31.310	
13	20.00	30.960	
14	24.00	41.560	
15	30.00	49.550	
16	36.00	52.760	
17	40.00	57.300	
18	45.00	58.510	
19	60.00	85.010	
20	72.00	71.920	
21	84.00	35.960	
22	95.00	28.100	
23	120.00	66.050	
24	150.00	55.590	

Specific Resistivity(Ω-m)	118	19.67	89.2	31.56

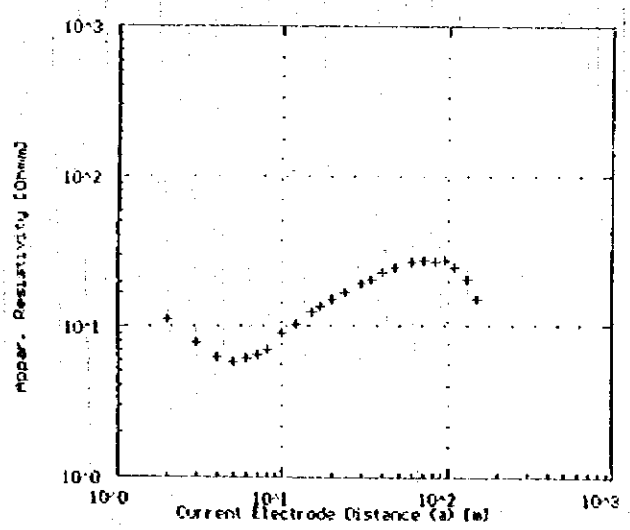
VES St. No.3 -DEJEN



Point (No)	AB/2 (dr)	a (m)	Eas (ohmm)
1	1.00	2.220	
2	2.00	3.290	
3	3.00	5.360	
4	4.00	5.580	
5	5.00	6.660	
6	6.00	7.950	
7	7.00	7.980	
8	8.00	9.210	
9	10.00	10.420	
10	12.00	15.930	
11	15.00	14.960	
12	17.00	15.660	
13	20.00	18.360	
14	24.00	21.990	
15	30.00	24.690	
16	35.00	25.550	
17	40.00	29.290	
18	50.00	31.050	
19	72.00	30.360	
20	94.00	26.900	
21	86.00	24.150	
22	110.00	20.720	
23	130.00	93.000	
24	150.00	9.420	

Specific Resistivity(Ω-m)	10	5	104	77.6	6.38

VES St. No.4 -DEJEN

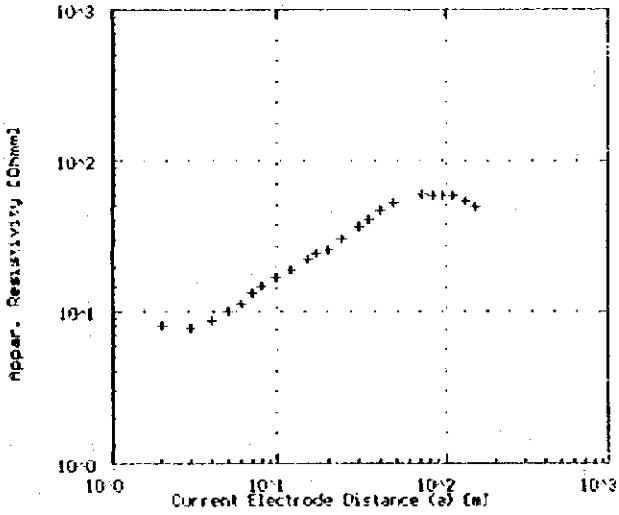


Point (No)	AB/2 (dr)	a (m)	Eas (ohmm)
1	1.00	16.630	
2	2.00	11.300	
3	3.00	3.720	
4	4.00	5.310	
5	5.00	5.830	
6	6.00	6.030	
7	7.00	6.370	
8	9.00	8.990	
9	10.50	8.980	
10	12.00	19.070	
11	15.00	42.360	
12	17.00	13.650	
13	20.00	15.070	
14	24.00	16.390	
15	30.00	18.810	
16	36.00	20.500	
17	40.00	22.010	
18	48.00	25.020	
19	60.00	27.130	
20	72.00	27.550	
21	86.00	26.900	
22	98.00	27.730	
23	110.00	26.520	
24	130.00	20.610	
25	150.00	15.070	

Specific Resistivity(Ω-m)	25	5	51.2	36	10.67

11.4

VES St. No.5 -DEJEN

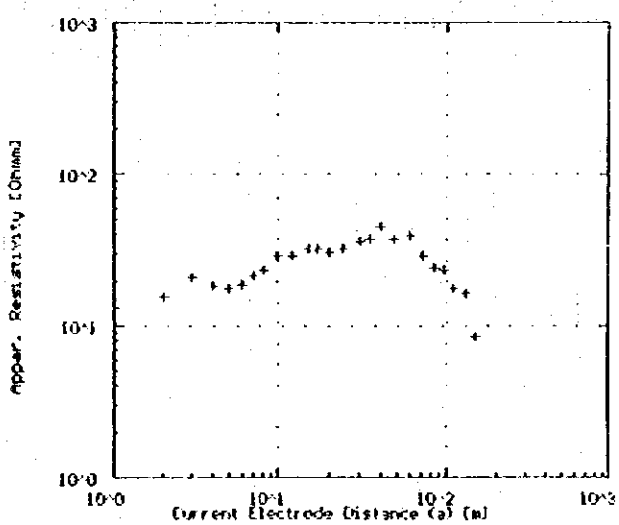


Point (No)	MN/2 (Mr)	a (m)	Per (ohmm)
1	1.00	14.730	
2	2.00	9.050	
3	3.00	7.320	
4	4.00	5.750	
5	5.00	10.050	
6	6.00	11.200	
7	7.00	13.030	
8	8.00	14.720	
9	10.00	17.020	
10	12.00	18.060	
11	15.00	22.030	
12	17.00	22.910	
13	20.00	25.620	
14	25.00	29.930	
15	30.00	36.550	
16	35.00	40.570	
17	40.00	46.070	
18	45.00	52.450	
19	50.00	58.780	
20	55.00	60.550	
21	60.00	58.580	
22	110.00	57.350	
23	120.00	51.090	
24	150.00	60.950	

Specific Resistivity(Ω-m)	21	4.2	54	255	4	38

77.25

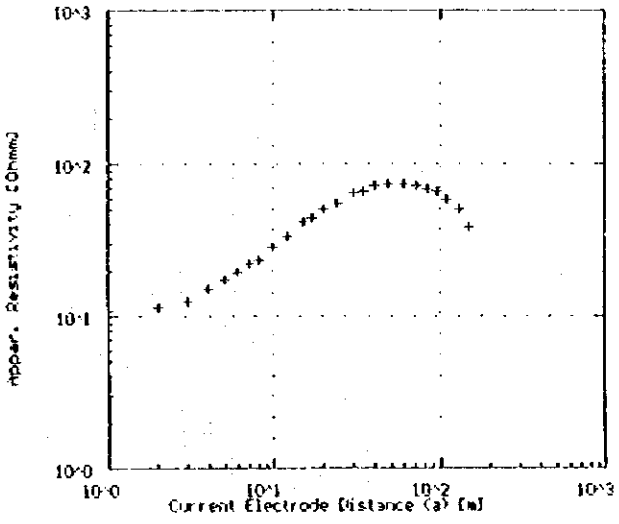
VES St. No.6 -DEJEN



Point (No)	MN/2 (Mr)	a (m)	Per (ohmm)
1	1.00	13.130	
2	2.00	15.700	
3	3.00	21.100	
4	4.00	19.090	
5	5.00	17.590	
6	6.00	19.940	
7	7.00	21.320	
8	8.00	23.510	
9	10.00	28.930	
10	12.00	29.390	
11	15.00	32.590	
12	17.00	32.560	
13	20.00	30.650	
14	24.00	32.190	
15	30.00	35.009	
16	35.00	37.350	
17	40.00	45.220	
18	45.00	37.380	
19	50.00	36.580	
20	72.00	29.850	
21	85.00	24.000	
22	90.00	23.510	
23	110.00	17.950	
24	130.00	15.330	
25	150.00	8.480	

Specific Resistivity(Ω-m)	9.8	19.6	53.4	42.75	9.25

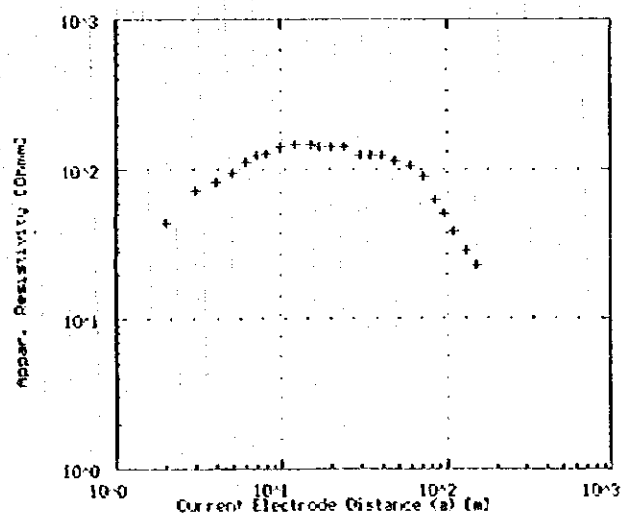
VES St. No.8 -DEJEN



Point (No)	MN/2 (m)	a (m)	Res (ohm)
1	1.00	19.990	
2	2.00	31.370	
3	3.00	42.030	
4	4.00	54.950	
5	5.00	67.270	
6	6.00	79.230	
7	7.00	91.090	
8	8.00	99.610	
9	10.00	120.260	
10	12.00	133.560	
11	15.00	161.650	
12	17.00	183.770	
13	20.00	210.240	
14	24.00	254.260	
15	30.00	306.930	
16	36.00	356.190	
17	40.00	392.850	
18	50.00	476.150	
19	60.00	536.980	
20	72.00	592.380	
21	84.00	654.580	
22	96.00	686.320	
23	110.00	651.660	
24	120.00	580.620	
25	150.00	380.620	

Specific Resistivity(Ω-m)	11	11	165	165	21.5

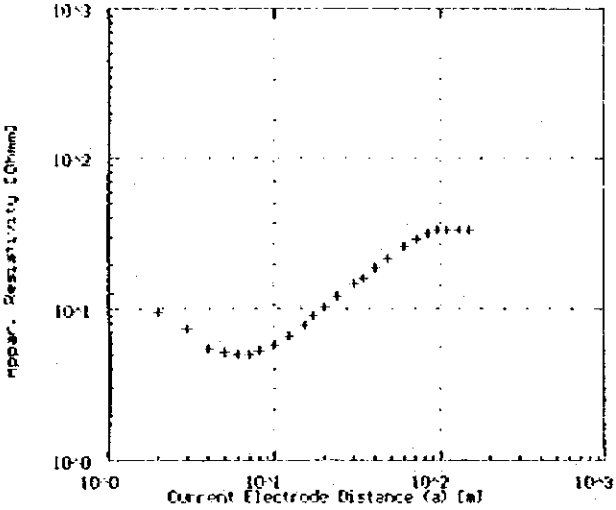
VES St. No.7 -DEJEN



Point (No)	MN/2 (m)	a (m)	Res (ohm)
1	1.00	28.260	
2	2.00	43.960	
3	3.00	71.590	
4	4.00	82.900	
5	5.00	95.770	
6	6.00	133.040	
7	7.00	124.610	
8	8.00	128.110	
9	10.00	169.990	
10	12.00	169.160	
11	15.00	166.950	
12	17.00	169.990	
13	20.00	166.640	
14	24.00	160.920	
15	30.00	134.340	
16	36.00	125.980	
17	40.00	125.600	
18	50.00	116.550	
19	60.00	105.130	
20	72.00	90.430	
21	84.00	83.570	
22	96.00	58.640	
23	110.00	37.990	
24	120.00	28.570	
25	150.00	22.610	

Specific Resistivity(Ω-m)	18	270	28.4	7.2	6.13

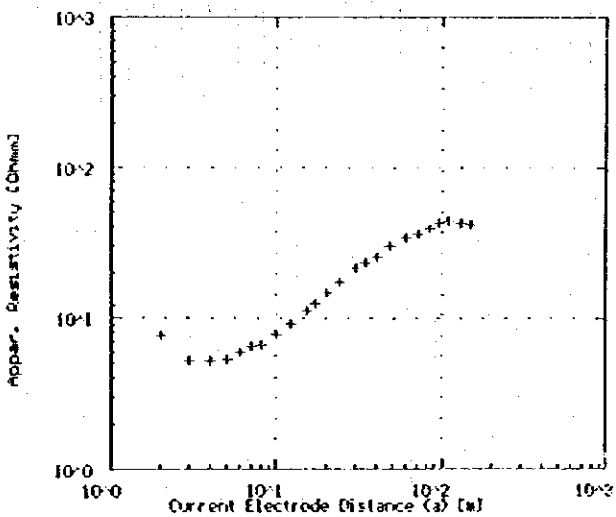
VES St. No.9 -DEJEN



Point (No)	AB/2 (Ar)	a (m)	Res (ohm)
1	1.00	12.910	
2	2.00	9.620	
3	3.00	7.350	
4	4.00	5.510	
5	5.00	5.100	
6	6.00	5.099	
7	7.00	5.010	
8	8.00	5.320	
9	10.00	5.370	
10	12.00	5.710	
11	15.00	7.930	
12	17.00	9.950	
13	20.00	10.870	
14	25.00	11.990	
15	30.00	14.510	
16	35.00	15.120	
17	40.00	18.710	
18	50.00	23.600	
19	60.00	25.930	
20	72.00	28.560	
21	85.00	31.390	
22	95.00	33.150	
23	110.00	33.950	
24	130.00	31.570	
25	150.00	32.970	

Specific Resistivity(Ω-m)	19.6	4.9	64	58

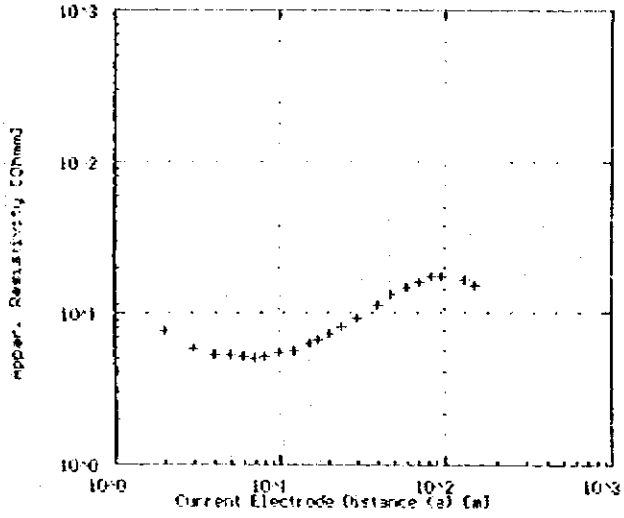
VES St. No.10 -DEJEN



Point (No)	AB/2 (Ar)	a (m)	Res (ohm)
1	1.00	12.250	
2	2.00	7.510	
3	3.00	5.220	
4	4.00	5.200	
5	5.00	5.370	
6	6.00	5.990	
7	7.00	6.370	
8	8.00	6.560	
9	10.00	7.910	
10	12.00	9.310	
11	15.00	11.300	
12	17.00	12.690	
13	20.00	14.570	
14	25.00	17.080	
15	30.00	21.200	
16	34.00	23.690	
17	40.00	25.420	
18	50.00	30.560	
19	60.00	34.290	
20	72.00	36.030	
21	85.00	39.560	
22	95.00	42.200	
23	110.00	43.520	
24	130.00	43.220	
25	150.00	41.850	

Specific Resistivity(Ω-m)	14.2	2.86	12	24	70.2	79.65

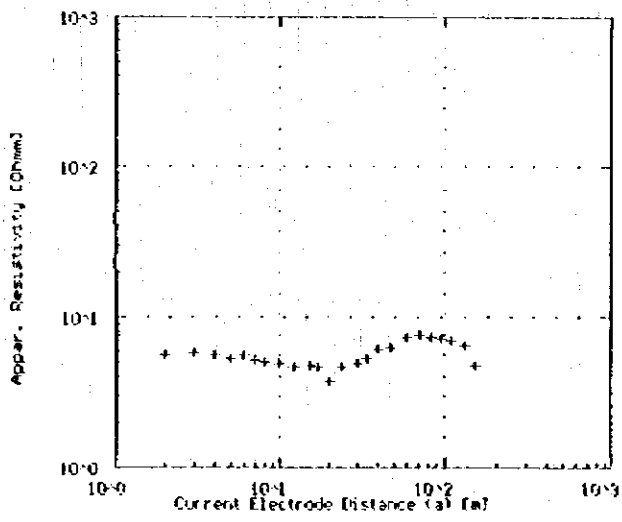
VES St. No.11 -DEJEN



Point [No]	AB/2 [Mr]	a [m]	Rs [ohm]
1	1.00	11.670	
2	2.00	7.669	
3	3.00	5.850	
4	4.00	5.390	
5	5.00	5.290	
6	6.00	5.249	
7	7.00	5.190	
8	8.00	5.230	
9	10.00	5.490	
10	12.00	5.650	
11	15.00	6.220	
12	17.00	6.620	
13	20.00	7.160	
14	25.00	8.160	
15	30.00	9.330	
16	40.00	11.390	
17	50.00	13.250	
18	60.00	14.700	
19	72.00	15.830	
20	84.00	17.410	
21	96.00	17.450	
22	110.00	16.330	
23	150.00	15.070	

Specific Resistivity(Ω-m)	20	5	31.2	25.73

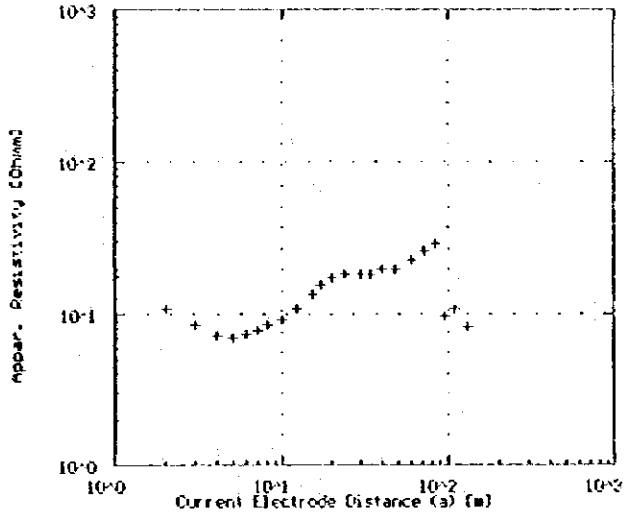
VES St. No.12 -DEJEN



Point [No]	AB/2 [Mr]	a [m]	Rs [ohm]
1	1.00	7.570	
2	2.00	5.599	
3	3.00	5.250	
4	4.00	5.629	
5	5.00	5.370	
6	6.00	5.650	
7	7.00	5.150	
8	8.00	5.650	
9	10.00	6.000	
10	12.00	6.000	
11	15.00	6.210	
12	17.00	6.200	
13	20.00	3.220	
14	25.00	6.670	
15	30.00	6.900	
16	36.00	5.350	
17	40.00	6.030	
18	50.00	6.320	
19	60.00	7.350	
20	72.00	7.650	
21	84.00	7.330	
22	96.00	7.260	
23	110.00	8.910	
24	130.00	6.520	
25	150.00	6.210	

Specific Resistivity(Ω-m)	8	5.33	3.7	4.65	13.95	4.08

VES St. No.13 -DEJEN



Point (No)	AB/2 [m]	a [m]	Res [ohm-m]
1	1.00	17.860	
2	2.00	10.930	
3	3.00	8.350	
4	4.00	7.130	
5	5.00	6.360	
6	6.00	7.360	
7	7.00	7.210	
8	8.00	8.440	
9	10.00	9.230	
10	12.00	10.090	
11	15.00	13.870	
12	17.00	15.590	
13	20.00	17.480	
14	25.00	13.090	
15	30.00	18.460	
16	35.00	18.360	
17	40.00	19.050	
18	45.00	19.590	
19	50.00	22.610	
20	72.00	26.270	
21	81.00	29.010	
22	95.00	9.650	
23	110.00	16.710	
24	130.00	8.160	

Specific Resistivity(Ω-m)	23.8	5.95	13.6	58.8	29.8		47.5

29.6

Appendix - 2

Result of Water Quality Test

Result of Physico-Chemical Analysis in Dejen

Sample No.1

Origin of Sample : Borehole No.1 (WSS)
Date of Collection: 19/Jan./95
Date of Analysis : 08/Feb./95

Physical Characteristics

Appearance	: Very Clear
Odor	: Odorless
Taste	: -
Color	: Nil
Settleable Solids	: Absent
Floating Solids	: Absent
Suspended Solids	: Absent
Total Dissolved Solids	: 160
Turbidity	: Nil
Temperature	: -
Conductivity	: 0.34 ms/cm

General Chemical Characteristics

Total Hardness as $CaCO_3$	: 170
Carbonate Hardness as $CaCO_3$	: 170
Non Carbonate Hardness as $CaCO_3$	: Nil
Total Alkalinity as $CaCO_3$	: 190
Bicarbonate Alkalinity as $CaCO_3$	: 190
Carbonate Alkalinity as $CaCO_3$	: Nil
PH	: 8.00
Silica	: -
Sulphide as Hydrogen Sulphide	: -
Carbondioxide	: -
Residual Chlorine	: -
Dissolved Oxygen	: -

Ionic Contents

Cations		Anions	
NH_4^+	: -	Cl^-	: 2.50
Na^+	: -	NO_2^-	: Nil
K^+	: -	NO_3^-	: 1.50
Ca^{++}	: 76.00	F^-	: 0.76
Mg^{++}	: 14.39	HCO_3^-	: 231.80
Fe(Total)	: 0.01	CO_3^{--}	: Nil
Mn^{++}	: 0.02	SO_4^{--}	: 8.00
Cu^{++}	: 0.15	PO_4^{---}	: 0.32

Remarks; All the analyzed chemical constituents are within the acceptable range in accordance with WHO drinking water quality guidelines.

Note; Unit is mg/litre unless otherwise stated.

Result of Physico-Chemical Analysis in Dejen

Sample No.2

Origin of Sample : Zemeten Borehole (Rural water supply)
Date of Collection: 12/Jul./95
Date of Analysis : 25/Jul./95

Physical Characteristics

Appearance	: Clear
Odor	: Odorless
Taste	: -
Color	: Nil
Settleable Solids	: Absent
Floating Solids	: Absent
Suspended Solids	: Absent
Total Dissolved Solids	: 234
Turbidity	: Nil
Temperature	: 19.1 °C
Conductivity	: 0.39 ms/cm

General Chemical Characteristics

Total Hardness as $CaCO_3$	: 200
Carbonate Hardness as $CaCO_3$	: 200
Non Carbonate Hardness as $CaCO_3$	: Nil
Total Alkalinity as $CaCO_3$	: 200
Bicarbonate Alkalinity as $CaCO_3$	: 200
Carbonate Alkalinity as $CaCO_3$	: Nil
PH	: 8.06
Silica	: -
Sulphide as Hydrogen Sulphide	: -
Carbondioxide	: -
Residual Chlorine	: -
Dissolved Oxygen	: -

Ionic Contents

Cations		Anions	
NH_4^+	: Nil	Cl^-	: 10.00
Na^+	: -	NO_2^-	: 0.02
K^+	: -	NO_3^-	: 5.72
Ca^{++}	: 48.00	F^-	: 0.468
Mg^{++}	: 19.51	HCO_3^-	: 244.00
Fe(Total)	: 0.01	CO_3^{--}	: Nil
Mn^{++}	: Nil	SO_4^{--}	: Nil
Cu^{++}	: 0.02	PO_4^{---}	: 0.96

Remarks; All the analyzed chemical constituents are within the acceptable range in accordance with WHO drinking water quality guidelines.

Note; Unit is mg/litre unless otherwise stated.

Result of Faecal Coliform Test in Dejen, Sampled and Analyzed on July/11,14/'95

No.	Kebele	Source	Place of Sampling	No of F.C. per 100ml	Remarks
1	-	BH1	BH1	0	The source, WT=21°C
2	1	BH1	Reservoir	12	WT=21°C, Capacity=50cum
3	1	BH1	P.Foun.1	1	WT=20.5°C, Directly fr pressure line
4	1	BH1	P.Foun.2	0	WT=20°C, Directly fr pressure line
5	1	BH1	P.Foun.3	4	WT=22°C, Supplied through reservoir
6	2	BH1	P.Foun.4	0	WT=18.5°C, Supplied through reservoir
7	2	BH1	P.Foun.5	15	WT=22°C, Supplied through reservoir
8	2	BH1	P.Foun.6	18	WT=20°C, Ph=7.4
9	2	BH1	P.Foun.7	7	WT=21°C, Supplied through reservoir
10	1	BH1	P.Conn.	5	WT=20.5°C, Directly fr pressure line
11	1	BH1	P.Conn.	15	WT=19°C, Directly fr pressure line
12	2	BH1	Y.Conn.	14	WT=21°C, Supplied through reservoir
13	2	BH1	Y.Conn.	17	WT=21°C, Supplied through reservoir
14	2	BH1	Y.Conn.	10	WT=21°C, Supplied through reservoir
15	2	BH1	P.Conn.	16	WT=20°C, At Tizale Dejen Hotel
16	2	BH1	P.Conn.	14	WT=20°C, At Muru Hotel, Via reservoir
17	1	BH1	Clay pot	88	WT=18°C, Fetched on the day, Covered
18	1	BH1	Clay pot	13	WT=17°C, Fetched 1 day before, Covered
19	1	BH1	Clay pot	TMTC	WT=13°C, Fetched on the day, Covered
20	1	BH1	Clay pot	TMTC	WT=17°C, Fetched on the day, Covered
21	1	BH1	Clay pot	TMTC	WT=16°C, Fetched 1 day before
22	2	BH1	Clay pot	26	WT=16°C, Fetched 1 day before, Covered
23	2	BH1	Clay pot	9	WT=17°C, Fetched 1 day before, Covered
24	2	BH1	Clay pot	9	WT=18°C, Fetched 1 day before, Covered
25	2	BH1	Clay pot	169	WT=16°C, Fetched 1 day before, Covered
26	2	BH1	Clay pot	14	WT=16°C, Fetched 1 day before, Covered
27	2	BH1	Clay pot	TMTC	WT=16°C, Fetched 1 day before, Covered
28	2	BH1	Clay pot	88	WT=15°C, Fetched 1 day before, Covered
29	2	BH1	Clay pot	42	WT=17°C, Fetched 1 day before, Covered
30	2	BH1	Clay pot	57	WT=16°C, Fetched 1 day before, Covered
31	2	BH1	Clay pot	8	WT=16°C, Fetched 1 day before, Covered
32	2	BH1	Barrel	81	WT=18°C, Plastic Barrel, 1 day before
There is only one water source (BH1) operated by WSS.					

Note; "F.C. means Faecal Coliform.
"BH" means borehole.
"HDW" means hand-dug-well.
"P.Conn." means private connection.
"Y.Conn." means yard connection.
"P.Foun." means public fountain.
"Barrel" means Barrel-container made of steel.
"TMTC" means too many to count.

Appendix - 3

Social and Gender Data

DEJEN - Activity Profile by gender

Spring/Public Fountain/Vendor Users

Activity	Gender			Time	Place
	M	F	Remarks		
Fetches drinking water	n	y	women and girls		
Does the laundry	n	y	mostly females		PF/at home
Waters livestock	y	n			spring
Takes water from container	y	y			
Teaches children hygiene	y	y	whoever is home		
Disposes of solid waste	n	y	few burn, few bury their refuse		
Digs a compost pit	y	n	very few have		
Constructs a latrine	y	n	some richer have		
Digs a drainage channel	y	n	some have		
Tends a kitchen garden	y	n	few have		
Disposes of animal waste	n	y			
Keeps latrine clean	n	y			
Keeps compound clean	n	y			
Takes sick child to clinic	y	y	whoever is home		

Well Owners and Private Connection Users

Activity	Gender			Time	Place
	M	F	Remarks		
Fetches drinking water	n	y	women and girls		
Does the laundry	n	y	women and girls		at home
Waters livestock	y	n	often paid labor		
Takes water from container	y	y			
Teaches children hygiene	y	y	whoever is home		
Disposes of solid waste	n	y	women and girls		
Digs a compost pit	y	n	some burn, some bury their refuse		
Constructs a latrine	y	n	if latrine, built by laborers		
Digs a drainage channel	y	y	few have		
Tends a kitchen garden	y	n	few gardens irrigated		
Disposes of animal waste	n	y			anywhere
Keeps latrine clean	n	y			
Keeps compound clean	n	y	women and girls		
Takes sick child to clinic	y	y	whoever is home		

DEJEN - Daily Schedule

Private Connection Users

Man	Time	Woman
Gets up, washes	5	
Goes to buy meat	6	
Sells meat from shop at home	7	
"	8	Gets up, washes
Eats breakfast	9	Eats breakfast prepared by
Sells meat	10	children and Drinks coffee
"	11	Manages domestic activities
"	12	*and sells soft drinks*
Eats lunch	13	Eats lunch
Sells meat	14	Manages domestic activities and
"	15	*Sells soft drinks*
"	16	"
"	17	"
"	18	"
"	19	Relaxes
Relaxes with family	20	"
"	21	"
Eats supper	22	Eats supper
Goes to sleep	23	Goes to sleep

Man sometimes goes to different towns and buys meat
Animals slaughtered at slaughter house in Dejen
Man has help in shop from children, woman has help from children also
Woman is sick

Public Fountain Users

Man	Time	Woman
	6	
	7	Gets up, washes, prepares breakfast
Gets up, washes, eats breakfast	8	**Fetches water**
Sits/protects home	9	Eats breakfast, goes to market
"	10	*Trades cereals*
"	11	"
"	12	"
"	13	"
"	14	Returns home, prepared lunch
Eats lunch	15	Eats lunch
Sits/protects home	16	Collects wood for domestic use
"	17	Does laundry, cleans home and
"	18	other domestic chores
"	19	"
"	20	Prepares supper
Eats supper	21	Eats supper
Goes to sleep	22	Cleans up, goes to sleep
	23	

Man is mentally ill

DEJEN - Daily Schedule (continued)

Well Users

Man	Time	Woman
	5	Wakes up, washes, makes breakfast
Wakes up, washes, eats breakfast	6	Eat breakfast with family
Drinks coffee	7	Drink coffee with family
Goes to work as daily laborer	8	Domestic activities, including
(Fetches stones and carries them		**Fetching water (five minutes)**
on own donkey)	9	*Sells soap at market*
"	10	"
"	11	"
"	12	"
Returns home, eats lunch	13	Returns home, prepares and eats lunch
Goes to fetch and carry stones	14	Domestic chores
(with own donkey)	15	"
"	16	Spins cotton for household use
"	17	Drinks coffee
Looks after and waters cattle	18	"
"	19	Prepares supper
Eats supper	20	Eats supper
Relaxes	21	Relaxes
Goes to sleep	22	Goes to sleep
	23	

Water for cattle is bought from well vendors during dry season and in wet season the cattle are watered at the river

When piped water supply system is not working in the town, the collection of water takes longer from the well

The children take care of the cattle during the daytime

DEJEN - Access and control profile*

Handdug Well Owners/PC Users

Resources	Access		Control		Comments
	male	female	male	female	
Money for water	y	y	y	y	
Money for soap	y	y	y	y	
Money for water container	y	y	y	y	
Money for water pot cover	y	y	y	y	not bought
Money for drying shelf	y	y	y	y	women/men
Money for building latrine	y	y	y	y	some have
Money for medicine	y	y	y	y	
Tools for digging pits	y	y	y	y	
Tools for constructing latrine	y	y	y	n	varies
Seeds and tools for vegetable gardens	y	y	y	y	
Land for digging pits	y	y	y	y	few bury, few burn
Land for digging latrines	y	y	y	y	most do have
Land for digging drains	y	y	y	y	
Land for vegetable gardens	y	y	y	y	few have but few irrigate
Income from selling water	y	y	y	y	
Income from selling vegetables	y	y	y	y	those with vegetables
Improved health	y	y	y	y	
Reduced time spent collecting water	n	y	n	y	
Reduced time spent caring for sick	y	y	y	y	

Spring/Public Fountain/Vendor Users

Resources	Access		Control		Comments
	male	female	male	female	
Money for water	y	y	y	y	
Money for soap	y	y	y	y	
Money for water container	y	y	y	y	
Money for water pot cover	y	y	y	y	homemade
Money for drying shelf	y	y	y	y	women/men
Money for building latrine	y	y	y	y	not all have
Money for medicine	y	y	y	y	
Tools for digging pits	y	y	n	n	may not own
Tools for constructing latrine	y	y	n	n	"
Seeds and tools for vegetable gardens	y	y	n	n	"
Land for digging pits	y	y	y	y	"
Land for digging latrines	n	n	n	n	some have
Land for digging drains	n	n	n	n	
Land for vegetable gardens	n	n	n	n	some have
Income from selling water	-	-	-	-	
Income from selling vegetables	y	y	y	y	provisional
Improved health	y	y	y	y	
Reduced time spent collecting water	n	y	n	y	
Reduced time spent caring for sick	y	y	y	y	

y = Yes, n = No

*It is likely that the methodology we have used does not disclose this type of data adequately.

All members of the community we spoke with said that money was a shared pot and that purchase of items was a joint decision. The major factor influencing access and control seems to be decided by who is earning money.

DEJEN - Needs Analysis

Well Owners and Private Connection Users

		Gender		Remarks
		M	F	
Practical needs				
Water	Adequate quantities of water from the water supply system each day	y	y	
	Dry season shortages to be rectified	y	y	In dry season piped supply supplemented by other sources
	Keep wells maintained	y	y	Wells are useful contingency supply
Sanitation	Financial assistance to build reasonable latrines	y	y	Some live in rented housing with no land
	Allocation of area for disposal of solid waste	y	y	Nowhere allocated at present and is causing nuisance
	Public latrines for those in Kebele rented housing	y	y	Others use surrounding area for defecation
Strategic needs				
Water	Prefer Government managed water supply system	y	y	
	PFs could be managed by the communities	y	y	
Sanitation	Community toilets to be managed by themselves	y	y	Will need assistance/ enforcement by authorities
	Rubbish disposal facilities to be organized and managed by authorities	y	y	
Health education	Community level health education	y	y	

y = Yes, n = No

DEJEN - Needs Analysis (continued)

Spring/PF/Vendor Users

		Gender		Remarks
		M	F	
Practical needs				
Water	Adequate quantities of water from the water supply system each day	y	y	
	Reduced time spent for water collection especially in dry season	y	y	Reduced queues and reduced distance to water supply facilities
Sanitation	Improved access to latrines. Need for women to have access to latrines even during daylight hours	y	y	Community latrines for those in rented housing and those who can not afford private latrines
	Allocate areas for refuse disposal and provide training and support for the safe disposal of refuse.	y	y	
Health education	Discussion groups for sanitary education required	y	y	
Strategic needs				
Water	Public fountains to be managed by the Government	y	y	One group willing to undertake community management
Sanitation	Public latrines to be managed by the Government	y	y	Only one group felt that community management was an option
	Public showers to be managed by the Authorities	y	y	Only would be used if inexpensive
Health education	Strengthen existing health education with community approach	y	y	

y = Yes, n = No

DEJEN - Social and Gender Considerations

Social/Gender differences	Underlying factors	Impact of the project	Possible measures to be taken
Variation in type and level of water service demanded	Variations in social and economic status	Richer households will not be satisfied without private connections	Improvements to the water system should include both public fountains and private connections
Households with larger incomes have better access to water and sanitation facilities than lower income households	Larger incomes allow people to construct latrines or install PCs	Middle income people will benefit most from any improvements in water supply or sanitation facilities	Discuss and develop ways of ensuring employment or income generation for lower income groups
Poor income groups experience the worst access to existing water and sanitation facilities	Poor people have little disposable income for water or sanitation improvements	Poor people may not benefit from project. Comparably more women headed households are in the low income groups	Income generation activities must be supported through the project particularly for low income households
Many people in favor of community managed communal latrines. Others felt this might be difficult	Enforcement of community member by other members can cause disharmony in a community	Community latrine management may start well but is likely to fail in the middle-long term	Support and training needs to be given to community groups and leaders. Enforcement must also be provided by authorities
Women only defecate under cover of darkness	The need for privacy determines the time that women can defecate	Women may all require latrine facilities at the same time thus putting pressure on resources	Sharing and management of community/public latrines must be facilitated with discussion of all community members
Women fetch water most of the time and women usually do the laundry. Girls sometimes help from any source and some boys help collect from PFs	Water collection and laundry are undertaken mostly by women and girls and less often by young males	Females will benefit most from time and energy savings from having a reliable water supply available near their homes	The project needs to help women identify how to spend any time released through improved water supply

Appendix - 4

Summary of Group Meeting

DEJEN - Summary of group meetings

Group 1 details	Group characteristics	Group needs
General	Amhara, mostly Christians, 8 women, 10 men, Food and alcohol sellers, Market traders, Labourers and Water Carriers	1-Electricity, 2-Water, 3-Improved health care and medicines
Water	PC, PF and PC Vendor Users. The PF works daily form 2-5pm and the PCs work after 6pm. Water supply is inadequate and women supplement supply with water from spring 3 km away where laundry is done. Some fetch water for living.	Would like additional public fountain and longer service time. These should be Government managed, although some assistance could be given with labour for construction and preparation of fence
Sanitation	Most practice open defecation and have no latrines due to lack of land, lack of control over land (Kebele rented houses) and lack of capital for latrines. Market area has large problem of poor sanitation.	Require public latrines because community management of latrines can not work. Prefer to have private latrines for individual households.
Health	Common diseases include pneumonia, diarrhoea and vomiting, especially for children. Not aware of the link between water and sanitation and diarrhoea. Have health education at clinic.	Willing to participate in health education on Sundays after 10am

Group 2 details	Group characteristics	Group needs
General	Amhara, Mostly Christians, 13 women, 7 men, many children, Government workers, Daily labourers and tea/tela sellers	1- Improved roads, 2-Electricity, 3-Water, 4-Sanitation
Water	Public fountain users, supplemented with river water during shortages. PFs open 3 hours daily but sometimes queue is too long to get served (not a matter of opening times but lack of water in system). Women fetch water and do laundry (at river).	Would like additional public fountain for people living away from the road. Would assist with labour for construction and with management. The PF should provide adequate water for the needs of the people.
Sanitation	All practice open defecation, there are no latrines due to lack of affordability and shortage of land. Most people are living in rented housing so do not have control over the land. Solid waste is also openly disposed.	Would like a public latrine to be shared by sex to be managed by the Authorities. Some 20% of people could afford to utilise loans to build private latrines. Need the Authorities to enforce the sanitary use of latrines. Need refuse disposal site.
Health	Common diseases include TB, diarrhoea and flu. Aware that diarrhoea is caused by poor sanitation. Health Education programmes have been attended at the clinic and the school.	Needs for health were not identified.

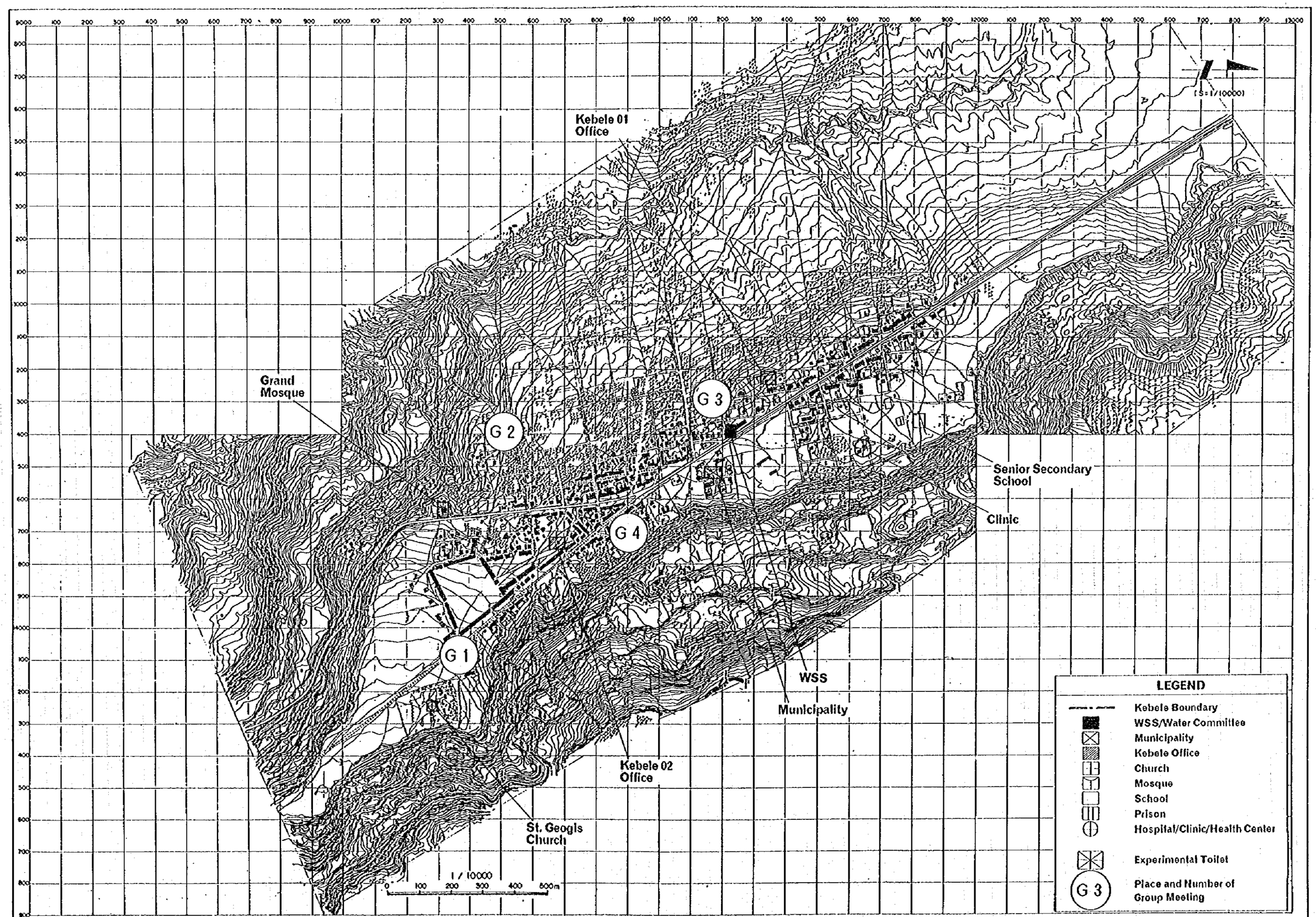
DEJEN - Summary of group meetings (Continued)

Group 3 details	Group characteristics	Group needs
General	Amhara, Mostly Christians, 8 women, 2 men, some children, Government workers, business people and petty traders	1-Electricity, 2-Water, 3-Improved health service
Water	Well and well vendor users(some PC vendor users) PFs are too far away. Well water quality is inadequate and quantity is insufficient in the dry season. Women fetch water for all purposes. PF price is 10 c:2-3 pots, well vendors charge 2-3 Birr/month	Would like additional public fountain in this area. Would assist with labour for construction and would fence it but would like a Government water seller and Government management. Could pay more for a reliable water supply service.
Sanitation	Most people have traditionally built pit latrines and as it is a new settlement, there are no problems as yet. Those who do not have practice open defecation, and do not have latrines due to lack of affordability. No problem with lack of land.	Some interest in loans for private latrines. No demand for public or communal facilities because of the unsanitary condition of the existing public latrines. No demand for refuse disposal facilities.
Health	No problem with common diseases. Aware that well water quality is bad for health. Health education has been received at the health clinic	Interest in extra information about health from health clinic staff (or people with adequate level of knowledge) at a more local level.

Group 4 details	Group characteristics	Group needs
General	Amhara, 6 women, 10 men, some children, Food traders, Petty traders and Crafts people	1-Water, 2-Electricity, 3-Health
Water	Public Fountain and Private Connection Users, but also supplement source with spring water. PF price is expensive for the poor (10c:2-3 pots). Women fetch from public fountain and do laundry at spring.	Some requirement for additional PCs, but most require additional public fountain with longer service time, and would help with labour for construction but require Government management of the PFs
Sanitation	Most practice open field defecation. No latrines because of lack of land and lack of capital for building. Existing public latrine is a problem because there is nobody to look after the cleaning of it (negligence by Municipality)	Community latrines would be an option and people could pay for the water connection and for emptying of these latrines, and could be community managed and maintained. Public latrine could function adequately if the Municipality took adequate care of it.
Health	Common diseases include TB. Aware of the link between open defecation and diarrhoea. Health education received at clinic	Would participate in continuous community level health education programme.

DEJEN - Summary of group meetings (Continued)

Group 5 details	Group characteristics	Group needs
General	Amhara, Mostly Christians, 8 women, 1 man, many children, Shop keepers, Tela sellers, Hotel proprietors and Daily Labourers	1-Electricity, 2-Sanitation improvements, 3-Water
Water	Private Connection Users, but in dry season when the pressure is too low they supplement water from wells, springs and river. PC water used for all purposes including laundry (by women). Price of water is a little too expensive already.	Would like a more reliable water supply service.
Sanitation	Most do not have latrines and use open areas for defecation. Most live in rented houses so have lack control over land and also lack capital for building latrines. Open site infront of houses used by others for urinating/excreting. Poor drainage also.	Would like community latrines to be shared by groups of families, but require land from Kebele. They would be used, cleaned and managed by the community but would need some enforcement by the authorities and responsible management of public latrine
Health	Common diseases include TB, flu and diarrhoea, and have some understanding on the cause of diarrhoea. Health education received at clinic.	Require more health education at community level, but this will not sort out the sanitation problem. That will require some enforcement from the authorities, without which it is better not to have a programme or sanitary facilities.


Kebele 01
Office
Grand
Mosque
G 2
G 3
G 4
G 1
Senior Secondary
School
Clinic
WSS
Municipality
Kebele 02
Office
St. Geogis
Church
1 / 10000
0 100 200 300 400 500m
LEGEND
Kebele Boundary
WSS/Water Committee
Municipality
Kebele Office
Church
Mosque
School
Prison
Hospital/Clinic/Health Center
Experimental Toilet
G 3
Place and Number of
Group Meeting

DEJEN

Appendix - 5

Financial and Socio-Economic Data

Table 1 (1) Summary of Financial Aspects of WSS in Eleven Centers

Item	Dupti	Mille	Bati	Werota	Aykel	Debre Tabor
1. Population	14,737	3,902	14,354	21,845	11,718	25,575
2. Water production & consumption in 1993/1994 (m3)	n.a. 35,565e	n.a. 29,232e	113,523 90,218	58,318 46,104	11,303e 10,173e	11,930 9,773
*Water consumption/ population/day (l)	6.6e	20.5e	17.2	5.8	2.4e	1.0
*Leakage ratio (%)	n.a.	n.a.	20.5	20.9	10.0e	18.1
3. Income & Expenditure in 1993/1994 (birr)	51,267 60,188	48,818 38,182	131,144 132,245	64,648 53,304	50,863e 22,560e	31,337 78,328
*Bill collection rate (%)	85.7	79.1	94.4	99.9	-	67.8
*Income/consumption (birr/m3)	1.44e	1.67e	1.45	1.40	5.00e	3.21
*Expenditure/production (birr/m3)	n.a.	n.a.	1.16	0.91	2.00e	6.57
*Income/Expenditure (%)	85.2	127.9	99.2	121.3	225.5e	40.0
4. No. of personnel, female, temporary/contract	10 1 10	11 5 11	25 5 8	18 4 0	13 4 8	18 5 0
*Production/worker (m3)	n.a.	n.a.	4,541	3,240	3,478e	663
*Income/worker (birr)	5,126	4,438	5,246	3,592	3,913e	1,741
*Expenditure/ worker (birr)	6,019	3,471	5,290	2,961	1,735e	4,352
5. Average monthly salaries (birr)	129	96	204	217	70	173
6. No. of house/ yard connections, public fountains, hydrants	190(70) 8(2) 1	89 8(5) 1	852 12	396 7(6)	- 5(3)	320 13(2)

Notes: 1. e = estimates or assumptions 2. n.a.= not available
3. parenthesized figure = functional

Table 1 (2) Summary of Financial Aspects of WSS in Eleven Centers

Item	Nefas Mewcha	Chagni	Bure	Bichena	Dejen
1. Population	13,726	26,823	14,742	14,629	10,250
2. Water production & consumption in 1993/1994 (m3)	42,216 31,206	74,219 55,045	66,278 55,008	17,810 15,826	46,409 41,201
*Water consumption/ population/day (l)	6.2	5.6	10.2	3.0	11.0
*Leakage ratio (%)	26.1	25.8	17.0	11.1	11.6
3. Income & Expenditure in 1993/1994 (birr)	56,457 79,567	68,590 72,172	66,791 102,309	34,679 71,591	62,089 67,846
*Bill collection rate (%)	91.7	85.8	98.2	96.8	89.0
*Income/consumption (birr/m3)	1.81	1.25	1.21	2.19	1.51
*Expenditure/production (birr/m3)	1.88	0.97	1.54	4.02	1.46
*Income/Expenditure (%)	71.0	95.0	65.3	48.4	91.5
4. No. of personnel, female, temporary/contract	19 5 1	17 6 2	22 7 0	20 6 2	17 3 0
*Production/worker (m3)	2,222	4,366	3,013	891	2,745
*Income/worker (birr)	2,971	4,035	3,035	1,735	3,652
*Expenditure/ worker (birr)	4,188	4,245	4,650	3,580	3,991
5. Average monthly salaries (birr)	153	143	241	170	211
6. No. of house/ yard connections, public fountains, hydrants	383 14(13)	327 12	478 13(12)	238 7	390 7

Notes: 1. e = estimates or assumptions 2. n.a. = not available
3. parenthesized figure = functional

Table 2 (1) Financiat Condition of Water Supply Service in Dejen

1. Oficial Water Price: 1 birr/m3 for all clients

2. Production and Consumption of Water, 1993/94

1) Production : 46,609 m3

2) Consumption: 41,201 m3

* Daily water consumption as divided by total population = 7.1 litre

* Leakage ratio = 11.6%

3. Income and Expenditure

1) Income : 62,088.54 birr

Major sources of income

(1) Water sales (incl. meter rent)	36,249.00 birr	(58.4%)
(2) Cash water sales	11,799.45 birr	(19.0%)
(3) Service charge	7,053.79 birr	(11.4%)
(4) Deposit	4,660.00 birr	(7.5%)

* Bill collection rate = 89.0%

* Income per unit consumption of water = 1.51 birr/m3

2) Expenditure: 67,846.06 birr

Major items of expenditure

(1) Salaries & wages	43,068.73 birr	(63.5%)
(2) Fuel (for generator)	15,026.64 birr	(22.1%)
(3) Office supply	2,524.71 birr	(3.7%)
(4) Water meter	2,003.98 birr	(3.0%)

* Expenditure per unit production of water = 1.46 birr/m3

* Income-expenditure ratio = 91.5%

4. Organization and Personnel

1) No. of personnel: 17 (3)

Table 2 (2) Financial Condition of Water Supply Service in Dejen

(1) Head, WSS	1
(2) Administration 1 head, 5 guards, 1 aid clerk	7
(3) Finance 1 (1) accounting clerk, 1 cashier, 5 (2) water sellers	7 (3)
(4) Urban water supply & sewerage 2 plumbers	2

Note: Parenthesized figure denotes the number of female workers.

* Production per worker = 2,745 m3/year

* Income and expenditure per worker = 3,652 birr, 3,991 birr/year

2) Average monthly salaries of employees: 211 birr

5. No. of Distribution Facilities

1) Yard connections : 390

(1) Household	:	314
(2) Governmental & public	:	17
(3) Commercial	:	59

2) Public fountains : 7 (all functional)

6. Problems and Bottlenecks

1) The office building is rented from an individual.
2) Financial problem.
3) Shortage of manpower: no operator, no bill collector, no meter reader.
4) Shortage of water sources: only one borehole.
5) Limited pipelines. No extension lines.
6) Reservoir is small and not elevated.
7) Shortage of pipes and fittings.
8) Shortage of water meters.
9) No vehicle to transport fuel.

Table 3 (1) Summary of Socio-Economic Aspects of Eleven Centers

Item	Dupti	Mille	Bati	Werota	Aykel	Debre Tabor
I. Administrative Conditions						
1. No. of gov't employees	500e	336	366	322	412	1,674
*No. of gov't employees/1,000 population	34	86	25	15	35	65
2. Average salaries of gov't employees (birr)	311	311	355	308	391	397
II. Population						
1. Population	14,737	3,902	14,354	21,845	11,718	25,575
2. Ethinic composition for top two (%)[Amh.=Amhara, Afa.=Afar, Oro.=Oromo, Tig.=Tigre, Kim.=Kimant, Age.=Agew]	Amh.84 Afa. 6	Amh.69 Oro.14	Amh.49 Oro.28	Amh.97 Tig. 3	Amh.73 Kim.20	Amh.100
3. Religious composition, Christians & Moslems (%)	42 58	43 57	12 88	80 19	81 19	95 5
4. Family size	4.5	4.6	6.2	6.3	5.5	5.7
5. Area (ha)	1,600e	68	260	640	322	1,402
*Population density (persons/ha)	9.2e	57.4	55.2	34.1	36.4	18.2
III. Educational Conditions						
1. No. of pupils/ students	3,182	457	2,500	3,817	3,944	7,950
*No. of pupils/ students per 100 population	22	12	17	17	34	31
2. Literacy ratio (%)	70	62	48	63	80e	74
3. Primary school enrollment ratio (%)	62	53	53	57	85e	75
IV. Medical Conditions						
1. No. of medical personnel	36	4	22	9	18	81

Table 3 (2) Summary of Socio-Economic Aspects of Eleven Centers

Item	Dupti	Mille	Bati	Werota	Aykel	Debre Tabor
*No. of medical personnel per 1,000 population	2.4	1.0	1.5	0.4	1.5	3.2
2. No. of cases for top ten diseases	14,943	1,611	11,642	18,084	13,683	21,318
*Estimated No. of cases per year as percentage of population (%)	30.4	12.4	24.3	24.8	35.0	25.0
3. Under 5 mortality rate (/1000)[n.a.=not available]	213	154	163	95	n.a.	73
4. Life expectancy (years)	47	53	52	61	55e	64
5. Households using septic tank / pit latrine (%)	86	45	68	61	39	65
V. Economic Conditions						
1. No. of commercial/industrial establishments	1,105	204	243	812	450	1,672
[parenthesized figures=No. of hotels/restaurants]	(331)	(162)	(68)	(201)	(115)	(574)
*No. of establishments per 1,000 population	75	52	17	37	38	65
	(22)	(42)	(5)	(9)	(10)	(22)
2. Monthly household income (birr)	334	223	306	262	182	248

Note: e=estimates

Table 3 (3) Summary of Socio-Economic Aspects of Eleven Centers

Item	Nefas Mewcha	Chagni	Bure	Bichena	Dejen
I. Administrative Conditions					
1. No. of gov't employees	541	727	845	499	378
*No. of gov't employees/1,000 population	39	27	57	57	37
2. Average salaries of gov't employees (birr)	297	368	292	374	407
II. Population					
1. Population	13,726	26,823	14,742	14,629	10,250
2. Ethinic composition for top two (%) [Amh.=Amhara, Afa.=Afar, Oro.=Oromo, Tig.=Tigre, Kim.=Kimant, Age.=Agew]	Amh.100	Amh.74 Age.19	Amh.94 Age. 4	Amh.99 Oro. 1	Amh.99 Tig. 1
3. Religious composition, Christians & Moslems (%)	94 6	44 56	92 7	67 33	65 35
4. Family size	5.9	6.1	6.8	6.2	6.8
5. Area (ha)	648	920	1,280	200	280
*Population density (persons/ha)	21.2	29.2	11.5	73.1	36.6
III. Educational Conditions					
1. No. of pupils/students	3,743	5,339	4,388	3,465	2,661
*No. of pupils/students per 100 population	27	20	30	24	26
2. Literacy ratio (%)	70	74	61	69	61
3. Primary school enrollment ratio (%)	59	77	69	68	64
IV. Medical Conditions					
1. No. of medical personnel	43	25	22	27	5

Table 3 (4) Summary of Socio-Economic Aspects of Eleven Centers

Item	Nefas Mewcha	Chagni	Bure	Bichena	Dejen
*No. of medical personnel per 1,000 population	3.1	0.9	1.5	1.8	0.5
2. No. of cases for top ten diseases	22,002	11,782	15,112	7,441	3,790
*Estimated No. of cases per year as percentage of population (%)	48.1	13.2	30.7	15.3	11.1
3. Under 5 mortality rate (/1000)[n.a.=not available]	196	144	131	173	155
4. Life expectancy (years)	49	54	56	52	53
5. Households using septic tank / pit latrine (%)	58	61	58	45	54
V. Economic Conditions					
1. No. of commercial/industrial establishments	860 (209)	546 (91)	246 (65)	414 (47)	345 (74)
[parenthesized figures=No. of hotels/restaurants]					
*No. of establishments per 1,000 population	63 (15)	20 (3)	17 (4)	28 (3)	34 (7)
2. Monthly household income (birr)	202	203	253	324	312

Note: e=estimates

Table 4 (1) Socio-Economic Conditions of Dejen

I. Administrative Conditions

1. Administrative Classification: Region 3, Zone = East Gojjam (?)

2. Government Organizations
1) Agricultural Department
2) Natural Resources Development and Environmental Protection (NRDEP)
3) Weroda Administration
4) Financial Department
5) Educational Office
6) Municipality
7) Health Clinic
8) Health Office
9) Merchandise Wholesale and Import Trade Enterprise
10) Culture and Sports Department
11) Road Transport Authority
12) Police
13) Post Office
14) Telecommunications
15) Weroda Court
16) Weroda Attorney
17) Ethiopian Grain Trade Enterprise
18) Commercial Bank of Ethiopia
19) Freight Transport Authority
20) Adult Education Office
21) Customs Office
22) Water Supply Service (WSS)

Notes: 1. Schools are not included in the above organizations.
2. There is no NGO. There are 6 public organizations.

3. No. of Government Employees and Their Average Monthly Salaries: 378, 407 birr

* No. of government employees per 1,000 population: 37

4. No. of Kebele: 2

II. Socio-Economic Conditions

1. Population
1) Total population: 10,250

2) Ethnic composition: Amhara (99.0%), Tigre (1.0%)

Table 4 (2) Socio-Economic Conditions of Dejen

3) Religious composition: Christians (65.0%), Moslems (35.0%)

4) Average family size: 6.8 persons

2. Area: 280 ha * Population density: 36.6 persons/ha

3. Educational Conditions
1) No. of schools, class rooms, teachers and pupils/students

Items	Kinder-garten	Elementary School	Junior High S.	Senior High S.
(1) No. of schools	2	3	1	1
(2) No. of class rooms	4	50	11	14
(3) No. of teachers	4	64	21	27
(4) No. of pupils/students	126	1,371	454	710

* No. of pupils/students per 100 population: 26

2) Literacy ratio: 60.6% (1984)

3) Primary school enrollment ratio: 63.9% (1984)

4. Medical Conditions
1) No. of medical institutions/establishments:
1 Health Clinic (or Health Station), 1 drug shop

2) No. of medical personnel: 5 health assistants

3) Incidence of diseases (Jul. 1993 - Jun. 1994)

(1) Top ten diseases

i. Pneumonia	876 cases	
ii. Skin infection	474	
iii. Rheumatism	448	
iv. Gastritis	371	
v. Diarrhea	328	
vi. Intestinal parasite	297	
vii. Venereal disease	283	
viii. Acute febrile illness	282	
ix. Malaria	229	i. to x.
x. (Accidents)	202	= 3,790

Table 4 (3) Socio-Economic Conditions of Dejen

(2) Estimated number of cases per year as percentage of population:
(3,790 x 1.5) / (10,250 x 5) = 11.1%

Notes: 1.5 = coefficient to estimate the total number of cases,
5 = coefficient to estimate covered population

4) Under 5 mortality rate: 154.7/1000 (1984)

5) Life expectancy: 53.2 years (1984)

6) Households more or less using septic tank and pit latrine: 54.0%

5. No. of Holy Places: 1 church, 2 mosques

6. Economic Conditions
1) No. of commercial and industrial establishments

Classification	Annual Income (birr)			
	< 1,000	1,000 - 3,000	3,000 <	Total
1. Hotels and restaurants				
Hotels	2	5	1	8
Bars	55	5	0	60
Restaurants	2	0	0	2
Tea rooms	1	0	0	1
Tej houses	3	0	0	3
Sub-total	63	10	1	74
2. Shops	161	62	17	240
3. Cottage industry				
Oil factories	0	0	2	2
Flour mills	0	24	0	24
Tyre repairing	0	2	0	2
Garage	0	0	1	1
Sub-total	0	26	3	29
4. Others	0	1	1	2
Total	224	99	22	345

Table 4 (4) Socio-Economic Conditions of Dejen

Notes: 1. Shops include traders of clothes, thread, textiles, spices and hot sauce, kerosene, leather and skin, leather products, grains, butter & honey, coffee, fruit & vegetables, building materials, salt, drugs, beverages, bakeries, groceries, photo shops, stationeries and sweet factories.

2. Others include filling stations and typing schools.

3. No. of local drink producers: 300 households

* No. of commercial and industrial establishments per 1,000 population: 34

2) Major occupations
(1) Trade (2) Day laborers (3) Government employment

3) Major products: edible oil, flour

4) Market
(1) Major marketable items:
grains, livestock, butter, milk, honey, etc.

(2) Prices of major marketable items

Grains (unit: birr/100 kg)

tef	sorghum	beans	chick peas	lentil	oil seed
220	180	250	190	250	300

Livestock (unit: birr/one)

ox	cow	sheep	goat	donkey	chicken
800	700	150	100	200	10

Table 4 (5) Socio-Economic Conditions of Dejen

Consumers' items (unit: birr)		
butter (kg)	honey (kg)	milk (litre)
40	9	2.25

(3) Market day - Saturday (3,000 people gather on the market day.)

4) Average monthly household income: 311.6 birr

Sources: Water Supply Service, Woroda Council, Financial Bureau, Educational Bureau and Health Center in Dejen; Socio-Economic Sampling Questionnaire Survey by JICA; Central Statistical Office

Appendix - 6

Result of Initial Environmental Examination

Project Description on Initial Environmental Examination in Dejen

Items	Description
Project Title	Eleven Centers Water Supply and Sanitation
Background	1. Insufficient water supply and low per-capita-consumption due mainly to high population growth, aged facilities and poor O&M. 2. Poor sanitation prevailing the Project site which could contaminate the water source(s).
Objectives	To supply domestic water which meets people's demand and to improve sanitary condition.
Location	Dejen, Region-3
Executing Agency	Water Supply and Sewerage Service Department Ministry of Water Resource
Beneficiaries	About 10,300 of the population to be benefited.
Dimensions of the Plan	Rehabilitation of existing facilities, and new boreholes, reservoir and distribution network.
Type of Work	Rehabilitation and new construction work
Purpose	1. To provide domestic water and improve sanitation facilities. 2. To initiate people's awareness on water use and sanitation.
Water Resource	Groundwater
Water Quality	The analyzed water quality is within WHO guideline values.
Main Facilities	Boreholes with pumping system
Water Storage Facilities	Reservoir (ground tank type) with enough capacity
Filtration Plant	Not to be considered.
Related facilities	Distribution pipes, public fountains, drainage system and latrines
Remarks	Chlorine or its derivatives such as mainly calcium hypochlorite is used for disinfection. in Ethiopia.

Site Description on Initial Environmental Examination in Dejen

Items	Description
Project Title	Eleven Centers Water Supply and Sanitation
Social Environment	
Residents (population, tribe, consciousness)	Population about 10,300, majority Amhara with relatively high consciousness.
Facilities related to life (electricity, etc.)	The electricity is generated. The town is lacated along Addis-Bahir Dar trunk road.
Health and Sanitation (diseases, clinic, etc.)	0 hospital, 1 health clinic, 1 drug store Intestine parasites and diarrhea are 2nd and 3rd
Natural Environment	
Topography, Geology and Hydrogeology	Located on right bank side of the Abay Gorge. Alkali-olivine basalt dominates the area.
Meteo-hydrology Groundwater/spring/river	Annual rainfall about 1030mm. Groundwater is expected in fracture zone. No spring, No river.
Endangered fauna and flora	Nil
Public Nuisance	
Nuisances	Water supply condition is relatively good, comparing to other towns. During rainy season, a few stagnant water appear
Regulations and Compensation	Although the land is officially owned by the state, those who lose their dwelling and commercial area because of the project will be given substitute land. Also, Compensation will be made for properties such as houses and trees, which will be damaged.
Remarks	1. The volume of reservoir is not sufficient to meet the demand of the population. And its elevation makes it impossible to cover all places of town. 2. DAP is used as fertilizer and pesticides are used only during pest outbreak. Herbicide is used frequently. 3. Occasional land subsidence has been reported by Dejen locality.

Scoping Format for Initial Environmental Examination in Dejen

Environmental Components	Classi-fication	Description
1.Social Environment		
1.1 Resettlement	B	The facilities are small and expected to give no resettlement.
1.2 Economic Activities	D	The economic activities will be enhanced by the water supply and sanitation improvement.
1.3 Facilities	B	The construction work and the facilities have little impact on existing facilities such as schools and hospitals.
1.4 Collapse of Communities	B	Nil. If a water users committee was organized by the community itself to look after the facilities especially public fountains, the community would be enhanced
1.5 Archaeological and Cultural Heritage	B	Nil
1.6 Vested Rights	C	Compensation shall be given for land and properties if these were affected by the Project. Few vendors partly depend on water selling for their income.
1.7 Public Health and Hygienic Condition	D/C	Sanitary improvement will enhance the condition. Drainage system must be accompanied with the improvement of water supply.
1.8 Waste Disposal	B	During construction works, there will be little waste disposal from the view of the small construction scale. After commissionning, no waste disposal is expected.
1.9 Accidental Damages to Facilities	C	Consideration be paid to the alignment of pipelines in order to avoid public nuisance to dwellers.
2. Natural Environment		
2.1 Geographic and Geological Condition	B	No effect is expected to geographic and geological condition.
2.2 Soil Erosion	C	The earth work gives little soil erosion, judging from the construction scale.

Note) A; Advance Impact, B; Negligible Impact C; Unknown Impact D; Enhancement

to be continued.....

2.3 Surface Water Quality and Quantity	B	Nil
2.4 Groundwater Quality and Quantity	C	Effect of overpumping be considered.
2.5 Hydrological Situation	B	No effect is expected to hydrological situation.
2.6 Terrestrial Fauna	B	Nil
2.7 Aquatic Fauna	B	Nil
2.8 Vegetation	B	Little effect is expected to vegetation.
2.9 Climatic Conditions	B	No effect is expected to climatic conditions.
2.10 Aesthetic Condition	B	The facilities would give little change to the condition judging from the size.
3. Public Nuisance		
3.1 Air Pollution	B	Nil
3.2 Water Pollution	B	Nil
3.3 Soil Pollution	B	Nil
3.4 Noise and Vibration	B	The construction works do not give rise to noticeable noise and vibration.
3.5 Land Subsidence	B	The location of new boreholes is designed away from the dwelling area. The land is composed of basalt lava, giving little expectation of land subsidence.
3.6 Odour	B	Nil
3.7 Traffic Nuisance	C	In case of pipeline being laid across road the traffic will be interrupted.

Note) A; Advance Impact, B; Negligible Impact C; Unknown Impact D; Enhancement

Appendix - 7

Project Cost Break-Down (Water Supply)

Summary of Cost Estimation of Water Supply in Dejen

No.	Description	F.C.(B)	L.C.(B)	Total(B)
I.	Target year of 2005			
1	Civil Work			
	Mobilization and Demobilization	100,000	150,000	250,000
	Excavation and Earth-work	8,240	27,700	35,940
	Trench excavation	388,480	889,130	1,277,610
	Pipe-work	217,500	217,500	435,000
	Reservoir	126,000	126,000	252,000
	Pumping station, R.C.pump house	88,032	58,656	146,688
	Access road	356,000	828,000	1,184,000
	Bore-hole (200mm casing)	72,960	109,440	182,400
	Water purifiction unit	10,000	15,000	25,000
	Booster pump and necessary works	240,000	400,000	640,000
	Electric submersible pump and necessary works	60,000	90,000	150,000
	Power supply	35,850	38,775	74,625
	Concrete work	112,440	195,240	307,680
	Masonsy work	6,000	24,500	30,500
	Structure	101,880	237,720	339,600
	Temporary work(10% of above total)	192,338	340,766	533,104
	Total of civil work	2,115,720	3,748,427	5,864,147
2	Material & Equipment	4,838,346	338,684	5,177,030
	Sub Total	6,954,066	4,087,111	11,041,177
3	Engineering cost(12% of sub tatal)	1,324,941		1,324,941
4	Contingency (5%)	354,350	204,356	558,706
	Total(birr)	8,633,357	4,291,467	12,924,824
	Total(Yen:1birr=15yen)			193,872,000
5	Buildings		758,591	758,591
6	WSSD's management cost		273,668	273,668
	Total		1,032,259	1,032,259
7	Prise escalation(6%)	518,001	319,424	837,425
	Grand Total	9,151,358	5,643,150	14,794,508
II.	Target year of 2010			
1	Morbilization and demorbilization			300,000
2	Rising line			2,529,000
3	Distribution network			540,000
4	New borehole with pumps & material			1,318,000
5	Booster pump with house			534,000
6	Power supply facilities			170,000
7	Chamber and structures			162,000
8	Buildings			562,200
9	Others			378,800
	Sub total			6,494,000
10	Engineering cost (10%)			649,400
11	Contingency (10%)			714,340
	Total			7,858,000
	Prise escalation(42%)			3,300,000
	Grand Total			11,158,000

Cost Estimation of Construction & Materials/Equipment of Dejen : Target year of 2005

No.	Description	Unit	Q'ty	Unit-Rate F.C.(B)	Unit-Rate L.C.(B)	Amount F.C.(B)	Amount L.C.(B)	Remarks
1.	Mobilization and Demobilization	LS				100,000	150,000	
2.	Excavation and Earth-work							
2-1	Clearing and grubbing the site	ha	3	480	2,400	1,440	7,200	to remove bushes, small forest and trees
2-2	Clear off the site	sqm	3,000	1	4	3,000	12,000	to remove top soil to an average depth of 20cm
2-3	Bulk excavation							
	a) Earth excavation	cum	100	6	14	600	1,400	
	b) Excavation of weathered rock	cum	100	10	20	1,000	2,000	
	c) Soft rock excavation	cum	50	14	32	700	1,600	
	d) Sound rock excavation	cum	50	30	70	1,500	3,500	
3.	Trench excavation							
3-1	Trench excavation for water pipe							
	1) Single pipe in trench							
	a) 0.6~1.0m depth	m	13,450	4	8	53,800	107,600	
	b) 1.0~1.5m depth	m	16,100	7	17	112,700	273,700	
	c) 1.5~2.5m depth	m	370	10	23	3,700	8,510	
3-2	Trench, Rock excavation	cum	300	30	70	9,000	21,000	
3-3	Back-fill with the same material	m	15,000	5	11	75,000	165,000	
3-4	Selected soil bedding	m	14,920	2	5	29,840	74,600	150mm thick below barrel
3-5	Back-fill with selected material	m	14,920	7	16	104,440	238,720	compacted in layers not more than 20cm thick
4.	Pipe-work							
4-1	Presure pipe NP 10							with push-in flexible joints
	1) PVC pipe							
	a) DN 50mm	m	9,940	5	5	49,700	49,700	
	b) DN 75mm	m	2,730	8	8	21,840	21,840	
	c) DN 100mm	m	2,540	10	10	25,400	25,400	
	d) DN 150mm	m	4,110	17	17	69,870	69,870	
4-2	Pressure steal pipe							fitting and supports for bridge and road
	DN 200mm	m	370	137	137	50,690	50,690	
5.	Reservoir							
5-1	Ground level reservoir	m3	140	900	900	126,000	126,000	
6.	Pumping station, R.C.pump house	sqm	48	1,834	1,222	88,032	58,656	with accessaries

Cost Estimation of Construction & Materials/Equipment of Dejen : Target year of 2005

No.	Description	Unit	Q'ty	Unit-Rate F.C.(B)	Unit-Rate L.C.(B)	Amount F.C.(B)	Amount L.C.(B)	Remarks
7.	Access road	m	4,000	89	207	356,000	828,000	3m wide gravel road with draine ditch
8.	Bore-hole							
8-1	New driling	m	178	320	480	56,960	85,440	including, casing, packing and pumping test
8-2	Rehabiritation	set	1	16,000	24,000	16,000	24,000	
9.	Water purifiction unit	No.	1	10,000	15,000	10,000	15,000	
10.	Booster pump	No.	4	60,000	100,000	240,000	400,000	foundation, pump, and motor with accessories
11.	Electric submersible pump (for deep well)	No.	3	20,000	30,000	60,000	90,000	foundation, and pump with accessories
12.	Power supply							
12-1	Generating set	No.	1	5,850	8,775	5,850	8,775	gererater with accessaries
12-2	High tension line	m	2,000	8	7	16,000	14,000	
12-3	Low tension line	m	1,000	6	4	6,000	4,000	
12-4	Trensformer	No.	2	4,000	6,000	8,000	12,000	transformer with accessaries
13.	Concrete work							
13-1	Normal concrete (250kg of cement per cum)	cum	100	250	500	25,000	50,000	including form-work, vibration and curing
13-2	Reinforced concrete (360kg of cement per cum) Water retaining structure	cum	200	275	642	55,000	128,400	including vibration and curing
13-3	Form-work Wall	sqm	120	37	87	4,440	10,440	including all necessary works
13-4	Reinforcement bars; Steel bars	kg	4,000	7	2	28,000	6,400	including cutting, bending and placing
14.	Masonsy work							
14-1	Roughly dressed 40cm thick stone elevation wall	sqm	100	60	245	6,000	24,500	up to 3m height
14-2	Brick work with mortor 25cm thick	sqm		23	92	0	0	
15.	Structure							
15-1	Construction of public fountains	No.	5	1,580	3,680	7,900	18,400	
15-2	Construction of hydrant	No.	10	230	540	2,300	5,400	
15-3	Construction of R.C.C. aeration chamber	No.	6	5,730	13,370	34,380	80,220	
15-4	Construction of R.C.C. valve chamber	No.	10	5,730	13,370	57,300	133,700	
	Sub-Total of Construction work					1,923,382	3,407,661	

No.	Description	Unit	Q'ty	Unit-Rate F.C.(B)	Unit-Rate L.C.(B)	Amount F.C.(B)	Amount L.C.(B)	Remarks
16.	Material & Equipment (Ref.table)							
16-1	CIF Cost at Addis Ababa					4,838,346		
16-2	Inland transportation cost						338,684	CIF cost x 7 %
	Sub-Total of Material & Equipment					4,838,346	338,684	
	Grand Total					6,761,728	3,746,345	
17.	Building							
17-1	Office	sqm	60		1,910		114,600	
17-2	Workshop	sqm	69		1,624		112,056	
17-3	Store	sqm	115		1,337		153,755	
17-4	Resience	sqm	180		2,101		378,180	
	Total						758,591	

Imported Cost (Material & Equipment) of Dejen :Target year of 2005

No.	Description	Unit	Q'ty	Unit Rate (B)	Amount (B)
1.	Pipe material				
	including joint and accessories				
1.1	PVC pipe NP-10				
	a) DN 50mm	m	10,440	15	156,600
	b) DN 75mm	m	2,870	30	86,100
	c) DN 100mm	m	2,800	40	112,000
	d) DN 150mm	m	4,320	80	345,600
1.2	Suspended pressure steel pipe				
	DN 200mm W/O gilt and screw	m	390	288	112,320
1.3	Fitting cost Total cost × 20%				162,524
2	Pumps (Pump with electric motor/accessories)				
2.1	Centrifugal pumps				
	a) Q= 0.8 m3/min H= 15m HP= 3.7kw	set	2	300,000	600,000
	b) Q= 0.46m3/min H= 120m HP= 30 kw	set	2	500,000	1,000,000
2.2	Submersible pumps with accessories				
	a) Q= 0.12m3/min H= 100m HP= 3 kw	set	1	130,000	130,000
	b) Q= 0.3m3/min H= 100m HP= 5.5kw	set	2	171,000	342,000
3	Power Supply(Materials&accessories)				
3.1	Power supply generating set				
	70 KVA	set	1	510,000	510,000
3.2	Tension line				
	a) High tension over head line	m	2,000	50	100,000
	b) Low tension over head line	m	1,000	28	28,000
3.3	Plate-form mounted transformer				
	Supply of transformer wiht acccessories				
	Transformer 60 KVA (H-Type)	set	2	55,300	110,600
4	Valve (Valve with accessories)				
4.1	Sluice valve				
	a) ϕ50	set		1,000	0
	b) ϕ75	set	3	1,300	3,900
	c) ϕ150	set	3	1,700	5,100
	d) ϕ200	set	1	2,200	2,200
4.2	High speed air valve				
	ϕ50	set	6	7,000	42,000
4.3	Check valve				
	150mm	set	1	10,000	10,000
5	Flow meter (Meter with accessories ϕ150)	set	1	60,000	60,000
6	Reservoir equipment	set	2	100,000	200,000
7	Well (Materials with accessories)				
7.1	Casing pipe FRP				
	DN 200	m	114	2,093	238,602
7.2	Screen FRP				
	DN 200	m	64	5,700	364,800
7.3	Riser pipe, stainless DN 65	m	200	180	36,000
8	Water purification unit	set	1	80,000	80,000
	Total				4,838,346

Investment Cost of Target Year 2010 in Dejen

No.	Description	Unit	Q'ty	Unit Rate (B)	Amount (B)
1	Mobilization and demobilization	LS			300,000
2	Rising line	Km	8.43	300,000	2,529,000
3	Distribution network	Km	4	150,000	540,000
4	New borehole with pump & material	Set	2	659,000	1,318,000
6	Booster pump with house	Set	1	534,000	534,000
7	Power supply facilities	Site	1	170,000	170,000
8	Chamber and structures	Set	6	27,000	162,000
9	Buildings	M2	6	93,700	562,200
	Others	LS			378,800
	Sub total				6,494,000
11	Enginering cost (10%)				649,400
12	Contingency (10%)				714,340
	Total				7,857,740

Appendix - 8

Meteorological Data

Table 1 Monthly Precipitation

Station: Dejen

Unit:mm

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1960	--	--	--	--	--	107.0	--	--	--	--	--	--	--
1961	--	--	--	--	--	--	70.0	--	--	--	--	--	--
1962	--	--	--	--	--	--	406.5	293.4	--	--	--	--	--
1963	--	34.2	53.0	146.0	131.0	109.0	--	244.1	50.3	--	--	--	--
1964	--	--	--	--	132.0	116.0	332.7	373.0	--	--	--	--	--
1965	--	--	--	65.3	--	--	197.4	194.6	48.5	84.4	26.0	2.7	--
1966	9.7	26.2	26.9	--	--	--	--	--	84.6	5.0	--	--	--
1967	0.0	0.0	--	23.3	77.1	87.9	195.5	183.5	--	--	--	--	--
1972	--	43.2	29.0	56.1	122.7	76.1	288.7	205.2	190.1	3.7	24.7	0.5	--
1973	0.3	1.9	1.2	55.3	177.6	203.3	260.0	354.4	182.2	162.6	13.5	19.5	1431.8
1974	2.2	0.0	70.1	10.5	177.5	117.5	328.2	196.9	53.4	24.4	17.2	0.0	997.9
1975	6.8	37.5	36.2	29.0	87.9	220.1	365.7	284.4	154.8	27.3	0.0	11.5	1261.2
1976	10.0	13.0	68.2	78.2	105.0	48.4	287.8	293.9	89.3	47.4	15.6	4.1	1060.9
1977	8.0	23.6	145.8	0.0	127.0	131.6	307.5	203.7	143.4	255.8	0.5	2.4	1349.3
1978	1.7	16.6	25.8	12.0	45.5	170.6	315.8	181.7	205.2	33.5	6.8	14.4	1029.6
1979	--	--	39.3	13.4	134.7	51.9	390.2	270.3	130.2	99.4	2.5	2.5	--
1980	3.7	43.2	71.0	145.3	67.1	112.0	262.0	361.5	132.1	76.1	0.0	0.0	1274.0
1981	0.0	0.0	64.8	47.0	53.5	99.7	423.4	304.6	156.1	30.5	11.1	4.7	1195.4
1982	1.4	14.1	--	--	79.4	49.6	270.6	343.5	123.8	181.0	84.2	0.0	--
1983	0.0	29.0	40.6	66.5	162.6	34.7	283.0	377.6	--.	102.3	84.3	0.0	--
1984	0.1	1.8	20.8	16.2	118.9	202.3	272.5	234.9	166.8	0.0	7.1	1.1	1042.5
1985	10.1	0.0	25.3	119.3	117.9	40.4	250.1	282.1	166.0	67.9	0.4	3.4	1082.8
1986	0.0	53.0	75.6	124.3	51.4	159.8	334.6	220.0	254.5	75.3	--	0.0	--
1987	0.0	21.4	126.8	34.5	115.4	89.3	249.0	343.3	95.9	62.1	0.0	2.0	1139.7
1988	18.3	41.9	0.0	26.3	11.4	93.4	382.4	432.6	216.2	113.5	0.0	0.3	1336.3
1989	0.0	18.7	159.9	117.9	43.1	103.2	216.2	429.7	215.2	69.5	0.0	65.1	1438.5
1990	0.8	19.6	109.3	57.9	27.3	124.3	348.0	304.9	214.9	20.8	0.0	0.0	1227.8
1994	0.0	0.0	59.7	14.2	116.8	97.8	401.9	364.0	259.0	0.0	1.4	--	--

Note: - = not calculated due to missing data

Table 2 Long Term Monthly Mean Potential Evapotranspiration (PET)

Station: Debre Markos

Unit:mm

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1st 10 days	38	39	40	39	40	43	44	47	48	47	48	46	
2nd 10 days	46	43	39	38	34	32	32	30	30	31	31	33	
3rd 10 days	33	34	37	39	41	39	36	34	34	35	36	37	
Total	117	116	116	116	115	114	112	111	112	113	115	116	1712

Table 3 Monthly Average Maximum Air Temperature

Station: Bichena

unit: ℃

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1968	–	23.2	26.5	24.5	26.3	23.3	20.2	20.9	–	22.5	23.2	–
1969	–	–	–	–	–	–	–	–	–	23.6	–	24.5
1970	24.9	25.9	23.9	25.9	27.7	–	21.6	20.9	–	23.8	23.5	23.9
1971	–	–	–	–	–	–	–	20.7	–	–	–	–

Table 4 Monthly Average Minimum Air Temperature

Station: Bichena

unit: ℃

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1968	–	8.7	8.9	9.8	12.0	11.5	10.7	11.3	–	10.1	8.6	–
1969	–	–	–	–	–	–	–	–	–	10.3	–	7.5
1970	9.5	10.6	10.6	10.9	11.6	–	9.9	10.0	–	10.0	10.0	9.9
1971	–	–	–	–	–	–	–	10.5	–	–	–	–

Note: - = not calculated due to missing data

Table 5 Monthly Average Air Temperature

Station: Bichena unit: ℃

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1968	–	16.0	15.5	17.2	19.2	17.4	15.5	16.1	–	16.3	15.9	–
1969	–	–	–	–	–	–	–	–	–	17.0	–	16.0
1970	17.2	18.3	17.3	18.4	19.7	–	15.8	15.5	–	16.9	16.8	16.9
1971	–	–	–	–	–	–	–	15.6	–	–	–	–

Note: - = not calculated due to missing data

Appendix - 9

Hydrological Data

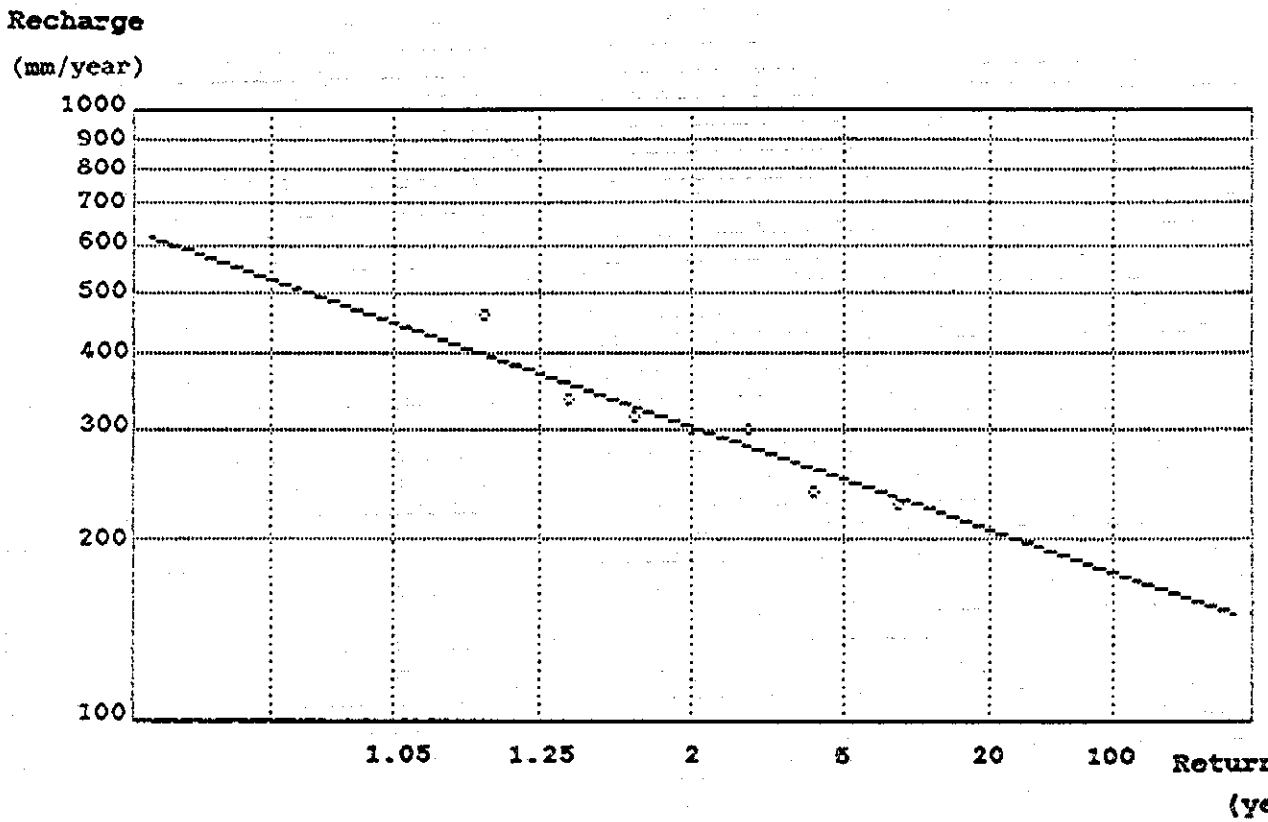
Table 1 Monthly Runoff of Muga River

Station: Yetmen nr. Dejen Unit: Upper in Million m3, Lower in mm

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
1980	–	–	0.75 2.0	1.45 3.9	40.08 106.9	3.91 10.4	55.55 148.1	51.85 138.3	19.90 53.1	12.23 32.6	2.02 5.4	1.17 3.1	–
1981	0.89 2.4	0.51 1.4	0.94 2.5	0.93 2.5	1.92 5.1	0.99 2.6	37.33 99.6	57.87 154.3	40.39 107.7	8.39 22.4	1.50 4.0	1.13 3.0	152.79 407.4
1982	–	–	2.11 5.6	1.05 2.8	3.02 8.1	1.01 2.7	12.40 54.7	50.30 131.3	21.34 90.1	22.13 74.7	2.54 4.8	1.80 3.5	–
1983	0.81 2.2	0.58 1.5	0.60 1.6	0.40 1.1	0.67 1.8	2.12 5.7	44.45 118.5	76.02 202.7	27.80 74.1	5.96 15.9	2.58 6.9	1.11 3.0	163.27 435.4
1984	0.62 1.7	0.36 1.0	0.33 0.9	0.23 0.6	1.62 4.3	18.34 49.0	–	35.50 94.7	32.40 86.4	2.35 6.3	1.06 2.8	1.00 2.7	–
1985	0.56 1.5	0.33 0.9	0.35 2.7	1.02 7.2	2.69 3.7	1.40 73.9	27.71 134.7	50.52 83.5	31.30 83.5	4.97 13.3	1.10 2.9	0.87 2.3	118.23 315.3
1986	0.60 1.6	0.39 1.0	0.69 1.8	0.88 2.3	0.46 1.2	14.43 38.5	39.24 104.6	58.84 156.9	34.57 92.2	6.23 16.6	0.97 2.6	0.71 1.9	158.00 421.3
1987	0.42 1.1	0.29 0.8	2.73 7.3	1.89 5.0	10.46 27.9	12.77 34.1	15.88 42.4	52.13 139.0	6.05 16.1	2.37 6.3	0.90 2.4	1.38 3.7	107.27 286.1
1988	0.66 1.8	0.87 2.3	0.23 0.6	0.30 0.8	–	1.09 2.9	58.94 157.2	118.50 316.0	40.18 107.2	24.77 66.1	2.45 6.5	0.49 1.3	–
1989	0.55 1.5	0.80 2.1	4.55 12.1	4.35 11.6	1.73 4.6	4.36 11.6	–	56.97 151.9	22.59 60.2	3.05 8.1	0.47 1.3	10.10 26.9	–
1990	1.44 3.8	2.30 6.1	1.74 4.6	1.31 3.5	1.55 4.1	0.58 1.6	20.41 54.4	44.49 118.6	24.49 65.3	4.13 11.0	0.72 1.9	0.53 1.4	103.68 276.5
1991	0.39 1.0	0.22 0.6	0.50 1.3	0.20 0.5	0.35 0.9	1.11 3.0	57.41 153.1	80.59 214.9	24.69 65.8	2.55 6.8	1.37 3.7	0.90 2.4	170.28 454.08
1992	0.72 1.9	0.75 2.0	0.52 1.4	1.98 5.3	2.68 7.2	1.12 3.0	15.91 42.4	57.19 152.5	29.78 79.4	12.83 34.2	1.94 5.2	1.25 3.3	126.67 337.8
1993	1.11 3.0	0.38 1.0	0.27 0.7	6.05 16.1	8.58 22.9	7.64 20.4	58.81 156.8	40.71 108.6	34.12 91.0	14.88 39.7	–	–	–

Note: - = Not calculated due to missing data

Figure 1 Probability Analysis on Annual Ground Water Recharge, Muga River at Yetmen near Dejen



Results of Analysis

Return Period (year)	Probability of Exceedance	Theoretical Values
2	.5	303.79
5	.2	249.14
10	.1	224.61
20	.05	206.21

Table 2 Monthly Water Balance Sheet for Ground Water Recharge, Muga River at Yetmen near Dejen

1981

Unit:mm

Elements	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
P	0.0	0.0	64.8	47.0	53.5	99.7	423.4	304.6	156.1	30.5	11.1	4.7	1,195.4
Q	2.4	1.4	2.5	2.5	5.1	2.6	99.6	154.3	107.7	22.4	4.0	3.0	407.4
P - Q	*	*	62.3	44.5	48.4	97.1	323.8	150.3	48.4	8.1	7.1	1.7	–
ETo	117	116	116	116	115	114	112	111	112	113	115	116	1,373
ET crop	81.9	81.2	81.2	81.2	80.5	79.8	78.4	77.7	78.4	79.1	80.5	81.2	961.1
ETa	–	–	62.3	44.5	48.4	79.8	78.4	77.7	48.4	8.1	7.1	1.7	–
ΔS	–	–	0	0	0	17.3	245.4	72.6	0	0	0	0	335.3

1982

Unit:mm

Elements	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
P	1.4	14.1	–	–	79.4	49.6	270.6	343.5	123.8	181.0	84.2	0.0	–
Q	–	–	5.6	2.8	8.1	2.7	54.7	131.3	90.1	74.7	4.8	3.5	378.2
P - Q	–	–	–	–	71.3	46.9	215.9	212.2	33.7	106.3	79.4	*	–
ETo	117	116	116	116	115	114	112	111	112	113	115	116	1,373
ET crop	81.9	81.2	81.2	81.2	80.5	79.8	78.4	77.7	78.4	79.1	80.5	81.2	961.1
ETa	–	–	–	–	71.3	46.9	78.4	77.7	33.7	79.1	79.4	–	–
ΔS	–	–	–	–	0	0	137.5	134.5	0	27.2	0	–	299.2

1985

Uint:mm

Elements	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
P	10.1	0.0	25.3	119.3	117.9	40.4	250.1	282.1	166.0	67.9	0.4	3.4	1,082.9
Q	1.5	0.9	0.9	2.7	7.2	3.7	73.9	134.7	83.5	13.3	2.9	2.3	315.3
P - Q	8.6	*	24.4	116.6	110.7	36.7	176.2	147.4	82.5	54.6	*	1.1	–
ETo	117	116	116	116	115	114	112	111	112	113	115	116	1,373
ET crop	81.9	81.2	81.2	81.2	80.5	79.8	78.4	77.7	78.4	79.1	80.5	81.2	961.1
ETa	8.6	–	24.4	81.2	80.5	36.7	78.4	77.7	78.4	54.6	–	1.1	–
ΔS	0	–	0	35.4	30.2	0	97.8	69.7	4.1	0	–	0	237.2

Note: * = Distorted data
– = not calculated due to missing data or distorted data

1986

Unit:mm

Elements	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
P	0.0	53.0	75.6	124.3	51.4	159.8	334.6	220.0	254.5	75.3	—	0.0	—
Q	1.6	1.0	1.8	2.3	1.2	38.5	104.6	156.9	92.2	16.6	2.6	1.9	421.3
P - Q	*	52.0	73.8	122.0	50.2	121.3	230.0	63.1	162.3	58.7	—	*	—
ETo	117	116	116	116	115	114	112	111	112	113	115	116	1,373
ET crop	81.9	81.2	81.2	81.2	80.5	79.8	78.4	77.7	78.4	79.1	80.5	81.2	961.1
ETa	—	52.0	73.8	81.2	50.2	79.8	78.4	63.1	78.4	58.7	—	—	—
ΔS	—	0	0	40.8	0	41.5	151.6	0	83.9	0	—	—	317.8

1987

Unit:mm

Elements	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
P	0.0	21.4	126.8	34.5	115.4	89.3	249.0	343.3	95.9	62.1	0.0	2.0	1,137.7
Q	1.1	0.8	7.3	5.0	27.9	34.1	42.4	139.0	16.1	6.3	2.4	3.7	286.1
P - Q	*	20.6	119.5	29.5	87.5	55.2	206.6	204.3	79.8	55.8	*	*	—
ETo	117	116	116	116	115	114	112	111	112	113	115	116	1,373
ET crop	81.9	81.2	81.2	81.2	80.5	79.8	78.4	77.7	78.4	79.1	80.5	81.2	961.1
ETa	—	20.6	81.2	29.5	80.5	55.2	78.4	77.7	78.4	55.8	—	—	—
ΔS	—	0	38.3	0	7.0	0	128.2	126.6	1.4	0	—	—	301.5

1988

Unit:mm

Elements	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
P	18.3	41.9	0.0	26.3	11.4	93.4	382.4	432.6	216.2	113.5	0.0	0.3	1,336.3
Q	1.8	2.3	0.6	0.8	—	2.9	157.2	316.0	107.2	66.1	6.5	1.3	662.6
P - Q	16.5	39.6	*	25.5	—	90.5	225.2	116.6	109.0	47.4	*	*	—
ETo	117	116	116	116	115	114	112	111	112	113	115	116	1,373
ET crop	81.9	81.2	81.2	81.2	80.5	79.8	78.4	77.7	78.4	79.1	80.5	81.2	961.1
ETa	16.5	39.6	—	25.5	—	79.8	78.4	77.7	78.4	47.4	—	—	—
ΔS	0	0	—	0	—	10.7	146.8	38.9	30.6	0	—	—	227.0

Note: * = Distorted data
- = not calculated due to missing data or distorted data

1990

Unit: mm

Elements	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
P	0.8	19.6	109.3	57.9	27.3	124.3	348.0	304.9	214.9	20.5	0.0	0.0	1,227.5
Q	3.8	6.1	4.6	3.5	4.1	1.6	54.4	118.6	65.3	11.0	1.9	1.4	276.5
P - Q	*	13.5	104.7	54.4	23.2	122.7	293.6	186.3	149.6	9.5	*	*	—
ETo	117	116	116	116	115	114	112	111	112	113	115	116	1,373
ET crop	81.9	81.2	81.2	81.2	80.5	79.8	78.4	77.7	78.4	79.1	80.5	81.2	961.1
ETa	—	13.5	81.2	54.4	23.2	79.8	78.4	77.7	78.4	9.5	—	—	—
△S	—	0	23.5	0	0	42.9	215.2	108.6	71.2	0	—	—	461.4

Note: * = Distorted data
- = not calculated due to missing data or distorted data

Appendix - 10

Calculation of Water Pipeline

Output data on distribution network for Dejen Case: Ordinary, 2005

Serial Number	Pipeline Number	Nord Number Start	Nord Number End	Dia. (mm)	Pipeline Length(m)	Flow (liter/sec.)	Velocity (m/sec.)	Hydraulic Gradient (m/1000)	Loss of Head (m)	Velocity Coefficient	Remarks
1	1	1	2	200	335	12.23	0.39	0.44	1.31	110	
2	2	2	3	150	480	3.80	0.22	0.29	0.61	110	
3	3	3	4	75	190	0.68	0.15	0.14	0.74	110	
4	4	3	5	150	370	2.06	0.12	0.07	0.20	110	
5	5	2	6	150	215	7.49	0.42	0.46	2.15	110	
6	6	6	12	150	320	3.92	0.22	0.21	0.65	110	
7	7	12	11	75	30	2.10	0.48	0.18	5.98	110	
8	8	11	10	75	95	1.01	0.23	0.15	1.55	110	
9	9	10	9	75	115	-0.29	-0.07	-0.02	-0.15	110	
10	10	9	7	75	335	-0.93	-0.21	-0.44	-1.32	110	
11	11	7	8	150	285	1.85	0.10	0.05	0.16	110	
12	12	7	6	150	180	-3.08	-0.17	-0.07	-0.41	110	
13	13	12	18	150	980	1.28	0.07	0.08	0.08	110	
14	14	11	16	75	440	0.92	0.21	0.57	1.29	110	
15	15	16	15	75	115	0.07	0.02	0.00	0.01	110	
16	16	15	13	75	240	-0.38	-0.09	-0.06	-0.25	110	
17	17	13	14	75	365	0.40	0.09	0.10	0.28	110	
18	18	13	10	75	215	-1.06	-0.24	-0.36	-1.69	110	
19	19	16	17	75	335	0.28	0.06	0.05	0.14	110	

Output data on distribution network for Dejen Case: Fire Fighting, 2005

Serial Number	Pipeline Number	Nord Number Start	Nord Number End	Dia. (mm)	Pipeline Length(m)	Flow (liter/sec.)	Velocity (m/sec.)	Hydraulic Gradient (m/1000)	Loss of Head (m)	Velocity Coefficient	Remarks
1	1	1	2	200	335	24.27	0.77	1.56	4.65	110	
2	2	2	3	150	480	2.35	0.13	0.12	0.25	110	
3	3	3	4	75	190	0.42	0.10	0.06	0.30	110	
4	4	3	5	150	370	1.27	0.07	0.03	0.08	110	
5	5	2	6	150	215	21.34	1.21	3.20	14.89	110	
6	6	6	12	150	320	17.37	0.98	3.26	10.18	110	
7	7	12	11	75	30	-0.43	-0.10	-0.00	-0.32	110	
8	8	11	10	75	95	-0.97	-0.22	-0.14	-1.44	110	
9	9	10	9	75	115	-1.93	-0.44	-0.59	-5.10	110	
10	10	9	7	75	335	-2.33	-0.53	-2.42	-7.23	110	
11	11	7	8	150	285	1.15	0.07	0.02	0.07	110	
12	12	7	6	150	180	-3.67	-0.21	-0.10	-0.57	110	
13	13	12	18	150	980	17.46	0.99	10.07	10.27	110	
14	14	11	16	75	440	0.43	0.10	0.14	0.32	110	
15	15	16	15	75	115	-0.10	-0.02	-0.00	-0.02	110	
16	16	15	13	75	240	-0.38	-0.08	-0.06	-0.25	110	
17	17	13	14	75	365	0.25	0.06	0.04	0.12	110	
18	18	13	10	75	215	-0.81	-0.18	-0.22	-1.01	110	
19	19	16	17	75	335	0.17	0.04	0.02	0.06	110	

Output data on distribution network for Dejen Case: Fire Fighting, 2010

Serial Number	Pipeline Number	Nord Number Start	Nord Number End	Dia. (mm)	Pipeline Length(m)	Flow (liter/sec.)	Velocity (m/sec.)	Hydraulic Gradient (m/1000)	Loss of Head (m)	Velocity Coefficient	Remarks
1	1	1	2	200	335	28.32	0.90	2.07	6.19	110	
2	2	2	3	150	480	3.62	0.20	0.27	0.56	110	
3	3	3	4	75	190	0.65	0.15	0.13	0.68	110	
4	4	3	5	150	370	1.96	0.11	0.07	0.18	110	
5	5	2	6	150	215	23.81	1.35	3.92	18.23	110	
6	6	6	12	150	320	18.72	1.06	3.74	11.68	110	
7	7	12	11	75	30	0.32	0.07	0.00	0.18	110	
8	8	11	10	75	95	-0.63	-0.14	-0.06	-0.63	110	
9	9	10	9	75	115	-1.96	-0.44	-0.61	-5.28	110	
10	10	9	7	75	335	-2.57	-0.58	-2.92	-8.71	110	
11	11	7	8	150	285	1.77	0.10	0.04	0.15	110	
12	12	7	6	150	180	-4.63	-0.26	-0.16	-0.88	110	
13	13	12	18	150	980	17.88	1.01	10.52	10.73	110	
14	14	11	16	75	440	0.78	0.18	0.42	0.96	110	
15	15	16	15	75	115	-0.03	-0.00	-0.00	-0.00	110	
16	16	15	13	75	240	-0.46	-0.10	-0.09	-0.36	110	
17	17	13	14	75	365	0.38	0.09	0.09	0.25	110	
18	18	13	10	75	215	-1.11	-0.25	-0.39	-1.83	110	
19	19	16	17	75	335	0.26	0.06	0.04	0.13	110	

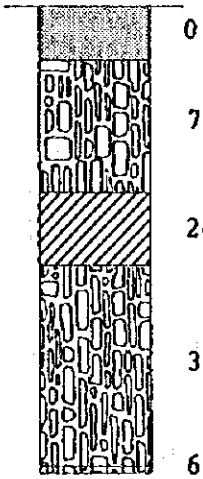
Output data on distribution network for Dejen Case: Ordinary, 2010

Serial Number	Pipeline Number	Nord Number Start	Nord Number End	Dia. (mm)	Pipeline Length(m)	Flow (liter/sec.)	Velocity (m/sec.)	Hydraulic Gradient (m/1000)	Loss of Head (m)	Velocity Coefficient	Remarks
1	1	1	2	200	335	18.61	0.59	0.95	2.85	110	
2	2	2	3	150	480	5.78	0.33	0.64	1.33	110	
3	3	3	4	75	190	1.04	0.24	0.31	1.63	110	
4	4	3	5	150	370	3.13	0.18	0.16	0.43	110	
5	5	2	6	150	215	11.40	0.65	1.00	4.67	110	
6	6	6	12	150	320	5.97	0.34	0.45	1.41	110	
7	7	12	11	75	30	3.21	0.73	0.39	13.05	110	
8	8	11	10	75	95	1.54	0.35	0.32	3.38	110	
9	9	10	9	75	115	-0.43	-0.10	-0.04	-0.32	110	
10	10	9	7	75	335	-1.41	-0.32	-0.96	-2.88	110	
11	11	7	8	150	285	2.82	0.16	0.10	0.35	110	
12	12	7	6	150	180	-4.69	-0.27	-0.16	-0.90	110	
13	13	12	18	150	980	1.94	0.11	0.17	0.18	110	
14	14	11	16	75	440	1.40	0.32	1.24	2.82	110	
15	15	16	15	75	115	0.11	0.03	0.00	0.03	110	
16	16	15	13	75	240	-0.58	-0.13	-0.13	-0.55	110	
17	17	13	14	75	365	0.61	0.14	0.22	0.61	110	
18	18	13	10	75	215	-1.62	-0.37	-0.79	-3.69	110	
19	19	16	17	75	335	0.42	0.10	0.10	0.30	110	

Appendix - 11

Geological Logs of Existing Boreholes

WSS Borehole No.1 in Dejen



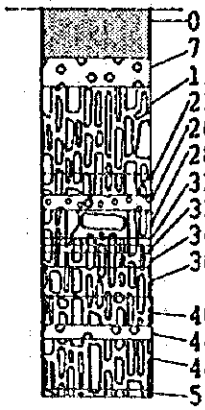
Depth	Lithology
0 -7.5 m	Clay, gray, with weathered basalt fragment
7.5- 26 m	Basalt, fresh, compact, dark gray to black
26 - 36 m	Weathered tuff, light gray to Blue gray
36 - 64 m	Weathered basalt
64 - 65 m	Fresh and compact basalt

Note : This borehole is abandoned due to a little yield.

Location : 500 m west of the town

Source : from "HYDROGEOLOGICAL BOREHOLE REPORT DEJEN #1" by J.C.Nonner

WSS Borehole No.2 in Dejen

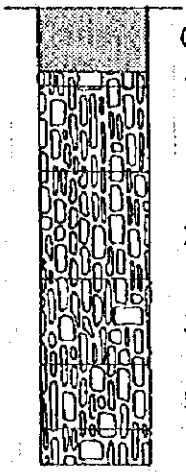


Depth	Lithology
0 - 7 m	Light brown clay
7 - 11 m	Clayey gravel, light brown
11 - 23 m	Slightly fractured basalt
23 - 26 m	Moderately fractured basalt
26 - 28 m	Granules and pebbles, water struck
28 - 32 m	Intensively fractured basalt
32 - 33 m	Moderately fractured basalt
33 - 34 m	Fresh Basalt
34 - 36 m	Moderately fractured basalt
36 - 40 m	Intensively fractured basalt with clay interbed, water struck
40 - 44 m	Intensively fractured scoriaceous basalt
44 - 46 m	Granules and pebbles
46 - 53 m	Moderately fractured basalt
53 - 54 m	Fresh hard basalt

Location : About 1 km northwest of the town

Source : from "Well Completion Report No.68 Dejen well No.2 Gojam Province" by Tibebe Dejene (EWWCA Northwest Regional Office), Nov.3/1984

Borehole for Tik village in Dejen



Depth	Lithology
0 - 9 m	Clay
9 - 11 m	Fragment of weathered basalt, boulders & gravels
11 - 23 m	Highly weathered basalt
23 - 38 m	Moderately weathered basalt
38 - 50 m	Weathered basalt
50 - 59 m	Weathered, fractured basalt
59 - 64 m	Fresh basalt

Source : from "water Supply Prospect at Tike former Producers, Co-operative Dejen Warda Gojjam Province" by Tefera Mekuria